

## Step Attenuator Repair



Lab – Dog !



### **Manual Step attenuator**

**Picture showing the location of the holding nuts for the nameplate, the nameplate has to be removed to gain access to the socket screws that hold the RF Cover in place !**



**The Screws holding the side panel in place are covered by this label, this label needs to be removed since removal of the side panel is essential in order to be able to remove the other covers !**



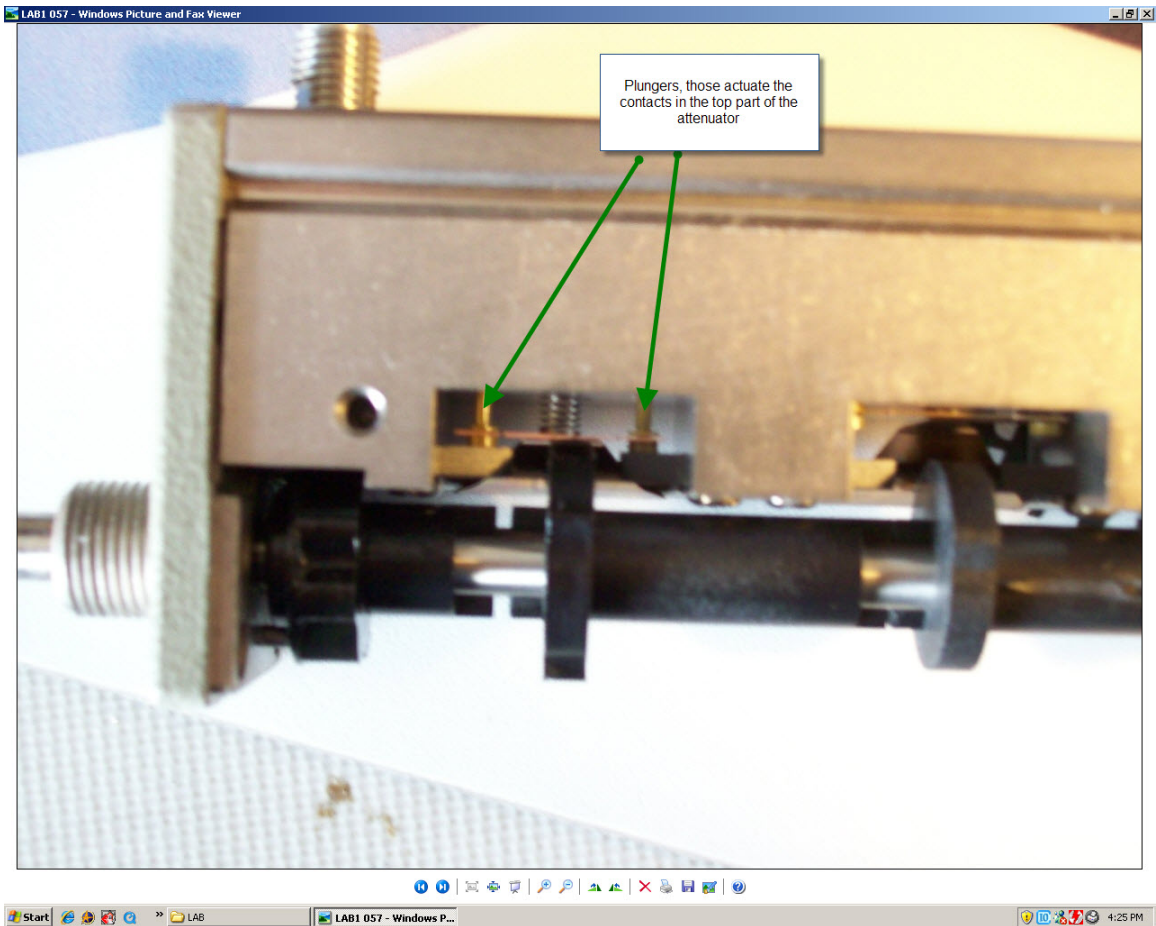
**The 2 5/16 nuts have been removed and the nameplate can now be pryd off using a utility knife !**



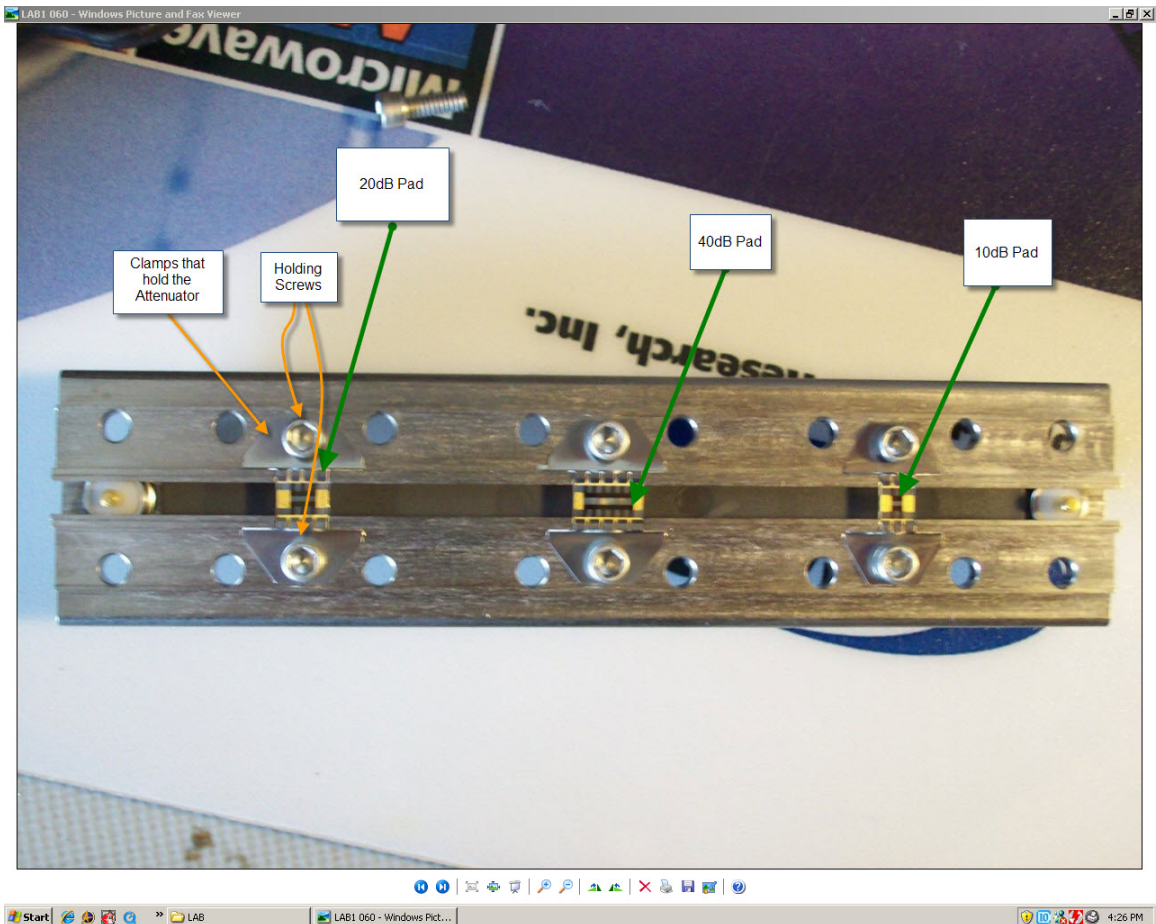
The screws holding the RF Cover are now visible and can be removed, please note that the screws above and below the SMA connectors usually are shorter in length to avoid interference with the screws holding the side panels !



