

THE MULTI-CHANNEL MEASURING DATA ACQUISITION INTERFACE FOR TPS QUADRUPOLE AND SEXTUPOLE MAGNET POWER SUPPLIES BY USING LABVIEW AS THE DEVELOPING TOOL

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Abstract

This paper presents an implementation of a multi-channel measuring data acquisition interface of quadrupole and sextupole magnet power supplies (MPS) for Taiwan Photon source (TPS) with LabVIEW as the developing tool. The multi-channel measuring data acquisition interface could reduce quantity of measurement instrument and loading of operator at the MPS acceptance test. The instrument devices of measurement system include a multiplexer, a dynamic signal analyzer (DSA) and a multi-channel digital voltage meter (DVM), GPIB is the communication interface between the multi-channel measuring data acquisition interface and instruments. There are three analyzing procedure for the output current of MPS in the default setting of the LabVIEW program, 1) Fast Fourier Transform of output current measured by DSA, 2) long-term stability of output current measured by DVM, 3) the error function curve fitting of output current by LabVIEW toolbox; after these three analyzing procedure is completed, the performance of each MPS can be automatically generated as a Microsoft Word report file.

INTRODUCTION

There are 485 units of quadrupole and sextupole magnet power supplies delivered from a local company in Taiwan. To reduce the quantity of measurement instrument and loading of operator at acceptance test of power supplies, a multi-channel measuring data acquisition program is implemented with LabVIEW as developing tool. There are three analyzing procedure to identify output current characteristics, 1) a multi-channel multiplexer Agilent 3488A combined with an Agilent 35670A DSA instrument for FFT analysis of output current, 2) a multi-channel multiplexer Agilent 3488A combined with a high resolution Agilent 3458A DVM to measure the long-term stability of output current, 3) the curve fitting tools of LabVIEW to fit error function curve between output current and current setting; after these three analyzing procedure were completed, the performance of each MPS can be automatically generated as a Microsoft Word report file.

There were two CHROMA ATE 62075H-30 (used as the sextupole magnet power supply) and three CHROMA ATE 62075H-30N (used as the quadrupole magnet power supply) mounted on a rack, the measuring

data acquisition program could control power supplies through USB interface and acquire the performance data within the measuring period. After the end of the measurement data acquisition procedure, power supplies would be automatically disabled for laboratory safety and energy saving.

THE STRUCTURE OF MEASUREMENT DATA ACQUISITION INTERFACE

The measuring system could be roughly divided into five functional blocks: CHROMA ATE 62075H-30/30N power supplies/the multi-channel DCCT /the measurement instruments (includes a multiplexer, a dynamic signal analyzer, a digital voltage meter, the virtual instrument control program) and USB/GPIB communication interface. Figure 1(a) is the structure of the measuring system, Figure 1(b) is the picture of the actual experimental environment that includes the CHROMA ATE 62075H-30/30N power supplies, measurement instruments, quadrupole and sextupole magnets.

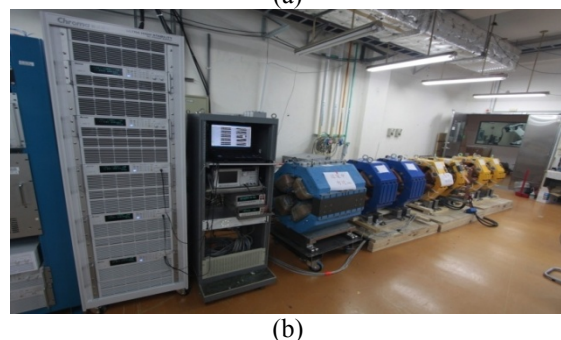
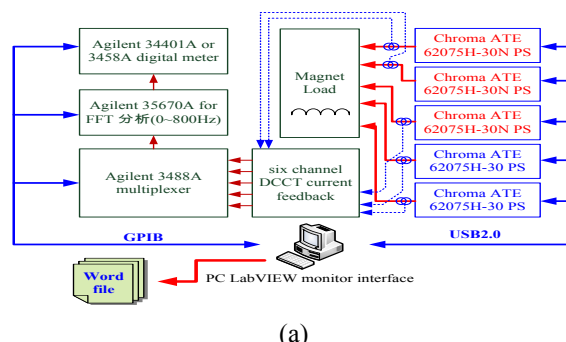


Figure 1: The measurement system (a) the structure of measurement system (b) the setup at the laboratory.

