

FURMAN

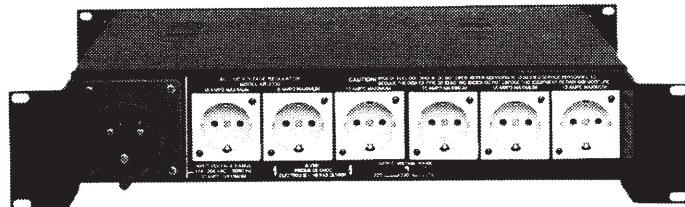
AC Line Voltage Regulator, 30 Amp

MODEL AR-2330

Instruction Sheet



AR-2330 front view



AR-2330 rear view, shown with optional rear rack ears

AR-Series Features

- Nominal output voltages vs. input capture ranges:

Voltage Setting	In-Regulation Range	Output Accuracy
220	174 to 264	±10V
230	181 to 276	±10V
240	190 to 288	±10V

- Usable range for most equipment is an additional 10% above and below the capture ranges shown in the table
- Ten-LED bar-graphs for Input Voltage and Output Current
- Extreme overvoltage or undervoltage causes instant shutdown, protecting equipment
- Extreme Voltage Shutdown indicator LED
- Output In Regulation indicator
- Seven regulated, conditioned Schuko outlets—six on the back panel, one on the front
- Output capacity 30 amps
- 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
- Rugged, two-space rack unit weighs only 50 lbs. (23 kg.)

FIRST: Select the Correct Voltage!

Before using your Voltage Regulator, be sure that the output voltage switch on the rear panel is correctly set for the AC voltage required by your equipment—either 220, 230 or 240V. 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 choosing a Furman AR-2330 AC Line Voltage Regulator. An AR-Series regulator is the perfect accessory to any audio, video, or computer rack-mount 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 above) and convert them to, and stabilize them at, the desired national voltage standard, ±10V. Voltages approximately ±10% beyond that range may be converted to usable levels, depending on the requirements of the equipment. See Figure 1.

The AR-2330 has six outlets on the back, and one outlet on the front. 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. There are no controls except an on-off breaker switch and an output voltage selector switch.

Limitations: These Line Voltage Regulators 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 line frequency.

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 rack-mount 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.

Wiring

The back panel of the AR-2330 provides a mounted IEC-309 male connector. A separate IEC-309 female cable-mounting power outlet is included with your AR-2330, recommended for use with 3 x 4 mm² wiring. Please follow the wiring diagrams below.

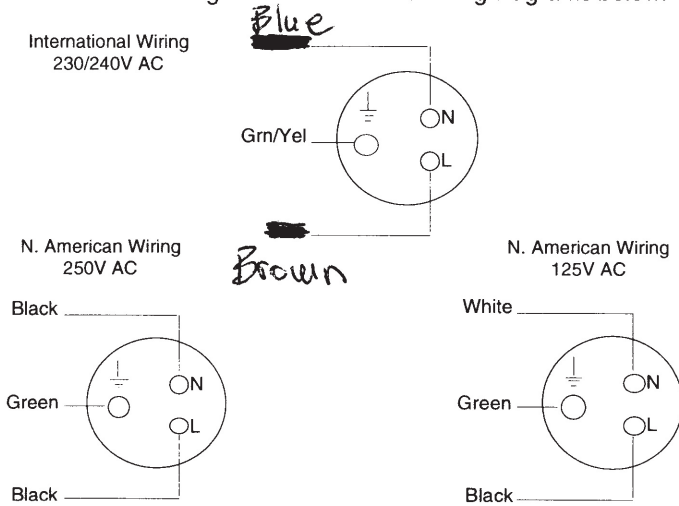
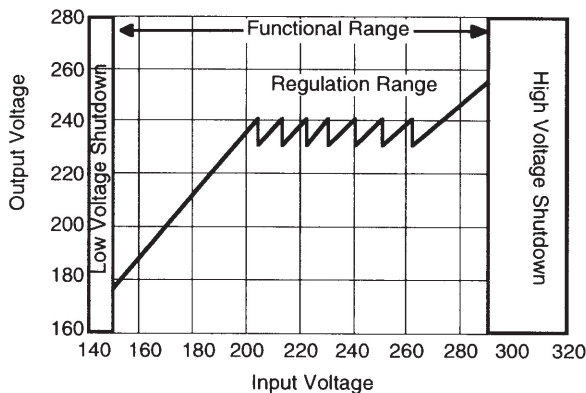


Figure 1: Output Voltage vs. Input Voltage (Set to 230V)



Limited Warranty

The Furman AR-2330 is warranted against failures due to defective parts or faulty workmanship for a period of one year 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-2330 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.