**Side view showing the RF Cover and camshaft assembly, the camshaft wears out over time which causes failures, the RF cover holds the attenuators.**



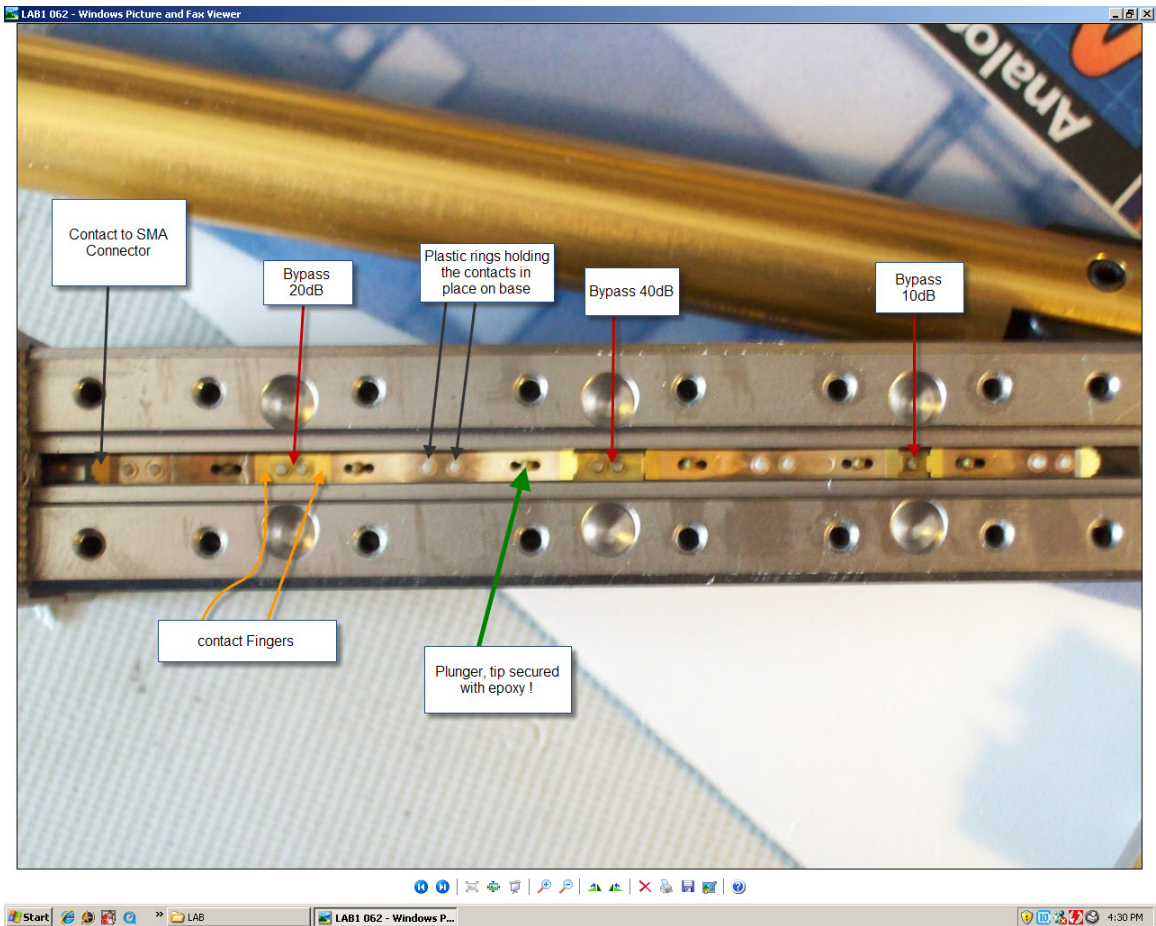
**The plungers actuate the contacts, manual and programmable step attenuators use different type of plungers !**