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THE STRUCTURE OF THE MAGNET POWER SUPPLIES

The circuit structure of quadrupole and sextupole magnet power supply is almost the same and shown in Figure 2. The current feedback transducer of quadrupole magnet power supply (QPS) is a DCCT and the current feedback element of sextupole magnet power supply (SPS) is a resistor shunt. The main specification of magnet power supply is as Table 1[1].

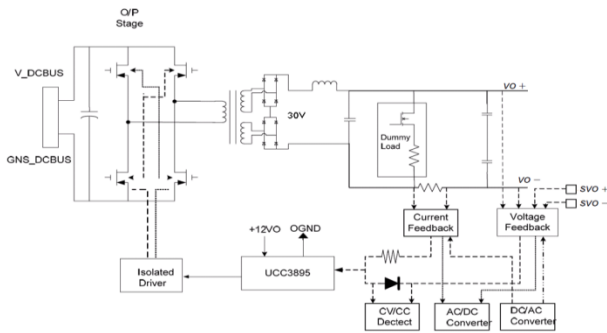


Figure 2: The circuit structure of MPS.

Table 1: The Specification of Magnet Power Supply

	CHROMA 62075H-30N	CHROMA 62075H-30
Output(A/V)	250A/30V	250A/30V
Short term stability	±1.25mA	±6.25mA
Long term stability	±2.5mA	±12.5mA
ADC/DAC resolution	24/20 bits	16/16 bits
Accuracy	±10mA	±50mA

THE MEASUREMENT DATA ACQUISITION PROGRAM

The display panel of the measurement data acquisition program consists of basic control panel of magnet power supplies, initial setting panel, the monitor panel, the error curve fitting panel, and a Microsoft Word generating report file panel. Figure 3 shows the initial setting panel of measurement data acquisition interface includes the of communication interface setting of measurement instrument and data storage path. The communication panel could display two kinds of console, the first one is USB2.0 communication console that could control QPS and SPS; the second one is GPIB communication console that could control the instruments [2].

Figure 4 shows the monitor panel of measurement data acquisition program includes real time display of the long-term output current stability of magnet power supplies and the FFT analysis of output current of magnet power supplies.

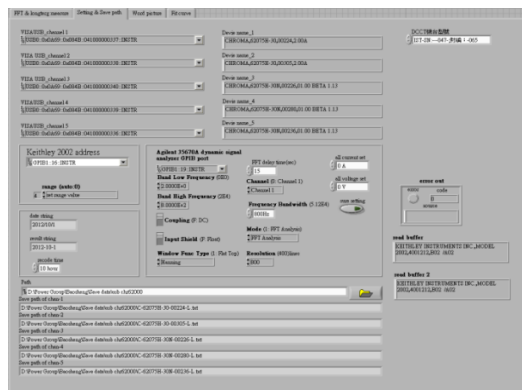


Figure 3: The initial setting panel of measurement data acquisition interface.



Figure 4: The monitor panel of measurement data acquisition program.

The error curve fitting panel of measurement data acquisition program is shown as 5. The error between current command and output current of magnet power supplies were fitted from 0 to 250 ampere with a step of 10 amperes with second order. With the fitted equation, the difference between current command output current of power supply could be minimized.

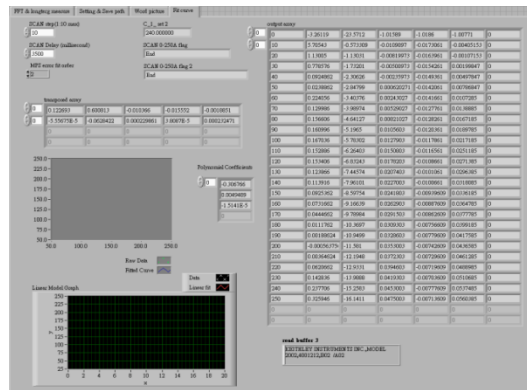


Figure 5: The error curve fitting panel of measurement data acquisition interface.

