Furman Sound, Inc.
1997 South McDowell Blvd.
Petaluma, California 94954-6919 USA
Phone: 707-763-1010 • Fax: 707-763-1310
www.furmansound.com
E-mail: info@furmansound.com

AC Line Voltage Regulator

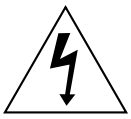
MODELS AR-1215, AR-1215J, AR-2306

Instruction Sheet

Safety Information

To obtain best results from your Furman AR-1215 or AR-2306, please be sure to read this manual carefully.

WARNING: To reduce the risk of electrical shock, do not expose this equipment to rain or moisture. Dangerous high voltages are present inside the enclosure. Do not remove the covers. There are no user serviceable parts inside. Refer servicing to qualified personnel only.



The lightning flash with arrowhead symbol, within an equilateral triangle, is intended to alert the user to the presence of uninsulated dangerous voltage within the product's enclosure that may be of sufficient magnitude to constitute a risk of electric shock.

Important Safety Instructions
Please Read Prior to Installation

1. Please read and observe all of the safety and operating instructions before the AR-1215 or AR-2306 is operated. Retain these instructions for future reference.

2. The AR-1215 or AR-2306 should not be used near water — for example, near a bathtub, washbowl, kitchen sink, laundry tub, in a wet basement, near a swimming pool, etc.

3. Do not place the AR-1215 or AR-2306 near heat sources such as radiators, heat registers, stoves, or other appliances that produce heat.

4. Route the power cord and other cables so that they are not likely to be walked on, tripped over, or stressed. Pay particular attention to condition of cords and cables at plugs, and the point where they exit from the AR-1215 or AR-2306. To prevent risk of fire or injury, damaged cords and cables should be replaced immediately.

5. Clean the AR-1215 or AR-2306 with a damp cloth only. Do not use solvents or abrasive cleaners. Never pour any liquid on or into the unit.

6. When left unused for a long period of time, the power cord of the AR-1215 or AR-2306 should be unplugged from the outlet.

7. The AR-1215 or AR-2306 should be serviced by qualified service personnel when:

   a. The power supply cord or the plug has been frayed, kinked, or cut.

   b. Objects have fallen or liquid has spilled into the unit.

   c. The AR-1215 or AR-2306 has been exposed to rain or other moisture.

   d. The AR-1215 or AR-2306 does not appear to operate normally or exhibits a marked change in performance.

   e. The AR-1215 or AR-2306 has been dropped, or the enclosure damaged.

8. The AR-1215 or AR-2306 requires that a safety ground be present for proper operation. Any attempt to operate the AR-1215 or AR-2306 without a safety ground is considered improper operation and could invalidate the warranty.

9. There are no user serviceable parts in the AR-1215 or AR-2306. Refer servicing to qualified service personnel only.

AR-Series Features

- AR-1215 and AR-1215J provide nine regulated, conditioned AC outlets—eight on the rear panel and one on the front
- AR-1215 and AR-1215J input capacity is 15 A; output capacity is 12 to 15 A
- AR-2306 provides eleven regulated, conditioned AC outlets—ten on the rear panel and one on the front
- AR-2306 input capacity is 6 A ; output capacity is 5 to 6 A
- Usable range for most equipment is an additional 10% above and below the ranges shown in the table below
- Extreme overvoltage or undervoltage causes instant shutdown, protecting equipment
- Extreme Voltage Shutdown indicator LED
- Output In Regulation indicator
- Ten-LED bargraph input voltmeter
- Fast-acting user-accessible circuit breaker protects against overload or shorts
- Very low stray magnetic field leakage
- On/off breaker switch
- Output voltage selector switch (AR-1215J and AR-2306 only)
- Compact, lightweight unit weighs only 12 lbs. (5.5 kg)

Nominal output voltages vs. input "In-regulation" ranges:

Output Accuracy	Model	Voltage Setting	In-Regulation Range
±5V	AR-1215	120	97 to 141
±5V	AR-1215J	120	97 to 141
±4V	AR-1215J	100	80 to 122
±10V	AR-2306	220	174 to 264
±10V	AR-2306	230	181 to 276
±10V	AR-2306	240	190 to 288

NOTE: The three models in the AR-Series differ in their nominal AC output voltages. Model AR-1215 produces 120 VAC. Model AR-1215J produces either 100 or 120 VAC. Model AR-2306 produces either 220, 230, or 240 VAC.

Where differences exist between models, information applicable to the AR-2306 is shown in the text of this manual in brackets [ ].

