

Operation of Control Rod Driving Mechanism controller at HANARO

Doo Seung Gyu^{a*}, Lee Min Woo^a, Choe Yeong San^a, Kim Hyung Kyoo^a

^aKorea Atomic Energy Research Institute, 989-111 Daedeok-daero, Yuseong-gu, Daejeon 305-353, Korea

*Corresponding author: doosg@kaeri.re.kr

1. Introduction

HANARO (High-flux Advanced Neutron Application Reactor) achieved its first critical operation in 1995.

Recently, there has been fast developments in the field of electronics. Many manufacturers of I&C components have disappeared or merged with the other companies. The suppliers of the control systems of the CRDM (Control Rod Driving Mechanism) at HANARO have disappeared. Therefore, we needed to change the control system of the CRDM since we cannot be provided with maintenance any longer.

In this paper, we investigated the operation of the control system of the CRDM when the controller and motor driver are changed.

2. Methods and Results

The CRDM system consists of a motor driver, encoder, motor, controller, etc. We will change the motor driver and controller. Thus, we detected the encoder signal when motor step signal was changed by the controller counter card.

2.1 Signal of the Interface Device

The pulse counter receives binary signals from the RTP3000 controller and outputs the pulse signals to the motor driver. The motor driver of the received pulse signal controls the motor by making a 24V step pulse for actual motor operation. We detected the step pulse of the motor operation by the encoder. These interface systems are shown in Figure 1. Two signals are detected from encoder because that the signals were determine to direction of motor

2.2 CRDM operation

Currently, the HANARO CRDM motor was rotated at an angle of 360 degrees when the motor was rotated by a 200 step operation. In other words, the motor was rotated 1.8 degrees by a 1 step pulse because

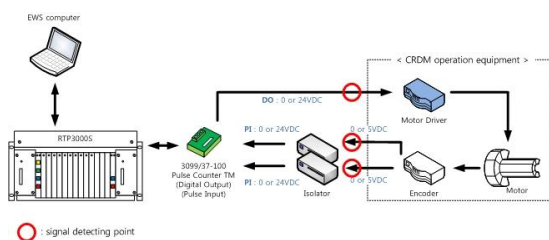


Figure 1. CRDM Interface

of the minimized shocks arising from the motor operation. The operating condition was considering the highest priority when the system is kept to control.

The RTP3000 controller calculates the step value and sends the 24 volt signal output of the motor driver by using a counter card. The 24 volt signal is 1 to 15 steps or 60 steps to meet the 3200 division ratio. In other words, the RTP 3000 controller activates the channel depending on the input values and operates the rotating direction and step operation of the motor depending on the activated channel.

The connections of the pulse counter card and motor driver are shown in Figure 2. Table 1 indicates the digital output signal of the RTP3000 controller.

Figure 3 show the results of one step of the RTP3000 controller. No.1 and No.2 are the detected signal from the encoder. No.3 describes the signal of the step operation.

