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P/N 5005-981

XDS Series
DC Power Supply
User and Programming
Manual
Series II

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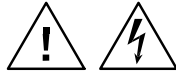
User and Programming Manual
P/N 5005-981
DC Power Supplies
Argantix

XDS Series II

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SAFETY SUMMARY

This power supply contains high voltage and current circuits that are potentially lethal. Because of its size and weight, electrical and mechanical stability must be ensured. The following safety guidelines must be followed when operating or servicing this equipment. These guidelines are not a substitute for vigilance and common sense. If this power supply is not used as specified in this manual, the protection provided by this equipment may be impaired. California Instruments assumes no liability for the customer's failure to comply with these requirements.

BEFORE APPLYING POWER

1. Check the units input rating on the type label and verify the correct voltage is applied to the unit (for example 208 V L-L, 3 Phase).
2. The chassis and cabinet of this power supply must be grounded to minimize shock hazard. A chassis ground is provided at the input terminal block. This is located at the back of the cabinet on the right hand side (looking at the back of the unit). The chassis ground must be connected to an electrical ground through an insulated wire (green/yellow) of sufficient gauge.
3. The XDS Series power supplies do not have internal AC mains disconnect. Instead, protection is provided by fuses. The on/off button only engages or disengages the bias supplies, it does not disconnect the AC mains to the unit. **It is strongly recommended to use a suitably rated circuit breaker or mains disconnect device with branch protection rating per local electrical codes between point of connection and the XDS unit AC input.**

FUSES

Use only fuses of the specified current, voltage, and protection speed.

DO NOT OPERATE IN A VOLATILE ATMOSPHERE

Do not operate the power supply in the presence of flammable gases or fumes. This product is designed to operate in a controlled environment. Do not expose to rain or snow.

DO NOT TOUCH ENERGIZED CIRCUITS

Disconnect the power cable before servicing this equipment. Even with the power cable disconnected, high voltage can still exist on some circuits. Discharge these voltages before servicing. Allow at least 30 minutes for all internal circuits to discharge before removing the top cover. Only qualified service personnel may remove covers, replace components or make adjustments.

DO NOT SERVICE ALONE

Do not remove covers, replace components, or make adjustments unless another person, who can administer first aid, is present.

DO NOT EXCEED INPUT RATINGS

Do not exceed the rated input voltage or frequency. Additional hazards may be introduced because of component failure or improper operation.

DO NOT MODIFY INSTRUMENT OR SUBSTITUTE PARTS

Do not modify this instrument or substitute parts. Additional hazards may be introduced because of component failure or improper operation.

MOVING THE POWER SUPPLY

When moving the power supply, observe the following:

1. Remove all AC power to unit.
2. ***Note that the handles are provided to pull instrument out of 19" instrument cabinet and are not designed to support the weight of the unit.***
3. Use two people to prevent injury.

SURFACE STABILITY

Operate the power supply only on a level surface.

SAFETY SYMBOLS:



THIS SYMBOL INDICATES DIRECT CURRENT



THIS SYMBOL INDICATES ALTERNATING CURRENT



THIS SYMBOL INDICATES BOTH DIRECT AND ALTERNATING CURRENT



THIS SYMBOL INDICATES THREE-PHASE ALTERNATING CURRENT



THIS SYMBOL INDICATES EARTH (GROUND) TERMINAL



THIS SYMBOL INDICATES PROTECTIVE CONDUCTOR TERMINAL



THIS SYMBOL INDICATES FRAME OR CHASSIS TERMINAL



THIS SYMBOL INDICATES ON (SUPPLY)



THIS SYMBOL INDICATES OFF (SUPPLY)



THIS SYMBOL INDICATES CAUTION, RISK OF ELECTRIC SHOCK



THIS SYMBOL INDICATES CAUTION (REFER TO ACCOMPANYING DOCUMENTS)

Electrical Safety Symbols Used in This Manual

WARRANTY INFORMATION

CALIFORNIA INSTRUMENTS CORPORATION warrants each instrument manufactured by them to be free from defects in material and workmanship for a period of five years from the date of shipment to the original purchaser. Excepted from this warranty are fuses and batteries that carry the warranty of their original manufacturer where applicable. CALIFORNIA INSTRUMENTS will service, replace, or adjust any defective part or parts, free of charge, when the instrument is returned freight both ways prepaid, and when examination reveals that the fault has not occurred because of misuse, abnormal conditions of operation, user modification, or attempted user repair. Equipment repaired beyond the effective date of warranty or when abnormal usage has occurred will be charged at applicable rates. CALIFORNIA INSTRUMENTS will submit an estimate for such charges before commencing repair, if so requested.

SERVICE PROCEDURE

If a fault develops, notify CALIFORNIA INSTRUMENTS at support@argantix.com or its local representative, giving full details of the difficulty, including the model number and serial number. On receipt of this information, service information or a Return Material Authorization (RMA) number will be given. Add the RMA number furnished to the shipping label. Pack the instrument carefully to prevent transportation damage, affix label to shipping container, and ship freight prepaid to the factory. CALIFORNIA INSTRUMENTS shall not be responsible for repair of damage due to improper handling or packing. Instruments returned without RMA No. or freight collect may be refused at California Instruments discretion. All XDS Series Instruments repaired will be returned freight collect, Ex Works CALIFORNIA INSTRUMENTS, 9689 Towne Centre Drive, San Diego, CA 92121-1964. If requested, an estimate of repair charges will be made before work begins on repairs not covered by the Warranty.

DAMAGE IN TRANSIT

The instrument should be tested when it is received. If it fails to operate properly, or is damaged in any way, a claim should be filed immediately with the carrier. The claim agent should obtain a full report of the damage, and a copy of this report should be forwarded to us by fax or email (Fax: 858 677 0940, Email: support@argantix.com). CALIFORNIA INSTRUMENTS will prepare an estimate of repair cost and repair the instrument when authorized by the claim agent. Please include model number and serial number when referring to the instrument.

SPARE PARTS

To order spare parts, user manuals, or determine the correct replacement part for your California Instruments products, please contact the Customer Service department by phone at + 1 858 404 6936, press 2 or by email support@argantix.com.

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1 Introduction

1.1 General Description



Figure 1-1: XDS Series DC Power Supply

The Argantix XDS Series of DC Programmable Power Supplies are designed specifically for laboratory test and systems applications requiring single output, variable DC voltage and current with good ripple and regulation characteristics. The XDS Series comes in a 3U chassis and can operate in constant current or constant voltage mode with auto crossover feature. Available Power levels are 5kW, 10kW and 15kW.

Simple front panel controls enable the voltage and current limit to be changed. Measurements of voltage, current, peak current and power can also be read from the front panel LED displays.

The front panel contains a output on/off button for controlling the DC supply output and an LED indicator that informs the operator of the output status at all time.

The left hand side LED display is used to display the programmed voltage as well as the measured output voltage. The LED display to the right is used to program the current or to display measured current, peak current or power. The display SELECT button can be used to set the desired display mode.

A standard RS232C and optional IEEE 488 interface is available for applications that require remote control and measurements. While operated remotely, the front panel can be locked out and the remote control status is indicated by a REMOTE LED.

A power on/off switch can be used to turn the DC supply on or off.

Note:	This user manual applies to the XDS models series II with the 5005-720-1 controller assembly. For first generation XDS DC models with controller assembly 5005-708-1, refer to user manual P/N 5005-980 instead. First generation XDS models typically do not have the air vents in the front panel.
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1.2 Bench Top use

The XDS Series DC Supply may be used as a bench top unit provided adequate provisions are made to protect the end-user from touching the output terminals. To this end, output covers are provided on all XDS units. These covers must be installed during use and may only be removed when the unit is not in use and disconnected from AC mains.

Adequate air flow must be maintained at all times so care should be taken not to block the front, top and side air intakes or the rear air exhaust. Leave at least 4" of clearance at the back of the unit to allow proper airflow.

1.3 Equipment Rack use

The XDS Series uses a 19" cabinet with rack ears and can be installed in a standard equipment rack. Due to the weight of the unit however, it must be properly supported by either a shelf or L brackets on both sides. The rack ears are not designed to support the full weight of the XDS unit when installed in a cabinet but only to prevent it from sliding out.

Contact Argantix customer support (support@argantix.com) for information on rack mount kits for specific cabinets depths.

Proper airflow must be maintained in the instrument cabinet and the rear of the cabinet should not be closed off by a door but rather a perforated screen allowing adequate airflow. It is also important to leave enough clearance above each unit as some of the air intake is on the top cover.

Note:	For optimal cooling, it is recommended to leave a 1.75" (1 U) space above each XDS unit.
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This space may be covered by a louvered cover plate to allow some air intake from the front of the cabinet. When planning cabinet space, allow for 4U per DC supply.

If insufficient rack space is available, the top vents may be blocked off by stacking units directly on top of each other but maximum power may not be available at maximum ambient temperature due to over temp fault.

2 Specifications

All specifications at $23 \pm 5^{\circ}\text{C}$ unless noted otherwise.

2.1 Electrical

2.1.1 AC Line Input

Standard:	-208: 208 VAC L-L -10% to 230VAC L-L +10 %
Options:	-400: 400VAC L-L $\pm 10\%$ -480: 480VAC L-L $\pm 10\%$
Frequency:	50 to 60 Hz ± 3 Hz
Phases:	3-phase, 3-wire plus safety ground
Power Factor:	> 0.65 typical.

2.1.2 Maximum Line Input Current per Phase at Low Line

Current		5 KW	10 KW	15 KW
Standard	-208	27A	54A	81A
Options	-400	18A	36A	54A
	-480:	18A	36A	54A
Recommended circuit protection per phase. (CB)				
Standard	-208	30A	60A	90A
Options	-400	20A	40A	60A
	-480:	20A	40A	60A

2.1.3 Output Power

DC Power:	5 KW, 10 KW or 15 KW depending on model. See section 2.1.5. Maximum power is available at full-scale voltage.
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2.1.4 Output Voltage

Voltage Range:	See section 2.1.5		
Voltage Programming:			
Model	Range	Resolution	Accuracy
XDS 30-XXX	0 - 30 V	0.01 V	± 0.08 V
XDS 40-XXX	0 - 40 V	0.01 V	± 0.08 V
XDS 50-XXX	0 - 50 V	0.02 V	± 0.16 V
XDS 80-XXX	0 - 80 V	0.02 V	± 0.16 V
XDS 100-XXX	0 - 100 V	0.1 V	± 0.2 V
XDS 150-XXX	0 - 150 V	0.1 V	± 0.4 V
XDS 250-XXX	0 - 250 V	0.1 V	± 0.8 V

XDS 300-XXX	0 - 300 V	0.1 V	± 0.8 V
XDS 400-XXX	0 - 400 V	0.1 V	± 1.6 V
XDS 600-XXX	0 - 600 V	0.2 V	± 1.6 V
Noise and Ripple:	See section 2.1.5		
Line Regulation:	< 0.1% of V Range		
Load Regulation:	< 0.1% of V Range		
External Sense	External Voltage Sense mode. Maximum voltage drop allowed at load terminals is 5% of voltage range. Note: For 600V models, maximum drop allowed is 3% (20Vdc).		
OVP Range:	0 to 110 % of V Range		
Transient Response:	A 30% step load will recover to within 2% of voltage range value within 2 msec.		
Stability:	+/- 0.05% of max. rating for 8 Hrs. at fixed line, load and temp after 30 minutes warm up period		

2.1.5 Ranges, Noise and Ripple

Model	Output				
	Power Max.	Volts Max.	Amps Max.	RMS Ripple Typical ¹	Peak-Peak Ripple typ.
XDS 30-167	5	30	167	15 mV	90 mV
XDS 30-333	10	30	333	15 mV	90 mV
XDS 30-500	15	30	500	15 mV	90 mV
XDS 40-125	5	40	125	15 mV	90 mV
XDS 40-250	10	40	250	15 mV	90 mV
XDS 40-375	15	40	375	15 mV	90 mV
XDS 50-100	5	50	100	15 mV	90 mV
XDS 50-200	10	50	200	15 mV	90 mV
XDS 50-300	15	50	300	15 mV	90 mV
XDS 80-62	5	80	62.5	25 mV	250 mV
XDS 80-125	10	80	125	25 mV	250 mV
XDS 80-187	15	80	187.5	25 mV	250 mV
XDS 100-50	5	80	50	25 mV	250 mV
XDS 100-100	10	80	100	25 mV	250 mV
XDS 100-150	15	80	150	25 mV	250 mV
XDS 150-33	5	150	33.3	25 mV	300 mV
XDS 150-66	10	150	66.7	25 mV	300 mV
XDS 150-100	15	150	100	25 mV	300 mV
XDS 250-20	5	250	20	100 mV	400 mV
XDS 250-40	10	250	40	100 mV	400 mV
XDS 250-60	15	250	60	100 mV	400 mV
XDS 300-17	5	300	17	100 mV	400 mV
XDS 300-33	10	300	33.3	100 mV	400 mV
XDS 300-50	15	300	50	100 mV	400 mV
XDS 400-12	5	400	12.5	250 mV	2 V
XDS 400-25	10	400	25	250 mV	2 V
XDS 400-37	15	400	37.5	250 mV	2 V

¹ Maximum RMS Ripple < 2 x typical value shown.

XDS 600-8	5	600	8.33	250 mV	2 V
XDS 600-17	10	600	17	250 mV	2 V
XDS 600-25	15	600	25	250 mV	2 V

2.1.6 Output Current

Current Range:	See section 2.1.5			
Current Programming:				
Accuracy:	Accuracy shown in last column as % of Full Scale (FS) from 100 % programmed to 0% programmed.			
Resolution:	Shown in column 3 by model.			
Model	Range	Resolution	Accuracy	
XDS 30-167 XDS 30-333 XDS 30-500	0 - 167 A 0 - 333 A 0 - 500 A	0.1 A 0.1 A 0.2 A	0.5 %	
XDS 40-125 XDS 40-250 XDS 40-375	0 - 125 A 0 - 250 A 0 - 375 A	0.1 A 0.1 A 0.2 A		
XDS 50-100 XDS 50-200 XDS 50-300	0 - 125 A 0 - 250 A 0 - 375 A	0.1 A 0.1 A 0.1 A		
XDS 80-62 XDS 80-125 XDS 80-187	0 - 62.5 A 0 - 125 A 0 - 187.5 A	0.02 A 0.1 A 0.1 A	0.5 %	
XDS 100-50 XDS 100-100 XDS 100-150	0 - 50 A 0 - 100 A 0 - 150 A	0.02 A 0.1 A 0.1 A		
XDS 150-33 XDS 150-66 XDS 150-100	0 - 33.3 A 0 - 66.7 A 0 - 100 A	0.01 A 0.02 A 0.1 A		
XDS 250-20 XDS 250-40 XDS 250-60	0 - 20 A 0 - 40 A 0 - 60 A	0.005 A 0.01 A 0.02 A	0.5 %	
XDS 300-17 XDS 300-33 XDS 300-50	0 - 16.7 A 0 - 33.3 A 0 - 50 A	0.005 A 0.01 A 0.02 A		
XDS 400-12 XDS 400-25 XDS 400-37	0 – 12.5 A 0 – 25.0 A 0 – 37.5 A	0.005 A 0.01 A 0.02 A		
XDS 600-8 XDS 600-17 XDS 600-25	0 - 8.3 A 0 - 16.7 A 0 - 25 A	0.003 A 0.005 A 0.01 A	0.5 %	
Line Regulation:	< 0.1% of I Range			
Load Regulation:	< 0.1% of I Range			
Stability:	+/- 0.05% of max. rating for 8 Hrs. at fixed line, load and temp after 30 minutes warm up period			

2.2 Measurements

	Voltage		
Model	Range	Resolution	Accuracy
XDS 30-XXX	0 - 30 V	0.01 V	± 0.05 V
XDS 40-XXX	0 - 40 V	0.01 V	± 0.05 V
XDS 50-XXX	0 - 50 V	0.02 V	± 0.1 V
XDS 80-XXX	0 - 80 V	0.02 V	± 0.1 V
XDS 100-XXX	0 - 100 V	0.1 V	± 0.2 V
XDS 150-XXX	0 - 150 V	0.1 V	± 0.3 V
XDS 250-XXX	0 - 250 V	0.1 V	± 0.5 V
XDS 300-XXX	0 - 300 V	0.1 V	± 0.5 V
XDS 400-XXX	0 - 400 V	0.1 V	± 0.5 V
XDS 600-XXX	0 - 600 V	0.2 V	± 1.0 V

	Current		
Model	Range	Resolution	Accuracy
XDS 30-167	0 - 167 A	0.1 A	± 0.3 A
XDS 30-333	0 - 333 A	0.1 A	± 0.5 A
XDS 30-500	0 - 500 A	0.2 A	± 1 A
XDS 40-125	0 - 125 A	0.1 A	± 0.3 A
XDS 40-250	0 - 250 A	0.1 A	± 0.5 A
XDS 40-375	0 - 375 A	0.1 A	± 0.5 A
XDS 50-100	0 - 100 A	0.1 A	± 0.3 A
XDS 50-200	0 - 200 A	0.1 A	± 0.5 A
XDS 50-300	0 - 300 A	0.1 A	± 0.5 A
XDS 80-62	0 - 66 A	0.02 A	± 0.1 A
XDS 80-125	0 - 125 A	0.1 A	± 0.3 A
XDS 80-187	0 - 187 A	0.1 A	± 0.3 A
XDS 100-50	0 - 50 A	0.02 A	± 0.1 A
XDS 100-100	0 - 100 A	0.1 A	± 0.3 A
XDS 100-150	0 - 150 A	0.1 A	± 0.3 A
XDS 150-33	0 - 33 A	0.01 A	± 0.05 A
XDS 150-66	0 - 66 A	0.02 A	± 0.1 A
XDS 150-100	0 - 100 A	0.1 A	± 0.3 A
XDS 250-20	0 - 20 A	0.005 A	± 0.025 A
XDS 250-40	0 - 40 A	0.01 A	± 0.05 A
XDS 250-60	0 - 60 A	0.02 A	± 0.1 A
XDS 300-17	0 - 17 A	0.005 A	± 0.025 A
XDS 300-33	0 - 33 A	0.01 A	± 0.05 A
XDS 300-50	0 - 50 A	0.02 A	± 0.1 A
XDS 400-12	0 - 12.5 A	0.005 A	± 0.025 A
XDS 400-25	0 - 25 A	0.01 A	± 0.05 A
XDS 400-37	0 - 37.5 A	0.02 A	± 0.1 A
XDS 600-8	0 - 8 A	0.003 A	± 0.013 A

XDS 600-17	0 - 17 A	0.005 A	± 0.025 A
XDS 600-25	0 - 25 A	0.01 A	± 0.05 A

	Power		
Model	Range	Resolution	Accuracy
All	0 - 5 KW 0 - 10 KW 0 - 15 KW	1 W 2 W 5 W	± 0.3 % FS

	Peak Current		
Model	Range	Resolution	Accuracy
All	See current table	See current table	See accuracy in current table + 3 x resolution

2.3 Environmental

Temperature Coefficient	
Voltage Set Point:	0.02%/C of V Range
Current Set Point:	0.03%/C of I Range
Ambient Temperature	
Operating:	0° to 40° C / 32° to 104° F
Storage:	-40° to 75° C / -40° to 167° F
Humidity:	0 to 80 % RH, non condensing
Cooling:	Forced Air. Front, side and top air intake, rear exhaust.
Altitude	
Operating:	2000 meters max.
Storage:	6000 meters max.

2.4 Mechanical

Dimensions:	Width: 19.00 "/ 482.6 mm Depth: 22.19"/ 563.3 mm (excluding bus bars and cover) Height: 5.25"/133.35 mm
Unit Weight:	15 kW model: Net: 90 Lbs. / 40.8 Kg. Gross: 125 Lbs. / 56.7 Kg 10 kW model: Net: 70 Lbs. / 31.8 Kg. Gross: 105 Lbs. / 47.6 Kg 5 kW model: Net: 50 Lbs. / 22.7 Kg. Gross: 85 Lbs. / 38.6 Kg
Material:	Chassis: Steel. (Anodized) Top cover: Aluminum (Anodized) Front panel Aluminum (Anodized)
Cooling:	Forced air, side and top intake, rear exhaust
Acoustic Noise Level: (Measured at 1 meter from front of unit).	5 KW: < 55 dBA 10KW: < 60 dBA 15KW: < 65 dBA
Internal Construction:	Modular construction.
Rear Panel Connections:	AC Power Input, DC power out, RS232, GPIB (option), Analog Programming (option)
Rack Mounting	Unit must be supported by shelf or brackets when mounted in 19" cabinet. No provisions for rack slides are made on instrument.

2.5 Agency Approvals

CE Mark:	GENERAL:	IEC 61326-1, 1998
	SAFETY:	IEC 61010-1, 2001
	EMC:	EN55011, Class A, Group 1
		IEC 61000-4-2, 1995 IEC 61000-4-4, 1995
		IEC 61000-4-5, 1995 IEC 61000-4-6, 1996
		IEC61000-4-8, IEC 61000-4-11, 1994

2.6 Remote Control Interfaces

Standard:			
Digital	RS232C Interface:		
		9 pin D-Shell connector	
		Handshake:	CTS, RTS
		Data bits:	8
		Stop bits:	1
		Baud Rate:	19200
		SCPI Syntax	
Analog			
	Input:	0 - 10 VDC / 0 – 5 VDC for 0 to full scale voltage (RPV) or current limit (RPC) .	
		Input impedance 10 KOhm	
		Accuracy: 0.5 %	
		See section 5 for details.	
	Output:	Auxiliary drive output signal.	
		See section 5 for details.	
Remote Inhibit	Shuts down output. Factory default operation is output disabled with contact closure or logic low input. Operation mode can be inverted to shut down when connection is broken/interrupted using SYST:CONF and SYST:SAVE commands. Connects to J22 pin 1 and 14 (Iso com) on rear panel.		
-IF Option:	GPIB Interface is part of -IF Option		
IEEE-488	IEEE-488 Interface option:		
		IEEE-488 (GPIB) talker listener Subset: AH1, L3, RL2, SH1, T8 IEEE-488.2 SCPI Syntax	

2.7 Protection

- Over temperature shut down
- Short circuit protection
- Overload protection
- Over voltage
- Voltage sense lines open.

2.8 Controls and Indicators

Controls:	Voltage Setting:	Digitally encoded rotary knob
	Current Setting:	Digitally encoded rotary knob
	Measurement Select	Push button
	Output on/off:	Push button
	Power on/off:	Toggle Switch
Indicators:	Display:	Dual, seven segment LED's
	LED's for:	Output on/off
		Constant Current mode
		Constant Voltage mode
		Remote Interface state
		Selected Measurement: Curr, Peak Curr, Power

2.9 Parallel Operation

Two or more XDS power supply of the same model number (voltage range and power level must match) may be combined to create a higher power system. This requires one master unit (default) and one or more auxiliary units (-AUX).

The maximum number of XDS units that can be paralleled is 5 (1 master + 4 auxiliary units).

The following specifications apply to multi-box XDS configurations:

Parameter	
Current Range:	Multiply by number of XDS units.
Current Programming:	
Accuracy:	Multiply by number of XDS units.
Resolution:	Same as single XDS unit.
Current Sharing	Within 2 % of combined current range.
Current ripple	Multiply by number of XDS units

2.10 Factory Configuration Options

All XDS models can be factory configured with the options shown below. Configuration changes can be made in the field if needed. Refer to Chapter 5 for details on changing configuration settings.

Option	Configuration
none	Stand-alone and Master operation.
-AUX	Auxiliary configuration. Can be used with Master XDS unit to increase power level.
-RPV10	Stand-alone operation with analog voltage programming, 0 – 10 V.
-RPV5	Stand-alone operation with analog voltage programming, 0 – 5 V.
-RPC10	Stand-alone operation with analog current limit programming, 0 – 10 V.
-RPC5	Stand-alone operation with analog current limit programming, 0 – 5 V.

2.11 -LC Option

The –LC option reduces the output capacitance of each DC power module. This results in improved rise and fall times compared to a standard XDS unit. The output noise and ripple specification is increased by a factor of 2 when adding the –LC option. This option is available only on models with voltage ranges of 100V and below. The –LC option must be ordered at time of initial orders. This option cannot be retrofitted.

-LC Option	Output capacitance with LC option Capacitance per 5 KW module.	Standard Unit Capacitance per 5 KW module.
30V	11200 uF	44000 uF
40V	7800 uF	30000 uF
50V	7800 uF	24000 uF
80V	3000 uF	7800 uF
100V	940 uF	4400 uF

Note: -LC option is available only on 30V, 40V, 50V, 80V and 100V output voltage range models.

3 Installation and Functional Test

3.1 Inspection

Inspect the shipping carton for possible damage before unpacking the unit. Carefully unpack the equipment.

