COMMSCOPE®

White paper

Return loss comparisons

Ground based system vs. short remote radio head jumper

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Contents

Typical system return loss

A system return loss test measures multiple devices at once in a wireless network.

The manner in which devices are connected impacts system return loss test results. Generally, devices that are farthest from the test point have their return loss masked by the insertion loss of intermediate devices.

Figure 1 shows a typical cell site sector for a ground-mounted base station radio that utilizes a coaxial feeder line to connect the radio to the antenna. The system return loss is a composite for the devices. The typical value for this type of configuration is presented in sheet 1.

The antenna's 14 dB return loss is masked by the insertion loss of the components located between it and the point of measurement. This insertion loss affects the measurement by twice the total additive value: once as the incident signal travels in the direction of the antenna and a second time as the reflected signal travels in the direction of the test equipment. As a result, system return loss measurements usually exceed the return loss of any single component (in this example, the typical system return loss measures 16.5 dB).

This example incorporates average return loss values; actual return loss values will be higher. Other components contribute to the system return loss value, but their return loss values are much higher than the antenna return loss values, reducing their overall contributions to the total.

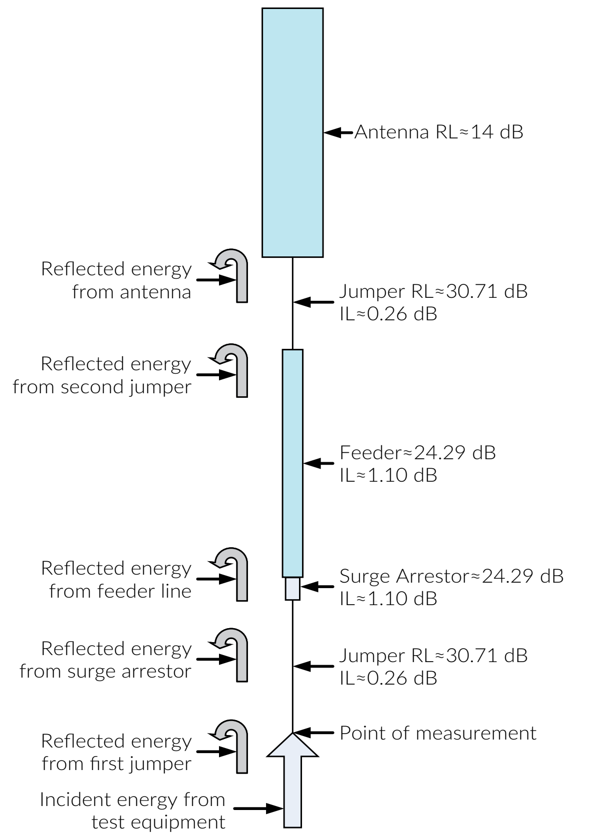

Figure 1: The diagram shows a traditional ground-mounted radio configuration

VSWR System Calculator - *Global*

COMMSCOPE®

Version 8.6

25-Jan-12

Frequency (MHz): 850.00

Component Used?	System Component	Max. VSWR	Return Loss (dB)	Cable Type / Component Loss (dB)	Cable Length (m)	Cable Length (ft)	Ins Loss w/2 Conn (dB)	% of Est. System Reflection	Reflections at input
	Antenna or Load	1.50	13.98					76.7%	0.1308
Yes	**Jumper**	1.06	30.71	LDF4-50A	3.048	10.00	0.26	1.8%	0.0202
No	Tower Mounted Amp	1.29	17.95	0.50			0.00	0.0%	0.0000
No	Jumper	1.06	30.71		0.914	3.00	0.00	0.0%	0.0000
No	Top Diplexer or Bias Tee	1.13	24.29	0.20			0.00	0.0%	0.0000
No	Jumper	1.06	30.71		0.914	3.00	0.00	0.0%	0.0000
Yes	**Main Feed Line**	1.13	24.29	AVA5-50	30.480	100.00	1.10	13.4%	0.0546
No	**Jumper**	1.06	30.71		0.914	3.00	0.00	0.0%	0.0000
No	Bias Tee	1.17	22.12	0.10			0.00	0.0%	0.0000
No	Jumper	1.06	30.71		0.914	3.00	0.00	0.0%	0.0000
Yes	**Surge Suppressor**	1.07	29.42	0.10			0.10	4.3%	0.0310
No	Jumper	1.06	30.71		0.914	3.00	0.00	0.0%	0.0000
No	Bottom Diplexer or Duplexer	1.13	24.29	0.20			0.00	0.0%	0.0000
Yes	**Jumper**	1.06	30.71	FSJ4-50B	3.048	10.00	0.38	3.8%	0.0291
								100.0%	

