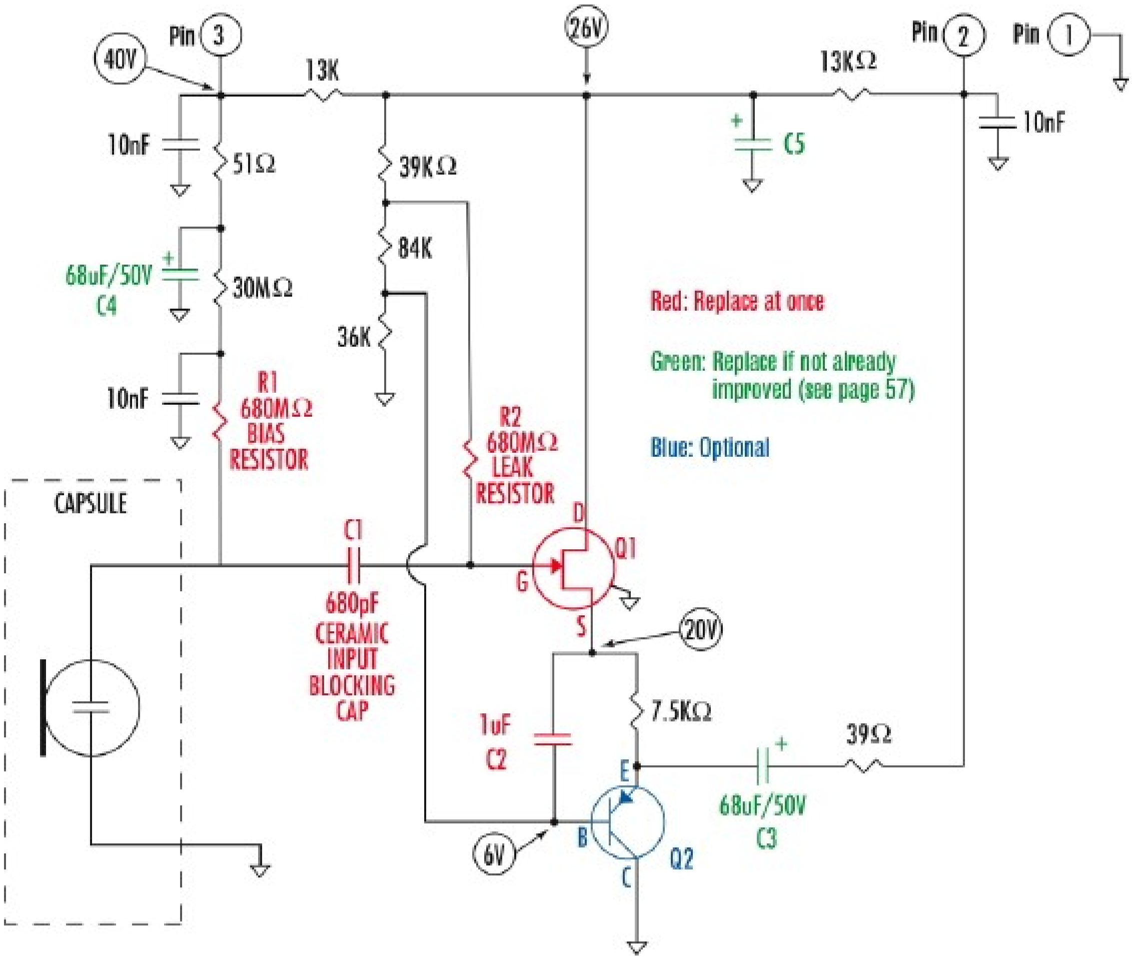
Oktava MC-012 Upgrades : A very good mic can be made better, By Scott Dorsey

Following publication of my article on upgrades for the Shanghai microphones ('Making Mics Better,' January 2002), a lot of people have been asking me about possible upgrades for the Oktava 012 microphones (MC012 and MK012). Since I work on a lot on these, I'd like to just generally talk about these microphones and the possible modifications for them

Whereas with the Shanghai mics I decided to throw out everything and replace all of the electronics, with the Oktavas the electronics are actually very well designed and pretty ingenious, and there really aren't too many substantial topology changes that need to be made. The design is quite simple, overall, but there are some things that can be cleaned up.

But because this is the case, it is going to take a good bit more skill than the Shanghai mic project, because we'll be working on existing boards that are fairly delicate rather than building everything from the bottom up. Also, there will be a number of decisions required about what you want to leave stock and what you want to replace. For that reason it's worth the time to take a very quick trip through the actual circuit and see what each section is doing. Refer to the schematic among the accompanying images and follow along.



Voltage from pin 3 goes through a set of three RC circuits to filter it out into a clean 48V line, which goes to a 680M resistor that applies a polarization voltage to the capsule. As the capsule charges, the voltage across it changes slightly because it takes some time to charge it up (that time being set by the capacitance of the capsule and the resistance of that 680M resistor).

We read that voltage through the 680 pF ceramic "input blocking" capacitor, into the gate of the FET, Q1. This FET also has a 680M resistor that keeps the gate somewhere around ground potential when there's no signal coming in through that ceramic capacitor. Remember: that cap only allows signal through, not the DC, and the resistor keeps the FET so that the gate is at about ground potential when there is no signal. This is how we can apply a high bias to the capsule and isolate it from the FET follower that doesn't want DC on the input.

