NETWORK ANALYZER USED IN MPD SLOW CONTROL SYSTEM AUTOMATION*

M. Birski[a,†], D. Dabrowski[b,c], M. Peryt[b,c], K. Roslon[b,c]
M. Bielewicz[c,d]

[a]University of Wrocław, Pl. M. Borna 9, Wrocław, Poland
[b]Warsaw University of Technology, Pl. Politechniki 1, Warszawa, Poland
[c]Joint Institute for Nuclear Research, Joliot-Curie 6, Dubna, Russia
[d]National Centre for Nuclear Research, A. Sołtana 7, Otwock-Świerk, Poland

Multi Purpose Detector (MPD) is a part of the NICA project at JINR (Dubna). Among many control systems, Slow Control System (SCS) is dedicated to handle and control parameters of detectors which vary with relatively slow sample rate and do not depend on the experiment. This paper describes network analyzer used in the MPD supply racks, as well as automation program made in LabVIEW. This device analyzes the main supply network parameters, *e.g.* current, power or voltage of each of 64 supply racks. Each rack consists of many control subsystems, *e.g.* temperature control, gas control and many others. In order to make these subsystems coherent in terms of data transmission, LabVIEW environment has been used. The network analyzer LabVIEW automation program is one part of the whole coherent automation system, containing a variety of subVI's connected by cluster links.

1. Introduction

The main goal of the NICA project at JINR (Dubna) is to study heavy ion and polarized proton and deuteron collisions [1]. Project comprises the following subprojects: upgrade of the existing superconducting synchrotron Nuclotron, the Baryonic Matter at Nuclotron (BM@N) experiment with ion beams extracted from the modernized Nuclotron, and an experiment with the Multi Purpose Detector (MPD) at the first (right-hand collider ring)

---

* Presented at the II NICA Days 2017 Conference associated with the II Slow Control Warsaw 2017, Warsaw, Poland, November 6–10, 2017.

† Corresponding author: birski@gmail.com

interaction point (IP) of NICA with a primary goal to study heavy-ion col-
lisions. MPD consists of many subdetectors *e.g.* Time Projection Chamber
(TPC), Inner Tracker (IT), Time-of-Flight (TOF) system and Electromag-
netic Calorimeter (ECal). Detector control system can be roughly divided
into two parts: readout systems which are responsible for data acquisition
and give information about the investigated phenomenas, and systems which
control physical parameters of detector such as currents and voltages. The
second ones are usually called SCS (Slow Control Systems). SCS is respon-
sible for maintenance and control detector parameters which are restricted
for proper work of the detector. Parameters such as temperature of gas
chamber or supply source voltages and currents do not have to be sampled
with relatively high frequency, as it occurs in data acquisition, thus these
systems are called Slow Control. SCS is a set of electronic circuts (hard-
ware), implemented software as well as technical documentation (bookware)
of the experiment control system.

2. MPD SCS

Slow Control System for MPD is currently under construction and con-
sists of many different hardware and software branches. MPD is supplied
by 64 racks and each rack comprises different modules. In this paper, elec-
trical network analyzer LUMEL N43 and dedicated LabVIEW software is
described. LUMEL N43 is the first device in the rack which is connected
to the power network (see Fig. 1). LUMEL N43 is connected with control
system by RS-485 serial port, and data transmission takes place through RS
bus. Network analyzer gives a lot of information about electrical network,
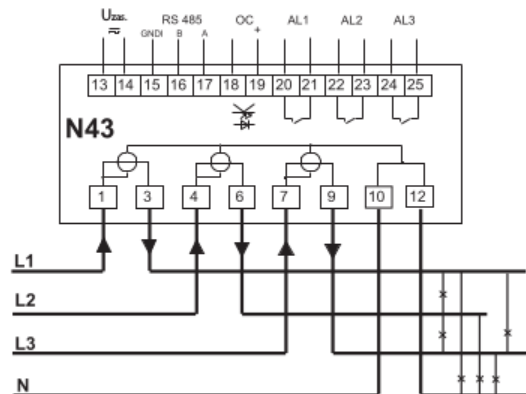these measured as well as calculated ones. Data are located in the registers.

Fig. 1. LUMEL N43 network analyser serial connection between power source and
rack.

