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DATA FLOW ON MEDIUM VOLTAGE POWER NETWORK

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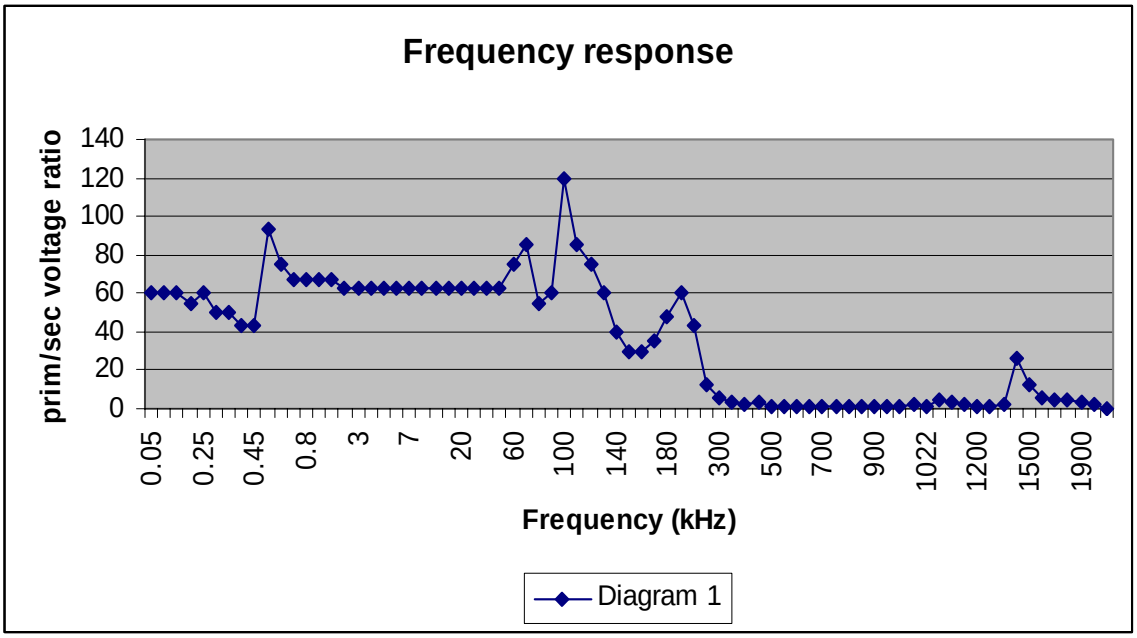
INTRODUCTION

This article is a description of an experiment which has last for a week and during this experiment data has been transferred over a 20 kV electrical network from one distribution transformer station to another. The total distance of data transfer was 5219 meters, and power analyzer functioned as data source. Data was sent every 5.5 seconds, transmission rate was 1200 bps, with frequency shift keying type of modulation.
Since 1996 in Electro distribution of Town Subotica a system of remote power meter reading is in use. System works in 160 houses in two distribution regions and for this application the ST7537 half duplex asynchronous frequency shift keying modem from SGS-Thomson is used. In addition with medium voltage Coupling device the same equipment we use for this experiment.
During the experiment data flow was without garbled data except one time when after a rainy day partial discharging occurred. This garbled data was overcome easily with adjusting down the gain of the signal.

DESCRIPTION

First step of the experiment was to find out the frequency response of the distribution transformer.
For this we used function generator and digital oscilloscope. We connected the sinus wave to the primary side of the transformer (medium voltage side) and measured secondary voltage. Diagram 1 shows the results. As we can see on lower frequencies there is a high attenuation of signal and on frequencies over 300 kHz there is no attenuation at all. There were signal distortions on frequencies 9-140 kHz, 180-250 kHz and 1.3-1.5 MHz.
The next step was to test our equipment, the medium voltage coupling device and the coupling capacitor to high voltage and with transformer. Figure 1 shows the circuit schematic of the medium voltage coupling device, as seen we have used phase to neutral point capacitive coupling method (grounded). We have experimented with two carrier frequency 132.45 kHz and 76.25 kHz. Best result was with 76.25 kHz, the remote meter reading works on 132.45 kHz so they can't disturb each other.