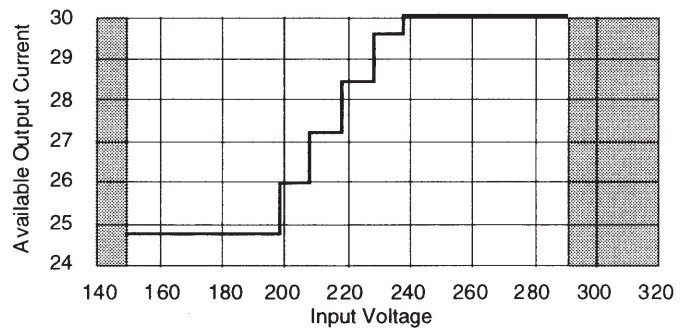
Warranty claims should be accompanied by a copy of the original purchase invoice showing the purchase date (if a Warranty Registration Card was mailed in at the time of purchase, this is not necessary). Before returning any equipment for repair, please read the important information on service, which 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 (R/A) Number. To get an R/A Number, please call or fax the Furman Service Department, (415) 927-1225, between 8 a.m. and 5 p.m. U.S. Pacific Time. Please display your R/A Number on the front of all packages.

Figure 2: Available Output Current vs. Input Voltage (Set to 230V)



AR-2330 SPECIFICATIONS

Current Rating:	30 amperes for input voltages of 228/238/248* or higher; derate at .11A per volt to a minimum of 24.8A
"In Regulation" Ranges:	Provides regulation ± 10 VAC in the following ranges: 220V mode, 174-264V; 230V mode, 181-276V; 240V mode, 190-288V.
Shutdown Range:	220V mode, below 146V or above 279V; 230V mode, below 152V or above 287V; 240V mode, below 158V or above 300 V.
Voltmeter Accuracy:	± 10 VAC
Spike Protection Modes:	Line to neutral, neutral to ground, line to ground
Spike Clamping Voltage:	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 (8 x 20 μ s pulse)
Maximum Spike Energy:	130 joules L-N, 160 joules N-G, L-G, 450 joules total
Noise Attenuation:	Differential mode: Greater than 40 dB Transverse and common modes: Greater than 60 dB, 1-200 MHz
Dimensions:	3.5" H x 19" W x 17" D (8.9 x 48.3 x 43.2 cm)
Weight:	48 lbs. (22 kg)

* Depending on Output Voltage switch setting

Maximum Load

The AR-2330 can handle loads totalling up to 30 amperes as long as the input voltage is equal to or above the selected output voltage (220, 230 or 240V). For voltages below that level, its capacity must be derated at approximately .11 amperes per volt. See Figure 2. 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 24.5 amps, or about 5600 watts at 230V. Please note that this refers to the *aggregate* power requirement of *all* equipment plugged into the Voltage Regulator, *not* to each individual item. Also, since the outlets used are rated at 16 amps, do not draw more than 16 amps through any one outlet.

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-2330, overvoltages are those over 279V in 220 mode, 287V in 230 mode and 300V in 240 mode.

When the input voltage exceeds that 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. The red LED labelled EXTREME VOLTAGE SHUTDOWN indicates the shutdown condition. The output is also shut down for extremely low input voltages: 146V in 220 mode, 152V in 230 mode and 158V in 240 mode.

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

Fuses and Circuit Breakers

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

1. A fast-blow 30 amp circuit breaker is used as the on/off switch. This breaker will trip if the unit's 30 amp capacity is exceeded at any time. If the circuit breaker is tripped, the on/off switch will switch off. To reset it, push the switch back to the on position.

