

AC Line Voltage Regulator

MODEL AR-2330D

Owner's Manual



AR-2330D front view



AR-2330D rear view, shown with optional RRM-2 rear rack ears

AR-Series Features

- Output capacity 30 amps
- Output voltage can be changed to 220V or 240V with internal jumper
- Usable range for most equipment is an additional 10% above and below the capture ranges shown in Specifications (pg. 4)
- One twist lock inlet and one regulated, conditioned twistlock outlet on rear panel
- Eight-tap toroidal autoformer
- 10-LED bargraph Input Voltage meter
- 10-LED bargraph true RMS reading Output Current meter
- Extreme overvoltage/undervoltage causes instant shutdown, protecting equipment
- Extreme Voltage Shutdown indicator LED
- Output In Regulation indicator
- Fast-acting user-accessible circuit breaker protects against overload or shorts. Also acts as ON/OFF switch.
- Low stray magnetic field
- Low noise, variable speed fan provides cooling for heavy-duty, continuous operation
- Rugged, two-space rack unit weighs only 49 lbs. (22 kg.)

Determine the Correct Voltage

Is 240V the correct voltage for your application?

The AR-2330D is factory set for 240V output. All equipment should be checked first, to be sure that 240V is a suitable voltage (normally listed near the power cord). If a lower voltage is desired, the AR-2330D should have its internal jumper changed to 220 or 230 volts. If in doubt, consult your dealer.

General Information

Thank you for choosing a Furman AR-2330D AC Line Voltage Regulator. An AR-Series regulator is the perfect accessory to any audio, video, or computer rackmount system requiring clean, filtered, and regulated AC power for optimum operation.

Furman Voltage Regulators are intended to protect sensitive electronic equipment from problems caused by AC line voltage irregularities—brownouts or overvoltages that can cause audio tonal changes, digital equipment malfunction (such as loss of MIDI programs or other data), or, in extreme cases, permanent damage. The AR-2330D accepts input voltages over a wide AC voltage range (see table above) converts them to, and stabilizes them at $\pm 10V$ for 240V output. (The output voltage can be changed to 220V or 230V with an internal jumper.) Voltages approximately $\pm 10\%$ beyond the AR-2330D's range may be converted to usable levels, depending on the requirements of the equipment. See Figure 1.

The AR-2330D has one twistlock inlet and one twistlock outlet on the rear panel. The outlet is regulated, spike-suppressed, and EMI/RFI filtered. There are no controls except an on-off breaker switch.

Limitations: The AR-2330D is for use with AC voltage only. DC voltages should never be applied to it. Also, it does not change or regulate line frequency. The output frequency will always be the same as the incoming line frequency.

Maximum Load

The AR-2330D can handle loads totalling up to 30 amperes as long as the input voltage is equal to or above the selected output voltage (240V). For voltages below that level, its capacity must be derated at approximately .15 amperes per volt. See Figure 2. To cope successfully with worst-case brownout conditions, you should take this into account. An easy way to calculate this yourself is to multiply input voltage by maximum input current (ex. 200V x 30A = 6000 watts) to get the maximum power the unit can handle at this input voltage. Then divide this number by the output voltage (6000/240 = 25 amps). If your load draws any more than 25 amps, it will cause the input current to rise above 30 amps and will then trip the breaker.

Extreme Voltage Protection

The AR-Series includes special circuitry to sense over- and under-voltages and positively shut down the output before possible damage is done. For the AR-2330D, overvoltages are those over 300V. When the input voltage exceeds that limit, the power will cut off. It will come back on automatically when the overvoltage is reduced to 285V or lower. The red LED labelled EXTREME VOLTAGE SHUTDOWN indicates the shutdown condition. The output is also shut down for extremely low input voltages, less than 158V.

To provide additional protection against a catastrophic high voltage condition, voltages over approximately 300V may cause an internal fuse to blow. This is a 250 mA/250V fuse and requires removal of the top cover. If this unlikely condition occurs, please remove power from the unit first.

Fuses and Circuit Breakers

There are three fuses and one fast-acting magnetic circuit breaker in the AR-2330D.

1. A precision 30 amp magnetic circuit breaker is used as the on/off switch. If the input to the unit exceeds 30 amps, the breaker will trip. Be sure to reduce your load before re-powering the unit, or it will likely trip again. Refer to the previous section "Maximum Load" if you are uncertain why the breaker is tripping, or want to understand the relationship between input voltage and current vs. output voltage and current.