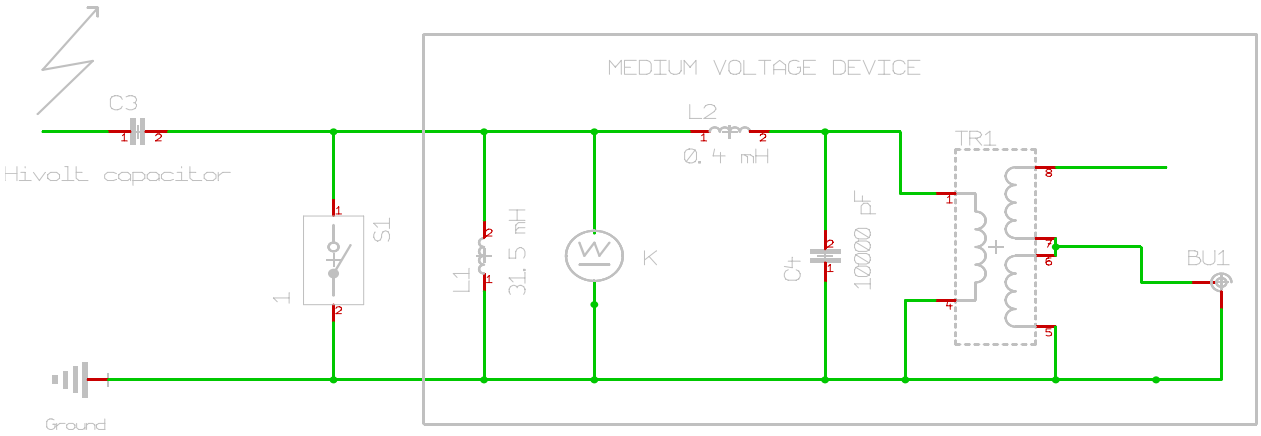


Fig. 1

After the medium voltage coupling device had passed the tests, we have established the whole equipment together with the power line modems and took it to the network. First we have send single commands between two transformers and tested them. In this phase we have noticed signal distortion with 132.45 kHz carrier frequency so we changed it to 76.25 kHz

Figure 2 shows the block diagram of the whole equipment.

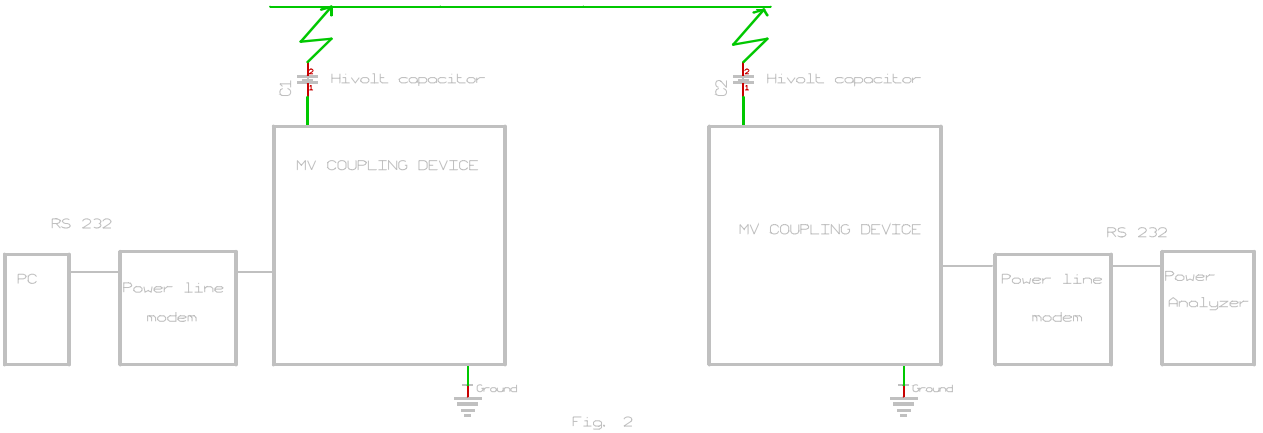


Fig. 2

Then we have raised the distance and the number of transformers between until we reached 5219 meters but it doesn't mean that we couldn't have connected more, because there was still reserve in signal amplitude.
Figure 3 shows sections and distances from data source marked as TS 107 to data receive marked as TS 29.