Save all packing materials until inspection is complete. Verify that all items listed on the packing slips have been received. Visually inspect all exterior surfaces for broken knobs, connectors or meters. Inspect for dented or damage exterior surfaces. External damage may be an indication of internal damage. If any damage is evident, immediately contact the carrier that delivered the unit and submit a damage report. Failure to do so could invalidate future claims.

3.2 Location and Mounting

Bench Use

The XDS Series DC Supply may be used as a bench top unit provided adequate provisions are made to protect the end-user from touching the output terminals. To this end, output covers are provided on all XDS units. These covers must be installed during use and may only be removed when the unit is not in use and disconnected from AC mains.

Adequate air flow must be maintained at all times so care should be taken not to block the top and side air intakes or the rear air exhaust. Leave at least 4" of clearance at the back of the unit to allow proper airflow.

Rack Use

The XDS Series uses a 19" cabinet with rack ears and can be installed in a standard equipment rack. Due to the weight of the unit however, it must be properly supported by either a shelf or L brackets on both sides. The rack ears are not designed to support the full weight of the XDS unit when installed in a cabinet but only to prevent it from sliding out. Four screws, two on each side of the front panel, should be used to secure the unit in place.

Proper airflow must be maintained in the instrument cabinet and the rear of the cabinet should not be closed off by a door but rather a perforated screen allowing adequate airflow.

NOTE:	The unit should be provided with the proper ventilation. The top, rear and both sides of the unit should be free of obstructions. A 1.75" (1 U) spacing between units mounted in the same cabinet is recommended.
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3.3 Input / Output Connectors

Table 3-1 lists all external connections for the XDS Series. Table 3-2 and Table 3-3 provide input and output connector descriptions.

NOTE: **DO NOT REVERSE THE EXT. SENSE CONNECTION POLARITY OR DAMAGE TO THE XDS SUPPLY WILL RESULT.**

For permanently connected equipment, a readily accessible disconnect device shall be incorporated in the fixed wiring. For equipment connected through an outlet socket, the outlet must be installed near the equipment and must be easily accessible.

NOTE: **For proper connection to the mains, a suitable circuit breaker or fuse is required. The rating will depend on the units' nominal AC input voltage. If a fuse is used, a suitable disconnect device should be installed to allow AC input to be removed from the supply.**

NOTE: **When connecting the AC Input wiring, DO NOT APPLY MORE THAN 32 INCH POUND (equivalent to 2.67 lbf feet or 3.62 Nm) of torque to the input terminal connection studs and screws.**

Table 3-1: Rear Panel Input and /Output Connectors

Connector		
AC Input	Function	Connects To
L1 – AC in L2 – AC in L3 – AC in CHASSIS - GND	Primary AC Power Input	208 - 230 VAC nominal (Std) 400 VAC nominal 480 VAC nominal Limit torque applied to 32 inch pound force/ 2.7 foot pond force / 3.6 Nm.
DC Output	Function	Connects To
Positive Bus Bar Negative Bus Bar	DC output	User Load Table 3-2
Other	Function	Table
Isolated Analog I/O	Control Interface (option)	DB15, J22, Table 3-5
RS232	Control Interface	DB9, J20, Table 3-4
Auxiliary I/O	Misc.	DB9, J21, Table 3-6
Remote Inhibit	Output shut-off	DB15, J22, Table 3-5
IEEE-488	Control Interface (option)	GPIO 24 pin, J23. See IEEE-488 standard for pin out.

Table 3-2: Output Connection Description

Supply Type	Connection Description
For Output voltages <= 60V	Bus Bar with threaded Stud. (Do not exceed 10 foot pound force / 13.5 Nm of torque when tightening nuts of bus bars)
For Output Voltages > = 80V	Bus Bar with threaded Stud and a rear safety cover (Do not exceed 10 foot pound force / 13.5 Nm of torque when tightening nuts of bus bars)

Table 3-3: Input Connection Description

AC In.	Designator	Dir.	Connection Description
1	ØA	Input	10-32 Threaded Stud
2	ØB	Input	10-32 Threaded Stud
3	ØC	Input	10-32 Threaded Stud
4	GND		10-32 Threaded Stud

Table 3-4: RS232C Connector J20

J20, Pin	Designator	Dir.	Description
1	Not used		N/C
2	TxD	Output	Transmit data
3	RxD	Input	Receive data
4	Not used		N/C
5	Common		Common
6	Not used		N/C
7	CTS	Input	Clear to send
8	RTS	Output	Request to send
9	Not used		N/C

Table 3-5: Analog I/O Connector J22

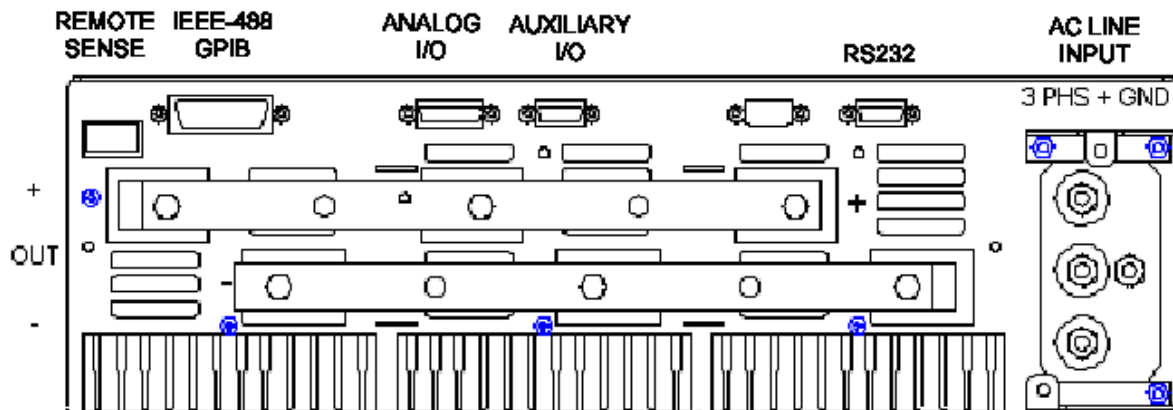
J22, Pin	Designator	Dir.	Description
1	ON / OFF	Input	ON/OFF (Remote Inhibit). Mode 0: Switch/relay contacts or a direct short between this terminal and ISO RTN (pin 10) will turn off the power supply. Mode 1: A logic high or a disconnect between this terminal and ISO RTN (pin 10) will turn off the power supply. The mode can be set over the RS232C or GPIB bus using the SYST:CONF command and retained at power on using the SYST:SAVE command.
2	Not used		N/C
3	Not used		N/C
4	V/I PROG 10V	Input Isolated	Remote analog programming. Using a 0-10VDC source referenced to pin 10 or 14 (ISO RTN/COM) will program the output voltage or current from 0 to 100%. Mode is determined by controller settings.
5	Not used		N/C
6	Not used		
7-9	Not used		N/C
10	ISO RTN	Isolated	Return path. Internally connected to pin 14.
11	V/I PROG 5V	Input Isolated	Remote analog programming. Using a 0-5VDC source referenced to pin 10 or 14 (ISO RTN/COM) will program the output voltage or current from 0 to 100%. Mode is determined by controller settings.

J22, Pin	Designator	Dir.	Description
11	Not used		N/C
12	Not used		N/C
13	Not used		N/C
14	ISO COM	Isolated	Return path to be used with pins V/I PROG 5V and V/I PROG 10V. Internally connected to pin 10.
15	Not used		N/C

Table 3-6: Auxiliary I/O Connector (Isolated) – J21

J21, Pin	Designator	Dir.	Description
1	Not used		N/C
2	ISO COM	Isolated	Return path to be used with pin 6.
3	Not used		
4	Not used		N/C
5	Not used		N/C
6	I MON	Output	Output current monitor.
7	Not used		N/C
8	Not used		N/C
9	Not used		N/C

Figure 3-1: Location of rear panel connectors.



3.4 Wire Sizing and Lug Size

The DC output is available from a set of copper bus bars, one for the positive terminal, out for the negative terminal. Each bus bar has two screw studs, (Penn Engineering, HFHB-0518-24, see www.pennfast.com) to which a set of two nuts and lock washers are attached. The recommended ring-lug size that mates with these 5/16-18 thread studs for connecting output wiring is 5/16" (standard) or 8M (metric). The wire gauge and ring-lug crimp size must be matched. Crimp ring lugs are generally available from Tyco/AMP and catalog vendors like Mouser, Digikey etc. See paragraph 3.5 for AC input wire lug size.

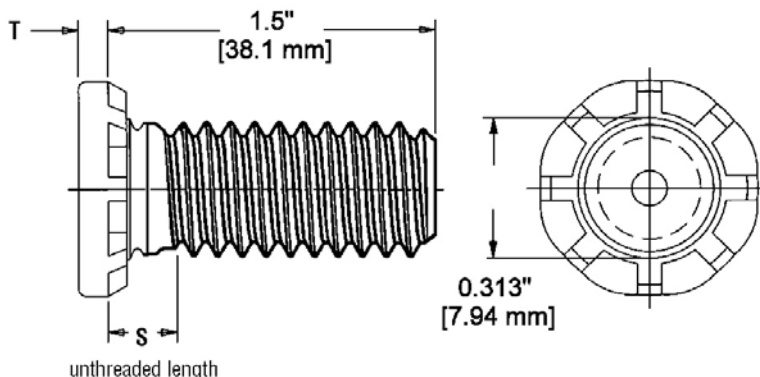


Figure 3-2: DC Output bus bar studs.

Care must be taken to properly size all conductors for the input and output of the power supply. Table 3-7 bellow gives minimum recommended wire size for the input. This table is derived from the National Electrical Code and is for reference only. Local laws and conditions may have different requirements. The table is for copper wire only.

Table 3-7: Minimum Wire Size Table

Size	Temperature Rating of Copper Conductor			
	60 C	75 C	85 C	90 C
	Types	Types	Types	Types
AWG MCM	RUW, T, TW UF	FEPW, M R, RHW, RUH, THW, THWN, XHHW, USE, ZW	V, MI	TA, TBS, SA, AVB, SIS, FEP, FEPB, RHH, THHN, XHHW
	Current Rating			
14	20	20	25	25
12	25	25	30	30
10	30	35	40	40
8	40	50	55	55
6	55	65	70	75
4	70	85	95	95
3	85	100	110	110
2	95	115	125	130
1	110	130	145	150
0	125	150	165	170
00	145	175	190	195
000	165	200	215	225
0000	195	230	250	260

For higher ratings wires can be paralleled or refer to the National Electrical Code.

3.5 AC Input Wiring

All XDS models require 3 phase AC input. A neutral connection is not available, as the XDS only requires a delta input. If only three-phase Wye AC power is available, verify the correct Line-to-Line voltage and connect only the phase wires.

The Safety Ground connection **MUST** be made to the stud marked with the earth ground symbol.

The AC input wires must be terminated with ring lugs (AC input stud size is ¼"-20 thread, M4 metric) of at least ¼" (7 mm) diameter. See Figure 3-3.

Before attaching wires to line input terminals, wires must pass-thru strain relief on the safety cover. Always install the AC input safety cover and strain relief provided with the unit. The ground wire should be longer than the three power phase wires by at least 1 inch.

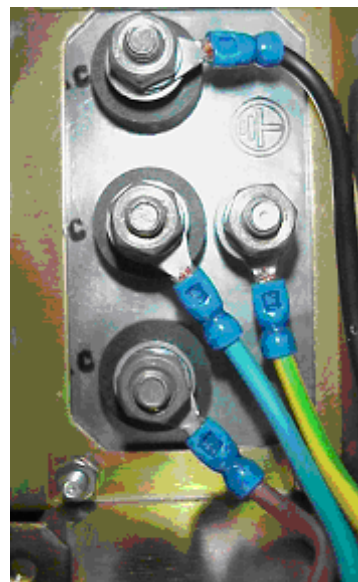


Figure 3-3: AC Input Terminals

3.5.1 EMI Toroid Installation – 400V Models

To meet CE Mark conducted emissions, models with 400V AC input must have the supplied ferrite toroid installed on the AC input wiring as shown. Loop the three phase conductors through the supplied toroid 4 times (4 turns). This means they loop around the outside of the toroid one time. This should be done before passing the AC input wires through the safety cover strain relief and attached them to the AC input terminal studs on the rear of the XDS unit.

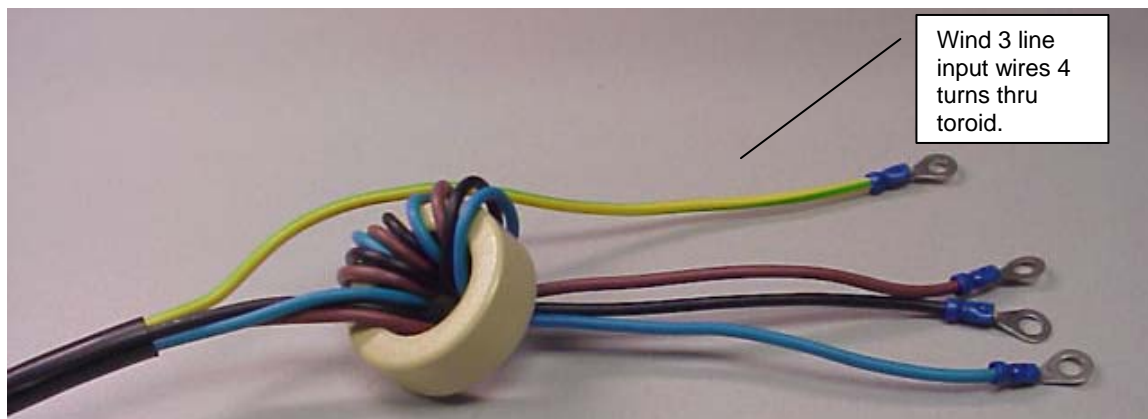


Figure 3-4: Toroid Installation, -400V input model.

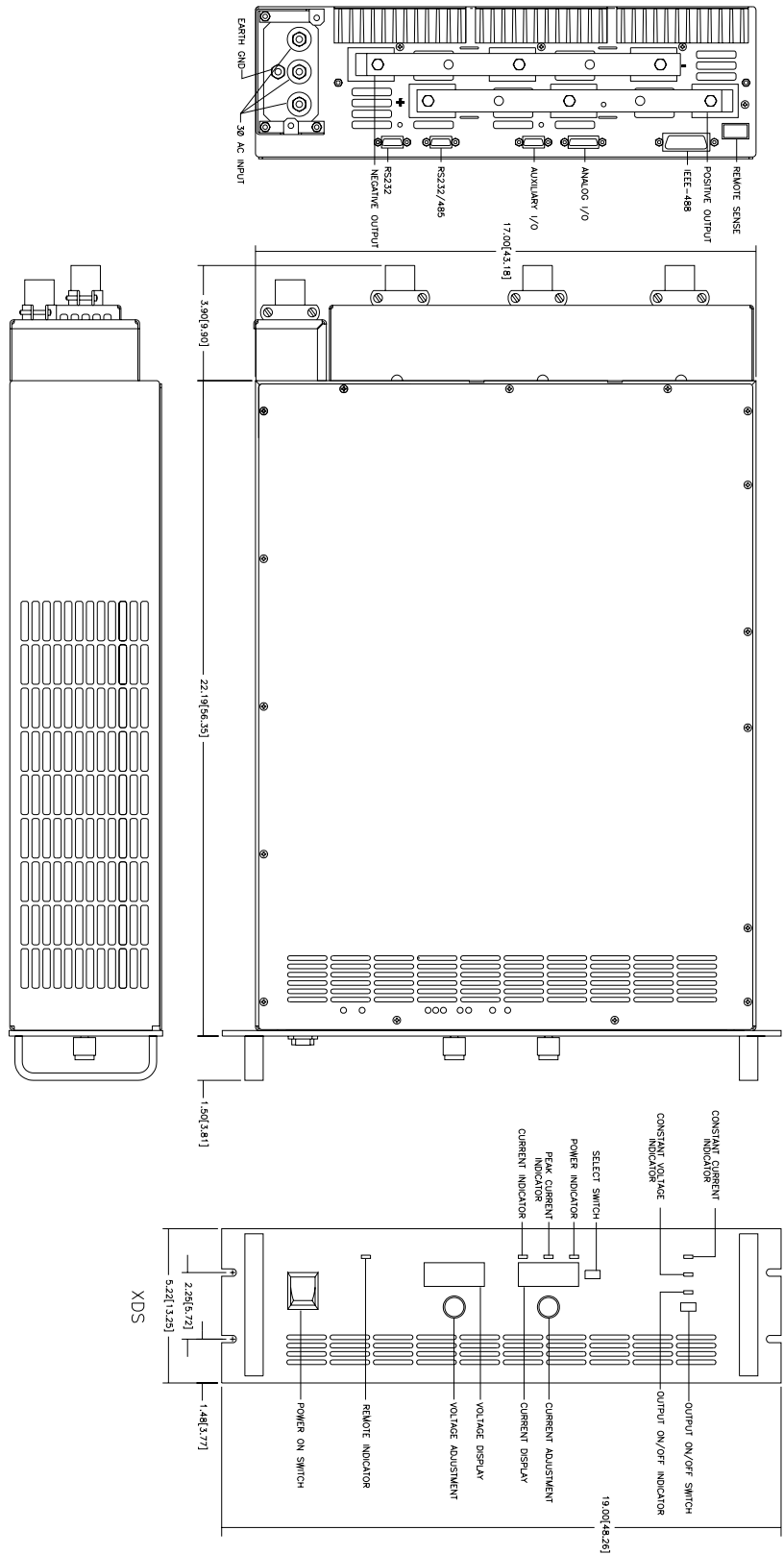


Figure 3-5: Outline Drawing XDS DC Supply

4 Front Panel Operation

4.1 Functional Controls

The front panel can be divided in a small number of functional areas:

- Status Indicator lights
- Shuttle knobs
- LED displays
- Button controls



Figure 4-1: Front Panel View

4.1.1 Status Indicator Lights

Seven green LED status indicators are located on the front panel. These LED's correspond to the following conditions:

CV MODE	Indicates the DC Supply is operating in the Constant Voltage mode.
CC MODE	Indicates the DC Supply is operating in the Constant Current mode.
OUTPUT	The Output LED indicates the status of the OUTPUT. The output is controlled by the OUTPUT ON/OFF button located directly below the LED. When the Output LED is not lit, the output voltage is not present at the output terminals regardless of the voltage setting.
CURR	Illuminates when the LED display shows the programmed or measured current.
PK CUR	Illuminates when the LED display shows the measured peak current.
PWR	Illuminates when the LED display shows the measured power.

REMOTE

The REMOTE LED indicates that the unit is in remote control mode. If the RS232C interface is used, the REMOTE state can be enabled by the controller using the SYST:REM command. Any time the REMOTE LED is lit, the front panel of the XDS Series unit is disabled. There is no LOCAL button that allows the user to regain control of the front panel. The SYST:LOC command will enable the front panel controls. When using the optional IEEE interface, the remote /local state is controlled by the REN (Remote Enable) interface line.

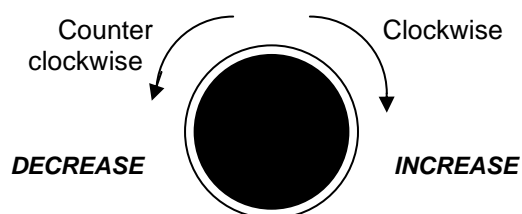
4.1.2 Shuttle knobs

Figure 4-2: Shuttle Knob

There are two shuttle knobs located below the LED displays which are used to change settings for voltage and current. The left shuttle always controls the voltage. The right shuttle always controls the current.

4.1.3 Buttons

There are only two buttons on the front panel. One is used to toggle the Output State, the other to toggle display modes for the right hand side segment LED. The following is a description of these buttons:

KEY	DESCRIPTION
OUTPUT ON/OFF	The OUTPUT ON/OFF button will toggle the output on or off. The LED above the button will light when the output is on. No output voltage will be present when the OUTPUT ON/OFF button is off despite the level of voltage programmed.
SELECT	<p>The SELECT button selects the function of the right Shuttle knob and the LED display. The right hand Shuttle knob will program the current limit and the display will show its value in the current mode. The display will revert back to showing the measured current after 3 seconds from the last movement of the shuttle. The SELECT button also allows selection of the desired measurement function readout. Available selections are:</p> <ul style="list-style-type: none"> • Current (Also puts the shuttle in Current Limit set mode) • Peak Current • Power <p>Measurements are updated 2 times per second. The display mode is indicated by the LED's above the segment LED display. Note that voltage measurements are available through the Voltage LED.</p>

4.1.4 LED Segment Displays

Settings and measurements are shown on two 4 digit, 7 segment LED displays. The voltage display shows the programmed voltage as the user turns the left knob. After releasing the knob for about 3 seconds, this display reverts back to displaying the measured output voltage. The right hand LED display is a multi purpose display. For setup purposes, it always displays the Current limit setting. After about 3 seconds on inactivity, this display switches to the selected measurement parameter. The SELECT button will define the operating mode or the selected measurement parameter for the right hand display.

4.2 How to examples...

This section covers some common tasks that are often performed with an DC power supply. These examples are written in a How to... format and provide step by step instructions on how to set up the DC supply for a specific task.

4.2.1 Set the Output

Output parameters are Voltage and Current Limit.

1. Disable the output by pressing the OUTPUT button. The LED above the button will turn off.
2. Use the left shuttle to set the output voltage. Clockwise will increase the output, counter clockwise will reduce the output. The display above the shuttle will show the voltage setting.
3. Use the right shuttle to set the current limit. The SELECT button will define the function of the right hand side LED display.
4. Enable the output by pressing the OUTPUT button.

4.2.2 Slew Output Values

The output parameters can be slewed using the shuttles.

1. Enable the output by pressing the OUTPUT button. The LED above it will turn on.
2. Use the left shuttle to set the output voltage. Clockwise will increase the output, counter clockwise will reduce the output. The display above the shuttle will show the voltage setting.
3. Use the right shuttle to set the current limit. The LED's located above the display will indicate the selected measurement display function.

4.2.3 Display Measurement Data

Measurements are always active and can be displayed as follows:

1. For voltage, the left display always displays the measured output voltage unless the knob is turned. As the knob is turned, the programmed voltage will be displayed instead. After releasing the knob for about 3 seconds, the display reverts back to the measured voltage.
2. All other measurements can be displayed by using the SELECT button to toggle through the available measurements. The LED's above the LED segment display indicates the current selection. The knob only affects the current limit set.
3. Moving the right shuttle knob will interrupt the selected measurement and put the display back in Current Limit adjust mode.

4.2.4 Control the Output

The Output can be disabled or enabled using the ON/OFF button as follows:

1. Pressing the OUTPUT button when the output LED is on will turn off the DC supply output. The programmed voltage setting will remain at the last program value.
2. Pressing the OUTPUT button again will engage the output and the output will revert to the last programmed value.

4.2.5 Measure Peak Inrush Current

The peak current measurement function of the XDS Series uses a sample and hold circuit to track the highest peak current found until reset. The peak current sample and hold circuit is reset any time the user toggles away from the peak current display mode to a different measurement using the SELECT button.

The peak inrush current for a unit under test can be measured using this function as follows:

1. Program the output to zero volts and turn off the output using the ON/OFF button.
2. Use the SELECT button to display the present peak current value.
3. Use the SELECT button again to toggle to any other measurement readout. This will effectively reset the peak current sample and hold circuit to zero amps.
4. Use the left shuttle knob to set the voltage to the nominal supply voltage of the unit under test.
5. Use the OUTPUT ON/OFF button to apply the programmed voltage to the unit under test.
6. Use the SELECT button to display the measured peak current value.

4.3 Setting the Power on Initialization Values

The power supply is shipped with default factory settings when the unit is powered up. The factory settings are:

Parameter	Factory default setting
Voltage	0.0 Volt
Current limit	Maximum available current.
Display mode	Voltage and Current measurement
Output state	OFF
Local / Remote State	Local. Front panel unlocked.

Table 4-1: Factory Default Power on Settings

It is possible to change the power on initialization values in one of two ways:

1. Using the RS232 or optional IEEE-488 interface and the supplied XDSGUI program.
2. Using the front panel.

To change the power on initialization values from the front panel, proceed as follows:

1. Set the unit up in the desired way from the front. (Voltage, current limit, output state, display mode).
2. Press and hold the SELECT key (normally toggles LED display mode).
3. While holding the SELECT key, press the OUTPUT ON/OFF key. This will save the present front panel settings in non-volatile memory register (NVM) no 7 and assign this register as the power on register.
4. Release both keys. Note that as step 2 is executed, the display mode will toggle. This means the display mode after power up is different from how the unit was set up. To avoid this, just toggle the display till one position before the desired power on mode first and then execute steps 2-4.
5. This procedure can be repeated as often as needed by the user.

