

SEREN

INDUSTRIAL POWER SYSTEMS INC.

MODEL R300 RF POWER SUPPLY OPERATOR'S MANUAL

Revision 1.5
Air Cooled
Standard Configuration

Document Number 6100080000

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Introduction

Thank you for acquiring your new SEREN IPS Radio Frequency Power Supply. The R300 RF Power Supply has been designed to provide the best value, ease of operation, and reliability for low-power plasma and processing systems. This manual covers specifications, installation, and operation of the R300 RF Power supply.

Information

To get answers for any questions you might have regarding your plasma or processing system, please contact your system vendor first. Your system vendor knows the intimate details of how your equipment interfaces and operates with the R300 RF power supply and can efficiently resolve system related problems.

For questions directly related to the R300 RF power supply you may call us, Monday through Friday, 8:00am to 5:00pm, United States eastern time, at:

1-856-205-1131

Service

For RF Power supplies purchased with a processing system, or covered under a service contract from your system vendor, please contact the system vendor to arrange for service.

For after-market or end user customers, a SEREN IPS customer service representative will arrange for service. Call us, Monday through Friday, 8:00am to 5:00pm, United States Eastern Time, at: **1-856-205-1131**

Please note: Equipment returned to us without prior authorization or without a Return Materials Authorization (RMA) number visible on the outside of the package will be refused.

How to Contact Us

Our address, telephone, and fax numbers are listed below.

SEREN Industrial Power Systems, Inc.
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Proprietary Information Notice

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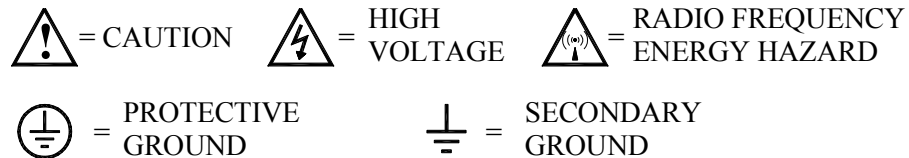
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Safety Notes

The R300 RF Power Supply has been designed and tested to meet strict safety requirements. These include independent lab examination and approval, and compliance to established standards. Please read the following instructions carefully before operating the RF Power Supply and refer to them as needed to ensure the continued safe operation of the RF Power Supply.

Follow all warnings and instructions marked on or supplied with the product.

Symbology:



Unplug or disconnect this equipment from the power source before cleaning or disconnecting the RF output cable from the rear panel.

Do not use this equipment near water, wet locations, or outdoors.

Do not place this equipment on an unstable cart, stand, or table. The RF Power Supply may fall, causing personal injury or damage to the RF power supply.

This product is equipped with a 3-wire power cord and grounding type plug. This is a safety feature. To avoid electric shock, this unit must be connected to the power source in compliance with the National Electrical Code ANSI C1 and/or any other codes applicable to the user. Improper installation may result in a shock or fire hazard.

It is the responsibility of the installer to provide a proper protective ground from the RF Power Supply to earth ground, in accordance with local and national electrical codes, and any other codes applicable to the user.

This RF Power Supply should be operated from the type of power source indicated on the marking label. If you are not sure of the type of power available, consult an electrician or your local power company.

The power supply cord and plug is the disconnect device for this equipment. If the plug is removed from the cord and the power cord is hard wired to the power source, it is the responsibility of the installer to provide a disconnect device.

Do not allow anything to rest on the power cord or interconnecting cables. Do not locate the RF Power Supply where persons will step on the power or interconnecting cables.

Slots and Openings in the equipment's front and rear panels are provided for ventilation. To ensure reliable operation of the RF Power Supply, these openings must not be blocked, covered, or restricted. Restricting the air inlets or exhaust will cause the unit to shut down from an over-temperature condition. Sustained over temperature conditions may degrade or damage the unit.

Never push objects of any kind into the slots and openings of the RF Power Supply's enclosure. They may touch dangerous voltage points or short out parts, which could result in a fire or electric shock.

Never spill liquid of any kind on or into the RF Power Supply.

Never remove covers or guards that require a tool for removal. There are no operator serviceable areas within these covers. Refer servicing to qualified service personnel.

This product is to be operated only when an appropriate cable and load is attached to the RF output connector. **DO NOT** operate this unit without connecting the output to the appropriate cable and load. **HAZARDOUS VOLTAGE PRESENT AT THE RF OUTPUT CONNECTOR – RISK OF ELECTRICAL SHOCK AND RADIO FREQUENCY ENERGY BURN.**



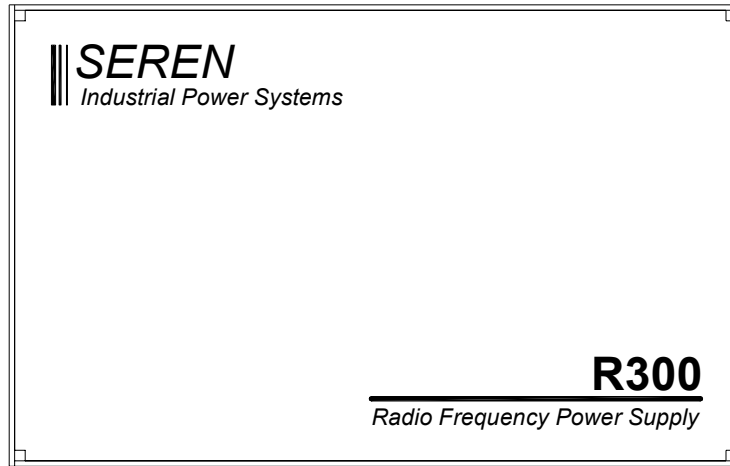
CAUTION!



