

RaneNote 133**DC Powering Rane RAP
(Remote AC Power) Units**

- Voltage & Current Requirements
- Connector Wiring
- Battery Operation
- DC-DC Converters
- MA 6S Battery Operation

Dennis Bohn
Rane Corporation

Mark Wentling
E&E Exports

© 1991 Rane Corporation

Introduction

This note explains how to operate Rane units designed for remote AC operation from DC power—whether batteries, DC-DC converters or DC power supplies. The techniques shown *do not require any unit modification*. All wiring is external to the unit. There are techniques that *do* require unit modification, but these are better left explained by our Technical Service personnel.

This note applies only to these listed products:

AC 22/22B
AC 23/23B
AD 22/22B
AP 13
AVA 22
CP 31
CP 52
CP 64
DC 24
DMS 22
GE 30
GE 130
GE 215
MP 22/22x/22z
MP 24/24x/24z
MS 1
PE 15
PE 17
RPE 228/228d
SM 26B
SSE 35
THX/SSE 22
VP 12

Background

First, a little history helps unravel our twisted DC-AC-DC path.

In 1987, Rane established a precedence among pro audio signal processing manufacturers by adding DC jacks to all its units. These jacks allowed users the option of powering several units from one remote power supply. Advantages cited included lower noise, system power sequencing, universal safety approvals, etceteras¹. That same year saw Rane call for the pro sound industry to adopt remote power supplies as standard².

A year later in 1988, Rane joined an industry-wide committee attempting to see if sufficient agreement could be reached to get the Audio Engineering Society (AES) to issue a Recommended Practice document concerning remote power supplies. It was to include voltage type, levels and connectors. Two years later in 1990, the committee disbanded without reaching sufficient agreement for AES action; however, a summary of progress did appear in the AES journal³.

Much was learned, and Rane decided to continue the pursuit of a separate remote power supply standard of its own. Participation in the AES committee demonstrated that using AC remote power was, overall, superior to DC power. Rane took this to heart and nicknamed their revised line of products *RAP*, an acronym for *Remote AC Power*. All units equipped with black DC jacks were redesigned with red AC jacks, and a remote power supply was shipped with each unit. Gone was DC, and gone was the option—now remote power was required⁴.

But Murphy likes to play her little jokes. Now we find ourselves once again explaining how to run Rane products from DC. Life is never dull.

DC Powering RAP Units

It came at us from several directions: Disney wanted to run Rane units from the 24 volt batteries used to power their magnificent floats. Consultants and contractors needed ways to comply with emergency paging requirements dictating that certain audio equipment run from batteries upon AC power failure. Car installers started calling about modifying units for competition auto installations. Requests came in for retrofitting Rane units for the upgrade RV market and even executive jets. A Southwest police department wanted to install FPE 13 parametric equalizers into police cars to improve intelligibility of reception. There was even a sightseeing outfit installing Rane products into tour buses for use by their guides.

Mark Wentling from E&E Exports (Los Angeles) gets the credit for elegantly solving the puzzle of how to DC power units designed for remote AC use. Mark worked for years as an audio design engineer (MXR, Music Man, Fender, to name a few) before getting into the export business. One day he looked at our voltage doubler circuit and mused that maybe if we were to add just two diodes (soon to become known as *the DC diodes*) it should be possible to power all Rane RAP units from DC. Amazing. He was right.

It took over a year to add the DC diodes to all the units⁵. This is a long time, but Rane knew that once the re-engineer-

ing was complete the actual cost of the diodes was small enough to warrant adding them to every RAP unit. As suspected, a grateful few benefited immensely.

Minimum DC Voltage

All Rane RAP units operate from an 18 VAC remote transformer equipped with a center tap. This powers a dual output DC voltage doubler found in each unit. The voltage doubler steps up the low AC voltage (necessary for worldwide safety agency compliance and exemption) to high enough levels to allow each unit's positive and negative voltage regulators to operate. These voltage regulators put out the industry standard levels of ± 15 VDC (*see the DC-DC Converter section for an exception*). This voltage runs all the internal circuitry and indicators.

