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THE ACCEPTANCE MEASUREMENT PLATFORM FOR TPS CORRECTOR MAGNET POWER SUPPLIES

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Abstract

This paper presents an implementation of a multi-channel measuring data acquisition interface of corrector magnet power supplies (CMPS) 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 CMPS acceptance test. The instrument devices of measurement system include a multiplexer, a dynamic signal analyzer (DSA) and a high-resolution digital voltage meter (DVM), GPIB is the communication interface between the multi-channel measuring data acquisition interface and instruments.

There are two analyzing procedures for the output current of CMPS 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; after these two analyzing procedures are completed, the performance of each CMPS can be automatically generated as a Microsoft Word report file.

INTRODUCTION

The CMPS module was designed by power supply group, NSRRC, and with corporation between power supply group of NSRRC and Center for Measurement Standards (CMS) of the Industrial Technology research Institute in Taiwan, CMS designed the crate for CMPS and delivered 1036 units of CMPS and 120 sets of crates to NSRRC. To reduce the quantity of measurement instrument and loading of operator at acceptance test of CMPS, a multi-channel measuring data acquisition program is implemented with LabVEIW. There are two 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 Keithely k2002 DVM to measure the long-term stability of output current; after these two analyzing procedures were completed, the performance of each MPS could be automatically generated as a Microsoft Word report file.

There were two types of CMPS, the first type of the ultra-high precision CMPS is with a DCCT as the feedback component, the magnets powered by this type of CMPS is listed at the left side of table 1, the second type of the high precision CMPS is with a shunt resistor as the feedback component, the magnets powered by this type of CMPS is listed at the right side of table 1.

Within the CMPS acceptance test period, CMPS crates were mounted on a rack, and with the measuring data acquisition program, CMPSs were controlled through CPSC control card with adopting the EPICS system as the communication protocol, and the performance data were acquired within the measuring period. After the end of the measurement data acquisition procedure, CMPSs would be automatically disabled for laboratory safety and energy saving.

Table 1: The Kind of Power Supply for Magnets

DCCT type		Resistor shunt type	
Magnet	**Quantity**	**Magnet**	**Quantity**
SR CPS HC	168	SR CPS SQ	168
SR CPS VC	168	Phase shifter	15
Dipole trim	48	SR fast CPS VC+HC	192
		section ID	68+40
		BR CPS VC+HC	96
		LTB+BTS CPS	23
		BR SPS	4

THE STRUCTURE OF MEASUREMENT DATA ACQUISITION INTERFACE

The measuring system could be roughly divided into five functional blocks, 1) CMPS converter modules, 2) the multi-channel DCCT, 3) the measurement instruments that include a multiplexer, a dynamic signal analyzer, a digital voltage meter and the virtual instrument control program, 4) CPSC control card, 5) the EPICS communication system. Figure 1(a) shows the structure of the measuring system, figure 1(b) is the picture of the actual experimental environment that includes CMPSs, the measurement instruments, multi-channel DCCT, fast corrector magnets and Type-A corrector magnets for booster ring.

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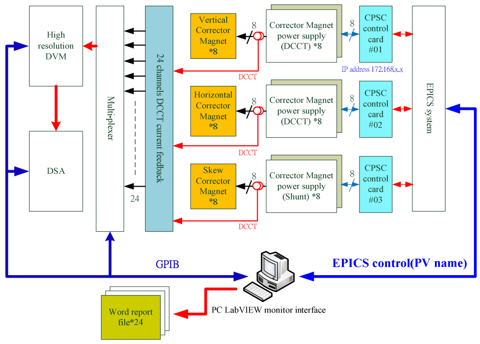
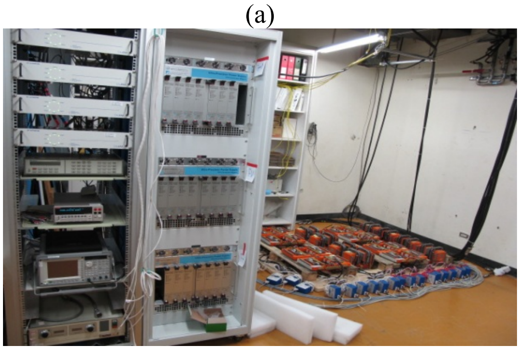


(a)



(b)

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

THE STRUCTURE OF THE MAGNET POWER SUPPLIES

The circuit structure of CMPS is shown in figure 2. The current feedback component of the ultra-precision magnet power supply is a DCCT and the current feedback component of the high precision magnet power supply is a resistor shunt. The main specification of two types of CMPS is as table 2[1].