To change the power on initialization values over the bus, proceed as follows:

1. Set the unit up in the desired way using the relevant bus commands.
2. Save the new setup you want to make the power-on setting to one of the 8 setup registers using the *SAV <n> command. (n = 0 through 7)
3. Assign the register as the Power-on register using the SYST:PON <n> command where <n> is register used in step 2.

4.4 Operating Modes

The XDS Series can operate in one of two modes of operation, voltage mode or current mode with automatic cross over.

Voltage Mode (CV) mode	In this mode of operation, the output voltage of the DC supply is regulated as long as the current limit set is not exceeded. If the current limit is reached due to the load condition, the DC supply crosses over to constant current mode by reducing the output voltage as needed to maintain the set current limit level.
Constant Current (CC) mode	In this mode of operation, the output current of the DC supply is regulated as long as the voltage set is not reached. If the output voltage reaches the set voltage, the DC supply crosses over to the constant voltage mode by reducing the output current as needed to maintain the set voltage level.

The currently active mode is always indicated by the CV and CC status LED's on the front panel and may also be queried through the remote control interface. The mode can not be changed by the user. It is determined by the load condition and the programmed values for voltage and current limit.

4.5 Special Features

The XDS Series offers some special features, which are explained in this section

4.5.1 Remote Inhibit / Remote Shutdown

The output of the DC supply can be controlled using a discrete input. This input is available on connector J22 at the rear panel of the XDS unit.

The Remote Inhibit or Remote Shutdown can be configured over the bus to operate in one of two modes:

RI Mode	Description
0	Active Low. A TTL logic low signal level or switch closure between pin 1 and pin 10 of J22 will DISABLE the output. This will override the front panel OUTPUT ON/OFF button or remote output state. This is the default mode.
1	Active High. A TTL logic low signal level or switch closure between pin 1 and pin 10 of J22 will ENABLE the output. This will override the front panel OUTPUT ON/OFF button or remote output state.

The SYST:CONF bus command may be used to set the polarity mode for the Remote Inhibit shutdown input. Once set, send the SYST:SAVE command so the new mode is retained at power up.

4.5.2 Bleeder circuit

The DC supply has an amplifier that can source but can't sink current. Under a no-load condition the output voltage will remain unless there is a provision to bleed the voltage from the storage capacitors across the output terminals. The XDS Series DC supply has a bleeder circuit that when activated will drop the output from its present value to a value closer to zero volts in approximately 150 milliseconds under a no-load condition. Actual times may vary by voltage range model.

This special bleeder circuit will activate when the output voltage is programmed to a value that is 10% lower than its prior voltage setting. For example if the output is set to 80 volts the bleeder will not activate if the voltage is programmed to 75 volts. If it is programmed to 40 volts however, it will activate since 40 volts is more than 10 % less than 80 V. Once activated, the bleeder circuit stays active until the voltage drops to 44 volts (110% of new setting). The bleeder circuit will work with either internal or RPV programming.

4.5.3 Over Voltage Protection (OVP)

The XDS Series offers an over voltage protection mode. This mode protects the power supply from over voltage damage.

The Over Voltage Protection (OVP) is controlled by the voltage measurements and as such reacts to the measured output voltage rather than the programmed value.

When the actual output voltage exceeds the OVP level the controller will disable the output and program the output to zero volts.

When operated from the front panel, the OVP level is fixed at 110% of the available voltage range. When operated over the remote control interface, the OVP trip level can be set by the user

as a percentage of voltage range. Allowable range is 0 to 110%. Bus operation also allows the OVP mode to be turned on (enabled) or off (disabled).

If the output voltage exceeds the set trip level and the OVP mode is enabled, the power supply will generate a -300, Device specific error and turn off the output. The mode is enabled with the VOLT:PROT:STAT command. The OVP mode provides another level of protection in addition to the volt:high user setting which prevents programming commands or front panel inputs above this level to be accepted.

5 Model Configurations

5.1 Available Configurations

The XDS controller can be reconfigured for various modes of operation. Generally, the mode of operation is factory set at the time of shipment and is indicated on the model number tag by a configuration option suffix. The following configurations are available.

Configuration	Configuration Option Suffix	Description
Master	None	Normal mode of operation. A single XDS unit in either 5, 10 or 15 KW power configuration. Both voltage and current limit are controlled from the front panel or over the bus.
Auxiliary	-AUX	Set to operate as an auxiliary unit to another XDS master unit. This allows parallel operation of up to 5 identical XDS units for higher power systems. The master unit controls auxiliary units. Voltage and current cannot be set from the front panel or over the bus. Measurements are still available however.
Master, remote programming, Voltage	-RPV5	Stand-alone mode with voltage controlled by external analog DC voltage input signal. Full-scale voltage required 5 VDC input. Current limit can be set from the front panel or over the bus.
Master, remote programming, Voltage	-RPV10	Stand-alone mode with voltage controlled by external analog DC voltage input signal. Full-scale voltage required 10 VDC input. Current limit can be set from the front panel or over the bus.
Master, remote programming, Current	-RPC5	Stand-alone mode with current limit controlled by external analog DC voltage input signal. Full-scale voltage required 5 VDC input. Voltage can be set from the front panel or over the bus.
Master, remote programming, Current	-RPC10	Stand-alone mode with current limit controlled by external analog DC voltage input signal. Full-scale voltage required 10 VDC input. Voltage can be set from the front panel or over the bus.

Table 5-1: XDS Controller Configuration Options

5.2 Changing Configurations

Factory configured models are pre-configured and calibrated for their indicated mode of operation. If a unit has to be redeployed for a different application than originally purchased for, the XDS unit can be reconfigured in the field.

To do so requires removal of the top cover. This voids the warranty seal and Argantix should be notified to ensure your warranty period remains in effect. Contact support@argantix.com to obtain authorization to reconfigure a unit.

All configuration changes are made through a series of jumper of the 5005-720-1 Controller assembly. This assembly is located directly behind the front panel. The jumpers are on the far side of the controller assembly and can be accessed without removing the controller from the XDS chassis.

The figure below shows the located on the controller assembly and jumpers when facing the front of the unit. Note that the top cover has been pushed back about 4 inches.



Figure 5-1: XDS Configuration Jumper Locations

Available configuration settings are shown in the table below.

Configuration	W1	W2	W5	W6	W9	W10	W11	W12	W13	W14	W15	W16
Master	1	0	1	0	0	1	0	1	0	0	0	1
Auxiliary (-AUX)	1	0	1	0	1	0	0	0	1	1	0	1
Master, -RPV	0	1	1	0	0	1	0	1	0	0	0	1
Master, -RPC	1	0	0	1	0	1	1	1	0	0	0	1

Table 5-2: Configuration Jumper Settings - Mode

Note: W15 and W16 jumpers settings shown apply to 10 and 15 KW Chassis. For 5 KW models, remove W16.

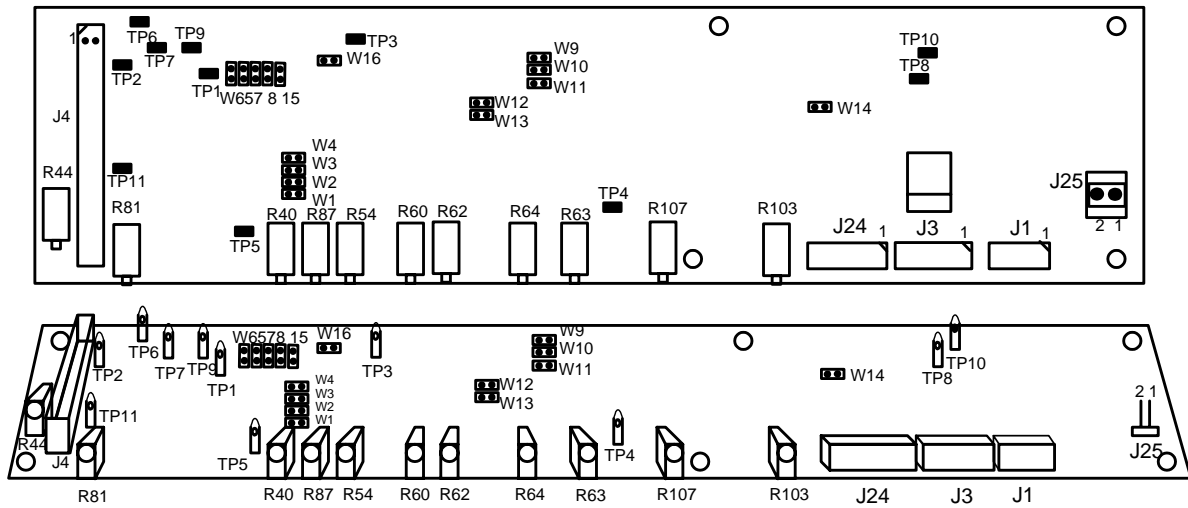


Figure 5-2: XDS Controller Jumper Locations – Front view, far side of PWB.

5.3 Stand Alone Configuration

In this mode, a single XDS DC power Supply is operated stand-alone. Power levels from 5 to 15 KW are available in this mode of operation. All settings can be made from the front panel as indicated in chapter 4 or over the bus as covered in chapters 9 through 12.

5.4 Parallel Mode

The XDS DC power supply can be paralleled to provide higher output current. This requires two or more unit of the same model. (Voltage range and power level must be the same). Thus, different XDS model numbers cannot be paralleled.

The parallel mode of operation is only supported on XDS Series II controller models. Older generation XDS models may not support this capability. Older XDS units can be easily identified, as they have no air inlets in the front panel.

5.4.1 Multi box connections

To parallel two or more XDS units, one unit acts as the Master and is used to program the output of all other units. The remaining unit(s) operate in an auxiliary mode. The output bus bars of all units must be tied together. The master's unit external sense connection must be connected as well.

The master provides the control signal (IMon) for all auxiliary units. This control signal is provided on Auxiliary I/O connector J21 at the rear panel. A DB9 connector is required. This requires the use of a 9 pin D-sub connector. Each auxiliary unit (-AUX) has an analog input on J22. A cable that connects IMon from the master unit to all analog inputs on the auxiliary units is required. Refer to Figure 5-3 for an interconnect cable diagram. A suitable interconnect cable for a two unit parallel system can be order through Argantix customer service department (support@argantix.com). Specify CI P/N 5005-051-1.

Both the Imon output of the master and the analog input on the auxiliary units are isolated from the DC output of the XDS unit. This means the GPIB or RS232 interfaces can be connected to all units without grounding either side of the DC output.

Refer to Figure 5-5 for a system-wiring diagram of a 2 box, 30 KW XDS system.

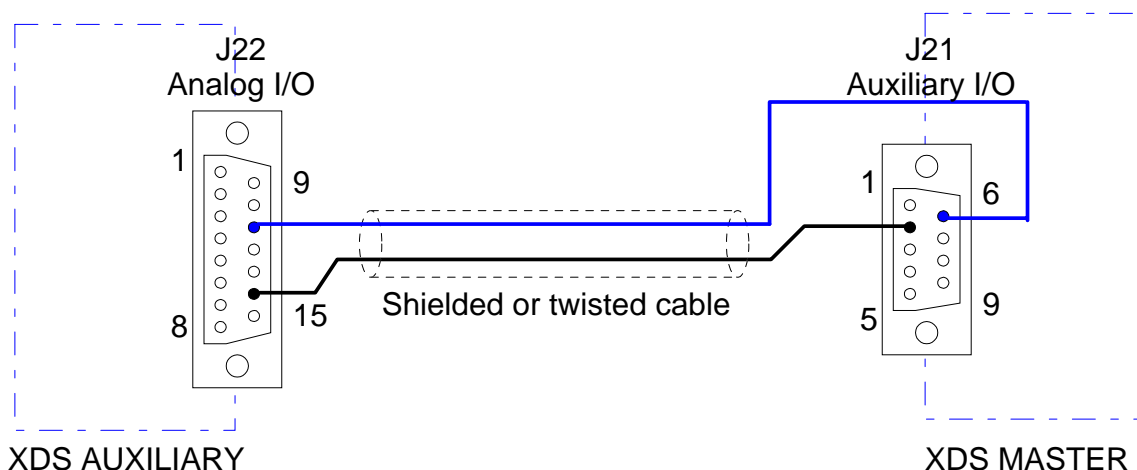


Figure 5-3: Master / Auxiliary Interconnect Cable Diagram

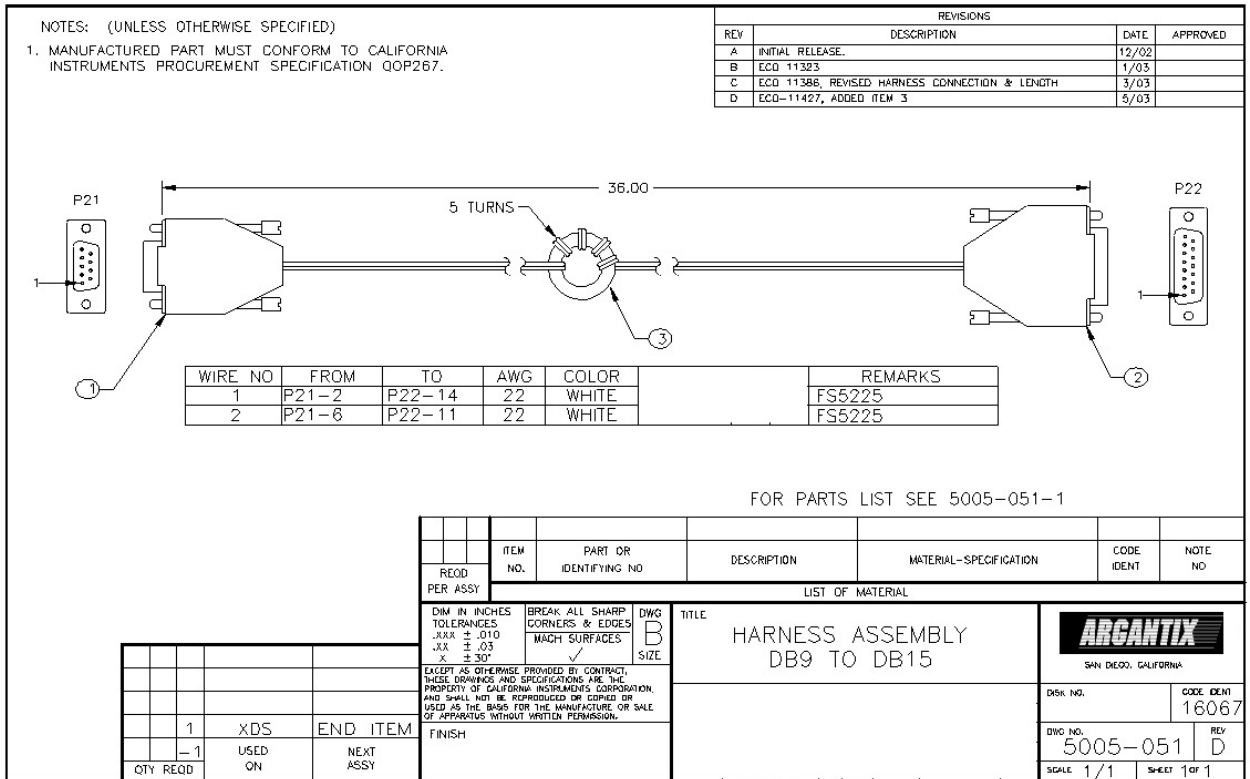


Figure 5-4: Parallel Cable Interconnect Accessory

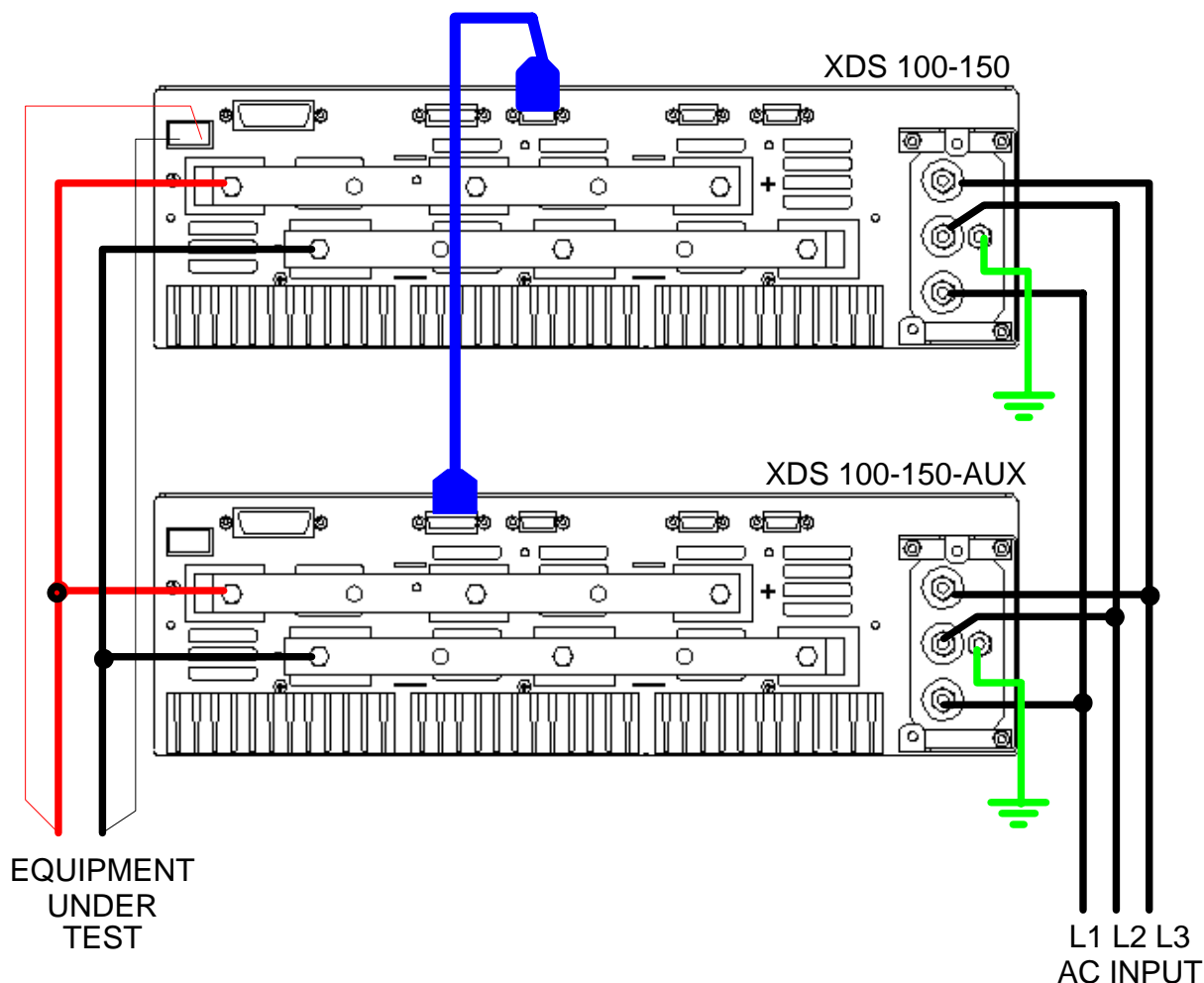


Figure 5-5: XDS 30KW System Connections

5.4.2 Multi box front panel control

The auxiliary unit(s) (-AUX) cannot be controlled from their respective front panel(s). Instead, they are controlled indirectly through the master XDS unit. The -AUX unit will display read back for output voltage on the left LED and the selected read back (current, peak current or power) on the right hand side LED. Turning the controls on an -AUX unit will result in a set of four dashes being shown on the readout. This indicates that front panel control is not available. After about 2 seconds of releasing the knob, the display will revert back to read back mode.

The Output On/Off key remains active. Generally, it is recommended to leave the output of the auxiliary unit turned on. This can be accomplished at power up using the power on setup register. (Refer to section 4.3).

5.4.3 Multi box remote control

Programming of voltage or current limit on auxiliary unit(s) (-AUX) cannot be done. Any attempt to send an output programming command will result in a -200, "Exection Error". All other commands remain active however, including output on/off and measurement queries. If the output is controlled remotely, the control program should always enable the output of the auxiliary units before enabling the master's output. The reverse is true for turning the output off.

Voltage measurements need only be done from the master unit. To obtain accurate current and power measurements, it is recommended to query all units and sum the data for total current and power readings. The master chassis of a multi-box system in parallel will not provide aggregate current or power measurements. To obtain these, the user must query the measurements from the master and all aux chassis and sum. Simply multiplying the value measured by the master by the total number of chassis may result in errors due to imperfect sharing.

5.5 RPV Mode

RPV stands for Remote Programming of Voltage. In this mode, the front panel voltage knob is rendered inoperative and an analog input is used to control the output voltage. This mode is available on a Master unit only.

Units configured for auxiliary operation (-AUX) or -RPC cannot be used with RPV.

There are two discrete inputs available for RPV mode on connector J22 (DB15) at the rear panel. Input pin 4 provides a 10VDC range input; input pin 11 provides a 5VDC range input. Both inputs are referenced to pin 14 (ISO COM).

These inputs can be calibrated using adjustment pot R103 but only one adjustment is available for either input so the unit must be calibrated for the required mode of operation.

5.6 RPC Mode

RPC stands for Remote Programming of Current Limit. In this mode, the front panel current knob is rendered inoperative and an analog input is used to control the current limit. This mode is available on a Master unit only.

If the XDS is to be used as a pseudo current source with analog control, the output voltage must be set to a high enough level given the load applied to ensure the XDS operates in Constant Current mode (CC). If the load is such that the set voltage is exceeded, the XDS will revert to constant voltage modes and the current will drop below the set level.

Units configured for auxiliary operation (-AUX) or -RPV cannot be used with RPC.

There are two discrete inputs available for RPV mode on connector J22 (DB15) at the rear panel. Input pin 4 provides a 10VDC range input; input pin 11 provides a 5VDC range input. Both inputs are referenced to pin 14 (ISO COM).

These inputs can be calibrated using adjustment pot R103 but only one adjustment is available for either input so the unit must be calibrated for the required mode of operation.

6 Principle of Operation

6.1 General

An explanation of the circuits in the DC supply is given in this section. Refer to block diagram in Figure 6-1.

6.2 Overall Description

Referring to block diagram in Figure 6-1 and Figure 6-2, the XDS DC power source consists of one to three high power DC modules, a controller, and a power supply board. The controller assembly uses a standard controller board and an optional GPIB board. An EMI filter is mounted to the rear panel and also serves as the input connection to the three phase AC mains.

The three phase mains is connected at the rear panel and passes through the EMI filter to provide AC power to each DC module and to the power supply board. Over current protection for the AC input is provided by appropriately sized fuses on each module. There is no master switch or circuit breaker, so, as long as mains power is applied to the input, the DC modules and power supply board are powered. A front panel switch enables the DC supply board to put the whole unit in the active state.

The controller, power supply, and each DC module are interconnected with a ribbon cable. This ribbon cable serves as the Supply/Control bus. The low voltage power supplies are directed from the power supply board to the controller and DC modules on this bus. Control signals also pass between all assemblies on this bus. Among other uses, these signals program the output, sense the output voltage, and detect fault conditions.

The standard interface assembly takes signals from the controller board and drives the RS232 connection on the rear panel.

A rear panel analog I/O connection allows remote isolated voltage and current programming of the DC output and remote shut down.

The optional interface assembly (-IF option) provides the GPIB output.

