

Fair-Rite #31 vs. #43

- The first two slides are re-plots of μ' and μ'' from Fair-Rite data sheets from the online pdf catalog
- The remaining slides are measured data for chokes wound with RG58 on several #31 and #43 cores, illustrating
 - Differences between #31 and #43 chokes
 - The effect of component tolerances
- S21 of chokes was measured in series with VNWA output and input, from which the VNWA software computed Zmag (orange), Rs (magenta), and Xs (black). The blue curve is S21.
 - The bottom of the graph is zero for Zmag and Rs (1,000 Ω /div)
 - The center of the plot is zero for Xs(1,000 Ω /div)
 - The top of the graph is zero for S21 (6dB/div)
- The plots are averaged to minimize noise in the measurement for low values of S21
 - This causes the “flat” spots at the frequency limits

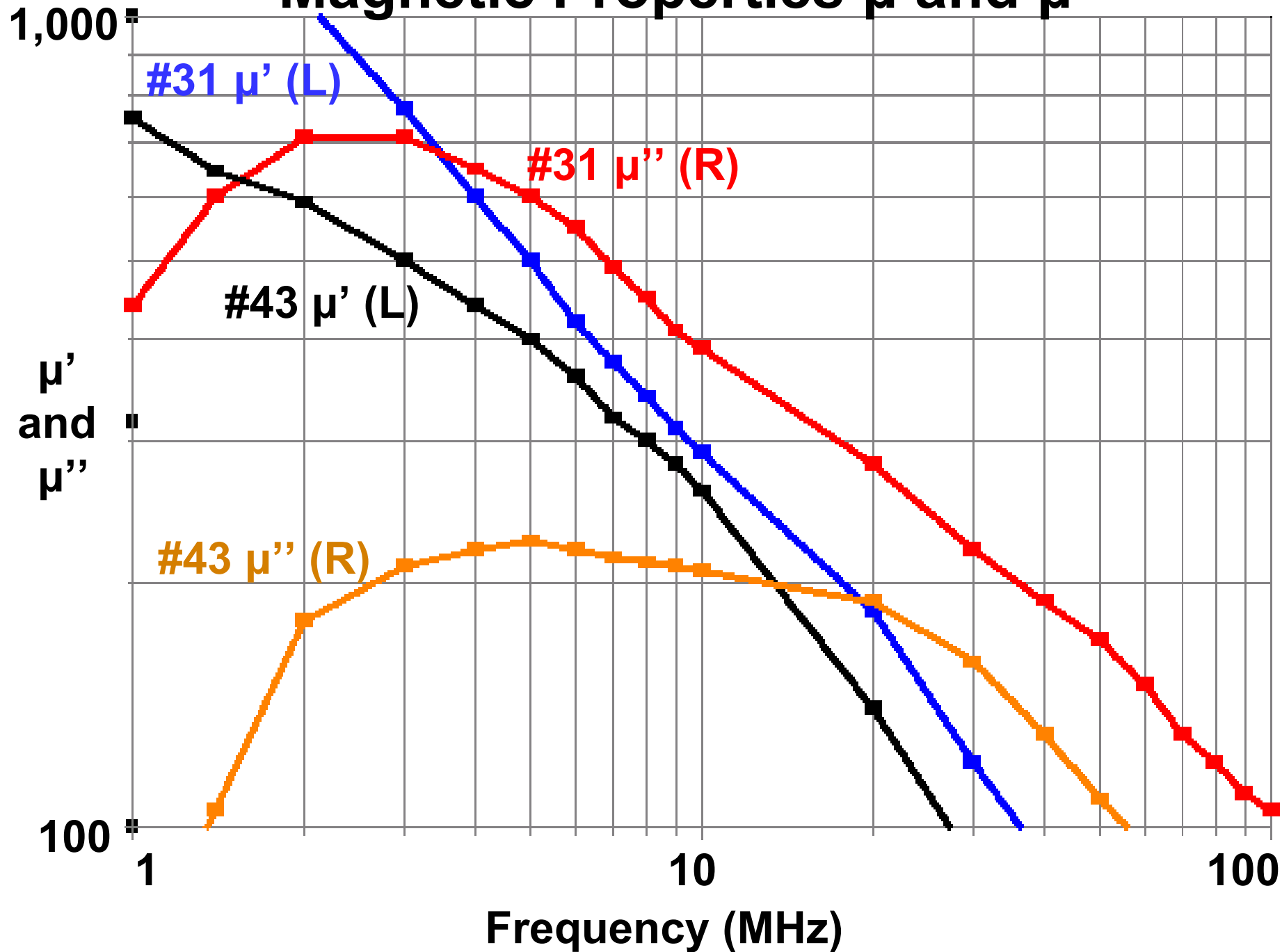
Fair-Rite #31 vs. #43

- It is the loss component that provides the most effective suppression
- The circuit into which the choke is inserted has some impedance $R_s + jX_s$ by virtue of its electrical length and termination
- Current is reduced by the sum of the impedances of that circuit and the choke
- The inductive or capacitive X_s values can add or cancel, but the R_s always adds, so it always reduces the current
- Resonance is controlled by choice of core, number of turns, and winding style

