

Neat way to check coax loss

The thought:

So how is your coax cable? – it ages, it gets water inside, it reduces your transmit & receive signals... With Field Day coming up, it might be the perfect time to CHECK your coax. If it is doing fine – excellent. If not, you have time to order some new coax and get it installed.

Tools you will need:

Have you ever noticed how coax makes SWR look better? Yep - It does that! We can use that property to determine the coax loss in decibels and compare that to new coax. As a bonus this method checks the connectors on the coax as well.

You need an antenna analyzer, a barrel connector, and a resistive load that will give you 3:1 SWR. You make the resistive load yourself inside a PL-259 connector! To get a 3:1 SWR you need three times 50 Ohms, so 150 Ohms. Here is the one I use. It has two 300 Ohm resistors in parallel soldered inside the PL-259.



Just twist the resistor leads together so they are in parallel (150 Ohms). Insert into the PL-259 so resistor leads come out of the tip. Bend the other resistor leads so they come out the side of the PL-259. Solder the resistor leads (tip & side) and clip off the excess resistor leads. Screw on PL-259 shell – you are done!

The method:

You are going to take 2 SWR measurements with your SWR analyzer at a given frequency. The key here is to use the same frequency that the coax manufacturers use to specify losses. Typical frequencies are: 28, 50, 144, & 440 MHz.

We will do a little math to determine the loss in this specific piece of coax. We will normalize our loss to 100 ft, and that will allow us to compare our coax directly against the manufacturer's specifications.

Here is an example:

I have a piece of RG-8X coax cable with PL-259 connectors that is 49.5 ft long.
I want to use it for HF, so I will test it at 28 MHz.

First, I connect the 3:1 SWR load directly to my SWR Analyzer and set the frequency to 28 MHz.
Get the SWR reading and write it down.

My set-up looks like this:



The SWR reads as 2.88 when the 3:1 SWR load is connected directly (with small adapter) to my antenna analyzer.

Now connect the test piece of coax between the antenna analyzer and the 3:1 SWR load. I did have to add a barrel connector (double SO-239) at the end of the coax so I could connect my 3:1 SWR load.

My set-up looks like this:



The SWR reads as 2.21 when the 3:1 SWR load is read through the coax cable under test.

Notice how the SWR went down when reading the 3:1 SWR load through the coax cable.

That may sound good at first, but that really means less power was reflected back towards the antenna analyzer – due to the LOSS in the cable....

So now we need to figure out how much loss this cable has and if this cable is good.

We have two SWR measurements:

2.88 – Directly on analyzer

2.21 – With coax cable

We now calculate (look up) the return loss for the above measurements. Please reference the Amphenol attachment at the end of this article that gives a conversion from VSWR to return loss.

You can also use an online converter to convert VSWR to return loss directly.

<https://www.allaboutcircuits.com/tools/vswr-return-loss-calculator/>

Here are the approximate return losses for our measurements:

2.88 SWR – Directly on analyzer => Return loss of 6.29 dB

2.21 SWR – With coax cable => Return loss of 8.48 dB

Now you subtract the smaller return loss number from the higher one AND divide by 2.

$(8.48 - 6.29) / 2 \Rightarrow$ **1.1 dB loss in our 49.5 ft cable and connectors**

By the way, you divide by 2 since we sent energy down the cable and it reflected back from the 3:1 SWR load. The signal experienced loss heading down the cable AND, on the way back (hence twice the loss).

Now we must normalize our numbers to 100 ft so we can compare directly with the manufacturer's specifications. Normalizing just means scaling our measurement to some standardized value.

Here is what the numbers mean in the equation below:

100 is the normalized length of 100 ft (manufacturers length data)

49.5 is the length of coax cable we have in feet

1.1 is the loss measurement we calculated in our cable

$$100/49.5 * 1.1 \Rightarrow 2.2 \text{ dB}$$

So, if our cable were 100 ft long it would have 2.2 dB of loss at 28 MHz.

Here is a handy quick reference chart with typical numbers from manufacturers:

Quick Reference of coax cable loss in dB per 100 ft						
	RG-58	RG-8X	LMR-240	RG-213	9913	LMR-400
3.5 MHz	0.8	0.65	0.45	0.3	0.23	0.2
7 MHz	1.2	0.85	0.64	0.5	0.32	0.3
14 MHz	1.7	1.21	0.91	0.7	0.46	0.5
28 MHz	2.4	1.74	1.29	1	0.65	0.7
50 MHz	3.2	2.36	1.73	1.4	0.88	0.9
144 MHz	5.5	4.2	2.95	2.4	1.54	1.44
440 MHz	9.9	7.92	5.23	4.4	2.82	2.7

Go over to the column for RG-8X coax and move down to 28 MHz.

You will see the number 1.74 dB.

Our piece of coax normalized to 100 ft has a loss of 2.2 dB, that is 0.46 dB MORE LOSS than a brand new piece of RG-8X coax.

Remember this piece of coax has 2x PL-259 connectors and I used a barrel connector in the measurement. For my purposes 0.46 dB additional loss compared to new...is fine...coax cable is GOOD!

Conclusion:

You can never escape loss, BUT you can find out if you are losing more than you should be 😊!!

