

## Lab 4 - Student Version



### Background Information:

Commissioning is the process of installing a new device into both a physical system and SCADA system. In this laboratory exercise, you will install a new device into your existing system and customize its logic according to a list of provided specifications. You will demonstrate that the system behaves as intended by following a commissioning plan.

The relay introduced in this laboratory exercise is the SEL 351 Protective Relay. The SEL 351 is most commonly used to provide distribution feeder protection and event metering. The device provides a variety of customizable settings and logic. You will configure the SEL 351 and your AcSELeRator RTAC project to respond to simulated fault conditions. When a fault is applied, your system should trip and open an output contact on the SEL 351. You will also need to configure logic in the SEL 351, SEL 849, and AcSELeRator RTAC software to trip the SEL 849 when the SEL 351 detects a fault.

Commissioning requires engineers to test the actual response of a new device to field conditions. You will use the KoCoS Automatic Relay Test System to apply secondary voltages and currents to the SEL 351. This system will be used to simulate different fault scenarios. The KoCoS will be remotely operated using a computer with the ARTES software installed.

### Learning Outcomes:

- Implement a new device into an existing system.
- Practice following a commissioning plan.
- Communicate between two different field devices through the use of a communications processor.

### Equipment Needed:

- ICS Lab
- SEL Quickset
- SEL AcSELeRator RTAC
- SEL RTAC
- SEL 351
- SEL 849
- KoCoS ARTES 460
- KoCoS ARTES Software
- KoCoS Voltage and Current Leads x8
- Cables
  - SEL C662 USB to Serial cable
  - Ethernet cable x2
  - Serial Cable x3
  - Serial Cable - Male to exposed leads

## Procedure

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1. Log into the main workstation and open the AcSELERator RTAC (SEL-5033) software.
2. Open the AcSELERator RTAC project you created for the previous lab.
3. Work down the checklist of items on the attached Commissioning Plan.
  - a. Finish all steps in a section before proceeding to the next step.
  - b. When you find you need help with a step, navigate to the corresponding appendices as shown in **Table 1**.
  - c. Settings and logic for the SEL 351 can be calculated in **Appendix B**.
4. The lab is complete once all checkboxes are filled.

**Table 1 - List of Supporting Reference Appendices**

Appendix A	Using SEL QuickSet
Appendix B	SEL 351 Settings and Logic
Appendix C	Connecting the SEL 351 to the RTAC
Appendix D	Connecting the KoCoS to the SEL 351
Appendix E	Navigating the ARTES Software

## Questions

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## Commissioning Plan

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### Device Status

- ☐ Device energized.
- ☐ Enable LED illuminated.
- ☐ Push target reset - All LEDs illuminate.
- ☐ Press STATUS button - No warnings or failures.

### Device Settings

- ☐ Serial communication enabled with SEL QuickSet.
- ☐ Settings from appendices B uploaded to the device.
- ☐ Logic uploaded to the device.
- ☐ Output contact 101 opens when using the “OPE” command in QuickSet terminal.
- ☐ Output contact 101 closes when using the “CLO” command in QuickSet.

### Device Communication

- ☐ Device added to AcSELeRator RTAC project.
- ☐ Device communication settings entered correctly in AcSELeRator RTAC project.
- ☐ Device’s offline tag is “false” when the AcSELeRator RTAC project is online.

### Relay Test System Physical Setup

- ☐ KoCoS is **NOT** energized.
- ☐ KoCoS voltage outputs connected to device voltage inputs.
- ☐ KoCoS current outputs connected to device current inputs.
- ☐ TA approves current and voltage contact connections.
  - ☐ TA Initials: \_\_\_\_\_

### Relay Test System Digital Setup

- ☐ KoCoS is energized.
- ☐ KoCoS connects to ARTES software.
- ☐ “ECE 444 Lab 4 Test Plan” opened in ARTES software.

### Ideal Conditions Test

- ☐ KoCoS runs “Ideal Conditions Test”
- ☐ Device does not trip.
- ☐ Device displays expected primary voltage and current values.

