

## I. Introduction

Thanks for your purchase of our Mark 4 Quad Electrolytic Capacitor Replacement Board PC-M4U. It has been designed to replace the original Dynaco Quad (4 section) Aluminum electrolytic capacitor. No longer in production, these original equipment capacitors have become nearly impossible to replace. Those that are available, due to their age, exhibit high leakage further compromising the amplifier reliability. Another problem with the original capacitor contributing significantly to their poor reliability is the marginal voltage rating (500VDC) that is frequently challenged even under typical conditions. Finally, the original capacitor exhibits a rising impedance characteristic well within the audio spectrum causing loose bass response and dull high frequencies.

The CAE replacement PC board solves all of these problems with the use of a high quality capacitor bank that not only increases the voltage rating (to 600VDC) but also increases the capacitance value. Most important to audiophiles, it uses contemporary high quality capacitors that provide both low and flat impedance characteristics. The net result is an amplifier that more dynamic, provides deeper bass and delivers more extended highs.

This document describes the specific instructions and steps associated with our Dynaco Upgrade board (PC-M4U). Additional documents referenced (and available from our web page [www.curcioaudio.com](http://www.curcioaudio.com) ) are :

- General Overview Assembly Notes (CAE Tech Note # 1)
- Soldering Tutorial (CAE Tech Note # 2)
- Recommended Tools & Test Instruments (CAE Tech Note # 3)

Please take the time to familiarize yourself with all of these documents in particular Tech Note # 1.

**Also, please note that this module houses components that have lethal voltages present on their leads and cases. Please take the appropriate care in both installing and operating this module.**

## II. General Overview

Take time to review all of the documentation provided including the aforementioned tech notes related to soldering technique and proper tools and test equipment. In the following sections we will guide you through several project phases. Each section has been carefully prepared with our own notes and comments from our customers to be sure that any anticipated question has been considered. The sequence is identical to that which we

follow when we complete the fabrication for our customers. Please follow the same sequence to maximize efficiency and eliminate errors. It is also very helpful to read each section before beginning to gain a visual idea of the construction.

Your project will be built in stages:

- If you have purchased the PC Board in its unassembled form (PWB-M4U) you will first assemble the components onto that board.
- Next, you will remove original Dynaco Aluminum QUAD Aluminum Electrolytic “Can”.
- You will then install the CAE replacement PC-M4U Board and connect it to the original corresponding connections using five new wires.
- You will then power up and perform a few simple electrical tests.
- Finally you will readjust the bias pots for each channel.

Although you are unlikely to encounter any problems, should they occur they would almost certainly be based on an improper assembly of the PC Board or the wiring to the Mark 4. Therefore to avoid the time consuming and frustrating task of troubleshooting afterwards please remember these simple suggestions:

- **The correct high quality Tools are essential to a successful installation.** I strongly recommend the use of a temperature controlled soldering station along with a “Solder Sucker” and Solder-Wick braid. Download our Solder Tutorial Tech note at our webpage ([www.curcioaudio.com](http://www.curcioaudio.com)) Technical Support section for suggested suppliers. Make sure you have a Digital Voltmeter (to measure DC Volts, Resistance, and with some models capacitance). Radio Shack stocks suitable choices at reasonable prices.
- **Proper soldering is crucial.** Please refer to our soldering tutorial and practice on surplus boards until you master the technique. Be especially careful to avoid solder bridges or “cold” solder joints. Our experience shows that nearly **95% of all problems are associated with soldering related errors.**
- Capacitors (this project is full of them) are polar- this means that **there is a right and wrong way to insert polarized components in the board.** If placed backwards, the component and probably others nearby will be damaged upon initial power application. Double check each step associated with these parts and once again later after you have had a chance to take a break.
- Some components are color coded with their value (mostly resistors, but there may be others). If you are not proficient at reading these codes, use an ohmmeter to double check the value of each resistor before insertion. It is very easy to confuse a 100 ohm metal film resistor with a 1000 ohm resistor or worse with a 100K ohm resistor.

## III. Internal Wiring

Unless otherwise specified, **you should use 20 to 22 gauge stranded wire with Teflon insulation**. Thicker wire, solid wire, or PVC insulation will cause problems - if not now (too much strain on the boards or parts) or later (reliability issues). This can't be overemphasized.