VSWR	RL (dB)	VSWR	RL (dB)	VSWR	RL (dB)	VSWR	RL (dB)	VSWR	RL (dB)
1.001	66.025	1.060	30.714	1.138	23.803	1.480	14.264	5.400	3.255
1.002	60.009	1.061	30.575	1.140	23.686	1.490	14.120	5.600	3.136
1.003	56.491	1.062	30.438	1.142	23.571	1.500	13.979	5.800	3.025
1.004	53.997	1.063	30.303	1.144	23.457	1.520	13.708	6.000	2.923
1.005	50.484	1.064	30.171	1.146	23.346	1.540	13.449	6.200	2.827
1.006	50.484	1.065	30.040	1.148	23.235	1.560	13.201	6.400	2.737
1.007	49.149	1.066	29.912	1.150	23.127	1.580	12.964	6.600	2.653
1.008	47.993	1.067	29.785	1.152	23.020	1.600	12.736	6.800	2.573
1.009	46.975	1.068	29.661	1.154	22.914	1.620	12.518	7.000	2.499
1.01	46.064	1.069	29.538	1.156	22.810	1.640	12.308	7.200	2.428
1.011	45.24	1.070	29.417	1.158	22.708	1.660	12.107	7.400	2.362
1.012	44.489	1.071	29.298	1.160	22.607	1.680	11.913	7.600	2.299
1.013	43.798	1.072	29.181	1.162	22.507	1.700	11.725	7.800	2.239
1.014	43.159	1.073	29.066	1.164	22.408	1.720	11.545	8.000	2.183
1.015	42.564	1.074	28.952	1.166	22.311	1.740	11.370	8.200	2.129
1.016	42.007	1.075	28.839	1.168	22.215	1.760	11.202	8.400	2.078
1.017	41.485	1.076	28.728	1.170	22.120	1.780	11.039	8.600	2.029
1.018	40.993	1.077	28.619	1.172	22.027	1.800	10.881	8.800	1.983
1.019	40.528	1.078	28.511	1.174	21.934	1.820	10.729	9.000	1.938
1.02	40.086	1.079	28.405	1.176	21.843	1.840	10.581	9.200	1.896
1.021	39.667	1.080	28.299	1.178	21.753	1.860	10.437	9.400	1.855
1.022	39.267	1.081	28.196	1.180	21.664	1.880	10.298	9.600	1.816
1.023	38.885	1.082	28.093	1.182	21.576	1.900	10.163	9.800	1.779
1.024	38.52	1.083	27.992	1.184	21.489	1.920	10.032	10.000	1.743
1.025	38.17	1.084	27.892	1.186	21.403	1.940	9.904	11.000	1.584
1.026	37.833	1.085	27.794	1.188	21.318	1.960	9.780	12.000	1.451
1.027	37.51	1.086	27.696	1.190	21.234	1.980	9.660	13.000	1.339
1.028	37.198	1.087	27.600	1.192	21.151	2.000	9.542	14.000	1.243
1.029	36.895	1.088	27.505	1.194	21.069	2.100	8.999	15.000	1.160
1.03	36.607	1.089	27.411	1.196	20.988	2.200	8.519	16.000	1.087
1.031	36.327	1.090	27.318	1.198	20.907	2.300	8.091	17.000	1.023
1.032	36.055	1.091	27.226	1.200	20.828	2.400	7.707	18.000	0.966
1.033	35.792	1.092	27.135	1.210	20.443	2.500	7.360	19.000	0.915
1.034	35.537	1.093	27.046	1.220	20.079	2.600	7.044	20.000	0.869
1.035	35.29	1.094	26.957	1.230	19.732	2.700	6.755	22.000	0.790
1.036	35.049	1.095	26.869	1.240	19.401	2.800	6.490	24.000	0.724
1.037	34.816	1.096	26.782	1.250	19.085	2.900	6.246	26.000	0.668
1.038	34.588	1.097	26.697	1.260	18.783	3.000	6.021	28.000	0.621
1.039	34.367	1.098	26.612	1.270	18.493	3.100	5.811	30.000	0.579
1.04	34.151	1.099	26.528	1.280	18.216	3.200	5.617	32.000	0.543
1.041	33.941	1.100	26.444	1.290	17.949	3.300	5.435	34.000	0.511
1.042	33.763	1.102	26.281	1.300	17.692	3.400	5.265	36.000	0.483
1.043	33.536	1.104	26.120	1.310	17.445	3.500	5.105	38.000	0.457
1.044	33.341	1.106	25.963	1.320	17.207	3.600	4.956	40.000	0.434
1.045	33.15	1.108	25.809	1.330	16.977	3.700	4.815	42.000	0.414
1.046	32.963	1.110	25.658	1.340	16.755	3.800	4.682	44.000	0.395
1.047	32.78	1.112	25.510	1.350	16.540	3.900	4.556	46.000	0.038
1.048	32.602	1.114	25.364	1.360	16.322	4.000	4.437	48.000	0.362
1.049	32.427	1.116	25.221	1.370	16.131	4.100	4.324	50.000	0.347
1.05	32.256	1.118	25.081	1.380	15.936	4.200	4.217	55.000	0.316
1.051	32.088	1.120	24.943	1.390	15.747	4.300	4.115	60.000	0.290
1.052	31.923	1.122	24.808	1.400	15.563	4.400	4.018	65.000	0.267
1.053	31.762	1.124	24.675	1.410	15.385	4.500	3.926	70.000	0.248
1.054	31.604	1.126	24.544	1.420	15.211	4.600	3.838	75.000	0.232
1.055	31.449	1.128	24.415	1.430	15.043	4.700	3.753	80.000	0.217
1.056	31.297	1.130	24.289	1.440	14.879	4.800	3.673	85.000	0.204
1.057	31.147	1.132	24.164	1.450	14.719	4.900	3.596	90.000	0.193
1.058	31	1.134	24.042	1.460	14.564	5.000	3.522	95.000	0.183
1.059	30.856	1.136	23.921	1.470	14.412	5.200	3.383	100.000	0.174

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