

## **A Study on Development of Maintenance Skill Training Simulator for Railway Vehicle**

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### ***Abstract***

*Generally, in the railway vehicle the driving force of gravity happens by the high-speed running and the repetitive impulse cause the degradation and the malfunction phenomenon shows differently because the durability of each component changes according to the internal and external causes.*

*The maintenance of propulsion control device which is played the very important role as to the stable service of the railway vehicle is greatly important among them. Therefore maintenance training propulsion control device simulator is needed to maximize learning through repetition and improve the maintenance practical skills training.*

*This paper designed the railway vehicle running device with a miniature for the railway vehicle maintenance training and developed a propulsion control device simulator equipped the imitation steering wheel.*

**Keywords:** *Railway vehicle, Malfunction phenomenon, Maintenance training, Propulsion control device simulator, Skills training*

### **1. Introduction**

Generally, in the railway vehicle the driving force of gravity happens by the high-speed running and the repetitive impulse cause the degradation and the malfunction phenomenon shows differently because the durability of each component changes according to the internal and external causes. With any way, the maintenance about the railway vehicle is necessary in order to prevent the loss because of the malfunction. The maintenance of propulsion control device which is operated the very important role as to the stable service of the railway vehicle is greatly important among them<sup>[1][2]</sup>. The structure and features and characteristics of each device about maintenance of propulsion control device should be understood accurately and maintenance utilizing that has to be accomplished. Therefore maintenance training propulsion

control device simulator is needed to maximize learning through repetition and improve the maintenance practical skills training<sup>[3][4]</sup>.

This paper designed the railway vehicle running device with small scale prototype for the railway vehicle maintenance training and developed a propulsion control device simulator equipped the imitation steering wheel. In addition, this paper applied a multi-thread technology in order to implement the staged fault and the propulsion control device protected operation test and confirm the validity as the propulsion control device simulator for the maintenance training.

## 2. Maintenance skill training simulator

Driving control device consists of miniature railway car driving unit which is mechanical, the electric power conversion system which is mechanical, simulation wheel which controls those for improving practical skills. And simulator is designed to conduct maintenance training through implementation of control and monitoring of each device fault simulations.

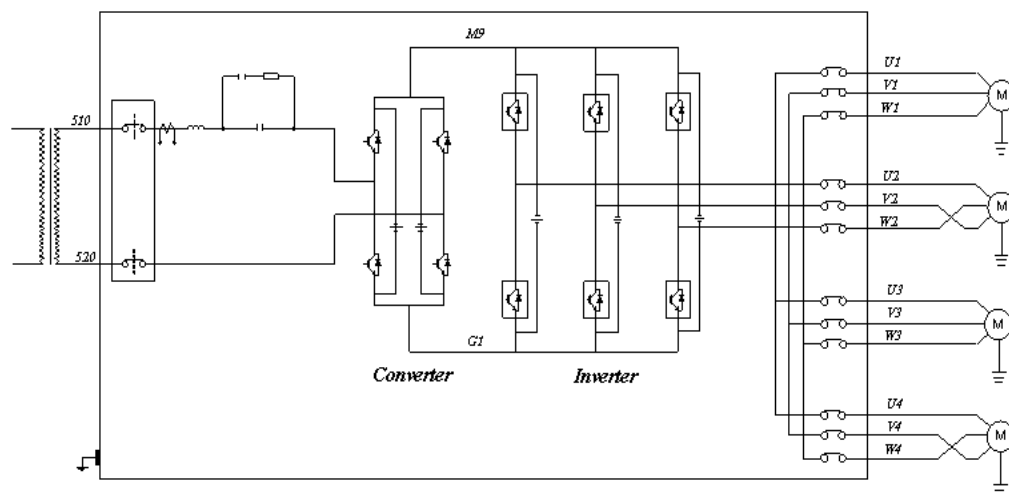


Figure 1. Circuit of the electric power conversion system

Figure 1 shows the circuit of the electric power conversion system, and consists of four motors for simulation of railway vehicle system. In addition 1C1M, 1C2M, 1C4M control was designed depending on the rail vehicle systems. And it was placed in a separate measuring terminal to prevent accidents.

## 3. Experiment result

Figure 2 is an example of a simulation fault in the driving control device operating program. It shows an implementing screen about battery voltage supply failure. The simulation malfunction of the battery voltage supply failure. The cause of the failure is a battery contactor failure.

Aside from this, rising out of pantograph, inability of the main circuit breaker input also appears on the same simulator program control screen. Maintenance training is performed through broken items showed screen.