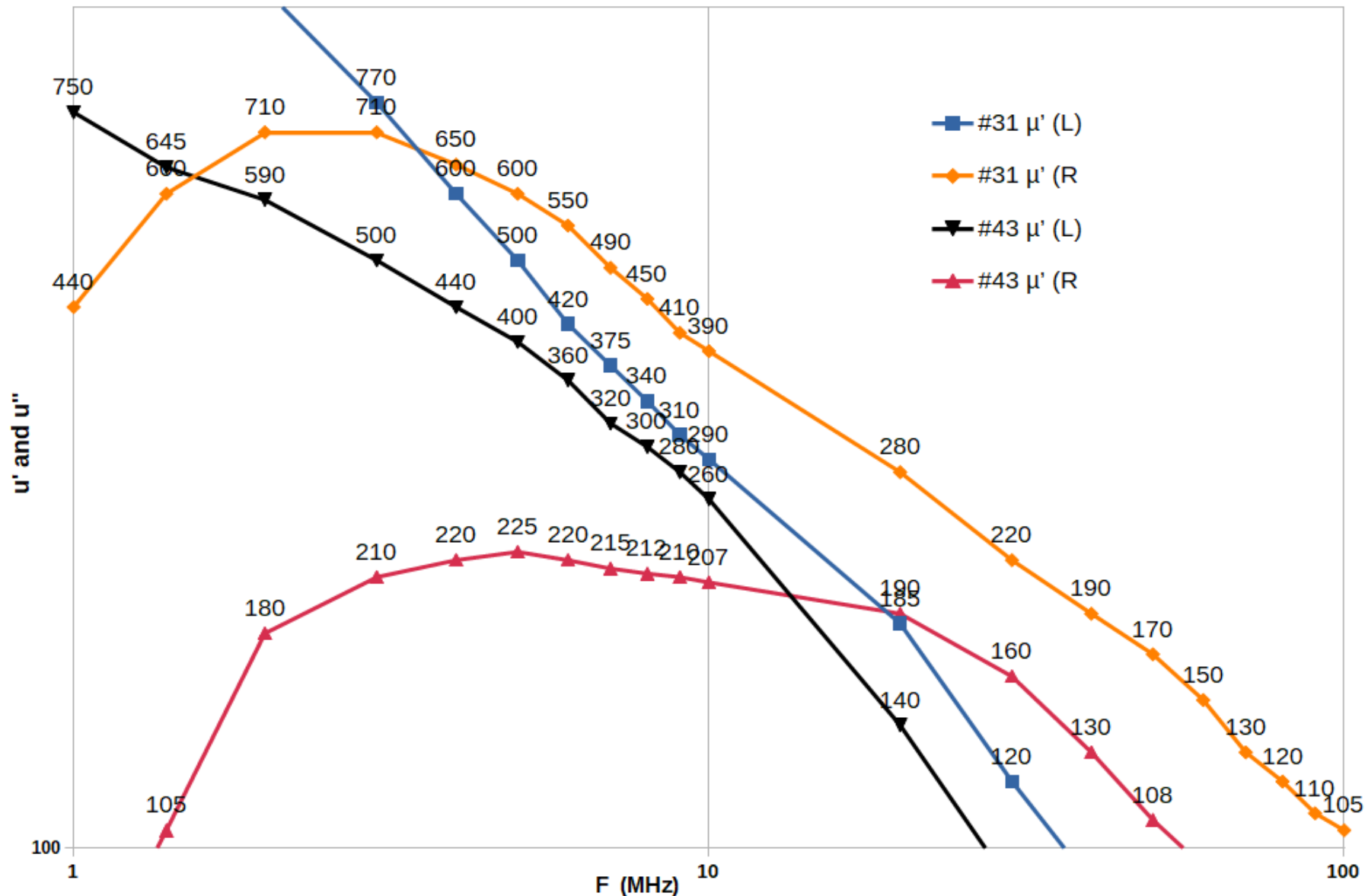
Fair-Rite #31 vs. #43

- **#43 is a NiZn ferrite, and has only the circuit resonance formed by the winding**
- **#31 is a MnZn ferrite, and has both the circuit resonance and a dimensional resonance that is the result of standing waves in the cross-section of the core**
- **The dimensional resonance is fairly high-Q**
 - **Frequency does not vary with turns or winding style**
 - **Impedance increases as the square of the turns**
 - **It can combine with the circuit resonance to provide the broader impedance curves shown in the #31 plots**
 - **Turns can be varied to provide high R_s values over a frequency range of 4:1 between about 3 and 21 MHz**

Magnetic Properties μ' and μ''



Fair-Rite #31 vs. #43



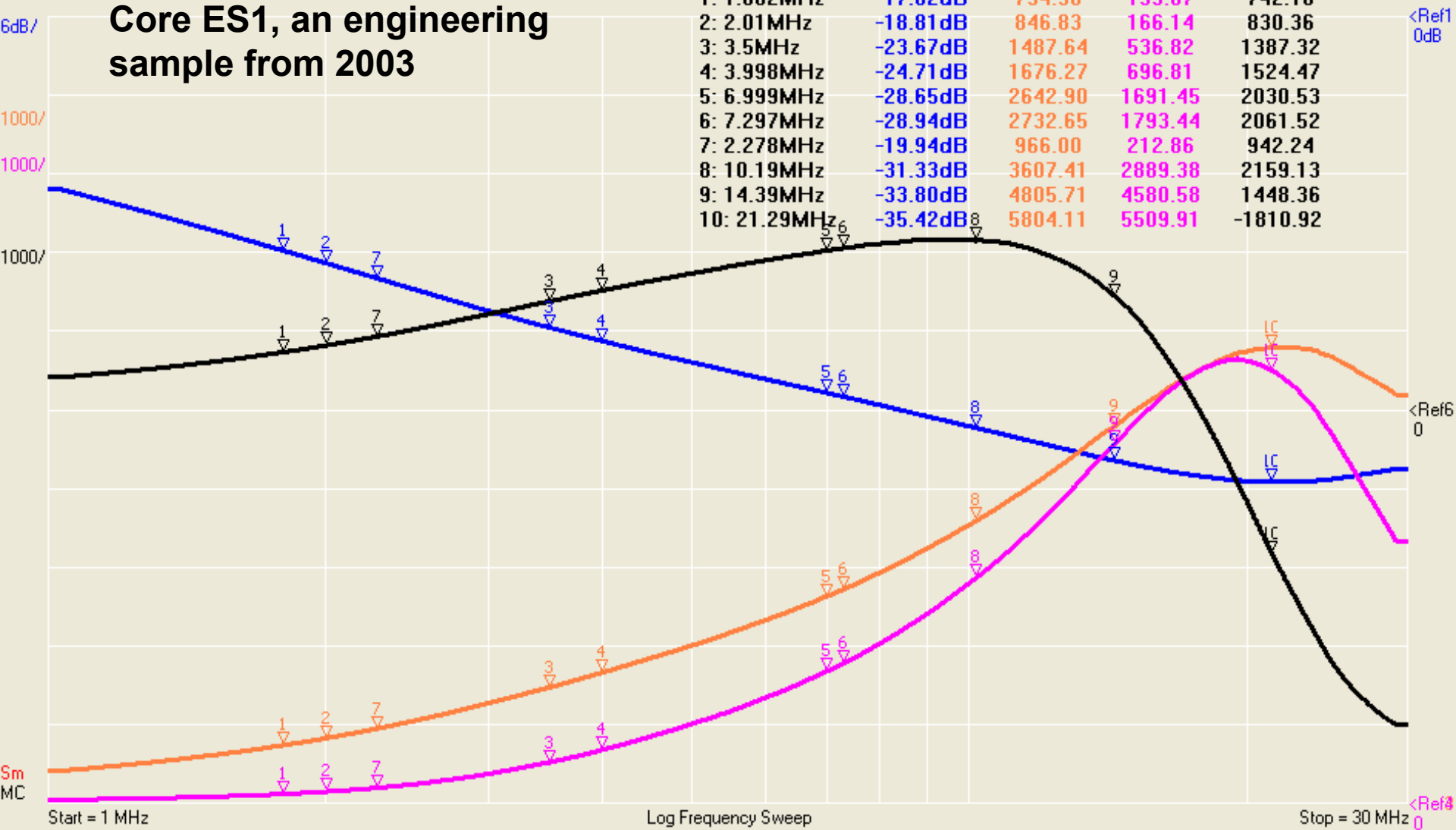
10 Turns RG58 on 2.4-in o.d. Fair-Rite #43 core

DG8SAQ Vector Network Analyzer Software

6/6/2018 11:05:48 AM 10 Turns on #43 Core 2643803802 #1 Eng Sample 2003

Core ES1, an engineering sample from 2003

| | | | | |
|--------------|----------|---------|---------|----------|
| 1: 1.802MHz | -17.82dB | 754.38 | 135.07 | 742.18 |
| 2: 2.01MHz | -18.81dB | 846.83 | 166.14 | 830.36 |
| 3: 3.5MHz | -23.67dB | 1487.64 | 536.82 | 1387.32 |
| 4: 3.998MHz | -24.71dB | 1676.27 | 696.81 | 1524.47 |
| 5: 6.999MHz | -28.65dB | 2642.90 | 1691.45 | 2030.53 |
| 6: 7.297MHz | -28.94dB | 2732.65 | 1793.44 | 2061.52 |
| 7: 2.278MHz | -19.94dB | 966.00 | 212.86 | 942.24 |
| 8: 10.19MHz | -31.33dB | 3607.41 | 2889.38 | 2159.13 |
| 9: 14.39MHz | -33.80dB | 4805.71 | 4580.58 | 1448.36 |
| 10: 21.29MHz | -35.42dB | 5804.11 | 5509.91 | -1810.92 |