In order to get data from the network analyser, LabVIEW sends a query and
waits for an answer. In Figs. 2 and 3, the LabVIEW code is shown, parts
A and B are the same codes but in order to make the code clear, parts
are shown separately. The code is executed from the left- to the right-hand
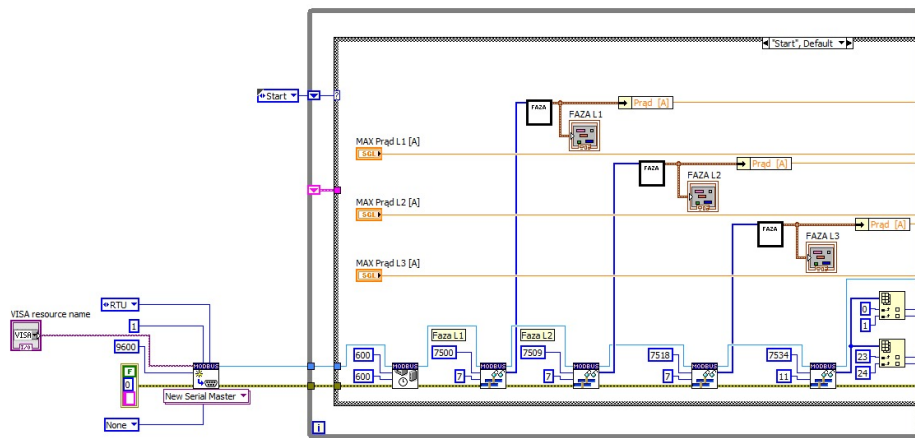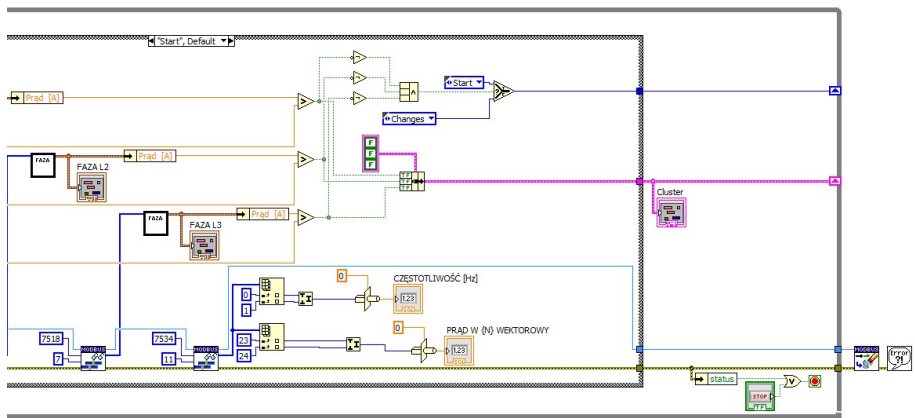

Fig. 2. Network analyzer LabVIEW code part A.

Fig. 3. Network analyzer LabVIEW code part B.

side. First of all, before the loop starts, modbus protocol parameterization
(New Serial Master) takes place. The whole data processing is being realized
within while loop. Waiting time was set up for 600 ms, what is technically
enough for SCS. In each iteration, seven most important parameters are
taken from registers for each phase (L1, L2, L2) and transmitted like ar-
rays through the code. For MPD, SCS needs the following parameters to
be taken into account: voltage (V), current (A), true power (W), apparent

power (VA), reactive power (VAR), power coefficient and phase tangent. Other two variables are vector current in N wire and frequency. Data are depicted on the front panel as it can be seen in figure 4. The front panel is a representation of GUI in LabVIEW terminology. The most important idea is data clustering. All parameters are packed into clusters and transfered by the shift register during each iteration. Data clustering allows data transfer among other VI's during one session. This idea also works for error transmission and handling. Due to the fact that data can be moved from one VI to another, a lot of applications appears. This program compares instantaneous value of current with maximum values given in advance. This is very important because, for instance, if current is exceeded, devices located in the rack can break down or even burn out. Technically, this option stands for safety and maintenance of the required values. Part of the code responsible for current comparison is also shown in Figs. 2 and 3. Instantaneous current value is being compared with the value given in advance. When the current exceeds maximum value, the program builds boolean cluster with TRUE value. This cluster is transmitted through the shift register during each iteration and can also be transmitted to another VI. Another VI can be in charge of safety and can turn off other devices which could break down due to increased current value. The program is made in elastic way so any needed values can be compared and sent to other VI's. This is a big advantage of LabVIEW data transmission scheme. If there is any registered unneeded current value, program moves the whole process to the "Changes" case, where another sophisticated process can be run.
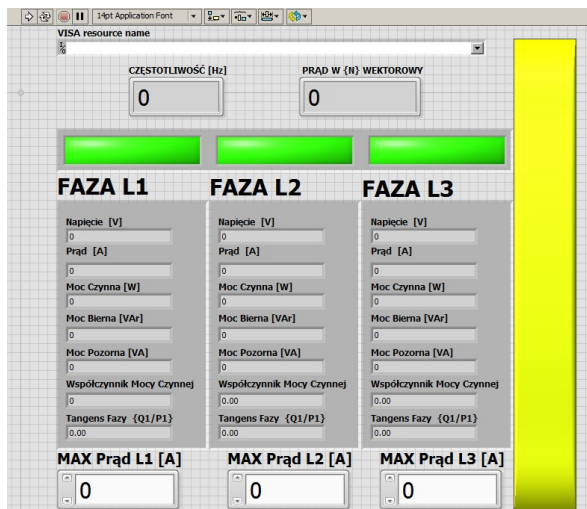

Fig. 4. Network analyzer LabVIEW front panel (GUI). Green lights become red when values are exceeded.

3. Conclusions

This paper describes LabVIEW code for MPD supplying rack network analyzer. Data transmission takes place through the RS-485 bus. Data clustering is a leading idea of MPD SCS LabVIEW codes. Clustered data transmission through shift registers allows fast and elastic connection between subVI's having different duties in the control system. The presented program has been made in order to give details about supply network parameters and can be treated as a portable subVI in a complex control system.

REFERENCES

[1] V.D. Kekelidze *et al.*, *PoS* **ICHEP2012**, 411 (2013).