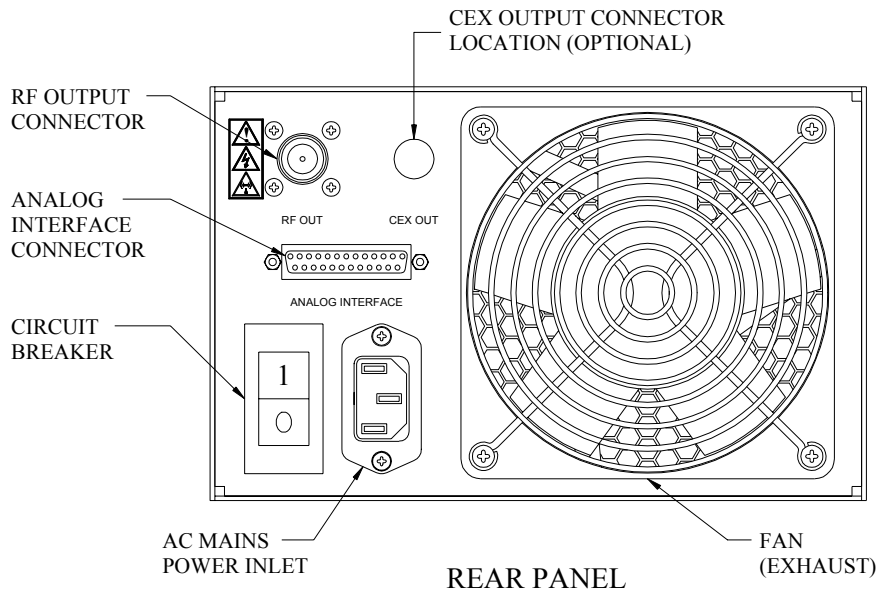
**ELECTRICAL SHOCK AND RF VOLTAGE
HAZARD PRESENT INSIDE UNIT AND AT RF
OUTPUT CONNECTOR.
DO NOT REMOVE COVERS.
REFER SERVICING TO QUALIFIED
SERVICE PERSONNEL.**

R300 RF Power Supply Features

The R300 RF Power Supply is a 300-Watt radio frequency power supply designed for plasma processing systems and laboratory and industrial use. The R300 RF Power Supply features simple interfacing and operating procedures, excellent long-term stability, and maintenance-free operation. The power supply's features are diagrammed below:



FRONT PANEL



REAR PANEL

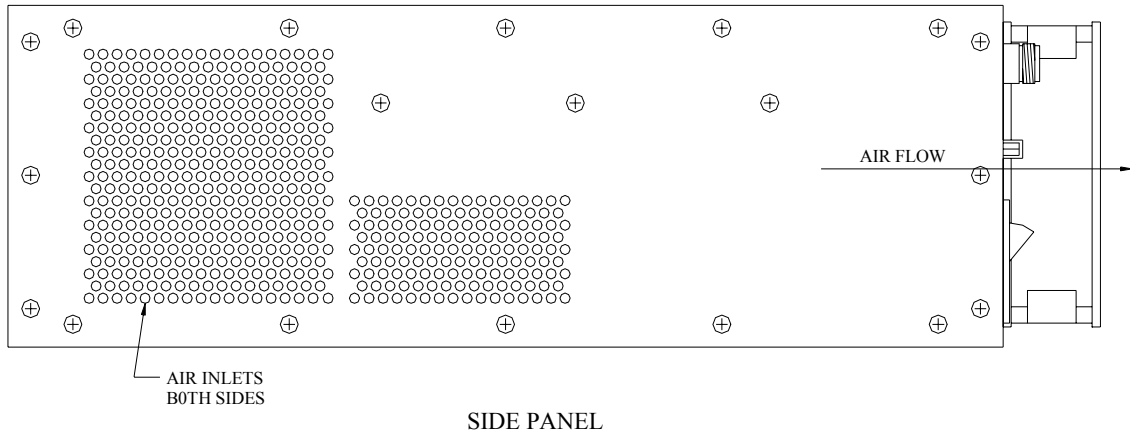


Figure 1: R300 RF Power Supply Features

Installation and Physical Dimensions

Recommended mounting:

The R300 RF Power Supply is designed for placement on a tabletop in a clean environment. The table must be capable of supporting the full weight of the unit. The user is responsible for providing mounting hardware.

Note: the weight of the R300 RF Power Supply unit is 45 pounds (20.4 kg)

Cooling Provisions:

Care must be taken to ensure the air inlets on the side panels and the rear panel fan are not obstructed or restricted. Restricting the air inlet or exhaust or installing the R300 RF Power supply in a dusty environment will cause the unit to shut down from an over-temperature condition. Sustained over temperature conditions may degrade or damage the unit. Severe dust contamination can clog the cooling system and cause internal damage.

Electrical Connections

AC Mains



To avoid electric shock, this unit must be connected to the power source in compliance with the National Electrical Code ANSI C1 and/or any other codes applicable to the user. Improper installation may result in a shock or fire hazard. Qualified personnel must perform AC mains connection.

Protective Ground (Protective Earth)



The R300 ICP Power Supply is provided with a 3-wire power cord. The green wire or green wire with yellow tracer stripe is the protective ground (protective earth) connection. It is the responsibility of the installer to provide a proper protective ground (protective earth) from the RF Power Supply to earth ground, in accordance with local and national electrical codes, and any other codes applicable to the user. Qualified personnel must perform the protective ground (protective earth) connection.

Disconnect Device

The power supply cord and plug is the disconnect device for this equipment. If the plug is removed from the cord and the power cord is hard wired to the power source, it is the responsibility of the installer to provide a disconnect device.

RF Output Connection

Connect the RF Output to the matching network or other suitable load with a length of coaxial cable. The length of the coaxial cable depends greatly on the plasma system and the matching network / load configuration. Coaxial cable type

RG-8 is the minimum recommended for R300 applications. Coaxial cable types RG-213, RG-225 or RG-393 are *preferred* for their higher voltage and temperature properties.

Analog Interface (control) Connection

Connect the analog interface to the ICP system controller with a shielded, multi-conductor cable. Foil shielded cable is recommended for this application. Refer to the Controls and Connections section for wiring details.