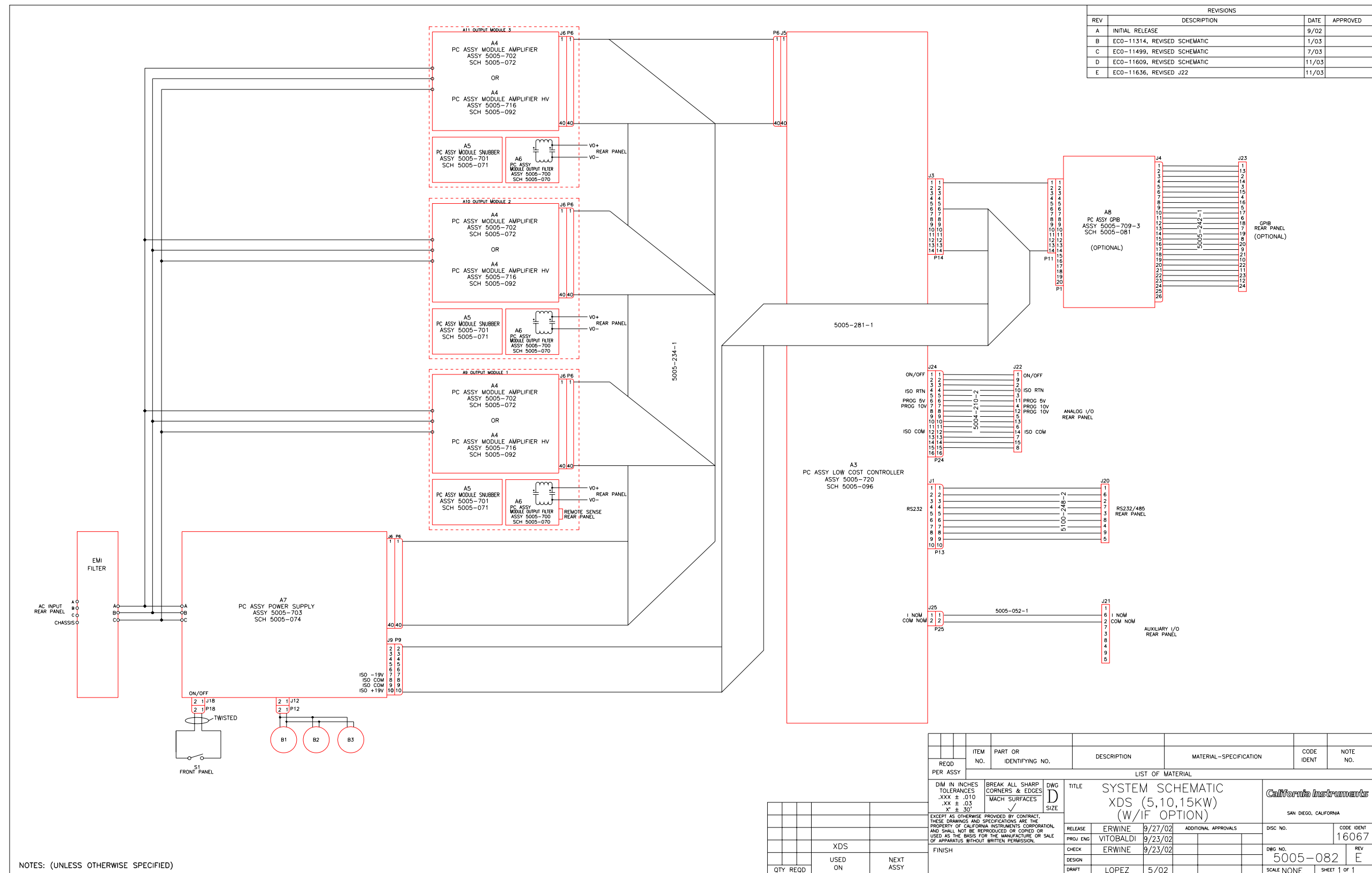


Figure 6-1: DC Power Supply Block Diagram - -IF option shown

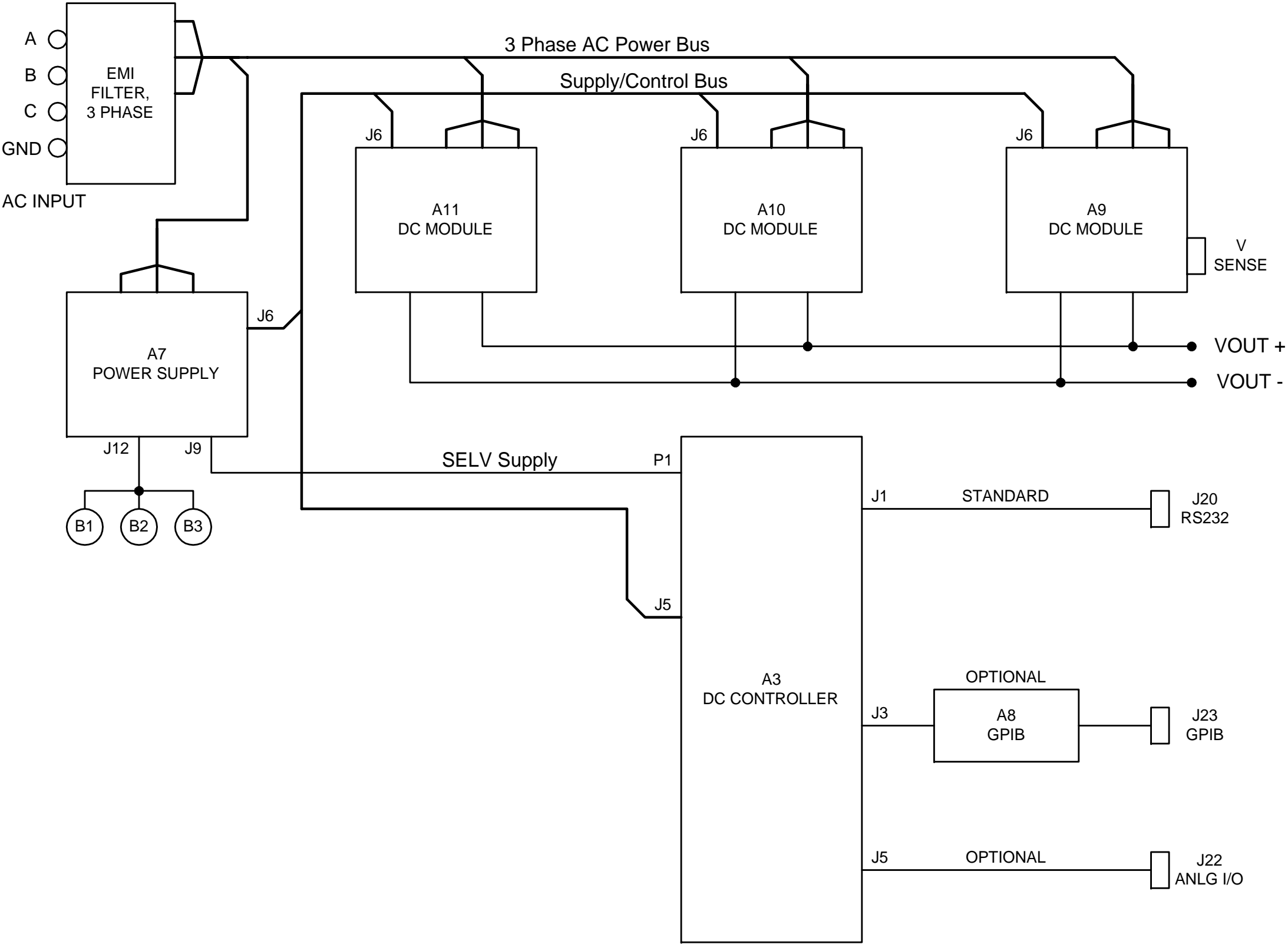


Figure 6-2: XDS DC Supply Simplified Block Diagram

6.3 Bias Power Supply (A7)

The power supply board (A7) uses the three phase AC mains to generate the various low voltage supplies required by the internal control circuits.

Three phase AC mains from the chassis EMI filter feeds the power supply board through one amp fuses. The AC is full wave rectified to feed bulk electrolytic capacitors through surge limiting thermistors. The bulk DC voltage is used by a flyback PWM converter to generate five isolated output windings and a sense winding. The PWM uses the sense winding to power its circuitry and regulate all of the outputs. Two of the output windings generate the +/- 19V SELV supply, two of the output windings generate the +/- 19V control supply, and the last output winding generates the +24 VDC supply to power the fans. Each of the five outputs goes through various stages of rectification and filtering, and each is protected by a polymeric fuse.

The +19 V control supply is down regulated by a small converter to create the relatively high current +15 V supply required by the DC module gate drive circuits.

The +24 V fan supply passes through a small variable output voltage converter. The output voltage is controlled between +12 V and +24 V depending on the master DC module output current. This controls the fan speed to reduce audible noise when the module is lightly loaded.

An over voltage, under voltage or phase lost detect comparator monitors the rectified input AC voltage and sends isolated logic signals to the controller if the mains voltage is not within the operating range.

Each of the DC output modules is synchronized to a common frequency, 93.75 kHz. The reference clock is generated from a crystal controlled oscillator on the power supply board. The oscillator frequency is divided down to provide three separate 93.75 kHz references, each separated by 120 degrees of phase from the other two.

The three phase AC mains is always active on the DC output modules and the DC supply board; there is no master switch or circuit breaker. The chassis is turned on or off by a small switch on the front panel. This switch applies or removes power from the DC supply board PWM controller chip. When the power to the PWM chip is removed, the flyback converter stops switching, all the bias supplies discharge to zero, and the complete unit is put in an "off" state.

Both power and control signals are distributed to the power modules and the controller through a 40 pin ribbon cable system interface, P/N 5005-234-1.

6.4 Power Module (A9 through A11)

Refer to Figure 6-3 for a block diagram of the DC module. The DC module rectifies and filters the AC mains voltage, switches the voltage with a phase modulated full bridge converter, passes the switched voltage through a voltage scaling isolation power transformer, rectifies and filters the output voltage, and directs the voltage to the output via bus bars.

The module mostly consists of the long amplifier board (A4), the small snubber (A5) and output filter (A6) boards, electrolytic filter capacitors on the input and output, power transformer, current sense transformer in the primary path of the power transformer, output rectifiers, and output inductor. Power semiconductors are soldered to the amplifier board to provide various functions. A heat sink provides not only a low impedance thermal path for the module, but also the structural base to which most of the components are mounted.

The AC mains from the three phase AC power bus enters the DC module at E1/E2/E3. The voltage passes through fuses and then a full wave rectifier (CR8-CR13). The DC voltage is filtered and stored on two electrolytic capacitors. The capacitors are configured in parallel for 208 volt mains or in series for 400/480 volt mains. High inrush current to the electrolytics is limited by a resistor. The resistor is shorted out by an SCR, CR14, during module operation.

Note: This bus bar is always live, even if the front panel On/Off switch is in the Off position. Use extreme cautions when servicing any part of this product.

The rectified/filtered mains voltage provides the high power bus for the H-bridge converter. The converter is phase-shift pulse width modulated using four IGBT's, Q12-Q15. The 93.75 kHz PWM clock frequency yields a 46.9 kHz frequency from the output of the H-bridge to the primary of the power transformer. A current transformer in the primary wire of the power transformer senses over current situations and is used for protection of the H-bridge.

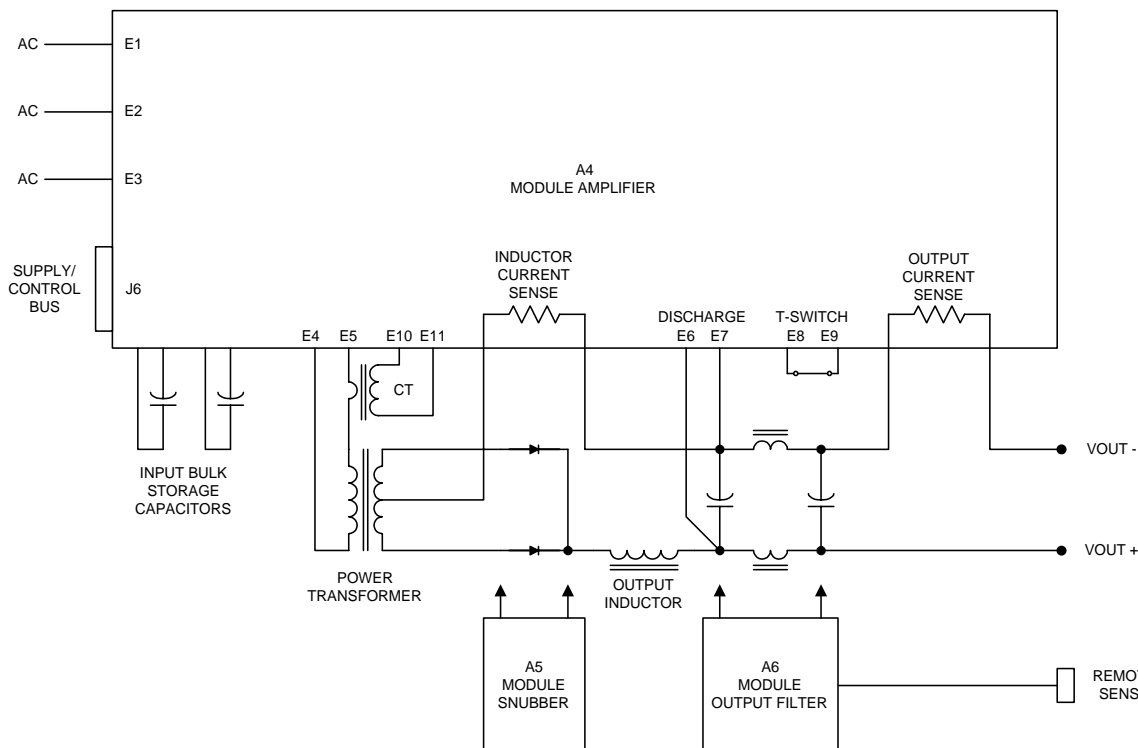


Figure 6-3: Power Module Block Diagram

The secondary arrangement of the power transformer depends on the output voltage. High voltage output models used a full-bridge arrangement. Low voltage output models use a center-tapped circuit. The latter is shown in Figure 6-3. The snubber board (A5) holds RC snubbers to control voltage spikes on the rectifiers. Circuit arrangement on this board varies per model output voltage. Secondary return current is monitored with a shunt resistor and represents the current in the output inductor. This current sense signal is used by the PWM controller for stability and protection.

The rectified output passes through a large filter inductor, to an electrolytic capacitor, through smaller inductors, and to a final electrolytic capacitor. A shunt in the output return lead senses output current for measurement and current programming. The output filter board (A6) mounts to the electrolytic capacitors. This board holds small filter capacitors and remote voltage sense circuitry. The voltage sense signals are fed back to the CPU controller assembly through the DC module amplifier board.

A thermal switch on the DC module heat sink opens if the monitored temperature is too high. This disables the DC module and is reported by the CPU controller.

A discharge circuit on the DC module amplifier board sinks current from the output electrolytic capacitors to quickly remove charge from the output. The level of discharge depends on the model output voltage and amount of external capacitance added by the user.

Each power module is made up of three PCB's, A4 through A6.

6.4.1 Amplifier Module (A4)

The amplifier module board is located perpendicular to the base heat sink of each power module. This board contains the switching control logic and power devices for both AC-DC and DC-DC stages of the power module.

6.4.2 Snubber Board (A5)

The snubber board is a small board located below the input electrolytic caps on the power board. The snubber board connects directly to the power diodes, which mount on an isolated mounting plate between the transformer and the output inductor.

6.4.3 Output Filter Board (A6)

The output filter board is located in the back of each power module, directly above the output electrolytic caps. One of the three power modules has an output filter board with external sense connector. (5005-700-1) This module is always on the far right of the chassis. The other two power modules (if present) have an output filter board without sense connections. (5005-700-2).

6.5 Controller Module (A3)

The Controller Module is designated A3. The controller module consists of a single printed circuit assembly that contains both the CPU, measurement circuits, control loop and user controls and indicators. The Controller Module has the circuits to perform the following operations:

1. Generates the output voltage and current reference signals and load regulates the output voltage or current.
2. Allows setting of Voltage and Current from the front panel or the standard RS232C or optional GPIB interface.
3. Measures and displays the output voltage, current, peak current and power.
4. Isolates and routes analog programming signal for Vprog or Iprog if -IF option is installed.

The controller assembly consists of the DC controller board (A3) and, optionally, GPIB board (A8). Refer to Figure 6-1.

The controller board is the core of this assembly. This board has a micro controller, A/D converters, reference, and logic circuits to program, calibrate, and measure the output of the XDS Power source. Voltage and current error amplifiers control the overall output according to user set values. Sensed voltage and current signals from the DC Output modules feed these error amplifiers and the measurement circuits. This board also holds the switches, rotary pulse generators, LED's, and seven segment displays at the front panel. An RS232 interface is standard to all XDS models and is part of the controller assembly.

The controller board has a total of 15 jumpers W1 through W15 that determine the mode of operation. Table 8-6, Table 8-7 and Table 8-8 show the valid jumper setting combinations. A "1" indicates the jumper is installed. A "0" indicates the jumper is out. Factory default settings are determined by the configuration option. See section 2.10. To change jumper settings, the top cover has to be removed to gain access. Contact Argantix (support@argantix.com) prior to doing so to ensure the warranty is not voided. The jumper locations on the back of the controller board are shown in Table 8-6, Table 8-7 and Table 8-8.

Analog Input

The controller board also contains an analog programming interface. This analog input may be used to control either the output voltage (default) or current limit. The desired mode is selected through jumper settings. See section 8.4

Analog Output (Imon)

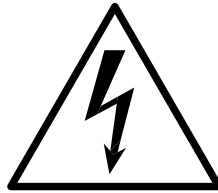
The controller board also has an analog output signal (Imon), which may be used to drive an XDS unit configured as an auxiliary unit. (-AUX). In this case, the control loop extends to the power modules in the -AUX unit and the voltage and current limit settings of all units can be controlled from the master unit.

6.5.1 Remote Control [Option] Interfaces (A8)

The XDS Series comes standard with an RS232C remote control interface. It can also be outfitted with a GPIB / IEEE 488 interface board. (Option -IF, Assembly A8).

The optional GPIB board (A8) provides a GPIB interface J4 to J23. A micro controller operating from SELV supplies handles the communication between the GPIB connection and the controller board.

The GPIB address for the DC power supply (if installed) is selected by a DIP-switch on the right side of the unit. Only one interface can be active at any given time and must be selected using DIP-switch position 6. (Refer to Figure 9-3: GPIB Address Selection Switch).



CAUTION

VOLTAGES UP TO 524 V_{AC} AND 600 V_{DC} MAY BE PRESENT IN CERTAIN SECTIONS OF THIS POWER SUPPLY. THIS EQUIPMENT GENERATES POTENTIALLY LETHAL VOLTAGES.



DEATH

ON CONTACT MAY RESULT IF PERSONNEL FAIL TO OBSERVE SAFETY PRECAUTIONS. DO NOT TOUCH ELECTRONIC CIRCUITS WHEN POWER IS APPLIED.

7 Calibration

Routine calibration should be performed every 12 months. Non-routine calibration is only required if a related assembly is replaced or if the periodic calibration is unsuccessful.

All routine calibrations can be performed without removing the top cover (Closed case calibration) through a series of adjustment pots reachable through the top cover. A calibration seal covers the access holes. This seal has to be removed or broken for this purpose.

7.1 Calibration Equipment

Equipment	Description
Digital Multimeter (DMM):	Two (2) HP 34401A
0.1%, 10 miliohm Current Shunt or 0.1%, 1 miliohm Current Shunt:	Isotek Model RUG-Z-R010-0.1 or equivalent or Isotek Model RUG-Z-R001-0.1 or equivalent
Load Bank:	Various power load resistors will be needed

Table 7-1: Calibration Equipment

Model	Voltage Range	Current	Load Resistor
XDS 30-167 XDS 30-333 XDS 30-500	30	167 A 333 A 500 A	0.18 0.09 0.06
XDS 40-125 XDS 40-250 XDS 40-375	40	125 A 250 A 375 A	0.32 0.16 0.107
XDS 50-100 XDS 50-200 XDS 50-300	50	100 A 200 A 300 A	0.50 0.25 0.167
XDS 80-62 XDS 80-125 XDS 80-187	80	62 A 125 A 187 A	1.29 0.64 0.428
XDS 100-50 XDS 100-100 XDS 100-150	100	50 A 100 A 150 A	2.0 1.0 0.667
XDS 150-33 XDS 150-66 XDS 150-100	150	33 A 66 A 100 A	4.545 2.273 1.5
XDS 250-20 XDS 250-40 XDS 250-60	250	20 A 40 A 60 A	12.5 6.25 4.167
XDS 300-17 XDS 300-33 XDS 300-50	300	17 A 33 A 50 A	17.647 8.823 6
XDS 400-12 XDS 400-25 XDS 400-37	400	12.5 A 25 A 37.5 A	32 16 10.67
XDS 600-8 XDS 600-17 XDS 600-25	600	8.33 A 16.67 A 25 A	72 36 24

Table 7-2: Load Resistors and Current by model

7.2 Routine Calibration

Equipment Setup:

Connect the required test equipment to the power supply as shown in Figure 7-1. The DMM can be connected to the common output bus bar at the rear of the unit.

Never connect the load wire to the SENSE terminal at the Rear Panel terminal strip. The load must be connected to the POWER bus bars. The external sense input of the DC supply must be connected at the same point as the DMM used to measure voltage. The DMM used to measure current must be connected across the reference shunt. Make sure the LO side of both DMM's is connected to the negative bus bar.

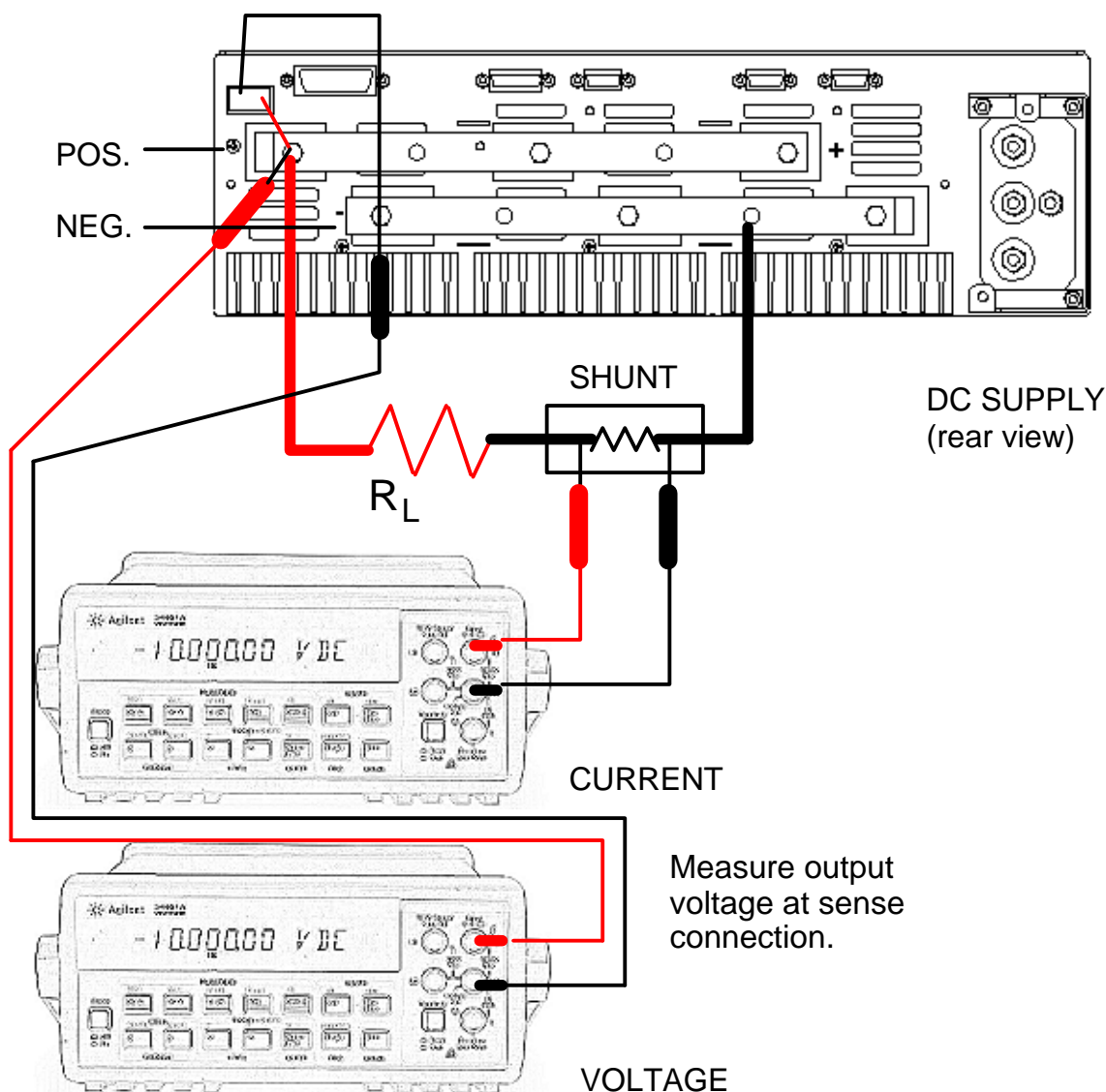


Figure 7-1: Test Equipment Hookup for Routine Output and Measurement Calibration

Adjustment Locations:

All adjustments are made manually on the XDS series using pots. The adjustment pots can be accessed through opening at the front of the top cover.

