ARRL Radio Designer Tips

***ARRL Radio Designer*, was published by ARRL beginning in late 1994. It was discontinued in August 2000 and is no longer available.**

How *ARD* Places Trace Markers

by David Newkirk, WJ1Z, ARRL HQ

Wayne Covington, KDØEA, wrote in ARRLCAD13:

```
     Does anyone on this list know---How does ARD decide where to put the
     trace markers?  Obviously on the trace in question, but exactly where
along
     the trace seems semi-arbitrary.
```

I don't have the algorithm ready to hand, but the hand-waving explanation is roughly this:

It's not arbitrary. *ARD* places the markers according to calculations done on the span, number and absolute placement of frequency steps within the *widest* frequency span specified in a netlist's FREQ block.

Getting a handle on how this works is easiest with a linearly stepped FREQ spec. For example, the spec

```
FREQ
  STEP 0MHZ 100MHZ 500KHZ
END
```

will result in markers at--as far as a brief on-screen report inspection allows--exactly 50 MHz, exactly 75 MHz, and *just above* 25 MHz. Things get a bit more complicated with log freq scales, but again--it's not arbitrary [you knew it really wouldn't be, of course :-)].

Yes, once *ARD* has determined the markers' positions for a given FREQ spec, they're fixed; this is why scaling a graph to a subsection of that widest FREQ range can make the markers seem to go away, or give you just one marker at a seemingly arbitrary place on a trace.

More on *ARD* Trace Markers

by Wayne Covington, KDØEA, writing in ARRLCAD15:

David Newkirk, WJ1Z, posted some good remarks on *ARD*'s trace markers. This prompted me to do some rudimentary experiments. I didn't learn anything remarkable, but I do have more on Dave's general guidelines, for those who wish to reposition trace markers.

ARD seems to place markers based on the frequencies that happen to be entered in the positions 1/4, 2/4, and 3/4 (or 1/3 and 2/3) of the way down its table of frequencies, give or take a position or two. In other words:

```
    in the case of three markers, about 25%, 50%, and 75% of the way through
    the table, producing four about equally wide intervals on a plot covering
    the full frequency range

    in the case of two markers, about 33% and 67% of the way through the
    table, producing three about equally wide intervals on a plot covering
    the full frequency range
```

In order to move the markers, insert or delete frequencies in the `FREQ` block, using the above guideline to determine how many and where, and re-analyze. Admittedly, this gives only limited control, but it is slightly better than nothing.

You are probably wondering why you might want to move a marker, given the limited control, so here is one example. As David mentioned, markers can go off-plot if you rescale. If you have several lines on the same plot, but no markers, it may be impossible to determine which line goes with which function on a paper copy of the plot. (Unless it is printed in color.)

I haven't found an exception to the divide-the-frequency-list-into-equal-length-pieces rule, but I haven't been able to discover how it decides on three vs two markers. Also, I haven't seen a case with four markers or only one marker.

For those interested in the details, what I did was:

```
a) A linear sweep of a circuit from 13.95MHZ to 14.45MHZ in 5KHZ steps,
   sending the output to a rectangular plot and to a table.  I rescaled the
   x-axis of the plot to get finer resolution on the marker placement.  The
   resulting markers were at:

   14.075MHZ -- matches 26th entry in the table (table had 101 entries total)
   14.200MHZ -- matches 51st entry
   14.325MHZ -- matches 76th entry

b) A logarithmic sweep from 5MHZ to 40MHZ in 100 steps, sending the output to
   a plot and a table as before.  The markers were at:

    8.633MHZ -- matches 27th entry in the table (not the 26th)
   14.291MHZ -- matches 51st entry
   24.162MHZ -- matches 76th entry (again there were 101 entries total)

(I can't explain the 27th entry vs the 26th in the above results.)

c) I added a linear set of frequencies to case b above, from 18MHZ to 20MHZ
   in 50KHZ steps.  The results:

   There were only two markers instead of three, at:

   13.419MHZ -- matches the 48th entry in the table (of 142 entries)
   19.500MHZ -- matches the 96th entry
```

```
d) I changed case to have only two new frequencies added instead of 41.
   There were still only two markers.
```

High-Precision Graph Scaling in *ARRL Radio Designer*

by David Newkirk, WJ1Z, ARRL HQ

ARRL Radio Designer lets you set graph limits only so finely with a given frequency unit selected. For maximum flexibility in scaling graphs when modeling narrowband circuits, select Hz, not kHz or MHz, for your graphs' frequency scales, and use the appropriate engineering notation when you define their limits in the **Graph Scaling...** dialog. In other words, ask not for graph limits of, say, 3.5727 and 3.5867 with MHz selected as your frequency unit; select Hz and ask for graph limits of 3.5727E+6 and 3.5867E+6.