Physical Dimensions

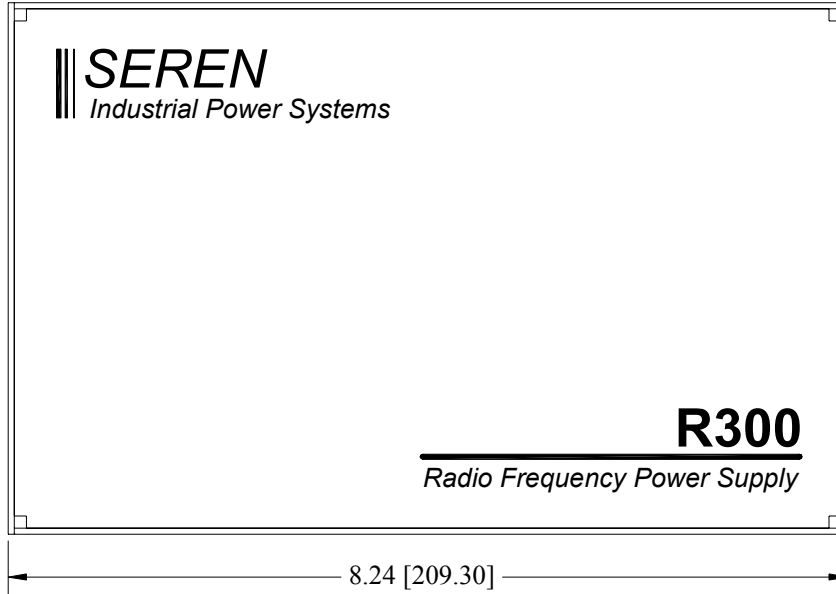


Figure 2: Front Panel Dimensions - inch [mm]

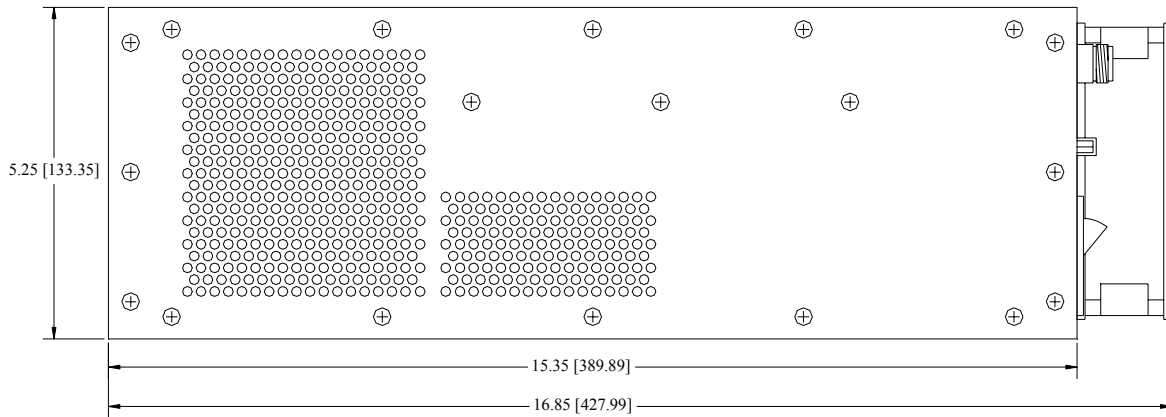


Figure 3: Side Dimensions – inch [mm]

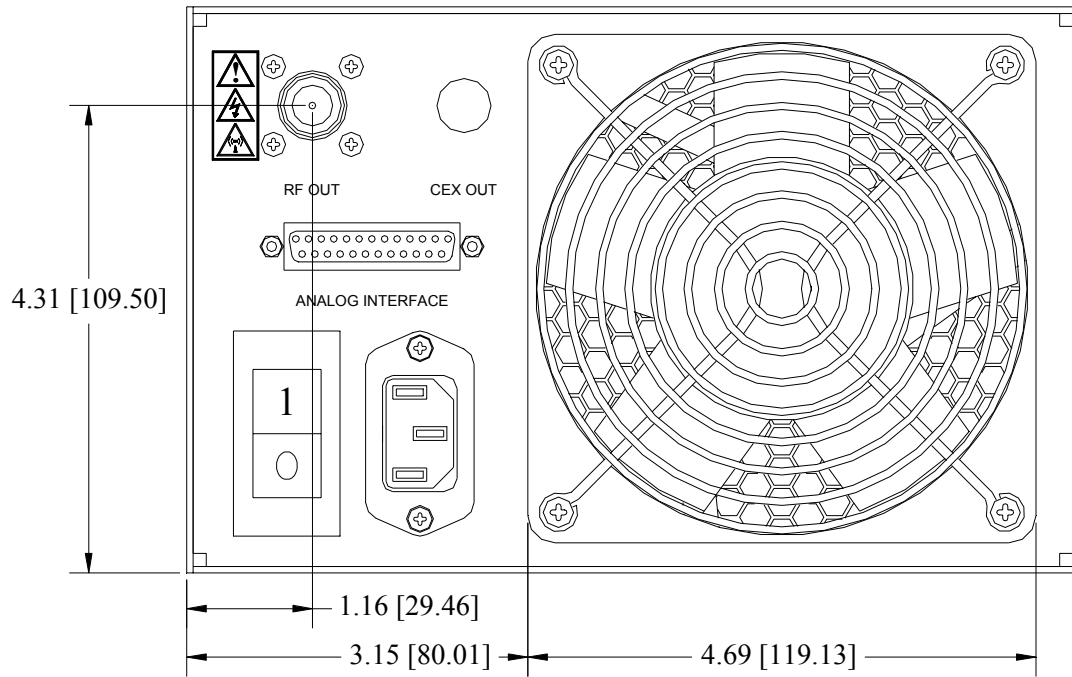


Figure 4: Rear Panel Dimensions – inch [mm]

Controls and Connections

Controls

With the exception of the rear panel circuit breaker, the R300 RF Power Supply has no operator accessible controls. All control functions are accomplished via the unit's analog interface connector and the plasma system's control circuitry.