### Symmetrical Fault Conditions Test

- ☐ KoCoS runs “Symmetrical Fault Conditions Test.”
- ☐ SEL 351 trips.
- ☐ Output contact 101 opens and turns off light when the device trips.
- ☐ Event report shows a 4 cycle wait time before the trip occurs.
- ☐ SEL 849 trips after device trips.

### Unbalanced Fault Conditions Test

- ☐ KoCoS runs “Unbalanced Fault Conditions Test.”
- ☐ TA witnesses the following events when the fault condition is applied :
  - ☐ SEL 351 trips.
  - ☐ Output contact 101 opens.
  - ☐ SEL 849 trips after device trips.
  - ☐ TA Initials: \_\_\_\_\_

### Equipment Takedown

- ☐ ARTES software closed without saving.
- ☐ KoCoS is **NOT** energized.

- ☐ Voltage and currents leads are removed from the device and KoCoS.
- ☐ AcSElerator RTAC project saved and exported.
- ☐ Device settings saved using QuickSet.
- ☐ Group 7 Settings uploaded to the device for the next group.

### Appendix A - Using SEL QuickSet

1. Use the C662 Cable to connect a serial port on the SEL 351 to a USB port on the workstation.
2. Open SEL Quickset.
3. Click the “Communication” button.
4. Set communication to Serial.
5. Use SEL 351’s front panel button interface to determine communication settings:
  - a. Click the SET button.
  - b. Navigate to PORT.
  - c. Navigate to the port you connected using the C226 cable.
  - d. Navigate to “Show” and click SELECT.
  - e. Populate the communication settings in QuickSet with those shown on the 351.
6. Connect the device. If no errors assert, communication has been made.
7. Open the SEL Terminal window and use the following commands to edit settings.

Command	Description
acc	Access to 1st level of device. Password is usually “OTTER”. Allows settings to be viewed.
2ac	Access to 2nd level of device, password is usually “TAIL”. Allows settings to be changed.
Sho 1	Displays group 1 settings within the SEL 351.
Sho L 1	Displays group 1 Logic within the SEL 351.
Set 1	Change group 1 settings of the SEL 351. Type the name of the setting you want to change to navigate to it quickly (Ex. Set 1 CTR). Type END while settings are being shown to skip through all other settings and save your changes.
Set L 1	Change group 1 logic of the SEL 351. Type the name of the logic variable you want to change to navigate to it quickly (Ex. Set L 1 RB1). Type END while settings are being shown to skip through all other settings and save your changes.
OPE	Asserts the open command relay word bit.
CLO	Asserts the close command relay word bit.

