TESTING OF OVERCURRENT RELAYS

PURPOSE:

1. To obtain basic knowledge about relays used in power systems.
2. Obtaining comprehensive information about Overcurrent Relays.
3. Recognizing and using the Overcurrent Relay Tester.
4. Setting and obtaining characteristics of reverse time overcurrent relays.

Preliminary:

1. What are relays used for in Power Systems?
2. How many types of relays are there used in power systems? What are they used for?
3. What are the differences between a reverse time overcurrent relay and a constant time OCR.
4. What are the differences between Directional Overcurrent Relay and Non-Directional OCR?
5. How and in what cases is the selection of the characteristic curve of a reverse time overcurrent relay carried out?
6. How is Ground Fault Protection different from phase protection in overcurrent relays? Which types of overcurrent relays are used for ground fault protection?
7. What do the terms primary relay, secondary relay and auxiliary relay mean?
8. The operation and usage of the RFD-200 S3 relay tester to be used in the experiment fields.

1. Protecting Power Systems with Relays

Transmission systems are planned and operated in a way that does not allow any power interruption or restriction. In order to ensure transmission continuity, it is necessary to reduce the rate at which the facilities are affected by faults (protection), to establish additional generation resources, and to ensure that the same load is fed from different directions.

The flow path of the generated energy starts from the generators in the power plants, continues with power transformers, energy transmission lines, medium voltage reduction transformers distribution lines and ends at the distribution transformers.

Short circuit failures, which cause sudden changes in system operating conditions, are one of the biggest factors that threaten the continuity of transmission. The damage caused by the sudden discharge of energy in an uncontrollable direction can be minimized by rapidly interrupting the transmission between the fault and the sources feeding it by means of the breakers closest to the fault point.

The relays used for this purpose detect unusual situations in the system and activate the circuit opening unit of the system. In order to achieve this purpose, relays control the specific quantities such as current, voltage and temperature in the system. Relays are adjusted by taking into account the values that the system designer or control officer accepts as capable of the system or that occur in the system as a result of some studies. Thus, if the system is subjected to a strain above the set values, the breaker control is activated and this part of the system is disabled.

In energy systems, relays are mainly; It can be classified as overcurrent differential and distance protection (impedance) relays. In this study, the coordination logic used in the protection of the energy system of overcurrent relays, which are mostly used in energy systems, will be emphasized and the relays will be tested.

1.1. Overcurrent Relays

Fault in the protected section of the line and in short circuits occurring outside this section The change in the amplitude and phase angle of the currents allowed the fault current to be used as a temporary element to the fault. Overcurrent relays can be classified into two main groups: primary and secondary overcurrent relays.

Secondary overcurrent relays are divided into directional overcurrent relays and non-directional overcurrent relays.

Overcurrent relays are fixed, reverse, very reverse, over-reverse time.

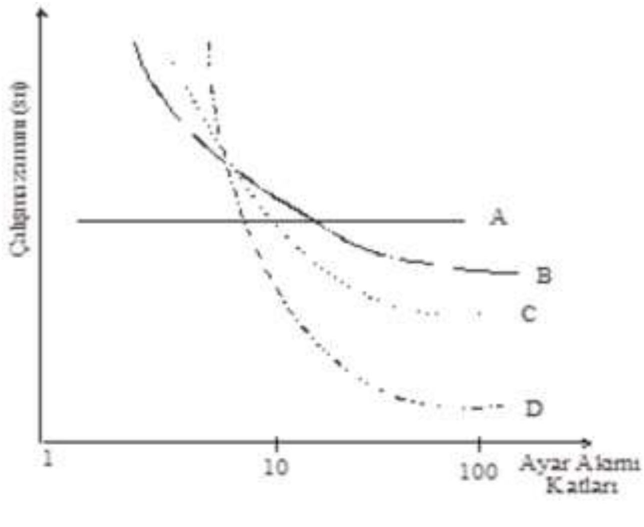


Figure – 1. Miscellaneous inverse time characteristics

The overcurrent relay is connected to the energy system through the current transformer. The current rating that the line can withstand for any short circuit or overload situation is calculated for the secondary side by considering the current transformer flipping ratio. This value to flow from the secondary is set as the operating current of the relay.