These regulators require an absolute minimum of ± 17 VDC to operate. In a typical RAP product the voltage doubler circuits create at least ± 20 VDC. Even with a 10% low AC mains line (normal pro audio design-limits) this guarantees regulator operation. Taking the ± 17 VDC number and allowing an additional one volt drop across the added DC diodes brings us to a *minimum required DC input of ± 18 VDC* to guarantee normal operation.

Maximum DC Current

Every RAP unit has the maximum required AC current silk-screened under the RJ12 modular POWER jack and also listed on its Data Sheet. The DC current equals *one-third (1/3) the AC current*. (See the VC 18 Voltage Converter Data Sheet for a listing of these DC currents.) The DC current is much less than the AC current for two reasons: DC eliminates the diode AC-to-DC conversion factor and the inefficient voltage doublers. These two combine for a factor of about three.

Connector Wiring

Rane uses RJ12 modular jacks wired per Figure 1. The details and history of this jack appear in *Rane Note 121*⁴. There is a distinguishing factor to note about this wiring. Even though it is not obvious why this configuration was adopted (it has to do with accidental telephone hook-up), the wiring is *symmetrical*. Although unintentional, this produced the very favorable byproduct of the plug *not being polarized when used for DC voltages*. When wiring-up or buying cable, it is not necessary to worry about pin numbers, or beginning from right or left, or whether it uses twisted or straight flat cable. Just remember: negative voltage goes to the center two pins, positive to the next outer pair, and the common goes to the two outside pins. Two parallel conductors for each connection are standard. This reduces wiring impedance and doubles current capacity. Rane uses and recommends 26 AWG size wire (two parallel 26 AWG wires are rated at 1.5 amps). Also observe the following:

Use only 6-wire cable and modular connectors for all interconnection. Common 4-wire cable and connectors will not work. Do not substitute 4-wire for 6-wire cable and connectors.

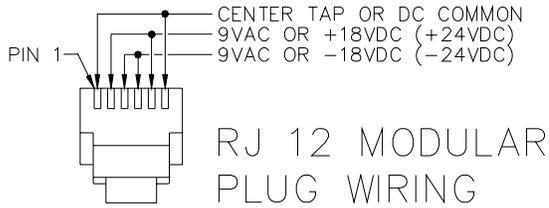
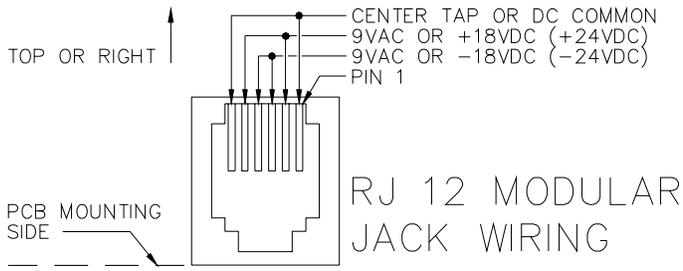