Analog Interface Connector:

The analog interface connector is located on the rear panel of the R300 RF Power Supply. Connector type: 25-pin male "D" sub-miniature. Control and status signals for the R300 RF Power Supply are available on this connector. See the table below for descriptions of the interface connector signals.

PIN	SIGNAL NAME	DESCRIPTION
1	AC-ON-1	Contact closure to pin 14 enables AC Mains power contactor. Low-voltage, floating circuit (24VAC 1A maximum).
2	EXTI*	EXTERNAL INTERLOCK. TLL logic level input. Active low. Internally pulled-up to +5VDC. Applying a contact closure from pin 2 to pin 15 or applying a logic level low to pin 2 allows the RF output to be enabled by the RFON* signal (pin 2). An open-circuit or applying a logic level high to this pin disables the RF output.
3	RFON*	RF ON. TLL logic level input. Active low. Internally pulled-up to +5VDC. Applying a contact closure from pin 3 to pin 16 or applying a logic level low signal to pin 3 enables the RF output, provided that a logic low state is present at pin 2. Applying a logic high signal to this pin disables the RF output. Note: If a logic low level is applied to this pin <i>and</i> a logic low level is applied to pin 2 (EXTI) when mains power is switched from off to on, RF power will be delivered immediately to the RF output
4	FWDP MON	Analog Output. Forward power monitor. 0 to +5.00VDC output is linearly proportional to 0 to 300 Watts of forward power.
5	REFP MON	Analog Output. Reflected power monitor. 0 to +5.00VDC is linearly proportional to 0 to 300 Watts of reflected power.

PIN	SIGNAL NAME	DESCRIPTION
6	SETPOINT	Setpoint Input. Analog differential input (+). 0 to +5.00VDC applied to this pin is linearly proportional to 0 to 300 Watts of forward power.
7	SETPOINT RET	Setpoint Return. Analog differential input (-). Note: This pin <i>must</i> be connected to a ground reference at the setpoint source (system controller) or the unit's output will behave erratically.
8	-	No Connection
9	RLIN	Remote Limit Input. Analog single-ended input. For use with dual-bias systems. Standard units are shipped from factory with this input disabled. Consult factory for dual-bias operation.
10	+5V	Current limited +5VDC output reference for power setpoint.
11	RFOK*	RF ON <i>and</i> OK. TTL logic level output. Active low. Internally pulled-up to +5VDC. A logic low state indicates the RF output is enabled <i>and</i> reflected power is less than 60 Watts
14	AC-ON-2	Contact closure to pin 1 enables the AC Mains power contactor. Low-voltage, floating circuit (24VAC 1A maximum).
15	EXTI RET	External Interlock Return. Internally connected to chassis ground.
16	RFON RET	RF ON return. Internally connected to chassis ground.
17	FWDP RET	Forward power monitor return. Internally connected to chassis ground.
18	REFP RET	Reflected Power monitor return. Internally connected to chassis ground.
19	GND	Internally connected to chassis ground.
20	GND	Internally connected to chassis ground.
21	RLI RET	Remote Limit Input return. Internally connected to chassis ground.
22	-	No Connection
23	-	No Connection
24	-	No Connection
25	-	No Connection

RF Output Connector

Connector: female type "N" coaxial connector. Connect to the customer-provided phase detector/matching network RF input. Recommended coaxial cable type: RG-213/U, RG-225/U or RG-393/U.



CAUTION: This product is to be operated only when an appropriate cable and load is attached to the RF output connector. **DO NOT** operate this unit without connecting the output to the appropriate cable and load. **HAZARDOUS VOLTAGE PRESENT AT THE RF OUTPUT CONNECTOR – RISK OF ELECTRICAL SHOCK AND RADIO FREQUENCY ENERGY BURN.**

CEX Connector (OPTIONAL)

Common Exciter Output. Connector: type BNC female. Used in dual-bias systems to synchronize a slave RF Power supply.

Output: 13.56MHz, 5V peak-to-peak nominal into a 50 Ohm load. Nominal 50 Ohms output impedance.

AC Mains Power Connector

Type: IEC320-C14 male power inlet.

The unit is supplied with a cord type appropriate for the line voltage listed on the ratings plate. Check your line voltage or consult an electrician before plugging in the R300 RF Power Supply.



NOTE: AC Mains Voltage IS NOT Field Re-configurable. Contact the factory or a Seren IPS Inc. service depot if you require a different line voltage.

Interface Circuits

Figure 5 through figure 8 illustrate the typical interface circuits used in the R300 RF Power Supply. Note: the "TTL" logic input signals have internal pull-up resistors.