1.2. Overcurrent Relay Coordination

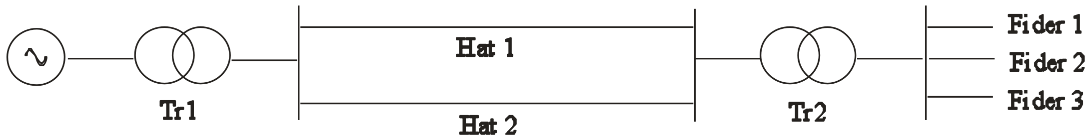


Figure – 2. Feeding the system via a double line

The basic principle in the operation of energy systems is that the part where the fault occurs is disabled.
and continue the work of other parts. For example, in a short circuit that occurs in Fider 1, if the breaker of Tr.2 trips, Fider 2 and Fider 3 will not be energized even though they are not faulty. Likewise, in case of a short circuit in Line 1, the tripping of the busbar to which Line 1 and Line 2 are connected will cause the whole system to be de-energized. However, while it is possible to energize the system through Line 2, this will be prevented.

1.2.1. Coordination with Fixed Time Relay:

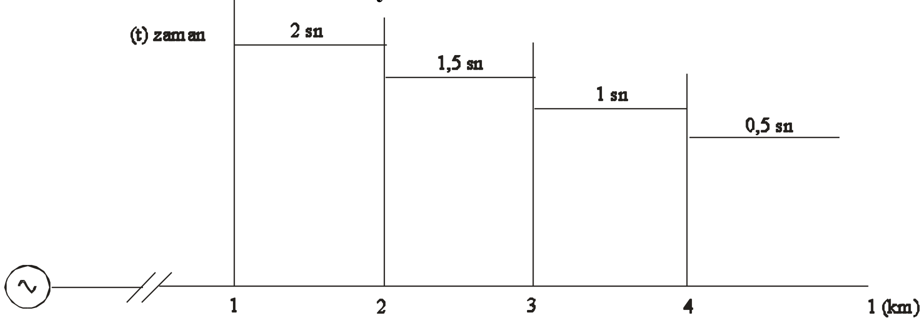


Figure – 3. Coordination of a system with a fixed-time relay

In fixed-time relay coordination, a time that increases as you move from the consumer to the source adjustment is made. Thus, in the short circuit that occurs at the end of the line, all relays start to work, but after 0.5 seconds, the part to which it is connected is disabled by warning the 4th relay breaker and the defective part is disconnected from the system. Other relays take their initial position when the fault is disabled and do not trip. If it is a short circuit between 2-3, the relays at points 1 and 2 will detect the fault and after 1.5 seconds, they will warn the relay breaker number 2 and ensure that the line is disabled from part 2.

There is also a drawback of fixed-time relay coordination: If the line connected in series is protected, faults close to the source (as it will show lower impedance) will cause a larger fault current, but these will be cleared late due to coordination. This problem can be solved by using a reverse time relay.