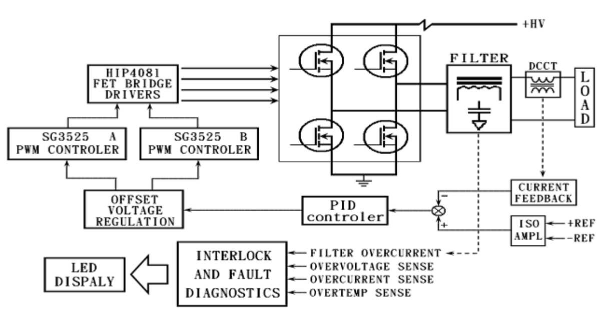


Figure 2: The circuit structure of MPS

Table 1: The Specification of Magnet Power Supply

	Ultra-precision	High-precision
Output(A/V)	±10A/±48V	±10A/±48V
Short term stability	±20uA	±40uA
Long term stability	±100uA	±200uA
Accuracy	±1mA	±2mA

THE MEASUREMENT DATA ACQUISITION PROGRAM

The display panel of the measurement data acquisition program consists of a basic control panel of CMPSs, an initial setting panel, the real-time monitor panel, and a Microsoft Word generating report file panel. Figure 3 shows the initial setting panel of measurement data acquisition interface includes the communication interface setting of measurement instrument, the measurement time setting, the data file name setting of magnets and the path of data storage. The communication panel can display two kinds of console, the first one is Ethernet communication console that could control CPSC card through PV name of EPICS system; the second one is GPIB communication console that could control the instruments [2-3].

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

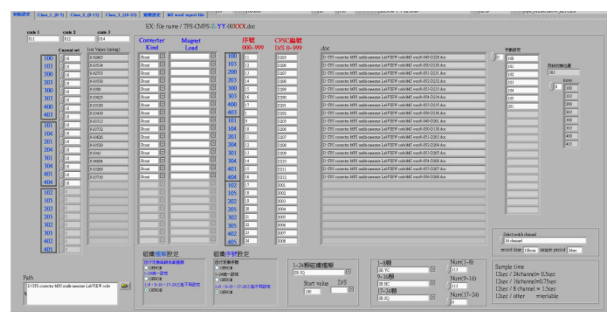


Figure 3: The initial setting panel of measurement data acquisition interface.

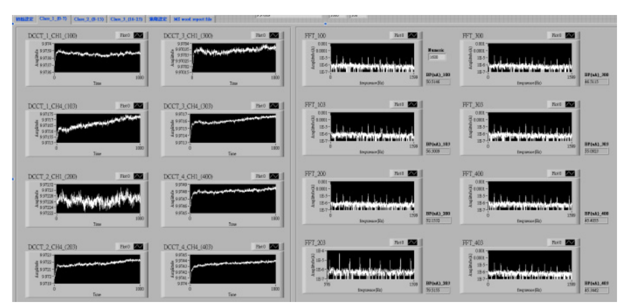


Figure 4: The monitor panel of measurement data acquisition program.

The format of graphics, text layout and output current characteristics of CMPS 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 functioned, the FFT analysis and long-term stability of output current were measured in this experiment, and

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finally the Microsoft Word testing report files were generated. The frequency spectrum of the output current of high precision CMPS is measured shown at top of figure 5, the ripple current floor is about 30μA (3ppm) and the 60Hz ripple is the biggest ripple component that is under 100uA (10ppm). The feedback current transducer of ultra-high precision MPS is a low S/N rate DCCT, the output current spectrum of ultra-high precision CMPS is measured shown at bottom of figure 5, the biggest ripple component that is under 50uA. The stability performance of CMPS with duration of 8 hours is shown at figure 6, the stability performance of the ultra-high precision CMPS is better than that of the high precision CMPS.