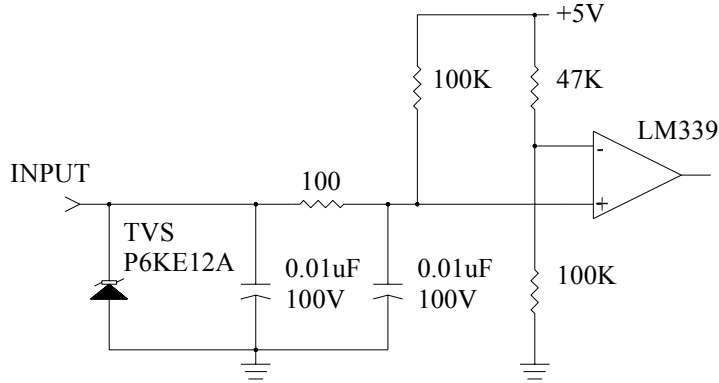


Figure 5: Typical "TTL" Logic Input Circuit

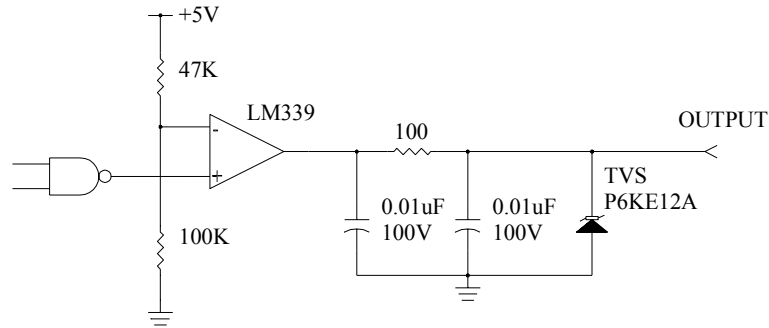


Figure 6: Typical "TTL" Logic Output Circuit

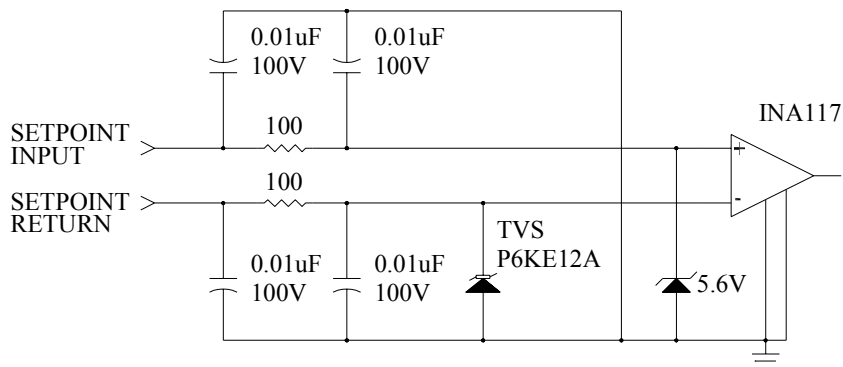


Figure 7: Setpoint Input Circuit

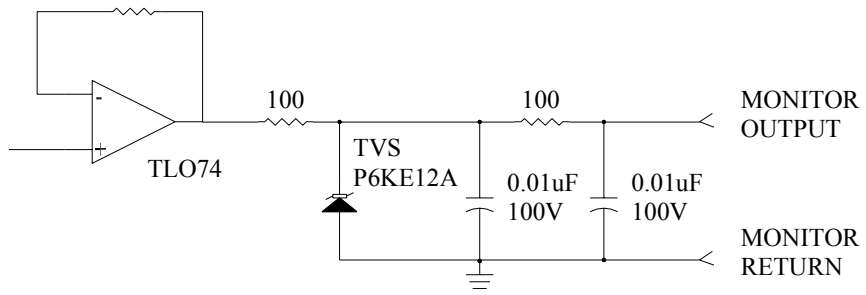


Figure 8: Power Monitor Output Circuit

Typical Interface Connections

The figure below illustrates typical analog interface connections.

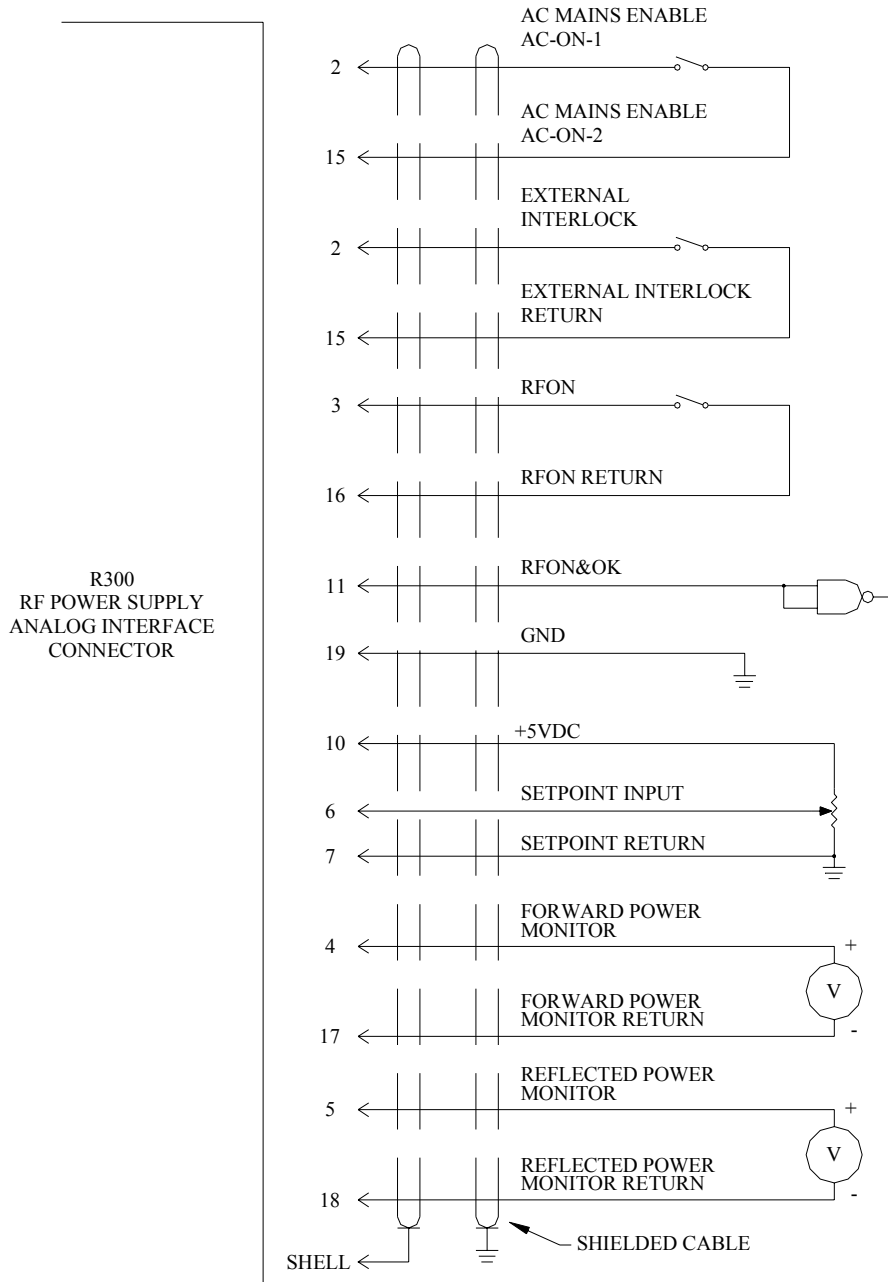


Figure 9: Typical Interface Connections

Operation

Operation of the R300 RF Power Supply is simple. Connect the RF Power Supply in a system configuration. Refer to figure 10 for a typical system configuration. Using the typical interface connection diagram in figure 9 as a guide, follow the steps below to operate the unit. Details pertaining to the plasma processing system (gas flow and control, sample, cooling, matching network, etc) are not within the scope of this document and have been omitted.

