



# Station Automation COM600 3.5 FDIR Operation Manual



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## 1. About this manual

### 1.1. Copyrights

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### 1.2. Trademarks

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### 1.3. General

This manual provides information on the FDIR functionality of COM600 Human Machine Interface (HMI). Information in this manual is intended for operators using the COM600 HMI.

### 1.4. Document conventions

The following conventions are used for the presentation of material:

- The words in names of screen elements (for example, the title in the title bar of a window, the label for a field of a dialog box) are initially capitalized.
- Capital letters are used for the name of a keyboard key if it is labeled on the keyboard. For example, press the ENTER key.
- Lowercase letters are used for the name of a keyboard key that is not labeled on the keyboard. For example, the space bar, comma key, and so on.

- Press CTRL+C indicates that you must hold down the CTRL key while pressing the C key (to copy a selected object in this case).
- Press ESC E C indicates that you press and release each key in sequence (to copy a selected object in this case).
- The names of push and toggle buttons are boldfaced. For example, click **OK**.
- The names of menus and menu items are boldfaced. For example, the **File** menu.
  - The following convention is used for menu operations: **MenuName > MenuItem > CascadedMenuItem**. For example: select **File > New > Type**.
  - The **Start** menu name always refers to the **Start** menu on the Windows taskbar.
- System prompts/messages and user responses/input are shown in the Courier font. For example, if you enter a value out of range, the following message is displayed:

```
Entered value is not valid. The value must be 0 - 30 .
```

- You can be asked to enter the string MIF349 in a field. The string is shown as follows in the procedure:

```
MIF349
```

- Variables are shown using lowercase letters:

```
sequence name
```

## 1.5. Use of symbols

This publication includes warning, caution, and information icons that point out safety-related conditions or other important information. It also includes tip icons to point out useful information to the reader. The corresponding icons should be interpreted as follows.



The electrical warning icon indicates the presence of a hazard which could result in electrical shock.



The warning icon indicates the presence of a hazard which could result in personal injury.



The caution icon indicates important information or warning related to the concept discussed in the text. It may indicate the presence of a hazard which could result in corruption of software or damage to equipment or property.



The information icon alerts the reader to relevant facts and conditions.



The tip icon indicates advice on, for example, how to design your project or how to use a certain function.

## 1.6. Terminology

The following is a list of terms associated with COM600 that you should be familiar with. The list contains terms that are unique to ABB or have a usage or definition that is different from standard industry usage.

| Term                          | Description   |
|-------------------------------|---|
| Device                        | A physical device that behaves as its own communication node in the network, for example, protection relay.                               |
| Event                         | Change of process data or an OPC internal value. Normally, an event consists of value, quality, and timestamp.                            |
| Intelligent Electronic Device | A physical IEC 61850 device that behaves as its own communication node in the IEC 61850 protocol.   |
| OPC                           | Series of standards specifications aiming at open connectivity in industrial automation and the enterprise systems that support industry. |
| Property                      | Named data item.  |

## 1.7. Abbreviations

The following is a list of abbreviations associated with COM600 that you should be familiar with.

| Abbreviation | Description   |
|--------------|---|
| FDIR         | Fault detection, fault isolation and load restoration |
| HMI          | Human Machine Interface                               |
| IED          | Intelligent Electronic Device                         |
| SAB600       | Station Automation Builder 600                        |
| SLD          | Single Line Diagram                                   |

## 1.8. Document revisions

| Document version/date | Product revision | History          |
|-----------------------|------------------|------------------|
| A/30.6.2011           | 3.5              | Document created |

## **2. Introduction**

### **2.1. Overview of FDIR**

FDIR provides a feeder automation function for radial distribution networks. It gathers data from protection and control IEDs and runs a fault detection, fault isolation and load restoration (FDIR) algorithm on Logic Processor to realize automatic fault restoration.

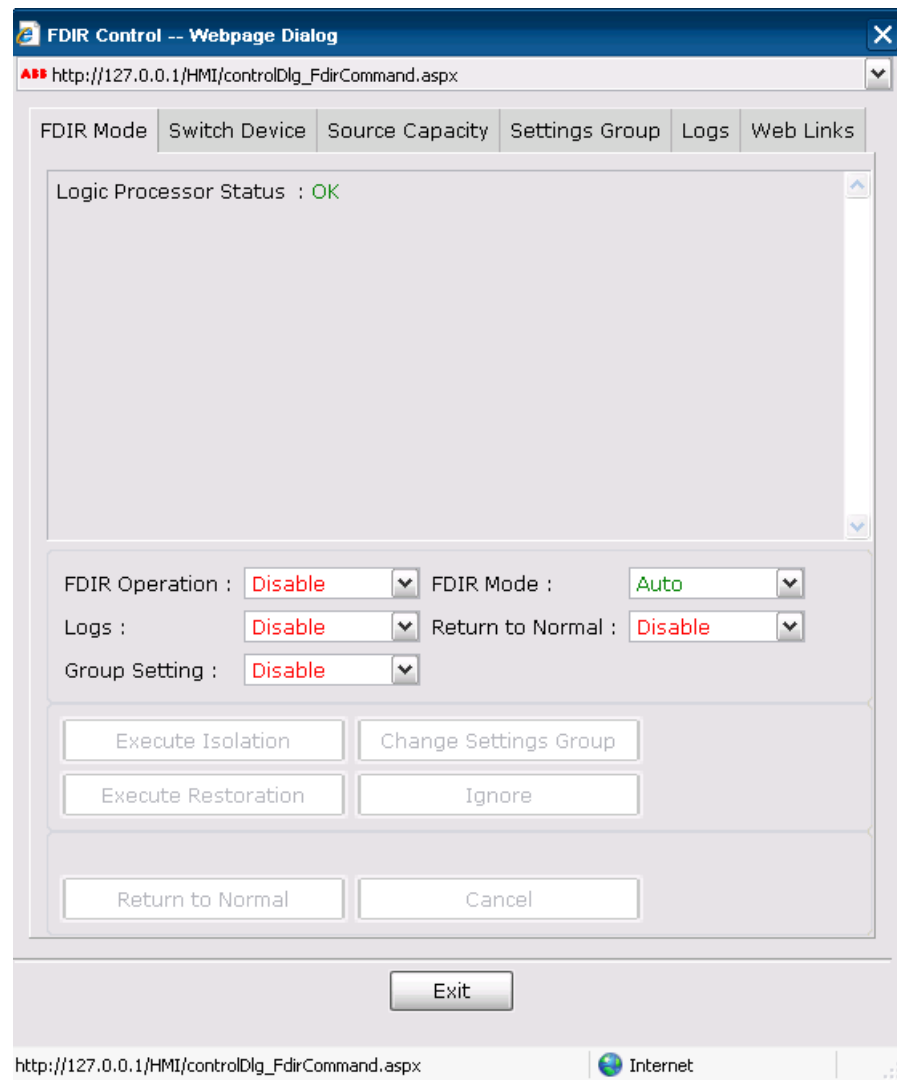
Before a fault happens, FDIR updates the network status by receiving switch status and load signals from the IED. When a fault happens in the network, FDIR on COM600 detects the location of the fault and issues switch operation commands from the algorithm to isolate faulted feeder sections from the network and restore the service to the healthy section. It also sends commands to IEDs controlling switches to return to the normal pre-fault condition when a fault has been cleared.

