

# Electronic Noise Reduction in the AMS Detection System

## 1 Introduction

This document describes a modification to reduce the electronic noise of the AMS detection and pre-amplification system. Smoothing capacitors are added to both the electron multiplier high-voltage electrical supply and to the output of the PMT-5 signal pre-amplifier. Both tasks are relatively simple and should be within the capabilities of most laboratory personnel. They are described in the following sections.

## 2 Smoothing Capacitor Addition to Electron Multiplier High Voltage Supply

A 4.7nF ceramic capacitor rated to a voltage of 6kV<sup>1</sup> is connected between the high voltage electrical supply to the electron multiplier and the instrument electrical ground. The capacitor may be installed in one of two alternate positions, depending upon the age and version of the instrument to which it is fitted. Both are described here.

### 2.1 Capacitor Addition to Earlier Instruments.

For instruments with electronic control units containing earlier versions of the high voltage circuit-board (revision numbers 1.06 or less), the smoothing capacitor is installed in the shielded feed-through housing on the multiplier vacuum flange containing the signal and multiplier high voltage connections (see figure 1). This installation is performed as follows.

Switch off multiplier high voltage.

Disconnect both the high voltage input and the electron multiplier output connections.

Unscrew the 2 large flat-head screws holding the cylindrical metal shield of the feed-through housing.

Undo the three screws holding the electrical connection mounting plate to the support pillars holding it to the vacuum flange.

Carefully de-solder the wires from the three electrical connections and remove the plate from the vacuum flange.

Using a 13mm wrench, remove the nut and washer holding the electron multiplier high voltage connection to the mounting plate, fit a ground-tag to this connector on the inside of the plate and re-fit the securing nut and washer. Tighten nut securely.

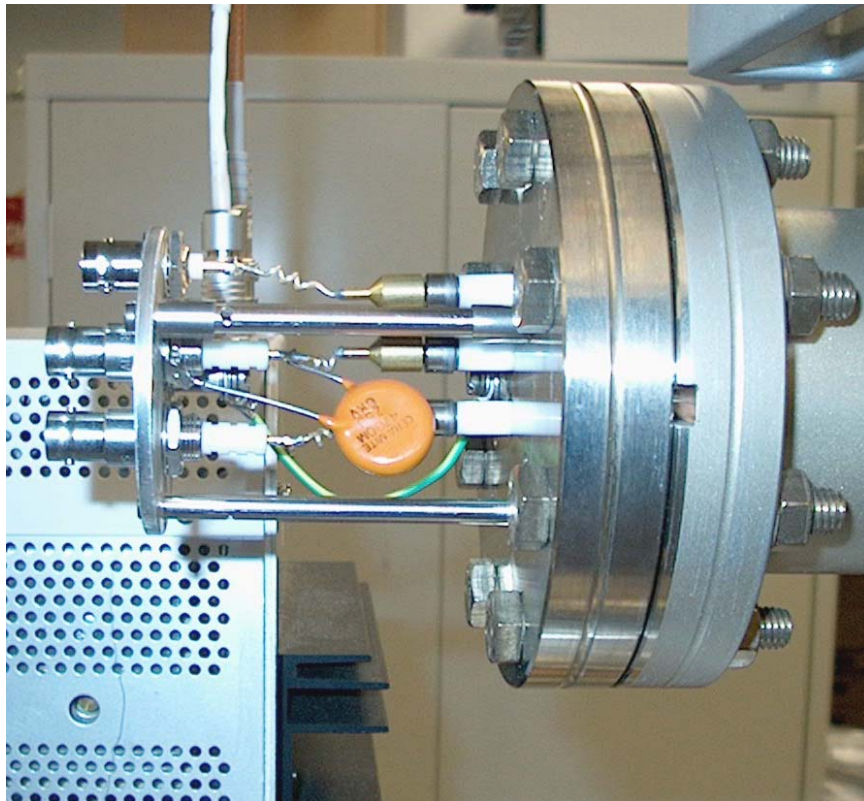
Re-solder the wires to the electrical connections and re-fit the connection mounting plate to the support pillars.

Carefully solder one leg of a 4.7nF / 6kV ceramic capacitor to the electron multiplier high voltage electrical supply and the other to the newly installed ground-tag. It will be necessary to trim the legs of the capacitor to ensure the correct fit. The capacitor must be positioned such that it does not come into contact with anything within the housing.

Re-fit the metal shield and secure with the two fixing screws.

