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A NO-SPECIAL-TOOLS SMD DESOLDERING TECHNIQUE (AUG 2009)

◊While the technique that Wayne Yoshida, KH6WZ described in his August 2009 *QST* article will work, it subjects the circuit board to excessive heat, which can very easily lift pads. I much prefer a two fisted approach. I use two 25 W irons with 1⁄16 inch tips, and heat both ends of the component at the same time. Then I use the tips of the soldering irons to lift the part off the board. See Figure 1. — *73, Stephen Wimmer, WUØF, 21106 NW 70th St, Raymond, NE 68428;* **wu0f@windstream.net**

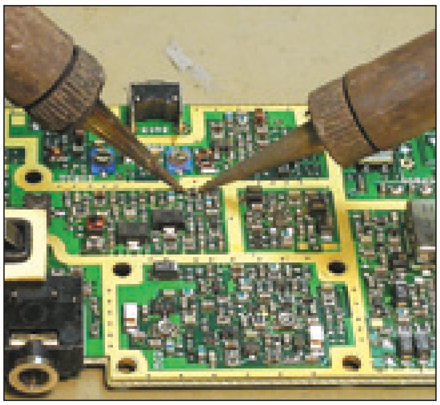

Figure 1 — Stephen Wimmer, WUØF uses a pair of 25 W soldering irons to heat both ends of a surface mount component at the same time to remove the component from the circuit board.

◊Thanks for your comments, Stephen. I agree that having two soldering irons is a good way to go. Even better are the SMD-dedicated, dual-tipped desoldering tweezer devices. Yes, there is a possibility of circuit board trace delamination because of excessive heat. This is true with any circuit board rework.

If one does not have two soldering irons, my method is a good trick. A lot of the boards I rework these days are extremely high quality and probably have multiple layers, and I have not experienced any delamination (yet). — *73, Wayne Yoshida, KH6WZ, 28181 Rubicon Ct, Laguna Niguel, CA, 92677;* **kh6wz@arrl.net**

A HIGH POWER RF SAMPLER

◊If one wants to measure characteristics of a transmitter or high-powered amplifier, some means of reducing the power of the device to 10 or 20 dBm must be used. The most straightforward way to do this is to use a 30 or 40 dB attenuator capable of handling the high power. A 30 dB attenuator will reduce a 100 W transmitter to 20 dBm. A 40 dB attenuator will reduce a 1 kW amplifier to 20 dBm. If further attenuation is needed, a simple precision attenuator may be used after the signal has been reduced to the 20 dBm level.

The problem with high-powered attenuators is that they are expensive to buy or build since the front end of the attenuator must handle the output power of the transmitter or amplifier. If one already has a dummy load, an RF sampler may be used to produce a replica of the signal at a reduced power level. This may be accomplished as simply as a voltage divider in parallel with the dummy load. Since we use 50 Ω systems, the resistor connecting to the center conductor of the load should be 2500 Ω in series with 50 Ω to ground to obtain 40 dB of attenuation. The ~2500 Ω load will not affect the impedance of the 50 Ω dummy load much, and the 50 Ω resistor at the bottom of the divider will provide a 50 Ω source impedance to the coax running to the test equipment. The problem with this method is that the 2500 Ω resistor must dissipate 30 W, if a 1500 W amplifier is being tested.

To avoid this problem, transformer RF samplers are used at the sacrifice of some bandwidth. The purpose of this Technical Correspondence letter is to share some of the parameters of several RF samplers that I have built and tested recently. A transformer sampler passes the center conductor of the coax, going from the transmitter or amplifier to the dummy load through a toroid as a single turn. The secondary of the transformer goes to a resistor network and then to the test equipment as shown in Figure 2. I have assumed that our source, whether a transmitter or amplifier, is a pure voltage source in series with a 50 Ω resistor. This most likely is not the case, but for analysis purposes, it will do.

