R.F. Note #99

Jack Riedel
November 6, 1984

Subjects:
1. K800 resonator design
2. Finger tests using rf
3. 1.2 MW Aydin Power Supply Test

1. K800 Resonator Design

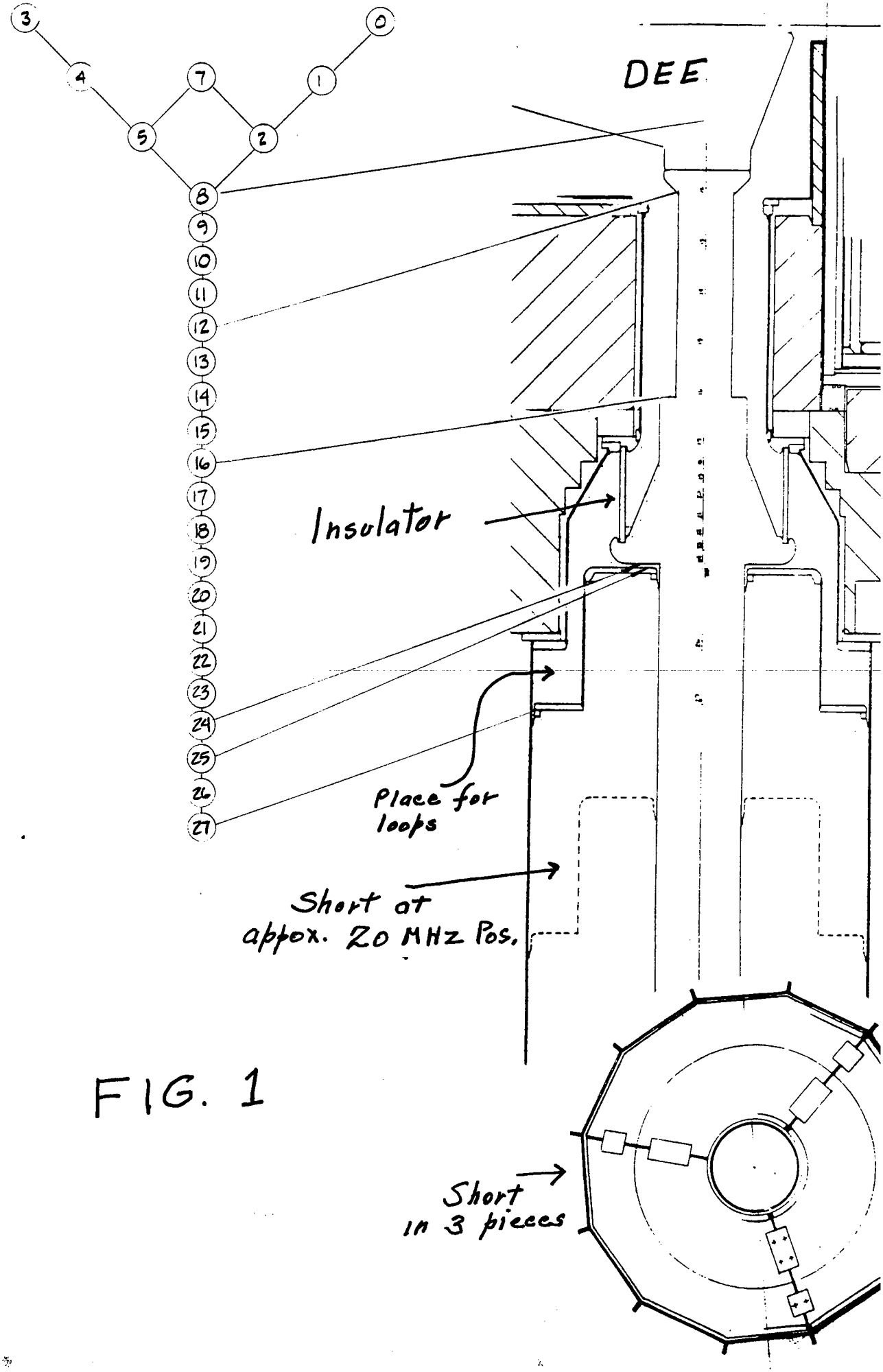
In RF note #98 a design was presented which would probably have worked. Many of the features of R. Worsham's design were retained; the same short geometry; and the location of the insulator was such that the corona ring was even with the magnet steel. The disturbing thing about this design was that there was no margin for error on the upper frequency (27.5 MHz) and the power was 300 KW per dee resulting in a high efficiency requirement from the transmitter. Also H. Blosser calculated that if we could reduce the power by 30% a saving of one million dollars would be achieved over a ten year period due to the cost of power at the rate of $ .07 per KWH.

