NanoVNA Tweezers Accuracy Examples

Capacitance

Table 1 lists the measurement results for the 6 precision NPO, ceramic capacitors mounted in the author's reference box. The measurements were recorded for frequencies close to 3, 15, 30, 50, 100 and 150 MHz. As shown all measurements that fell within range of this measurement technique were within specification, most within 1%. The measurement of the 100 pF capacitor at 100 and 150 MHz was out of range for the *nanoVNA* because of the very low reactance values but as the accuracy was still within 2% the results were included here. The accuracy diminishes somewhat if the reactance of the components deviate significantly beyond the 50 Ohm design impedance of the VNA bridge circuit. For that reason the measurements were not recorded for the 1pF@3MHz(Xc=53K), 470pF@100MHz(Xc=3.4) and 470pF@150MHz(Xc=2.26) tests as the reactance values were beyond the range of what can be accurately measured using this method. To confirm measurement consistency the same measurements were made a few days later. I was pleased to find that the results remained within about 0.5% of the previous tests.

Tweezer NanoVNA/NanoVNA-Saver Reference Box Capacitor Measurements 20201015						
Frequency MHz:	3.05	15.05	30.04	49.53	100.52	150.00
Spec. Value	Measured pF	Measured pF	Measured pF	Measured pF	Measured pF	Measured pF
1pF +/- 0.1pF	N/A	1.03	1.06	1.04	1.08	1.08
4.7pF +/- 0.25pF	4.51	4.56	4.59	4.58	4.59	4.62
10pF +/- 0.1pF	9.9	9.96	9.99	9.98	10.02	9.96
47pF +/- 0.47pF	46.92	46.99	47.05	47.07	47.27	47.25
100pF +/- 1 pF	100.72	100.61	100.65	100.58	101.51	101.89
470pF +/- 4.7pF	469.86	467.43	464.12	465.25	N/A	N/A

Table 1: Capacitor Measurement Accuracy Examples

Inductance

Table 2 lists the measurement results for the inductors which are specified to have a +/-2% tolerance. Inductor value specifications are relatively complex compared to capacitors as the values must be specified at specific test frequencies due to stray capacitance and other factors. In comparison to typical RF ceramic capacitors which have a very high Q the coil wire resistance and other losses reduce the Q of inductors resulting in a much more complex impedance measurement. Stray capacitance causes all inductors to become self resonant at some frequency. The apparent value of inductance changes rapidly as the frequency of self resonance is approached. Because of these factors a lower frequency sweep of 50 KHz to 15 MHz was adopted for measuring the larger value inductors.

Tweezer NanoVNA/NanoVNA-Saver Reference Box Inductor Measurements						
Sweep 50KHz to 150MHz:						
Specified Value	**3 MHz**	**15 MHz**	**30 MHz**	**50 MHz**	**100 MHz**	**150 MHz**
10nH+/-2% or 0.2nH @ 250 MHz	N/A	10.46	10.24	10.13	10.85	10.78
47nH+/-2% or 1nH @ 200 MHz	N/A	47.92	47.61	47.37	47.37	47.02
100nH+/-2% or 2nH @ 150 MHz	100.74	98.74	98.07	98.04	98.38	98.72
Sweep 50KHz to 15MHz:						
Specified Value	**0.5 MHz**	**1 MHz**	**2 MHz**	**5 MHz**	**10 MHz**	**15 MHz**
470nH+/-2% or 10nH @ 50 MHz	481.6	480.1	477.11	474.5	471.1	468.6
1uH +/-2% or 20nH @ 25 MHz	1.004	993.6	985.6	977.5	971.5	969.4
4.7uH+/-2% or 0.1uH @ 7.9 MHz	4.6	4.57	4.56	4.57	4.65	4.82

Table 2: Inductance Measurement Accuracy Examples

The 10nH and 47nH inductors could not be measured at 3 MHz because of their very low reactance values which were too low for accurate measurement with the bridge. As shown the majority of the inductors measured within the +/-2% specification. Other measurement results are quite close to the specified values and sufficiently close for most practical purposes. However because of the inherent inductor impedance complexities and the wider tolerance specifications it was not surprising that there was more variation of results in comparison to capacitor measurements.