1.2.2. Coordination with Reverse Time Relay:

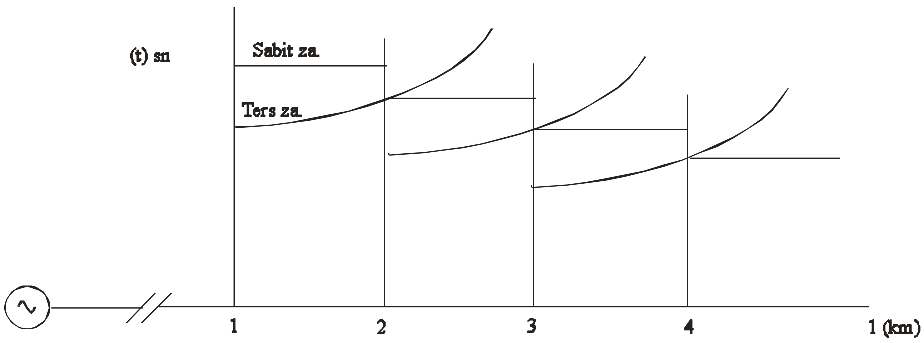
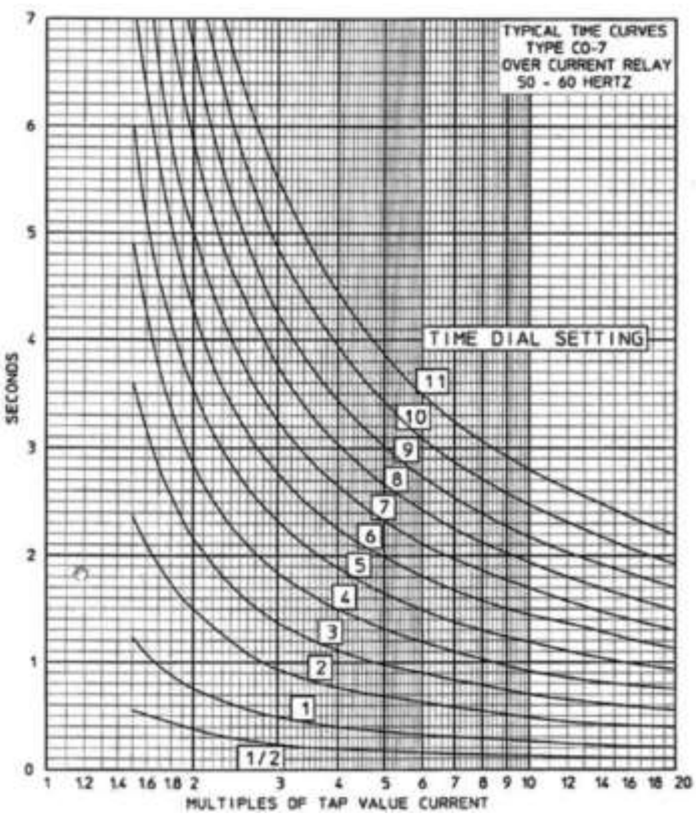


Figure – 4. Comparison of fixed and reverse time relays



Relays work The time is changed by means of the time setting unit on the relay depending on the amplitude of the working current of the relay. Horizontal axis, Relay threshold current value **multiplier**. When setting the relay, the time delay setting curve is also selected (Time Dial Setting).

Reverse Time In relays The operating time is inversely proportional to the current applied to the relay. As the amplitude of the current increases, the operating time also decreases depending on the current-time characteristic of the relay.

Figure – 5. Reverse time Overcurrent Relay Curve Selection.

In the case of using a reverse time relay, the tripping time of the relay will be shortened as the amplitude of the fault current increases. Thus, if the appropriate curve adjustment is made for each position, the relays will go to open at the appropriate times, fulfilling the principle of selectivity.

2. EXPERIMENT

In the experiment, a current-time graph of a reverse-time overcurrent relay will be obtained. The device to be used for the test is the RFD-200 S3 relay tester.

2.1. Security:

Please do not turn on the device after making the necessary connections. Make sure that the connections are checked by the test manager.

2.2. Introduction:

2.2.1. General description and specifications:

RFD-200 S3 Relay tester is a device designed to test and measure the performance of electromechanical, electronic and microprocessor-based protection relays. It is a portable and easy-to-use device that allows many test relays used indoors and outdoors to be tested.

2.2.2. Built-in digital timer:

The built-in digital timer on the RFD-200 S3 Device has independent start and end trigger inputs. This allows the transition time between events (from start to finish or from end to start) to be recorded independently in both milliseconds and revolutions. This timer has three different types of operation.

The "internal trigger" mode activates and stops the timer according to the presence of voltage and current at the time of application.

The "Dry-Contact" mode triggers the timer according to the change in the contacts that are going to open and there is no current.

The "Wet-Contact" mode triggers the timer according to the change in the current contacts. In short, the timer according to these three working modes; operating status, decommissioning or triggered according to voltage variations.

2.2.3. AA Current Source:

The device has 3 different output value current sources (10A, 40A and 100A).