Legacy Jumper / TL Cables	Andrew	CommScope	Field Install VSWR	SureFlex VSWR
1/2 inch Superflexible Copper	FSJ4-50B		1.13	1.06
1/2 inch Foam Copper	LDF4-50A		1.13	1.06
1/2 inch Superflexible Aluminum		SFX 500	1.10	
1/2 inch Foam Aluminum		FXL 540	1.10	

Legacy Transmission Lines	Andrew	CommScope		
7/8 inch Copper	LDF5-50A		1.13	
1 1/4 inch Copper	LDF6-50		1.13	
1 5/8 inch Copper	LDF7-50A		1.13	
7/8 inch Virtual Air Copper	AVA5-50		1.13	
7/8 inch Virtual Air Copper	AVA5-50FX		1.13	
1 5/8 inch Virtual Air Copper	AVA7-50		1.13	
7/8 inch Aluminum	AL5-50	FXL 780	1.13 | 1.10	
1 1/4 inch Aluminum		FXL 1480	1.10	
1 5/8 inch Aluminum	AL7-50	FXL 1873	1.13 | 1.10	

Typical Conn Loss (2per cable)	0.028
Typical System Reflection:	0.1493
Typical System VSWR:	1.35
Typical System Return Loss (dB):	16.5
Worst System Reflection:	0.2656
Worst System VSWR:	1.72
Worst System Return Loss (dB):	11.6
Total Insertion Loss (dB):	1.85

RL to VSWR converter		Feet to meters converter	
Return Loss (dB)	VSWR	Feet	meters
17.00	1.33	3.00	0.914

Sheet 1: This spreadsheet shows the system return loss calculation for figure 1

In figure 2, the base station radio is mounted next to the antenna and connected with a short jumper. As a result, there is little insertion loss to mask the return loss of the antenna. The system return loss measurement will essentially equal the return loss of the antenna plus some small loss associated with the jumper insertion loss. See sheet 2 for the typical system return loss (14.4 dB) for this type of configuration.

Both antennas used in these examples offer the same return loss values, yet each configuration yields a markedly different result.

System return loss limits have been set based on legacy configurations and not updated to reflect current installation trends. With the increased reliability of radio components, RRUs are being deployed at the tops of towers next to the antennas, as illustrated in figure 2. However, system return loss limits are still being enforced based upon values determined for figure 1. Without the additional insertion loss of the feeder line, the system return loss more closely reflects the antenna return loss.

Additionally, even though figure 2 represents a configuration that returns a lower system return loss measurement, its system performance is actually improved due to the removal of the feeder line loss. Without feeder loss, equivalent isotropic radiated power (EIRP) is higher in the downlink, while the noise figure is better in the uplink.