2. A fast-blow 250 mA amp fuse is located inside the unit, as previously mentioned. To replace it, the unit must be completely disconnected from all power and removed from its rack. The six hex head screws and one Allen head screw holding the top cover must be removed.

3. A Fast Blow 1 amp fuse protects a low current auxiliary winding on the large transformer.

Input Voltage Monitoring

The row of ten LED's at the top left of the front panel make up a meter that indicates INPUT VOLTAGE. Only one LED will light up at a time. There are two red LED's at the endpoints. When lit, they indicate that the input voltage may be above or below the point where it can be restored to the selected nominal output voltage (though it may still be restored to a usable level) but is not high or low enough to cause an extreme voltage shutdown.

Output Voltage Monitoring

A green LED labelled OUTPUT IN REGULATION indicates proper function (i.e., that the output voltage of the selected output voltage is within $\pm 10V$ of the 240V output. Your equipment should work normally when this light is on, and often will work satisfactorily even when it is off.

Output Current Monitoring

The AR-2330D's ammeter reads AC current from 0 to 30 amps, in 3-amp steps. Currents above the 30 amp limit read red, with yellow indicating a warning zone. Please keep in mind that the ammeter may not read at all if the total load connected is less than 2 amps (240 watts). This is a likely occurrence if only relatively low power, signal processing-type equipment is connected. With the master switch off, the ammeter can still read, but will only do so if equipment drawing at least 2 amps is connected to the unswitched outlet.

The ammeter is capable of giving a reliable indication of current drawn by all kinds of equipment, thanks to its true-RMS-reading circuitry. This means that loads like power amplifiers, which are primarily capacitive and inductive, will read as accurately as purely resistive loads like heaters. Ammeters that respond only to average AC current may vary widely from RMS reading meters.

Design

The AR-2330D uses a design based on an eight-tap toroidal autoformer. The toroidal design assures minimal leakage of stray magnetic fields, and, because of its high efficiency, a very compact size for its rating. The Voltage Regulator's circuitry monitors the incoming line voltage with each cycle, comparing it to an extremely precise voltage reference, accurate to $\pm 0.15\%$. If a voltage fluctuation requires that a different tap be selected, the new tap is electronically switched exactly at the zero-crossing, to avoid distorting the AC waveform. If necessary, it can switch taps as often as once each cycle. Some commercial voltage regulators using multiple-tapped transformers switch taps at uncontrolled times, thereby creating voltage spikes and clicks that can leak into the audio! Hysteresis in the switching circuits avoids "chatter" or unnecessary switching back and forth between adjacent taps. And unlike voltage regulators that employ ferro-resonant transformers, the Furman AR-Series is not sensitive to small errors in line frequency, making them ideal for use with generators.

Supply Cable Wiring

The AR-2330D's rear panel provides a NEMA L14-30P male inlet connector; a NEMA L14-30 cord mounted female connector is included with the unit. Please refer to the "Rear View" wiring diagram at right.

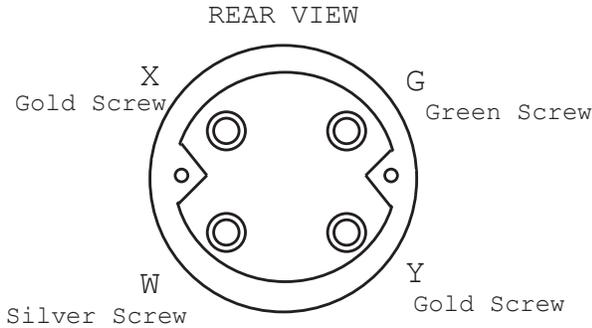
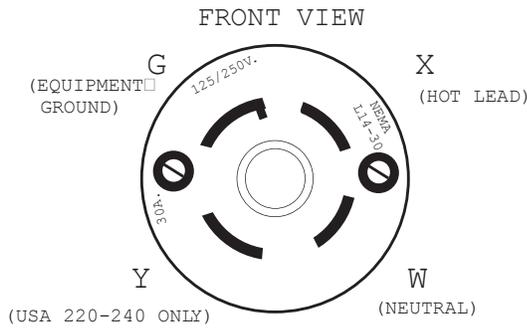
Wire the two hot leads (black) to X and Y (black, and white or red), and the equipment ground (green) to G.

It is essential that all equipment powered by an AR-2330D be properly grounded!