The FET is powered by power coming from both pins 2 and 3 through two 13K resistors. Most of the phantom current goes through there (the actual amount of current that goes through R1 to polarize the capsule is miniscule, so the load that the circuit produces is well-balanced between pins 2 and 3).

When the FET turns on, current flows through it, which goes through the 1 uF capacitor C2 into the base of Q2. This causes Q2 to turn on, and signal flows through the 68 uF capacitor (C3) and 39 ohm resistor onto pin 2. Pin

3 doesn't have anything driving it at all, but it does have C4 sitting there to shunt any signal on it to ground. As a result, the output is effectively unbalanced, which is a possible problem when driving long cables but will be generally acceptable.

There are three capacitors directly in the signal path, none of them of particularly high quality, plus that second 68 uF capacitor (C4) becomes part of the signal path when the microphone is used with a transformer-balanced preamplifier—since the transformer primary is basically in series with pins 2 and 3.

The topology is a bit strange and it's nothing like the Schoeps circuit that I discussed in an earlier article, but it also uses one fewer transistor and therefore fits into a smaller circuit board and is cheaper to manufacture in quantity.

Some words of warning

Now, before actually working on these mics, I want to make a couple of comments. First of all, some of these mics come with a thin coating of urethane conformal coating over all of the parts, in order to seal out moisture, and this can be a bit alarming the first time you try soldering to it because it will burn off. Don't worry about that, although if it worries you a lot you can remove it with flux-remover. It will leave an ugly white stain but that won't hurt anything.

Also you need to know these boards are very delicate. Overheating them will lift the pads very easily and wreck the board. You need to use a solder sucker and a very careful hand on them. If you don't have some experience working on delicate boards, you might want to find a friend who does to help you go over this.

If you do lift a pad, you can usually take a little piece of wire and make a quick and dirty substitute. But I have seen a lot of problems on these mics caused by tiny breaks in the board traces that become very difficult to find. Many of them are intermittent and all you can do is go over every joint and make sure it's secure.

To work!

The first thing we can do to dramatically improve the sound of this mic is to replace those two 680M leak and bias resistors with 1G ohm resistors, or 2G resistors (made from two 1G resistors in series). This is especially important since weird substitutions will often be found in some of the Oktava mics that are not purchased through a dealer who specifically selects them. It seems sometimes the folks on the Oktava production line will substitute all kinds of weird things if the 680M resistors are not available.

Changing these out for 2G resistors dramatically improves both the top end and the bottom end, and the frequency response plot of the mic is substantially improved. The top end becomes much more airy and less muffled.

Another problem on the front end is C1, that 680 pF ceramic capacitor. It's not a very good-quality capacitor, and in fact it's mildly piezoelectric. Tapping on it causes very audible sounds in the output. Replace it!

One substantially better possibility is to use one of the Panasonic COG ceramic types, usually an 820 pF value. The COG dielectric is much less sensitive to vibration and has lower distortion. It's also possible to use silver mica or glass types here if you have a source for them. C1 is the capacitor that is on the back side of the board between the two teflon posts. The photograph (Figure 2) shows an AVX glass capacitor being used, so yours will look a little different.

You will find a huge improvement from replacing the FET with a low-noise type. I recommend the 2SK170BL types (and make sure you get the BL). See the sidebar for a couple of notes on this transistor. The 2SK170BL has three pins, unlike the original whic h has a fourth pin tied to ground in order to shield the case, and the pinout is a little different because it is in a different type of case. Let the photographs be your guide to how you should install it.

It is usually easier to remove R1 and R2, remove the FET, then solder the PC board sides of R1 and R2 down, then the two FET leads that go to the PC board, and finally the FET and resistor leads that go to the raised teflon posts. After doing this, carefully clean the PC board and put the mic together and listen to it. You want to check things out every step of the way to make sure everything works properly, if only because it is so easy to damage the boards.

If you really want to, you can replace Q2 with a 2N5087 type. This isn't a huge improvement, and it's not really worth the trouble unless the original has failed. Q2 is operating as a follower, providing just current gain and not voltage gain, so it's not really very critical.

Next to go are three of the tantalum capacitors. C2 must go. In a perfect world, we would put a film capacitor here since it is directly in the signal path, but even the smallest 1 uF capacitor is too large to fit here. Due to this, and because the input impedance of Q2 is rather low, a larger value would be a good idea. I recommend using a 10 uF 25V type from Panasonic. If possible, it helps to put a small film capacitor of around 0.1 uF across this as a bypass, but to be honest just replacing it is a big step up.

The most physically difficult part is replacing C3 and C4, which are the cylindrical wet-slug tantalum caps, one directly in the signal path, and the other for bypassing the unused output leg to ground. Replacing these is not as big a deal as replacing C2 in terms of the sound improvement you'll hear.

The BCC capacitors from Digi-Key that I list in the parts list are much better than the originals, and they physically fit the board. There are much better-quality capacitors available, it's true, but getting some that actually fit into those locations is a serious problem. I can't even recommend film bypass caps across these because there really isn't any space to even put such bypass caps on the board.

Occasionally you will even find some of the mics that have the BCC or Philips capacitors already in place; some of the newer production ones seem to be doing this. If you see that, don't bother replacing them.