Reconnect the electron multiplier high voltage supply and signal output cables.

Switch on multiplier high voltage supply and test.



**Figure 1** – Location of 4.7nF / 6kV ceramic capacitor in feed-through housing.

## **2.2 Capacitor Addition to Later Instruments.**

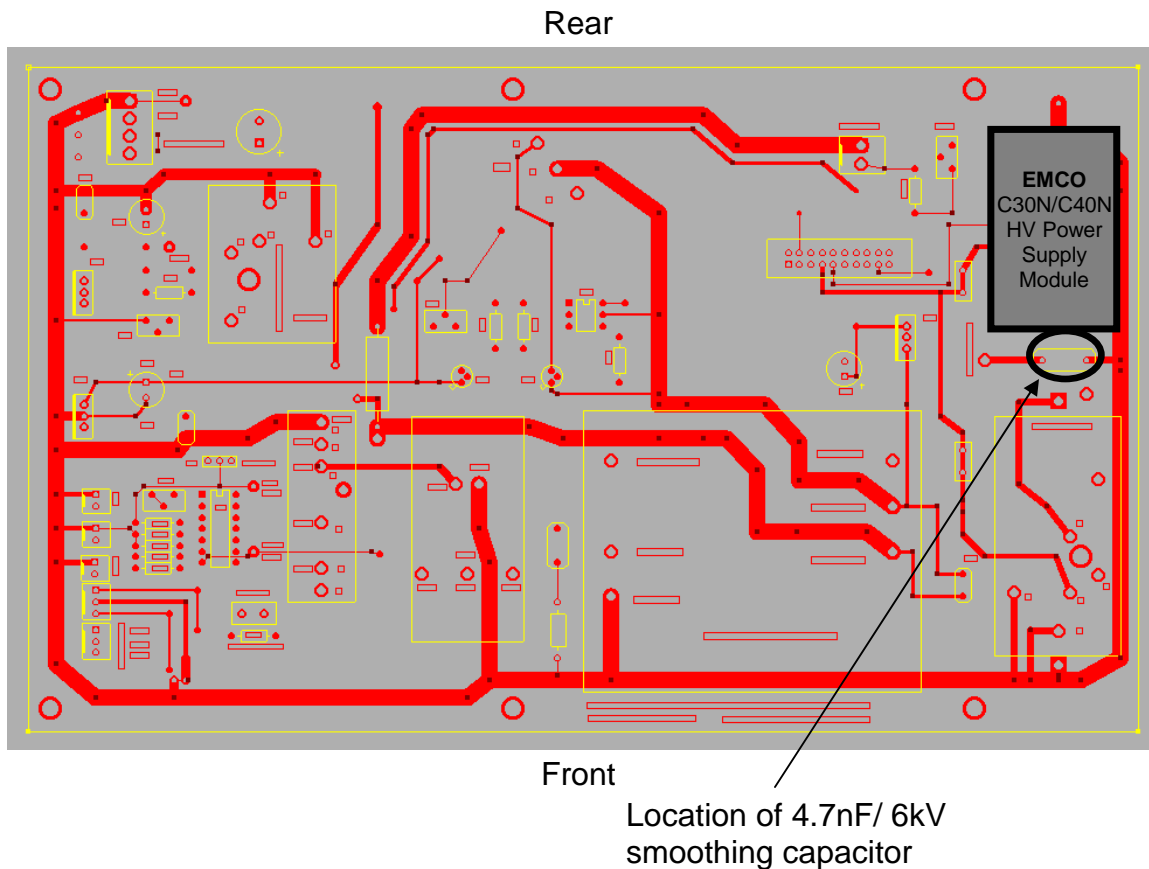
For instruments with electronic control units containing later versions of the high voltage board (revision numbers 1.07 or above), the high voltage smoothing capacitor may be added directly to the main board. This may be easier than installation into the shielded feed-through chamber on the vacuum flange as

described in 2.1, but should only be attempted by those who feel competent in working with high voltage electronics. The installation is performed as follows.

Switch off power to the electronics box.

Disconnect all cables from the electronics box and remove it from the rack. Remove the top of the box to expose the circuit boards inside. The high voltage main board is the larger circuit board on the right hand side of the box when viewed from the front.

The 4.7nF/6kV ceramic capacitor is soldered to the circuit board immediately below the electron multiplier high voltage power supply module. This module is either an EMCO C30N or C40N unit, which is a metallic silver color and approximately 1 inch wide by 2 inches long. Located immediately forward of the module when viewed from the front of the box are two conducting tracks facing each other end on that are separated by a short gap (see figure 2). The right hand track is connected to the broad ground rail that runs around the edge of the circuit board.

