

전원 공급 시스템의 절연 결함을 감지하기 위한 재설정 프로그램에 관한 연구

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A study on the reset program to detect insulation faults in the power supply system

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요약

This paper presents a reset program that is used throughout the operation of the Insulation Monitoring Device (IMD) to quickly detect insulation fault when an unexpected insulation fault occurs in the Power Supply Systems (PSS). The reset program can improve the response time up to 4 times.

I. 서론

In unearthed systems, IMD is a mandatory device to monitor insulation resistance R_e between PSS and ground to avoid unexpected accidents such as short circuits, fire, etc., causing damages to human and power systems. When an insulation fault occurs and IMD cannot detect the insulation fault fast enough, electrical accidents can occur before users are alerted. In this paper, a reset program was proposed to help IMD quickly detect the insulation fault and promptly warn users.

II. 본론

Figure 1 shows an overview of IMD. IMD is connected between conductor lines of PSS and the ground, so it combines with insulation resistance R_e and insulation capacitance C_e to form a closed circuit. A signal generator injects a test signal having a magnitude of U_p into the PSS through a signal coupling block and through R_e and C_e to the ground [1]. The value of insulation resistance R_e is calculated after U_{Rm} is determined in steady state region. The determination of steady state for U_{Rm} signal is based on the calculated values of U_{Rm} by averaging after every t_n second. Averaging time for each cycle starts from t_0 , and it is increased after each cycle.

Figure 2 shows graphs that compare operation of IMD with and without reset program. In the case of IMD without reset program shown in Figure 2(a), when insulation fault occurs at t_n , it needs two more sampling cycles t_{n+1} and t_{n+2} to calculate insulation resistance R_e and send an insulation alarm. However, in the case of IMD with reset program shown in Figure 2(b), when insulation fault occurs at t_n , by noticing an abnormal change in the magnitude of U_{Rm} signal, reset program can quickly detect insulation fault. At that time, sampling time is reset to t_0 and after two sampling cycles t_0 and t_1 IMD with

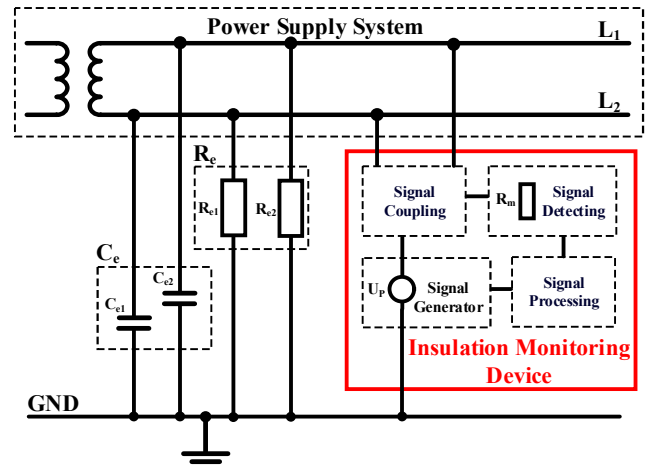


Figure 1. Overview of IMD.

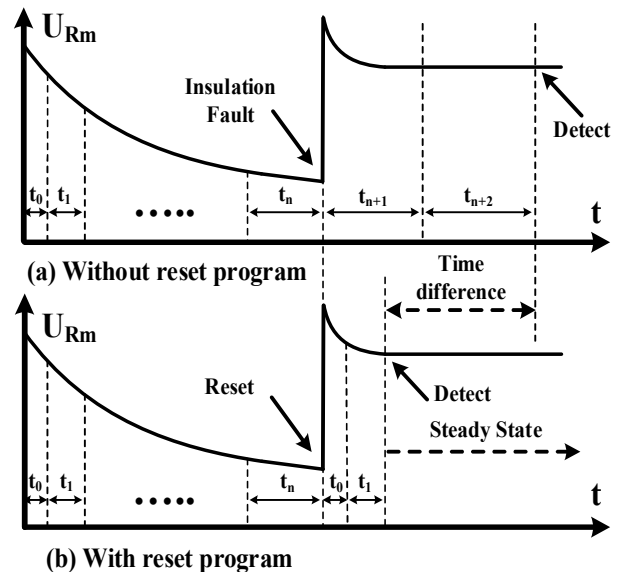


Figure 2. Comparison between with and without reset program.

reset program sends an insulation alarm signal only after (t_0+t_1) seconds. As a result, reset program can detect insulation fault and send an insulation alarm faster than IMD without reset program, especially when the time of the insulation fault is closer to the steady state, which means the t_n is very large.

Simulations with an IMD model built in Simulink are carried out to prove the fast response the reset program to a sudden insulation fault. The simulation is setup with $C_e = C_{emin}$ and the insulation error occurs when R_e drops from nearly infinity value to half of the R_{min} value [2]. As shown in Table 1, the response time with the reset program is improved by 4 times compared without the reset program when the fault time n is changed during the transient state time n_{trans} of the output signal.

Table 1. Response time with and without reset program.

Fault time n/n_{trans}		Response time (s)	
		with reset program	without reset program
Far from steady state	0.2	4.155	4.155
	0.3	5.484	8.866
Close to steady state	0.8	5.572	21.26
	0.9	5.484	21.26
	1.0	5.893	21.26

III. 결론

This paper presents a reset program used in IMD to quickly detect insulation fault and gives prompt warning signals to users. Compared with IMD without reset program, IMD with reset program can response 4 times faster.

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참 고 문 헌

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