## 3. Human Machine Interface operations

### 3.1. FDIR control dialog

The FDIR Control dialog can be used to enable/disable FDIR and setup parameters, simulate faults, and view FDIR logs.

You can open the FDIR Control dialog in the COM600 HMI by selecting **FDIR** in the menu bar.



FDIR\_control\_dialog.png

Figure 3.1-1 FDIR Control dialog

## 3.2. FDIR mode

### 3.2.1. Enabling or disabling FDIR

You can disable FDIR function at any time, especially when the network is not radial, communication with most IEDs is poor, or all IEDs are in the local mode during commissioning.

To enable or disable FDIR on COM600:

1. In COM600 HMI, select **FDIR**.
2. In the **FDIR Control** dialog, select the **FDIR Mode** tab.
3. In the **FDIR Operation** list, select **Enable** or **Disable**.

### 3.2.2. Changing the FDIR running mode

You can select either **Auto**, **Manual** or **Test** mode as the FDIR running mode.

In the **Auto** mode, when a fault is detected, the system will open a switch or several switches to isolate the fault and close a switch or several switches to restore power to the loads.

In the **Manual** mode, you can carry out the same procedures manually.

In the **Test** mode, you can select any switch to simulate a fault. FDIR produces isolation and restoration commands without sending the actual commands to the device.

To change the FDIR running mode:

1. In COM600 HMI, select **FDIR**.
2. In the **FDIR Control** dialog, select the **FDIR Mode** tab.
3. In the **FDIR Mode** list, select **Auto**, **Manual** or **Test**.

### 3.2.3. Enabling or disabling logging

To enable or disable FDIR logging function:

1. In COM600 HMI, select **FDIR**.
2. In the **FDIR Control** dialog, select the **FDIR Mode** tab.
3. In the **Logs** list, select **Enable** or **Disable**.

### 3.2.4. Enabling or disabling returning to normal switch operation sequence

When a fault is cleared after fault detection, fault isolation, and load restoration, you can return the system to the normal switch operation sequence if the *Return to Normal* feature is enabled in the system.

When you select the alert icon in the header area, the system asks if you want to return to the normal switch operation sequence. You can either confirm it or cancel it.

To enable to disable returning to normal switch operation sequence:

1. In COM600 HMI, select **FDIR**.
2. In the **FDIR Control** dialog, select the **FDIR Mode** tab.
3. In the **Return to Normal** list, select **Enable** or **Disable**.

### 3.2.5. Enabling or disabling changing of protection setting groups

You can enable or disable changing of protection setting groups during FDIR operation. If the **Setting Group** function is enabled, the system will check the load change on the switch before the FDIR operation. The system will send a change setting group command to the IED controlling the switch, if necessary.

To enable or disable changing of protection setting groups:

