



**Neve V-Series  
Console  
Restoration  
Technical Brief**

by

**Gregory G. Davis**

October 2004

© 2004 Audio Engineering Services LLC  
All Rights Reserved

Unauthorized duplication or re-transmission by any means  
without prior written permission is expressly prohibited.

## 1. Analog Neve VR Master Recording Console Restoration Considerations

### System Ownership / Returns on Investments

A 1990 vintage model VR console today enjoys a substantial resale value, often retaining more than 25% of the original system cost. The currently available AMS Neve 88R is the direct descendant of the VR, and in a 72 input format, is currently priced over \$750k. The Neve 88R remains the company flagship - an analog large format audio recording console. The high value of the new 88R Neve console has the effect of increasing the value of the older Neve VR series consoles. The VR recording console format has proven to have lasting economic value and sonic performance potential. Reinvestment in component renewal of the perishable and consumable parts will restore full like new operation of analog console systems. 30-year system operating lifetimes can continue to be an economic reality for analog audio consoles.

In comparison with analog consoles, digital systems follow a different economic model. Digital systems are based upon disposable hardware, forgettable software, and are made instantly obsolete by newer-faster-more powerful computers. Large format digital audio console solutions currently cost as much as the equivalent analog price, do not have renewable components, and typically have 0 resale value after 10 years of operation. The digital system ownership path requires a constant process of manufacturer supported "upgrades" which essentially dispose of the old hardware and replace with new hardware at 45% discount from manufacture list.

### General Service Requirements for Analog Recording Consoles

If the console owner is pro-active in the ownership maintenance strategy, the console will deliver high quality audio performance in the long term. Comparisons with the world of high performance automobiles is often useful. The Neve VR audio console is indeed like a hot rod high performance British automobile, the Aston Martin. If you drive the Aston on the track at hammer down full speed for long enduro racing, you will expect to replace not only the tires, but to also rebuild the gear box, rear end, motor, and suspension. Likewise, if you drive your VR hard, and you should, you will need to keep a continual investment in replacement of the parts that are consumed in the natural course of audio hot rodding. These consumable parts include lights, leds, jacks, connectors, switches, pots, capacitors, faders, etc. Electromechanical and electrochemical parts are inherently subject to wear and degradation over time, with use, and with respect to operating temperatures.

With a superior understanding of the replacement schedule of the consumable parts, AES LLC can assist the VR console owner with a fair and up front commitment to a realistic maintenance strategy that will guarantee the NEVE VR productivity in the world of high performance audio recording and mixing.

## **2. General Service Requirements for analog circuits using electrolytic capacitors:**

If there is any topic that is more misunderstood about Neve VR consoles, it is the subject of the electrolytic capacitor. Switches, pots, connectors, etc, are maintenance topics with their own unique science. The capacitor is however, the key component which determines the long term audio performance capability of the Neve VR, and will be the singular focus of this paper.

The electrolytic capacitor is inherently perishable, and must be renewed periodically to maintain the high audio performance capabilities of the Neve VR console. Improved replacement part designs are available in 2005 which were unavailable in 1990 or 1995. Properly implementing the new parts opens the door to even better audio performance in the Neve VR console, a stellar design to begin with.

Electrolytic capacitors are used in the analog circuit design for dc power filtering and inter-stage audio signal coupling. Each of the Neve VR audio channel modules contains 215 electrolytic capacitors in 21 different sizes and values, all using a wet electrolyte between aluminum foil layers. The wet electrolyte in these capacitors has a limited and finite operating lifetime. The operating lifetime depends on multiple variables, most significantly the ambient operating temperature. Each 10°C increase in ambient operating temperature decreases the component life span by a multiplier by 2x. Heat management in the console environment can be the largest lifespan variable of these parts between renewal cycles.

The circuit application use of the electrolytic capacitor will additionally influence life span behavior. Audio signals have a unique way of introducing a form of stress inside the chemical nature of the electrolytic capacitor. Cathodic degeneration of polarized aluminum electrolytic capacitors will occur when transferring AC audio power through the device without DC bias. Elevated temperatures accelerate ion migration and growth of 2<sup>nd</sup> destructive oxide layer at the cathode. Hydrogen is released during this chemical reaction and accelerates the out-gassing induced loss of electrolyte (Capacitor SPEWAGE defined!!). Newly available non-polar electrolytic capacitors can be selected and retrofitted in the VR channel module to gain a multiplied benefit of 105°C rated operational temperature capacity, longer lifespan in the audio coupling modes, and lower audio distortion in the process.