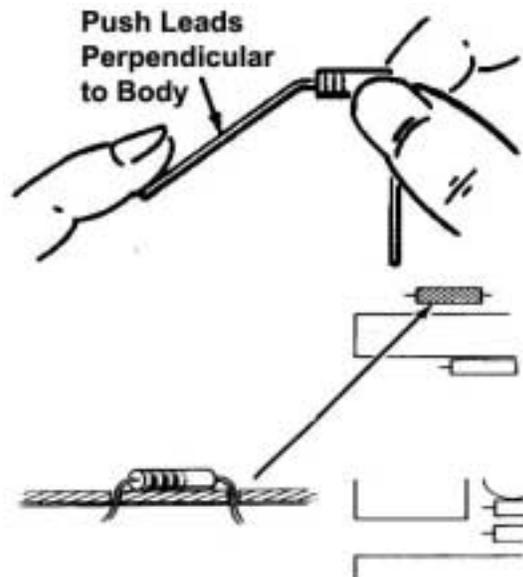
## III. Assembly

### A. Building the PC Board (PC-M4U)

Components are to be inserted on the non foil side and soldered on the foil side. The sequence of assembly has been chosen so that the components with the lowest profile (such as jumpers, low power resistors, IC's etc.) are installed first with higher profile components added until the highest profile components are installed last.

Refer to the component placement drawing (Figure 1). Be sure to observe correct orientation of polar components (capacitors). Be sure also to check with an ohmmeter resistor values if you are not absolutely sure of how to read metal film resistor color codes.

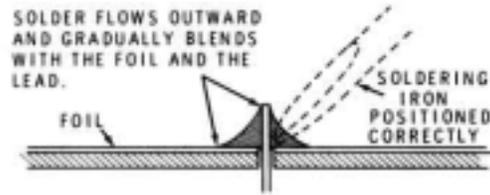
1. Begin by installing all of the ½ Watt resistors. There are a total of 8 ½ Watt resistors. Refer to Figure 1 (Top View PC Board Component Placement Diagram). The board has been designed so that a gentle radius near the body of the resistor will position the leads in alignment with the associated holes in the PC Board. Note that the ½ Watt resistors should be inserted so that the body of the resistor rests gently against the PC Board. After inserting the resistor leads thru the board, a slight bending outward of the leads will hold the part in place until you can solder it in place.



2. Install the single 3 Watt metal Oxide resistor. You should also gently bend the leads of these resistors similar to the ½ Watt resistors (but of course with a greater radius). But unlike the ½ Watt resistors, the 3 Watt Resistor should be spaced away from the plane of the PC Board by 1/16" to allow for heat dissipation.

3. Install the six (8) electrolytic capacitors (2X 100uF@350VDC, 4X 100uF@250VDC, & 2X 47uf@350VDC). The 100/350VDC are the larger diameter (7/8") caps. However be careful with not confusing the 100/250VDC with the 47/350VDC – they have the same diameter – refer to the placement diagram. Also, be very careful to observe the correct polarity. The black band on the capacitor represents the negative lead (the board is marked with a "+" to indicate the positive (opposite) lead. Be careful to insure that the leads fully extend thru the PC Board and that you have sufficient tab length to obtain a solid solder connection.

4. Visually inspect all of your solder connections. Refer to the adjacent diagram. Quality solder connections should be smooth and shiny. Dull surface or large blobs on the PC board should be cleaned and resoldered. In this case remove the old solder with solder wick or similar and resolder the connection.



## B. Removing the Original Dynaco QUAD Capacitor & Bias Rectifier

1. To begin removing the original Dynaco Quad Capacitor, remove the top cover (should be held in place with either 4 or six screws (depending upon the vintage) along the side. These screws will release both the top perforated metal cage and the bottom "U" cover.
2. Remove the 2 output tubes (and label them for reinstallation later), the rectifier tube, and the 7199 driver tube. I recommend that you clean the dust and grime from the amplifier both topside and below where you will be doing most of your work. A vacuum cleaner following the path of a soft paintbrush will work very well here.
3. Turn the amplifier over and locate the wire connected to Quad capacitor section "4" (as per the original Dynaco wiring diagram – included). At the capacitor, you should notice a TRIANGLE symbol. The other end of the wire should be connected to the Dynaco driver PC board (PC-4) terminal number "8". Desolder the wire at the PC board (you can leave the other end connected to the Quad Capacitor. Also there will be connected a wire going to pin 4 of the Octal Socket located on the front side of the amplifier. Assuming you are not using that socket to power a Dynaco PAM preamp, you can simply cut this wire at the Octal Socket. Note - There is also a 6800 resistor connected to capacitor lug "4" – it will be discarded so feel free to leave it connected.