You will also see another unlabeled capacitor soldered onto the rear of the PC board. This is C5. On most newer mics you will find a Philips or BCC part here. On an old mic you can easily replace it with a better one. I will guarantee that the parts from Digi-Key listed in the parts list will fit inside the case, and I will also guarantee that you will have a very difficult time finding any others that will fit.

I cannot stress enough how important it is to keep the PC board immaculately clean, especially around the FET. Any tiny little bit of flux buildup will cause noise problems. If you can use a conformal coating over the board after cleaning, it will prevent problems in humid environments, but you can live with the urethane conformal coat removed (and in fact some of them are shipped from the factory with no conformal coat).

Results you can hear

All these changes will uniformly improve the sound quality of the Oktava mics and, while they aren't for the fainthearted, they are entirely possible to do on a small bench with a pencil iron and a hand solder removal tool if you have a careful hand. If you do the work carefully and keep the board clean, you will be very impressed by the sonic improvement.

This is most certainly not a good first project, but for someone with some experience working on delicate boards it can be well worth the small investment in time and parts.

Scott Dorsey (dorsey@recording mag.com) has helped hundreds of readers upgrade their mics with his January 2002 article, and is fascinated to find out how many people will give his latest brainchild a try.

SUBSTITUTED PARTS

Schematic # / Description / Digi-Key Part Number

R1, R2 2x 1000M (1G) resistor MOX200J-1000MEG-ND C6 1x 820 pF COG ceramic capacitor P4860-ND C2 1x 10 uF 25V tantalum capacitor P2049-ND C3, C4 2x 68 uF 63V electrolytic capacitor 4073PHCT-ND C5 1x 47 uF 40V electrolytic capacitor 4047PHCT-ND

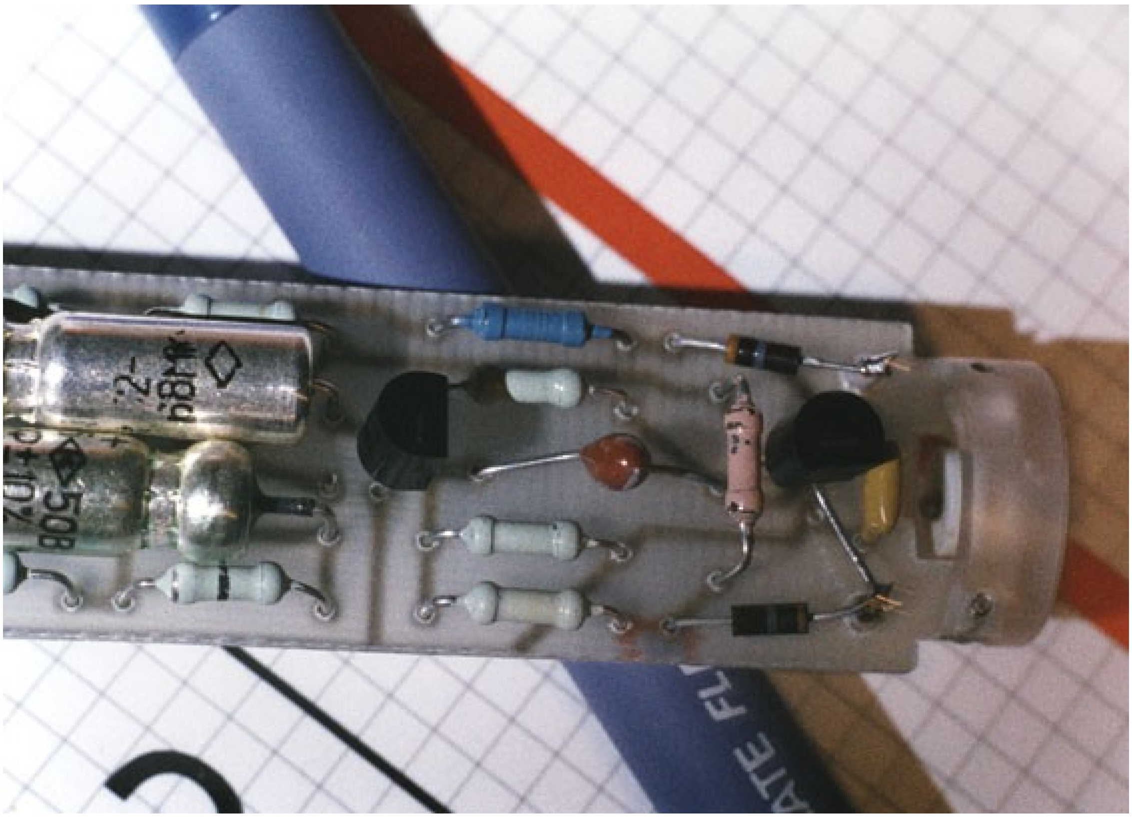
Note that these particular parts have been selected for physical size as well and that other substitutions will probably not fit.