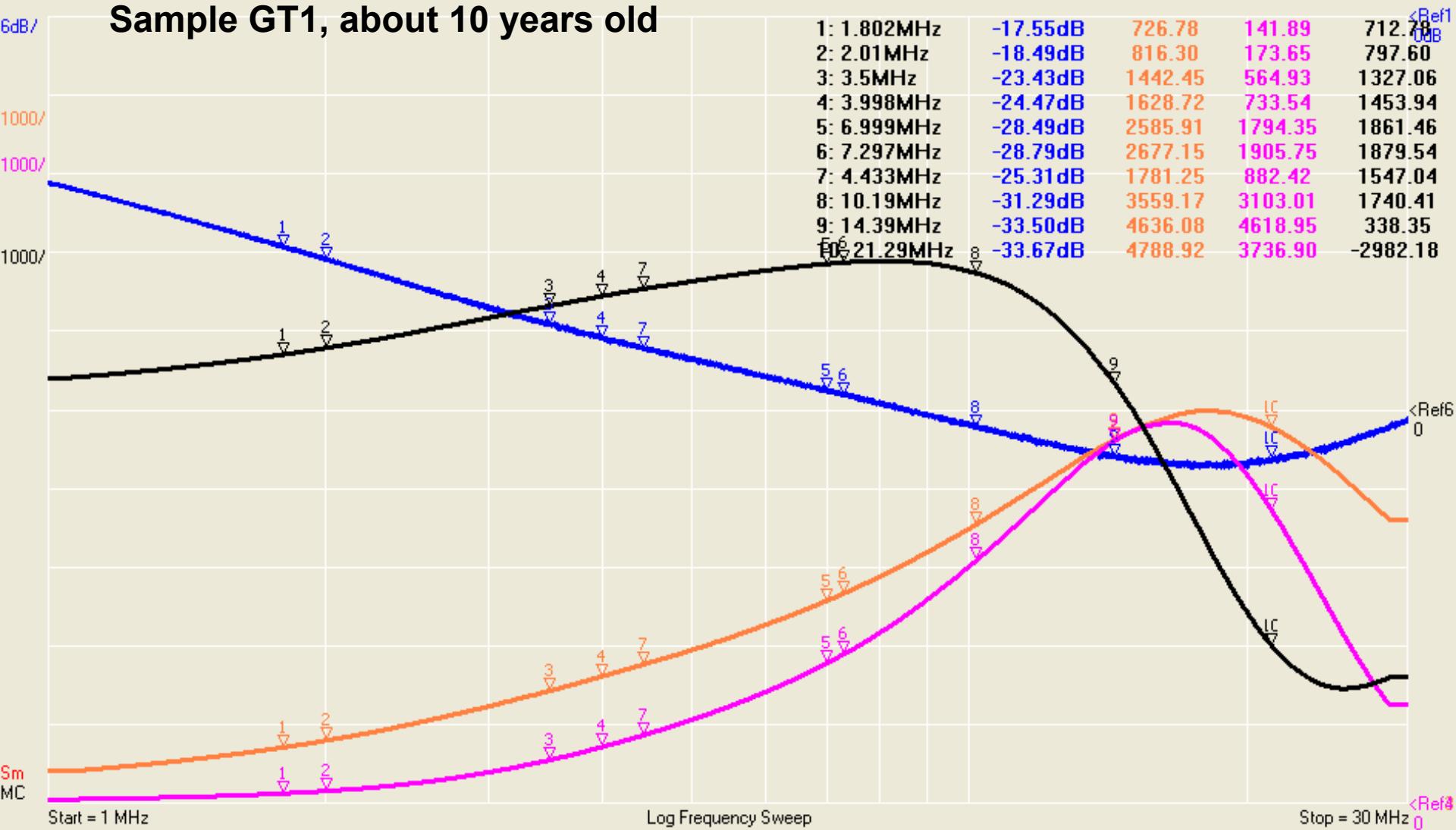
=> TX Att. = 30 dB S21 dB t2s Mag t2s Real t2s Imag

10 Turns RG58 on 2.4-in o.d. Fair-Rite #43 core

DG8SAQ Vector Network Analyzer Software

5/21/2018 4:57:14 PM 10T Test Cable GT1 Core #43 Mix

Sample GT1, about 10 years old



Start = 1 MHz Log Frequency Sweep Stop = 30 MHz

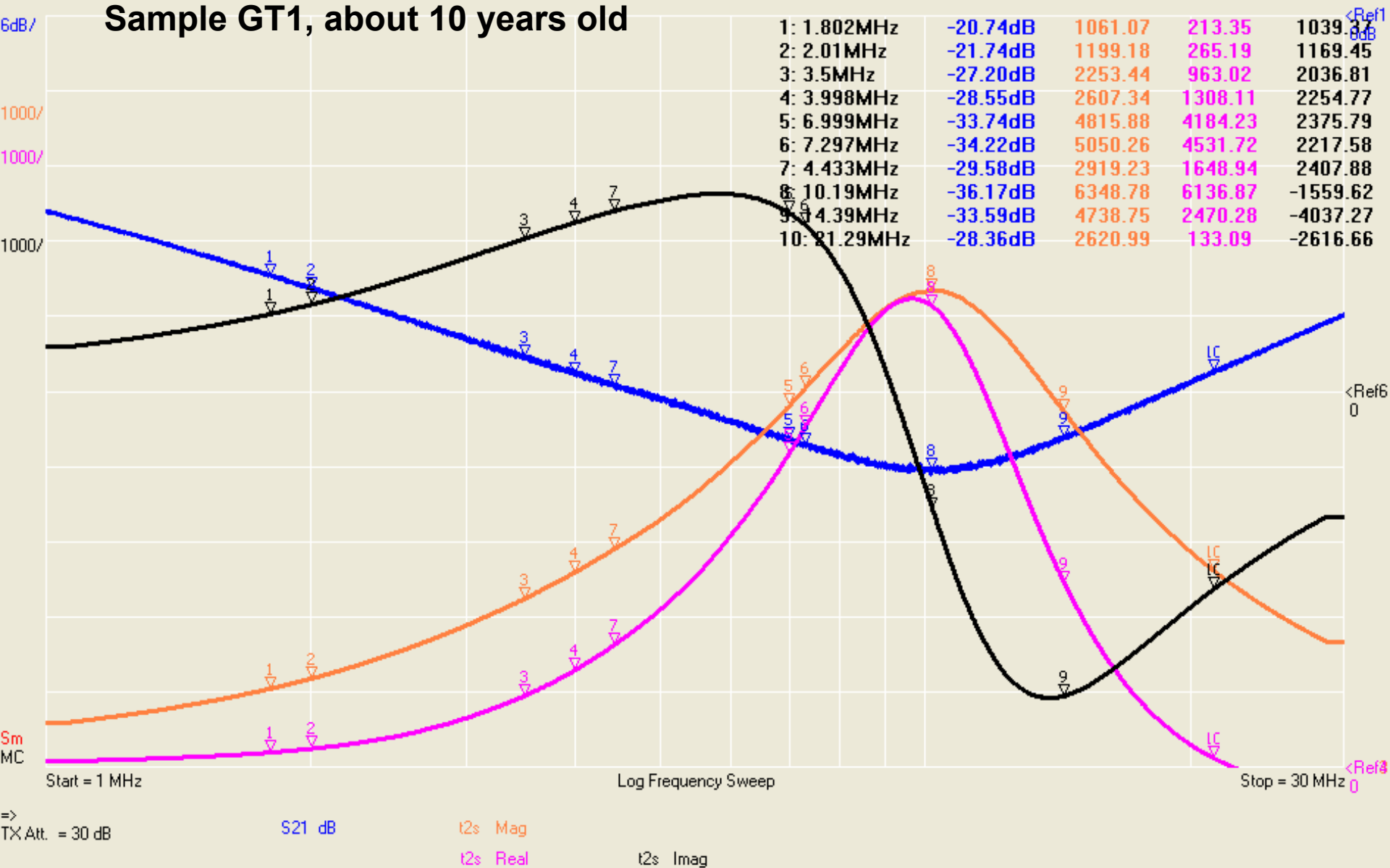
TX Att. = 30 dB S21 dB t2s Mag t2s Real t2s Imag