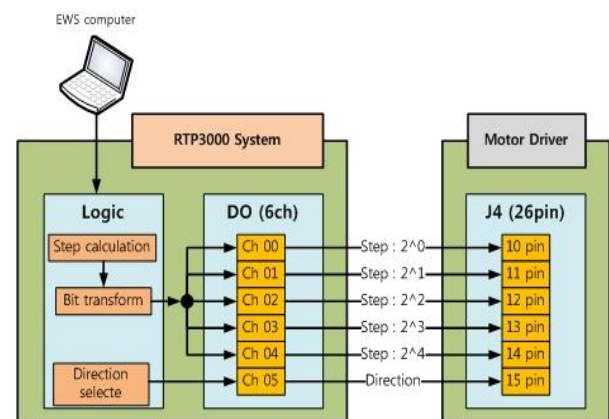


Figure 2. Connection of Pulse Counter Card and Motor Driver

Table 1. Digital output signal of RTP3000 controller

Step	Dir.	Step						Step	Dir.	Step						
		ch05	ch04	ch03	ch02	ch01	ch00			ch05	ch04	ch03	ch02	ch01	ch00	
+01	OFF	OFF	OFF	OFF	OFF	OFF	On	-01	On	OFF	OFF	OFF	OFF	OFF	On	OFF
+02	OFF	OFF	OFF	OFF	OFF	On	OFF	-02	On	OFF	OFF	OFF	OFF	On	OFF	OFF
+03	OFF	OFF	OFF	OFF	OFF	On	On	-03	On	OFF	OFF	OFF	OFF	On	On	OFF
+04	OFF	OFF	OFF	OFF	On	OFF	OFF	-04	On	OFF	OFF	OFF	On	OFF	OFF	OFF
+05	OFF	OFF	OFF	On	On	OFF	On	-05	On	OFF	OFF	OFF	On	On	OFF	On
+06	OFF	OFF	OFF	On	On	OFF	On	-06	On	OFF	OFF	OFF	On	On	OFF	OFF
+07	OFF	OFF	OFF	On	On	On	On	-07	On	OFF	OFF	OFF	On	On	On	On
+08	OFF	OFF	On	On	OFF	OFF	On	-08	On	OFF	On	OFF	OFF	OFF	OFF	OFF
+09	OFF	OFF	On	OFF	OFF	On	On	-09	On	OFF	On	OFF	OFF	OFF	OFF	On
+10	OFF	OFF	On	OFF	On	On	On	-10	On	OFF	On	OFF	On	On	On	On
+11	OFF	OFF	On	OFF	On	On	On	-11	On	OFF	On	On	OFF	On	On	On
+12	OFF	OFF	On	On	OFF	OFF	On	-12	On	OFF	On	On	On	On	On	On
+13	OFF	OFF	On	On	On	On	On	-13	On	OFF	On	On	On	On	On	On
+14	OFF	OFF	On	On	On	On	On	-14	On	OFF	On	On	On	On	On	On
+15	OFF	OFF	On	On	On	On	On	-15	On	OFF	On	On	On	On	On	On
+60	OFF	On	OFF	OFF	OFF	OFF	OFF	-60	On	On	OFF	OFF	OFF	OFF	OFF	OFF

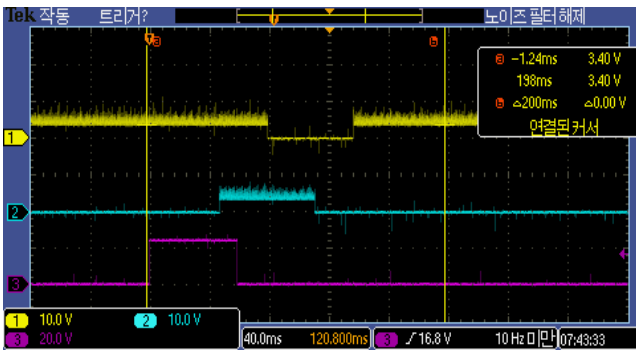


Figure 3. Results of one step from RTP3000 controller



Figure 4. Results of 60 steps from the RTP3000 controller

To the case, the one step operation (No.3 in Fig. 3) results in once detected encoder signal (No.1 and No.2 in Fig. 3)

Figure 4 shows the 60 step operations. It confirms that an operation of 60 times of motor at the figure 4 becomes the drive signal of once. That is possible because the RTP3000 controller calculates the signal of the EWS computer and the signal of the motor operation sends corresponding channel for step operations. In addition, HANARO CRDM must operate within 200 ms[1][2]. Figure 4 shown the operation was completed with 160 ms.

3. Conclusions

From the experiment, If we changed the controller and motor driver in the CRDM of HANARO, the CRDM will operate normally. The next step will be to apply the device to an MLC (Multi-loop controller) of HANARO to see if it is possible to support normal operation.

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