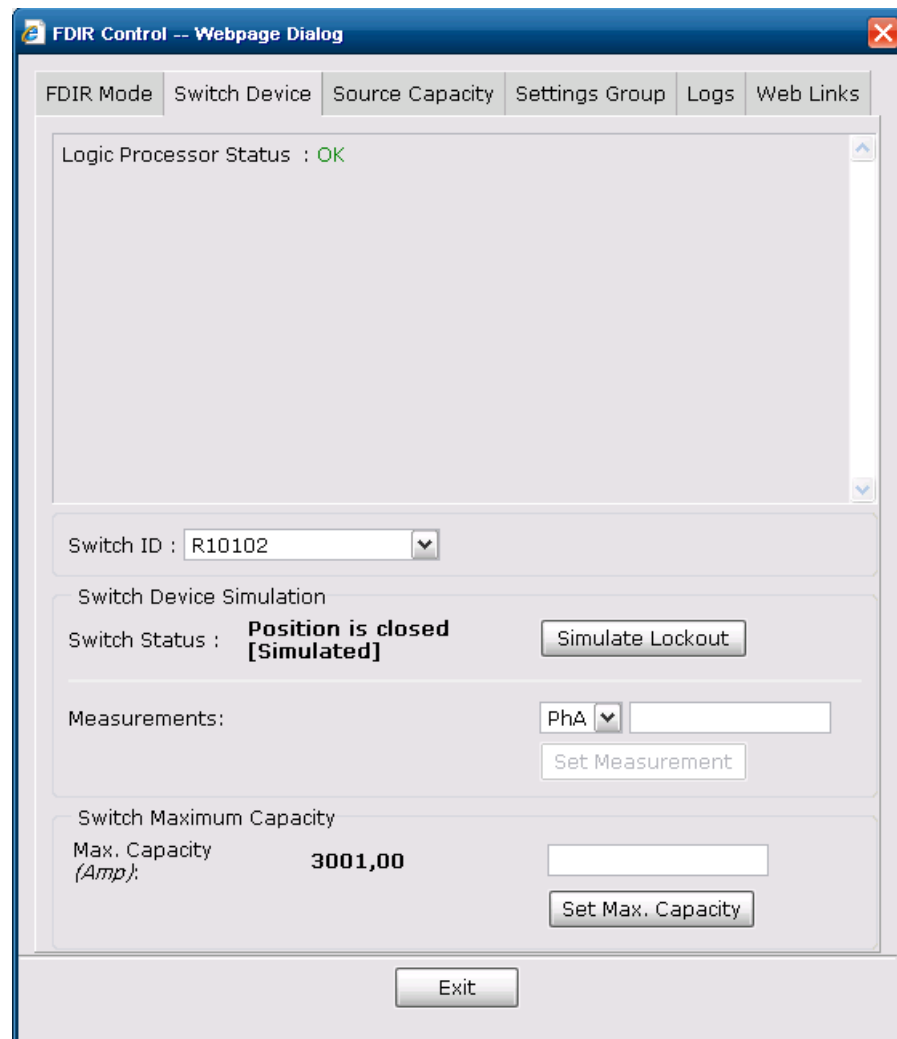
1. In COM600 HMI, select **FDIR**.
2. In the **FDIR Control** dialog, select the **FDIR Mode** tab.
3. In the **Group Setting** list, select **Enable** or **Disable**.

## 3.3. FDIR simulation

### 3.3.1. Simulating faults

To simulate a fault:

1. Set the IED to the simulation mode in SAB600 and redownload the configuration to COM600.
2. In COM600 HMI, select **FDIR**.  
The **FDIR Control** dialog opens.



FDIR\_fault\_simulation

Figure 3.3.1-1 Fault simulation

3. In the **FDIR Control** dialog, select the **FDIR Simulation** tab.
4. In the **Switch ID** list, select the switch name.
5. Click **Simulate Lockout**.



If the **Simulate Lockout** button is not enabled, the switch is not in the simulation mode.

### 3.3.2. Simulating load

The node load can be changed to run a different simulation scheme if the IED is in the simulation mode.

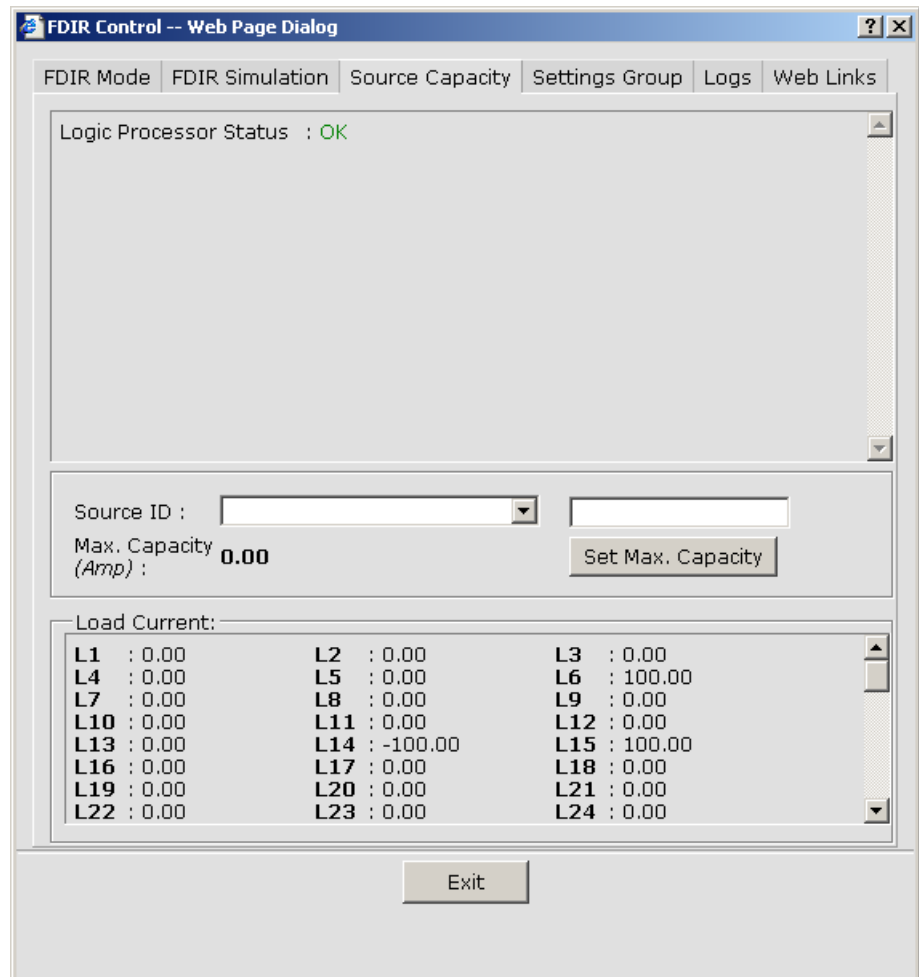
To change the node load:

1. In COM600 HMI, select **FDIR**.  
The **FDIR Control** dialog opens.
2. In the **FDIR Control** dialog, select the **FDIR Simulation** tab.
3. In the **Switch ID** list, select the switch name.
4. In the **Measurements** field, type a new load value.
5. Click **Set Measurement**.