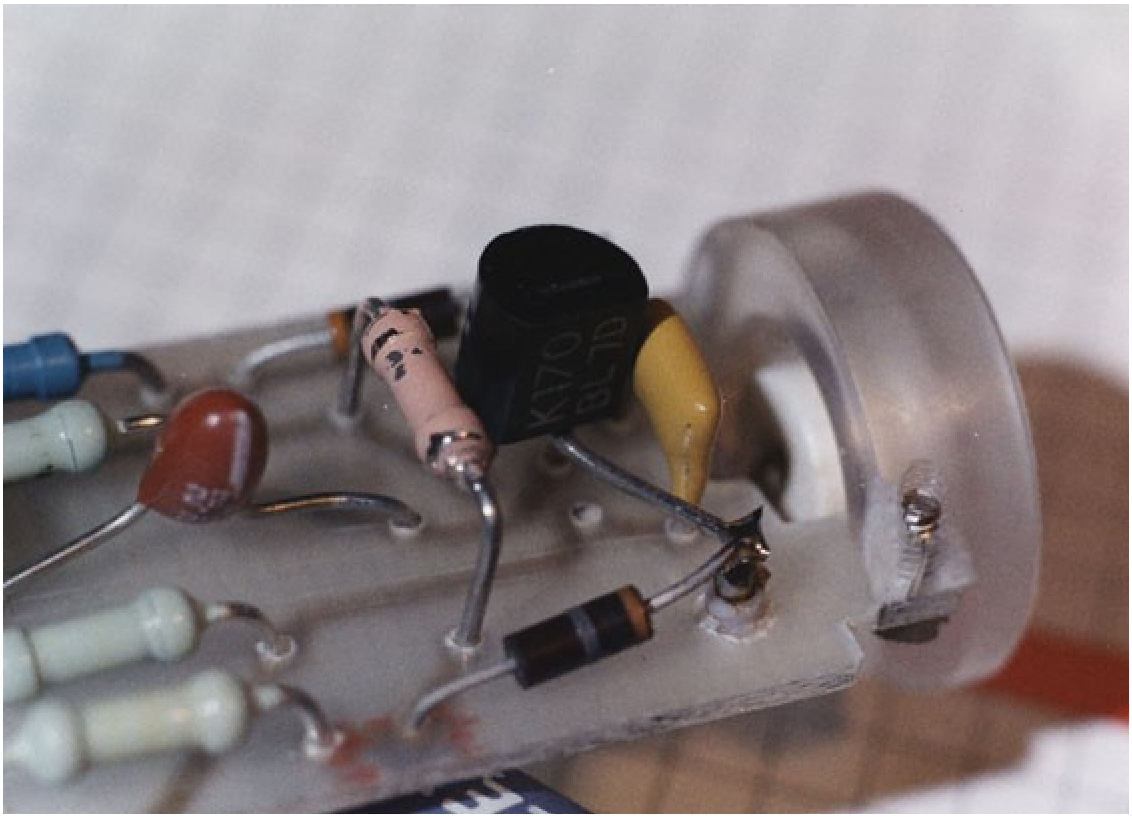
Q1 2SK170BL FET (see below) Q2 1x 2N5087 transistors 2N5087-ND You might want... Chemtronics flux remover pen CW9100 Paladin solder sucker PAL1700-ND

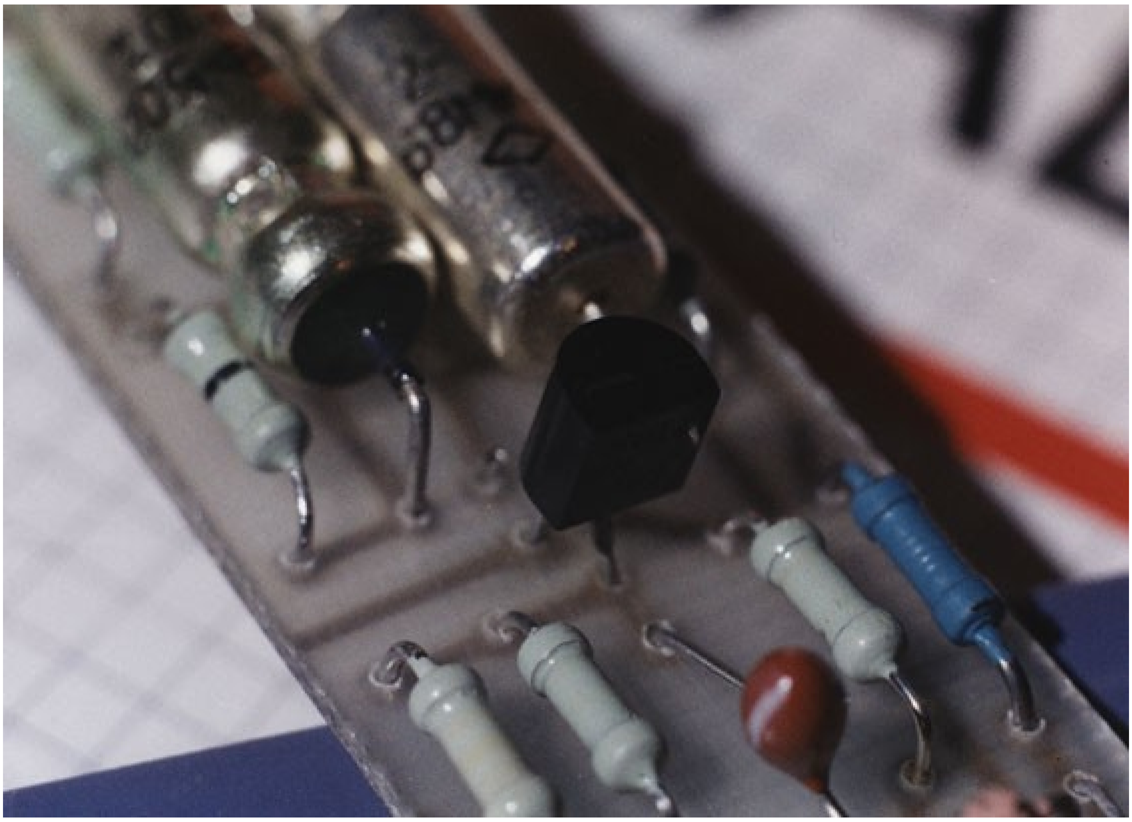
These parts are available in the US from Digi-Key, at 800/DIGIKEY or www.digikey.com.

