Configuration of ARGO-M Optoelectronic Subsystem and Its Performance Experiments

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ABSTRACT

The optoelectronic subsystem of ARGO-M, Korean mobile SLR system, measures the start and stop epoch of laser pulses to compute the distance from a station to satellites, which includes SPD (Start Pulse Detector), C-SPAD, PDU (Pulse Distribution Unit), Event Timer and ISA card. The SPD developed by KASI (Korea Astronomy and Space Science Institute) and detects start laser signals on the transmitting optical table. C-SPAD from Peso-consulting in Czech is used to detect the returns from satellites. A032-ET from Institute of Electronics and Computer Science in Latvia measures the precise start and stop epoch. The PDU receive signals from SPD and C-SPAD deliver to A032-ET and ISA card, which was developed by KASI and performed various tests. ARGO-M runs KHz laser ranging which requires a fast optoelectronic control of RG generation and laser fire command. For these missions, ARGO-M uses the ISA card which was developed by Graz in Austria and consists of 500ps internal Event Timer, RG generator and the laser fire controller. The experiment based on components was performed to guarantee and validate the performance of all components belonging to the optoelectronic subsystem. In addition, the experiment of the integrated optoelectronic subsystem including the ground target was also carried out for the functional and performance verification of ARGO-M in the laboratory by using the laser with 15ps pulse width. In this study, the design and performance test results are provided for SPD, PDU and Event timer. And the test results of the integrated optoelectronic subsystem is also presented with its configuration and analyzed.

1 Block diagram of optoelectronic

As shown in Figure 1, the optoelectronic system of ARGO-M consists of three components: event timer, optoelectronic controller and transmitting/receiving photon detectors.

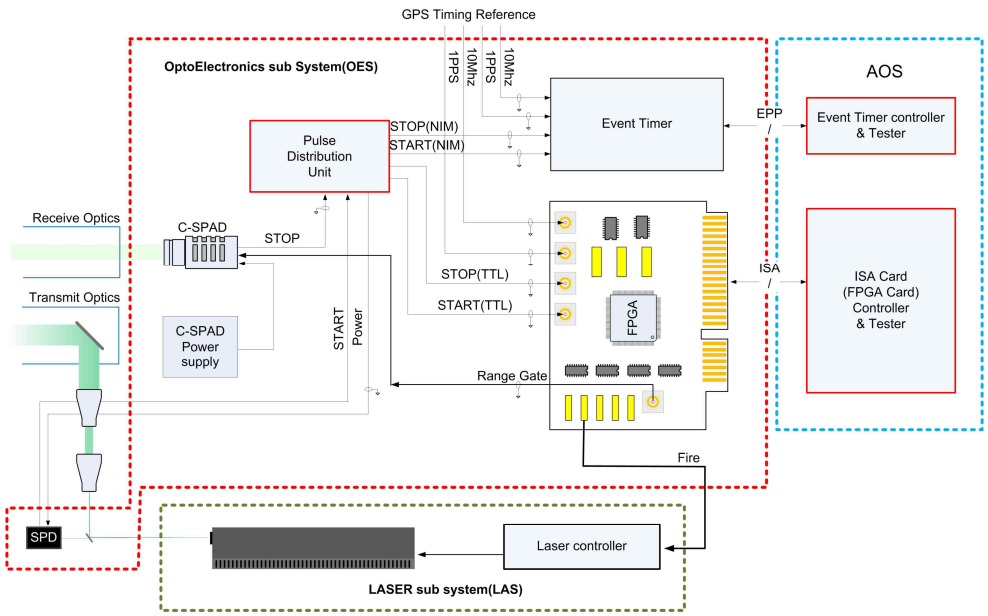

Figure 1. Block diagram of optoelectronic subsystem

2 Start Pulse Detector (SPD)

The SPD made by KASI detects the start laser pulse which is located in transmit optical table. The SPD is placed behind the 2nd laser reflecting mirror, which uses penetrated beam through the mirror to maximize the transmit efficiency of laser beam. The SPD has a focus lens to adjust input light intensity for optimal performance. The PIN diode in SPD uses FCI-125G-006HRL made by OSI optoelectronics.