### 3.4. Changing source capacity limit

To change source capacity limit:

1. In COM600 HMI, select **FDIR**.  
The **FDIR Control** dialog opens.
2. In the **FDIR Control** dialog, select the **Source Capacity** tab.



FDIR\_Simulate\_Fault

Figure 3.4-1 Fault simulation

3. In the **Source ID** list, select the source name.

4. Enter the new source capacity limit value in the field next to the source name.
5. Click **Set Max. Capacity**.



Changes to the source maximum capacity limit are temporary. They will be overwritten when you turn off the simulation mode and redownload the project to COM600.

### 3.5. Viewing the active settings group

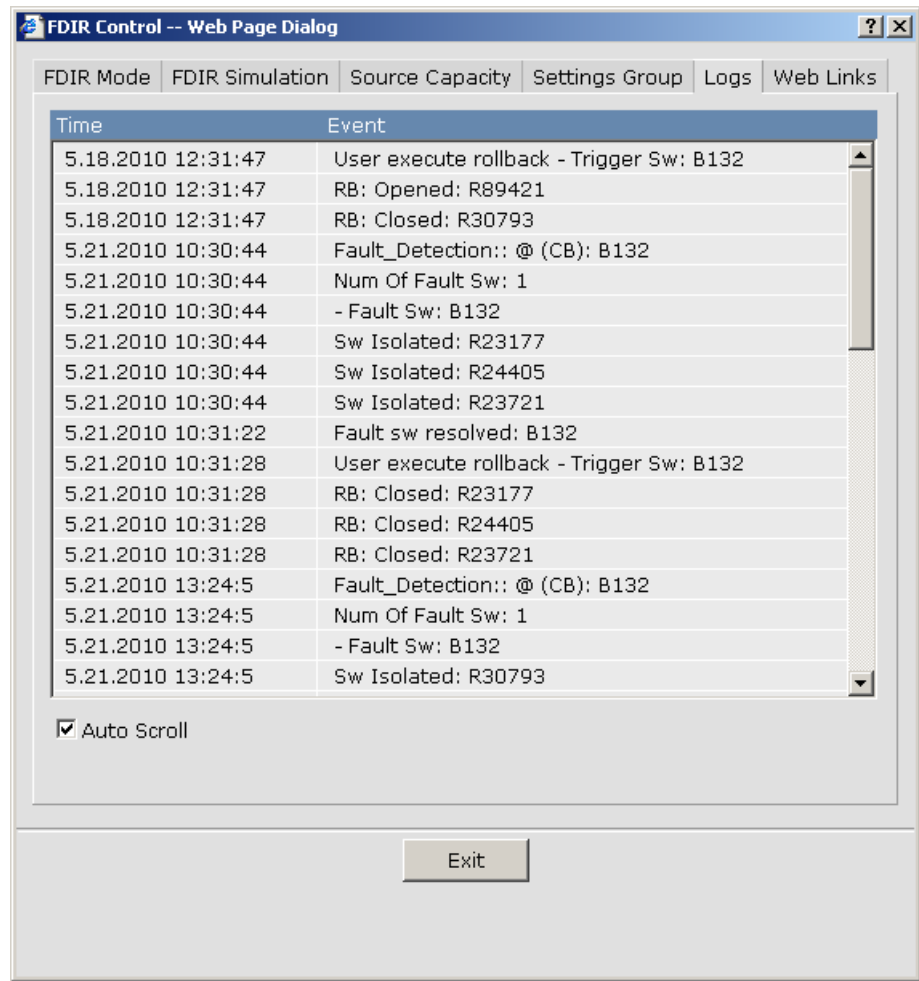
To view the active settings group for a switch:

1. In COM600 HMI, select **FDIR**.
2. In the **FDIR Control** dialog, select the **Settings Group** tab.
3. Select the switch from the **Switch ID** list.  
You can see the active settings group below the list.

### 3.6. Viewing FDIR log

To view the FDIR log:

1. In COM600 HMI, select **FDIR**.
2. In the **FDIR Control** dialog, select the **Logs** tab.  
You can see time and events on the Logs tab.



FDIR\_Source\_Log.png

Figure 3.6-1 FDIR source log

## 3.7. FDIR testing

### 3.7.1. Testing FDIR logic

FDIR provides a testing feature to verify the FDIR logic.

You can test the functions as instructed in the following sections:

- 3.7.2, Setting IEDs to simulation mode
- 3.7.3, Simulating fault in Manual mode
- 3.7.4, Simulating return to normal
- 3.7.5, Simulating FDIR blocking

### 3.7.2. Setting IEDs to simulation mode

To set IEDs to simulation mode:

1. In SAB600, select the IED in the Communication structure.
2. In the IED property window, set **Simulation Mode** to **True**.