So, in response to Blosser's plea for reduced power we moved the insulator 7.7 inches closer to the median plane, threw out Worsham's short and modified the geometry in the region between the dee valley and the insulator. Figure 1 shows the new geometry, the new short, and, again the sketch showing the correlation between the geometry and the calculations. We now have a good frequency margin (28.2 MHz upper frequency) and the power at 27.5 MHz has been reduced to 170 KW, a reduction of 36% from the previous design.

All in all it was a lucrative weekend spent coming up with this design, and I presume that I will get a substantial share of the one million dollars thus saved!

Table I shows the entered parameters and Table II the results for 27.5 MHz. Note that the short margin is 1.5" and there is 6 inches vertical clearance for the neutralizing loops. Note also that the stem current is down by half the power saving.

Meanwhile, J. Vincent has written some subroutines to be used with Superfish so that the results are printed out in a similar format to that in Table II above. His results for the same geometry, show a stem current 6% higher and a power 8% higher. The frequencies are within 2%. So we can assume that "I am right, and you are right, and everyone is right and all is - just right."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DEE
Insulator
Place for loops
Short at approx. 20 MHz Pos.
Short in 3 pieces

FIG. 1

MV8000 CORRECTED 10,1,84

.275187E+08 .275332E+08 ← Frequency iterations.

FOR 27.53 MHZ THE RESULTS ARE

N	Z	L	A	B	G	H	K	Q	C
0	0.0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	10.8
1	91.6	11.0	6.00	4.00	2.00	6.00	1.53	13.85	0.0
2	61.7	11.0	10.00	6.00	4.00	3.00	1.24	13.85	0.0
3	0.0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	10.8
4	84.0	11.0	10.00	6.00	2.00	6.00	1.34	13.85	0.0
5	54.1	11.0	11.00	4.00	4.00	3.00	1.25	13.85	0.0
6	0.0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	9.6
7	33.6	10.0	8.00	6.00	3.00	3.00	1.24	12.59	0.0
8	0.0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	36.0	3.0	20.00	9.00	0.00	0.00	1.50	2.52	0.0
10	54.0	1.0	20.00	8.12	0.00	0.00	1.00	0.84	0.1
11	64.7	1.0	20.00	6.80	0.00	0.00	1.00	0.84	0.1
12	86.0	1.0	21.00	5.00	0.00	0.00	1.00	0.84	0.1
13	51.2	4.8	11.75	5.00	0.00	0.00	1.00	4.03	0.1
14	51.2	4.8	11.75	5.00	0.00	0.00	1.00	4.03	0.0
15	51.2	4.8	11.75	5.00	0.00	0.00	1.00	4.03	0.0
16	23.0	4.8	11.75	8.00	0.00	0.00	1.00	4.03	0.1
17	23.0	4.8	11.75	8.00	0.00	0.00	1.00	4.03	0.0
18	51.8	1.7	19.00	8.00	0.00	0.00	1.00	1.52	0.4
19	49.5	1.7	21.00	9.20	0.00	0.00	1.00	1.52	0.4
20	46.9	1.7	23.40	10.70	0.00	0.00	1.00	1.52	0.4
21	46.4	1.7	25.60	11.80	0.00	0.00	1.00	1.52	0.4
22	39.2	1.7	25.60	13.30	0.00	0.00	1.00	1.52	0.4
23	23.1	1.3	25.60	17.40	0.00	0.00	1.00	1.09	0.4
24	23.1	1.3	25.60	17.40	0.00	0.00	1.00	1.09	0.0
25	69.7	1.5	25.60	8.00	0.00	0.00	1.00	1.26	0.1
26	7.5	6.7	25.60	22.60	0.00	0.00	1.00	5.62	0.1
27	20.8	6.0	32.00	22.60	0.00	0.00	1.00	5.04	0.2