Figure 1. RJ 12 Modular Jack & Plug Wiring

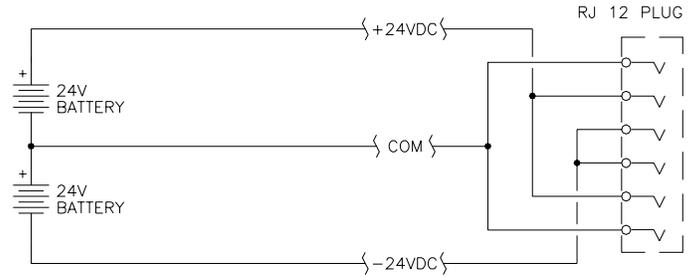


Figure 2. Battery Wiring for RAP units

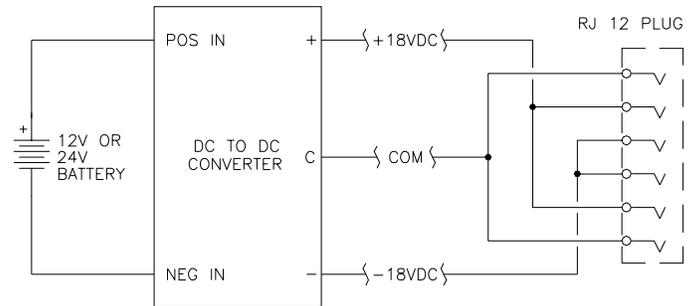


Figure 3. DC-DC Converter Wiring

Battery Operation

Figure 2 shows the correct wiring for battery operation. Note this requires *two* batteries wired in series to create the necessary bipolar input voltage. One is not enough. If only one battery is available, see the next section on DC-DC Converters. Also note the batteries must be rated 24 V. The more common 12 V batteries do not provide enough input voltage to operate the regulators. If the regulators do not operate, the unit's noise performance is apt to be unacceptable. The unit *will work*, but it will *not work properly*. Sometimes you are lucky and can get away with it, but not too often. We have seen enough noisy 12 VDC installations to make us recommend 24 V batteries *only*.

DC-DC Converter Operation

Powering RAP units from only one battery requires a DC-DC converter. Figure 3 shows the typical arrangement. What is not common are the output voltage levels of ± 18 VDC. These satisfy our previously discussed minimum for regulator operation. Unfortunately the more commonly found ± 15 VDC converters should not be used. Again, maybe you will be lucky and not have noise problems, but don't bet on it. Higher output voltage converters may also be used, but should not exceed ± 24 VDC. Greater than this begins to tax the regulator's maximum power limit.

Caveat: The PE 17 is an exception. The PE 17 uses internal ± 17 VDC regulators, and requires at least a ± 20 V DC-DC converter. Beware.

Remember to observe the maximum DC current requirements when buying the converter.

DC Power Supply Operation

A DC power supply is an alternative to using batteries or DC-DC converters. Figure 4 diagrams the hook-up required. As shown, wire a dual power supply (or two single supplies) in series to produce a bipolar output voltage. Setting each supply for 18 volts results in a single ± 18 VDC source. This arrangement is popular for emergency use where many RAP units run from one large DC power supply operated by a master AC mains UPS source.

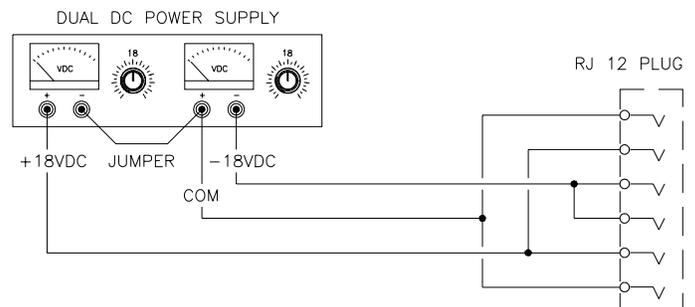


Figure 4. DC Power Supply Wiring

References

1. D. Bohn, *Rane Note 118: Remote Power System*, (Rane Corporation, 1987). Although out of print, interested parties may obtain photocopies upon request.
2. D. Bohn, "Remote Power Supply Standards: A Proposal," *S&VC*, Vol. 5, pp. 70-78, Nov.15, 1987).
3. "Summary of Progress Before Dissolution of AES Working Group on Power Supply Interfacing," *J. Audio Eng. Soc. (News of the Standards Committee)*, Vol. 39, pp. 275-276 (Apr 1991).
4. D. Bohn, *Rane Note 121: RAP—Remote AC Power: An Idea Long Overdue*, (Rane Corporation, 1989).
5. The PS 1, RPS 4 and SM 82 RAP units do not have DC diodes. On the PS 1 and the RPS 4 it was felt they would never be needed, and on the SM 82 the addition proved too difficult.
6. Richard Clark & David Navone, "Isolation," *AUTOSOUND 2000 TECH BRIEFS*, June/July 1992, pp. 149-153. Subscriptions and individual copies available from Autosound 2000 Tech Briefs, 2563 Eric Lane, Suite D, Burlington, NC 27215, (910) 570-0341. Very highly recommended reference series for anyone involved in automotive sound installation. These guys are the gurus—no one knows more.