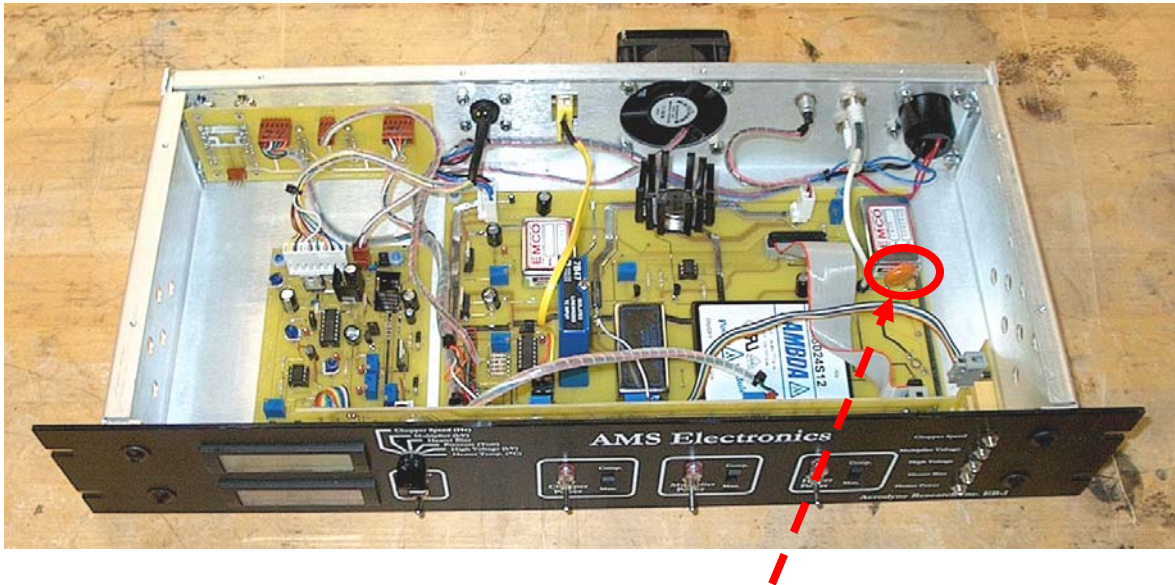


**Figure 2** – High Voltage Board Layout showing Position of EMCO C30N/C40N HV module and Location of 4.7nF/6kV ceramic smoothing capacitor.

Trim and bend the legs of the capacitor appropriately and solder one leg to each of the tracks indicated above (see figure 3).

Replace electronics box cover and re-install in instrument rack. Re-connect all cables to the electronics box.

Apply power to the electronics unit and switch on electron multiplier power supply to test system.



Location of 4.7nF/ 6kV  
smoothing capacitor

**Figure 3** – High Voltage Board within Electronic Control Unit showing Position of EMCO C30N/C40N HV module and 4.7nF/6kV ceramic smoothing capacitor.

### 3 Smoothing Capacitor Addition to PMT-5 Pre-amplifier.

In addition to adding a smoothing capacitor to the electron multiplier high voltage supply, a further 47 nF ceramic capacitor<sup>2</sup> rated at a voltage of 25V is also added to the signal output connection of the PMT-5 pre-amplifier. This installation occurs as follows.

Disconnect all cables from the PMT-5 preamplifier and remove it from the AMS instrument.

Using a 1/16" hex driver, remove the dial from the range selector switch.

Remove the eight cross-head (Philips) screws along the side of the unit which hold the upper case to the main body.

