

# REMOTE PLC-BASED MONITORING

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## ABSTRACT

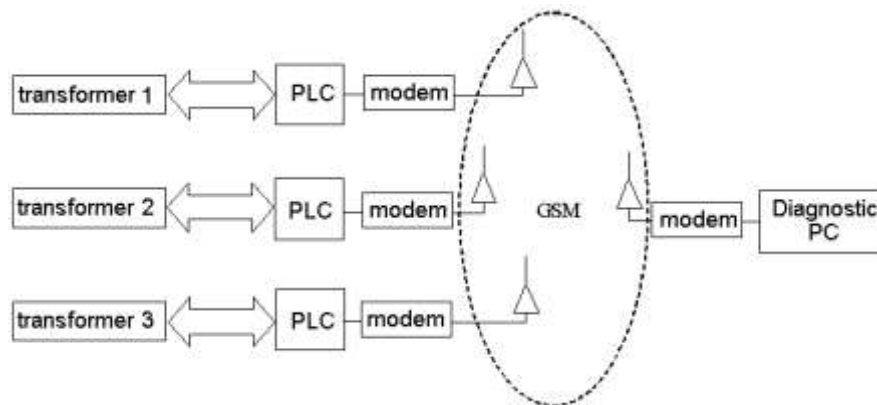
This paper deals with monitoring and diagnostics of block transformer using General Pocket Radio Service technology. In general there is description of experimental monitoring base for measuring block transformers over 40MVA and sending this measured file to diagnostic PC.

## 1. INTRODUCTION

Block transformers are commonly build as part of power plants or part of industrial complexes, but there are many block transformers build far away of civilization. One of the most used and enough reliable industrial control system is PLC. So I use PLC as meter, controller, archive and communicator for monitoring block transformer.

This system is more universal then traditional systems (wireless Pear-to-pear connection, char recorder, etc.), because measured data can by transferred from anywhere to anywhere automatically without human intervention. The only condition is GSM signal available.

Basic system idea is at Figure 1.



**Figure 1:** Basic system idea.

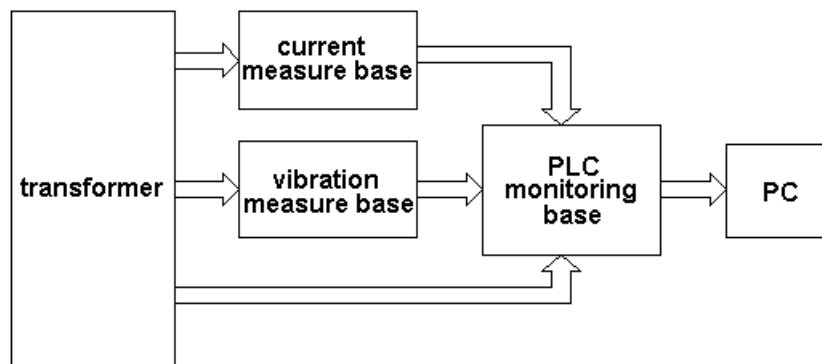
## 2. HARDWARE

Experimental equipment of monitoring base is only one part of system for measuring and diagnostic block transformer over 40MVA.

Measuring system consists of:

- Meter of analog signals (included in PLC)
- Circuit of binary inputs (included in PLC)
- Monitoring controller (included in PLC)
- Processing, file transfer and diagnostics
- Other measuring equipment which is not part of this project (Current measure base and Vibration measuring base)

Position of PLC base in measuring series is visible at Figure. 2.



**Figure 2:** System schema.

### 2.1. PARTS OF PLC BASE

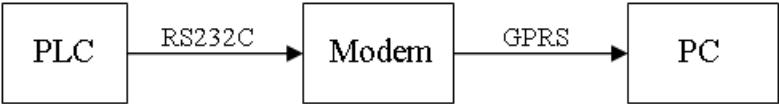
- **Meters of analog signals** – temperature measuring (from -25°C to 250°C, Pt100), humidity measuring (signals 4-20 mA), gas content in oil measuring (0-160 kPa  $\approx$  4-20 mA), current measuring (0-250 A  $\approx$  0-5 A  $\approx$  4-20 mA), vibration measuring (100 Hz, 200 Hz, 300 Hz, 400 Hz, 500 Hz and 600Hz each at own signal 4-20 mA) and gas analysis.
- **Circuit of binary inputs** – coolant pump switching, system door opening, Buchholz relay, control relay and critical current level exceeding
- **Monitoring Controller** – PLC Siemens, Simatic S7-300, CPU 314C with I/O modules (29AI – universal, 2AO, 29 BI and 16 BO) including CP340 (RS232C communication processor)
- **Modem** – GPRS modem Siemens MC39i (84,6 kB download and 21,6 kB upload)
- **Diagnostics PC** – PC with enough HDD space, internet connection and special software (Tramon)

### 3. COMMUNICATIONS BETWEEN PC AND PLC

Monitoring Controller is equipped with module to communicate via RS232C. It makes possible to use modem for GPRS communication.