4. Next locate the wire connected to Quad capacitor section “3” (designated as a SQUARE symbol near the capacitor lug). The other end should be connected to the Dynaco driver PC board (PC-4) terminal number “6”. Desolder the wire at the PC board (you can leave the other end connected to the Quad Capacitor).
5. Next, desolder the wires connected to capacitor section “2” (there is no Symbol associated with the capacitor for this lug). There are 2: one of the two choke leads, and the RED lead from the output transformer. Label each of these wires “2”. Note – The other end of the 6800 resistor from step 3 is connected to this lug – you may leave it connected as it will be discarded.
6. Next, at Quad capacitor lug “1” (designated as a CIRCLE on the associated capacitor lug). There are two wires: the remaining choke lead from the choke and a wire going to pin 8 of the rectifier tube (GZ34). Desolder the wire going to pin 8 of the rectifier tube at the rectifier tube. Desolder the choke lead and label it “1”. For your reference, you can identify pin 8 by counting clockwise from the bottom of the tube starting at the tab.
7. The final connection to the Quad Capacitor will be the ground connection at one of the four ground lugs (outer perimeter). Locate that wire and disconnect it at the point it connects to the amplifier (can be one of several places but will be located near the nearby terminal strip). You should also Desolder the wire from the ground lug at the capacitor to facilitate removal.
8. If you have followed the 6 previous steps correctly, all the wires connected to the Quad Electrolytic Cap should be free. If so, feel free to cut the wires at the capacitor to prepare it for removal. This capacitor is held in place by 4 tabs that are either twisted and / or soldered to the chassis. You will need to remove the solder (using a vacuum “solder sucker”) to easily remove it. This is perhaps the most difficult step of the process. Make sure your soldering iron tip is clean and “wetted” with a fresh shot of solder and immediately begin to heat the connection. Wait until the solder is fully molten (this may take a minute or so) and then place the solder vacuum pump in a position to suck the greatest quantity of solder. Once you have removed the solder, using gas pliers you can twist the tabs to the position (face perpendicular to the center of the can) that will release the capacitor.
9. Remove the wire clamp and screw (the mounting hole is nearby the GZ34 rectifier tube) and reinstall it using a 4-40 X 3/8” screw (fed through the clamp and into the chassis from the bottom side). Use a 3/8” 4-40 threaded spacer to secure it on the top side of the chassis. The spacer will be used to secure one end of the PC-M4U assemble later.

## C . Preparation & Installation of the New CAE Mark 4 QUAD Capacitor Board (CAE-PC-M3U)

1. The original wires were too short to reach the terminals of the replacement capacitor board once it is in place. Therefore you will need to prepare a set of 5 wires to connect from the PC-M4U replacement cap board to their associated connections inside the amplifier. To do this, cut, strip (1/4"), tin, and connect as described the following (5) five lengths of 22 ga. stranded wire (preferably Teflon insulated):
  - a. 3.5" Length of Black to Terminal "GND" of PC-M4U
  - b. 3" Length of RED to Terminal "1" of PC-M4U
  - c. 3" Length of WHITE to Terminal "2" of PC-M4U
  - d. 11" Length of GREEN to Terminal "3" of PC-M4U
  - f. 11" Length of BLUE to Terminal "4" of PC-M4U
2. Install the remaining 4-40 X 3/8" spacer on the PC-M4U assembly at the hole nearest the center (not the edge) of the board. The screw should enter from the component side and the spacer attach to the foil side. Secure well.
3. Group the wires towards the GND terminal and lightly twist together the BLUE & GREEN wires along their full length
4. Group the wires and insert the bundle from the top of the amplifier through to the bottom through the hole originally occupied by the Dynaco Quad capacitor. Orient the PC-M3U so that the two largest diameter capacitors are nearest the GZ34 rectifier tube socket. Secure in place using a single 4-40 X 1/4" screw to the 3/8" threaded spacer previously installed near the rectifier tube socket.
5. Turn over the amplifier and notice that the remaining 3/8" spacer is aligned so that it is near the edge of the cutout formerly occupied by the original Quad capacitor. You will use a screw, washer and 4 pin terminal strip to secure this remaining spacer to the edge of the cutout. To do this take a 4-40 X 3/8" screw, feed it through the mounting hole for the 4 pin terminal strip and place a 1/4" washer on the other side. Secure this assembly to the threads of the remaining 3/8" spacer (originating from the center hole in the PC-M4U assembly) and secure so that the PC-M4U module is aligned perpendicular with the long edge of the chassis. The terminal strip should be orientated so that it aligns with the edge of the cutout (refer to Figure 2). Note – if you have difficulty fitting the width of the PC-M4U module between the power and output transformers, loosen the four screws securing the power transformer (the one nearest the short edge of the amplifier) and relocate it so that it is as far as possible to the edge of the amplifier.