FIRST: Select the Correct Voltage!

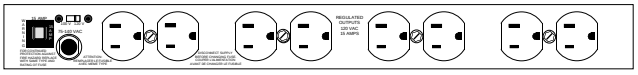
Before using your Voltage Regulator, be sure that if there is an output voltage switch on the rear panel (just above the cord, on Models AR-1215J and AR-2306 only), it is correctly set for the AC voltage required by your equipment. Each item of equipment that you intend to power with the Voltage Regulator should have its required voltage indicated on it, usually on the rear near the cord. If in doubt, consult your dealer.

General Information

Congratulations on your purchase of a Furman AR-1215, AR-1215J, or AR-2306 AC Line Voltage Regulator. The AR-Series regulators are designed specifically for 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. They accept input voltages over a wide AC voltage range (see table on page 1) and convert them to a steady, stable output at the desired standard voltage, plus or minus five [ten] volts. Voltages approximately ±10% beyond that range may be converted to usable levels, depending on the requirements of the equipment. See graphs on the back page.

AR-1215 front view



AR-1215J rear view (the switch above the AC cord is not present in the AR-1215)

AR-2306 rear view

NOTE: The three models in the AR-Series differ in their nominal AC output voltages. Model AR-1215 produces 120 VAC: AR-1215J produces either 100 or 120 VAC; and AR-2306 produces either 220, 230, or 240 VAC.
Where differences exist between models, information applicable to the AR-2306 is shown in brackets [ ] in the instructions.

The AR-1215 has eight [AR-2306 has ten IEC-320] convenience outlets on the rear panel, and one on the front panel. All are functionally interchangeable. The outlets are regulated, spike-suppressed, and filtered against RFI with a 3-pole filter, making the unit a full-function power conditioner. The AR-1215 has no controls except an on-off breaker switch. (The AR-1215J and AR-2306 also have an output voltage selector switch.)

Note: The AR-1215 and AR-2306 are for use with *AC voltage only*. DC voltages should never be applied to them. Also, they do not change or regulate line frequency. The output frequency will always be the same as the incoming frequency.

Maximum and Minimum Load

The AR-1215 and AR-1215J can handle loads totalling up to 15 amperes as long as the input voltage is equal to or above 124 volts (or 104 volts if using AR-1215J set to 100 volt output). For voltages below that level, its capacity must be derated at approximately 113 milliamperes per volt. (See graphs on back page.) As a practical matter, therefore, to cope successfully with worst-case brownout conditions, you should plan your total load so that it does not exceed 12 amps, or 1400 watts. Please note that this refers to the aggregate power requirement of all equipment plugged into the Voltage Regulator, not to each individual item.

The AR-2306 can handle loads totalling up to 6 amperes as long as the input voltage is equal to or above the selected output voltage. For voltages below that level, its capacity must be derated at approximately 23 milliamperes per volt. (Again, please see graphs on back page.) As a practical matter, therefore, to cope successfully with worst-case brownout conditions, you should plan your total load so that it does not exceed 5 amps, or 1100 watts. Please note that this refers to the aggregate power requirement of all equipment plugged into the Voltage Regulator, not to each individual item.

NOTE: While there is no minimum load requirement for the AR-1215 or AR-2306, you may experience an audible mechanical hum coming directly from the unit when the POWER switch is on with nothing plugged in. This effect will disappear as soon as you plug in any equipment drawing 40 to 50 watts total.

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 volts AC; in Japan, 100 volts; and in many other countries 220, 230, or 240 volts. 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.

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. See the Specifications on the back page for the exact voltages at which shutdown occurs. When the input voltage exceeds the limit, the power will cut off. It will come back on automatically when the overvoltage is removed as long as the voltage has not exceeded 300V [all models]. The red LED labelled EXTREME VOLTAGE SHUTDOWN indicates the shutdown condition. The output is also shut down for extremely low input voltages.

To provide protection against a catastrophic error in AC mains wiring, dangerously high voltages (those over approximately 300V) will cause an internal fuse to blow, but equipment plugged into the Voltage Regulator will not be damaged.

Fuses and Circuit Breakers

There is one fuse and one circuit breaker in the AR-Series. In the event that the unit appears to be completely dead (neither the Power switch nor any LED's light up), unplug the power cord and the load and check the breaker. If the circuit breaker is tripped, a white button will pop up. Push it back in to reset it. The purposes of these circuit protection devices are:

1. A fast-blow 15 amp [6 amp] circuit breaker is accessible at the rear panel without removing the unit from the rack.

This breaker will trip if the unit's 15 amp [6 amp] capacity is exceeded at any time.