N	Z	L	DEG	DEG	R/M	V	I	W	E	L1(N)	IMP
0	0.0	0.0	0	0	0.0E+00	2.00E+05	2.5E+02	0.0E+00	3.7E+07	0.0	5.4E+02
1	91.6	11.0	10	24	2.2E-02	1.86E+05	6.3E+02	1.9E+03	5.0E+07	16.5	2.1E+02
2	61.7	11.0	16	30	7.1E-03	1.68E+05	1.1E+03	2.3E+03	6.2E+07	16.5	1.1E+02
3	0.0	0.0	0	0	0.0E+00	1.98E+05	2.6E+02	0.0E+00	3.7E+07	0.0	5.7E+02
4	84.0	11.0	9	23	1.1E-02	1.85E+05	6.5E+02	1.0E+03	5.3E+07	16.5	2.0E+02
5	54.1	11.0	15	29	7.6E-03	1.68E+05	1.2E+03	2.9E+03	7.0E+07	16.5	9.8E+01
6	0.0	0.0	0	0	0.0E+00	1.74E+05	2.0E+02	0.0E+00	2.5E+07	0.0	6.0E+02
7	33.6	10.0	3	16	7.9E-03	1.68E+05	1.0E+03	1.3E+03	9.6E+07	15.0	1.2E+02
8	0.0	10.0	0	0	0.0E+00	1.68E+05	3.3E+03	0.0E+00	0.0E+00	0.0	3.4E+01
9	36.0	13.0	45	48	6.3E-03	1.60E+05	3.5E+03	5.5E+03	1.6E+07	3.0	3.3E+01
10	54.0	14.0	59	60	3.0E-03	1.56E+05	3.5E+03	9.2E+02	3.5E+06	1.0	3.2E+01
11	64.7	15.0	64	65	3.4E-03	1.51E+05	3.5E+03	1.1E+03	2.8E+06	1.0	3.0E+01
12	86.0	16.0	71	71	4.3E-03	1.45E+05	3.5E+03	1.4E+03	2.0E+06	1.0	2.9E+01
13	51.2	20.8	61	65	4.9E-03	1.27E+05	3.7E+03	7.8E+03	1.3E+07	4.8	2.4E+01
14	51.2	25.6	65	69	4.9E-03	1.08E+05	3.8E+03	8.4E+03	9.5E+06	4.8	2.0E+01
15	51.2	30.4	69	73	4.9E-03	8.81E+04	3.9E+03	8.9E+03	6.6E+06	4.8	1.6E+01
16	23.0	35.2	55	59	3.6E-03	7.90E+04	4.1E+03	7.0E+03	1.1E+07	4.8	1.4E+01
17	23.0	40.0	59	63	3.6E-03	6.95E+04	4.2E+03	7.6E+03	8.4E+06	4.8	1.2E+01
18	51.8	41.7	77	79	3.1E-03	6.12E+04	4.3E+03	2.5E+03	1.2E+06	1.7	1.0E+01
19	49.5	43.3	78	80	2.7E-03	5.33E+04	4.3E+03	2.3E+03	9.8E+05	1.7	8.8E+00
20	46.9	45.0	79	81	2.4E-03	4.57E+04	4.3E+03	2.0E+03	7.7E+05	1.7	7.5E+00
21	46.4	46.7	81	82	2.1E-03	3.82E+04	4.3E+03	1.9E+03	5.8E+05	1.7	6.3E+00
22	39.2	48.3	81	82	2.0E-03	3.18E+04	4.3E+03	1.7E+03	4.5E+05	1.7	5.2E+00
23	23.1	49.6	77	78	1.7E-03	2.91E+04	4.4E+03	1.0E+03	4.1E+05	1.3	4.7E+00
24	23.1	50.9	78	80	1.7E-03	2.64E+04	4.4E+03	1.1E+03	3.2E+05	1.3	4.3E+00
25	69.7	52.4	86	88	2.8E-03	1.69E+04	4.4E+03	2.1E+03	7.7E+04	1.5	2.7E+00
26	7.5	59.1	70	76	1.4E-03	1.23E+04	4.5E+03	4.9E+03	1.4E+06	6.7	1.9E+00
27	20.8	65.1	85	90	1.3E-03	5.78E+02	4.5E+03	4.1E+03	1.1E+05	6.0	9.0E-01