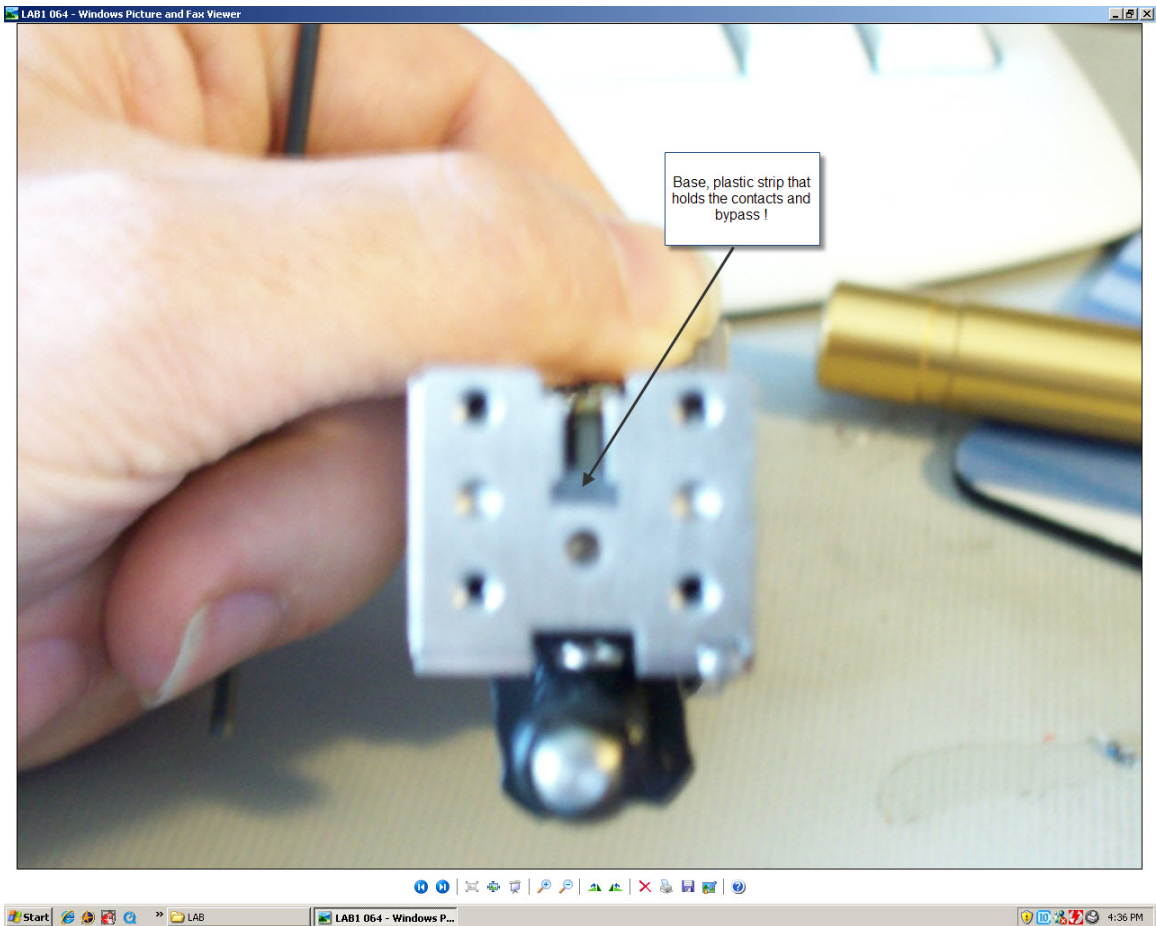
**The RF cover, you can see the pads as well as the holding screws and clamps that hold the attenuators in place, the attenuator pads can be checked with a DVM and should measure about 50ohms to ground from the gold pads, this however does not apply to the 10Db pad which normally measures higher !**