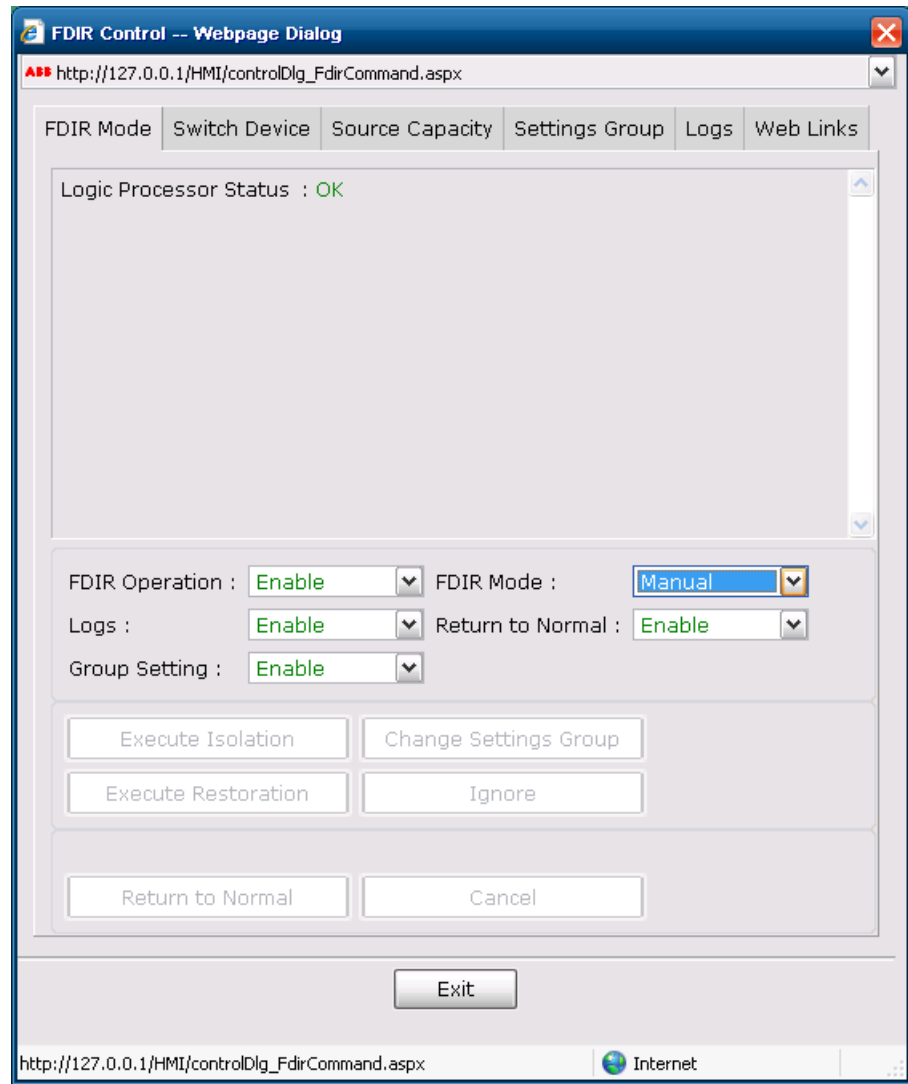


If there are IEDs in live mode, the fault simulation can cause operation on the live IEDs.

3. In Gateway Management tool, select **Reset** and click **Update & Reload**.

### 3.7.3. Simulating fault in Manual mode

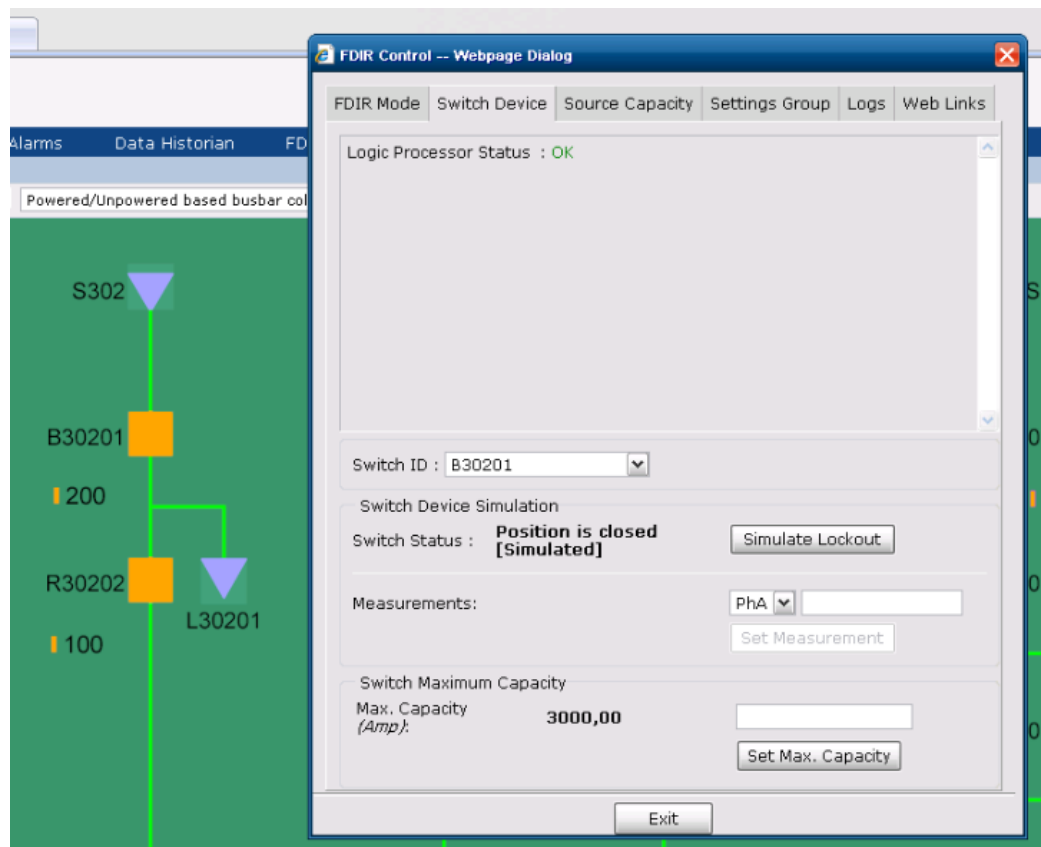
This section shows the simulation of the fault on load L30201. First in FDIR Control dialog, set FDIR mode to Manual, see Figure 3.7.3-1.



Set\_FDIR\_Manual\_Mode.PNG

Figure 3.7.3-1 Setting FDIR mode to Manual

When FDIR detects fault from B30201, the downstream switch R30202 should open to isolate the fault L30201 from the network. Then, one of the two tie breakers R30103 and R10104 that are normally open will close to restore power to load L30202.