12 Turns RG58 on 2.4-in o.d. Fair-Rite #43 core

DG85AQ Vector Network Analyzer Software

5/21/2018 4:55:20 PM 12T Test Cable GT1 Core #43 Mix

Sample GT1, about 10 years old



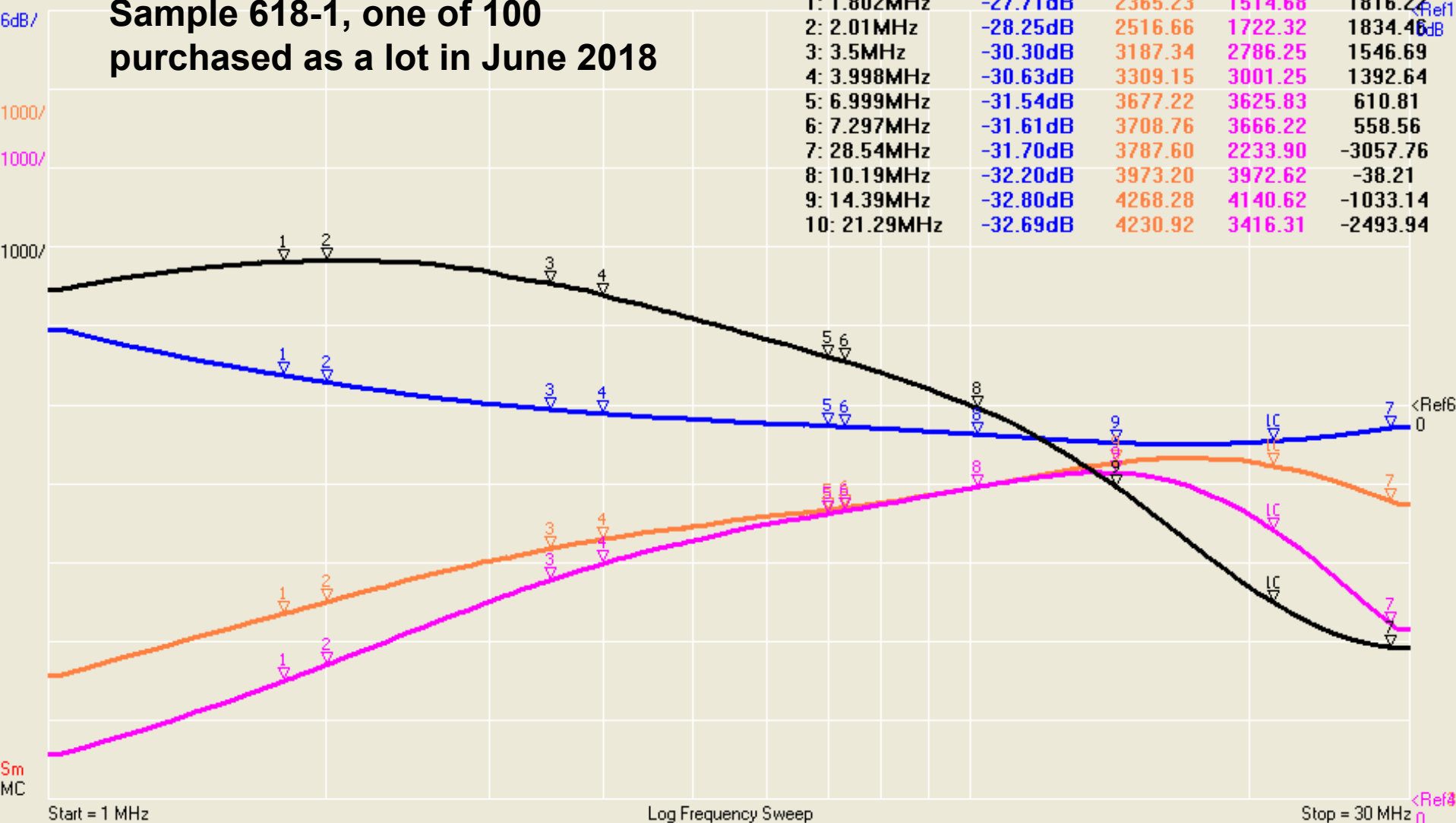
10 Turns RG58 on 2.4-in o.d. Fair-Rite #31 core

DG8SAQ Vector Network Analyzer Software

6/20/2018 1:12:11 PM 10 Turns on #31 618-1 2.4-in o.d. Core

**Sample 618-1, one of 100
purchased as a lot in June 2018**

| | | | | |
|--------------|----------|---------|---------|----------|
| 1: 1.802MHz | -27.71dB | 2365.23 | 1514.68 | 1816.22 |
| 2: 2.01MHz | -28.25dB | 2516.66 | 1722.32 | 1834.46 |
| 3: 3.5MHz | -30.30dB | 3187.34 | 2786.25 | 1546.69 |
| 4: 3.998MHz | -30.63dB | 3309.15 | 3001.25 | 1392.64 |
| 5: 6.999MHz | -31.54dB | 3677.22 | 3625.83 | 610.81 |
| 6: 7.297MHz | -31.61dB | 3708.76 | 3666.22 | 558.56 |
| 7: 28.54MHz | -31.70dB | 3787.60 | 2233.90 | -3057.76 |
| 8: 10.19MHz | -32.20dB | 3973.20 | 3972.62 | -38.21 |
| 9: 14.39MHz | -32.80dB | 4268.28 | 4140.62 | -1033.14 |
| 10: 21.29MHz | -32.69dB | 4230.92 | 3416.31 | -2493.94 |