**Also inspect the pads for cracks which is a common failure mode.**

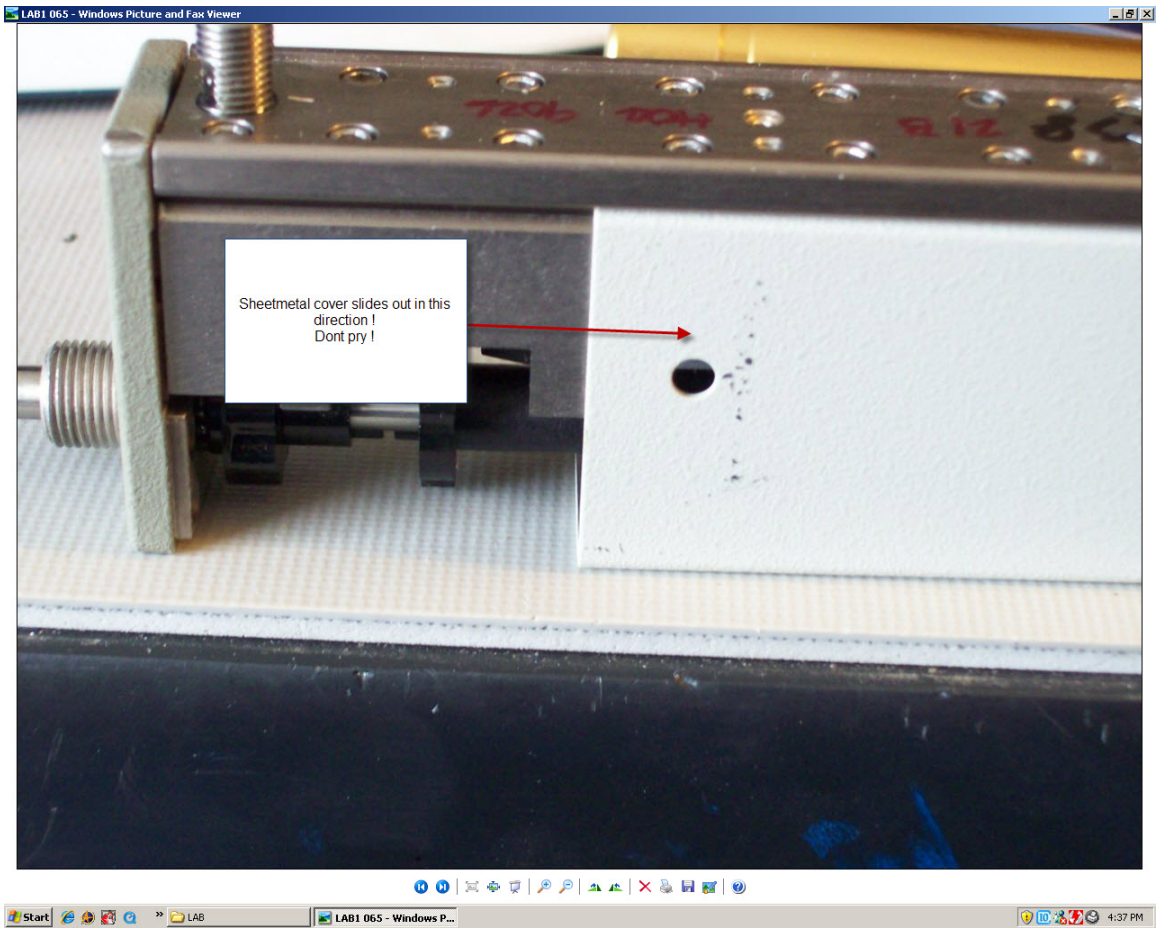




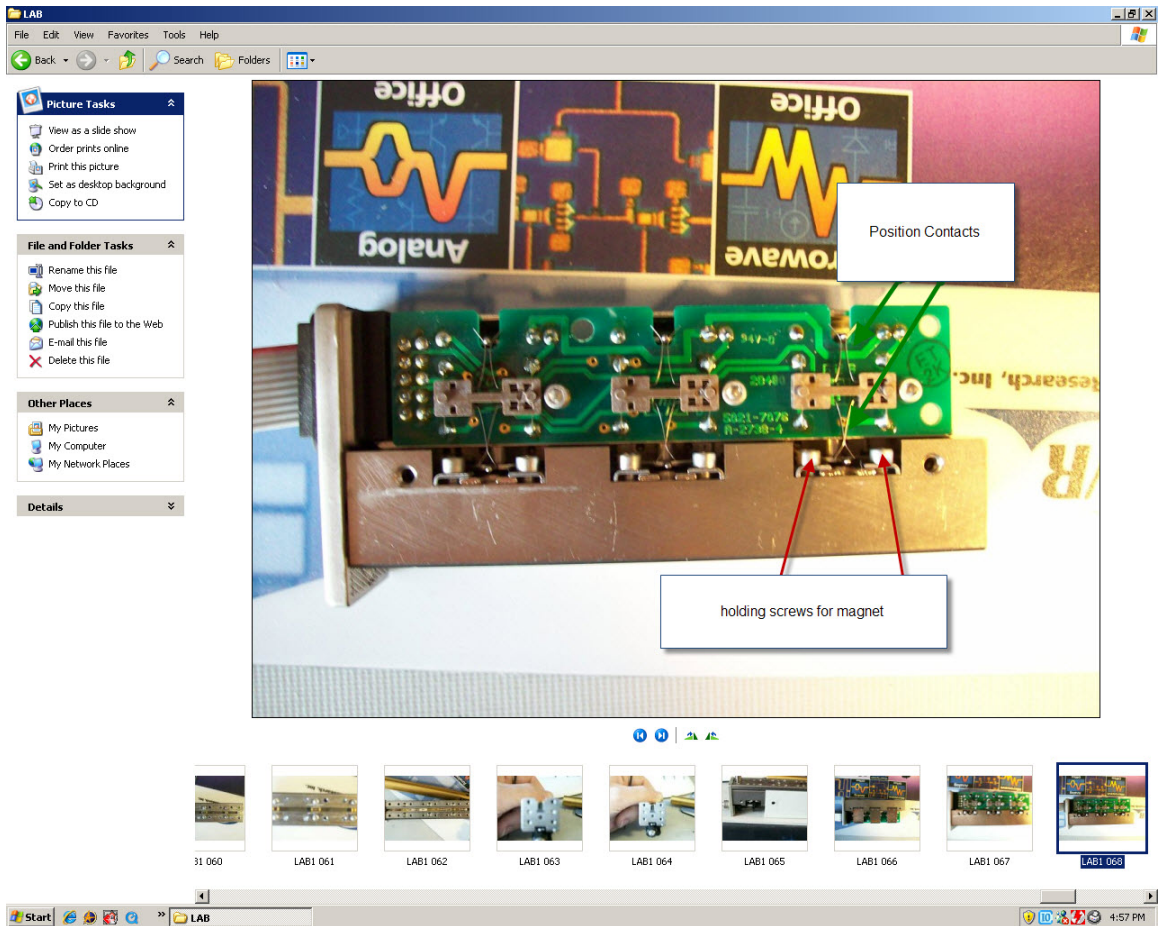
**This picture shows the contacts and bypass for each Attenuator cell, bypass and contacts are mounted on a base made out of plastic which can be replaced, also visible here is the tip of the plunger which is secured with epoxy**



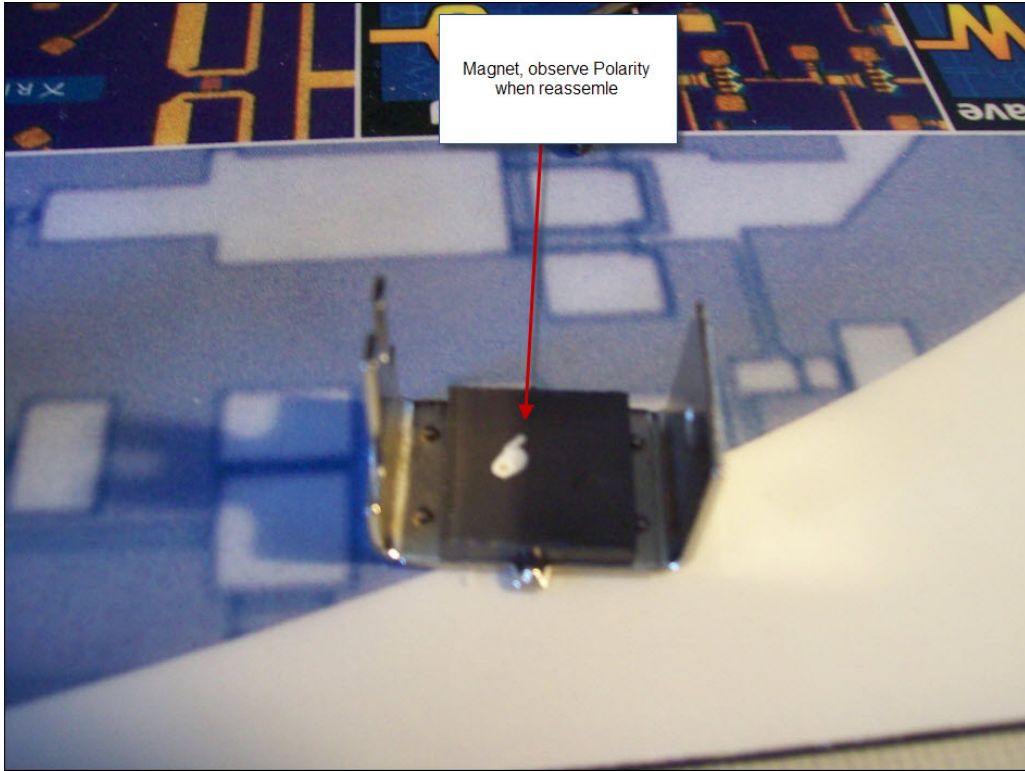
**Side view shows the base, once all plungers have been removed the base slides out to the side of the attenuator allowing access to the bypass and contacts.**