2.2.4. Auxiliary Output Contact:

There is one set of Normally Open and Normally Closed auxiliary contacts on the device (240Vaa/3A). Output can be obtained through these contacts.

2.2.5. AA/DC Voltage Sources:

There is an AA voltage source that can operate in the range of 0-250V and a DC voltage source that can operate between 0-300 V on the device.

2.2.6. Measuring Instruments:

The device has a voltmeter that can measure between 0-600V. The test current is shown on the LCD screen. The measurable current value is between 0-250A. There is also an ammeter so that an external current can be measured. This ammeter has a measurement range of 0-6A and is protected by a circuit breaker.

2.3. Audits and Indicators:

Figure 6 shows the control and indicator sections of the RFD-200 S3.

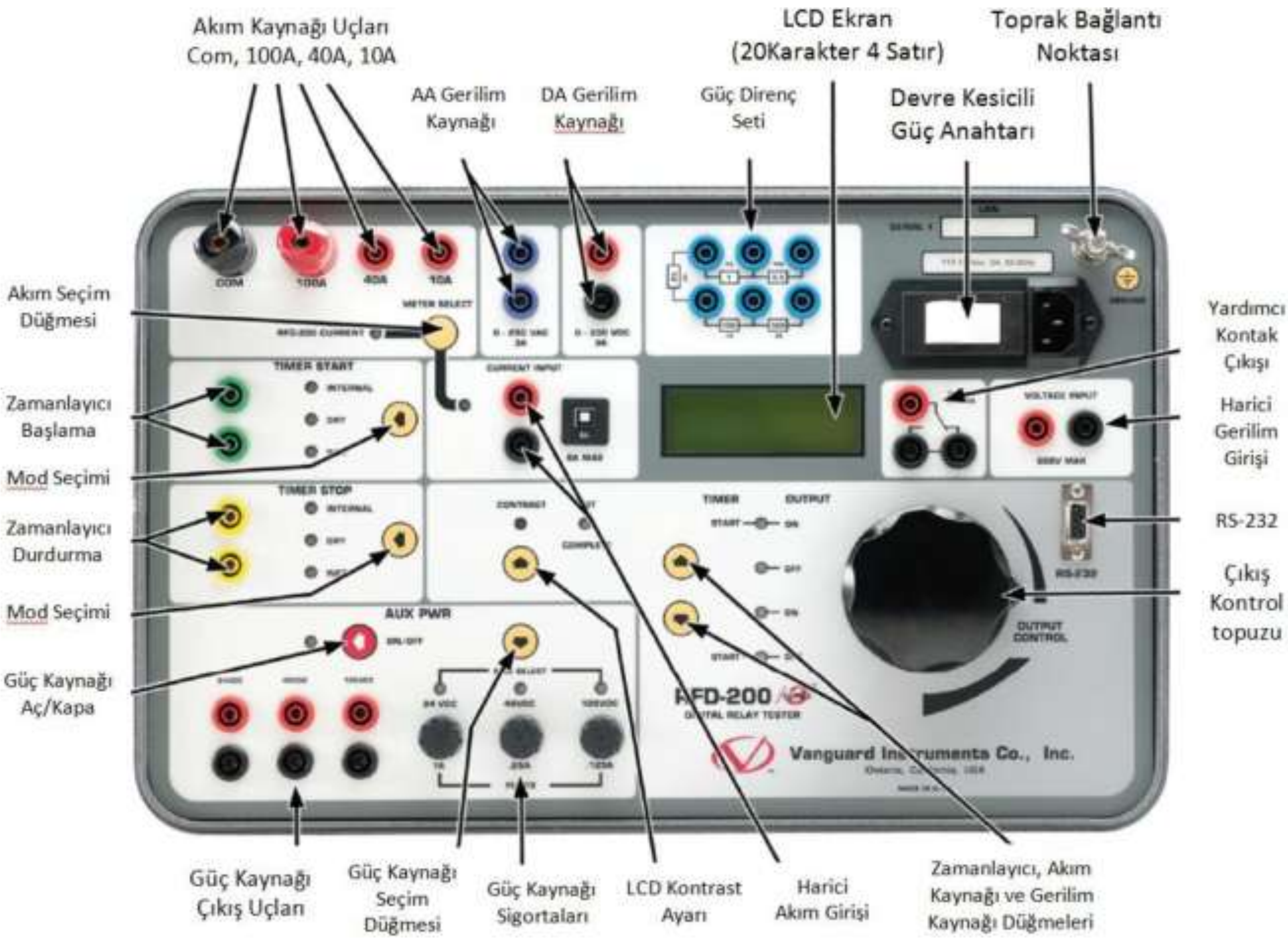


Figure – 6. RFD-200 S3 Relay Tester Inspection & Indicators

2.4. Time Delay Test Setting for RFD-200 S3 (Current-Time Graph Extraction)

The following steps will be taken to measure the time response of an overcurrent relay:

a. Connect the RFD-200 S3 current source output to the relay coil as shown in Figure 7.

b. Set the [TIMER START] input to "internal". The device starts working in this mode when it is first started.

Figure b.1

Figure c.1

c. Move the [TIMER STOP] input to the "dry" position and connect it to the dry contacts of the relay as shown in Figure 7.

d. Set the values shown in TABLE 1 *in the relevant parts on the front of the Overcurrent relay*.

xt	$I >> xI_s$	$I_sA > (A)$	$I_sC > (A)$	$I_{s\ ground} > (A)$
0.4	14	2	2	1

Table 1. Overcurrent Relay Setting Chart