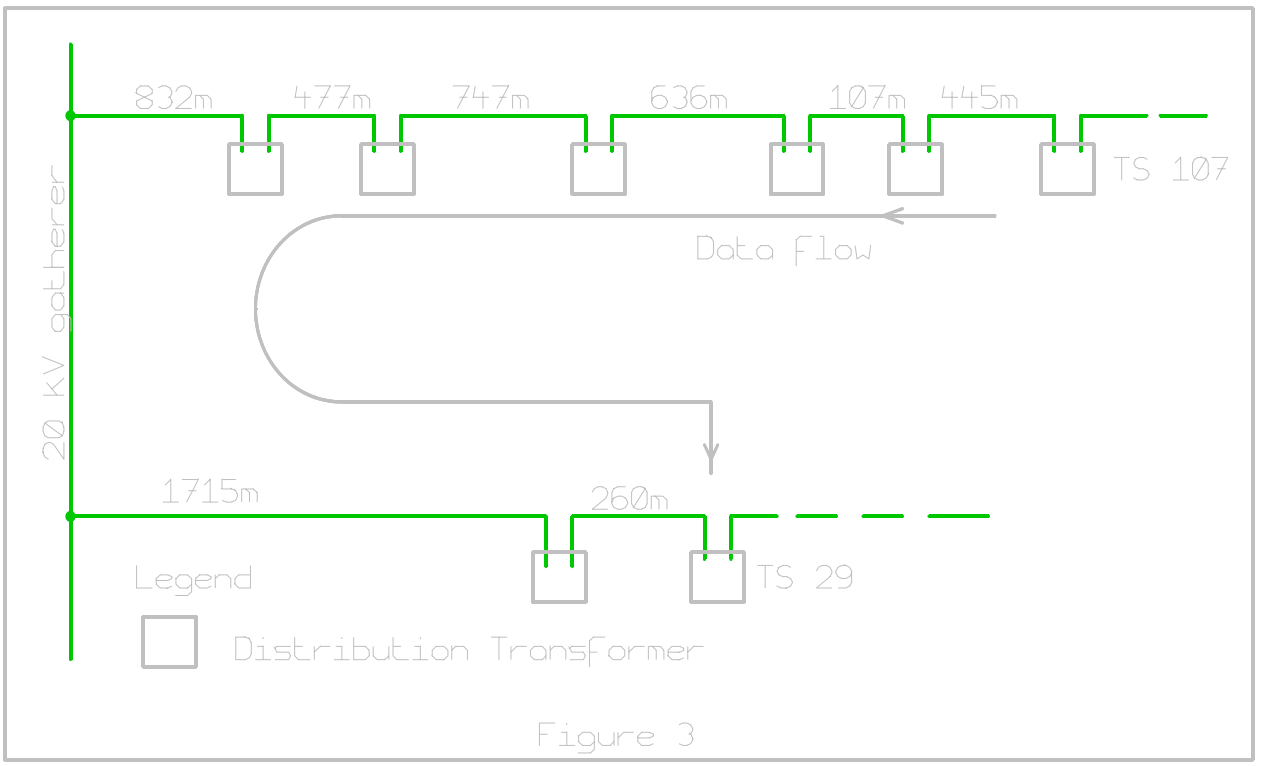


Figure 3

After this we have connected the power analyzer to measure parameters of distribution transformer

(TS 107) and on the other side PC only with terminal program to collect measured data. The data's can be also easily adopted by SCADA (Supervisory Control and Data Acquisition) programs and made all further employments.
With only 1.7 V peak to peak signal amplitude we have achieved a very nice data transfer on over 5 km distance. The input sensitivity of the modem allows very low receive level 1 mV$_{RMS}$ typically.SGS-THOMSON (1)

CONCLUSIONS

Manufacturers of home automation appliances have used power line for communications for at least 15 years.
Today they offer power line modems for: shared broadband internet access, security cameras, voice over IP calls, audio and video streaming and transfer, PC file and application sharing, etc.
So it is time for electricity distribution managers to notice that they can use power line not just for energy transfer.

LIST OF REFERENCES

1. SGS-THOMSON, 1993, ST7537 HOME AUTOMATION MODEM, 73

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