1. PRELIMINARY

Disable AC mains power to the RF Power Supply. Apply and maintain the indicated signals to the following interface connector pins until instructed otherwise.

INTERFACE CONNECTOR PIN	SIGNAL NAME	LOGIC STATE
3	RFON*	TTL HIGH
2	EXTI*	TTL HIGH

Enable AC mains power to the RF Power Supply (enable circuit breaker and connect together interface connector pins 1 and 14).

2. POWER SETTING:

Apply the desired power setpoint voltage to interface connector pins 6 and 7. The optimum required power level varies depending on the system and desired process.

3. ENABLE INTERLOCK

Apply and maintain a TTL logic level low signal to interface connector pin 2 (EXTI*).

Note: Changing the state of interface connector pin 2 (EXTI – external interlock) to 5.0VDC at any time will override the RFON* signal and disable the RF output.

4. ENABLE RF OUTPUT

Apply and maintain a TTL logic level low signal to interface connector pin 3 (RFON*). Immediately begin the system process (via OEM's equipment)

5. TUNE

Allow time for the matching network to tune. Performance parameters and operational status can be monitored at the points shown in figure 9 during the tune and run cycles.

6. RUN

Adjust the output power as required. Performance parameters and operational status can be monitored at the points shown in figure 9.

7. SHUT OFF

Apply and maintain a TTL logic level high signal to interface connector pin 3 (RFON*). The RF output will switch off.

Typical System Configuration

Refer to figure 10 for a typical system configuration. Note: Seren IPS does not supply the matching network, plasma chamber, process apparatus, system controller, or interconnecting cables with the R300 RF Power Supply.

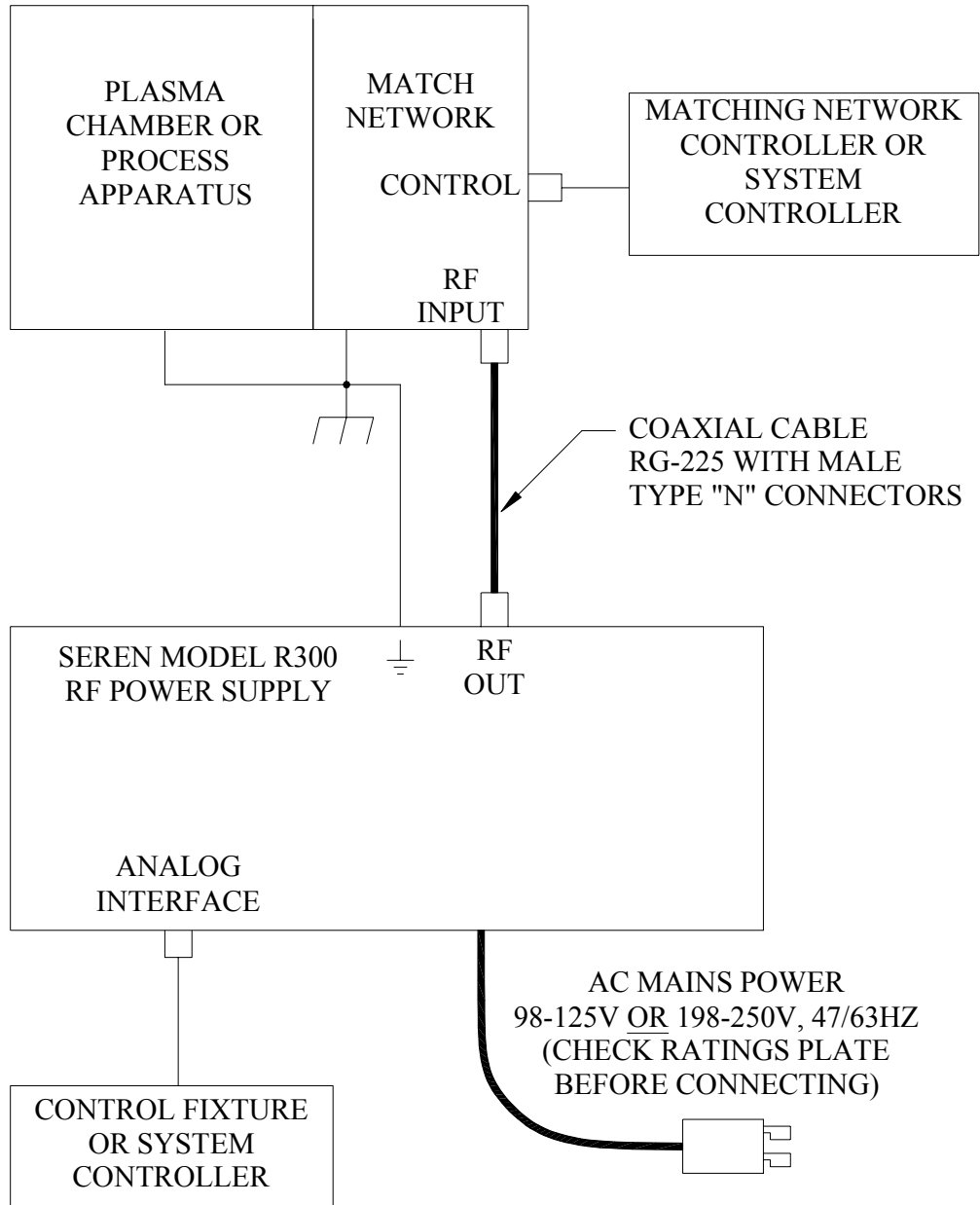


Figure 10: Typical System Configuration

Maintenance

The R300 RF Power Supply is designed to be maintenance free. There are no internal adjustments or user maintainable assemblies inside the unit. The R300 is designed for use in a clean environment. Periodically check the side panel air inlets for accumulation of dust and debris. Clean the air inlets with a vacuum cleaner if they appear dirty or clogged.