Network\_simulation\_pre-fault.PNG

Figure 3.7.3-2 Network simulation pre-fault



Before you start simulating the fault, set the switch status and proper measurements in COM600 HMI to make sure the radial network is valid, and select the path for testing.

To simulate a fault:

1. In COM600 HMI, select **FDIR**.
2. In the **FDIR control** dialog, select the **FDIR Simulation** tab.
3. Select **B30201** in the **Switch ID list** and click **Simulate Lockout**.  
In the single line diagram, the switch B30201 opens and the alert icon flashes in the header area.
4. Click the alert icon.  
The FDIR control dialog opens with the fault description and isolation suggestion.

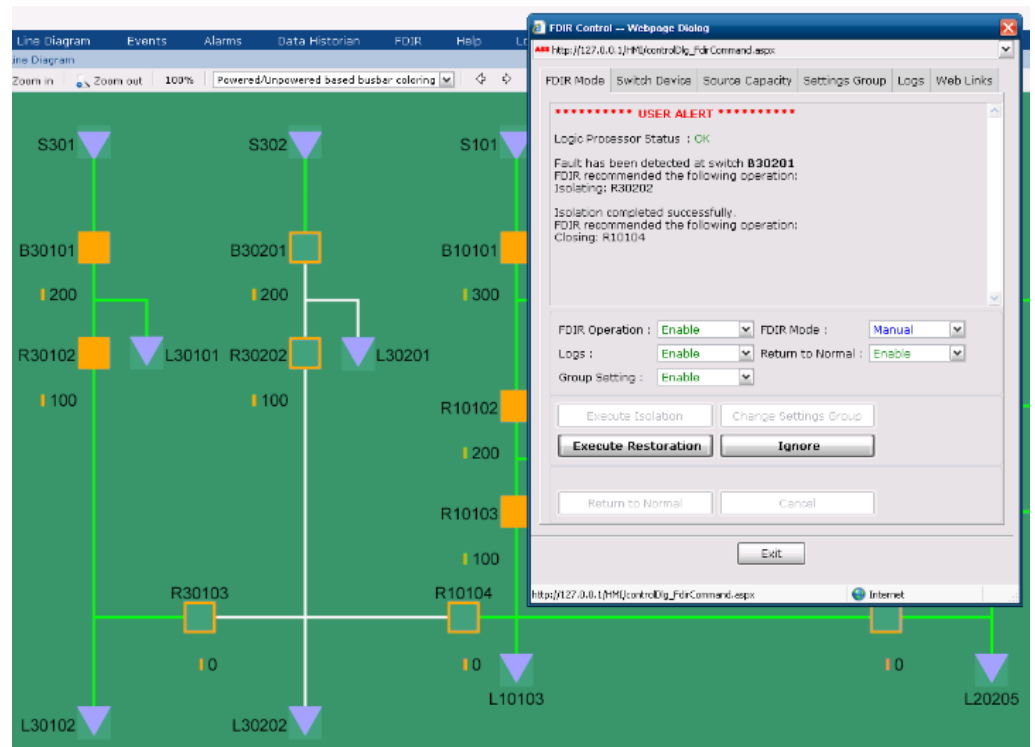


Fault\_detected.PNG

Figure 3.7.3-3 Fault detected

5. In the **FDIR Mode** tab, click **Execute Isolation** if the suggestion is valid, or **Ignore**. In COM600 HMI, the isolation switch must be open. In the **FDIR Control** dialog, you can see a suggestion for load restoration, if you have clicked **Execute Isolation**.

