

# Program for Three Phase Induction Machine Education Measurement

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**Abstract** — This paper deals with program for education measurement of three phase induction machine. This type of motor is the most used motor today. Measuring test stand is described in the first part. Measuring program is described in second part. This program consist from five parts and all these parts are described.

**Keywords** — education, dynamometr, induction machine.

## I. INTRODUCTION

Three phase induction machine is the most used electric motor. The measuring of this motor type is one of the basic tasks in education laboratories. The program for better explanation of this measuring and for explanation of behavior of this motor was elaborated.

Program is created in LabVIEW from National Instruments. This program is part of complex test stand, which is used for education of rotational electric machines [1]. This test stand consists of power supply part, mechanical part for placing of the motor, dynamometer, measuring part and personal computer.

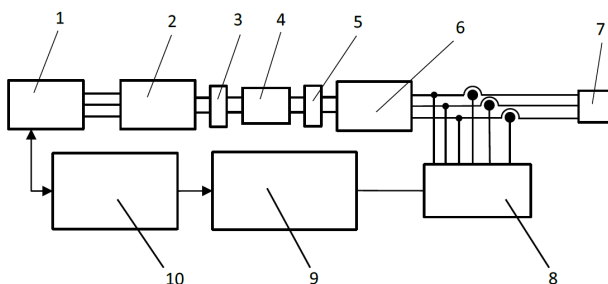


Fig.1. Structure of the test stand [1]

Legend: 1 – inverter, 2- servomotor, 3 - torsionally stiff coupling, 4 – torque transducer, 5 - torsionally stiff coupling, 6 – measured motor, 7 – power supply, 8 – set of LEM transducer, 9- data acquisition card, 10 – personal computer

The dynamometer consists of servomotor, inverter and ballast (or loading) resistance. The servomotor is synchronous machine and serves as loading unit for measured motor. The inverter is used for the servomotor control. Part of this inverter is optional card, which makes

possible to control this inverter by user's own program. This program controls loading of the measured motor and protection of the test dynamometer from unsafe operation.

The measuring part consists of the torque transducer, current and voltage sensors and data acquisition card (PCIe – 6351 from National Instruments). The torque transducer measures torque and revolution. Current output is for measured torque and pulse output is for revolution (60 pulse per one revolution) measurement.



Fig.2. Test stand

## II. MEASURING PROGRAM

Measuring program was created in LabVIEW. This program was chosen from several reasons. Some of this reasons are:

- simpler creating of graphic interface and program part,
- existence of library for measuring, controlling and analyzing of the measured signal.

LabVIEW enables to create virtual instruments. The Virtual instrumentation is approach to create measuring device by creating own PC program which replaces hardware part of this device. This program can be easily changed or upgraded and it can be cheaper than upgrading of a classical measuring device.

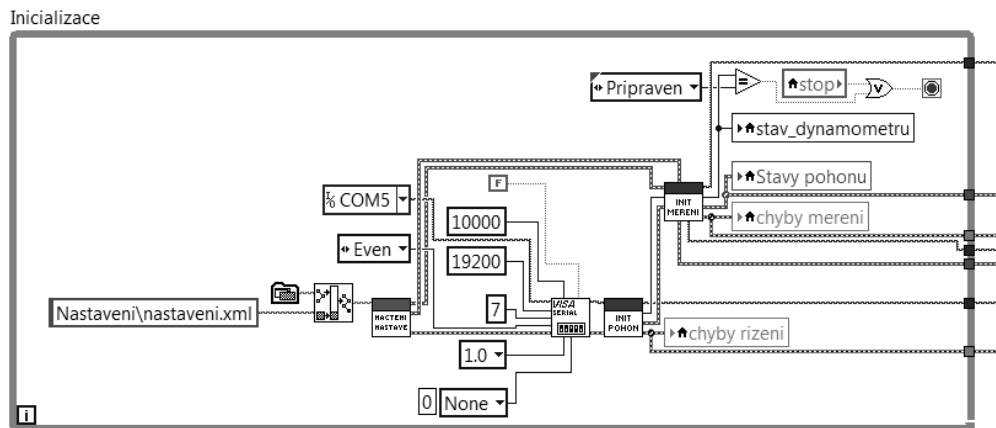


Fig. 3 Initialization task

Program for measuring consists of five basic parts – initialization loop, user's event loop, measuring loop, inverter controlling loop and closing part.

The initialization part (Fig.3) reads XML initializations file as first operation. These define name, measuring channel, rate, number of samples and time to record. XML utilization makes possible to change setting of measuring part without changing of program source code. Initialization continues with initialization of communication via serial port, because communication between PC and inverter is running on RS-485 link. Next step of initialization is confirmation of communication with inverter and setting of starting parameters. Setting of data acquisition task continues after setting of the inverter. The data acquisition task is divided into two separate tasks. First task is for measuring analog values (voltage, current, torque). Each of these values has its own setting in XML file with settings value of:

- name of channel,
- unit,
- physical channel in data acquisition device,
- upper limit,

- lower limit,
- offset of sensor,
- scale of sensor.

