THE SOFTWARE AND CAPABILITIES OF DIAGNOSTIC SYSTEM FOR STABILITY OF MAGNET POWER SUPPLIES AT NOVOSIBIRSK FREE ELECTRON LASER

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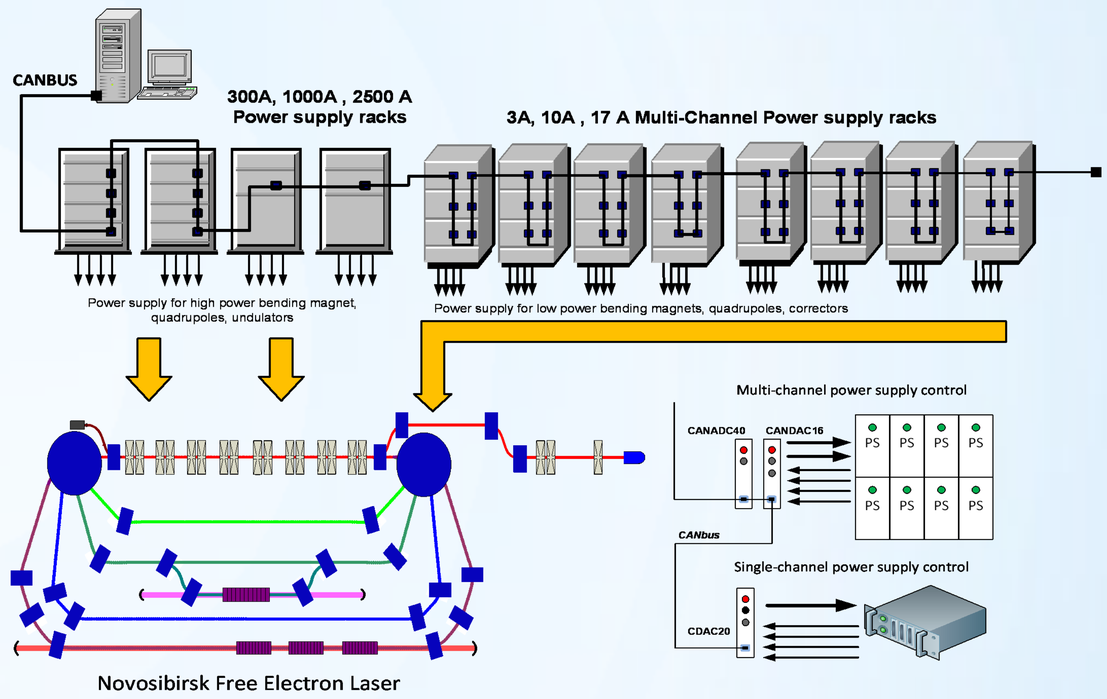
Abstract

The magnetic system of Novosibirsk free electron laser (FEL), which contains a lot of magnetic elements, is fed by power supplies of different types. The accuracy and stability of the output current of these power supplies directly influences the coherent radiation parameters and operation of the entire FEL facility. In this connection, we developed a system for diagnostics of the power supplies state, integrated into the common FEL control system. The main task of this system is to analyze the output current of the power supplies and calculate their stability characteristics. Besides, this system is capable to determine the amplitude and frequency of output current ripples, if any, for a particular power supply and display obtained results. The main architecture and some other capabilities of this system, and presents examples of its usage are described here.

Table of requirements on current set-on accuracy and long-term stability for different types of power supplies used on Novosibirsk FEL :

PS type (by max. output current)	Set-on accuracy (% form Imax)	Long-term stability (% from Imax)
3A	**1.0**	**0.2-0.3**
10A	**1.0**	**0.2-0.3**
300A,1000A	**0.01**	**0.02**
2500A	**0.01**	**0.01**

The main scheme of control and supply of magnetic elements of the microtron-recuperator