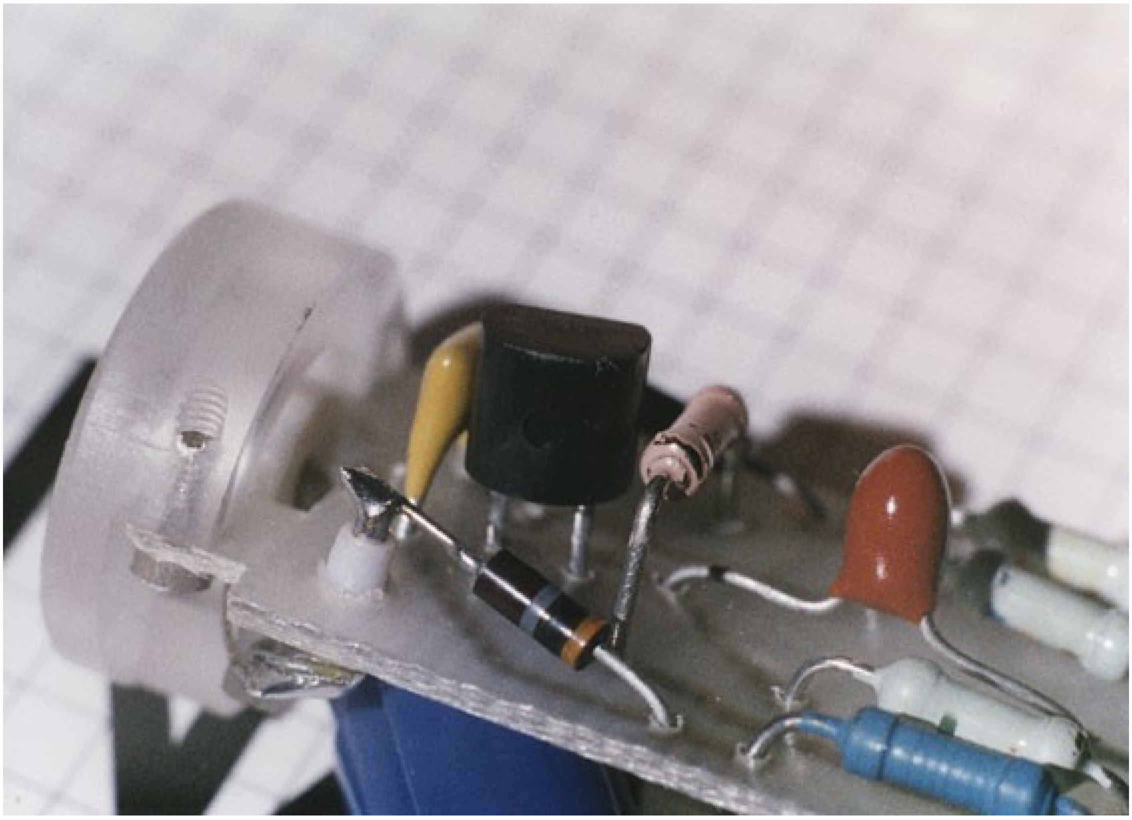
The specified Toshiba 2SK170BL FET is sometimes available from B+D Enterprises (800/458-6053 or www.bdent.com) or MCM Electronics (800/543-4330 or www.mcmelectronics.com). They both have a minimum order and do not always stock the 2SK170BL (and no, other 2SK170 variants won't work).