39 W ANNULUS= 3140.34

39 W INS FLANGE= 0

W/DEE KW	E/DEE MVA	Q	R SH	C EQ PF	C COUP NPF
169	1018	6015	118	294	2378

2 ← No of iterations

Ready

EXIT

$ LO

RIEDEL logged out at 5-NOV-1984 21:33:24.3(

NO CARRIER

DEE

START OF VALLEY IRON

Ins

Short L

TABLE I

13 → 17.

25
26
27

TABLE II

Fingers. Whereas previously I have recommended that we use the same pressurized door spring design for the stem short, I now am recommending that we use our new carbonized silver fingers. Previously we had tested a finger at 60 Hz and found that with a little air blowing on it, it could carry 100 amps with a temperature rise of less than 100^{O}C. Since then we have tested a finger using 30 MHz R.F. and find that with no air it can carry 42 amps with a temperature rise of only 40^{O}C. During the next week we will increase this current to 55 amps I suspect it will do fine, especially if we blow a little air by it.

Now even using Superfish's value of 4954 amps for the stem current, this results in only 39.5 amps per finger (there will be 125 fingers per inner short). Using these fingers for both the inner and outer stem will result in much greater simplicity of short fabrication. I think, however, that we should still sprinkle six or eight photosensitive transistors about the inner stem short, and 12 about the outer shorts.

Aydin Testing. For a while, on Friday, 11/2/84, it seemed like the Aydin 1.2 MW P.S. was going to be O.K. There were some idiosynchrisies about the controls, but it did run for two hours delivering, 800 KW into our two dummy loads. On Monday morning we found that the spark gap across the filter choke was melted down and shorted out. So we wasted a day making a new spark gap and installing closed circuit TV to watch it. On Tuesday, 11/6/84, we again came on, but this time with provision to instantly cut off the output current.

We were now also monitoring the output voltage. At 10 KV, with the total current approximately 20 amps, the peak to peak voltage ripple was 10% at 60 Hz, and about 3% at 720 Hz. This is a puzzle. The supply has no business producing 60 Hz ripple. On suddenly removing the current the voltage rose by 20%, which is to be expected from the increased leakage inductance of the supply.

Above 17.5K.V. we would get unaccounted for overcurrents which shut us off, but with perserverence, especially if we came on with no load and then applied the load, we could get on. AT 20 KV we were drawing 800 KW (40 amps) and the tap changer was all the way up. It is obvious that at 1.2 MW the supply would not be able to deliver 20 KV.

Everytime we shut the current off we would get a crowbar. ------ I see that I am entering excessive detail into this r.f. note. So, suffice it to say that soon the rectifier transformer developed shorted turns, and thus failed! Again we are out of business with our K800 r.f. system final power supply, and the odds are that three or four months will elapse before we can try again. C'est la vie.

JR/as