RelCom WR-28 Waveguide Switch at 47 GHz

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As amateur radio operators, we tend to make the best use out of what we have to work with. This is especially true when we use waveguide or waveguide components that were primarily designed for a band outside our frequency of interest. On 10 GHz, where the primary waveguide size is WR-90, we quite often use the next sizes up like WR-75 and WR-62. On 24 GHz, WR-42 is the primary waveguide of choice but we do use WR-28 which is designed for 26 to 40 GHz. The low frequency cutoff of WR-28 is 21.081 GHz allowing the waveguide to pass 24 GHz with little or no attenuation. Moving up to 47 GHz, we would normally be looking for WR-22 or WR-19, but this waveguide gets rather pricey. So why not try WR-28? Especially if you are looking for a waveguide switch for 47 GHz.

When Greg AA5C was assembling his 47 GHz transverter, I suggested that he try to use the RelCom WR-28 waveguide switch as a TR switch. I was unaware of the magnitude of the problem that Barry previously described at 47 GHz with the RelCom waveguide switch. Measurements by Greg on his 47 GHz transverter with the RelCom relay installed showed a 4 dB plus increase in receive noise figure and a 4 dB loss in power out put on transmit. Setting up bench tests, it became evident that this was truly the case. These observations were predicted by Barry in his swept measurements. It was also apparent that intentionally mis aligning the flanges could lower the loss.

Our attention then turned to the choke that was machined into the RelCom switch. A cross sectional view of a typical choke to flat waveguide junction is shown in Figure 1.

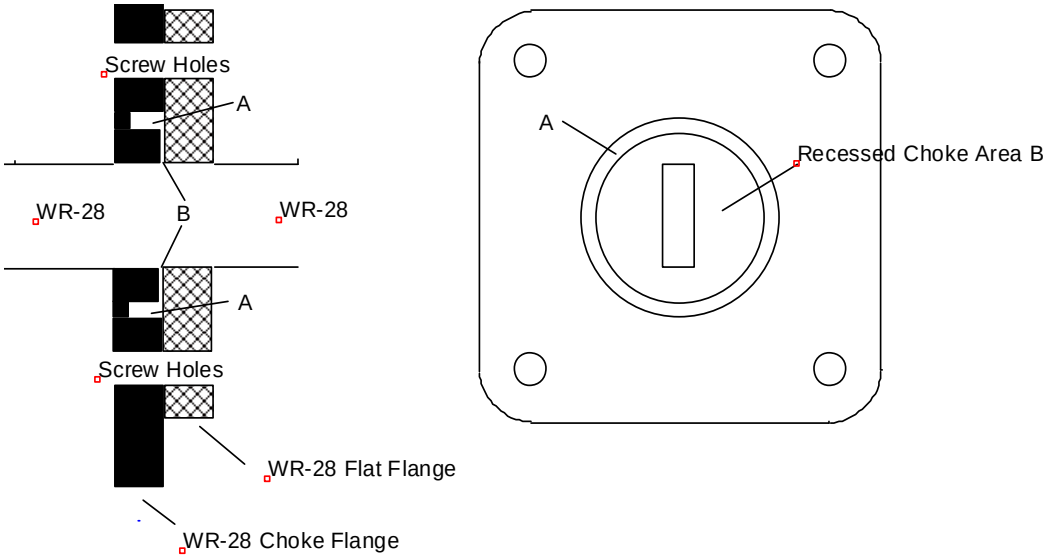

Figure 1. Cross sectional view

The choke consists of 2 resonant structures A and B. The grove at A is roughly a quarter-wave long at the original design frequency. B shows a recessed area that is inside the area defined by the groove A. Both of these structures are designed to provide a low impedance at the junction of the choke flange and the flat flange. This helps minimize loss at the junction of the 2 waveguides. Since WR-28 is normally optimized for a frequency in the 26 to 40 GHz frequency range, it is not surprising that the WR-28 choke might have some unusual response at 47 GHz.

At this point, I decided to compare WR-28 choke flanges. I went into my waveguide box and found what I believe to be a typical WR-28 flange with choke and I compared dimensions between this choke and the choke on the RelCom switch. The comparison is shown in Figure 2.

Parameter	Choke Depth	Choke Width	Recessed Area
Std Flange	.100”	.022”	.006”
RelCom Flange	.100”	.025”	.0025”

Figure2. WR-28 Choke Flange Dimensions

It was apparent that both of these flanges probably have different resonant frequencies or traps that may affect 47 GHz. I had to find a way to change the resonant frequency of the choke. I decided to fill the trench with something conductive. I used the leads from a ¼ watt carbon resistor whose wire diameter was .025”. I was able to insert 2 layers of resistor lead in the trench on 2 ports of the switch. When retested, I had reduced the loss of the waveguide switch from nearly 5 dB, down to about 2.5 dB at 47088.1 MHz. Clearly the choke is having a significant effect on 47 GHz. Now comes the question of what can be done about the recessed area. It is only recessed by .0025” but encompasses an area of .324” and is still forming a sort of tuned circuit at the junction of the 2 flanges. I don’t have a good answer other than trying some tuning on the WR-28 waveguide leading into the switch. If I was having an issue with a normal piece of WR-28 waveguide with a choke flange, I would file it flat as Barry as suggested. However, I would not chance filing on the RelCom switch. Put some screws in the waveguide and tune it up!

Bottom line…be aware of the WR-28 choke flange at 47 GHz!

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