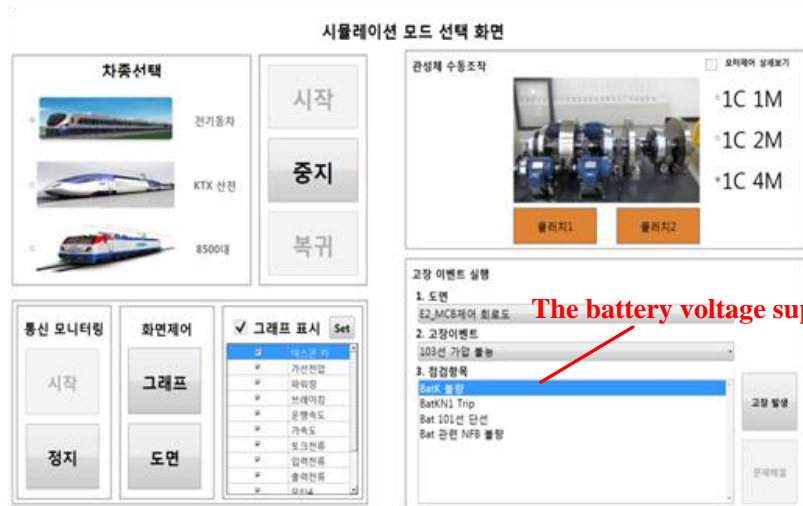


Figure 2. Battery failure simulation screen

Induction Motor Over Load(IMOL) fault code is that if U, V, W current of traction motor exceed the set value for the 2[ms] or more, turning off the converter/inverter gate through the traction motor overload detection as a IMOL protective action and CIFR Lamp showing a major failure of power converter is turned on. Fig. 3 is the screen of simulated driving. If IMOL fault code is occurred, it detects IMOL fault code and CIFR fault code and FAULT lamp turned on.

If an IMOL fault occurs while driving to controller P4, MCB is not blocked, output current and the motor current of the inverter is cut off. Because it is controlled so as not to overload, the voltage and current is appearing at zero.



Figure 3. IMOL protection operation simulation (simulated steering wheel)

Fig. 4 is propulsion control device output waveform where (a) is a powering, (b) is a inverter input RMS current, (c) is a inverter output RMS current. If a fault occurs while driving to controller P4, powering signal is applied because MCB is not blocked. It is confirmed that output current of the inverter is cut off by inverter gate off.

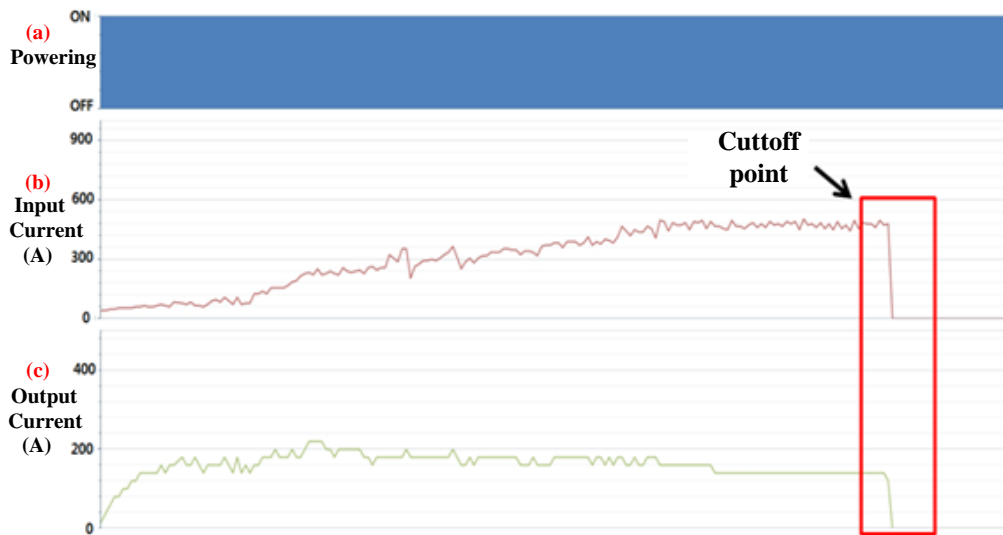


Figure 4. IMOL protection operation simulation output

## 4. Conclusion

Because fault of propulsion control device has an effect on the train operation, maintenance Training is needed. In this paper, we developed a propulsion control device simulator for maintenance training of the device among the device with the electrical and mechanical mechanisms of railway vehicle

In addition, we implemented a failure that occurs in the actual rail vehicle and confirmed the difference of protection operation and waveform according to the failure cause through protective action simulation of propulsion control device.

As a result, we understood the characteristics of the propulsion control system and it is determined to improve the time shortening and maintenance practical skills through a failure measures and maintenance training.

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