If a current, I, flows into the dummy load, then a current, I / N flows in the secondary of the transformer, where N is the number

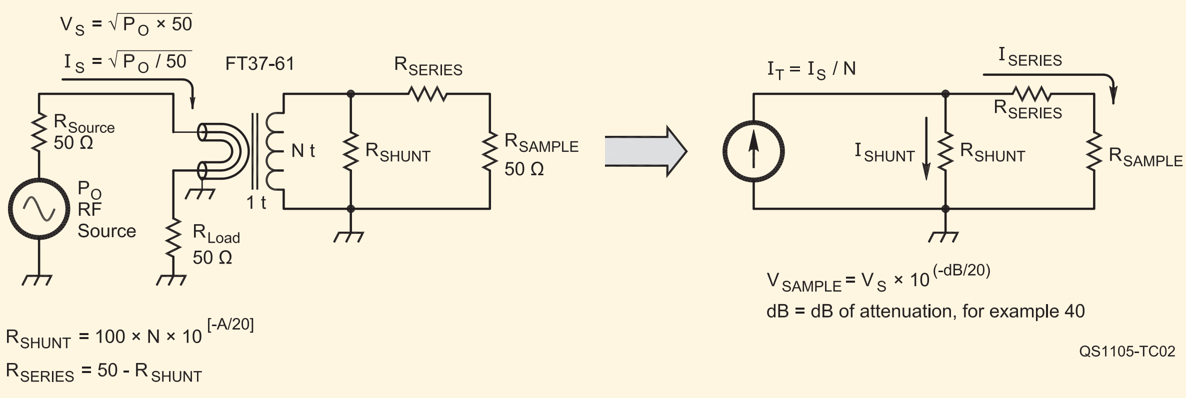

Figure 2 — RF sampler circuit diagram and equivalent circuit showing calculations.

Larry D. Wolfgang, WR1B ♦ Senior Assistant Technical Editor ♦ tc@arrl.net

Figure 3 — RF sampler using box construction.

of turns on the secondary. Figure 2, also, shows the equivalent circuit, substituting a current source for the transformer. I have selected 40 dB for the attenuation and 15 turns for the secondary of the transformer. If R_{SHUNT} = 15 Ω, and R_{SERIES} = 35 Ω, then the voltage across a 50 Ω load resistor is 1/100 of the voltage across the dummy load, which is 40 dB of attenuation.

Reflecting this resistor combination back through the transformer yields 0.06 Ω in series with the 50 Ω dummy load impedance. This is insignificant. Furthermore, reflecting 25 Ω from the primary to the secondary places 5625 Ω in parallel with R_{SHUNT}, which does not significantly affect its value. That being said, looking back into the sampler from the test equipment, you see 50 Ω, which is what we want. Even at low frequencies, where the reactance of the secondary winding is lower than 15 Ω, the impedance looking back into the sample port is close to 50 Ω.

I built a sampler of sorts about 8 years ago as an integral part of a homebrew amplifier. I was focused on the amplifier, so the sampler is not as good as it could be. The sampler published in the sidebar on page 43 of "A Peak Reading RF Power Meter" in the March 2010 issue of *QST* was supposed to be a direct copy of that sampler circuit. That sampler uses a T50-2 powdered iron core with 33 turns followed by a 4 dB resistive attenuator. The resistor values on that schematic were for a PI-attenuator instead of the T-attenuator shown. This sampler has fair SWR looking through it, a bad SWR looking back into the sampled port, and a useful bandwidth extending from 1 MHz to 60 MHz. The new samplers described here use an FT37-61 ferrite core followed by two resistors as described above. The through-line SWR is good up to 200 MHz, the SWR is fair looking back into the sampled port, and the useful bandwidth extends from 0.5 MHz to about 100 MHz. If you are interested in an accurate representation of the 3rd harmonic of your HF transmitter or amplifier, it is important for the sampler to give accurate attenuation into the VHF range.

Figure 4 — RF sampler using tube construction.

Figure 3 shows a photo of a sampler built into a 1.3 × 1.3 × 1 inch (inside dimensions) box constructed from single-sided circuit board material. The through-line connection is made with a short piece of 141 semi-rigid coax with the shield grounded *only* on one side to provide electrostatic shielding between the toroid and the center conductor of the coax. R_{SHUNT} is hidden under the toroid, and R_{SERIES} is shown connected to the sample port. This construction technique looks like a short piece of 200 Ω transmission line in the through-line, which affects the SWR at higher frequencies. This can be corrected by compensating with two 3 pF capacitors connected to the through-line input and output connectors as shown in the photo. The compensation difference in through-line SWR was reduced from 1.43:1 to 1.09:1 at 180 MHz by adding the capacitors. This compensation, however, causes the attenuation to differ at high frequencies depending on the direction of the through-line connection, so a different design was explored.