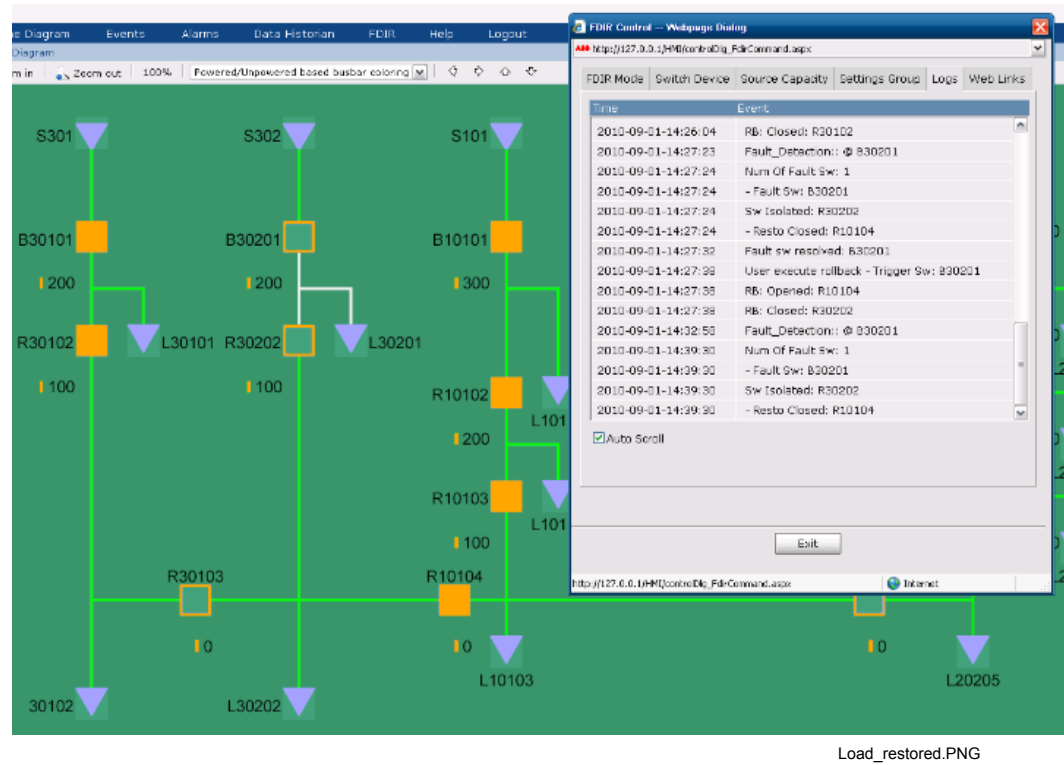
## FDIR Operation Manual



Fault\_isolated.PNG

Figure 3.7.3-4 Fault isolated

- In the **FDJR Mode** tab, run the load restoration by clicking **Execute Restoration** if the suggestion is valid, or click **Ignore**. If you clicked **Execute Restoration**, you should see load L30201 isolated from the network in the COM600 HMI, and power restored to load L30202.



Load\_restored.PNG

Figure 3.7.3-5 Load restored

### 3.7.4. Simulating return to normal

In the restoration mode, if the fault is cleared, you can close the switch powering the previous fault load. The system will try to return to pre-fault normal mode.

To simulate returning to normal:

1. In the FDIR Control dialog, select the switch B30201 and click **Clear Lockout**.
2. In COM600 HMI, click the switch B30201 and close it by clicking **Close** and then **Operate** in the **Switch device control** dialog.  
You can see the alert icon flashing in the header area.
3. Click the alert icon.
4. In the **FDIR Mode** tab of the **FDIR Control** dialog, click **Return to Normal** if it is valid, or click **Cancel**.

If you select **Return to Normal**, the network returns to the pre-fault normal state.



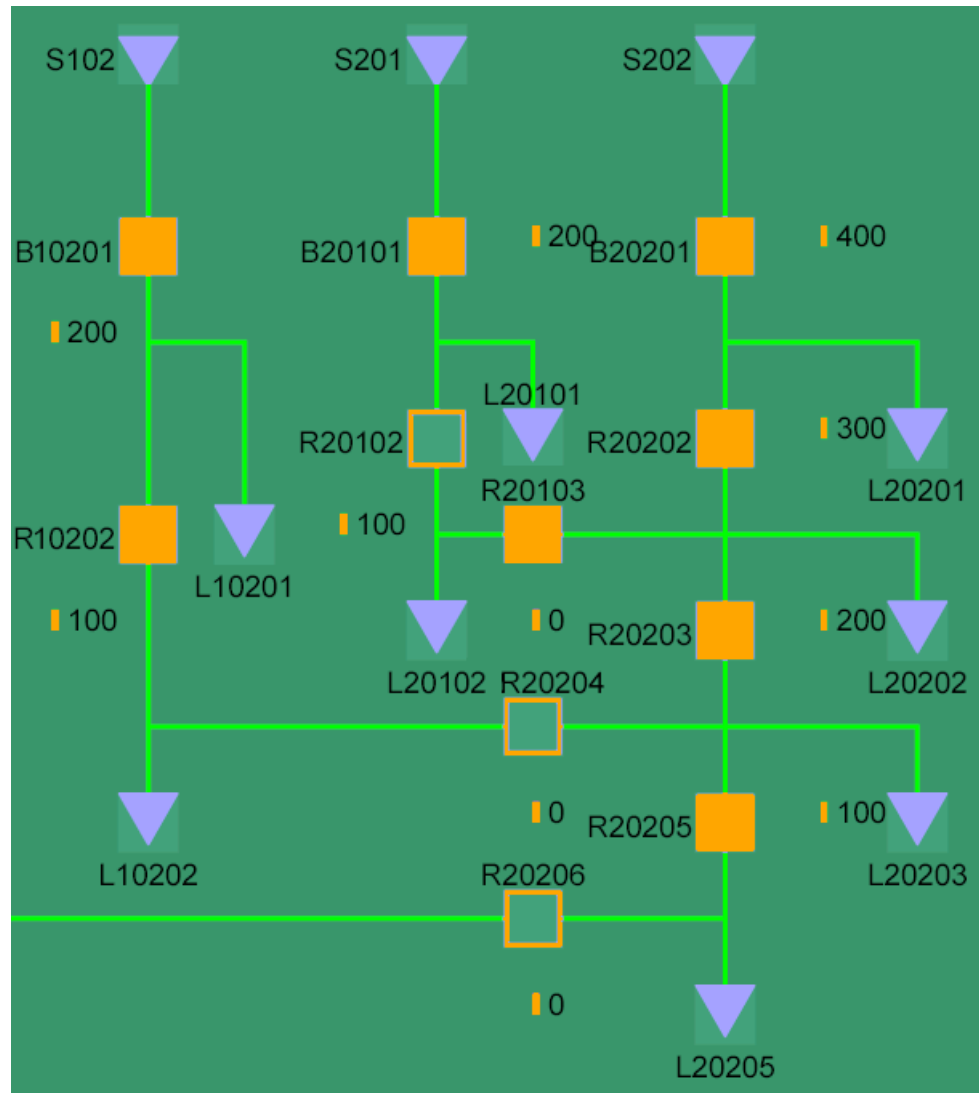
FDIR\_return\_to\_normal.png

Figure 3.7.4-1 Return to normal state

### 3.7.5. Simulating FDIR blocking

FDIR is blocked, if the communication to the IED is bad, the switch is hot-line-tagged, or the IED is in the fault mode (the Health attribute is showing warning or alarm).

You can test this blocking feature also in simulation mode.



