Telephony 101 – Transmitter Specifications November 25, 2012

Hello All,

As always, please send any questions about the reading assignment directly to me at oldtimetelephones@goeaston.net. I will bundle questions if necessary, repeat the questions, and give answers in an e-mail to the TCI List Server before moving on to the next reading assignment. This way everyone will benefit from these questions and answers. By sending questions directly to me, we will avoid unnecessary clutter on the List Server. Previous reading assignments, notes, questions, and answers are available in the TCI Library at http://www.telephonecollectors.info/telephony-101/.

Please start reading at the last paragraph on p. 22 and finish Chapter 2 on p. 24. In this assignment, we will first discuss the sound (i.e., acoustic) properties of transmitters and then their electrical properties.

In the Sound section of the Appendix (p. 227-228), you saw that one needs to transmit frequencies in the range of a few hundred cycles per second to a few thousand in order to be able to reproduce spoken words. So a good laboratory can take any transmitter and test it – I couldn't do this, but Bell Labs could. They would take a tone generator, whose frequency could be varied in this range, put it in front of a transmitter, and then measure the voltage across the transmitter at all these frequencies. If the tones were all of the same loudness, and this always produced the same voltage across the transmitter, you would have a perfect transmitter. It would be producing electrical signals with exactly the same amplitude and frequency as the input sound. This, of course, is high fidelity or hi fi. Such a transmitter would show a response on the graph in Fig. 2-13 that was a horizontal straight line. If this horizontal line was high up on the graph, this would mean that the measured voltage was large and the transmitter was sensitive.

Now back to reality. A round disc of metal is going to want to vibrate preferentially at some frequencies – in a manner similar to Bell's vibrating reeds. So the trick is to manufacture a disc that doesn't have prominent resonances in the voice frequency range. You can see from Fig. 2-13 that it took many years to achieve this goal.

I'd like to comment a little further on the graph in Fig. 2-13. The response in decibels (dB) uses a unit dreamed up in the 1920s at the Bell Labs to compare signal strengths. There's a very good article on this in Wikipedia (http://en.wikipedia.org/wiki/Decibel). The decibel is something like counting the zeros in a number and multiplying by 10. For example, if a transmitter produces the same voltage as the standard reference voltage, the number of zeros is zero and the response is 0 dB. If a transmitter produces 10 times that of the reference voltage, the number of zeros is one and the response is 10 dB. If the ratio is 100, the number of zeros is two and the response is 20 dB. Etc. This isn't a precise definition, but if you are looking for that you will have to do some mathematics – not here.

You don't have to remember anything about decibels (dB) except that they are an indication of the voltage produced by a transmitter when exposed to tones of the same loudness. The higher the curves are on the graph indicates generally higher transmitter voltages. The smoother the curves are on the graph indicates generally better sound fidelity.

Finally on this subject, I am a little proud of my research on Fig. 2-13. I located a 1938 article that compared the 323 and 395 transmitters; a 1951 article that compared the 395 and F1 transmitters; and a 1975 article that compared the F1 and T1 transmitters. The graphs in these articles were all drawn a little differently, but three generations of Bell Labs engineers all used the same Bell Labs procedures and reference units. So I was able to measure points on all their graphs and re-plot those points on the single graph shown in Fig. 2-13.

Regarding the other subject of electrical properties of transmitters, they are pretty simple. A resistance transmitter is just a resistor that varies a little. The impedance of a resistor does not depend on frequency and is simply called the resistance for dc and ac (see p. 218 – you've been there before). I think the rest of this section in the book is self-explanatory.

If there are any questions about the current reading assignment, we will deal with the questions before moving on to the next reading assignment.

Ralph

Telephony 101 – Transmitter Specifications November 28, 2012

Hello All,

We received a number of good questions on this reading assignment, so below I will repeat the questions and give answers.

Question 1.

Does the resistance of a T1, for example, vary between 75 to 275 ohms while it is being spoken into within the voice frequency range? Or is that the normal resistance range due to carbon granule construction differences? If so, what would be the resistance range of the transmitter while speaking or blowing into it?

The resistance value, such as 75-275 listed in Table 2-1, is the normal resistance at rest. I'm sure it varies because of construction differences, but it also varies with position and some other things like packing and cohering. Tap on them or blow on them and this resistance will change noticeably. Transmitters in my experience are quirky. Regarding the important resistance change when speaking, it is about 1/100-th of its normal resistance. You will see some related numbers in Part Three of the book.

Question 2.

Is the variable resistance created by the diaphragm compacting and relaxing the carbon between the electrodes?

Yes. Compact them and their resistance decreases. Relax them and their resistance increases.

Question 3.

What size are the carbon granules and how tightly are they packed into a T1?

I'm sorry but I really don't know.

Question 4.

I know most of this has been explained but it's hard to comprehend how a small pile of carbon granules can be changed enough by a weak human voice to have much of an effect on resistance.

It is amazing, isn't it, but very small ac electrical signals are all that's needed to make the sensitive Bell receivers work.

Question 5.

Is the frequency resonance the same as the sidetone?

No. Sidetone in telephony is the sound you hear in the receiver of the transmitting telephone, which can be higher than the sound heard in the receiver of the receiving telephone. More on this much later. For you radio guys, our sidetone bears no relation to your sidetones around a carrier frequency.

Question 6.

In the times that the telephone conversations were held with just one apparatus on each side, meaning that the transmitters were also used as receivers, what kind of signal did the person use to let the other party know that it was their time to talk or listen? And, I know that I'm getting a little ahead, but what was the year that the phones have two units – one transmitter and one receiver?

I really don't know on the first part. Maybe "roger that," "over and out," or something like that in 19th Century jargon. You'll see in Chapter 8 that two "telephones" were used on Williams'coffin phones by 1878.

Question 7.

How do you test a transmitter? I thought you could check a transmitter by just measuring ohms. On page 24 you indicated your measurements were "made with an appropriately applied operating voltage" and compare the results with your Table 2-1.

Yes, of course, you can use a multimeter, but you will go nuts if you try to use a digital meter because of the unstable nature of the transmitter resistance. Be sure your analog meter has a 1-ohm or 100-ohm scale. If it only has a 1k-ohm scale, you probably will not be able to get a reading. Also, be sure to hold the transmiter upright if it is a solid-back type. And tap on the edge of it to loosen carbon granules that might have clung together without being disturbed for 50 years. I used typical operating conditions to make sure I didn't introduce any anomalies, but I'm not sure it was necessary.

If you have any follow-up questions, send them directly to me. We will now move on to the next reading assignment, which I will post soon.

Ralph