2. A fast-blow 1/4 amp fuse is located inside the unit. This fuse will blow if the unit has been connected to a voltage that is above the range of the Extreme Voltage Shutdown circuitry (approximately 200 VAC for AR-1215 and AR-1215J; approximately 400 VAC for AR-2306). 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. The internal fuse is located in a holder near where the AC cord enters the unit. Replace the fuse only with the exact same type.

Input Voltage Monitoring

The row of ten LED's at the 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.

The AR-1215J and AR-2306, which have switchable output voltages, also have multiple scales on the Input Voltage meter corresponding to the selected voltage. On the AR-2306, there are three scales, with the top for 220V, the middle for 230V, and the bottom for 240V.

Output Voltage Monitoring

A green LED labelled OUTPUT IN REGULATION indicates proper function (i.e., that the output voltage is within ±5V of the selected output voltage). Your equipment will always work normally when this light is on, and often will work satisfactorily even when it is off.

If you wish to monitor your AR-1215's output voltage more precisely, you may want to use a Furman PL-PLUS Power Conditioner and Light Module in conjunction with it [use model PL-PLUS-E with model AR-2306].

The PL-PLUS is the perfect complement to a Furman Voltage Regulator to assist in rack power distribution. It offers a 20-LED bargraph line voltage meter to monitor the incoming line (the Voltage Regulator output), twin slide-out, swiveling lights with a dimmer control for equipment illumination, and eight [ten] additional outlets with their own spike and surge protection and RFI filtering.

Installation

Because of their toroidal transformer design, Furman Voltage Regulators may be positioned near most other equipment without fear that the other equipment will be disrupted by leakage of a strong 50/60 Hz magnetic field. Nevertheless, suggested rack locations would be either at the top or bottom.

As with any rackmount equipment, be sure to use 10-32 machine screws for mounting in the rack's tapped holes (this is not a metric size). In particular, beware of 10-24 screws, which may fit if forced but which will strip the threads. To avoid marring the front panel finish, use plastic washers under the screw heads.

Design

The AR-Series 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 ±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. Most 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 those voltage regulators that employ ferro-resonant transformers, Furman Voltage Regulators are not sensitive to small errors in line frequency, making them ideal for use with generators.

Three Year Limited Warranty

The Furman AR-1215, AR-1215J, and AR-2306 are warranted against failures due to defective parts or faulty workmanship for a period of three years after delivery to the original owner. During this period, Furman will make any necessary repairs without charge for parts or labor. Shipping charges to the factory or repair station must be prepaid by the owner; return shipping charges (via UPS Ground) will be paid by Furman.

This warranty applies only to the original owner and is not transferable. Also, it does not apply to repairs done other than by the Furman factory or Authorized Repair Stations. This warranty may be cancelled by Furman at its sole discretion if the AR-1215, AR-1215J, or AR-2306 unit has been subjected to physical abuse or has been modified in any way without written authorization from Furman. Furman's liability under this warranty is limited to repair or replacement of the defective unit.

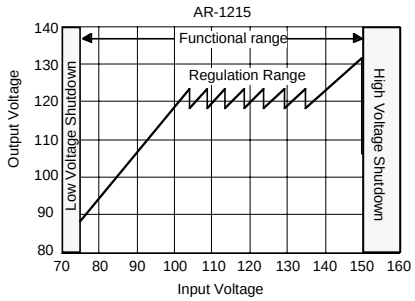
Furman will not be responsible for incidental or consequential damages resulting from the use or misuse of its products. Some states do not allow the exclusion of incidental or consequential damages, so the above limitations may not apply to you. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state. Warranty claims should be accompanied by a copy of the original purchase invoice showing the purchase date (if a Warranty Registration Card was mailed in at the time of purchase, this is not necessary). Before returning any equipment for repair, please read the important information on service, which follows.