It is not necessary to check communication between CP340 and modem, because the automatic software repeater is included. The repeater is started after long response time or error message.

Modem transforms incoming data for GPRS communication. This data are going through internet to PC's communication hardware. At this communication hardware packets are caught by Tramon Connector Software and saved as Tramon dataBase file.

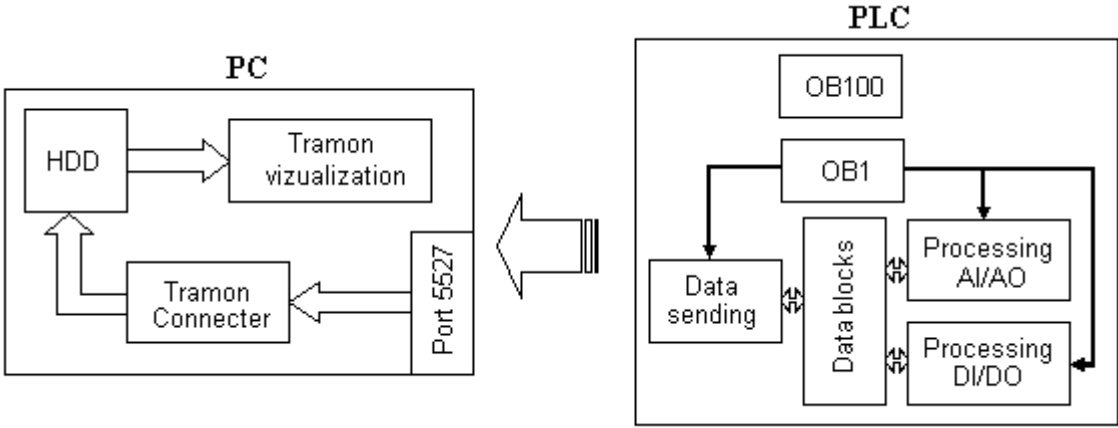


**Figure 3:** Communication principle.

These data are sent every day. But the sending interval can be longer or shorter, it depends on free memory in PLC. To save one day history it is required 229 kB memory space plus program memory space. Memory request depends on number of samples between sending, number of inputs (data blocks) and data types.

### 4. SOFTWARE

Software structure is at Figure 4.



**Figure 4:** Software structure.

PLC is programmed for data measuring, their recalculation, and temporary storage and sending to PC.

#### 4.1. PLC PROGRAM

PLC program consists of 5 parts:

- **Organization blocks** (OB1, OB100) – blocks of basic settings (communication processor address and time)
- **Processing AI/AO** – one sample is logged every program cycle and every minute or ten (slower inputs) minutes average value is calculated and saved in DB (each input belongs to one DB). This part of program includes permissible value level. Errors are saved in special DB. PLC can send urgent SMS to Control Center.
- **Processing DI/DO** – if some binary input change level, this change is saved in DB including date, time and type of change.
- **Data sending** – sequential part of program. It calls functions and system functions to send AT commands in first and last part of sending sequence. Then switch modem in data mode and send data on port 5527. The system functions include sending repeat algorithm.
- **Data memory** – Data Blocks

#### 4.2. PC PROGRAMS

There are two programs:

- **Tramon Connector** – catching packets and save packets incoming on port 5527. Every month new file is created.
- **Tramon visualization** – This program can open Tramon dataBase file. Data is divided by input and presented as graph or table.

### 5. CONCLUSION

This PLC Base can be use to measure any electrical or mechanical equipment and send these informations to PC connected to internet and if it is necessary PLC could control some part of measured system. Because this base is really expensive, it is not smart to use it anywhere. For measuring parameters of block transformer over 40 MVA, this measuring system is profitable, because price of this type of transformers is very high.

### ACKNOWLEDGEMENT

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