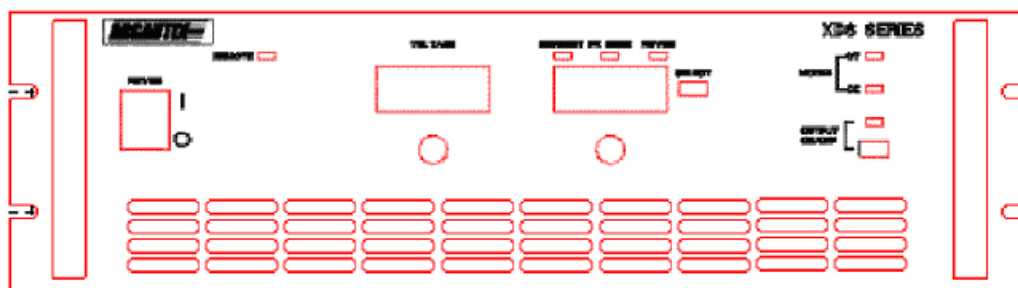
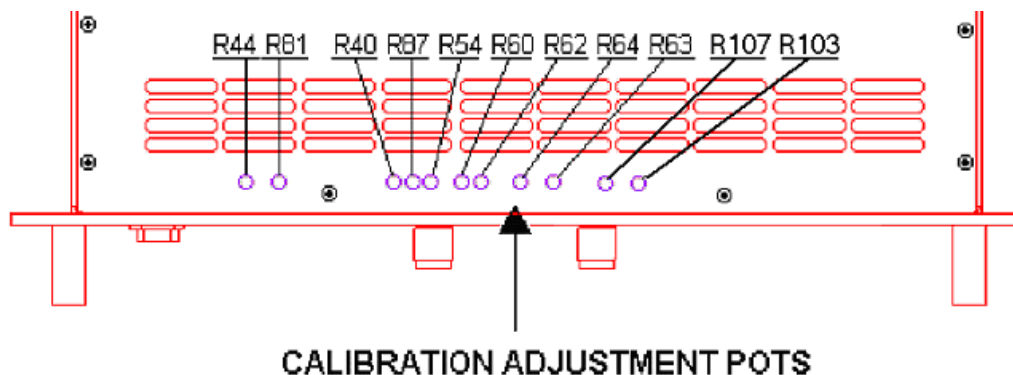


Figure 7-2: Calibration Adjustments

The following tables provide a reference of the adjustment pots accessible without removing the top cover. If the XDS unit is mounted in a cabinet system, it may be necessary to pull it forward by a few inches to access the front part of the top cover where the adjustment pots are located. Always use caution when sliding the unit out of a cabinet, as its weight must be properly supported.

Reference	Parameter	Type
R40	Output Voltage	Full Scale
R44	7.4 VDC Reference	Normalization
R54	Voltage Measurement	Full Scale
R60	Current Measurement	Offset
R62	Current Measurement	Full Scale
R63	Current Limit	Full Scale
R64	Peak Current Measurement	Full Scale
R81	Volt Measurement	Offset
R87	Output Voltage	Offset
R103	Analog Programming Input (J22 pin 4 and J22 pin 11)	Full Scale
R107	Current Limit	Offset

Table 7-3: Calibration Adjustment Reference by number

The adjustment pots are located from left to right (R44 R81 R40 R87 R54 R60 R62 R64 R63, R107, R103) standing in front of the XDS unit as shown in Table 7-4.

L to R	Parameter	Type	Reference
1	PRV Analog input (option)	Normalization	R44 (do not adjust)
2	Volt Measurement	Offset	R81
3	Output Voltage	Full Scale	R40
4	Output Voltage	Offset	R87
5	Voltage Measurement	Full Scale	R54
6	Current Measurement	Offset	R60
7	Current Measurement	Full Scale	R62
8	Peak Current Measurement	Full Scale	R64
9	Current Limit	Full Scale	R63
10	Current Limit	Offset	R107
11	Analog Programming Input (J22 pin 4 and J22 pin 11)	Full Scale	R103

Table 7-4: Calibration Adjustment Reference by location left to right

7.2.1 Output Voltage Calibration

Offset Calibration

- Set programmed voltage to 5% of full-scale voltage by using the Voltage Knob.
- Adjust R87 until DVM output voltage reading matches the set voltage as closely as possible.

Full Scale Calibration

- Set programmed voltage to 90 % of full scale voltage value
- Adjust R40 until DVM reading equals the set voltage as closely as possible.

7.2.2 Measurement Calibration

Voltage Measurement Offset Calibration

- Set programmed voltage to 1 % of full scale
- Adjust R81 until output voltage measurement on front panel equals DVM reading

Voltage Measurement Full Scale Calibration

- Set programmed voltage to full scale value
- Adjust R54 until output voltage measurement on front panel equals DVM reading

Current Measurement Offset Calibration

- Set programmed load current to 1% of full load
- Adjust R60 until output current measurement on front panel equal Shunt output current reading.

Current Measurement Full Scale Calibration

- a) Set programmed load current to 90 % of full load
- b) Adjust R62 until output current measurement on front panel equal shunt output current reading.

Peak Current Measurement Full Scale Calibration

- a) Set programmed output current to full load
- b) Adjust R64 until unit peak current measurement on front panel equals output current reading.

7.3 Non-Routine Calibration

7.3.1 Current Limit Calibration

This calibration procedure sets the current limit trip point at the right current level. To perform a current limit calibration, proceed as follows:

Offset Calibration

- a) Apply load and set voltage to full scale, current limit to 2% of range
- b) Adjust R107 until DVM output current reading matches the set current level as closely as possible.

Full Scale Calibration

- a) Set programmed output current to full scale
- b) Adjust R63 until the DC supply starts going into current limit.

7.3.2 Analog Input Calibration

This calibration is performed at the factory only and should not be done by the end user unless the controller mode has been field reconfigured.

To adjust the analog input calibration, use pot R103.

RPV Adjustment

For RPV mode, use a DVM to determine the output voltage while applying a DC input level from a small, low noise DC reference supply. Apply some load when performing this calibration.

RPC Adjustment

For RPC mode, a load sufficient to draw 90% of available current is required. Full power is not needed so a lower voltage than full scale can be used to perform the analog current full scale calibration.

7.3.3 Current Sharing Calibration on Multi-box Systems

Systems consisting of multiple XDS units in parallel may require periodic checking and adjustment of the current sharing. If a system was shipped configured from the factory, the current sharing was set at the time of shipment. Systems that are configured in the field using XDS units that were not originally factory configured as such, must be checked and adjusted as needed. This section covers the required adjustment procedure.

This test makes adjustments to all Auxiliary power sources used in a multi-box power system. The test is done with the assumption that all measurement calibrations have been performed on all power sources used in the system. The load for the parallel power system must be derived from Table 7-2. In order to derive the resistance needed for the load find the load resistance value for a 15 KW OUTPUT. Multiply this value by the factor $15/(\text{total power in KW})$. This value will be the full-load resistance value.

For example if the power system has an 80 volt range and the total system power level is 25 KW the full-load resistance is: $(15/25) \times 0.427 = 0.256$ ohms.

Proceed as follows:

1. Connect the analog cable, 5005-051-1, between the Master power source and each Auxiliary power pin11 source. J21 of the Master must connect to J22 of the Auxiliary Source. J21 pin 2 of the Master source must connect to J22 pin 14 of each Auxiliary source. J21 pin6 of the Master source must connect to J22 of each Auxiliary source.
2. Configure the auxiliary unit's controller if it is not already set for –AUX configuration. In each Auxiliary power source remove jumper W12 and install jumper W13 and W14 on the 5005-720 controller board. Note, if the intended –AUX unit has a P/N 5005-708-1 controller board, it does not support parallel operation.
3. If the total system power is 45 KW or more install jumper W15 on the Master Controller board. W16 should already be installed.
4. Connect the outputs of all of the power sources in parallel. Use adequate wire sizes. Connect a suitable current shunt in series with each unit so the current delivered by each unit can be monitored individually. If suitable current shunts are not available, the internal current read back of the XDS units may be used instead provided the current measurement calibration of each XDS unit has been verified beforehand.
5. Apply the full-load resistance value derived above. Make sure the load is rated for the power level that will be dissipated.
6. Turn on the line power first for the Master power source followed by each Auxiliary source.
7. Apply the output of each Auxiliary source followed by the Master source. Make sure that the output voltage stays at a low value, less than 0.5% of full-scale voltage, after each Auxiliary source has the output applied.
8. Note: If the Master and Auxiliary power sources are not of the same model (same number of amplifiers) a constant, R , must be determined for the full-scale current tracking of the Auxiliary power source. $R = (\text{Auxiliary maximum current}) / (\text{Master maximum current})$ For most power systems the model number of the Master and Auxiliary will be the same to the value of R will be equal to 1. This would mean the current delivered by the sources should be the same.
9. The full-load current from each Auxiliary source should match the full-load current delivered by the Master within 5%. The current delivered by each Auxiliary source must match the current delivered by the Master times the constant R . For example if the constant is $2/3$ when the Master is delivering 100 amps the Auxiliary with the constant R should be delivering 66.66 amps. In order to make this adjustment slowly increase the output voltage of the Master source while observing the load current supplied by each Auxiliary source. The

Auxiliary sources will not precisely track the current of the Master (the Master current times the value of R) at the lower values of current. Increase the voltage until the total load current of the power system is equal to the maximum current of the Master power source. Use **R103** in each Auxiliary source to adjust the load current contributed by the Auxiliary source equal to that of the Master source times the value of R for the individual Auxiliary power source.

10. Increase the voltage for the full-load current. Record the total and the amount of current supplied by each source. Adjust **R103** if necessary to balance the currents. Remove the load to check the load regulation.

Configurations with more than 2 XDS units.

Follow this procedure for each of the –AUX units in the parallel system configuration. For systems with more than one –AUX unit, it may be necessary to adjust each unit in turn until they all share within stated tolerances.

Example

The following is an example of the parallel adjustments of a 2-box power system:

Master power source: XDS100-150

Auxiliary power source: XDS100-100

In step 8, the value of R will be 0.6666

In step 8, when the total system current is 100 amps, the maximum current rating of the lowest power source, the Auxiliary source must be adjusted with R103 to 40 amps at the same time the Master is delivering 60 amps ($60 \times .6666 = 40$ amps)

In step 9, R103 in the Auxiliary should be adjusted to 100 amps when the Master is delivering 150 amps.

8 Service

8.1 General

This section describes suggested maintenance and troubleshooting procedures. The troubleshooting procedure is divided into two sections. The first section deals with basic operation and connection of the equipment. The second section requires opening the unit and using the LED indicators and a simple multi meter to troubleshoot the unit down to the module level. Only a qualified electronic technician should attempt this level of troubleshooting.

8.2 Basic Operation

Table 8-1: Basic Symptoms

PARAGRAPH	PROBLEM
8.2.1	Poor Output Voltage Accuracy
8.2.2	Poor Output Voltage Regulation
8.2.3	No Output and no lights on front panel
8.2.4	No output but "Display" on front panel is on
8.2.5	Error -300
8.2.6	Can't program DC supply on GPIB or RS232

8.2.1 Poor Output Voltage Accuracy

If the power supply exhibits poor programmed voltage accuracy, the following item may be at fault:

Table 8-2: Poor Output Voltage Accuracy

CAUSE	SOLUTION
The calibration is incorrect.	Calibrate the output.

8.2.2 Poor Output Voltage Regulation

If the AC Power supply exhibits poor voltage regulation the following item may be at fault:

Table 8-3: Poor Output Voltage Regulation

CAUSE	SOLUTION
The Remote Sense lines are not connected at the same point monitored by the external voltmeter used for load regulation check.	Connect DC voltmeter to Remote Sense lines on the Rear Panel Power Output terminal strip.
The External voltage sense connection is open.	Check the sense connections. Make sure not to reverse the sense polarity or damage to the unit may occur.

8.2.3 No Output and No Lights on Front Panel

Table 8-4: No Output and No Lights on Front Panel

CAUSE	SOLUTION
Front panel power switched off.	Switch the breaker on.
No input power to the input connector.	Ensure correct input power.
Blown fuse.	Check fuses on the DC bias power supply and replace with same type and rating. See Figure 7-2.

8.2.4 No Output but “Display” on Front Panel is On

Table 8-5: No Output But “Display” Is On

CAUSE	SOLUTION
“OUTPUT ON” switch is turned off.	Turn OUTPUT ON switch to “ON”.
Current limit programmed down or to zero.	Program current limit higher.
Voltage programmed down or to zero.	Turn amplitude control up.
Remote Inhibit Input is active	Remote Inhibit (On/Off) input on rear panel connector J22 is pulled up or down. This renders the Output On/Off button inactive. The polarity of the Remote Inhibit input is determined by the SYST.CONF command. See sections 3.3 and 4.5.1 for details.
Controller configuration lost. Evident by inability to set voltage or current to any other value than 0.	If the controller encounters an incorrect configuration check sum at power up, it defaults to a "SAFE" state by setting the voltage and current range to 0 V and 0 A. The unit is inoperative in this state until the configuration data is reset. This requires the use of the RS232C interface. Contact factory for assistance.

8.2.5 Error -300

Error -300 indicates a device specific error. It is usually associated with an over power, over temperature, sense wiring or AC line input condition. An Error -300 will result in the output being turned off and the voltage set to 0 V. To recover from an Error -300, the voltage must be programmed up and the output turned back on after the error condition has been removed.

CAUSE	SOLUTION
Internal heat sink temperature is too high.	Operate power supply between 0 and 40°C.
Fans or ventilation holes are blocked.	Remove obstructions.
Fans not working.	Check DC bias supply (A7) and connection cable harness for DC fans. If +24 VDC is present at fan terminals and fans don't turn, replace fans.
The output is overloaded.	Remove the overload.

CAUSE	SOLUTION
AC input line outside operating limits	Verify correct AC input voltage is applied.
AC input phase missing	Check the AC input line to make sure all three phases are present.
Sense connection Fault	Check for reversed polarity sense or shorted sense connections. If the sense wires have been reversed and the output turned on, damage may have occurred to the sense board. Contact service if the unit no longer functions with proper sense connections restored.

8.2.6 Can't Program on GPIB or RS232

If the power supply does not respond to RS232C or GPIB programming, the following items may be at fault:

CAUSE	SOLUTION
The power supply unit address is incorrect.	Update address. See section 9.4
The RS232C interface has been used and the DC supply has not been powered down since.	Note that on the XDS Series DC Supply, only one interface can be active at one time. If the RS232C interface is used, the GPIB interface is automatically disabled until the power is cycled. Also check the RS232C/GPIB selection switch setting on the address DIP switch. See section 9.4.
No terminator is sent with each command.	The XDS Series expects a LineFeed (LF or Hex 0A) as a message terminator after each command string.
GPIB or RS232 cable is loose at power supply rear panel.	Check connection, tighten jackscrews.
RS232 has failed.	Incorrect cable is used. Cable must be straight through 9 pin D to 9 pin D to PC RS232C port. Check correct baud rate setting in application program if it is user controlled. DC Supply interface is fixed at 19200 baud, 8 bits, 1 start, 1 stop bit.
GPIB Assembly has failed.	Replace the GPIB Assembly.

8.3 Module Removal

Figure 8-1 shows the location of the internal modules and assemblies.

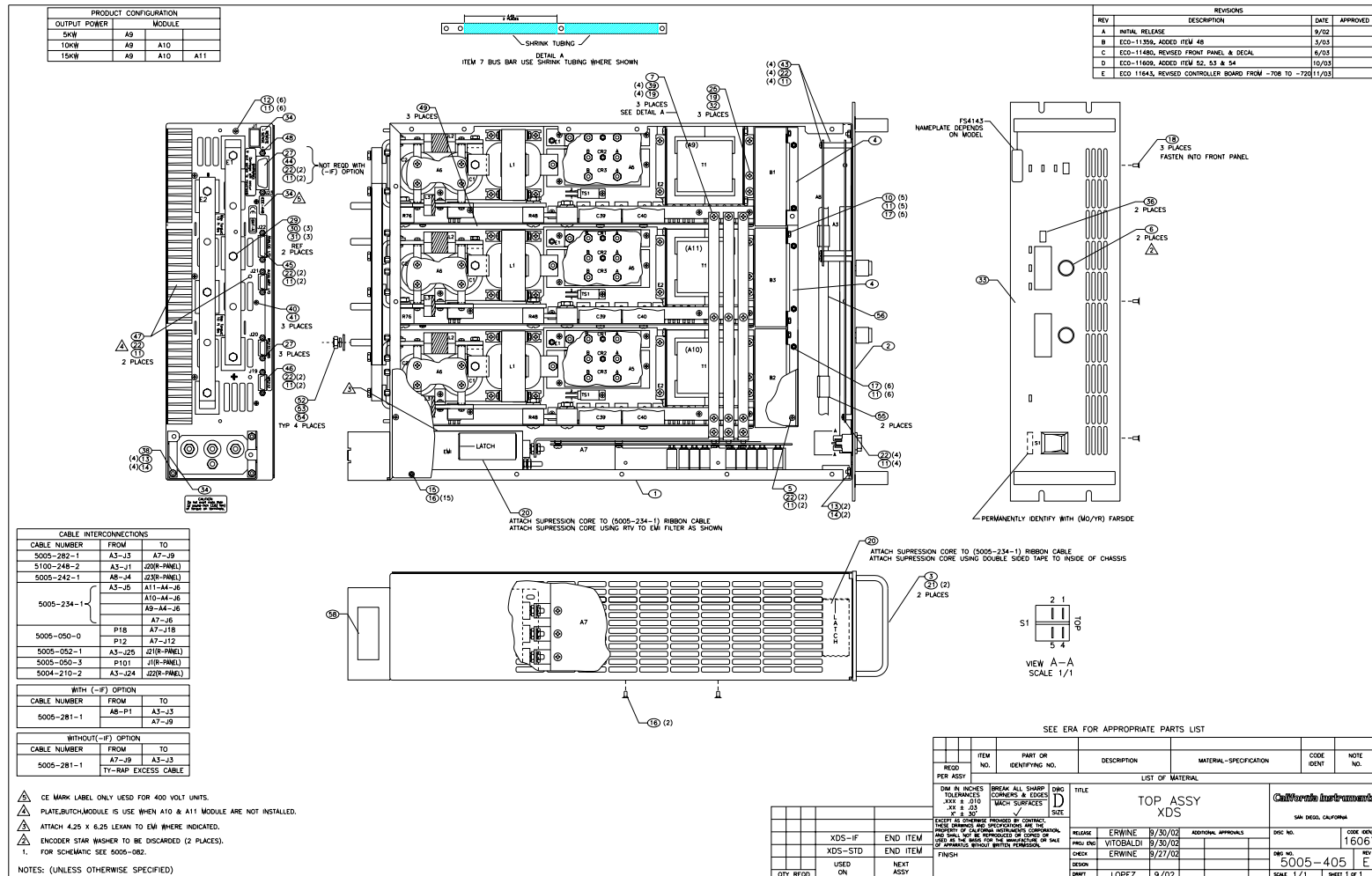


Figure 8-1: Assembly Location

8.3.1 Controller Module Removal / Replacement

The warranty seals on the power supply have to be broken for the following procedure. Contact Argantix customer service through email at support@argantix.com to obtain permissions to do so to avoid voiding the product warranty.

If a fault is found that requires the replacement of the Controller Module (Assembly A3) follow the following steps and refer to Figure 8-1 for the module locations:

1. Turn off the front panel On/Off switch. Remove any input power from the rear panel terminal block by disconnecting or unplugging or otherwise disconnecting the AC input.
2. Allow time for any caps to discharge. This may take several minutes.
3. Remove the top cover.
4. Remove the screws along the bottom of the front edge that hold the front panel to the chassis.
5. Remove the two nuts in the top corners of the front panel that hold the front panel to the chassis.
6. Disconnect the system interface (40 pin) ribbon cable from the controller and disconnect the power ribbon cable (10 pin). You can now remove the front panel assembly from the chassis.
7. Place the front panel assembly on a static free work surface.
8. Remove the two front panel knobs. Requires a small Allen wrench.
9. Remove 5 screws that hold the controller PCB assembly to the front panel. The controller assembly can now be removed.
10. Any new controller that is installed must be correctly configured for the Voltage and Current ranges of the XDS model. The voltage and current limits and the serial number stored in the NVM configuration data of the controller must also be set correctly using the RS232C interface. The XDSGUI may be used for this purpose if the authorized password is known. For correct jumper settings, see section 8.4.

8.3.2 Power Module Removal / Replacement

The warranty seals on the power supply have to be broken for the following procedure. Contact Argantix customer service through email at support@argantix.com to obtain permissions to do so to avoid voiding the product warranty.

If a fault has been found that indicates the failure of the amplifier module (Assembly A9 through A11), check the condition of the AC line input fuses on each of the power modules. before replacing the amplifier. Refer to Figure 8-1 for the location of the fuse.

If it is determined that the amplifier module must be replaced, perform the following procedure:

1. Turn off the input circuit breaker.
2. Disconnect all AC input power at the rear panel. Allow any capacitors to bleed down.
3. Remove the power supply top cover by removing (13) #6-32 x 5/16" FLH screws.
4. Remove the module interface cable that connects the modules to the Bias Supply and the controller to clear the EMI shield. Then remove the EMI shield.
5. Remove the (2) #6-32 x 1" screws and lock washers that hold the amplifier module at the rear panel.
6. Disconnect the 40-pin ribbon system interface cable that connects all power modules along the top and then remove the EMI shield. If any cables run across the top of the EMI shield, they may have to be unplugged at the controller as well.
7. Remove the horizontal AC input power bus bars that run across the top of the three power modules.
8. Remove the fan in front of the power module that needs to be removed.
9. Remove the screw at the front of the heat sink that holds the power module to the chassis.
10. Remove the amplifier by pulling it away from the rear panel and lifting it up and out of the chassis.
11. The amplifier may be replaced by following this procedure in reverse order.
12. Check the amplifier AC fuses located on the front of the power module PCB (A4), and replace it if necessary.

8.4 Controller Jumper Settings

The XDS controller has a number of configuration jumpers. These jumpers are normally factory set but there may be situations when the jumper settings have to be changed. Specifically, under the following circumstances:

1. Adding one or more 5 KW power modules to an existing 5 KW or 10 KW unit.
2. Changing the operation of the controller from internal Volt or Current programming to Analog Input Volt or Current programming or for parallel mode. See also chapter 5.

To change jumper settings, the unit has to be powered down and completely disconnected from AC mains to ensure safety. This change should only be made by qualified personnel experienced with working on high power electronic test equipment.

The warranty seals on the power supply have to be broken to remove the top cover. Contact Argantix customer service through email at support@argantix.com to obtain permissions to do so to avoid voiding the product warranty.

The following table shows the correct jumper configurations. Configurations not shown should be avoided as they may render the unit inoperative. The controller board has a total of 15 jumpers W1 through W15 that determine the mode of operation. Table 8-7 through Table 8-8 shows all valid jumper setting combinations. A "1" indicates the jumper is installed. A "0" indicates the jumper is out. To change jumper settings, the top cover has to be removed to gain access. Contact Argantix prior to doing so to ensure the warranty is not voided.

The jumper locations on the back of the controller board are shown in Figure 8-2. The view is projected from the front, looking down on the back of the 5005-720-1 controller assembly on the front panel. Note that W15 must be installed for parallel systems of 35KW or higher.

Configuration	W1	W2	W5	W6	W9	W10	W11	W12	W13	W14	W15	W16
Master	1	0	1	0	0	1	0	1	0	0	0	1
Auxiliary (-AUX)	1	0	1	0	1	0	0	0	1	1	0	1
Master, -RPV	0	1	1	0	0	1	0	1	0	0	0	1
Master, -RPC	1	0	0	1	0	1	1	1	0	0	0	1

Table 8-6: DC Controller Configuration Jumper Settings - Mode

Output Power	W3	W4	W7	W8
5 kW	0	0	0	0
10 kW	1	0	1	0
15 kW	1	1	1	1

Table 8-7: DC Controller Jumper configurations - Power Level

OVP Mode	W9	W10
OVP in % of V Range	0	1
OVP in % of V Setting	1	0

Table 8-8: DC Controller Jumper configurations - OVP mode

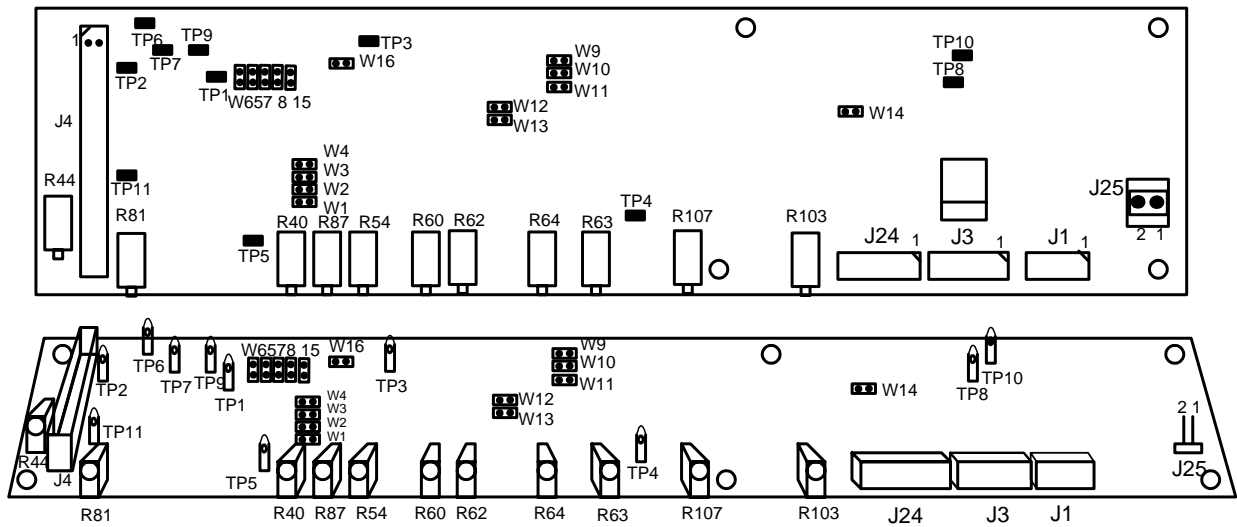


Figure 8-2: XDS Controller Jumper Locations – Front view, far side of PWB.