Never cut off the power cord ground pin or use a "cheater" adaptor on any of your equipment!

Installation

The AR-2330D is designed for mounting in a standard 19-inch rack. Because of its weight, the best position for it is at the bottom of the rack. Its toroidal transformer minimizes magnetic leakage, but nevertheless, due to its high capacity, it can radiate an appreciable magnetic field. Therefore, we recommend that it not be positioned adjacent to sensitive, low level signal processors, especially mic preamps, mixers, tape recorders, etc. Power amps may be more suitable "rack neighbors." As with any rackmount equipment, be sure to use 10-32 machine screws for mounting in the rack's tapped holes, and to avoid marring the front panel finish, use plastic washers under the screw heads.



Three Year Limited Warranty

Furman Sound, Inc., having its principal place of business at 1997 South McDowell Blvd., Petaluma, CA 94954 ("Manufacturer") warrants its AR-2330D (the "Product") as follows:

Manufacturer warrants to the original Purchaser of the Product that the Product sold hereunder will be free from defects in material and workmanship for a period of three years from the date of purchase. The Purchaser of the product is allowed fifteen days from the date of purchase to complete warranty registration by mail or on-line at the Furman website. If the Product does not conform to this Limited Warranty during the warranty period (as herein above specified), Purchaser shall notify Manufacturer in writing of the claimed defects. If the defects are of such type and nature as to be covered by this warranty, Manufacturer shall authorize Purchaser to return the Product to the Furman factory or to an authorized Furman repair location. Warranty claims should be accompanied by a copy of the original purchase invoice showing the purchase date; this is not necessary if the Warranty Registration was completed either via the mailed-in warranty card or on-line website registration. Shipping charges to the Furman factory or to an authorized repair location must be prepaid by the Purchaser of the product. Manufacturer shall, at its own expense, furnish a replacement Product or, at Manufacturer's option, repair the defective Product. Return shipping charges back to Purchaser will be paid by Manufacturer.

THE FOREGOING IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. Manufacturer does not warrant against damages or defects arising out of improper or abnormal use of handling of the Product; against defects or damages arising from improper installation, against defects in products or components not manufactured by Manufacturer, or against damages resulting from such non-Manufacturer made products or components. This warranty shall be cancelable by Manufacturer at its sole discretion if the product is modified in any way without written authorization from Furman Sound. This warranty also does not apply to Products upon which repairs have been affected or attempted by persons other than pursuant to written authorization by Manufacturer.

THIS WARRANTY IS EXCLUSIVE. The sole and exclusive obligation of Manufacturer shall be to repair or replace the defective Product in the manner and for the period provided above. Manufacturer shall not have any other obligation with respect to the Products or any part thereof, whether based on contract, tort, strict liability or otherwise. Under no circumstances, whether based on this Limited Warranty or otherwise, shall Manufacturer be liable for incidental, special, or consequential damages. Manufacturer's employees or representatives' ORAL OR OTHER WRITTEN STATEMENTS DO NOT CONSTITUTE WARRANTIES, shall not be relied upon by Purchaser, and are not a part of the contract for sale or this limited warranty. This Limited Warranty states the entire obligation of Manufacturer with respect to the Product. If any part of this Limited Warranty is determined to be void or illegal, the remainder shall remain in full force and effect.

Service

Before returning any equipment for repair, please be sure that it is adequately packed and cushioned against damage in shipment, and that it is insured. We suggest that you save the original packaging and use it to ship the product for servicing. Also, please enclose a note giving your name, address, phone number and a description of the problem.

NOTE: All equipment being returned for repair must have a Return Authorization (R/A) Number. To get an R/A Number, please call the Furman Service Department, (707) 763-1010 ext. 40, between 8 a.m. and 5 p.m., U.S. Pacific Time. Please display your R/A Number prominently on the front of all packages.