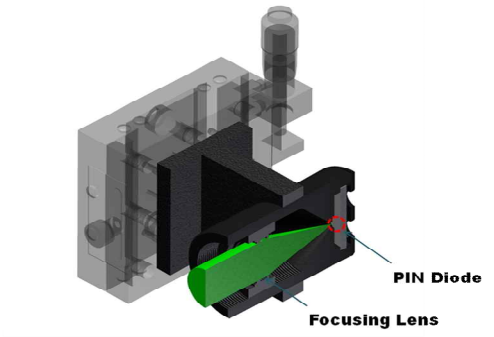

Figure 2. SPD structrure

Part No	SFH229	FCI-125G-006HRL [KASI]
Company	OSRAM	OSI optoelectronics
Reverse voltage[max. V]	20	20
Capacitance [pF/V_R,V]	13/0	0.65/5
Rise time [s/V_R,V]	10ns/10	35ps/5
Peak sensitivity[nm, peak]	380~1100(860)	400~1100(750)
Spectral sensitivity[A/W]	0.62/850nm	0.36/850nm
Dark current[pA/V_R]	0.05nA/10	0.02pA/5
Active area diameter	0.3 mm²	150 um²

Figure 3. PIN Diode specifications

3 Pulse Distribution Unit (PDU)

The PDU delivers start and stop signal to Event Timer and ISA card. The pulse width of the start and stop signal is expanded using R-C time-constant circuit at first stage of this unit. The PDU circuit is connected by one-to-one between the transmitter and the receiver using Emitter-Coupled-Logic(ECL). This unit has three kind of output port. Primary output port is for event timer, secondary output for signal monitoring and TTL output for ISA Card. The PDU with 1U height was developed by KASI. It supplies the SPD power and It has also the LED indicator on the front panel to check start and stop signal status.

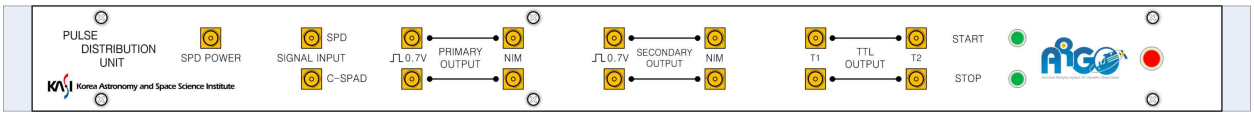

Figure 4. Front panel of Pulse Distribution Unit

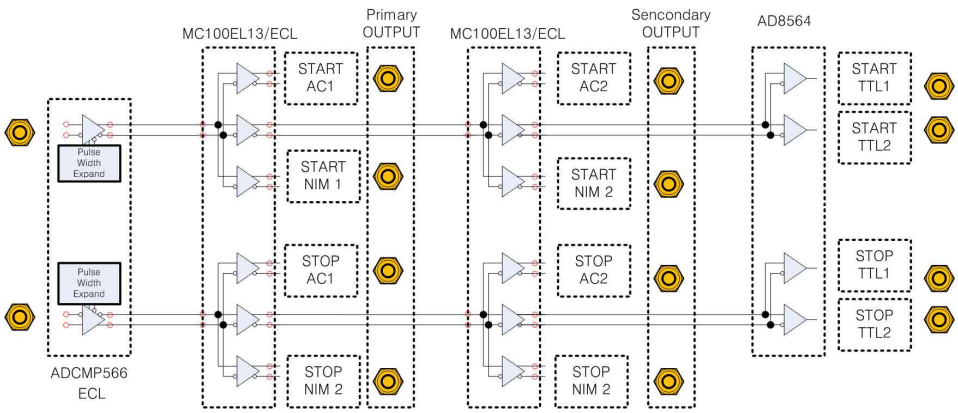

Figure 5. Block diagram of Pulse Distribution Unit

4 C-SPAD & ISA card

The C-SPAD(Peso consulting) is used for stop signal detector of ARGO-M. KASI performed the function and performance test of the C-SPAD by various means. Test results are presented in the integrated test results of this poster.

This ISA card was designed by Graz in Austria and also manufactured by KASI. ARGO-M operates KHz laser ranging which requires a fast optoelectronic control to generate RG and to execute laser fire command.

Figure 6. C-SPAD

Figure 7. ISA card

5 Event timer performance test

ARGO-M uses Riga A032-ET to measure start and stop epoch. KASI performed A032-ET performance test using Symmetricom GPS receiver for timing reference and SRS DG-645 delay generator to generate start and stop signal. The left picture below represents configuration for this test and the right graph shows the test result of A032-ET. The legend of 01, 02 and 03 means no connection between GPS receiver and delay generator. But the last legend of 01(10MHz) means the connection between the GPS receiver and the delay generator to supply 10MHz clock. KASI also checked 60ns dead time period through the test.