Seriously Scientific. Absolutely Magic.

Electrolytic capacitor components will reach the end of their useful life in wholesale batches. After just a 5% failure rate, the console usability will be seriously compromised by over 600 faults in the console. Please note that new Neve VR channel modules were available from AMS Neve in 1999 as a special order at \$5,437.50 each, with 40 week lead times. A more reasonable alternative is to renew the 215 electrolytic components in the channel modules in a logical manner in order to establish a new baseline of predictable operation. This property of analog system renewal is unique to analog system design. AES LLC has therefore created a unique program for capacitor upgrade and renewal.

### **3. Neve Channel module small fader subassembly technical issues:**

In a small percentage of these electrolytic parts, the combined factors of specific manufacturing sources, components of specific type, value, and physical circuit location, may prematurely leak active electrolyte. This chemical is intensively alkaline and can permanently damage a subassembly circuit board beyond reasonable repair. Your console should be inspected by an AES LLC qualified engineer to determine the potential risk of known vendor specific component failure types. Immediate intervention is advised to prevent circuit board carnage described below.

The small fader subassembly is particularly vulnerable to permanent and un-repairable damage caused by electrolyte leakage. This subassembly contains 77 electrolytic capacitors and is the most sensitive to increasing ambient temperatures, increasing the risk of electrolyte leakage. The electrolyte will chemically react with the copper traces, and contaminate the fiberglass insulation between copper traces. The audio switching performed on the small fader subassembly uses Field Effect Transistors, which have gate control input impedances of greater than 10 million Ohms. Electrolyte leakage will compromise the insulation resistance between these copper tracks to the gate control inputs to the audio switching FET's. This will cause improper operation of the module signal routing status and control. The functional result is completely illogical operation of the channel module (like electronic Alzheimer's disease).

### **4. VR Master Recording Console Capacitor Restoration Plan**

AES LLC will provide engineering for parts specification to create module subassembly restoration kits. Parts are to be selected for criteria of sonic performance, physical suitability, longevity, reasonable cost, and availability for work flow progress efficiency.

AES LLC will provide a specific list of restoration workstation technical equipment for use in the restoration project. Additional AES LLC specified workstations must be set up for concurrent rework by multiple technicians. The equipment kit may be purchased from AES LLC, or any other vendors of choice.

AES LLC will make capacitor restoration kits available to maintain continuous project progress at rates of up to 40 subassembly kits per week, allowing for limitations of component vendor source lead time variables as specified in point 1.

AES LLC will provide one day of engineering service for the purpose of technical training on the use of specified equipment, and one day for the purpose of technical evaluation testing of the console.

AES LLC will provide the module subassembly restoration kits containing replacement electrolytic capacitors selected as per criteria of point 1. The kits are a composed of individually packaged and labeled components for each component type on each sub-assembly circuit board.

## **5. Practical aspects of the VR Master Recording Console Capacitor renewal program**

The capacitor renewal process is simple and straight forward.

Part 1: Remove all electrolytic capacitors from the subassembly.

Part 2: Install the replacement parts as per the component reference designator labels fixed to the parts bag for each component type, for each sub assembly circuit board.

Note: If components are left over...Find the component location missing the required part by checking the label list on the parts bag. Each component type bag has a maximum of 15 component reference designation parts in each bag. A kit of capacitor parts for 10 EQ subassemblies typically has 80 separately labeled parts bags, each bag with a module position assignment number, an engineering kit assignment number, the pcb subassembly type part number, and the component reference designation numbers for the parts installations.

AES LLC additionally provides a detailed technical documentation reference book to assist in the identity of functional application for each capacitor at each pcb location.

AES LLC agrees that customer information is proprietary and confidential, and will not be released without the express written permission.

AES LLC provides all component warranties are as specified by the component manufacturers.

### **Conclusions**

AES LLC empowers the VR console owner with the knowledge and confidence that his console will reliably deliver the highest audio performance. AES LLC empowers the VR console owner by training his designated technical support engineers on the proper techniques for maintaining the Neve console.

Post Script: AES LLC recommends that the Neve VR console is powered off during idle periods of more than 12 continuous hours.