=>
TX Att. = 30 dB

S21 dB

t2s Mag

t2s Real

t2s Imag

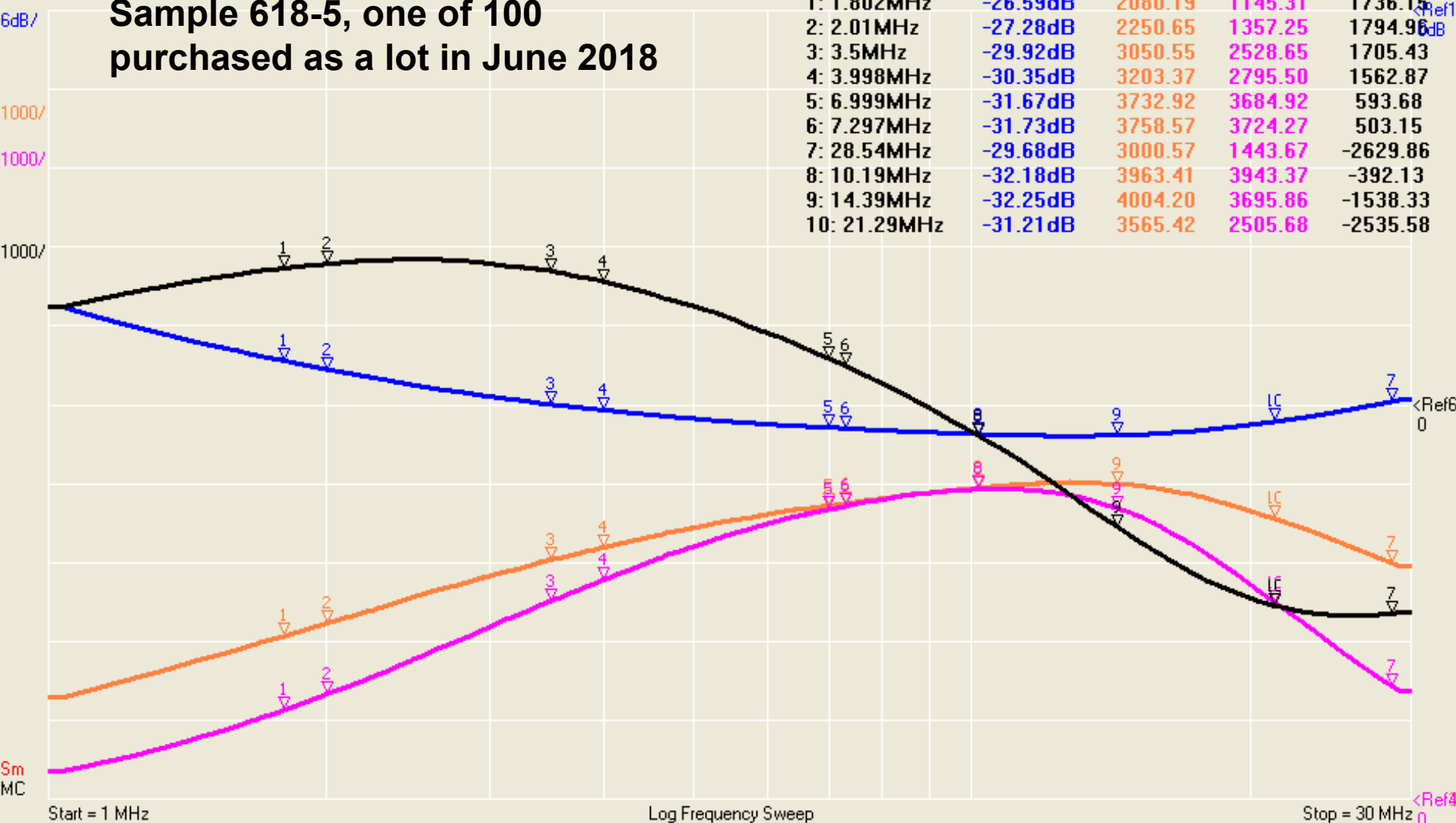
10 Turns RG58 on 2.4-in o.d. Fair-Rite #31 core

DG85AQ Vector Network Analyzer Software

6/20/2018 1:41:27 PM 10 Turns on #31 618-5 2.4-in o.d. Core

**Sample 618-5, one of 100
purchased as a lot in June 2018**

| | | | | | |
|--------------|----------|---------|---------|----------|-------|
| 1: 1.802MHz | -26.59dB | 2080.19 | 1145.31 | 1736.15 | <Ref1 |
| 2: 2.01MHz | -27.28dB | 2250.65 | 1357.25 | 1794.96 | 6dB |
| 3: 3.5MHz | -29.92dB | 3050.55 | 2528.65 | 1705.43 | |
| 4: 3.998MHz | -30.35dB | 3203.37 | 2795.50 | 1562.87 | |
| 5: 6.999MHz | -31.67dB | 3732.92 | 3684.92 | 593.68 | |
| 6: 7.297MHz | -31.73dB | 3758.57 | 3724.27 | 503.15 | |
| 7: 28.54MHz | -29.68dB | 3000.57 | 1443.67 | -2629.86 | |
| 8: 10.19MHz | -32.18dB | 3963.41 | 3943.37 | -392.13 | |
| 9: 14.39MHz | -32.25dB | 4004.20 | 3695.86 | -1538.33 | |
| 10: 21.29MHz | -31.21dB | 3565.42 | 2505.68 | -2535.58 | |



=>
TX Att. = 30 dB

S21 dB

t2s Mag

t2s Real

t2s Imag

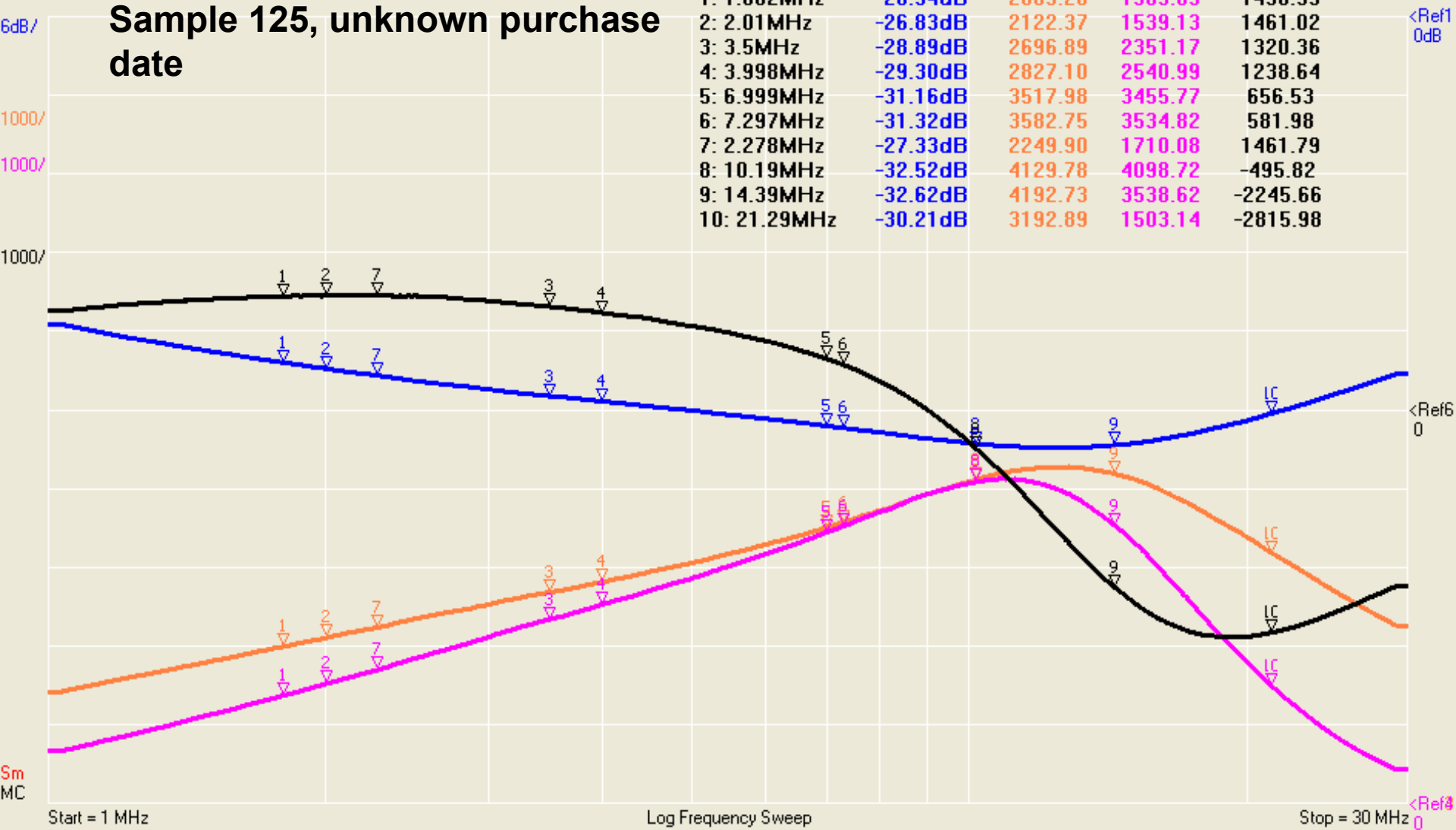
10 Turns RG58 on 2.4-in o.d. Fair-Rite #31 core