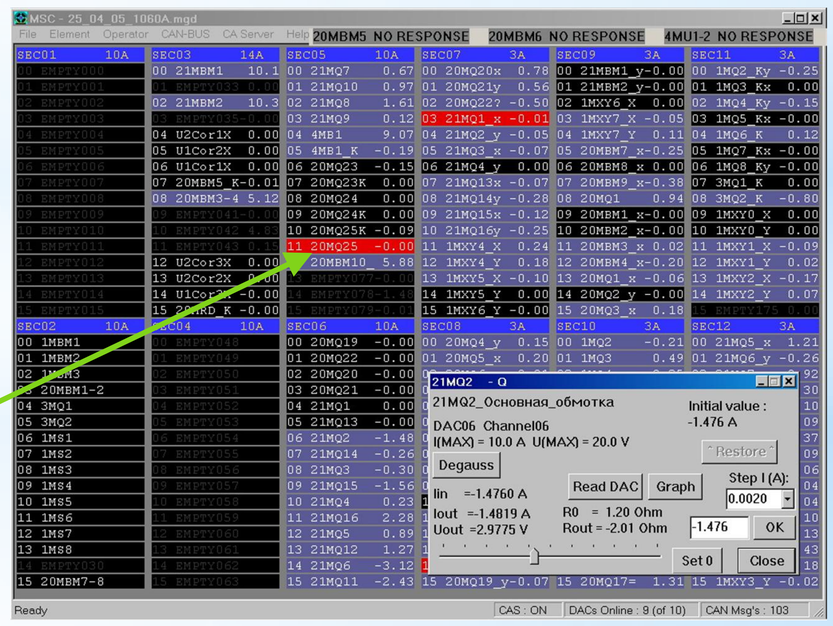
Different types of output current control methods and corresponding hardware and software algorithm

Output current control method	Operating mode of control devices(ADC)	Functionality of control software
Monitor current set-on accuracy	Standard multi-channel mode of measurement	Compare specified and measured current value in “real-time”, during all time of operation of control software
Monitor current long-term stability	Standard multi-channel mode of measurement	Compare current value, measured just after specifying new one and last measured value at in “real-time”, during all time of operation of control software
Detect single, short-term current deviations	Single-Channel mode of measurement, running on long time duration	Storing and displaying the output current waveform, obtained during single-channel measurement
Detect continuous output current ripples	Consistent series of single-channel measurements of output currents for all power supplies, connected to ADC	Consistent processing obtained waveform, calculating average current value, mean square deviation, and maximum deviation for all power supplies

Displaying status of all power supplies on main window of control program

During operation, control software calculates relative difference between specified and measured current value, same as difference between current value, measured just after specifying new one and last measured value for all power supplies.

If calculated difference exceeds allowed value, string, representing corresponding power supply is painted with red color

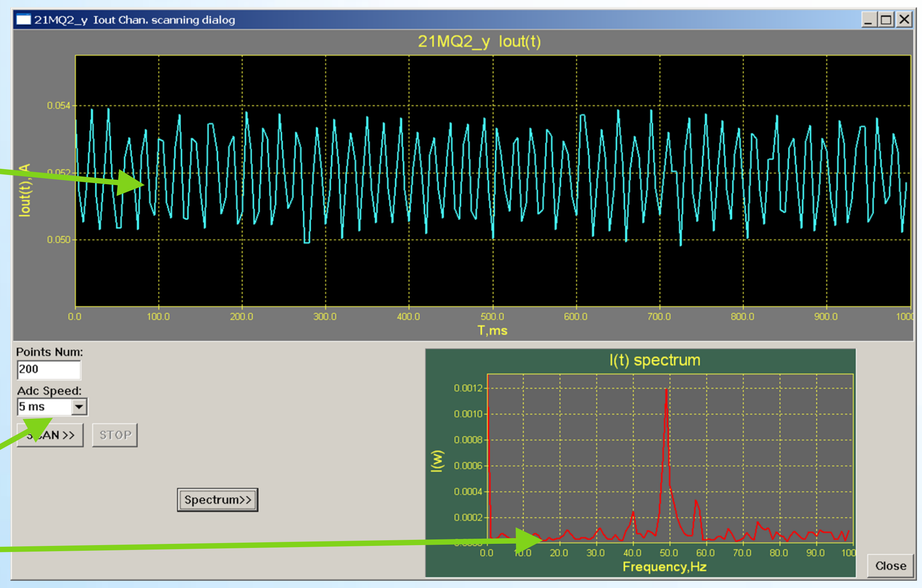


Dialog window with waveform of single-channel measurement and spectrum of output current of specified power supply.

Waveform of output current of power supply with 50Hz ripples

Parameters of single-channel measurement and obtained waveform:
1.Number of measurements
2.Time per one measurement

Spectrum of output current waveform



Dialog window with plot of results of cyclic single-channel scanning of output currents of all power supplies

To detect possible output current ripples, control software initiates cycle of single-channel measurements of output currents of all power supplies.
During cycle, program switching to ADC channel, connected to current power supply, starting single-channel measurement, obtaining number of measurements specified by user, processing obtained waveform, outputs resulting values to plot, and switching to next power supply.

Results, obtained after processing single-channel measured waveform for every power supply:
Red v-bar shows maximum deviation of current from average current of obtained waveform,
Blue v-bar shows mean square deviation of current values in obtained waveform

Number of power supply in whole list

Parameters of single-channel measurement :
1.Number of measurements
2.Time per one measurement

Waveform of output current of power supply currently scanned