Figure 4 shows a different approach using 9/16 inch diameter, 0.14 inch wall thickness, hobby brass tubing. The idea here is to lower the impedance of the through-line so no compensation is needed. The through-line SWR for the tube sampler is 1.08:1 at 180 MHz, which is as good as the box sampler, and the sensitivity to through-line direction is reduced. Although the high frequency attenuation is not as good as the box sampler, the construction technique provides a more consistent result.

Both samplers use 15 turns of no. 28 AWG wire on an FT37-61 core, which just fits over the 141 semi-rigid coax. R_{SHUNT} is a 15 Ω, 2 W, noninductive resis-

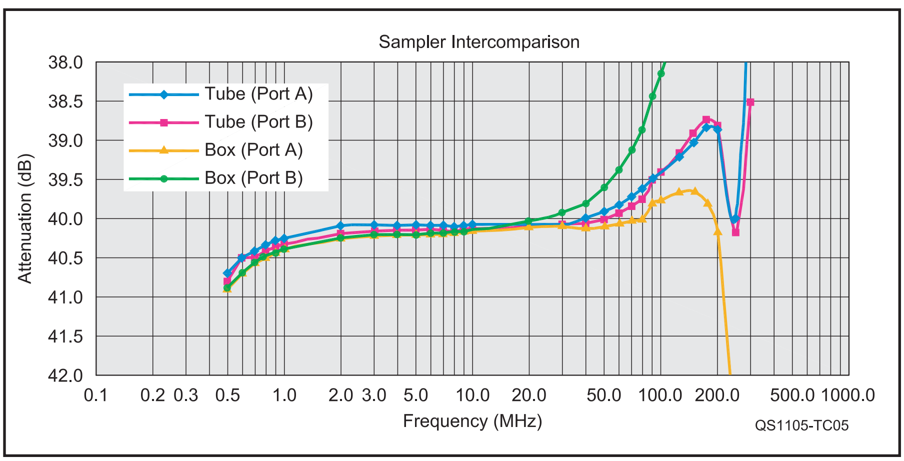

Figure 5 — Attenuation versus frequency of box and tube constructed RF samplers. The A B Port distinction refers to the direction of the through-line connection.

tor, and R_{SERIES} is a 34.8 Ω, ¼ W, 1% noninductive resistor. The power dissipation of the resistors and the flux handling capability of the ferrite core are adequate for sampling a 1500 W source. For those uncomfortable using BNC connectors at high power, an SO-239 version may be constructed using an FT50A-61 core and larger tubing.

The attenuation versus frequency of both samplers is shown in Figure 5. The A B port distinction is used to show the through-line direction dependency. The measurements shown on this graph were made using an HP 3335A signal generator with an HP 3586C selective level meter from 0.5 to 30 MHz, an HP 3335A with an HP 438A power meter and HP 8484A sensor from 40 to 80 MHz, and an HP8642A signal generator with an HP438A/HP8484A from 90 to 300 MHz. Thanks to NØQO for his help with these measurements. — *73, Tom Thompson, WØIVJ, 990 Toedtli Dr, Boulder, CO 80305;* **tlthompson@qwest.net**

SOLDERING SURFACE MOUNT COMPONENTS (JAN 2010)

◊Larry, thanks for your story in regards to soldering surface mount components in the January 2010 issue of *QST*. It has renewed my resolve to try again. It's sort of like those poker lessons with my pals; I paid for the lessons, and the teachers benefited. I have built three of the New Jersey QRP Club DDS VFO daughter boards. The first is still working, but I lifted the foil while soldering the second one.

The last one I paid to have soldered, but after a short play it quit. I, like you, set it aside for a sunny day. So, last night I rolled up my sleeves, got out my digital camera, headband magnifiers, and other tools. I managed to cleanly lift the old DDS chip and prepare the board for the new IC. The digital camera idea works great. I've ordered two new DDS chips (still cheaper than those "poker lessons") and can hardly wait to try again. Oh yes, wish me luck!

Update

I was successful with the DDS VFO. It did not work on my first attempt but it turned out my soldering was okay on the new 28 pin DDS IC. I had a poor solder connection on a board jumper. I fixed that and then had output on a few bands, but the frequencies were all wrong. After I downloaded the new HEX file from the AMQRP website (**www.amqrp.org/kits/kits.html**) and reprogrammed the controller PIC, I was home free.