6. Once you have aligned the PC-M4U module, tighten the screw on the top side of the amplifier that is near the GZ34 output tube.

You will now connect the PC-M3U to the amplifier in the following steps:

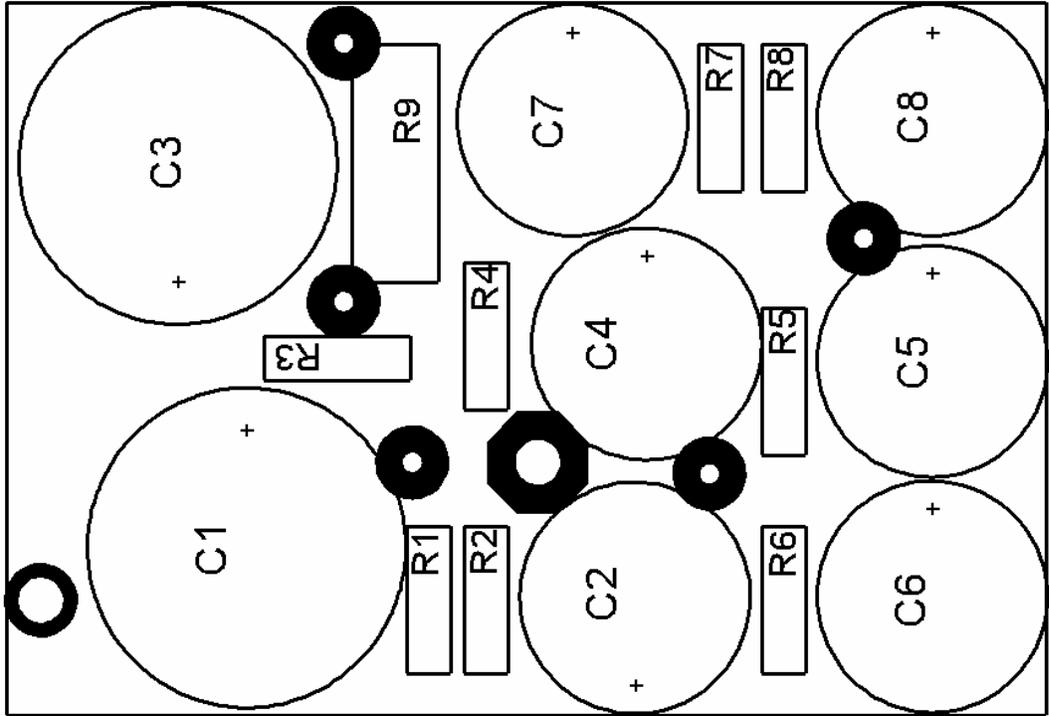
7. Feed the Twisted pair of Blue & Green wires down the length of the amplifier along the Original Dynaco 5 pin terminal strip (holding the bias supply components) towards the Dynaco Driver PC Board (PC-4).
  - a. Connect the GREEN Wire to Terminal “6” on the Dynaco PC-4 printed circuit board.
  - b. Connect the BLUE wire to Terminal “8” of the Dynaco PC-4 printed circuit board.
8. Locate the RED wire from the PC-M3U board labeled “1”. Solder it to terminal “1” of the 4 pin terminal strip (just installed). See Figure 2. To this same terminal (“1”) connect a short piece of wire to pin 8 of the GZ34 rectifier tube. Finally connect the choke lead labeled “1” to this same terminal.
9. Locate the WHITE wire from the PC-M3U board labeled “2”. Solder it to terminal “3” of the 4 pin terminal strip (just installed). See Figure 2. To this same terminal (“3”) the remaining choke lead (should be labeled “2”). Finally connect the RED lead from the Output Transformer to this same terminal.
10. Locate the BLACK wire from the PC-M3U board labeled “GND”. Solder it to the Ground Terminal of the Original Dynaco 5 Pin terminal strip. This will be the same terminal where the power transformer RED/YELLOW lead is connected.