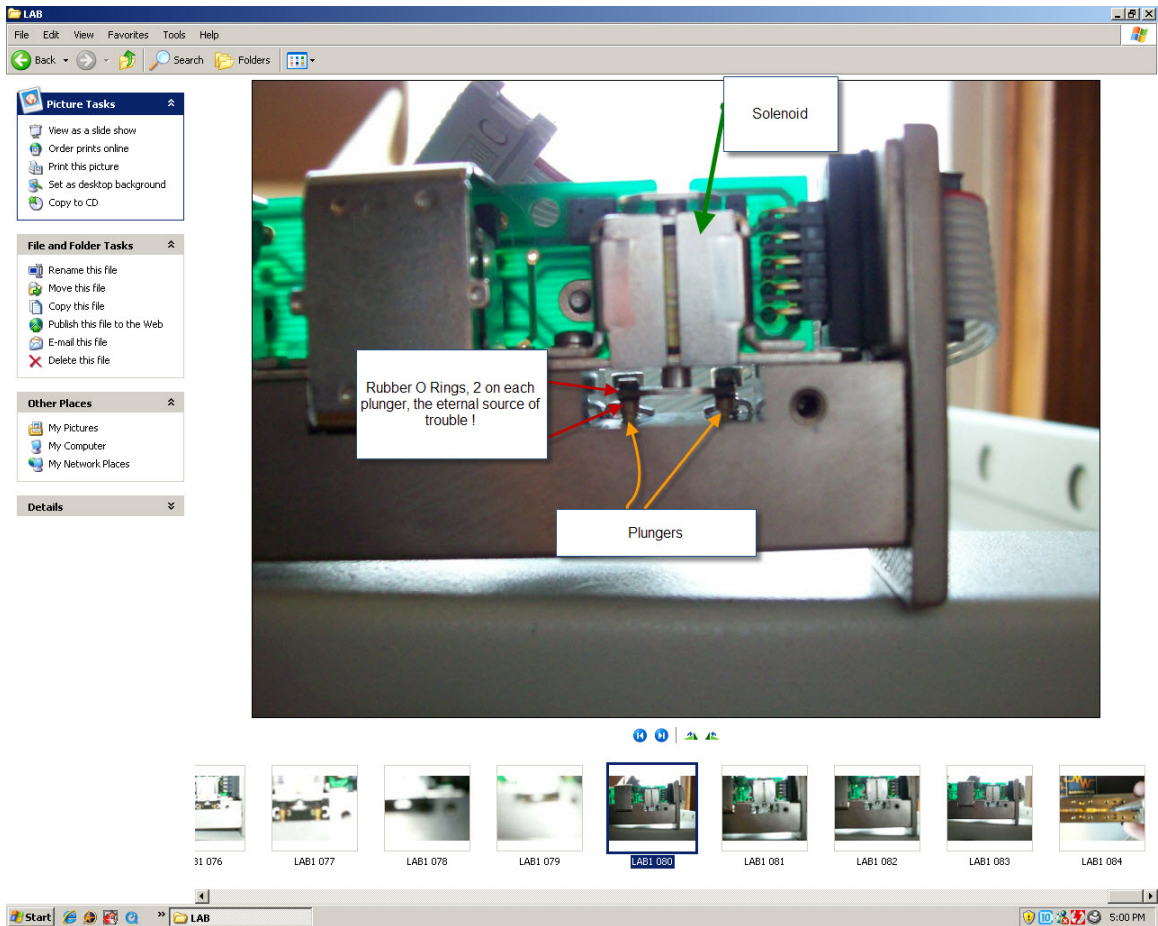
**The cover slides out to the side, this is the proper way to do it folks !**