e. Set the test current by selecting the "ON" mode in the control mode section.

f. Turn off the power source by selecting the "OFF" position from the control mode section.

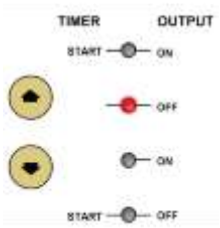


Figure f.1

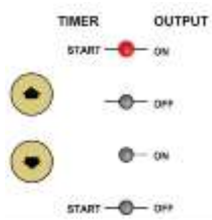


Figure g.1

g. Again, select the "Start-On" position from the control mode section and start the test.

The timer of the RFD 200 S3 will start counting as soon as the coil of the relay is energized and the main

It will also stop as soon as the state of the contacts changes. The elapsed time and test current will be seen on the screen throughout the test.

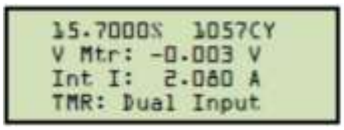


Figure g.2

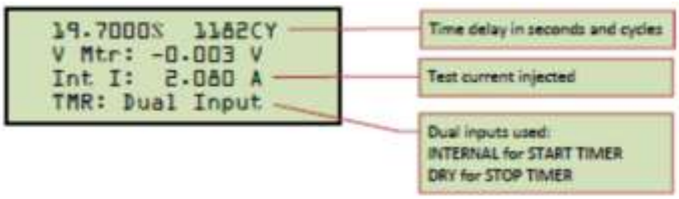


Figure h.1

h. When the test is finished, the LCD display and the [TEST COMPLETE] led will flash. The time delay will be shown on the screen in milliseconds and cycles. The current level used to perform the test will also be seen on the screen. A typical result screen will be as in Figure h.1 (flashing):

i. Adhering to the application method given above, perform and record the measurements specified in Table 2 below.

1.Ölçüm	xt Sabit	$I_{s\,g}$ > (A); Sabit = a	Giriş Akımı değişken	Açma süresi=?	T– I/I_s Grafiğini oluşturunuz.
2. Ölçüm	xt Sabit	1 $I_{s\,g}$ > (A); Sabit = a 2. $I_{s\,g}$ > (A); Sabit = 2a	1. Giriş Akımı = b 2. Giriş Akımı = 2b	Açma süresi=?	Fark var mıdır? Sebebi nedir? Yorumlayınız.
3. Ölçüm	xt = 0.7	$I_{s\,g}$ > (A); Sabit = a	Giriş Akımı değişken	Açma süresi=?	1. Ölçümden farkı nedir? Açıklayınız.
4. Ölçüm	xt Sabit	I >> xI_s = 4A	Giriş Akımı 2A=>5A	Açma Akımı, Açma süresi=?	Yorumlayınız.