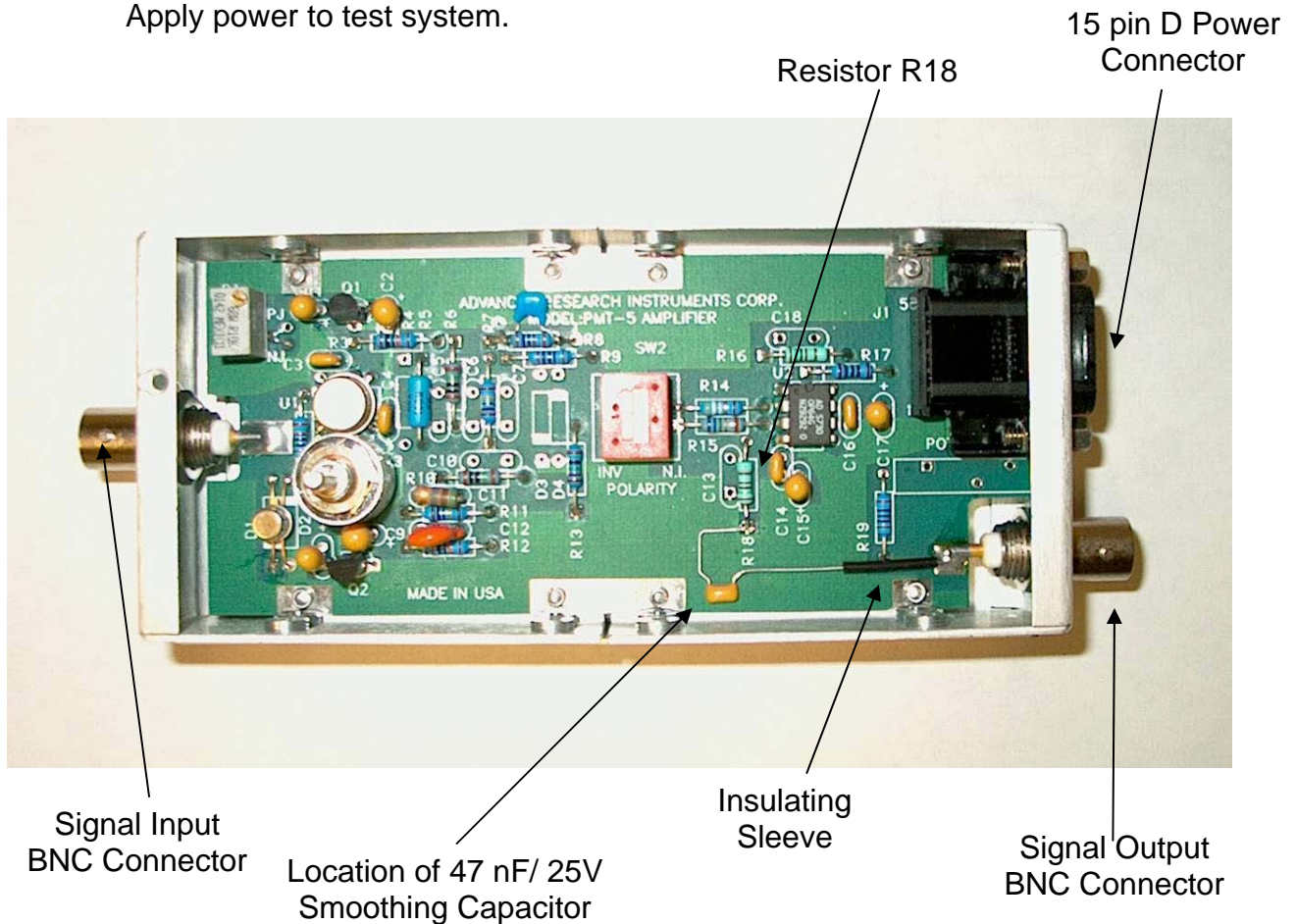
Locate the solder pad where the center pin of the signal output BNC connector is connected to the printed circuit board.

Locate resistor R18 on the printed circuit board (see figure 4). One pin of R18 (located closest to the side wall of the outer shell) is electrically connected to the chassis of the pre-amplifier. Verify this by performing a continuity test using a DVM.

Install an insulating sleeve on one leg of a 47 nF/25V capacitor and solder to the point at which the BNC center pin is soldered to the circuit board. Solder the other leg to the ground pin of R18. Bend and trim the legs of the capacitor to fit (see figure 4). Adjust the insulating sleeve to prevent the possibility of any connection between R19 and the capacitor leg.

Reassemble PMT-5 and refit to AMS instrument.

Apply power to test system.



**Figure 4** – PMT-5 Pre-amplifier with Top Cover Removed Showing Location of 47 nF/25V Smoothing Capacitor

#### **4. Assistance.**

For enquiries or further assistance with the modifications described in this document, please contact Aerodyne Research.

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<sup>1</sup> P/N 46F5248, Newark Electronics (Newark InOne), USA, 1-800-463-9275, or equivalent

<sup>2</sup> P/N 29F013, Newark Electronics (Newark InOne), USA, 1-800-463-9275, or equivalent

#### Document Revisions:

Sept. 2005 – corrected 47 pF to 47 nF (JTJ)