DG85AQ Vector Network Analyzer Software

6/3/2018 5:01:47 PM 10 Turns on #31 cores #125 Was White #31

Sample 125, unknown purchase date

| | | | | |
|--------------|----------|---------|---------|----------|
| 1: 1.802MHz | -26.34dB | 2005.26 | 1383.89 | 1450.93 |
| 2: 2.01MHz | -26.83dB | 2122.37 | 1539.13 | 1461.02 |
| 3: 3.5MHz | -28.89dB | 2696.89 | 2351.17 | 1320.36 |
| 4: 3.998MHz | -29.30dB | 2827.10 | 2540.99 | 1238.64 |
| 5: 6.999MHz | -31.16dB | 3517.98 | 3455.77 | 656.53 |
| 6: 7.297MHz | -31.32dB | 3582.75 | 3534.82 | 581.98 |
| 7: 2.278MHz | -27.33dB | 2249.90 | 1710.08 | 1461.79 |
| 8: 10.19MHz | -32.52dB | 4129.78 | 4098.72 | -495.82 |
| 9: 14.39MHz | -32.62dB | 4192.73 | 3538.62 | -2245.66 |
| 10: 21.29MHz | -30.21dB | 3192.89 | 1503.14 | -2815.98 |



=> TX Att. = 30 dB S21 dB t2s Mag t2s Real t2s Imag

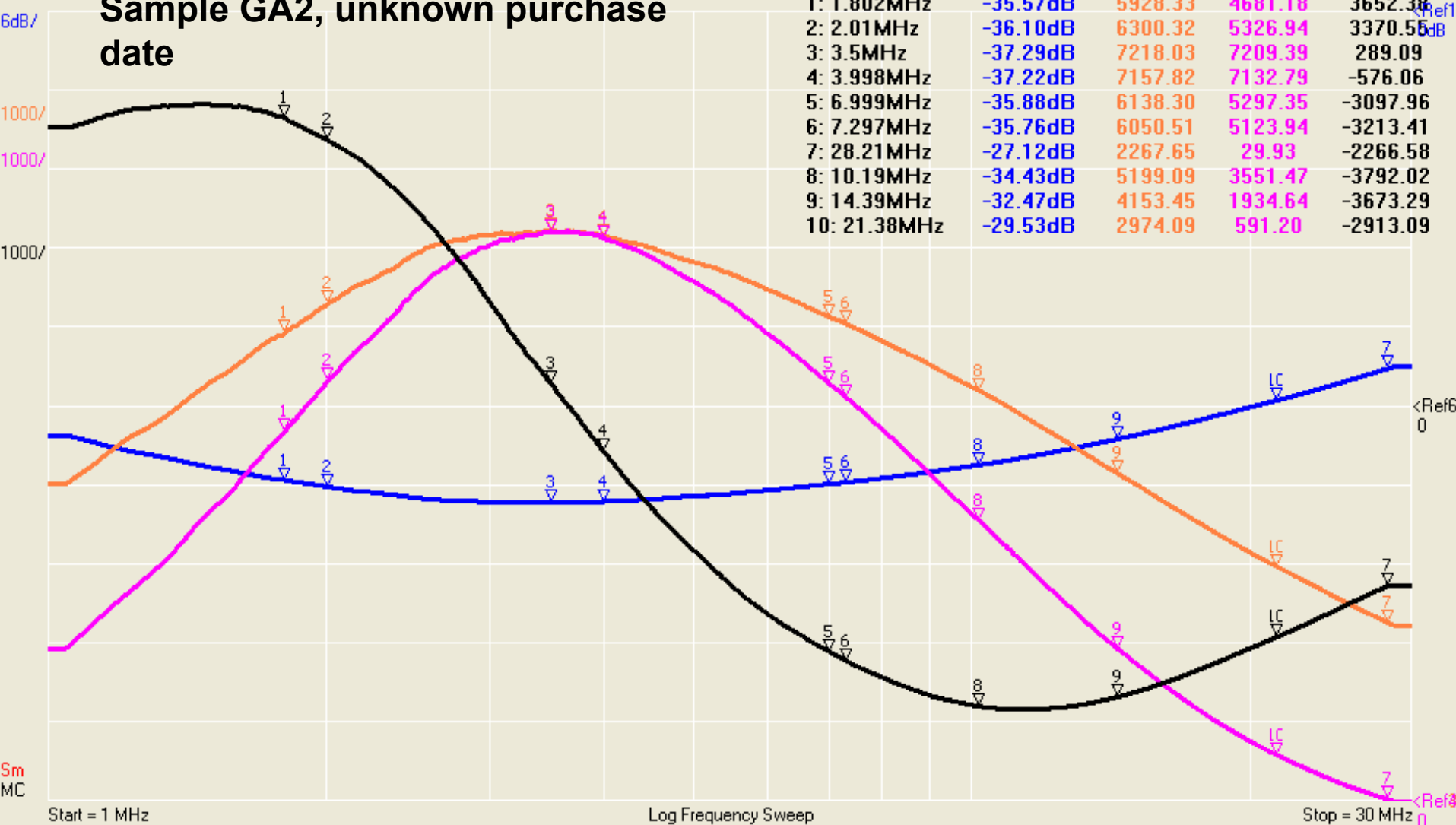
15 Turns RG400 on 2.4-in o.d. Fair-Rite #31 core

DG85AQ Vector Network Analyzer Software

11/6/2018 2:34:59 PM 2.4-in #31 Core #GA2RG400 15 Turns Short Leads

Sample GA2, unknown purchase date

| | | | | |
|--------------|----------|---------|---------|----------|
| 1: 1.802MHz | -35.57dB | 5928.33 | 4681.18 | 3652.38 |
| 2: 2.01MHz | -36.10dB | 6300.32 | 5326.94 | 3370.56 |
| 3: 3.5MHz | -37.29dB | 7218.03 | 7209.39 | 289.09 |
| 4: 3.998MHz | -37.22dB | 7157.82 | 7132.79 | -576.06 |
| 5: 6.999MHz | -35.88dB | 6138.30 | 5297.35 | -3097.96 |
| 6: 7.297MHz | -35.76dB | 6050.51 | 5123.94 | -3213.41 |
| 7: 28.21MHz | -27.12dB | 2267.65 | 29.93 | -2266.58 |
| 8: 10.19MHz | -34.43dB | 5199.09 | 3551.47 | -3792.02 |
| 9: 14.39MHz | -32.47dB | 4153.45 | 1934.64 | -3673.29 |
| 10: 21.38MHz | -29.53dB | 2974.09 | 591.20 | -2913.09 |