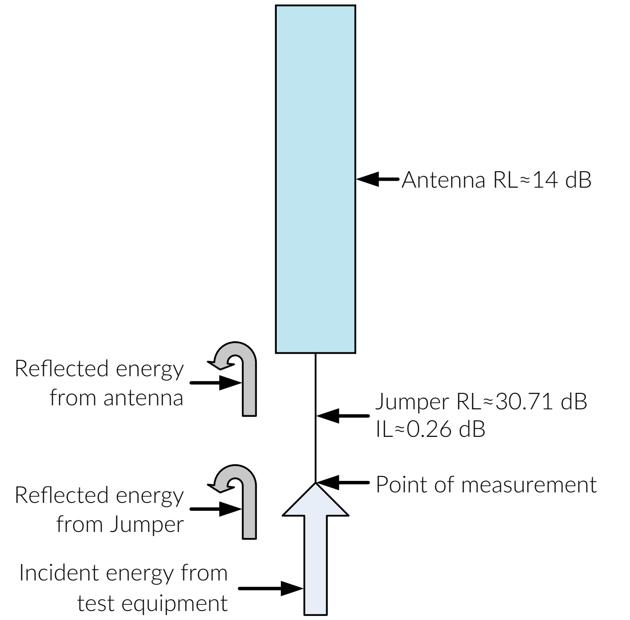

Figure 2: This diagram shows a typical tower-mounted radio (RRU) configuration

VSWR System Calculator - *Global*

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Frequency (MHz): 850.00

Component Used?	System Component	Max. VSWR	Return Loss (dB)	Cable Type / Component Loss (dB)	Cable Length (m)	Cable Length (ft)	Ins Loss w/2 Conn (dB)	% of Est. System Reflection	Reflections at input
	Antenna or Load	1.50	13.98					97.7%	0.1884
Yes	**Jumper**	1.06	30.71	LDF4-50A	3.048	10.00	0.26	2.3%	0.0291
No	Tower Mounted Amp	1.29	17.95	0.50			0.00	0.0%	0.0000
No	Jumper	1.06	30.71		0.914	3.00	0.00	0.0%	0.0000
No	Top Diplexer or Bias Tee	1.13	24.29	0.20			0.00	0.0%	0.0000
No	Jumper	1.06	30.71		0.914	3.00	0.00	0.0%	0.0000
No	**Main Feed Line**	1.13	24.29		30.480	100.00	0.00	0.0%	0.0000
No	**Jumper**	1.06	30.71		0.914	3.00	0.00	0.0%	0.0000
No	Bias Tee	1.17	22.12	0.10			0.00	0.0%	0.0000
No	Jumper	1.06	30.71		0.914	3.00	0.00	0.0%	0.0000
No	**Surge Suppressor**	1.07	29.42	0.10			0.00	0.0%	0.0000
No	Jumper	1.06	30.71		0.914	3.00	0.00	0.0%	0.0000
No	Bottom Diplexer or Duplexer	1.13	24.29	0.20			0.00	0.0%	0.0000
No	**Jumper**	1.06	30.71		3.048	10.00	0.00	0.0%	0.0000
								100.0%	

Legacy Jumper / TL Cables	Andrew	CommScope	Field Install VSWR	SureFlex VSWR
1/2 inch Superflexible Copper	FSJ4-50B		1.13	1.06
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1/2 inch Superflexible Aluminum		SFX 500	1.10	
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7/8 inch Copper	LDF5-50A		1.13	
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7/8 inch Aluminum	AL5-50	FXL 780	1.13 | 1.10	
1 1/4 inch Aluminum		FXL 1480	1.10	
1 5/8 inch Aluminum	AL7-50	FXL 1873	1.13 | 1.10	

Typical Conn Loss (2per cable)	0.028
Typical System Reflection:	0.1907
Typical System VSWR:	1.47
Typical System Return Loss (dB):	14.4
Worst System Reflection:	0.2176
Worst System VSWR:	1.56
Worst System Return Loss (dB):	13.2
Total Insertion Loss (dB):	0.26

RL to VSWR converter		Feet to meters converter	
Return Loss (dB)	VSWR	Feet	meters
14.00	1.50	3.00	0.914

Sheet 2: This spreadsheet shows the system return loss calculation for figure 2

Typical system reflection vs. worst system reflection

To this point, we have addressed reflected signals in the typical fashion, when the vectors add randomly at the measurement point. However, in certain instances, the reflected signals' vectors add constructively at the measurement point. In such cases, the system return loss measurement is far worse than typical, a phenomenon unattributed to any single component. Rather, it is the measurement of the components taken in their configuration that result in this vector alignment.

Sheets 1 and 2 illustrate what this value would be for the configurations in figures 1 and 2, respectively.

One method of scrambling the vectors randomly is changing the length of the bottom jumper or feeder line by 90 degrees of phase shift. This is usually done by removing the connector, trimming the cable length, and re-installing the connector on the shortened cable.

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