Restricting the air inlet or exhaust or installing the R300 RF Power supply in a dusty environment will cause the unit to shut down from an over-temperature condition. Sustained over temperature conditions may degrade or damage the unit. Severe dust contamination can clog the cooling system and cause internal damage.

Problem Solving

Problem Solving Chart

The following chart lists some conditions that may occur and the recommended solutions. Follow the suggested solutions until the problem is corrected. If the problem persists, please contact your system vendor.

Condition	Suggested Solutions
<p>The RF power supply does not turn on – fan is not turning.</p>	<p>Check that the R300 RF power supply is connected to a power receptacle.</p> <p>Ensure the power cord is fully seated into the power inlet on the rear panel of the unit.</p> <p>Ensure there is power to the receptacle and that the rear panel circuit breaker is set to the “ON” position.</p> <p>Cycle the front panel circuit breaker from the “ON” position to the “OFF” position and back to the “ON” position</p> <p>Ensure a contact closure (short circuit) is applied between pins 1 and 14 of the rear panel analog interface connector (AC Mains enable)</p>
<p>RF output decreases or shuts off after running for an extended period of time.</p>	<p>Ensure the RF power supply has adequate air intake and exhaust – intake air temperature <i>must</i> be less than 40°C.</p> <p>Make sure the R300 RF power supply’s air inlets and air exhaust are not blocked or clogged with dirt or debris.</p> <p>Check system equipment cabinet for obstructed air openings or dirty air filters.</p>
<p>No RF output – the R300 RF power supply is on and the rear panel fan is turning</p>	<p>Verify the EXTERNL INTERLOCK signal on the analog interface connector (pin 2) is at a TTL logic level low state.</p> <p>Verify the RFON signal on the analog interface connector (pin 3) is at a TTL logic level low state.</p> <p>Check the Setpoint Voltage – it must be greater than 0 Volts DC.</p>
<p>No Plasma present in vacuum system</p>	<p>The applied power setpoint may be too low for plasma ignition. Check the system’s recommended power setpoint.</p> <p>Check the matching network and ensure that it is operating properly.</p> <p>CAUTION: Turn off the rear panel circuit breaker before connecting or disconnecting the RF output cable.</p> <p>Check for a disconnected or faulty RF output cable.</p> <p>Verify the RF output cable is the proper length per the system vendor’s specifications.</p>

Condition	Suggested Solutions
Reflected power will not tune to zero	<p>Depending on the system, after tuning, 3 to 8 watts of reflected power may be considered acceptable for normal operation. Check your vendor's system specifications. Otherwise, check the items listed below:</p> <p>Check the matching network and ensure that it is operating properly.</p> <p>CAUTION: Turn off the front panel circuit breaker before connecting or disconnecting the RF output cable.</p> <p>Check for a faulty RF output cable.</p> <p>Verify the RF output cable is the proper length per the system vendor's specifications.</p>
RFON&OK signal is not at a logic low state	<p>Verify the EXTERNL INTERLOCK <i>and</i> RFON signals on the analog interface connector (pins 2 and 3 respectively) are at a TTL logic level low state.</p> <p>Reflected power is 60 Watts or greater. Check the plasma system and ICP matching network and ensure they are operating properly.</p>
Plasma shuts off shortly after ignition	<p>This is usually caused by a high reflected power condition. The R300 RF power supply's protective circuits activate and limit the output power or the processing system detects a high reflected power condition (or other fault condition) and turns off the RF output. Refer to the RFON&OK signal (above).</p> <p>Check the matching network and ensure that it is operating properly.</p> <p>Check for a faulty RF output cable.</p>