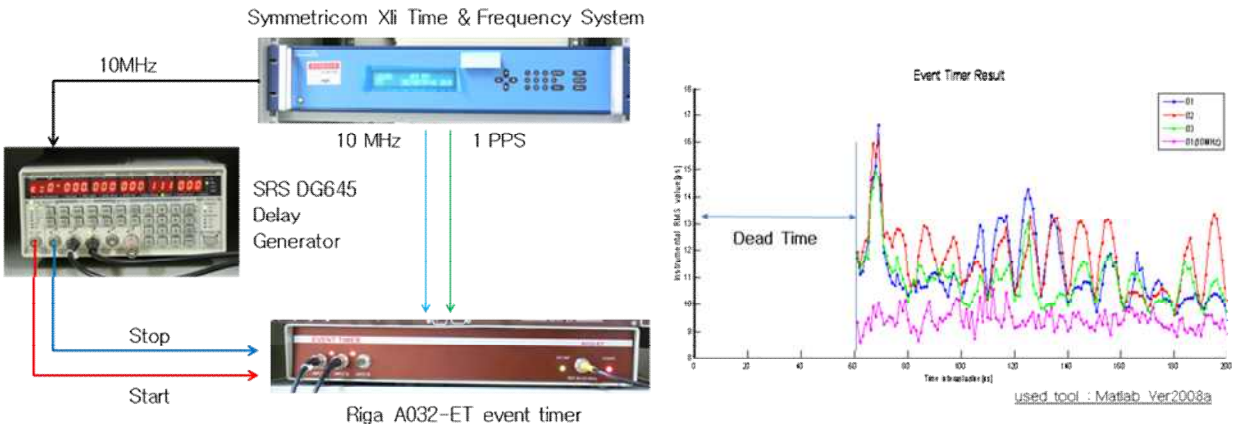

Figure 8. Configuration of event timer test(left) & its result(right)

6 Conclusion

Besides components of optoelectronic subsystem such as SPD, C-SPAD, PDU, ISA Card and event timer, RGL-532 laser, transmitting optics, ground target and receiving optics are also used for the integrated test of optoelectronic subsystem in the laboratory. Especially, we made the ground target consisting of a prism and a aluminum reflector to verify C-SPAD performance as well as the receiving optics similar to telescope.

The test measurement of integrated optoelectronic subsystem was done by using A032-ET event timer. Figure 9 shows the integrated test results with 13.5ps RMS accuracy which actually depends on the laser beam strength coming to C-SPAD.

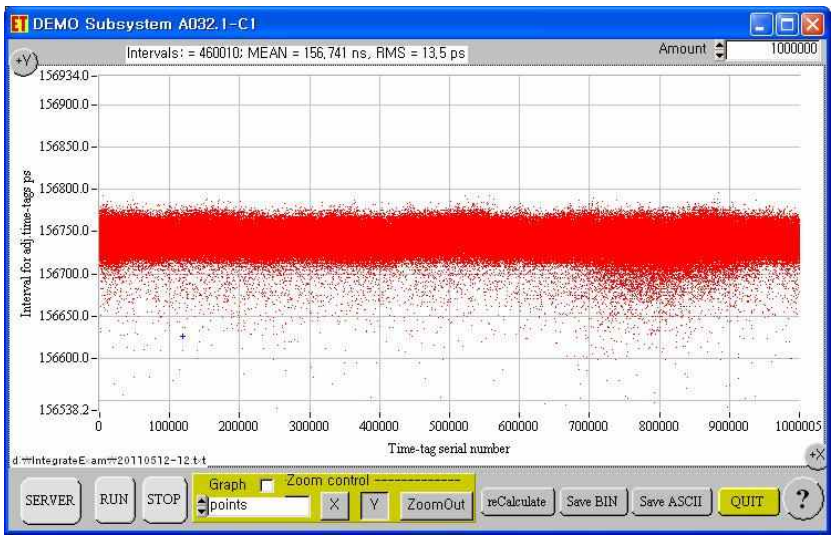

Figure 9. The test result of the integrated optoelectronic subsystem

Acknowledgements

This study was supported by "SLR system development program for space geodesy" project of KASI funded by the Ministry of Education Science and Technology(MEST).

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