=>
TX Att. = 10 dB

S21 dB

t2s Mag

t2s Real

t2s Imag

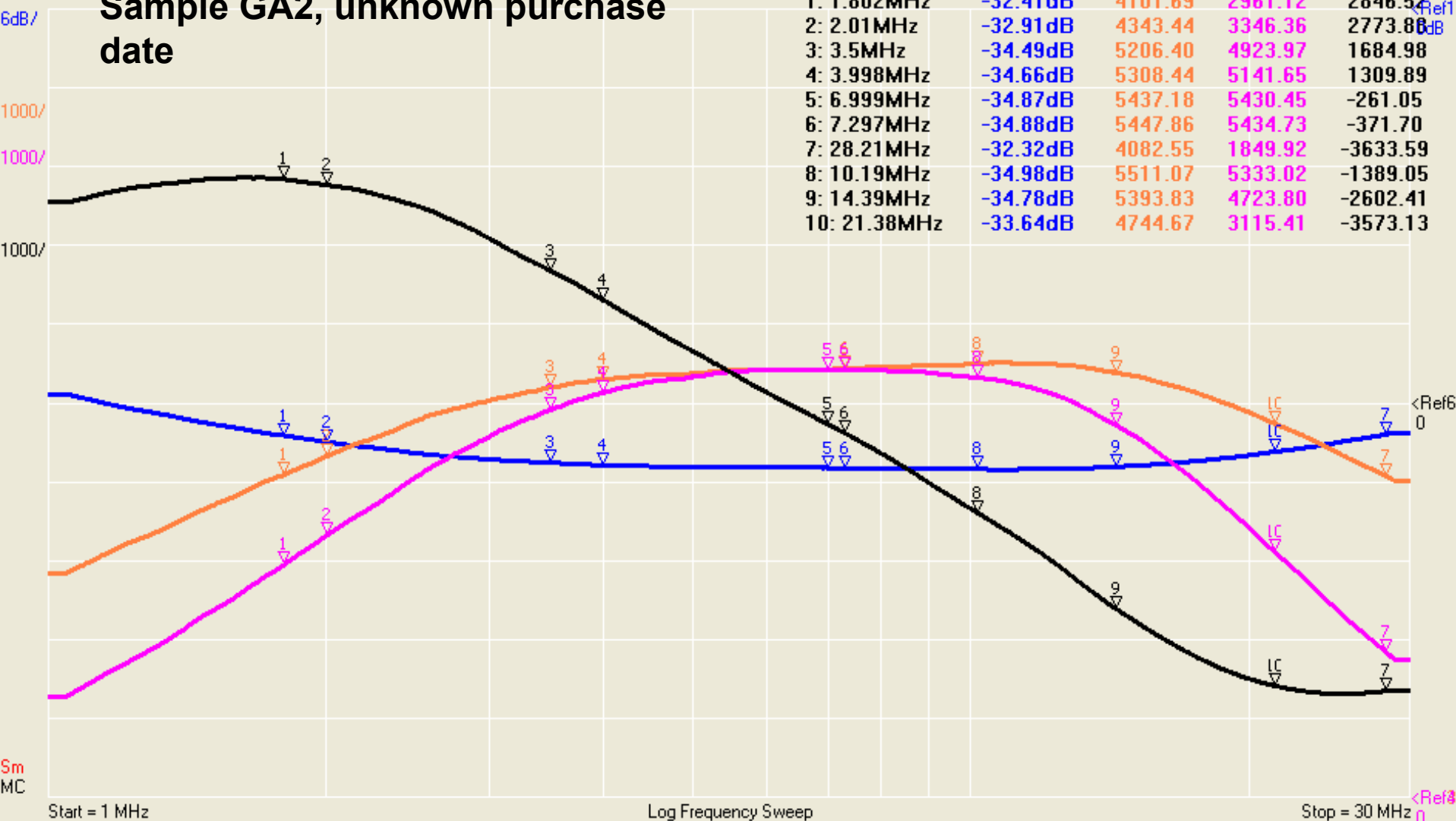
13 Turns RG400 on 2.4-in o.d. Fair-Rite #31 core

DG8SAQ Vector Network Analyzer Software

11/3/2018 12:46:54 PM 2.4-in #31 Core #GA2 RG400 13 Turns Short Leads

Sample GA2, unknown purchase date

| | | | | |
|--------------|----------|---------|---------|----------|
| 1: 1.802MHz | -32.41dB | 4101.69 | 2961.12 | 2846.52 |
| 2: 2.01MHz | -32.91dB | 4343.44 | 3346.36 | 2773.86 |
| 3: 3.5MHz | -34.49dB | 5206.40 | 4923.97 | 1684.98 |
| 4: 3.998MHz | -34.66dB | 5308.44 | 5141.65 | 1309.89 |
| 5: 6.999MHz | -34.87dB | 5437.18 | 5430.45 | -261.05 |
| 6: 7.297MHz | -34.88dB | 5447.86 | 5434.73 | -371.70 |
| 7: 28.21MHz | -32.32dB | 4082.55 | 1849.92 | -3633.59 |
| 8: 10.19MHz | -34.98dB | 5511.07 | 5333.02 | -1389.05 |
| 9: 14.39MHz | -34.78dB | 5393.83 | 4723.80 | -2602.41 |
| 10: 21.38MHz | -33.64dB | 4744.67 | 3115.41 | -3573.13 |



=> TX Att. = 10 dB

S21 dB

t2s Mag

t2s Real

t2s Imag

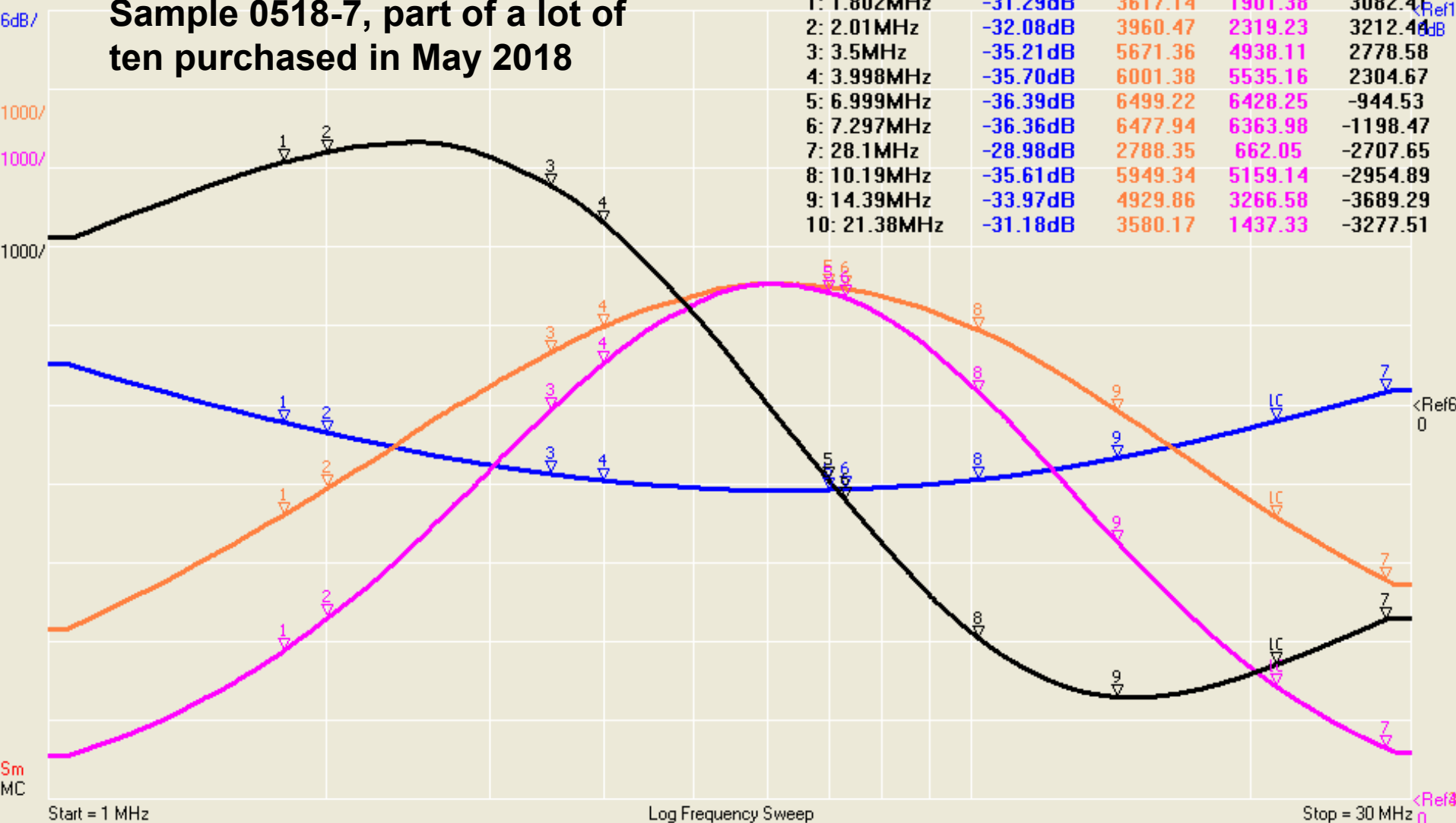
13 Turns 400 on 2.4-in o.d. Fair-Rite #31 core