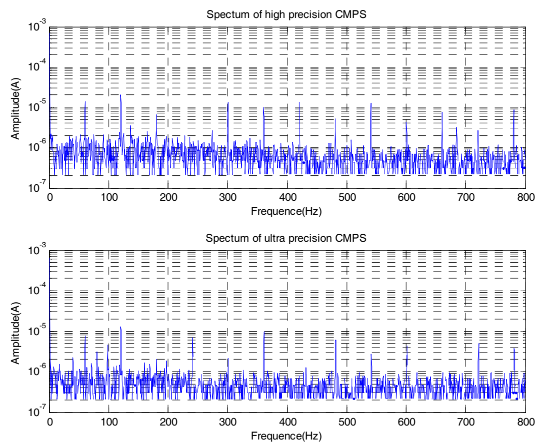

Figure 5: The frequency spectrum, (a) High-precision MPS (b) Ultra-precision MPS.

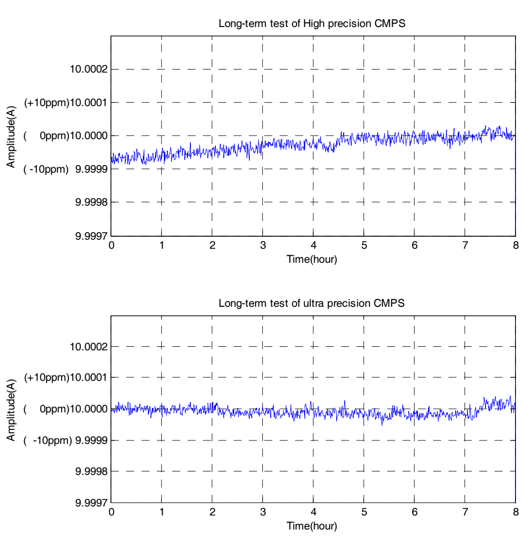

Figure 6: The stability performance within 8 hours, (a) High precision CMPS (b) Ultra-high precision CMPS.

The statistics of the output current ripple performance of CMPSs is shown at top of figure 7, output current ripple of most of ultra-high precision CMPS were within ±5 ppm that is better than that of the high precision MPS. The statistics of the output current stability performance of CMPSs is shown at bottom of figure 7, the stability of ultra-high precision CMPS were also better than that of the high precision CMPS.

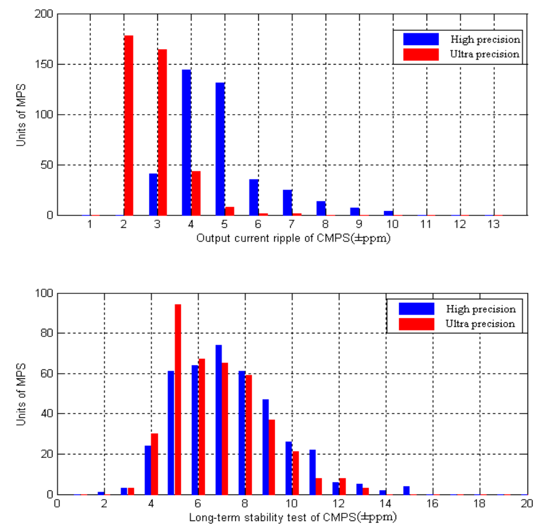

Figure 7: the output current performance of MPS statistics, (a) current ripple (b) Long-term stability.

CONCLUSION

Each CMPS were tested with the real magnet load, and the performance of each CMPS was well within the specification. The performance of the ultra-high precision and high precision CMPSs were suitable to be used as the TPS corrector magnet power supplies. By reducing measurement instrument and manpower loading with the virtual measurement data acquisition program, the acceptance test of the 1036 units of magnet power supply was completed just within 60 working days.

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