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 300 VAC). 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.

NOTE: There are two different types of internal fuses. There are seven 30 amp fuses to protect the voltage switches against faults in the control circuits (see the section on Design), and the 1/4 amp fuse mentioned above, to protect the small transformer against line voltages greater than 300 VAC. For continued protection, replace fuses only with the exact same type and rating. The internal fuses are on the main circuit board.

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.

The AR-2330 has switchable output voltages, and also has multiple scales on the Input Voltage meter corresponding to the selected voltage. There are three scales, with the top for 220V, the middle for 230V, and the bottom for 240V.

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 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.

RF/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.

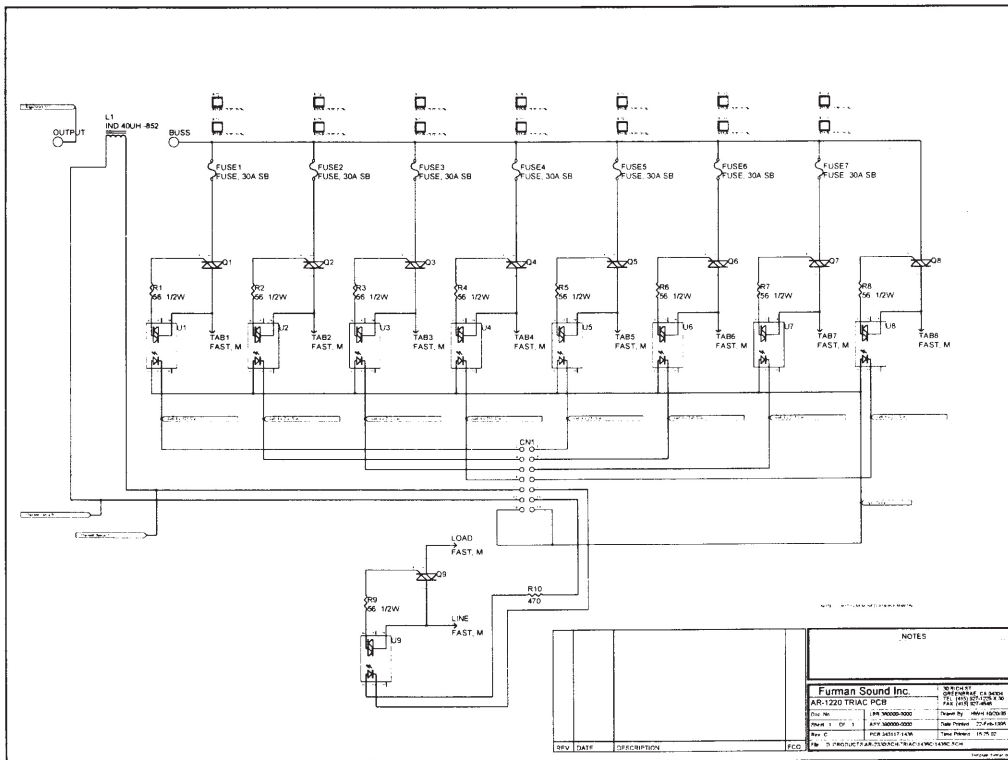
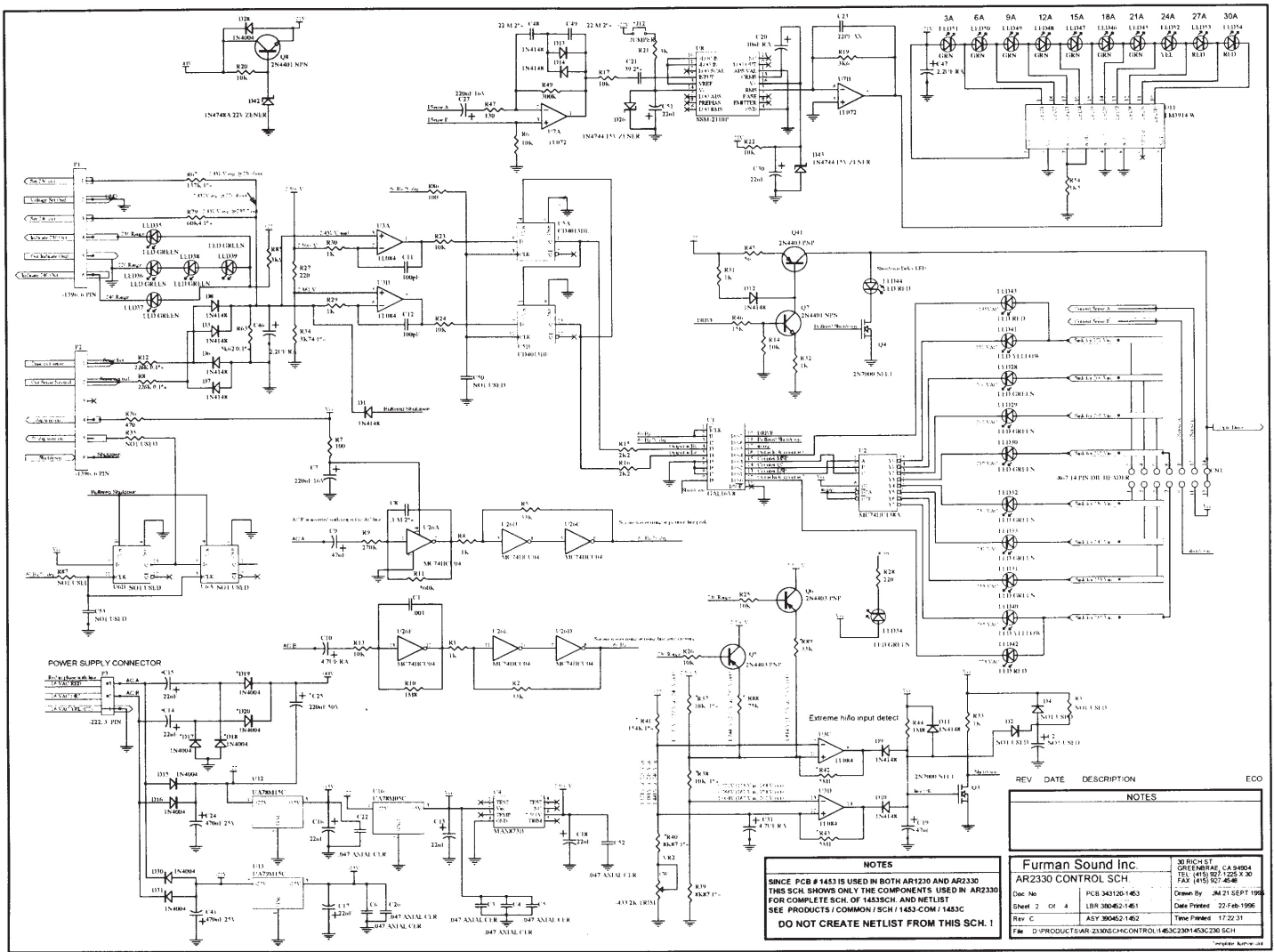
Output Voltage Monitoring

A green LED labelled OUTPUT IN REGULATION indicates proper function (i.e., that the output voltage is within $\pm 10V$ of the selected output voltage). Your equipment always will work normally when this light is on, and often will work satisfactorily even when it is off. If you wish to monitor your AR-2330's output voltage more precisely, you may want to use a Furman Sound **PL-PLUS-E Power Conditioner and Light Module** in conjunction with it.

The PL-PLUS-E is the perfect complement to a Furman Voltage Regulator to assist in rack power distribution. It offers a 20-LED bar-graph 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 ten additional outlets with their own spike and surge protection and RFI filtering.

Design

The AR-2330 uses a design based on an eight-tap toroidal autotransformer. 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. 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, the Furman AR-Series is not sensitive to small errors in line frequency, making them ideal for use with generators.



NOTE: THIS TRIAC PCB SCHEMATIC APPLIES TO TWO FURMAN AR-SERIES MODELS: THE AR-2330 AND AR-1220