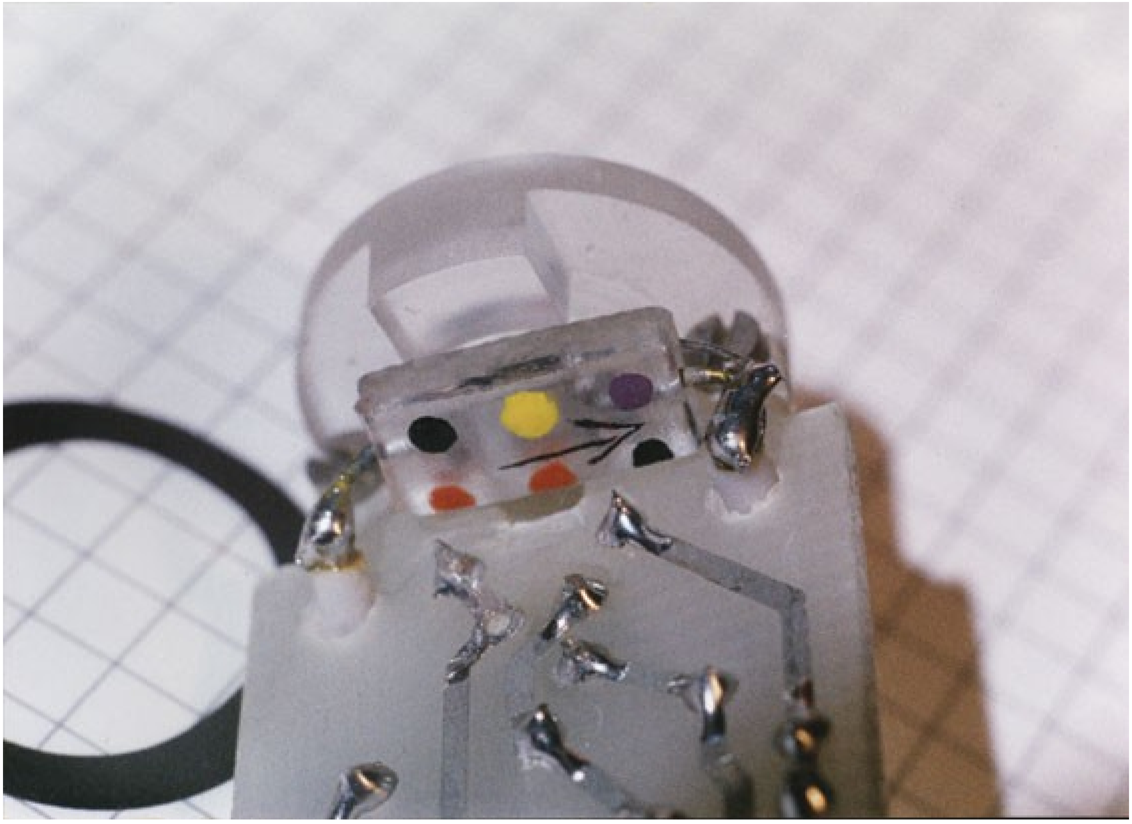
You should know that this is considerably more than the going rate and the parts I am selling aren't any better than anyone else's. I don't want to be in the business of selling parts, but I understand that some of these are difficult to get. So I am doing this as a service if you have no other alternative.—SD