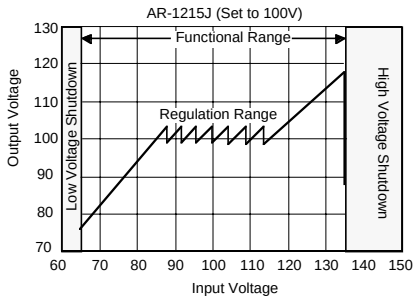
Service

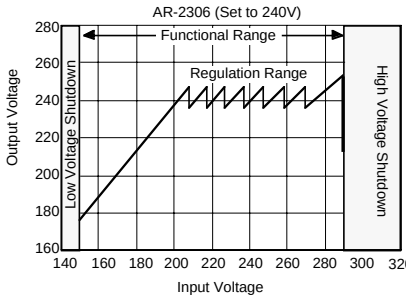
Before returning any equipment for repair, please be sure that it is adequately packed and cushioned against damage in shipment, and that it is insured. We suggest that you save the original packaging and use it to ship the product for servicing. Also, please enclose a note giving your name, address,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

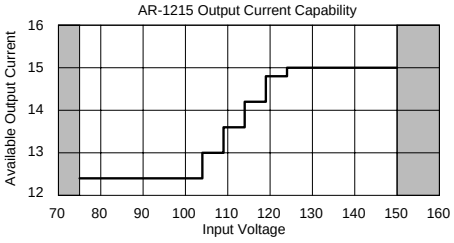
NOTE: All equipment being returned for repair must have a Return Authorization (RA) Number. To get an RA Number, please call the Furman Service Department, (707) 763-1010, ext. 40, between 8 a.m. and 5 p.m. U.S. Pacific Time, or fax to (707) 763-1310. Please display your RA Number prominently on the front of all packages.

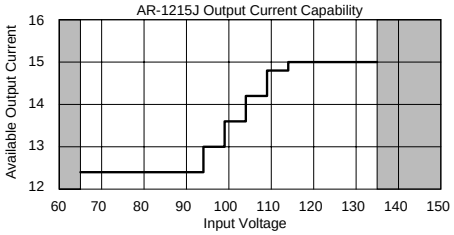
Output Voltage and Current vs. Input Voltage for All Models

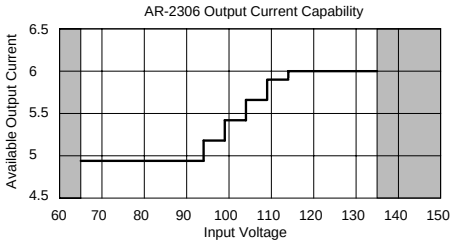












Other Furman Voltage Regulators

AR-1220, 20 amps at 120 VAC
AR-1230, 30 amps at 120 VAC

AR-2330, 30 amps at 220/230/240 VAC

AR-PRO, 30 amps at 120 VAC, worldwide use

AR-2330D for Video Projectors, 30 amps at 220/230/240 VAC

AR-1215, AR-2306 SPECIFICATIONS

Output Current Rating:	AR-1215: 15 amperes for input voltages of 124V (104V for AR-1215J in 100V mode) or higher; derate at 113 mA per volt to a minimum of 12.3A. AR-2306: 6 amperes for input voltages of 228V/238V/248V (depending on Output Voltage switch setting) or higher; derate at 23 mA per volt to a minimum of 4.9A.
"In Regulation" Ranges:	AR-1215 (and AR-1215J set to 120V): provides regulation ±5V from 97V to 141V. AR-1215J (set to 100V): provides regulation ±4V from 82V to 115V. AR-2306: provides regulation ±10V in the following ranges: 174-264V (220 mode), 181-276V (230 mode), 190-288V (240 mode).
Shutdown Range:	AR-1215 (and AR-1215J set to 120V): Below 75V or above 150V. AR-1215J: (set at 100V): Below 65V or above 135V. AR-2306: Below 146V or above 279V (220 mode); Below 152V or above 287V (230 mode), Below 158V or above 300V (240 mode).
Voltmeter Accuracy:	AR-1215 (and AR-1215J set to 120V): ±5V. AR-1215J (set to 100V) : ±4V. AR-2306: ±10V.
Spike Protection Modes:	Line to neutral, neutral to ground, line to ground.
Spike Clamping Voltage:	AR-1215/AR-1215J: Initial turn-on at 200V; TVSS rating of 400 volts peak at 500 A, L-N, N-G, L-G (tested to UL-1449). AR-2306: Initial turn-on at 390 volts peak L-N; 680 volts peak N-G, L-G.
Response time:	1 nanosecond.
Maximum surge current:	6,500 amps.
Maximum spike energy:	AR-1215/AR-1215J: 80 joules per node; 240 joules total. AR-2306: 130 joules L-N, 160 joules N-G, L-G, 450 joules total.
Noise attenuation:	Transverse and common modes: 20 dB at 200 kHz, rising to >40 dB, 1 to 100 MHz.
Dimensions:	1.75" H x 19" W x 8.5" D.
Weight:	12 lbs. (5.5 kg)

The Furman AR-1215, AR-1215J and AR-2306 are made in the U.S.A.