STUDY OF ANTI-INTERFERENCE TECHNIQUE IN KLYSTRON GALLERY

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Abstract

There is RF electromagnetism leakage in klystron gallery of NSRL of Hefei. In order to ensure communication signal in gallery not to be disturbed, the leaked noise has been reduced using anti-interference technology. The contrast test of leaked noise has also been made, and the result shows effectiveness of anti-interference technique which is used.

1 SHIELDING OF THE COMMON GROUND WIRE

As Fig.1, the common ground wire AB radiates electromagnetic noise during thyratron discharges[1]. Because the noise frequency is $f = 1.820MHz$, the penetration depth is $\delta = 4.9 \times 10^{-2} mm$. In order reduce the noise, the ground wire is shielded in Cu, whose thickness is $0.1mm$. Fig.2 and Fig.3 respectively show the noise voltages before and after adopting shielding measure to the common ground wire. After adopting anti-interference technique, the noise voltage is reduced 6.09dB.

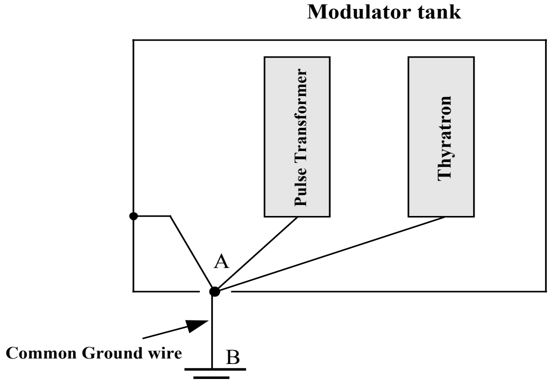

Figure 1: Sketch-map of the common ground wire.

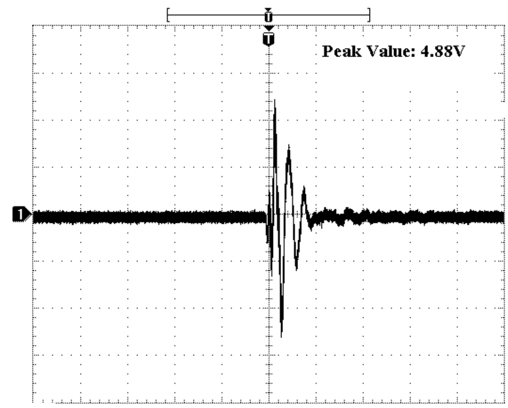

Figure 2: Noise voltages before adopting shielding measure to the common ground wire.

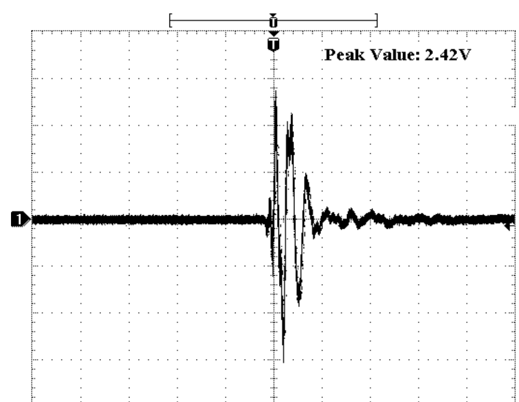

Figure 3: Noise voltages after adopting shielding measure to the common ground wire.

2 SHIELDING OF THE TRANSMISSION CABLE BETWEEN MODULATOR AND KLYSTRON

When klystron-modulator hydrogen thyratron discharges, the transmission cable between modulator and klystron radiates electromagnetic noise. In order reduce the noise, the cable is shielded in Cu. Fig.4 shows the sketch-map of transmission cable, Fig.5 and Fig.6 respectively show the noise voltages before and after adopting shielding measure. After adopting anti-interference technology to the cable, the noise voltage is reduced 9.27dB.

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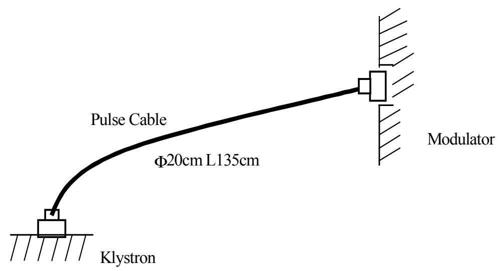

Figure 4: Sketch-map of transmission cable.

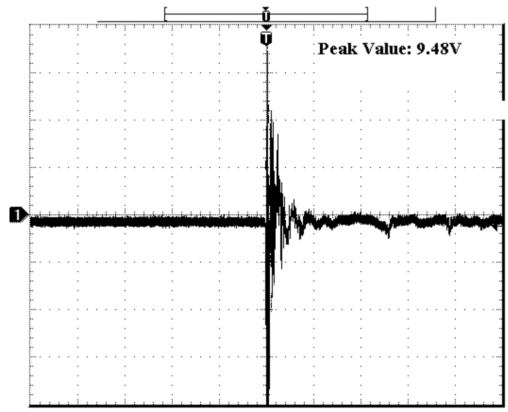

Figure5: Noise curve before adopting shielding measure to the cable.

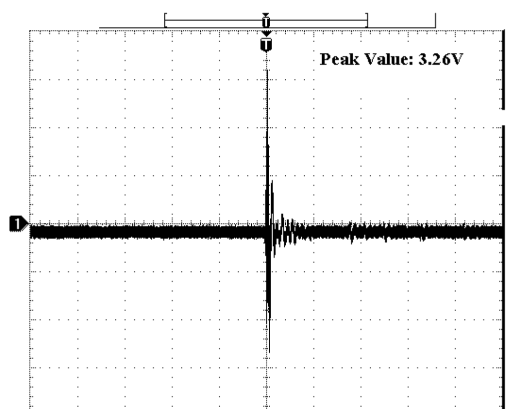

Figure 6: Noise curve after adopting shielding measure to the cable.