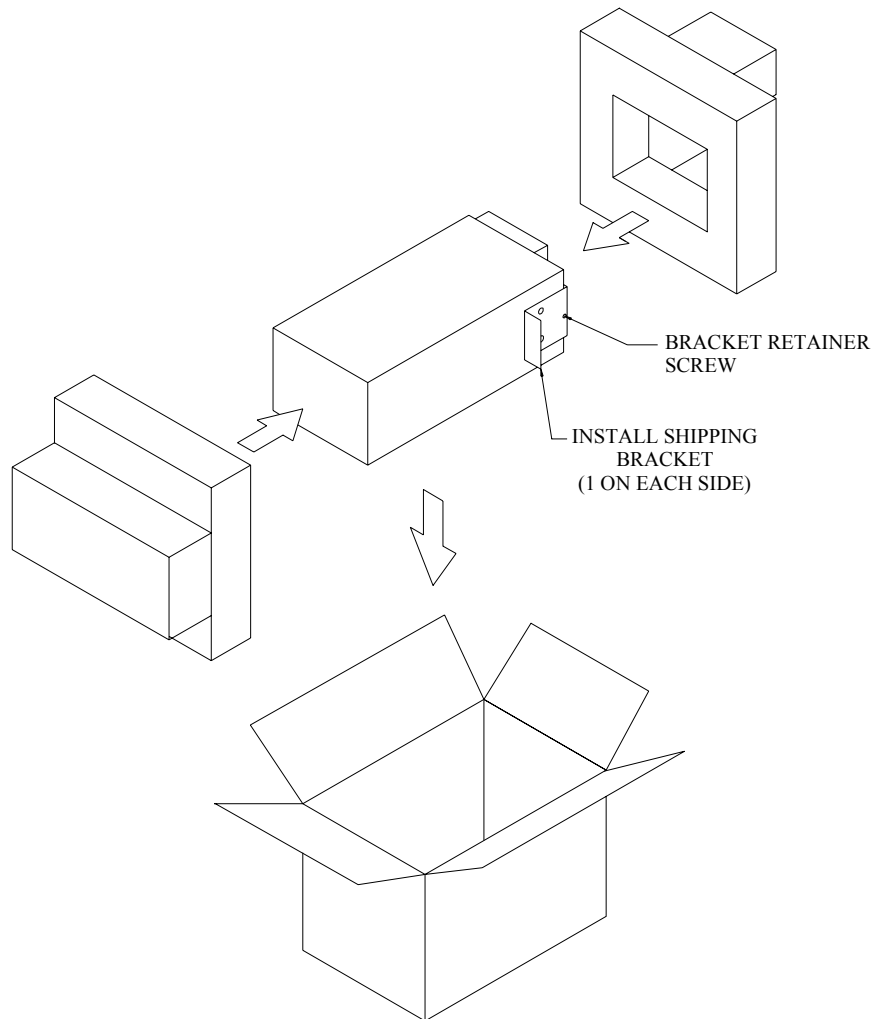
Packing the R300 RF Power Supply

Pack the R300 RF Power Supply in its original packing material and box for shipping, or moving. To prevent damage to the unit during transit, the original packing material must be used. If you need to ship the R300 RF Power Supply and you do not have the original packing materials, please contact our customer service department. A customer service representative can arrange to supply you with the proper packing materials.

To obtain packing materials, contact our customer service department at: 856-205-1131

Refer to the diagram below when packing the unit.

1. Install a shipping bracket (Seren IPS Inc. part number 430099) on each side of the R300 RF Power supply. Secure with retainer screw.
2. Install foam end caps as shown.
3. Place in box as shown.



Technical Data

Output Frequency:	13.56 MHz
Frequency Stability:	0.005% Short Term
RF Power Output	300 Watts into a 50 Ohm load
Output Impedance:	50 Ohms +/- 5 Ohms
Metering Accuracy:	Forward: +/- 1% Full Scale, +/- 3% of reading
Temperature Coefficients:	0.025% per °C
Output Connector:	Type N female
Power Stability:	0.1% Long Term @ 25°C typical
Load Tolerance:	No oscillation or failure into a mismatch
Noise, Hum, and Ripple:	-40dBc
Harmonic Distortion:	All harmonics less than -45dBc
Spurious Radiation:	Meets or exceeds FCC and VDE regulations
Control:	Analog, via 25 pin male "D" connector
Common Exciter Output (Optional):	13.56 MHz, 5Vp-p into 50 Ohms. Connector: type BNC female.
Operating Temperature/Humidity:	0 to +40°C, 10% to 90% relative humidity, non-condensing.
Output Protection:	Forward power limits on amplifier current, transistor power dissipation and excessive reflected power. RF output is open and short circuit protected.
Thermal Protection:	Internal temperature sensor disables RF output upon over temperature condition.
Over Current Protection:	98-125V Models: Circuit breaker, 10 Amp over-current, 1000 Amp interrupt capacity 198-250V Models: Circuit breaker, 5 Amp over-current, 1000 Amp interrupt capacity
Cooling:	Air, 110 CFM fan below 11,000 feet
Power Required:	47-63Hz, Single Phase, 1100 KVA, 800 Watts, Power factor: 0.71 98-125V: 10 Amps maximum 198-250V: 5 Amps maximum

Power Cord Supplied:	98-125V Models: 16/3 Type SJT, 2m length, with IEC320-C13 female connector and NEMA 5-15P male plug. 198-250V Models: 18/3 Type SJT, 2m length, with IEC320-C13 female connector and NEMA L6-15P plug.
Overall Dimensions, inch (cm):	5.25 (13.35) High x 8.25 (20.95) Wide x 17.00 (43.18) Deep, including fan
Weight:	45 LBS / 20.4Kg

SEREN 1 Year Limited Warranty

SEREN IPS Inc. products are warranted to the original purchaser against defects in material and workmanship for a period of one year from the date of delivery. SEREN IPS Inc. will repair or replace, at its option, all defective products returned freight prepaid during the warranty period, without charge, provided that there is no evidence the product has been mishandled, abused, or misapplied. Our liability under this warranty is limited to servicing, repairing, or replacing any defective products for a period of one year after delivery to the original purchaser.

If warranty service is required, the equipment must be returned, transportation charges prepaid, to our factory or authorized service depot. In the case of misuse, abnormal operating conditions, or other non-warranty work, a repair cost estimate will be submitted for approval before work is started.

WHAT THE WARRANTY DOES NOT COVER:

This warranty covers only defects in materials and workmanship provided by SEREN I.P.S. and does not cover equipment damage or malfunction from misuse, abuse, accident, act of God, non-SEREN I.P.S. modification or upgrade. Improper return shipping, packaging, or shipping damage is not covered. SEREN I.P.S. will not be liable for any incidental or consequential damages resulting from your use or inability to use your RF Power Supply.

IF YOU HAVE A PROBLEM

The first step is to contact your system vendor. Often, problems perceived as RF Power Supply related are system related. Consult with your system vendor to determine the nature of the problem. Your system vendor knows the intimate details of how your processing system interfaces and operates with the R300 RF Power Supply and can efficiently resolve system related problems.

If it is determined that the RF Power Supply has a problem, contact our customer service department at **1-856-205-1131**. Before you call, please be ready to provide the model of your RF Power Supply, its serial number, date of manufacture, a description of the problem, and the manufacturer of the processing system it is used on.

HOW IS WARRANTY SERVICE OBTAINED?

Our customer service representative will explain how to obtain service under this warranty. Please save the original packing materials in order to facilitate shipment.

Glossary of Terms

A	Amperes
AC	Alternating Current
CEX	Common Exciter
DC	Direct Current
RF Generator	Industry term for RF Power Supply
KHz	Kilo Hertz, a measurement unit of frequency (1000 Hertz)
KVA	Kilo Volt-Amperes
MHz	Mega Hertz, a measurement unit of frequency (1,000,000 Hertz)
RF	Radio Frequency
TTL	Transistor-Transistor Logic
VAC	Volts, Alternating Current
VDC	Volts, Direct Current
W	Watts