8.5 Replaceable Parts

In order to ensure prompt, accurate service, please provide the following information, when applicable for each replacement part ordered.

- Model number and serial number of the instrument. Specify any configuration option such as –LC if present as this may affect the replacement part or module required.
- Part number for the sub-assembly where the component is located.
- Component reference designator if applicable (REF #)
- Component description.

All replaceable part orders should be addressed to:

Argantix

Attention: Customer Service
9689 Towne Centre Drive
San Diego, California 92121-1964
United States of America

Orders may also be placed using fax number: 1 858 677 0904 or email to support@argantix.com.

REF #	PART #	DESCRIPTION	VENDOR	QTY
1	5005-720-1	PC Assy, Controller	CI	1
2	5005-709-3	PC Assy, GPIB (-IF option)	CI	1
3	5005-703 5005-723	PC Assy, Bias Supply - or - PC Assy, Bias Supply	CI	1
4	5005-702	PC Assy, Power Module ²	CI	1 - 3
5	5005-700-1	PC Assy, Output Filter w Sense	CI	1
6	5005-700-2	PC Assy, Output Filter w/o Sense	CI	0 - 2
7	241182	Fan, 4, 24 VDC	EBM W2G110 EBM 4214H Comair MS24B3	1 - 3
8	270212	Fuse, Bias Supply, 600 V, 1A	Bussman KTK1 LittleFuse KLK1	3
208 V Input Models (-208)				
	250753	PC Assy, EMI Filter, 90 A, 250 V	Tri-Mag SF1819	1
		Fuse, Power Module, 600 V, 30A	Bussman KTK30 LittleFuse KLK30	3 / Mod
400 V Input Models (-400)				
	250763	PC Assy, EMI Filter, 57 A, 440 V	Tri-Mag SF1812	1
		Fuse, Power Module, 600 V, 20A	Bussman KTK20 LittleFuse KLK20	3 / Mod

² Note that power modules used in XDS units with the –LC option have different output capacitor components. See Table 8-10.

REF #	PART #	DESCRIPTION	VENDOR	QTY
480 V Input Models (-480)				
	250762	PC Assy, EMI Filter, 45 A, 480 V	Tri-Mag SF1811	1
		Fuse, Power Module, 600 V, 15A	Bussman KTK15 LittleFuse KLK15	3 / Mod

Table 8-9: Replaceable Parts

Output filter board capacitor part numbers for a 5 KW DC power module.

Model	Standard Power Module	-LC Option
30 V	2 x 22000 uF (P/N 611437)	2 x 5600 uF (P/N 611435)
40 V	2 x 15000 uF (P/N 611436)	2 x 3900 uF (P/N 611422)
50 V	2 x 12000 uF (P/N 611441)	2 x 3900uF (P/N 611422)
80 V	2 x 3900 uF (P/N 611422)	2 x 1500uF (P/N 611439)
100 V	2 x 2200 uF (P/N 611438)	2 x 470uF (P/N 611440)
150 V	2 x 1500 uF (P/N 611439)	N/A
250 V	2 x 560 uF (P/N 611472)	N/A
300 V	2 x 470 uF (P/N 611440)	N/A
400 V	2 x 330 uF (P/N 611449)	N/A
600 V	4 x 220 uF (P/N 611445)	N/A

Table 8-10: Power Module Output Capacitance

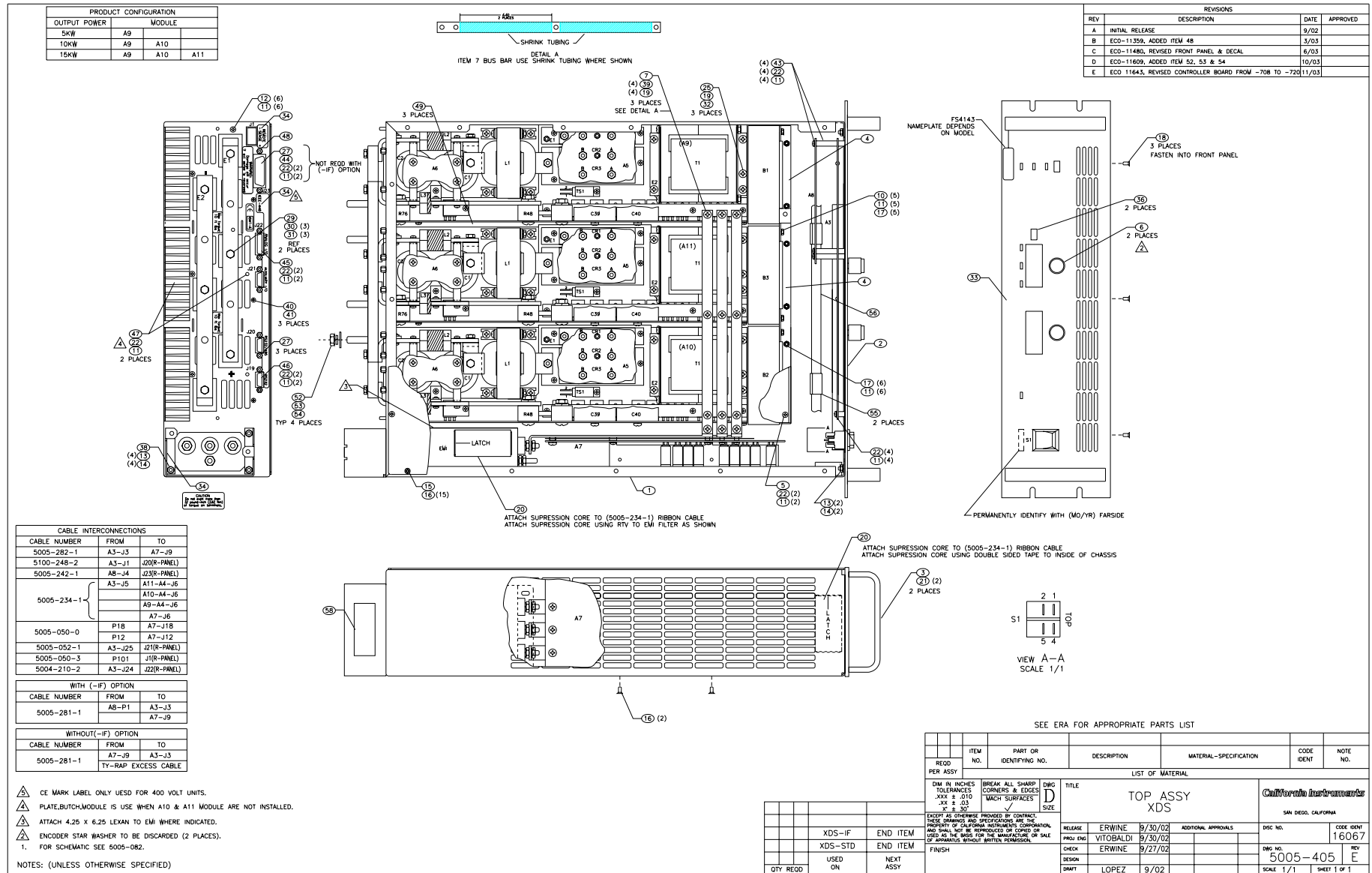


Figure 8-3: Replaceable Fuse Locations

9 Remote Control

9.1 Introduction

The XDS Series comes standard with an RS232C serial interface on the rear panel. It can optionally be furnished with an IEEE-488 / GPIB interface at the time of purchase. The GPIB interface is part of the -IF option.

Units are shipped with the Argantix Graphical User Interface program - XDSGUI. This Windows™ program provides a soft front panel to the instrument when connected to a PC through the RS232C or IEEE-488 interface. Additional benefits are obtained from using the PC as a control interface. Some of these benefits include the ability to store measurement data to disk and produce output transients to simulate DC supply conditions.

The XDSGUI is a Windows™ program and as such requires a PC capable of running Windows 98™, or Windows NT™/2000/XP. For best performance, a Pentium based PC is recommended.

Complete information on how to use the XDSGUI can be found in the on-line help supplied with the program. Use the Help menu or press on any of the many Help keys located in all program windows for an explanation of the relevant screen or function.

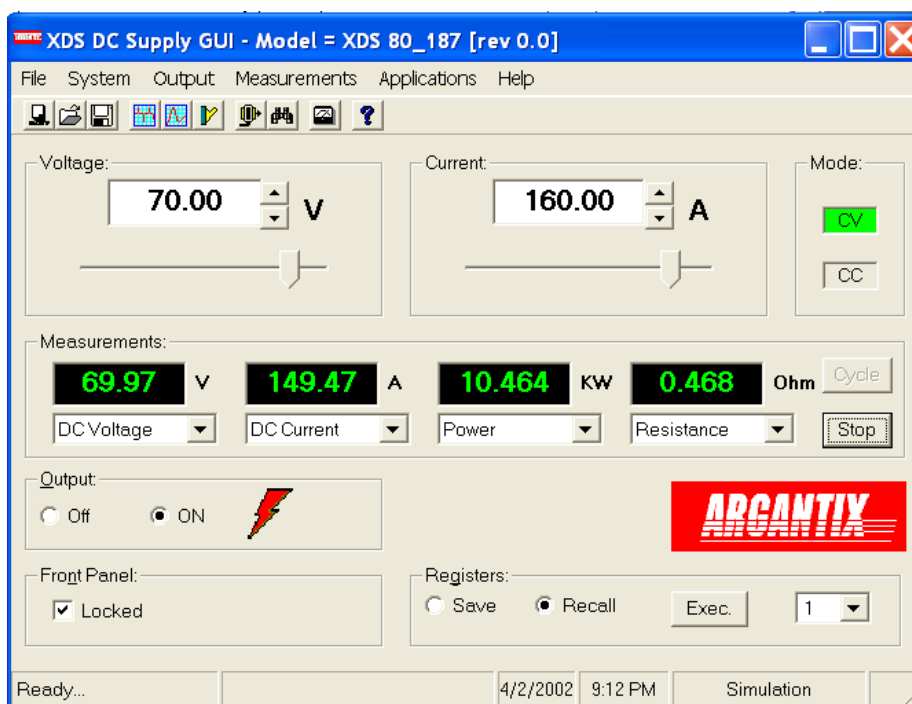


Figure 9-1: XDSGUI Main screen

9.2 XDSGUI Program Requirements

To successfully install and operate the XDSGUI program, you will need the following equipment:

Argentix XDS Series DC power supply.

PC capable of running Windows 98™, Windows 2000™ or Windows XP™

- RS232C communications port
 - RS232C serial cable (supplied with the product.)
- or
- If option -IF (GPIB) is installed, a National Instruments IEEE-488 Controller Card

Note: *The XDSGUI can be run in the absence of a DC power supply. If no DC supply is available, the XDSGUI can be operated in a simulation mode. The program will detect these conditions and start up in simulation mode after notifying the operator. Measurements in this case will be simulated and should not be used for any analytical purpose.*

9.3 RS232C Interface

A suitable cable to connect the power supply to a 9 pin PC-AT style serial port is supplied with the power supply.

The XDS Series expects a LF (Hex 10) terminator at the end of each string sent over the RS232C interface. If the programming environment you use to develop test programs does not append a LF terminator to each output string, the XDS Series will not respond. This may be the case for programs like LabView™ using VISA drivers.

9.3.1 Serial Communication Test Program

The following sample program written in Quick-BASIC can be used to check communication to the XDS Series Power supply over the RS232C serial interface. The interface is optional and must be installed for this to work.

```
'Argentix RS232C Communication Demo Program
'(c) 2002 Copyright California Instruments, All Rights Reserved
'
'This program is for demonstration purposes only and is not to be
'used for any commercial application
'=====
'Function and Subroutine Declarations
DECLARE FUNCTION retstring$ ()

'=====
'MAIN PROGRAM CODE
'=====

'OPEN COM2. Replace with COM1, COM3 or COM4 for Com port used
'The input and output buffers are set to 2K each although
'this is not required for most operations.

OPEN "COM2:19200,n,8,1,BIN,LF,TB2048,RB2048" FOR RANDOM AS #1 LEN = 1
CLS
PRINT "**** INTERACTIVE MODE ****"
'Enter and endless loop to accept user entered commands
DO
```

```

INPUT "Enter Command ('quit' to exit)--> ", cmd$
IF cmd$ <> "QUIT" AND cmd$ <> "quit" THEN
  IF cmd$ <> "" THEN
    PRINT #1, cmd$ + CHR$(10);
  END IF
  IF INSTR(cmd$, "?") THEN
    PRINT "Power supply query response = "; retstring$
  END IF
  'Check for Errors after each command is issued
  PRINT "Sending non-query syntax check *ESR?"
  'On fast PC's we may have to hold off between commands
  FOR t = 0 TO 1000: NEXT t
  PRINT #1, "*ESR?" + CHR$(10);
  esr% = 0 'Clear last error
  'Mask off bits 5,4,3,2 only. Other bits are not used.
  esr% = VAL(retstring$) AND 60
  'Process esr% value for error bits
  IF esr% AND 4 THEN
    PRINT "**** Query Error Reported by power supply ****"

  END IF
  IF esr% AND 8 THEN
    PRINT "**** Instrument Dependent Error Reported by power supply ****"
  END IF
  IF esr% AND 16 THEN
    PRINT "**** Command Execution Error Reported by power supply ****"
  END IF
  IF esr% AND 32 THEN
    PRINT "**** Command Syntax Error Reported by power supply ****"
  END IF
  'Clear ERR. -XXX Message from front panel if any error occurred
  IF esr% <> 0 THEN
    PRINT #1, "*CLS" + CHR$(10);
  END IF
END IF
LOOP UNTIL cmd$ = "QUIT" OR cmd$ = "quit"
'Close COM port on exit
CLOSE #1
END
'=====

FUNCTION retstring$
  'This function returns a response string from the XDS Series
  'power supply. The QBasic statement LINE INPUT cannot be used
  'as the XDS Series does not return a CR <13> after a response
  'message. The LINE INPUT function waits for a CR before
  'returning a string. The P Series returns a LF <10> instead
  'so we need to poll each returned character for a LF to
  'assemble the response string. The COM port needs to be
  'opened AS random with a record length of 1 for it to support
  'this function. Also, the device number is assumed to be #1
  'Optionally, this value could be passed as a parameter to
  'make this program more generic.

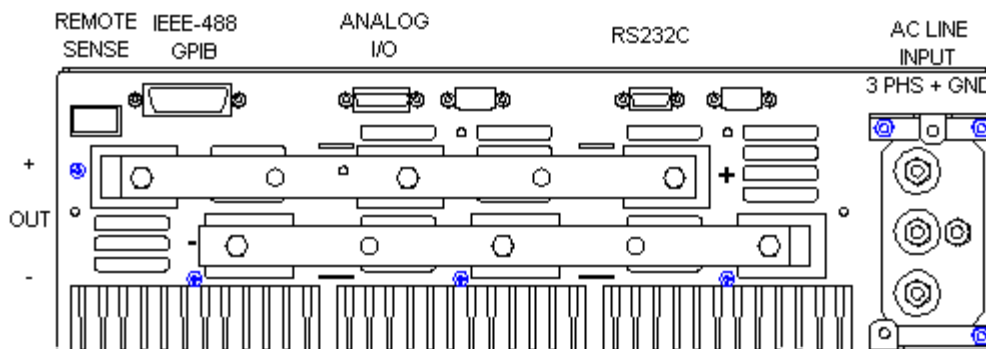
  DIM char AS STRING * 1
  DIM resp AS STRING
  char = ""
  resp = ""
  DO
    char = INPUT$(1, #1)
    resp = resp + char
  LOOP UNTIL char = CHR$(10)
  'Return result
  retstring$ = LEFT$(resp, LEN(resp) - 1)
END FUNCTION

```


9.4 Optional IEEE Interface

The XDS Series can optionally be equipped with an IEEE-488 interface in addition to the standard RS232C interface.

Figure 9-2: Rear Panel View



The IEEE address of the XDS DC Supply is set using the DIP-switch at the right side of the unit. (When facing power supply from the front). The switch is located on the controller board (A1) and visible through the side air intake openings. Switch position 4 through 0 corresponds to bits 4 through 0 of the IEEE address. The desired interface is selected by moving DIP-switch position 5 to the correct mode. Only one interface can be active at a time.

Note: Always turn off the power supply and disconnect AC input power when changing this DIP setting. Use a non-metallic object to change switch positions for the Address.

Figure 9-3: GPIB Address Selection Switch



- The dark section represents the switches.
- The above configuration would cause the unit to be in GPIB mode at address 10.
- Listen only mode is not supported and this switch must be in the up position (Listen Only mode OFF) to work properly.

Note: Switch setting changes do not take effect until power is cycled.

9.5 XDSGUI Installation

This section covers installation of the XDSGUI from the distribution disk to the user's PC. Make sure the PC is capable of running Windows.

9.5.1 Connecting to the PC Using RS232

Connect the power supply to the PC using an RS232C cable.

The power supply RS232C port settings are set as follows:

Baud rate:	19200 baud
Data bits:	8
Stop bits:	1
Parity bits:	none
Handshake:	Hardware

The power supply source is configured to accept the above setting.

9.5.2 Connecting to the PC Using the optional IEEE-488/GPIB interface

Connect the power supply to the PC using an IEEE-488 interface cable. A National Instruments GPIB controller card is required to use the XDSGUI program.

Make sure the IEEE-488 interface is selected by checking the DIP switch on the side of the unit. It should be in the IEEE-488 position. (See section 9.4).

Set the desired IEEE address using DIP switch position 4 through 0 on the rear panel. (See section 9.4).

9.5.3 Installing the XDSGUI Software

The XDSGUI software is distributed on CD-ROM. The XDSGUI must be installed from CD using the included setup program as all required files are compressed. To install the XDSGUI, proceed as follows:

1. Turn on the PC and boot up in Windows™
2. Insert the CD in your CD-ROM drive.
3. Run the Setup.exe program from the root directory of the CD.
4. A CD Browser like program will open. Select the product series for which you want to install the software and select the GUI Software tab. Select an available operating system (typically 32 bit Windows) and click on the Install button to begin the installation.
5. Follow the instructions provided by the setup program to complete the installation.
6. When the installation has completed, remove the CD ROM and store in a safe place.

If prompted to do so, reboot the PC to activate the new settings. You are now ready to start using the XDSGUI software.

9.6 Trouble Shooting - RS232C

This section provides guidelines for resolving communication problems that may occur when using the XDSGUI software under Windows™.

You may encounter problems when using the serial interface with the XDSGUI program that is supplied with the interface option for this source.

Symptoms:

1. Unable to verify connection to the power supply through RS232C interface. Time-out occurs and dialog box appears that asks if you want to switch to simulation mode. An error message (ERR - 100) may appear on the front panel LED's of the power supply.

- Or -

2. Verification is successful but slewing of voltage or current limit results in an ERR -100.

Things to check first:

1. Is any PC com port available for communication with the power supply? On older PC's com port interrupts are often shared between com 1 and com3 as well as com2 and com 4. If any of these other com ports is in use, it may prevent you from using the com port that shares the same interrupt.
2. Did you use the RS232C cable that was supplied with the power supply? If not, make sure you obtain the correct cable. (DB9 to DB9, straight through, male to female).

Resolution for Symptom 1

The XDS Series of power supplies require hardware handshaking to control data flow from the PC to the Power supply. After receiving a command, the power supply asserts the DTR line to hold off further communication from the PC until the command just sent has been processed. Under Windows, it is possible to use a 16 byte transmit buffer if a 16550 UART is present. This FIFO exceeds the length of most Power supply commands. When enabled, this mode may result in more than one command being placed in the UART output buffer. If this happens, the handshake from the Power supply will not prevent the content of this buffer being sent to the Power supply and thus will result in more than one command being sent to the Power supply.

To resolve this problem, the UART FIFO length needs to be reduced or disabled altogether. The procedure to disabled the FIFO mode is outlined in the next paragraph.

Note: If turning off the UART FIFO conflicts with other applications that need to run on the same PC using the same COM port, this solution may not be acceptable. In this case, skip this step and proceed to the second symptom resolution, which relies on a software implemented hold-off instead of turning off the FIFO buffer.

Procedure

1. Make sure the XDSGUI program is closed and no device is using the com port in use.
2. From the Windows™ desktop, right click on the “My Computer” icon which is located in the top left corner of the screen.
3. From the popup menu, select the “Properties” entry.
4. This brings up the System Properties dialog box
5. From the tabs shown at the top of the dialog box, select the “Device Manager” tab.
6. The relevant screen is shown in Figure 9-4.
7. Expand the Ports(COM&LPT) tree selection by clicking on the ‘+’ sign
8. Select the COM port you plan to use to communicate with the P or XDS Series power supply.
9. With the correct COM port selected, click on the Properties button at the bottom left of the dialog box.
10. This brings up the settings dialog box for the COM port. In this example, COM2 is used.
11. From the tabs at the top of the dialog box, select the “Port Settings” tab.
12. This should bring up the dialog shown in Figure 9-6.
13. Next, select the Advanced button to bring up the advanced port settings dialog box shown in Figure 9-5.

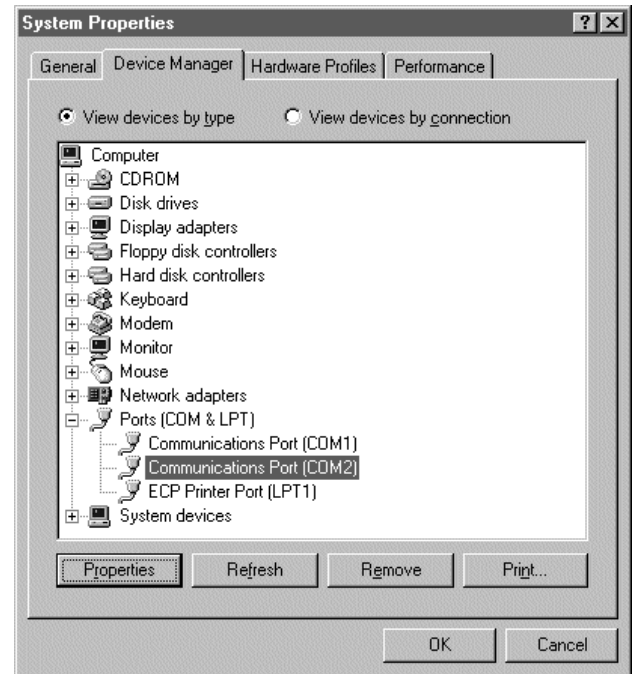


Figure 9-4: System Properties Dialog Box

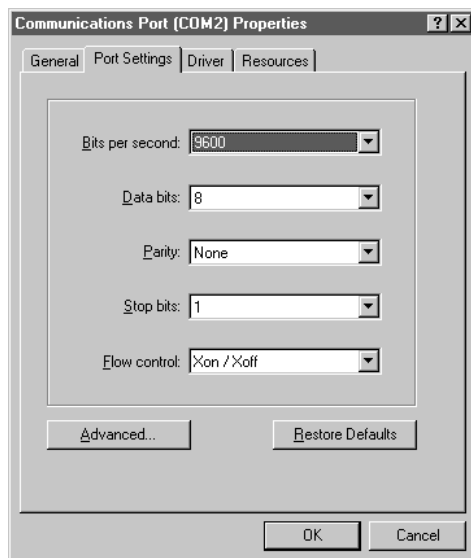


Figure 9-6: COM Port Properties Dialog Box

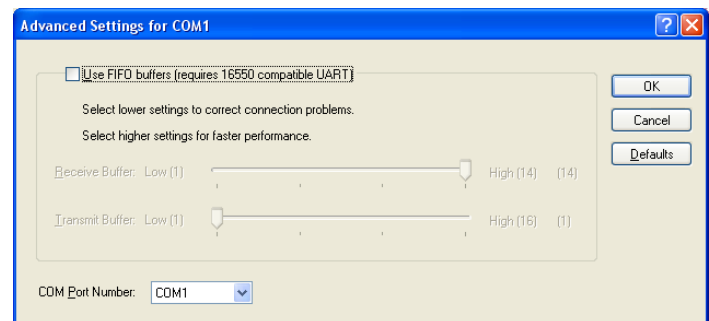


Figure 9-5: Advanced Port Settings Dialog Box

14. At the top of the dialog box, disable the “Use FIFO buffers (requires 16550 compatible UART)” checkbox. This will bypass the UART FIFO's and enable the hardware handshake to work correctly. If the FIFO cannot be turned off, set the Receive buffer to max (14) and the Transmit buffer to min. (1).
15. Click on the all OK buttons to close all dialog boxes that remain open.
16. This should enable the XDSGUI to work correctly.