Table 2. Measurements to be taken in the experiment.

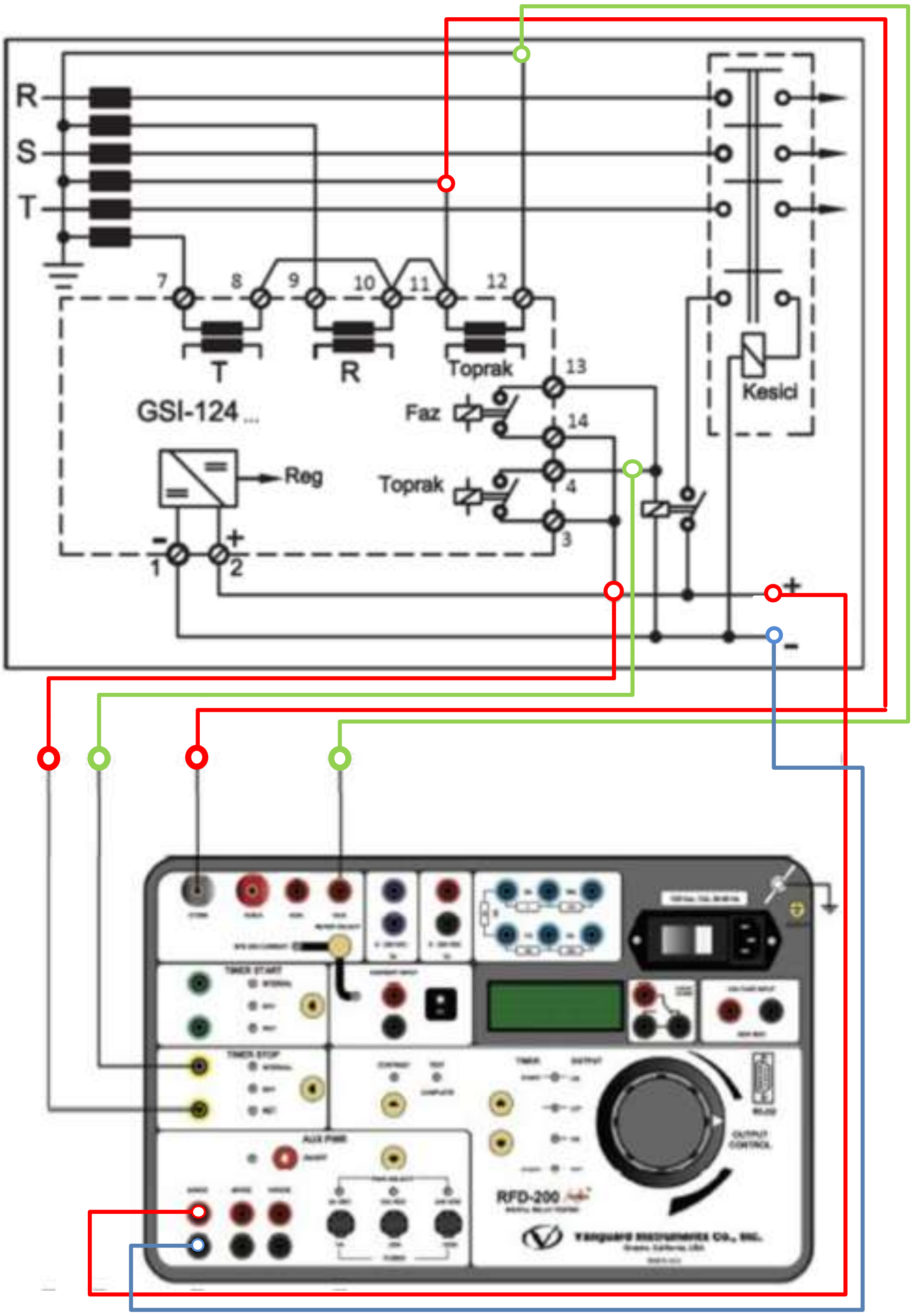


Figure – 7. RFD-200 S3 Relay Tester and Overcurrent Relay Connection