Once completed, inspect each connection again and carefully look for signs of melted insulation near adjacent wires.

## D . Final Checkout & Initial Power Application

1. Replace the power fuse (3A Slo-Blo) with a 1A AGC (quick trip). Install the driver tube (7199) and the rectifier tube (GZ-34). The output tubes should not be in place for this test.
2. Connect a voltmeter to pin 8 of the rectifier tube. The negative lead (Black) should be connected to the amplifier chassis. The positive lead (Red) should be connected to pin 8 of the rectifier tube. Set the voltmeter to measure 500 Volts DC.
3. Plug in and apply power to the amplifier. The voltage reading should be approximately 475 to 575 VDC. If you are using a tube rectifier, this reading should appear after approximately 30 seconds – if you are using the solid state rectification, it should appear immediately.
4. Measure the voltage at terminal pin 8 of the Dynaco PC driver board. It should be approximately 445 VDC. This may vary but should be about 50 volts less than the voltage measurement in step 3.
5. Measure the voltage at terminal pin 6 of the Dynaco PC driver board. It should be approximately 380 VDC. This may vary but should be about 100 volts less than the voltage measurement in step 3. Power down and wait 15 minutes.
6. Place a RCA shorting plug into the signal input of your Mark 4. Install the two output tubes. Replace the original 3A fuse. Rotate the original Bias Potentiometer fully counterclockwise. Connect your DC Voltmeter to monitor the current thru the output tubes by measuring the voltage across the 13.5 ohm resistor located at pins 1 & 8 of the output tubes - connect the negative lead (Black) to the chassis and connect the Positive lead (Red) to the junction of the 13.5 ohm resistor and the Output Tube pins 1 & 8. Monitor the voltage as the tubes reach operating temperature. If the voltage begins to exceed 2.5 volts quickly remove power. Otherwise adjust the Bias pot to obtain 1.56 volts. Remove power.
7. Replace the cover and enjoy.