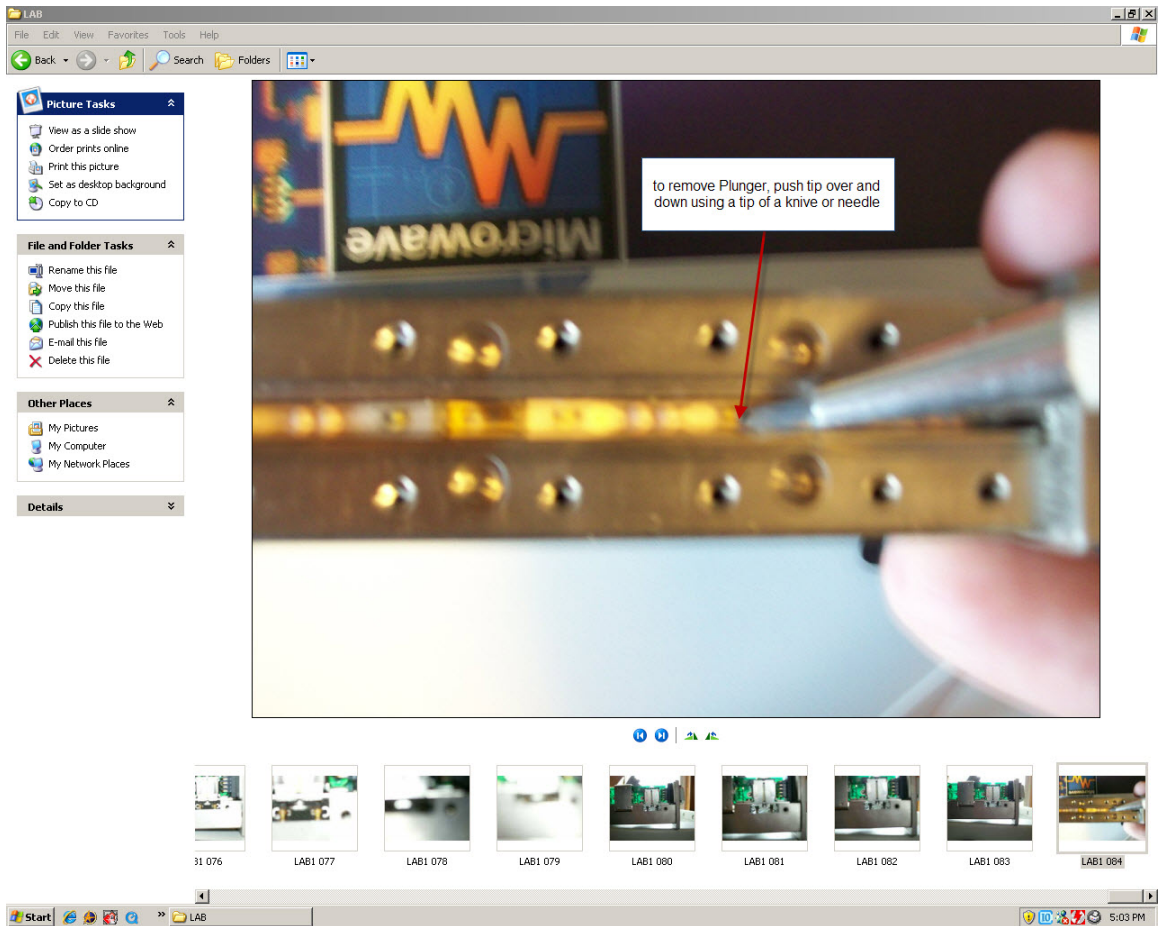
**A programmable attenuator, visible are the holding screws for the magnet as well as the contacts that turn the solenoid off once the switching has been completed, the little prongs that actuate the contacts are supposed to have a plastic sleeve over them, pay attention to this when you open a attenuator as missing sleeves are a common failure mode**



**The magnet removed, please note the polarity of the magnet during dis and reassembly**



**This picture shows the solenoid as well as the plungers , the o rings are not clearly visible in this picture but there are 2 on each plunger, missing or deteriorated O-Rings account for 75% of all step attenuator failures !**



**Plungers can be removed by using a needle or pointy knife , use it to push the tip of the plunger over and down until its free from the contact, during re assembly you will use it to push the tip over to align it with the mounting hole in the contact.**

## **Attenuator Repair For HP/Agilent Microwave Equipment**

*From the HP\_Agilent\_Equipment Mailing List on Yahoo:*

---

Since Agilent continuously ups the spare part prices and discontinues parts it has become more and more important to go past normal repair practices.

Step Attenuators for example can be repaired without any special tools or cleanroom environment ! Lets take a look at the failure modes first, there are a few:

1. Blown pads: Usually common with spectrum analyzers if a level past the damage level of the attenuator was applied
2. Cracked pads: Pad has developed a hairline crack due to mechanical stress !
3. Improper contact: The contact in between the attenuator and contact fingers is disturbed.
4. Stuck solenoid: Quite common if attenuator hasnt been used in awhile

After we remove the attenuator from the instrument the first step is to obtain the pinout and build us a little test bench consisting of a power meter and a signal generator, the good old 8481D or 8484A will do nicely, if you don't have a signal generator, use the 50MHz calibrator output of the 435 or 436 or similar model. Connect the cal output to the 30dB pad, connect the sensor and zero and calibrate meter, the meter will read -30dBm.

Disconnect the sensor from the attenuator and insert the Step Attenuator, set step attenuator to 0 dB, note the level on the power meter, now switch in the attenuator sections one by one, measure and note the level. 70dB attenuators are comprised of one each 10, 20 and 40dB pads while 110dB attenuators normally comprise of one each 10 and 20 dB pads and two 40dB pads!

Check every section individually, you should hear a click as you enable each section. If you find a bad section note the value it should have if all sections appear to be good repeat the test at a higher frequency using a signal generator. If everything appears to be OK at low frequency then most likely you have an attenuator that just needs cleaning.

Now let's take the attenuator apart, looking at the top you will see a nut on each SMA connector, remove this nut this will allow for you to remove the nameplate, under the plate you will see a wealth of Allen screws, remove those but note that the screws close to the SMA connector are shorter than the other ones.

Now look at the small sideplate, not the one with the ribbon cable but the other side - there are 4 small Allen screws, remove those and then remove the sideplate. Be careful not to lose the little wire mesh here ! now slide out the U shaped cover and remove the top side.

You now have two parts, one being the bottom side containing the solenoids and the other one being the top part containing the attenuator pads.



First lets inspect the pads, you can measure them with an ohm meter, they should measure in the vicinity of 50 ohms , except of the 10dB pad which can measure up to 70 ohms or more.

Inspect the pads visually, are there any burned or cracked pads? If all pads look OK and check out at DC, take a surgical swab and isopropyl alcohol and carefully clean the contact pads on the attenuators.

Next look at the contacts. Enable all solenoids and observe the position of the contact tongues, they should be slightly above the surface of the block. Carefully clean the contact tongues with alcohol, be careful not to bend them.