3 ANTI-INTERFERENCE MEASURE OF MODULATOR VENTHOLE

There are eight permanent ventholes on the top of the modulator tank, which radiate HF electromagnetic noise. The cut-off wave-guide pipe is used to reduce the noise. According to the principle of cut-off wave-guide, when the frequency of electromagnetic wave is less than the cut-off frequency of wave-guide pipe, the pipe has attenuation effect[2]. Fig.7 shows the structure of rotundity wave-guide pipe, and Fig.8 shows the sketch-map of cut-off wave-guide venthole of modulator.

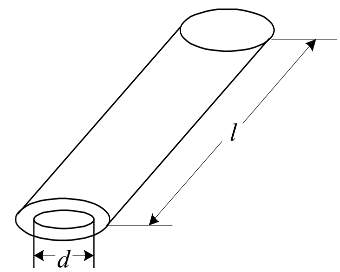

Figure 7: Structure of rotundity wave-guide pipe.

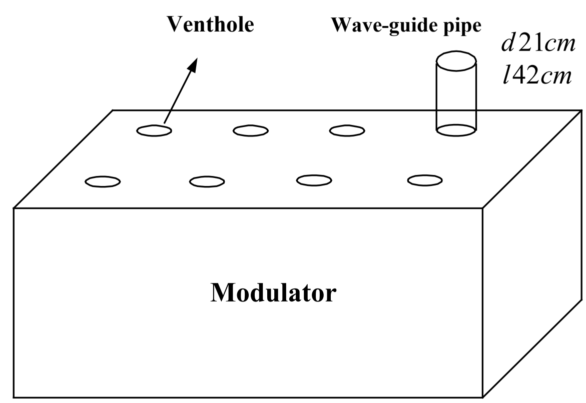

Figure 8: Sketch-map of cut-off wave-guide venthole of modulator.

The cut-off frequency of rotundity wave-guide pipe and wavelength are[3]

$$f_c = \frac{17.5}{d}\ (GHz);\quad \lambda_c = 1.71d\ (cm)$$

Where

d is the diameter of rotundity wave-guide pipe.

According to the formula[4]

$$A = 1.823\times10^{-9} f_c \sqrt{1-(\frac{f}{f_c})^2}\cdot l\quad (dB)$$

where

A is attenuation coefficient;

f_C is the cut-off frequency of rotundity wave-guide pipe;

f is the frequency of electromagnetic wave;

l is the length of wave-guide pipe.

Because the diameter of venthole is $d = 21cm$, the cut-off frequency of rotundity wave-guide pipe is

$$f_C = \frac{17.5}{d} = \frac{17.5}{21} = 0.833(GHz) = 833MHz$$

The noise frequency is $f = 1.820MHz$, so

$$f << f_c$$

Thus

$$A = 1.823 \times 10^{-9} f_c \cdot l \quad (dB)$$

That is

$$A = 32\frac{l}{d} \quad (dB)$$

Because $l = 42cm$, and the inner diameter $d = 21cm$, the noise attenuation coefficient is

$$A = 32\frac{l}{d} = 32\frac{42}{21} = 64(dB)$$

Fig.9 and Fig.10 respectively show the noise voltages before and after adopting cut-off wave-guide pipe. After adopting the pipe to the venthole, the noise voltage is reduced 18.42dB. But there is difference between theoretical calculation and experimental test.

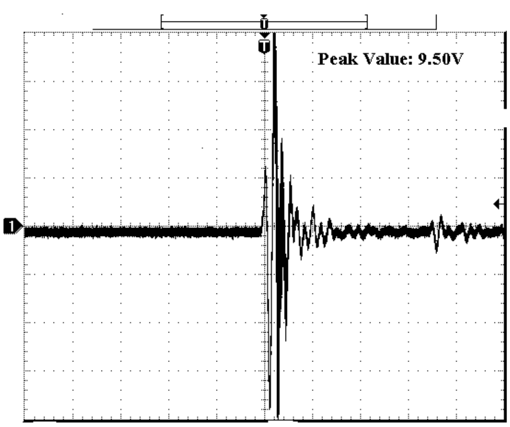

Figure 9: Noise curve before adopting cut-off wave-guide.

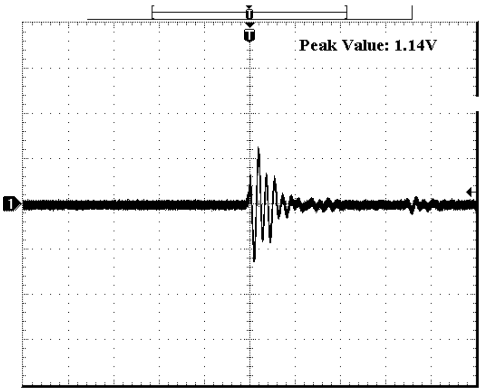

Figure 10: Noise curve after adopting cut-off wave-guide.

4 CONCLUSION

So, after taking anti-interference measures to the common ground wire, the transmission cable and the venthole, the noise voltage is respectively attenuated 6.09dB□9.27dB and 18.42dB. The experiments indicate that what we have adopted is effective.

REFERENCES

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