### Appendix B - SEL 351 Settings and Logic

1. Use the following device settings.

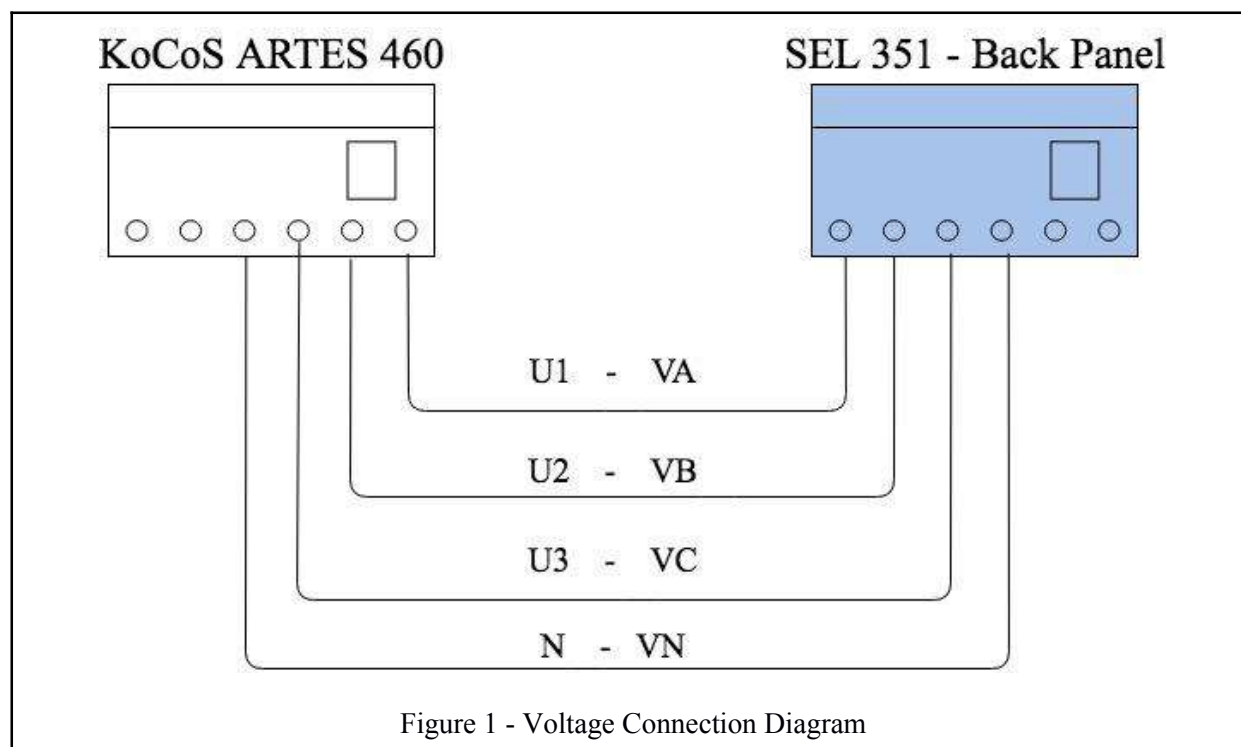
- a. CTR: 480
  - b. CTRN: 480
  - c. PTR: 180
  - d. PTRN: 180
  - e. E50P: 2
  - f. 50P1P: 2.00
  - g. 50P2P: 4.00
  - h. 67P1D: 4
  - i. 67P2D: 0
2. Use the following Logic Settings
  - a. [REDACTED]
  - b. Students will have to change the OUT101 logic to close when a close command is issued, and open when an open command is issued.
  - c. Students will have to configure remote bit settings within the SEL 351, the AcSELeRator RTAC Project, and the SEL 849. The RTAC will monitor the status of Remote Bit 1 (RB1) in the SEL 351, and will periodically send the status to a remote bit in the SEL 849. If this bit is enabled in the 849, the 849 will trip. [REDACTED]  
[REDACTED]