I seem to get too much solder on the pins and have to rely on solder wick to remove the excess. I guess that's the way it's going to have to be.

I have had good success cutting the tip off of a cocktail toothpick and using instant glue to attach it to the surface mount part. Then I have a nice handle to hold it in place while I solder one side. After I solder the other side down, I break off the toothpick, trim it and glue it to the next part. The parts end up with glue on them but it beats tweezers.

If you have to trim a circuit, start with a higher value of resistor than you need, and then stack a second resistor on top of the first. It looks funny but cuts down on foil lifting. The technical articles are always my favorite in *QST*. — *73, Roger Monroe, K7NTW, PO Box 236, Clearlake, WA 98235;* **k7ntw@arrl.net**

MORE ON RESISTORS IN PARALLEL (JAN 2010 TC)

◊I would like to add some "interesting info" to the nice letter by Bob Raffaele, W2XM, in the January 2010 Technical Correspondence column.

Calculating parallel resistor equivalents by the conductance method is easier than it looks when you use a little-known quirk of many four-function calculators.

Virtually all of the cheap four-function calculators contain a logic error that implies a "1" left in the register after clearing. Try this on your calculator to see if it includes this logic error.

To take a reciprocal, enter the number and then "divide" then "equal."

Enter 5, ÷, = and see 0.2 on the display. [If your calculator displays 1 or something else, then it does not have this logic error. — *Ed.*]

The process of adding reciprocals to find the combination of resistors in parallel takes advantage of the Memory + (M+) and Memory Recall (MRC) functions.

Example: Suppose you want to know the total resistance of a 15 Ω resistor in parallel with a 30 Ω resistor. Enter 15, ÷, = to see 0.0666. Then use M+ (adds to memory) enter 30, ÷, = to see 0.0333 on the display. Then hit M+ and MRC, and see 0.09999. Finally, press ÷, = and see 10.00. The parallel combination of a 15 Ω and a 30 Ω resistor is 10 Ω.

Try it with three 30 Ω resistors of in parallel. The result will be 10 Ω. Of course clear the memory before starting each combination (press MRC twice).

I recall some discussion in the computer industry after the low cost four function units appeared. As I remember the explanation, a carry bit was left and it looked like a 1 when a divide was done. This causes no harm to any normal entry so the error was left and has been propagated to almost all four function units.

There are other "unknown" functions that are useful. The first number and first command entered stay in place until replaced. Example: 2 × = gives 4, then press = and get 8, it continues until the accumulator overflows.

Enter pi, 3.14159265, multiply and then any number entered followed by = will give the "pi times" function. — *Regards, Ralph Dieter, K1RD, 78 Olde Lantern Rd, Bedford, NH 03110;* **k1rd@k1rd.net**

WIRELESS ROUTER INTERFERENCE (DEC 2010 DOCTOR IS IN)

◊The December 2010 "Doctor is In" answer to the question about RFI related to a Linksys wireless router seemed to overlook the most likely source of the interference: the switching power supply (wall adapter) that is supplied with the router. The modern, lightweight switch-mode supplies provided with electronics today are notorious sources of RF interference. The description of the noise as spaced every 30 kHz is typical of the noise from these devices. The RFI is conducted back into the house wiring, helping to spread the pain. The noise is also carried into the load device, in this case the router. Connect the router to unshielded Ethernet wiring and the noise sprays everywhere!

The best fix is to replace the switch-mode power adapter with a linear type. A few minutes in a surplus or thrift store will turn up many suitable adapters for a buck or two. Many of these devices run on 12 V dc making it even easier for hams to find replacement supplies.

If replacement of the power adapter is not possible, then filtering the input and output of the switching power supply is the best bet using bypass capacitors, chokes and so on. Switching (pun intended) to a linear power supply can be much easier — and probably even cheaper.

Earlier in 2010 I presented a paper related to this topic to the National Association of Broadcasters Engineering Conference. If you'd like to read it, visit **www.wd8das.net/nab.pdf**. — *73, Steve Johnston, WD8DAS, 2309 Tulare St, Fitchburg, WI 53711;* **sbjohnston@aol.com**

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