Resolution for Symptom 2

Execute the suggested procedure to resolve symptom 1 first. If an occasional error continues to occur while slewing the voltage or frequency slider controls in the XDSGUI program, increase the command delay parameter located in the System, Interface dialog. The default value for the CmdDelay is set to 30 and is displayed below the command line of the Interface window. Change this value to 40 by entering the new value from the keyboard.

Try to connect again. You may have to cycle the power on the power supply if it still shows the Err - 100 display.

Higher values than 40 may be set for the CmdDelay parameter if this fix does not resolve your problem.

9.7 Trouble Shooting - IEEE-488 / GPIB

This section provides guidelines for resolving communication problems that may occur when using the power supply with or without the XDSGUI software with a IEEE-488 / GPIB interface.

Symptoms:

1. Unable to verify connection to the power supply through IEEE-488 interface. Time-out occurs any time an attempt is made to verify connection.

Things to check first:

1. Is the interface option set to use the IEEE-488 interface instead of the RS232C interface? The DIP switch on the right side panel of the power supply is used to select the desired interface mode. Refer to section 0. If the GPIB option (option -IF) was ordered, it should be set this way from the factory but may have been changed after shipment).
2. Does the bus address selected in the System, Interface dialog match the address set using the DIP switches on the power supply. The GPIB address selected must match the settings on the DIP switch. If changes are made to the DIP switch setting, the power supply must be cycled off and on to have the new settings take effect.
3. Did you connect the cable in correctly and are both ends of the GPIB cable securely tied down?

Resolution for Symptom 1

When using a fast IEEE-488 bus controller, the power supply's IEEE-488 interface may not handshake fast enough to satisfy the controllers timing requirement. If this is the case, a time-out will result any time a command is sent to the power supply. To rectify this situation, the IEEE-488 controller must be set to use delayed bus timing. For National Instruments GPIB controller cards running under Windows™, this can be done from the device manager.

Select the GPIB interface and click on the NI-488.2M Settings tab. An Advanced button at the bottom of the screen will provide access to the Bus Timing parameter. Try setting this value to 500 nsec or

2μsec to operate with the power supply's GPIB interface.

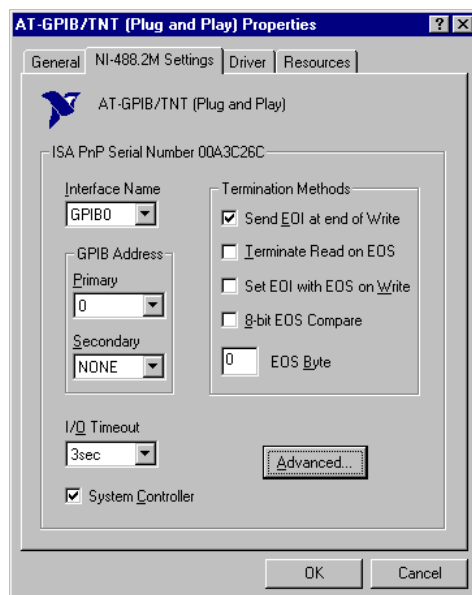


Figure 9-7: NI PCI-GPIB Settings

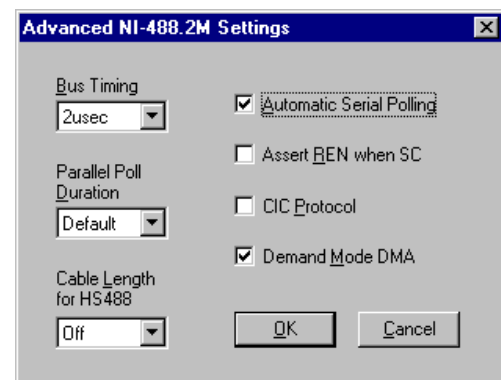


Figure 9-8: NI PCI-GPIB Advanced Settings Dialog

Test Sequence Program Directory Files

9.8 Software Registration

Updates of this and other Argantix programs and drivers are posted on a regular basis on the Argantix web site. You can find available programs by selecting the Software, GUI's and Drivers menu. To gain access to these downloads, you will need to register as a user on our web site. For instructions on how to register and request the required access level for software downloads, visit our web site at

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10 Introduction to SCPI

SCPI (Standard Commands for Programmable Instruments) is a programming language for controlling instrument functions over the RS232 or IEEE 488 bus. The same SCPI commands and parameters control the same functions in different classes of instruments. For example, you would use the same MEAS:VOLT? command to measure the Power supply output voltage or the output voltage of a SCPI-compatible Multimeter.

10.1 Conventions Used in This Manual

Angle brackets<>	Items within angle brackets are parameter abbreviations. For example, <NR1> indicates a specific form of numerical data.
Vertical bar	Vertical bars separate alternative parameters. For example, 0 1 indicates that either "0" or "1" can be used as a parameter.
Square Brackets[]	Items within square brackets are optional. The representation [SOURce:]VOLT means that SOURce: may be omitted.
Boldface font	Boldface font is used to emphasize syntax in command definitions. CURR <NRf> shows a command definition.
Upper case font	Upper case font is used to show program lines in text. OUTP 1 shows a program line.

10.2 The SCPI Commands and Messages

This paragraph explains the syntax difference between SCPI Commands and SCPI messages.

The power supply supports two types of commands, IEEE-488-2 common and SCPI subsystem commands.

- IEEE-488-2 common commands are generally not related to specific operations but to controlling overall Power supply functions such as reset, status and synchronization. All common commands consist of a three-letter mnemonic preceded by an asterisk:

*RST *IDN? *SRE 255

- SCPI Subsystem commands perform specific Power supply functions. They are organized into an inverted tree structure with the "root" at the top. Some are single commands while others are grouped within specific subsystems. **You must include the root header in all commands sent to the Power supply.**

Refer to appendix A for the SCPI tree structure.

Types of SCPI Messages

There are two types of SCPI messages, program and response.

- A program message consists of one or more properly formatted SCPI commands sent from the controller to the Power supply. The message, which may be sent at any time, requests the Power supply to perform some action.
- A response message consists of data in a specific SCPI format sent from the Power supply to the controller. The Power supply sends the message only when commanded by a program message called a "query."

The SCPI Command Tree

As previously explained, the basic SCPI communication method involves sending one or more properly formatted commands from the SCPI command tree to the instrument as program messages. The following figure shows a portion of a subsystem command tree, from which you access the commands located along the various paths (you can see the complete tree in appendix A).

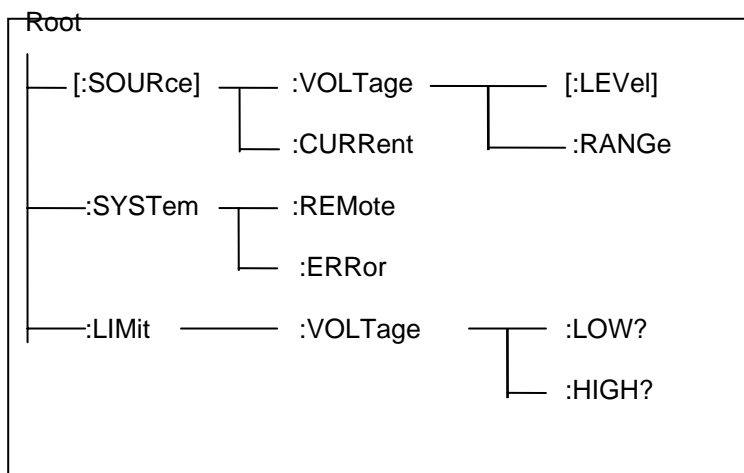


Figure 10-1: Partial Command Tree

The Root Level

Note the location of the ROOT node at the top of the tree. Commands at the root level are at the top level of the command tree. The SCPI interface is at this location when:

- The Power supply is powered on
- A device clear (DCL) is sent to the Power supply
- The SCPI interface encounters a message terminator
- The SCPI interface encounters a root specifier

Active Header Path

In order to properly traverse the command tree, you must understand the concept of the active header path. When the Power supply is turned on (or under any of the other conditions listed above), the active path is at the root. That means the SCPI interface is ready to accept any command at the root level, such as **SOURCE** or **MEASurement**.

If you enter **SOURCE** the active header path moves one colon to the right. The interface is now ready to accept **:VOLTage** or **:CURRent** as the next header. You must include the colon, because it is required between headers.

Note: The XDS Series interface buffer is limited to 21 characters, however. As such, compound commands are not recommended as they often exceed this message length limit.

Moving Among Subsystems

In order to combine commands from different subsystems, you need to be able to restore the active path to the root. You do this with the root specifier (:). For example, you could set the output voltage to 60 V and set the display mode to power.

```
VOLT 60
```

```
DISP:MODE 3
```

Because the root specifier resets the command parser to the root, you can use the root specifier and do the same thing in one message:

```
VOLT 60::DISP:MODE 3
```

Including Common Commands

You can combine common commands with system commands in the same message. Treat the common command as a message unit by separating it with a semicolon (the message unit separator). Common commands do not affect the active header path; you may insert them anywhere in the message.

```
VOLTage 115;*ESE 255
```

```
OUTPut 0;*RCL 2
```

10.3 Using Queries

Observe the following precautions with queries:

- Set up the proper number of variables for the returned data.
- Read back all the results of a query before sending another command to the power supply . Otherwise a Query Error will occur and the non-returned data will be lost.

10.4 Structure of a SCPI Message

SCPI messages consist of one or more message units ending in a message terminator. The terminator is not part of the syntax, but implicit in the way your programming language indicates the end of a line (such as a newline or end-of-line character).

The Message Unit

The simplest SCPI command is a single message unit consisting of a command header (or keyword) followed by a message terminator.

CURRent?<newline>

VOLTage?<newline>

The message unit may include a parameter after the header. The parameter usually is numeric:

VOLTage 20<newline>

OUTPut 1<newline>

Combining Message Units

The following command message is briefly described here, with details in subsequent paragraphs.

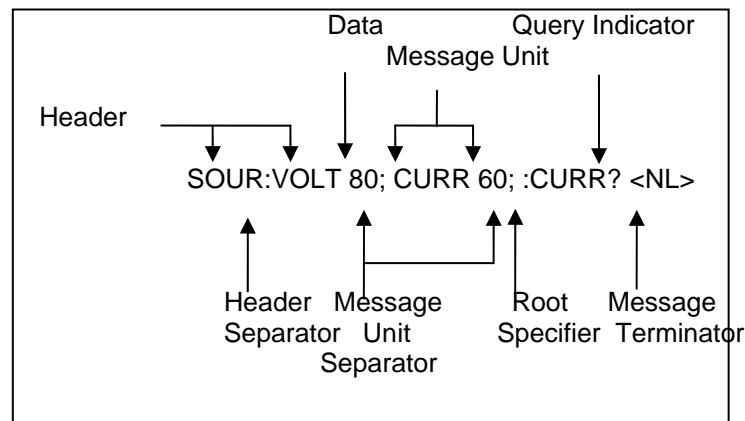


Figure 10-2: Command Message Structure

The basic parts of the above message are:

Message Component	Example
Headers	SOURC VOLT CURR CURR
Header Separator	The colon in SOUR:VOLT
Data	80 60
Data Separator	The space in VOLT 80 and CURR 60
Message Units	VOLT 80 CURR 60 CURR?
Message Unit Separator	The semicolons in VOLT 80; and CURR 60;
Root Specifier	The colon in :CURR?

Query Indicator	The question mark in CURR?
Message Terminator	The <NL> (newline) indicator. Terminators are not part of the SCPI syntax

Note: **The use of compound messages such as the one shown in Figure 12-2 is not recommended as they typically exceed the available receive buffer length of the XDS Series interface.**

Headers

Headers are instructions recognized by the power source. Headers (which are sometimes known as "keywords") may be either in the long form or the short form.

Long Form	The header is completely spelled out, such as VOLTAGE, SYSTEM, and OUTPUT. The XDS Parser will stop parsing the remainder of any command after its short form has been parsed. Effectively, this means the remainder will be a don't care and syntax errors will not be detected or reported.
Short Form	The header has only the first three or four letters, such as VOLT, SYST, and OUTP. The XDS parser only parses the short form of all SCPI commands and ignores any remainder.

The SCPI interface is not sensitive to case. It will recognize any case mixture, such as VOLTAGE, VOLTage or Voltage. Short form headers result in faster program execution.

Note: **In view of the 21 character receive buffer size of the XDS Series, the short form is recommended under all circumstances.**

Header Convention

In the command descriptions used in this manual, the proper short form is shown in upper-case letters, such as DELay.

Header Separator

If a command has more than one header, you must separate them with a colon, e.g. (SYSTem:ERRor LIMit:VOLT:LOW).

Optional Headers

The use of some headers is optional. Optional headers are shown in brackets, such as VOLTage[:LEVel] 100.

Query Indicator

Following a header with a question mark turns it into a query (VOLTage?).

Message Unit Separator

When two or more message units are combined into a compound message, separate the units with a semicolon (VOLT 100;CURR 60).

Root Specifier

When it precedes the first header of a message unit, the colon becomes the root specifier. It tells the command parser that this is the root or the top node of the command tree. Note the difference between root specifiers and header separators in the following examples:

SOURce:VOLTage:LEVel 100	All colons are header separators
:SOURce:VOLTage:LEVel 100	Only the first colon is a root specifier
SOURce:VOLTage:LEVel 100;:CURRent 55	Only the third colon is a root specifier
You do not have to precede root-level commands with a colon; there is an implied colon in front of every root-level command.	

Message Terminator

A terminator informs SCPI that it has reached the end of a message. The only permitted message terminator is:

- newline (<NL>), which is ASCII decimal 10 or hex 0A.

In the examples of this manual, there is an assumed message terminator at the end of each message. If the terminator needs to be shown, it is indicated as <NL> regardless of the actual terminator character.

10.5 SCPI Data Formats

All data programmed to or returned from the power source is in ASCII. The data type may be numerical or character string.

Numerical Data Formats

Symbol	Data Form
--------	-----------

Talking Formats

<NR1>	Digits with an implied decimal point assumed at the right of the least-significant digit. Examples: 273
<NR2>	Digits with an explicit decimal point. Example: .0273
<NR3>	Digits with an explicit decimal point and an exponent. Example: 2.73E+2
<Bool>	Boolean Data. Example: 0 1

Listening Formats

<Nrf>	Extended format that includes <NR1>, <NR2> and <NR3>. Examples: 273.2 , 2.73E2
<Bool>	Boolean Data. Example: 0 1

Character Data

Character strings returned by query statements may take either of the following forms, depending on the length of the returned string:

<CRD>	Character Response Data. Permits the return of character strings.
<AARD>	Arbitrary ASCII Response Data. Permits the return of unlimited 7-bit ASCII. This data type has an implied message terminator.
<SRD>	String Response Data. Returns string parameters enclosed in double quotes.

10.6 Programming Tips

When developing custom application code, the following guidelines should be followed if possible:

All commands should be terminated with <NL> (hex 0A) character. In "C", the \n character sequence will result in a <NL> character. This is the message terminator.

The receive buffer of the XDS is limited to about 21 characters. Avoid sending long compound message strings consisting of multiple commands. Commands longer than the receive buffer will result in "-100, Syntax Error"

Successive non-query commands (e.g. VOLT 100) sent to the unit should be spaced at least 20 msec apart. This is to allow the interface of the unit to receive and transmit the command over it's internal optically isolated serial bus to the main processor. This process takes place for both GPIB and RS232C control so this 'command hold-off' delay period is needed regardless of which interface is used. The same delay is not required following a query command (e.g. VOLT?) as the application program generally waits for the response before sending the next command.

Inserting this delay does not affect real through put as the unit would not respond any faster if commands were sent consecutively without delays in between.

Some commands take extra time to execute as they update the non-volatile memory of the unit. In particular, the *SAV command requires 300 msec to complete. No commands should be send during this time period.

It is good practice to check for error messages using the *ESR? or SYST:ERR? Queries. The XDS does not generate an SRQ on the GPIB bus so programmed polling is needed to check for status or errors.

11 SCPI Command Reference

Where appropriate, related commands or queries are included. These are listed because they are either directly related by function, or because reading about them will clarify or enhance your understanding of the original command or query.

This chapter is organized as follows:

- Subsystem commands, arranged by subsystem
- IEEE 488.2 common commands

11.1 Subsystem Commands

Subsystem commands are specific to Power supply functions. They can be a single command or a group of commands. The groups are comprised of commands that extend one or more levels below the root. The description of common commands follows the description of the subsystem commands.

The subsystem command groups are listed in alphabetical order and the commands within each subsystem are grouped alphabetically under the subsystem. Commands followed by a question mark (?) take only the query form. When commands take both the command and query form, this is noted in the syntax descriptions.

11.2 Measurement Subsystem

This subsystem programs the measurement capability of the power supply.

Subsystem Syntax

MEASure	
:CURRent?	
[:LEVel]	Returns the average DC value of current
:AMPLitude	
:MAX?	Returns peak current measurement reading
:RESet	Resets the peak current measurements
:POWer	Returns the DC power measurement reading.
:VOLTage?	Returns the DC voltage measurement reading

MEASure:CURRent[:LEVel]?

This query returns the DC value of the DC current being sourced at the output terminals. Note that the output must be on to obtain current flow.

Query Syntax	MEASure:CURRent?
Parameters	None
Examples	MEAS:CURR?
Returned Parameters	<NR2>
Related Commands	OUTP 0 1 MEAS:CURR:AMPL:MAX?

MEASure:CURRent:AMPLitude:MAX?

This query returns the peak current value of the output current being sourced at the output terminals. Note that the output must be ON to obtain current flow. The peak current measurement circuit uses a sample and hold method and latches the highest peak current value found since the last peak measurement reset command.

Query Syntax	MEASure:CURRent:AMPLitude:MAX?
Parameters	None
Examples	MEAS:CURR:AMPL:MAX?
Returned Parameters	<NR2>
Related Commands	OUTP 0 1 MEAS:CURR?

MEASure:CURRent:AMPLitude:RESet

This command resets the peak current measurement sample and hold circuit to zero.

Query Syntax	MEASure:CURRent:AMPLitude:RESet
Parameters	None
Examples	MEAS:CURR:AMPL:RES
Related Commands	MEAS:CURR:AMPL:MAX?

MEASure:POWer?

This query returns the DC power delivered to the unit under test by the Power supply. Note that the output must be on to obtain current flow.

Query Syntax	MEASure:POWer?
Parameters	None
Examples	MEAS:POW?
Returned Parameters	<NR2>
Related Commands	MEAS:VOLT? MEAS:CURR?

MEASure:VOLTage?

This query returns the average DC voltage being sourced at the output terminals. Note that the output must be on or no voltage will be present at the output terminals.

Query Syntax	MEASure:VOLTage?
Parameters	None
Examples	MEAS:VOLT?
Returned Parameters	<NR2>
Related Commands	OUTP 0 1

11.3 Source Subsystem

This subsystem programs all the output parameters of the power supply.

Subsystem Syntax

[SOURce:]		
CURRent:		
[LEVel]		Set the current value in amps.
HIGH		Set the maximum current allowed
LOW		Set the minimum current allowed
LIMit:		
CURRent?		Current range limit: Model specific
VOLTage?		Voltage range limit. Model specific
MODE?		Returns power supply operating mode.
VOLTage:		
[LEVel]		Set the output voltage value in volts.
HIGH		Set the maximum voltage allowed
LOW		Set the minimum voltage allowed
PROTection		
	[:LEVel]	Set the over voltage protection trip level in % of range.
	STATe	Enables or disables OVP mode.

[SOURce:]CURRent[:LEVel]

This command sets the current limit of the output. If the load current exceeds the programmed current limit, the power supply will cross over from voltage mode to current mode. In this mode, the output voltage will fold back as much as needed to retain the current at the programmed limit.

The current may be set between the low limit and high limit as programmed using the CURR:HIGH and CURR:LOW commands. However, the high limit cannot be higher than the model's capability (configuration limit) which can be queried with the LIM:CURR? command. The low limit cannot be less than zero. The *RST state for high and low current is zero for low, and maximum configuration limit for high. (model specific).

Command Syntax	[SOURce:]CURRent <NRf>
Parameters	value between CURR:HIGH and CURR:LOW settings.
Unit	A (amperes)
*RST	Defined by the PON
Examples	CURR 5
Query Syntax	CURRent?
Returned Parameters	<NR2>
Related Commands	CURR:HIGH CURR:LOW

[SOURce:]CURRent:HIGH

This command sets the maximum programmed current that will be accepted by the power supply. If a value above this limit value is programmed, a "-200 Execution Error" will be generated.

The current limit may be set between zero and the model's capability (configuration limit) which can be queried with the LIM:CURR? command. The high limit cannot be less than the low limit however. The *RST state for high current limit is the maximum configuration limit. (model specific).

Command Syntax	[SOURce:]CURRent:HIGH <NRf>
Parameters	0 to LIM:CURR? value.
Unit	A (amperes)
*RST	Max. Current
Examples	CURR:HIGH 5
Query Syntax	CURRent:HIGH?
Returned Parameters	<NR2>
Related Commands	CURR CURR:LOW

[SOURce:]CURRent:LOW

This command sets the minimum programmed current that will be accepted by the power supply. If a value below this limit value is programmed, a "-200 Execution Error" will be generated.

The current limit may be set between zero and the model's capability (configuration limit) which can be queried with the LIM:CURR? command. The low limit cannot be more than the high limit however. The *RST state for low current limit is zero.

Command Syntax	[SOURce:]CURRent:LOW <NRf>
Parameters	0 to LIM:CURR? value.
Unit	A (amperes)
*RST	0
Examples	CURR:LOW 5
Query Syntax	CURRent:LOW?
Returned Parameters	<NR2>
Related Commands	CURR CURR:HIGH

[SOURce:]LIMit:CURRent?

This command queries the maximum current the power supply can deliver. Only the Query format of this command is available to the user.

Command Syntax	[SOURce:]LIMit:CURRent <NRf>
Parameters	maximum current [command protected]
Query Syntax	LIMit:CURRent?
Returned Parameters	<NR2>

[SOURce:]LIMit:VOLTage?

This command queries the maximum voltage the power supply can deliver. Only the Query format of this command is available to the user.

Command Syntax	[SOURce:]LIMit:VOLTage<NRf>
Parameters	maximum voltage [command protected]
Query Syntax	LIMit:VOLTage?
Returned Parameters	<NR2>

[SOURce:]MODE

This command is used to query the power supply's operating mode. The power supply can operate in either Constant Voltage or Constant Current mode. A numeric value is returned for a MODE? Query and is encoded as shown in the table below:

Value	Mode
0	Undefined.
1	Constant Voltage (CV)
2	Constant Current (CC)
3	Cross over CV and CC mode

Table 11-1: Mode query result decoding

Command Syntax	[SOURce:]MODE?
Parameters	None
Query Syntax	MODE?
Returned Parameters	<NR1>
Related Commands	none

[SOURce:]VOLTage[:LEVel]

This command programs the DC output voltage level of the power supply.

The voltage may be set between the low limit and high limit as programmed using the VOLT:HIGH and VOLT:LOW commands. However, the high limit cannot be higher than the model's capability (configuration limit) which can be queried with the LIM:VOLT? command. The low limit cannot be less than zero. The *RST state for high and low voltage is zero for low, and maximum configuration limit voltage for high. (model specific).

Command Syntax	[SOURce:]VOLTage[:LEVel] <NRf>
Parameters	value between VOLT:HIGH and VOLT:LOW settings.
Unit	V (rms voltage)
*RST Value	0 volt
Examples	VOLT 250 VOLT:LEV 25
Query Syntax	[SOURce:]VOLTage[:LEVel]?
Returned Parameters	<NR2>
Related Commands	VOLT:HIGH VOLT:LOW

[SOURce:]VOLTage:HIGH

This command sets the maximum programmed voltage that will be accepted by the power supply. If a value above this limit value is programmed, a "-200 Execution Error" will be generated.