**Figure 1 PC-M4U  
 Component Placement**



**Figure 2 CAE PC-M4U  
 MK-4 QUad Cap Upgrade Module**

**Wiring Diagram  
 Bottom of Chassis View**

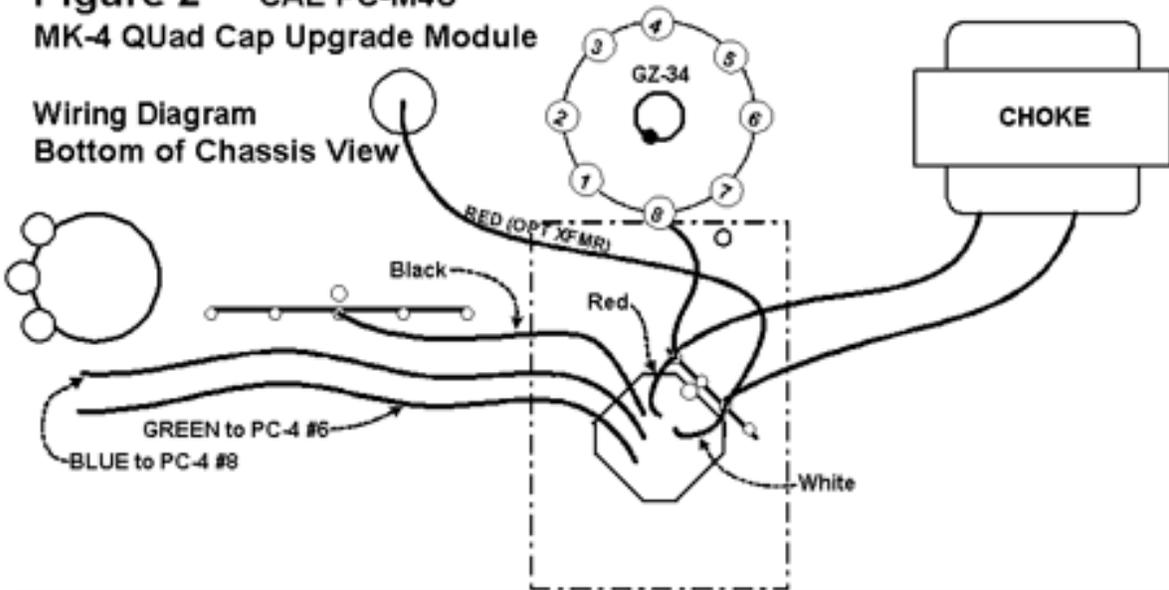
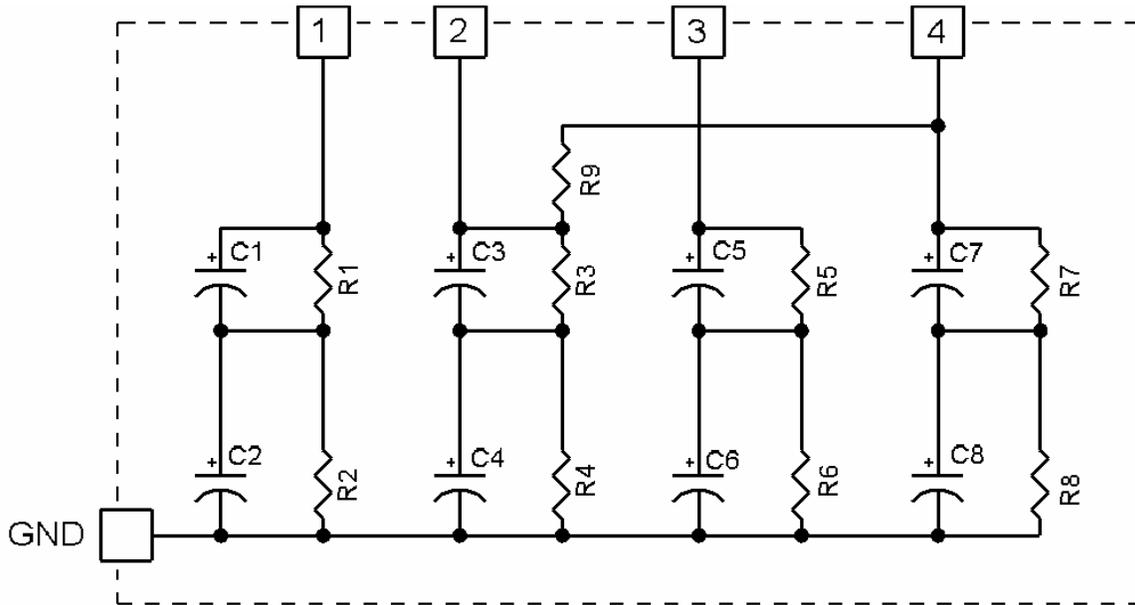


Figure 3 – M4U Schematic Diagram



## CAE QUAD Cap Module

3-03 R1

Mark 4 QUAD Capacitor & Bias Supply Module, CAE# ASM-M4U

PAGE 1

DESIG	DESCRIPTION	QNTY	PART NUMBER	VAL / VOLT
C2, C4, C6, C8	CAPACITOR, ELECTROLYTIC (RADIAL)	4	MSR#140-XRL-250V100	100uF/250VDC
C1, C3	CAPACITOR, ELECTROLYTIC (RADIAL)	2	MSR#140-XRL-350V100	100uF/350VDC
C5, C7	CAPACITOR, ELECTROLYTIC (RADIAL)	2	MSR#140-XRL-350V47	47uF/350VDC
R1, R3, R5, R7	RESISTOR, CARBON FILM	4	MSR#29SJ500-330K	330K, 1/2W
R2, R4, R6, R8	RESISTOR, CARBON FILM	4	MSR#29SJ500-220K	220K, 1/2 W
R9	RESISTOR, METAL OXIDE	1	DK#P6.8KW-3BK-ND	6.8K, 3W
X1	PRINTED CIRCUIT BOARD	1	CAE# PC-M4U	
X3	PC BOARD STANDOFFS, THREADED	2	CAE# 512-5011	

NOTES:

CAE# - Curcio Audio Part Number

DK# - DigiKey Part Number

MSR# - Mouser Part Number



# **Dynaco MK4 Electrolytic Cap Upgrade Assembly, Installation, and Adjustment Manual**

PC-M4U Rev 1a 3/03