Figure 1:
AR-2330D Output Voltage vs. Input Voltage

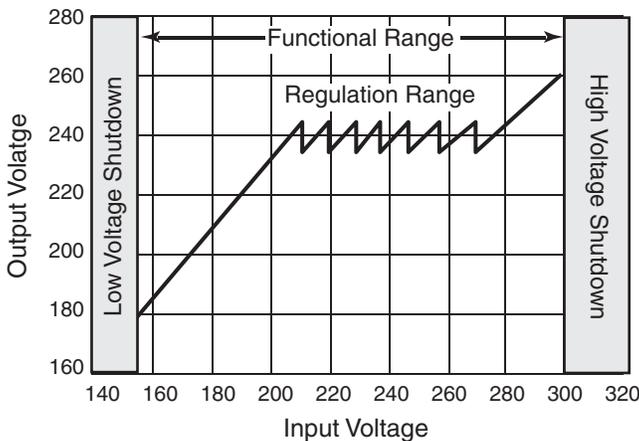
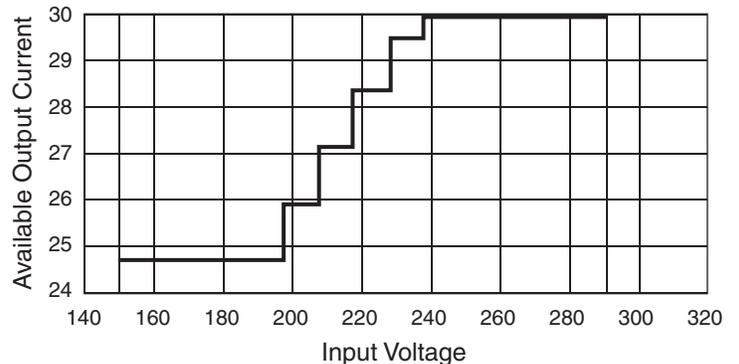


Figure 2:
AR-2330D Available Output Current vs. Input Voltage



Definitions

VOLTAGE REGULATION: The AC line voltage is a number indicating the nominal electrical potential that has been adopted in a region for powering electrical equipment of all kinds. In most of North America it is 117-120 volts AC; in Japan, 100 volts; and in many other countries 220, 230, or 240V. The actual voltage can fall below or rise above this nominal level due to brownouts, power cutbacks, use of substandard wiring, and other causes. These deviations can cause poor performance or malfunction. A regulator is a device which, through use of a transformer, corrects the voltage deviation by stepping it up or down so that it is as close as possible to the nominal level.

SPIKE: A pulse of energy on the power line. Spikes can have voltages as high as 6000 volts. Though they are usually of very short duration, the energy they contain can be considerable, enough to damage sensitive solid-state components in audio and computer equipment. Spikes can also foul switch contacts and degrade wiring insulation. They are an unavoidable component of electric power. They are caused unpredictably by electric motors switching on or off (on the premises or outside), utility company maintenance operations, nearby lightning strikes, and other factors. Spikes (also called surges or transients) are absorbed by special components called MOV's in the AR-series to provide safe voltage levels to protect your equipment.

RFI/EMI INTERFERENCE: Noise from RFI (Radio Frequency Interference) or EMI (Electro Magnetic Interference) involves lower voltages and less energy than is found in spikes, but it is continuous rather than transient in nature. It is not likely to cause physical damage, but it can certainly be annoying, producing static in audio circuits, "snow" on video screens, or garbled data in computers. Noise can be introduced into AC lines by nearby radio transmitters, certain kinds of lighting, electric motors, and others. Because noise occurs at higher frequencies than the 50 or 60 Hz AC line, it can be effectively reduced through use of low-pass filtering.

AR-2330D SPECIFICATIONS

Current Rating:	30 amperes for input voltages of 248/238/228* or higher; derate at .15A per volt to a minimum of 24.8A	Spike Clamping Voltage:	Initial turn-on at 390V peak L-N; 680 volts peak N-G, L-G
Output Voltage:	240 VAC. Can be changed to 220V or 230V via internal jumper	Response Time:	1 nanosecond
"In Regulation" Ranges:	Provides regulation ± 10 VAC in the following ranges: 240V mode, 190-287V; 230V mode, 181-276V; 220V mode, 174-264V	Maximum Surge Current:	6,500 amps (8 x 20 ms pulse)
Shutdown Range:	Below 150V or above 300V	Maximum Spike Energy:	130 joules L-N, 160 joules N-G, L-G, 450 joules total
Inlet:	One 30A NEMA L14-30P twistlock connector (male)	Noise Attenuation:	Transverse and common modes: Greater than 60 dB, 1-200 MHz
Outlet:	One 30A NEMA L14-30R twistlock connector (female)	Dimensions:	3.5" H x 19" W x 17" D (8.9 x 48.3 x 43.2 cm)
Voltmeter Accuracy:	± 10 VAC	Weight:	49 lbs. (22 kg)
Spike Protection Modes:	Line to neutral, neutral to ground, line to ground		

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