DG8SAQ Vector Network Analyzer Software

10/22/2018 4:48:01 PM RG400 on Fair-Rite 2.4-in #31 Toroid #0518-7 13 Turns

Sample 0518-7, part of a lot of ten purchased in May 2018

| | | | | |
|--------------|----------|---------|---------|----------|
| 1: 1.802MHz | -31.29dB | 3617.14 | 1901.38 | 3082.41 |
| 2: 2.01MHz | -32.08dB | 3960.47 | 2319.23 | 3212.44 |
| 3: 3.5MHz | -35.21dB | 5671.36 | 4938.11 | 2778.58 |
| 4: 3.998MHz | -35.70dB | 6001.38 | 5535.16 | 2304.67 |
| 5: 6.999MHz | -36.39dB | 6499.22 | 6428.25 | -944.53 |
| 6: 7.297MHz | -36.36dB | 6477.94 | 6363.98 | -1198.47 |
| 7: 28.1MHz | -28.98dB | 2788.35 | 662.05 | -2707.65 |
| 8: 10.19MHz | -35.61dB | 5949.34 | 5159.14 | -2954.89 |
| 9: 14.39MHz | -33.97dB | 4929.86 | 3266.58 | -3689.29 |
| 10: 21.38MHz | -31.18dB | 3580.17 | 1437.33 | -3277.51 |



=>
TX Att. = 10 dB

S21 dB

t2s Mag

t2s Real

t2s Imag

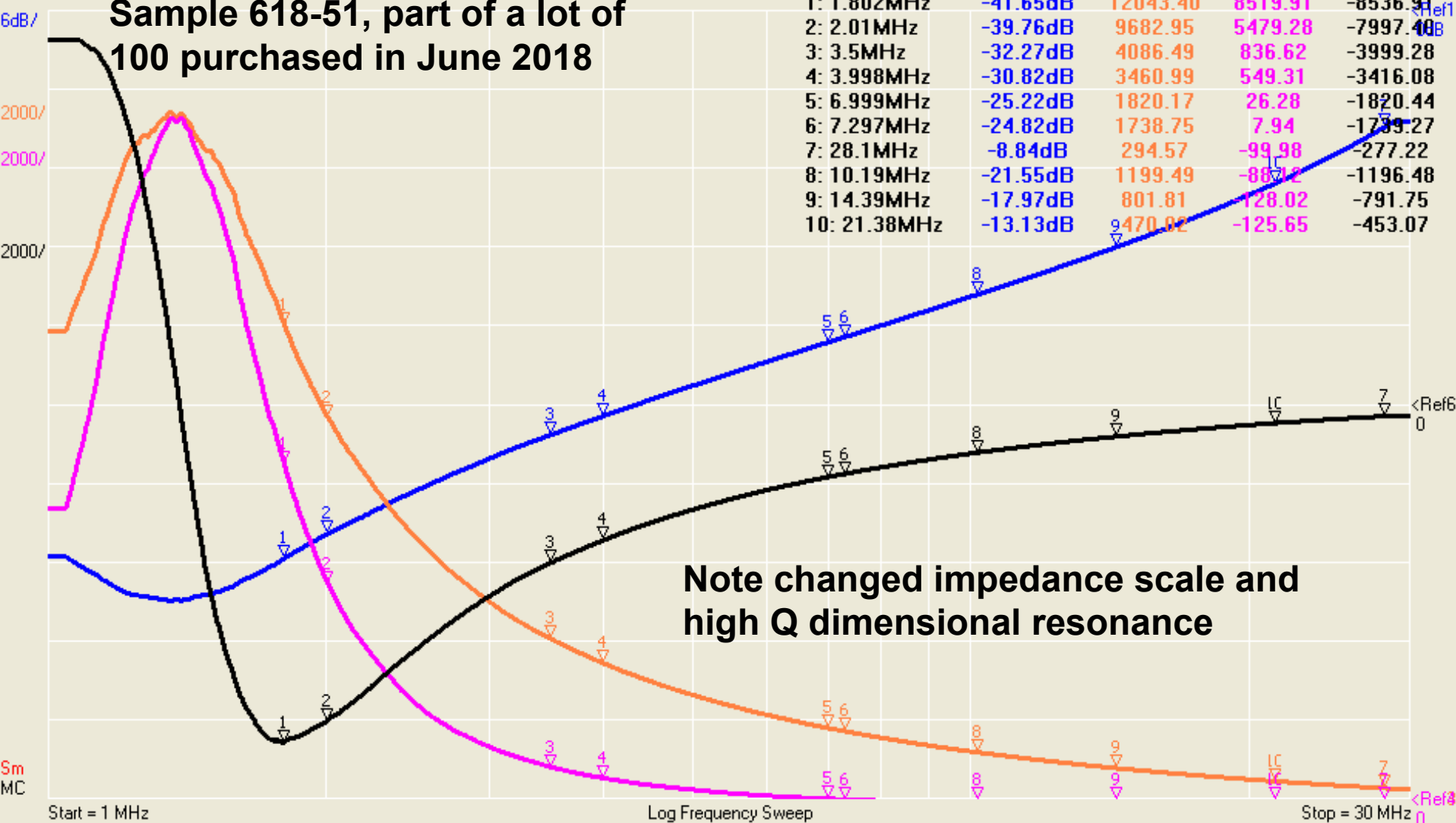
21 Turns 400 on 2.4-in o.d. Fair-Rite #31 core

DG8SAQ Vector Network Analyzer Software

10/22/2018 5:21:32 PM RG400 on Fair-Rite 2.4-in #31 Toroid #618-51 21 Turns

Sample 618-51, part of a lot of 100 purchased in June 2018

| | | | | |
|--------------|----------|----------|---------|----------|
| 1: 1.802MHz | -41.65dB | 12043.40 | 8519.91 | -8536.91 |
| 2: 2.01MHz | -39.76dB | 9682.95 | 5479.28 | -7997.40 |
| 3: 3.5MHz | -32.27dB | 4086.49 | 836.62 | -3999.28 |
| 4: 3.998MHz | -30.82dB | 3460.99 | 549.31 | -3416.08 |
| 5: 6.999MHz | -25.22dB | 1820.17 | 26.28 | -1820.44 |
| 6: 7.297MHz | -24.82dB | 1738.75 | 7.94 | -1739.27 |
| 7: 28.1MHz | -8.84dB | 294.57 | -99.98 | -277.22 |
| 8: 10.19MHz | -21.55dB | 1199.49 | -887.2 | -1196.48 |
| 9: 14.39MHz | -17.97dB | 801.81 | -128.02 | -791.75 |
| 10: 21.38MHz | -13.13dB | 470.02 | -125.65 | -453.07 |



Sm
MC

Start = 1 MHz

Log Frequency Sweep

Stop = 30 MHz

=>
TX Att. = 10 dB

S21 dB

t2s Mag

t2s Real

t2s Imag