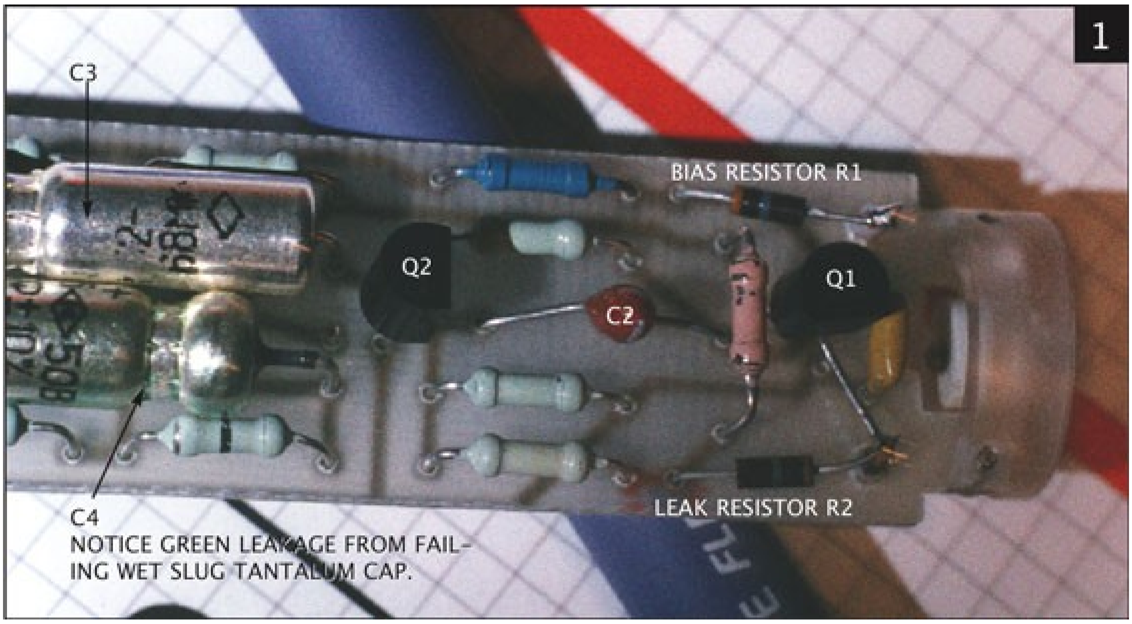


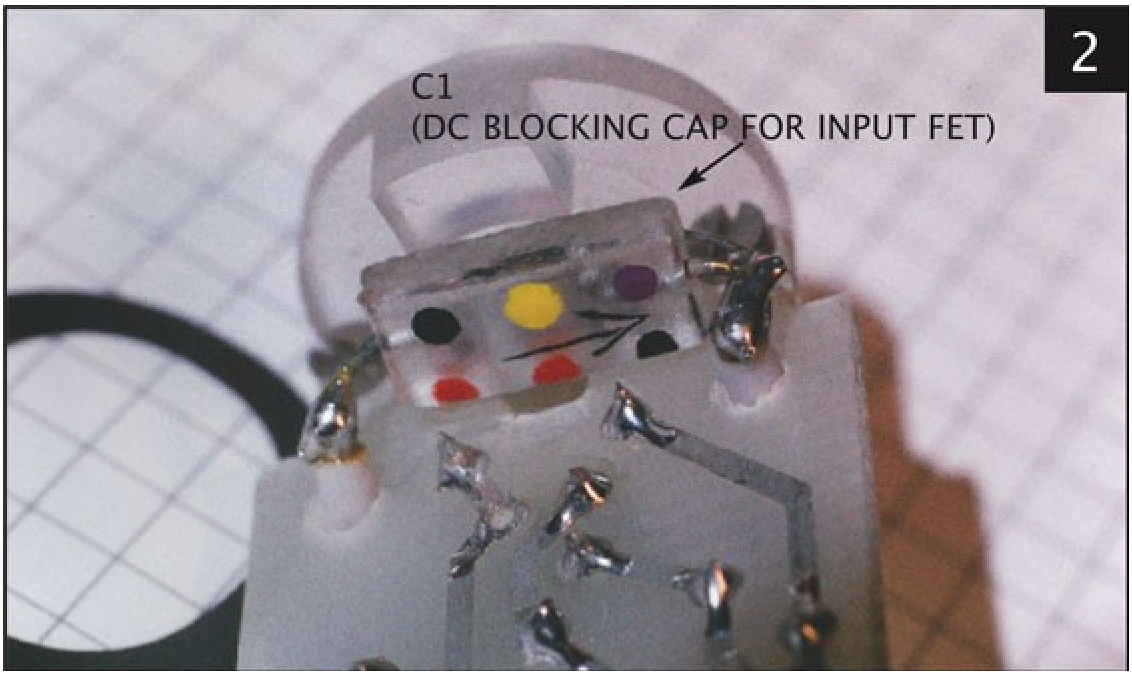

K170

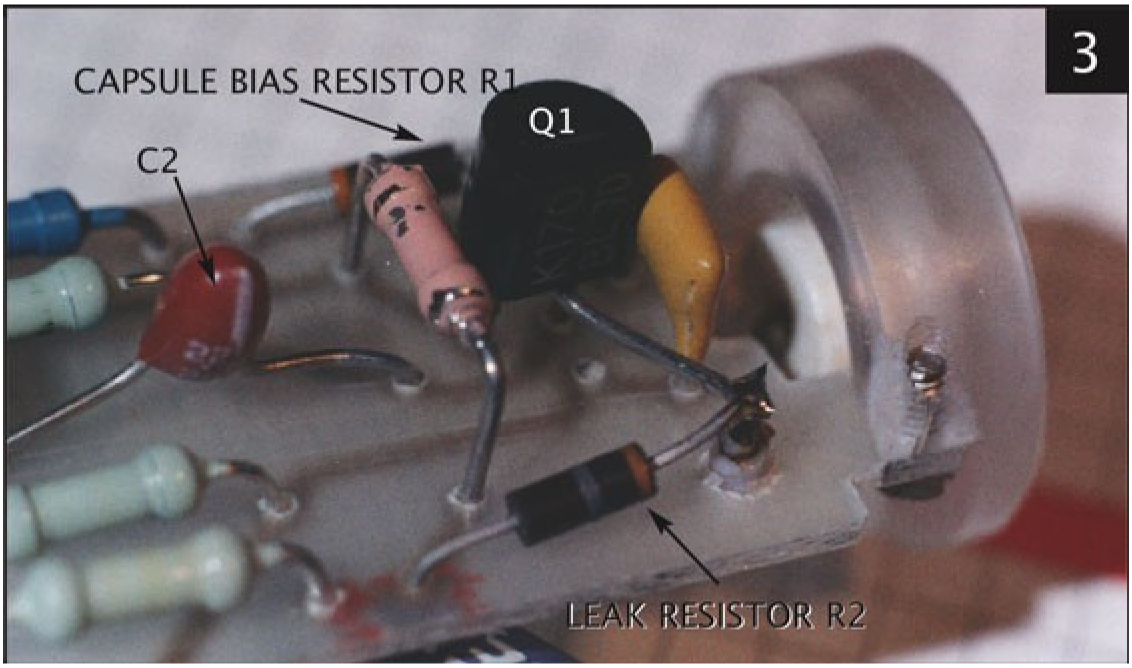


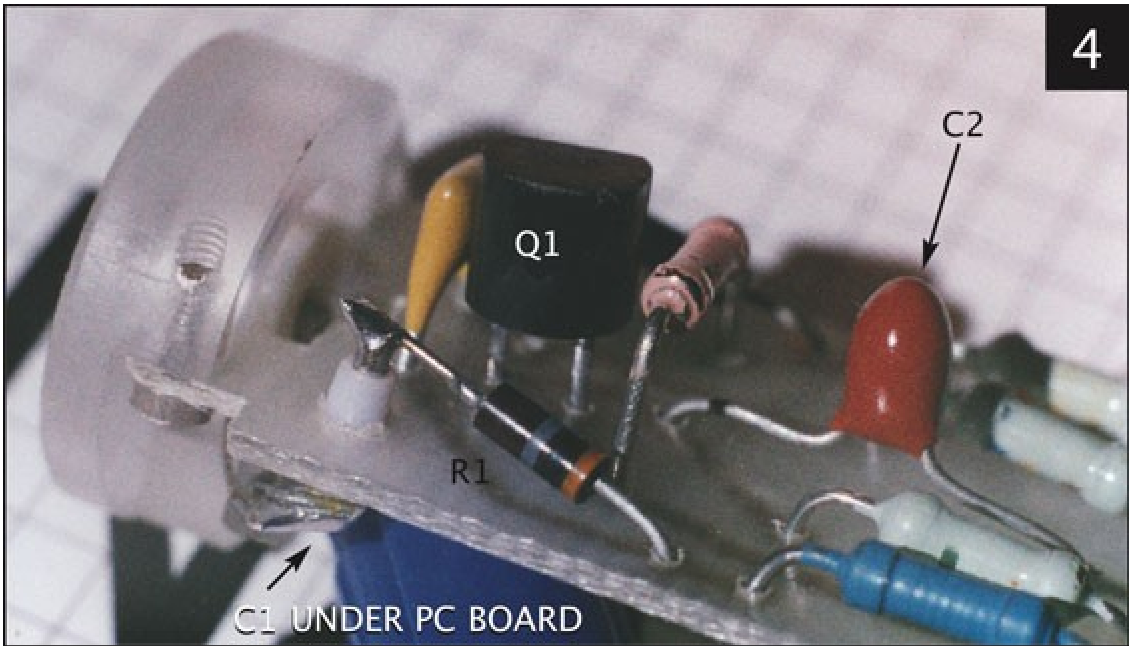


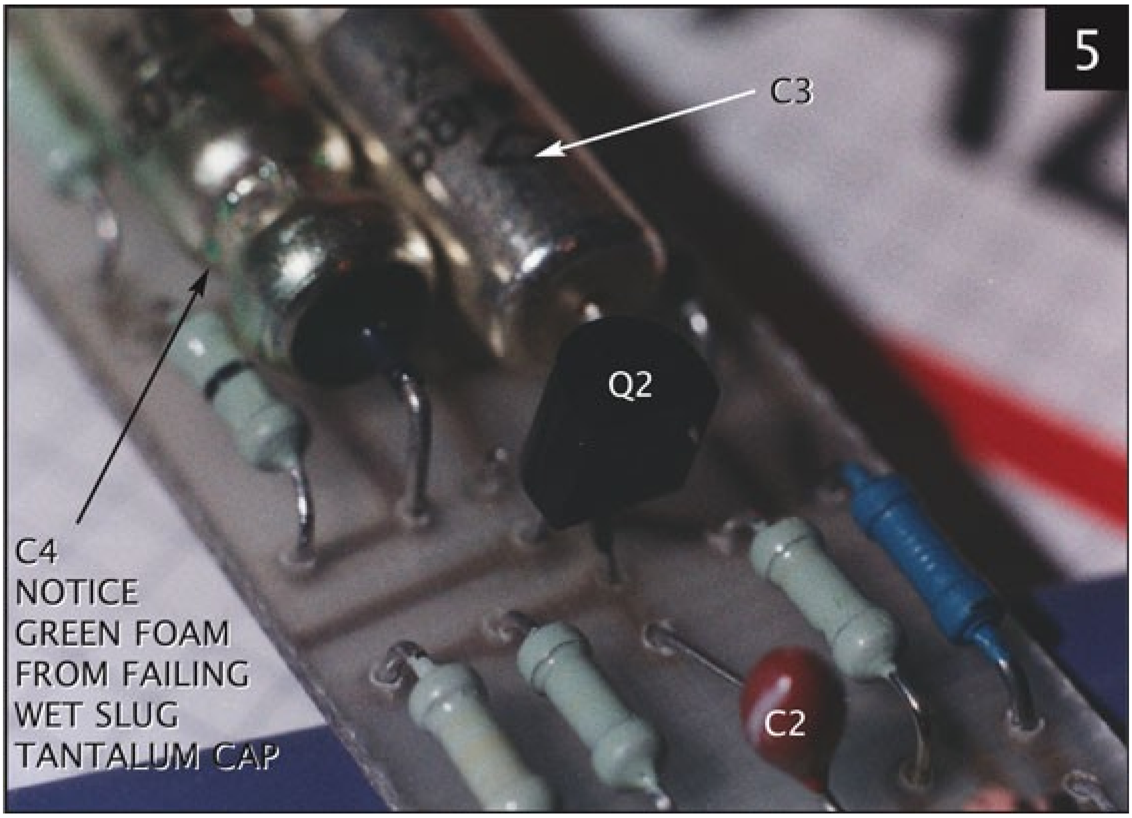



1
C3
BIAS RESISTOR R1
Q2
Q1
C2
LEAK RESISTOR R2
C4
NOTICE GREEN LEAKAGE FROM FAIL-
ING WET SLUG TANTALUM CAP.


2
C1
(DC BLOCKING CAP FOR INPUT FET)


3
CAPSULE BIAS RESISTOR R1
C2
Q1
LEAK RESISTOR R2


4
C2
Q1
R1
C1 UNDER PC BOARD


5
C3
Q2
C4
NOTICE
GREEN FOAM
FROM FAILING
WET SLUG
TANTALUM CAP
C2