Next put the solenoids back into the 0 position and look at the top of the solenoids. You will see two little white plastic rods. Where those meet the solenoid you should see little rubber rings, there are 4 of those on each segment, usually over the years they go brittle and then disappear. With those rings gone the attenuator wont make contact anymore, you can buy the rings from watchmakers supply stores as they are being used for sprocket gaskets !

Now if your gaskets are there put the attenuator back together after you cleaned everything and it should work now.

If you have a broken or burned pad, don't stress over it. The pads are used in all HP attenuators so just find a similar attenuator on ebay and take the pad you need out of it, you can also buy pads from Agilent however be prepared to pay \$100-150 per piece

Lothar

## HP Attenuator Part Number Information

*From the HP\_Agilent\_Equipment Mailing List on Yahoo:*

---

Generally HP Sold Step attenuators under 2 part designations: 849x and 33321 or 33322x.

All 849x attenuators were sold as end product for bench use, the 3332x variants were sold as OEM models at a discounted price to instrument manufacturers and ATE integrators.

All 33321 and 33322 cross exactly to 849x models. Those attenuators were sold over the new equipment sales channels or authorized distributors. The attenuators had 24V coil voltage and a round Viking connector to be driven by the 11713A and similar Attenuator Switch Drivers.

The suffix letter was as follows:

- A Manual Step Attenuator 4GHz
- B Manual Step Attenuator 18GHz
- G Programmable 4GHz
- H Programmable 18GHz
- K Programmable 26GHz
- L Programmable 40/50GHz

The main numbers designate the range of attenuation:

- 33321 usually is a 70dB Step Attenuator
- 33322 usually is a 110dB Attenuator
- 8494 is 11dB
- 8495 is 70dB
- 8496 is 110dB
- 8497 is 90dB

Outside of those numbers there is a gammut of attenuators that have part numbers such as 33321-60049.

The absence of a suffix letter and the - xxxxx makes it a part # which means it was an attenuator that was used in a piece of Agilent test equipment so it can only be ordered via parts desk, those attenuators almost always have a ribbon cable assembly that either terminates in a 14pin dip connector or a 1 row header connector.

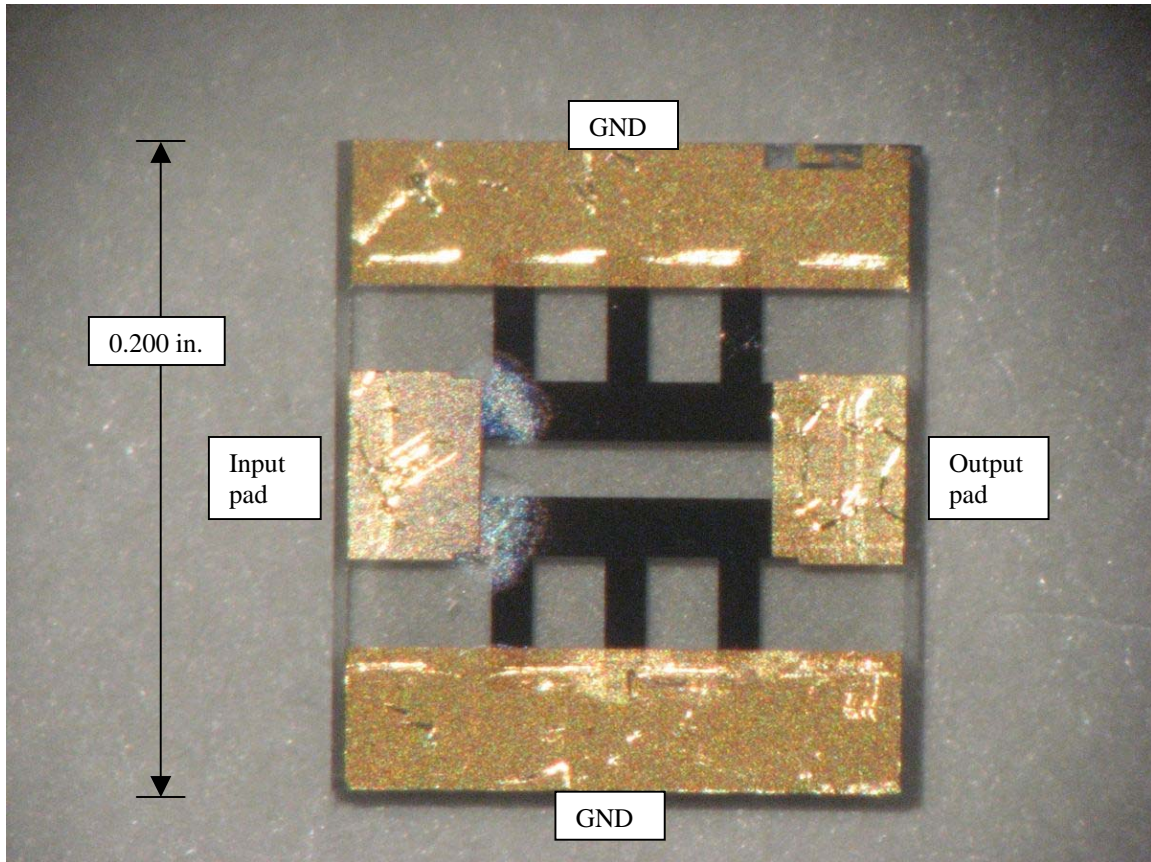
The attenuator can also have a 5086 or a prefix matching the instrument it was used in such as 08642-xxxxx or 08902- xxxxx. Specifications for such attenuators are really hard

to come by since they fall under Agilent proprietary information. Sometimes the attenuators had tighter tolerances compared to the regular off the shelf parts or a reduced or extended frequency range. For the 8902A for example, 18GHz step attenuators were used because they offered a much better VSWR up to the 1.3GHz used than the 4GHz models.

The only way to get specs is to find out the NSN and check on the Internet bid board system for a technical data package, however this is a complicated process.