The voltage limit may be set between zero and the model's capability (configuration limit) which can be queried with the LIM:VOLT? command. The high limit cannot be less than the low limit however. The *RST state for high voltage limit is the maximum configuration limit. (model specific).

Command Syntax	[SOURce:]VOLTage:HIGH <NRf>
Parameters	0 to LIM:VOLT? value.
Unit	V (Volt)
*RST	Max. Voltage
Examples	VOLT:HIGH 5
Query Syntax	VOLTage:HIGH?
Returned Parameters	<NR2>
Related Commands	VOLT VOLT:LOW

[SOURce:]VOLTage:LOW

This command sets the minimum programmed current that will be accepted by the power supply. If a value below this limit value is programmed, a "-200 Execution Error" will be generated.

The voltage limit may be set between zero and the model's capability (configuration limit) which can be queried with the LIM:VOLT? command. The low limit cannot be more than the high limit however. The *RST state for low current limit is zero.

Note: This feature is best reserved for program control applications. If a low voltage limit is set over the bus and the unit is subsequently used stand-alone from the front panel, it is possible that the voltage is set to 0 volt as a result of a fault condition. If this happens, the front panel voltage knob will be locked out from that point forward and the operator will be unable to remedy this lock-out as the volt low limit cannot be set from the front panel. To avoid these potential lock-outs, leave the volt low limit at 0 Volts.

Command Syntax	[SOURce:]VOLTage:LOW <NRf>
Parameters	0 to LIM:VOLT? value.
Unit	V (Voltage)
*RST	0
Examples	VOLT:LOW 5
Query Syntax	VOLTage:LOW?
Returned Parameters	<NR2>
Related Commands	VOLT VOLT:HIGH

[SOURce:]VOLTage:PROTection[:LEVel]

This command programs the OVP trip level of the power supply.

The OVP trip level is set as a percentage of voltage range. Allowable range is 0 to 110%. If the output voltage exceeds the set trip level and the OVP mode is enabled, the power supply will generate a -300, Device specific error and turn off the output. The mode is enabled with the VOLT:PROT:STAT command. The OVP mode provides another level of protection in addition to the volt:high user setting which prevents programming commands or front panel inputs above this level to be accepted. The OVP function is based on the measured output voltage rather than the programmed output value.

Command Syntax	[SOURce:]VOLTage:PROTection[:LEVel] <NR1>
Parameters	percentage of V range
Unit	%
*RST Value	110
Examples	VOLT:PROT 80 VOLT:PROT:LEV 25
Query Syntax	[SOURce:]VOLTage:PROTection[:LEVel]?
Returned Parameters	<NR1>
Related Commands	VOLT:PROT:STATE

[SOURce:]VOLTage:PROTection:STATe

This command enables or disables the OVP mode of the power supply.

The OVP mode state may be set using this command. If the output voltage exceeds the set trip level and the OVP mode is enabled, the power supply will generate a -300, Device specific error and turn off the output. If the OVP mode is disabled, nothing will happen. Valid parameters are 0 for OVP off and 1 for OVP on.

Command Syntax	[SOURce:]VOLTage:PROTection:STATe <NR1>
Parameters	0 1
*RST Value	0
Examples	VOLT:PROT STAT 0 VOLT:PROT:STAT 1
Query Syntax	[SOURce:]VOLT:PROT:STAT?
Returned Parameters	<NR1>
Related Commands	VOLT:PROT[:LEV]

11.4 Output Subsystem

This subsystem controls the output of the power supply.

Subsystem Syntax

OUTPut

[:RELAy] Turns the output on or off.

DROP

[:TIME] Sets the output voltage for a specified amount of time or indefinitely to the voltage level set.

:LEVel Sets the absolute voltage level to 'drop' to.

OUTPut[:RELAy]

The output of the Power supply can be turned on (1) or off (0) using this command. The status of the output relay can be queried as well. Note that if the output is shut-down by the remote shut-down input signal on connector J22, the output query only returns the programmed state, not the actual state of the output. Thus, the remote shut-down (remote inhibit) overrides the programmed state of the output.

Command Syntax	OUTPut[:RELAy] <bool>
Parameters	<Bool> 0 1
*RST Value	defined by the PONS
Examples	OUTP 1
Query Syntax	OUTPut?
Returned Parameters	0 1
Related Commands	OUTP:DROP OUTP:LEV

OUTPut:DROP[:TIME]

The output drop command may be used to change the voltage to the UUT for a specific period of time. This command may be used to change the output voltage for a period of time as little as 1 msec or as long as 4000 sec. The voltage setting during this time is determined by the OUTP:DROP:LEV command.

The parameter passed with the OUTP:DROP command is the event duration in seconds. This value can range from 0.001 (1 msec) to 4000 (1 hour, 6 min, 40 sec) but only four digits of resolution are allowed. If no parameter is passed, the output is set to the programmed drop level indefinitely or until a voltage command is issued. Thus valid time periods are:

Time range	Range
0.001 - 9.999	1 msec to 10 secs
10.00 - 99.99	10 secs to 100 secs
100.0 - 999.9	100 secs to 1000 secs
1000 - 4000	1000 secs to 4000 secs
no parameter	Infinite time. Use VOLT command to turn output on.

Output drop status query

The status of a drop in progress can be queried using the query format of the OUTP:DROP command. This query will return a <Bool> indicating if the output time specified has expired (0) or the drop is still in progress (1).

Command Syntax	OUTPut:DROP <NRf>
Parameters	<NRf> none
*RST Value	none
Examples	OUTP:DROP 0.001
Query Syntax	OUTP:DROP?
Returned Parameters	0 1
Related Commands	OUTP:DROP:LEV

OUTPut:DROP:LEVel

The output drop level command sets the voltage level used by the OUTP:DROP:TIME command. The level set must be between the VOLT:HIGH and VOLT:LOW limits or a "-200, Execution Error" will be generated.

Command Syntax	OUTPut:DROP:LEVel <NRf>
Parameters	<NRf>
*RST Value	0
Examples	OUTP:DROP:LEV 20.5
Query Syntax	OUTP:DROP:LEV?
Returned Parameters	<NR2>
Related Commands	OUTP:DROP

11.5 Display Subsystem

DISPlay:MODE

This command is used to control the right hand side Power supply LED display. The command will allow the multifunction LED display to switch between display of:

1. current setting or current measurement,
2. peak current measurement
3. power measurement.

The encoding for the mode command is as shown in the table below,

Parameter	Value
Current	1
Peak Current	2
Power	3

Table 11-2: Display Mode Command Encoding

Command Syntax	DISPlay:MODE <NR2>
Parameters	1 2 3
*RST Value	1
Examples	DISP:MODE 2
Query Syntax	DISPlay:MODE?
Returned Parameters	<NR1>
Related Commands	none

11.6 System Commands

The system commands control the system level functions of the Power supply.

Subsystem Syntax

SYSTem:

CONFigure	Sets the Remote Inhibit (RI) polarity mode
ERRor?	Returns the error number and error string
KLOCK	Keyboard Lock. Sets the power on REMOTE/LOCAL state.
LOCal	Go to local mode
PON	Define the power on register number
REMOte	Go to remote mode

SYSTem:CONFigure

This commands set the polarity mode for the Remote Inhibit shutdown input. Once set using the SYST:CONF command, the mode can be retained at power up by sending the SYST:SAVE command. Factory setting is 0 or active low. In this mode, the output will be disabled when the RI is pulled to ground or shorted. When set to 1, the output will be enabled when the RI is pulled to ground or shorted.

Note: This function is only supported on DC supplies with firmware revision 0.4 or higher. See *IDN? for firmware revision.

Query Syntax	SYSTem:CONFigure
Parameters	0 1
Returned Parameters	<NR1>,<SRD>
Example	SYST:CONF 0, followed by SYST:SAVE

SYSTem:ERRor?

This query returns the next error number followed by its corresponding error message string from the remote programming error queue. The queue is a FIFO (first-in, first-out) buffer that stores errors as they occur. As it is read, each error is removed from the queue. When all errors have been read, the query returns 0,"No Error". If more errors are accumulated than the queue can hold, the last error in the queue is -350,"Queue overflow".

Query Syntax	SYSTem:ERRor?
Parameters	None
Returned Parameters	<NR1>,<SRD>
Example	SYST:ERR?

SYSTem:KLOCK

This command sets or clears the power on LOCAL or REMOTE state. When set (1), the Power supply will power up in remote state, locking out all keyboard controls. The local state can only be entered by sending a bus command. This mode may be used to prevent operator access to front panel controls under all conditions. Note that changing the state of the KLOC setting does not change the REMOTE or LOCAL state. This setting only affects the REMOTE/LOCAL state at power-up.

Command Syntax	SYSTem:KLOCK
Parameters	0 1
Example	SYST:KLOC 1
Query Syntax	SYST:KLOC?
Returned Parameters	<NR1>
Related Commands	SYST:REM SYST:LOC

SYSTem:LOCal

This command sets the interface in Local state, which enables the front panel controls. This command only applies to the RS232C interface. If IEEE 488 is used, the remote/local state is determined by the REN line on the IEEE 488 interface but the SYST:LOC and SYST:REM command will also be accepted and will toggle the remote state despite the status of the IEEE REN line.

Command Syntax	SYSTem:LOCal
Parameters	None
Example	SYST:LOC
Related Commands	SYST:REM

SYSTem:REMOte

This command sets the interface in the Remote state, which disables all front panel controls. This command only applies to the RS232C interface. If IEEE 488 is used, the remote/local status is determined by the REN line on the IEEE 488 interface but the SYST:LOC and SYST:REM command will also be accepted and will toggle the remote state despite the status of the IEEE REN line.

Command Syntax	SYSTem:REMOte
Parameters	None
Example	SYST:REM
Related Commands	SYST:LOC

SYSTem:PON

This command is used to define the register value the power supply will use to initialize its parameters at power up. If data in the selected register is not valid or the selected register is 8, the initialization will be with factory default values. Refer to Table 4-1: Factory Default Power on Settings on page 33.

Command Syntax	SYSTem:PON <NRf>
Parameters	0 to 8
Examples	SYST:PON 1
Query Syntax	SYST:PON?
Returned Parameters	<NR1>
Related Commands	*RST

11.7 Common Commands

Common commands begin with an * and consist of three letters (command) or three letters and a ? (query). Common commands are defined by the IEEE 488.2 standard to perform some common interface functions. The power supply responds to the required common commands that control status reporting, synchronization, and internal operations. XDS Series units also respond to optional common commands that control stored operating parameters.

Common commands and queries are listed alphabetically. If a command has a corresponding query that simply returns the data or status specified by the command, then both command and query are included under the explanation for the command. If a query does not have a corresponding command or is functionally different from the command, then the query is listed separately. The description for each common command or query specifies any status registers affected. Refer to Chapter 13 which explains how to read specific register bits and use the information that they return.

Common Commands Syntax

*CLS	Clear status
*ESE <n>	Standard event status enable
*ESE?	Return standard event status enable
*ESR?	Return event status register
*IDN?	Return instrument identification
*RCL <n>	Recall instrument state
*RST	Reset
*SAV <n>	Save instrument state
*SRE <n>	Set service request enable register
*SRE?	Return service request enable register
*STB?	Return status byte

11.7.1 *CLS

This command clears the following registers (see chapter 13 for descriptions of all status registers):

- Standard Event Status
- Status Byte
- Error Queue

Command Syntax	*CLS
Parameters	None

11.7.2 *ESE

This command programs the Standard Event Status Enable register bits. The programming determines which events of the Standard Event Status Event register (see *ESR?) are allowed to set the ESB (Event Summary Bit) of the Status Byte register. A "1" in the bit position enables the corresponding event. All of the enabled events of the Standard Event Status Enable Register are logically OR-ed to cause the Event Summary Bit (ESB) of the Status Byte Register to be set. See Section 16 for descriptions of the Standard Event Status registers.

The query reads the Standard Event Status Enable register.

Table 11-3: Bit Configuration of Standard Event Status Enable Register

Bit Position	7	6	5	4	3	2	1	0
Bit Name	PON	not used	CME	EXE	DDE	QYE	not used	not used
Bit Weight	128		32	16	8	4		

CME	Command error	DDE	Device-dependent error
EXE	Execution error	QYE	Query error
PON	Power-on		

Command Syntax	*ESE <NRf>
Parameters	0 - 255
Power-On Value	128
Example	*ESE 129
Query Syntax	*ESE?
Returned Parameters	<NR1>(Register value)
Related Commands	*ESR? *STB?

11.7.3 *ESR?

This query reads the Standard Event Status register. Reading the register clears it. The bit configuration of this register is the same as the Standard Event Status Enable register (see *ESE).

Query Syntax	*ESR?
Parameters	None
Returned Parameters	<NR1>(Register value)
Related Commands	*CLS *ESE *ESE?

If the *ESR? returns the value of the status bits in the ESR register. Refer to Table 11-4 for the status bits and their meaning.

Table 11-4: Bit Configuration of Standard Event Status Register

Bit Position	7	6	5	4	3	2	1	0
Bit Name	PON	not used	CME	EXE	DDE	QYE	not used	not used
Bit Weight	128		32	16	8	4		

CME	Command error	DDE	Device-dependent error
EXE	Execution error	QYE	Query error
PON	Power-on		

11.7.4 *IDN?

This query requests the power supply to identify itself. It returns the data in four fields separated by commas. Note that any installed options such as –IF are not reflected in the *IDN? query response. The presence of these options that may affect the power supply's capabilities must be determined by using other queries.

Query Syntax	*IDN?	
Returned Parameters	<AARD>	
	Field	Information
	AX	Manufacturer
	xx-xx	Model number, Volt - Current
	nnnnn	Serial number or 0
	Rev. x.x	Revision level of firmware
Example	"AX,XDS80-63,12345,Rev 1.0"	

11.7.5 *RCL

This command restores the power supply to a state that was previously stored in memory with a *SAV command to the specified location. The XDS Series offers eight non-volatile memory locations for storing instrument setups.

Command Syntax	*RCL <NRf>	
Parameters	0 through 7	
Example	*RCL 3	
Related Commands	*RST *SAV	



WARNING: *Recalling a previously stored state may place hazardous voltages at the power supply output if the output state saved is ON.*

11.7.6 *RST

This command resets the power supply to a setting defined by the values in the register defined by PON if valid or by the following factory-defined states:

Note: When using the *RST command, allow a 100 msec delay in your program for the XDS supply to complete the reset procedure before sending subsequent bus commands.

Table 11-5: *RST Default Parameter Values

Item	Value	Item	Value
VOLT	0.0 V	VOLT HIGH	Max. available
		VOLT LOW	0
CURR	Max. available	CURR HIGH	Max. available
		CURR LOW	0
OUTP	0 (OFF)	DISP:MODE	1 (CURRENT)

Command Syntax	*RST
Parameters	None
Related Commands	*SAV

Table 11-6: Status Registers - Power on Conditions

Register	Status on Power On	Status after *RST
- ESE register	All 0's	All 0's
- ESR register	PON bit = 1, all others 0	PON = 0, all others unaffected
- STB register	All 0's	All 0's
- SRE register	All 0's	All 0's

11.7.7 *SAV

This command stores the present state of the power supply to a specified location in memory. The XDS Series offers eight non-volatile memory locations for storing instrument setups.

Note: Writing data to Flash memory as a result of receiving a *SAV command takes approximately 300 msec. No other commands should be sent to the unit during this period as they may be ignored.

Command Syntax	*SAV
Parameters	0 through 7
Related Commands	*RCL *RST

11.7.8 *SRE

This command sets the condition of the Service Request Enable Register. This register determines which bits from the Status Byte Register (see *STB for its bit configuration) are allowed to set the Master Status Summary (MSS). A 1 in any Service Request Enable Register bit position enables the corresponding Status Byte Register bit and all such enabled bits then are logically OR-ed to cause Bit 6 of the Status Byte Register to be set. See Section 13 for more details concerning this process.

When the controller conducts a STB? command, the MSS bit is not cleared. When *SRE is cleared (by programming it with 0), the source cannot generate an MSS bit.

Command Syntax	*SRE <NRf>
Parameters	0 to 255
Default Value	128
Example	*SRE 255
Query Syntax	*SRE?
Returned Parameters	<NR1>(Register binary value)
Related Commands	*ESE *ESR

11.7.9 *STB?

This query reads the Status Byte register, which contains the status summary bits and the Output Queue MAV bit. Reading the Status Byte register does not clear it. The input summary bits are cleared when the appropriate event registers are read (see Section 13 for more information).

Table 11-7: Bit Configuration of Status Byte Register

Bit Position	7	6	5	4	3	2 - 0
Bit Name	OPER	MSS	ESB	MAV	QUES	not used
Bit Weight	128	64	32	16	8	

OPER operation status summary

MSS master status summary

ESB event status byte summary

QUES questionable status summary

MAV message available

Query Syntax	*STB?
Returned Parameters	<NR1> (Register binary value)

12 Programming Examples

12.1 Introduction

This chapter contains examples on how to program the Power supply. Simple examples show you how to program:

- Output functions such as voltage and current
- Measurement functions

The examples in this chapter use generic SCPI commands. See Section 10 for information about encoding the commands as language strings. Where appropriate, optional commands are shown for clarity in the examples.

12.2 Programming the Output

Power-on Initialization

When the Power supply is first turned on, it comes up with the output state defined by the PON register number. If the register number or the register has no valid data, the Power supply initializes to the following state.

```
VOLT 0.0  
OUTP 0
```

The following commands are given implicitly at power-on:

```
*RST  
*CLS  
*SRE 128  
*ESE 0
```

*RST is a convenient way to program all parameters to a known state. Refer to Table 11-5 under the *RST command in paragraph 11.7.6 to see how each programmable parameter is set by *RST.

Enabling the Output

To enable the output, use the command:

```
OUTP 1
```

Voltage

The output voltage is controlled with the VOLTage command. For example, to set the output voltage to 125 volts, use:

```
VOLTage 125
```

The maximum voltage that the Power supply can output is limited by model configuration and the user set voltage limits. These values are defined by the LIMIT subsystem and the VOLT:HIGH and VOLT:LOW commands.

Current Limit

To set the current limit use:

```
CURRent <n>
```

where $\langle n \rangle$ is the current limit in amperes.

If the load attempts to draw more current than the programmed limit, the power supply switches to a constant current mode and will reduce the output voltage as required.

The maximum current that the Power supply can output is limited by model configuration and the user set current limits. These values are defined by the LIMIT subsystem and the CURR:HIGH and CURR:LOW commands

12.3 Making Measurements

The source has the capability to return current, peak current, power and voltage measurements.

Voltage Measurement

To measure the voltage, use:

```

OUTP 1                                /* Close output if it was not closed already.
MEAS:VOLT?

```

Current Measurements

To measure the RMS current, use:

MEAS:CURR?

To measure the peak current, use:

```
MEAS:CURREN:AMPL:RES      /* resets track and hold for peak curr. meas.
                           /* It may be need to turn the output on or program
                           /* as specific voltage at this time before taking a
                           /* peak current reading.
MEAS:CURREN:AMPL:MAX?     /* retrieves peak current reading.
```

Power Measurements

To measure the power, use:

MEAS:POW?

13 Status Registers

You can use status register programming to determine the operating condition of the power supply at any time. For example, you may program the Power supply to generate an MSS bit when an event such as a current limit occurs. When the MSS bit is set, your program can then act on the event in the appropriate fashion.

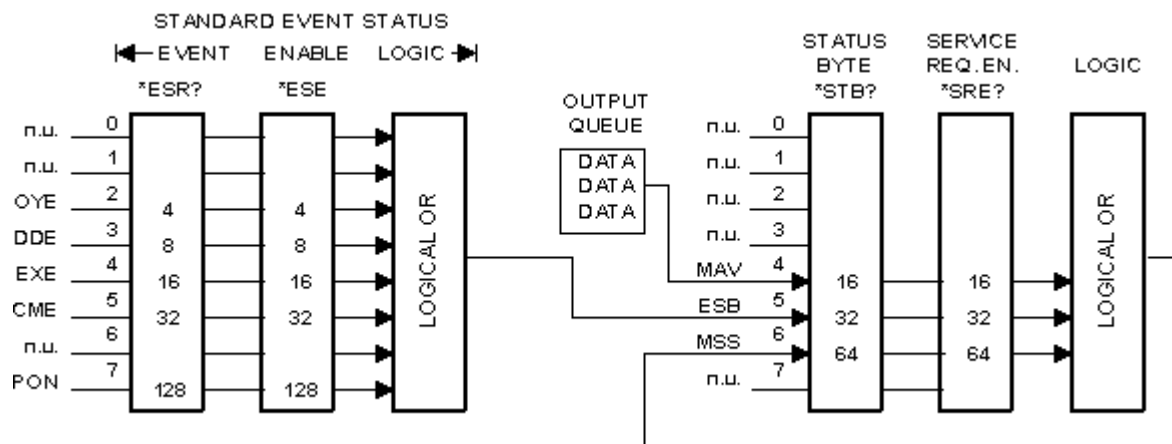


Figure 13-1: Power Supply Status System Model

Figure 13-1 shows the status register structure of the power supply. The Standard Event, Status Byte, and Service Request Enable registers and the Output Queue perform standard IEEE-488 functions as defined in the IEEE 488.2 Standard Digital Interface for Programmable Instrumentation.

13.1 Power-On Conditions

Refer to the *RST command description in paragraph 11.7.6 for the power-on conditions of the status registers.

13.2 Standard Event Status Group

This group consists of an Event register and an Enable register that are programmed by Common commands. The Standard Event register latches events relating to interface communication status. It is a read-only register that is cleared when read. The Standard Event Enable register functions similarly to the enable registers of the Operation and Questionable status groups.

Command	Action
*ESE	programs specific bits in the Standard Event Enable register.
*ESR?	reads and clears the Standard Event register.

The PON bit in the Standard Event register is set whenever the Power supply is turned on.

13.3 Status Byte Register

This register summarizes the information from all other status groups as defined in the IEEE 488.2 Standard Digital Interface for Programmable Instrumentation. The bit configuration is shown in Table 11-7.

Command	Action
*STB?	reads the data in the register but does not clear it (returns MSS in bit 6)

The MSS Bit

This is a real-time (unlatched) summary of all Status Byte register bits that are enabled by the Service Request Enable register. MSS is set whenever the Power supply has one or more reasons for needing service. *STB? reads the MSS in bit position 6 of the response but does not clear any of the bits in the Status Byte register.

The MAV bit and Output Queue

The Output Queue is a first-in, first-out (FIFO) data register that stores Power supply-to-controller messages until the controller reads them. Whenever the queue holds one or more bytes, it sets the MAV bit (bit 4) of the Status byte register.

13.4 Examples

The following section contains examples of commonly used operations involving the status registers.

You can determine the reason for an MSS bit set by the following actions:

Step 1: Determine which summary bits are active. Use:

*STB?

Step 2: Read the corresponding Event register for each summary bit to determine which events caused the summary bit to be set. Use:

ESR?

Note: *When an Event register is read, it is cleared. This also clears the corresponding summary bit.*

Step 3: Remove the specific condition that caused the event. If this is not possible, the event may be disabled by programming the corresponding bit of the status group Enable.

Appendix A: SCPI Command tree

Command Syntax Tree

Root	Level 1	Level 2	Level 3	Level 4
	[SOURce]	:CURRent	[:LEVel]	
			:HIGH	
			:LOW	
		:LIMit	:VOLTage	
			:CURRent	
		:MODE?		
		:VOLTage	[:LEVel]	
			:HIGH	
			:LOW	
			:PROTection	[:LEVel]
				STATe
	OUTPut	[:RELay]		
		:DROP	[:TIME]	
			: LEVel	
	MEASurement	:CURRent	[:LEVel]	
			:AMPLitude	:MAX?
				:RESet
		:POWER?		
		:VOLTage?		
	DISPlay	:MODE		
	SYSTem	:CONFigure		
		:ERRor?		
		:KLOCK		
		:LOCAL		
		:PON		
		:REMOte		

Appendix B: SCPI Conformance Information

SCPI Version

The XDS Series DC power supplies conform to SCPI version 1990.0.

Appendix C: Error Messages

Error Number	Error Message String	Error Causes
0	"No error"	
-100	"Command error"	Generally the result of sending a command that uses incorrect syntax.
-200	"Execution error"	Generally the result of sending a value that is out of range, i.e., a VOLT 200 command when the voltage range is only 150 V. Alternatively, programmed voltage or current may be outside of user set high and low programming limits.
-300	"Device specific error"	This error can have several causes, all them hardware related. Possible causes are: 1) AC input over voltage, under voltage or missing input phase. 2) Over temperature condition. 3) Sense connection reversed or shorted.
-350	"Queue overflow"	Generally caused by too many errors being generated without reading error status, causing error buffer to overflow.
-400	"Query error"	Generally caused by sending a query followed by another command without accepting the query response first.

Table 13-1: Bus Error Messages

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