Second task is for measuring of digital values. This task is used for the measuring values of revolution. Frequency of output signal from the torque transducer is used for revolution measurement.

If there is not error via initialization, initialization task is finished.

Next three parts (user's event loop, measuring loop, inverter controlling loop) are running as parallel loops.

Communication among these loops is made by two queues. Queue securing state, when there will be send more than one message at same time. First queue serves for sending states among loops. There are defined 6 states – initialization, preparation, running, closing, error and re-initialization. This program works as the state machine. Second queue serves for sending message from user's event loop to inverter controlling loop.

User's event loop reads event from control part of program front panel.

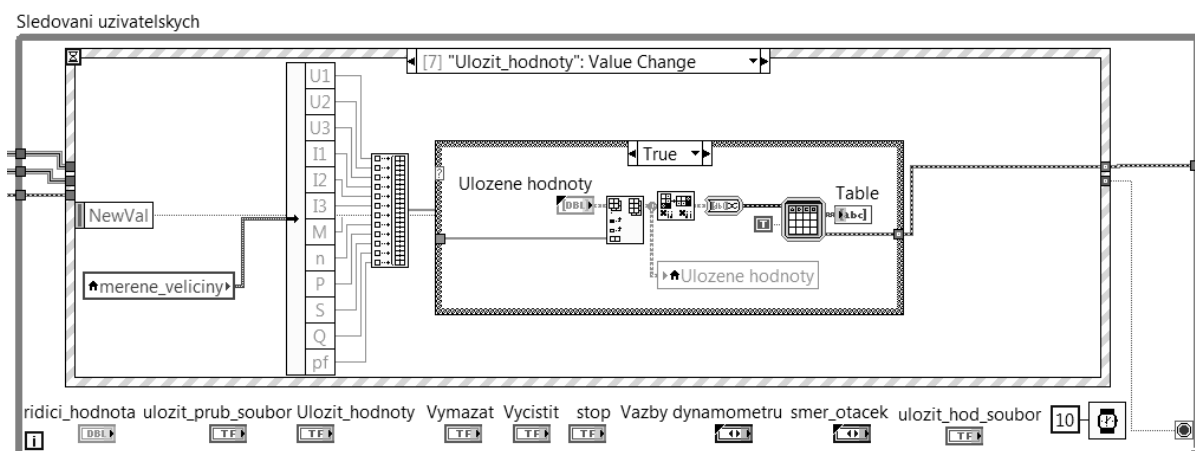


Fig. 4 User's event task

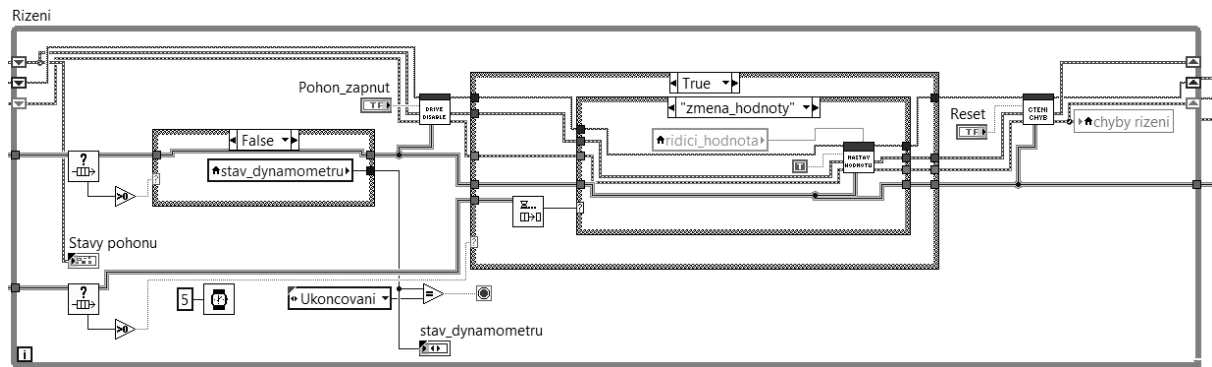


Fig. 5 Inverter controlling loop

The measuring loop measures and processes measured values. Values are read from data acquisition card with a set sampling frequency. Values are collected in the collector, which collects such number of samples, which correspond to the set length of the record. After collector, values are sent to the calculation block, which calculates the RMS value of voltage, and current, power, active power, reactive power and power factor. For this calculation free library LabVIEW [2] was used. Calculated values are displayed on program front panel. There are next five possibilities to display:

- save calculated values in the table,
- waveforms with changing scale and offset,
- phasor diagram,
- fast Fourier transformation of voltage
- fast Fourier transformation of current.

Calculated values as all as waveforms can be saved in files.

Inverter controlling loop (Fig 5) serves for setting value to the inverter and for controlling of communication. When there is a message in the second queue, this loop sends adequate message to the inverter. This loop controls communication and reads inverter error for confirmation inverter health.

### III. CONCLUSION

Presented program serves as education measuring of induction machine. The program can measure static values as well as dynamic characteristics.

Loading via different loading characteristics will be the next step of development, as well as transformation via transformation to the two axis theory.

### ACKNOWLEDGMENT

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