#### **Appendix C - Connecting the SEL 351 to the RTAC**

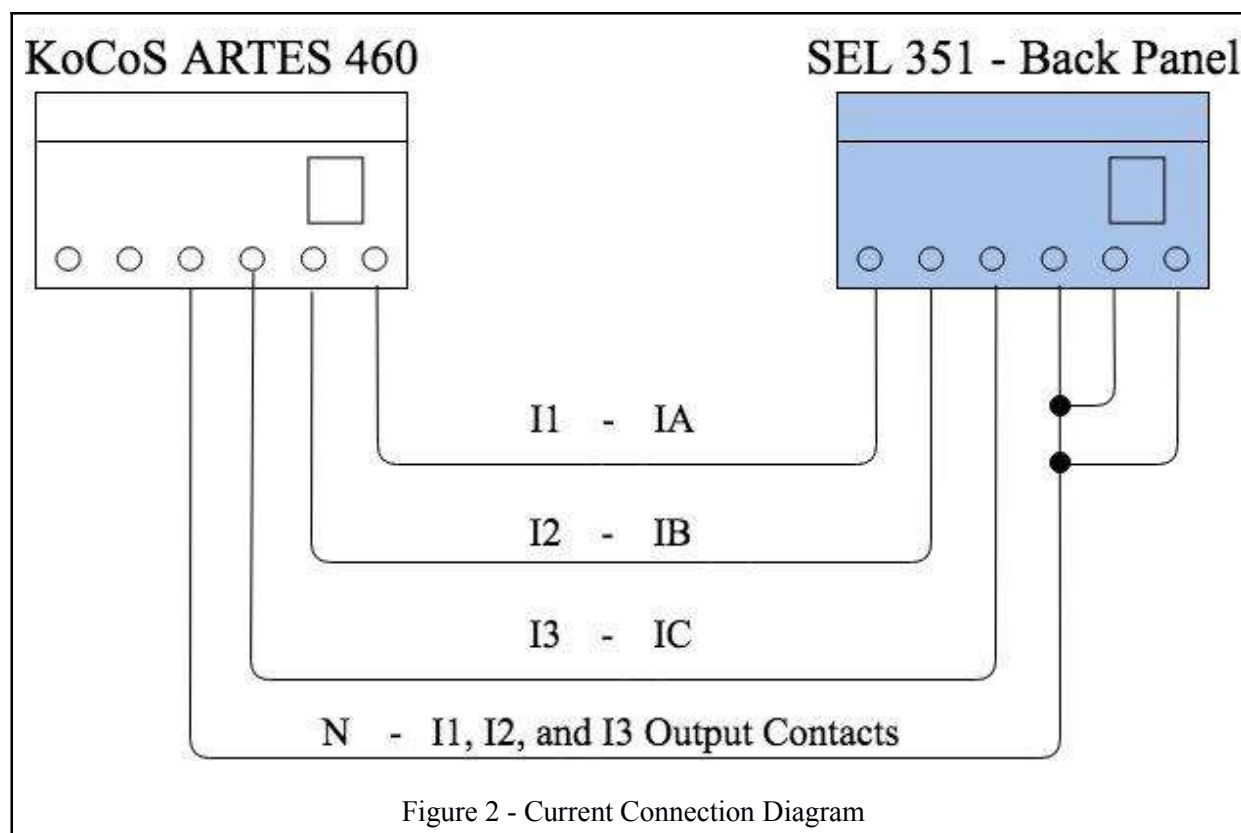
1. Connect a serial cable from the SEL 351 to the SEL RTAC.
2. Add an SEL 351 to the devices in the AcSELeRator RTAC project. The connection type is serial.
3. Use the SEL 351 front panel to determine and populate the communication settings.
4. Take the project online and check that the SEL 351's offline tag is false.

#### **Appendix D - Connecting the KoCoS to the SEL 351**

1. Ensure that the KoCoS system is **NOT** energized while attaching leads.
2. Connect the voltage contacts to the SEL 351 back panel voltage contacts in a Wye connection as shown in Figure 1 below.



3. Connect the Current contacts in a Wye connection as shown in Figure 2 below.



## Appendix E - Navigating the ARTES Software

1. Log in to the computer to the left of the main desktop.
  - a. User: [REDACTED]
  - b. Password: [REDACTED]
2. Open the software ARTES.
3. Click the “Home” symbol, then click “Open”
4. Open the device labelled SEL 351-7
5. Click on the “Test System” Tab.
6. Expand the button labelled “Connections,” and open settings. Ensure that the settings match those shown below.

Figure 3 - Image of ARTES Communication Settings

7. Save the settings and click “Connect” to start communication with the KoCoS system. Once connected, the “Connections” button will have a green circle.
8. Under the “Start” Tab, expand the “Monitors” button and select “Test Plan”
9. Once in the test plan tab, click “Open.”
10. Open the test plan labelled “ECE 444 Lab 4 Test Plan.”
11. Select all test steps, and click “OK” to import the test plan.
12. Expand the test plan and click on the desired test step.
13. Navigate to the “Start” tab.
14. Run the test by clicking “Start”
  - a. Warning: Starting the test will energize voltage and current outputs.
15. Stop the test in the ARTES program after confirming .

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## Notes