Lothar

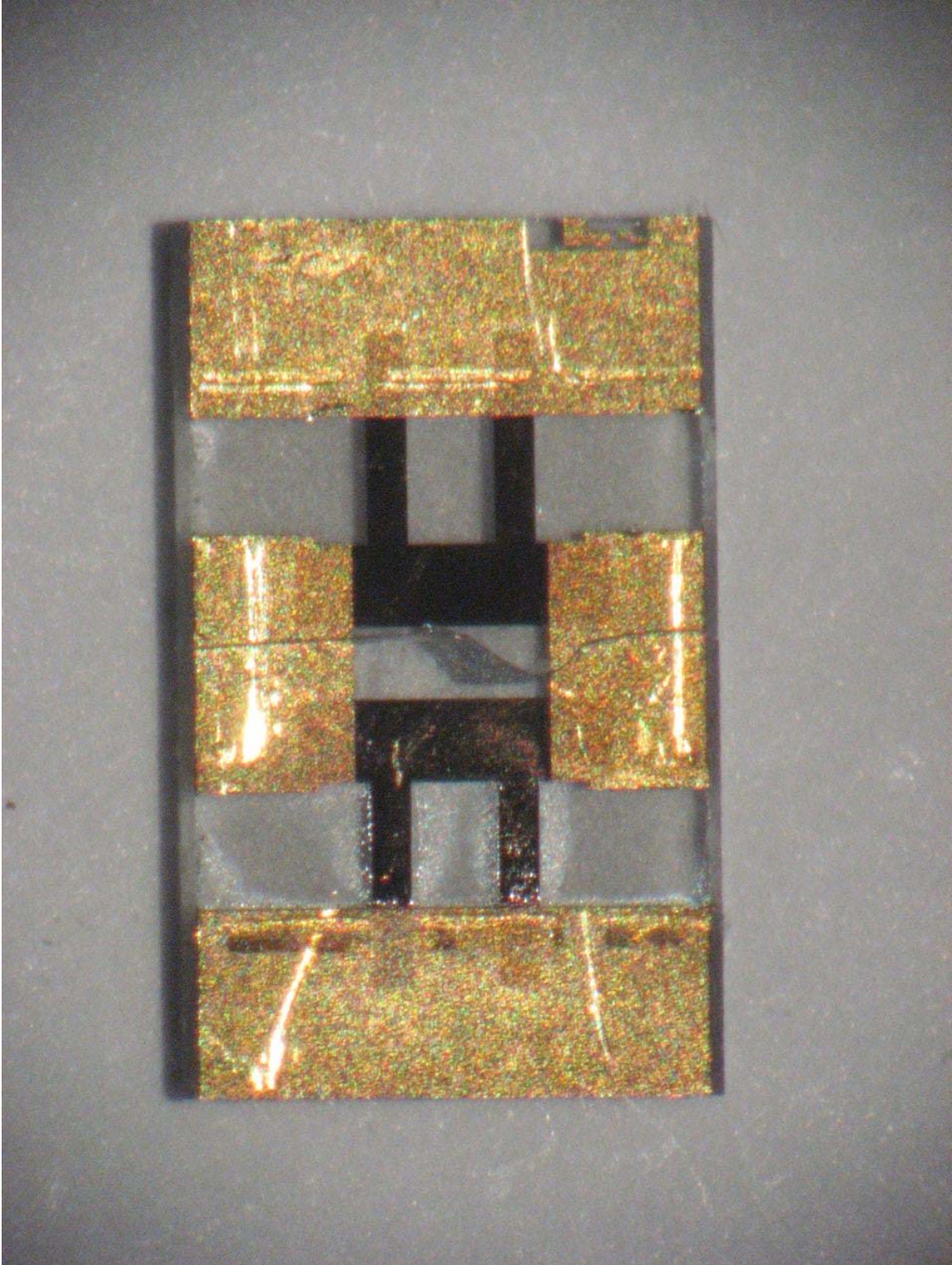
Notes from Jacques Audet VE2AZX



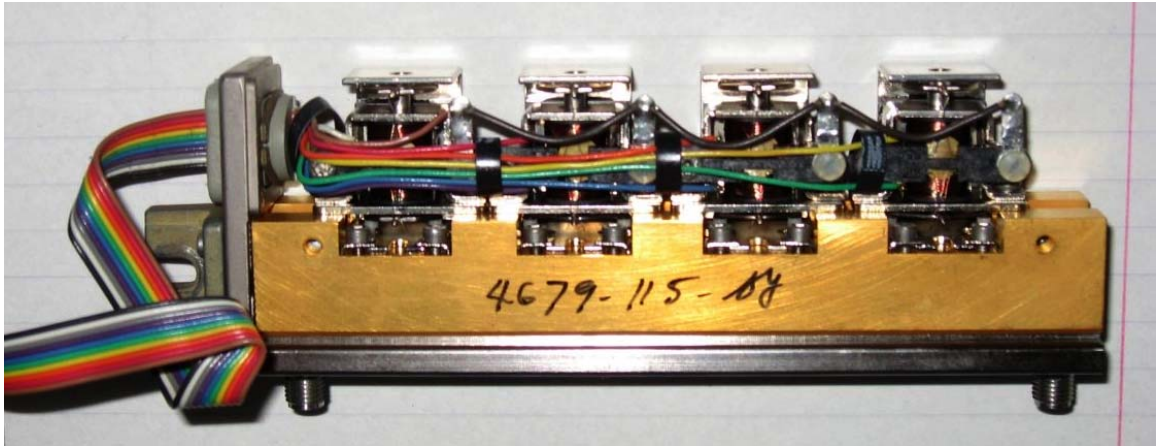
**Defective 20 dB attenuation pad. Shows infinite resistance to gnd on input pad. Probably blown by excessive power at input pad.**



**Pad carrier. Third pad is missing. The fourth pad is 10 dB. It is shorter. The SMA connectors are at both ends.**



**Defective 10 dB attenuation pad. Notice the crack in the glass substrate. The bottom side seems to have overheated.**



**View of attenuator after removing shield.**