The format of graphics, text layout and output current characteristics of power supplies were set at the Microsoft Word report file generating panel of the

measurement data acquisition program. After the end of measurement, the long-term output current stability of MPS would be automatically generated as a Microsoft Word report file for each MPS.

EXPERIMENT RESULT

The virtual measurement data acquisition program was well functional, FFT analysis and long-term stability of output current are measured in this experiment, finally the Microsoft Word testing report file is generated. The model 62075H-30 is a standard power supply product of CHROMA and its performance was measured and suitable to be used as the sextupole magnet power supply. The spectrum of CHROMA 62075H-30 is demonstrated in top of Figure 6. The new model 62075H-30N power supply is designed for TPS by CHROMA, a DCCT is adopted as the feedback current transducer and 24bits regulation analog to digital converter is embedded, its performance was good to be used as the quadrupole magnet power supply. As shown in Figure 7, the stability performance of 62075H-30N power supply is better than that of 62075H-30.

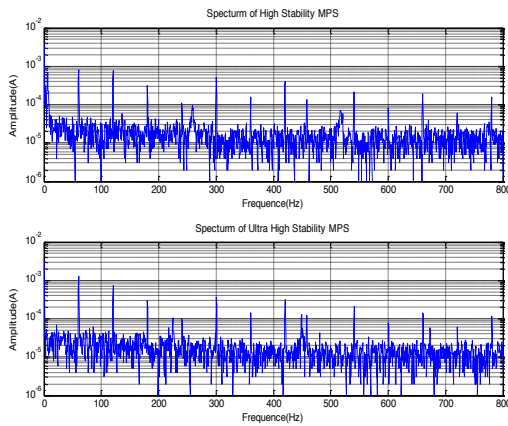


Figure 6: The frequency spectrum of MPS, (a) 62075H-30 (b) 62075H-30N.

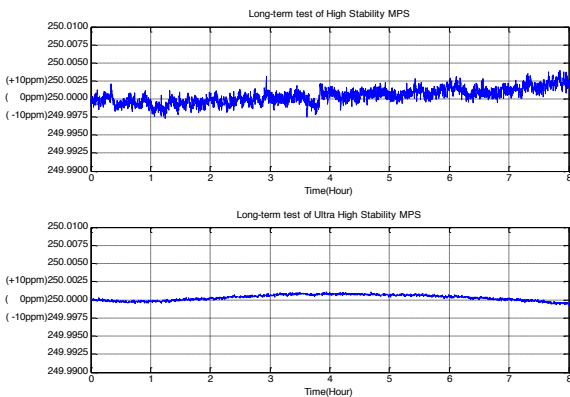


Figure 7: The stability performance within 8 hours, (a) 62075H-30 (b) 62075H-30N.

There was delicate MS Word report file for each magnet power supply and the format is shown in Figure 8. The Word report file contains some information, the device serial number, current setting, frequency spectrum of output current, long-term stability of output current, offset value of output current and error function between current setting and output current.

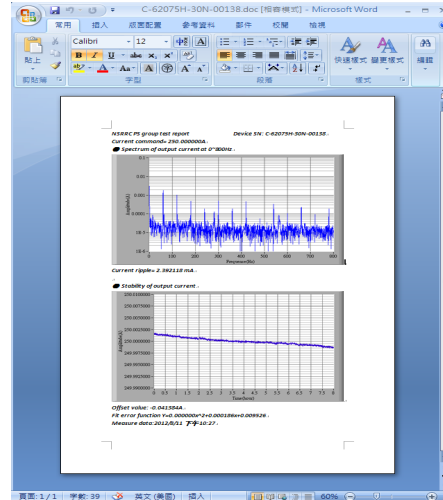


Figure 8: The MS Word report file of MPS.

CONCLUSION

Each power supply was tested with the real magnet load, and the performance of each power supply was well within the specification. The performance of the CHROMA 62075H-30/30N power supplies were suitable to be used as the sextupole and quadrupole magnet power supplies. By reducing measurement instrument and manpower loading with the virtual measurement data acquisition program, the acceptance test of the 485 units of magnet power supply was completed just within 50 working days.

REFERENCES

- [1] Catalog of CHROMA power supply product.
- [2] www.ni.com

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