Pre-Fault\_Network.PNG

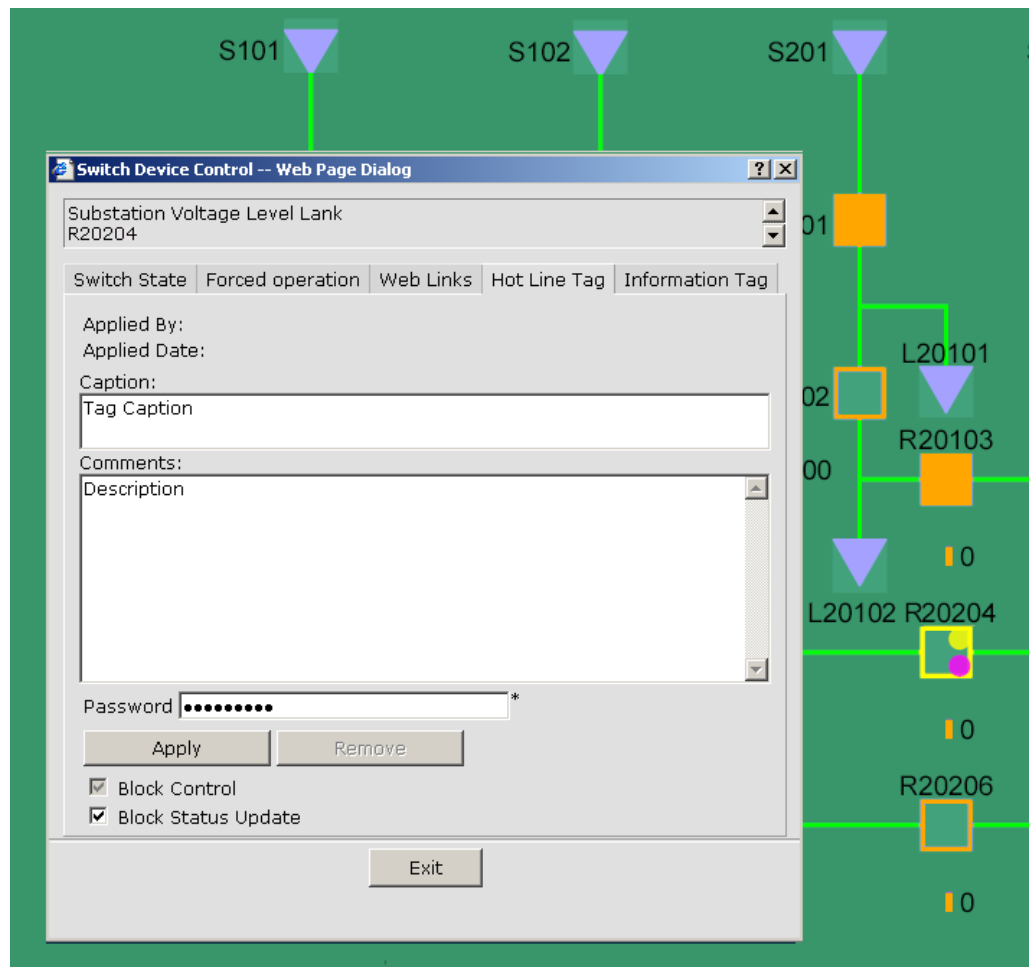
Figure 3.7.5-1 Pre-fault network

As the starting point to simulating FDIR blocking, see the path shown in Figure 3.7.5-1. When L20202 is in fault mode, R20202 will trip, and R20103 and R20203 can be opened to isolate the fault. After the isolation, the loads 20102 and L20203 have two possible load restoration paths to close R20102 and R20204.

In the following testing example, you can simulate a Hot Line Tag on the path from R20204.

To simulate FDIR blocking:

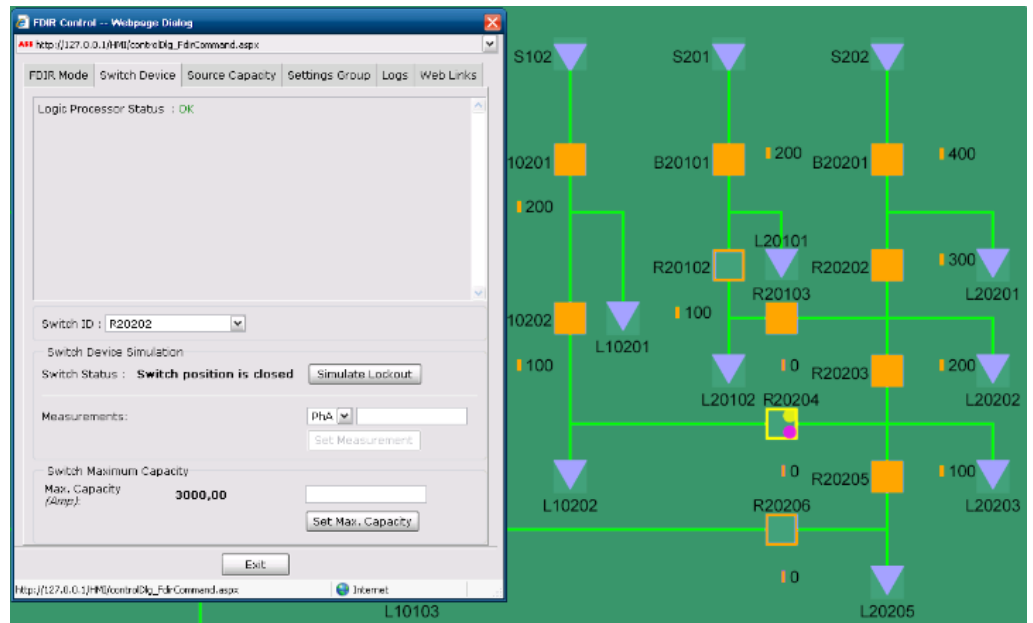
1. In COM600 HMI, click **R20204** and apply Hot Line Tag on it.



FDIR\_Hot\_Line\_Tag.png

Figure 3.7.5-2 Applying Hot Line Tag

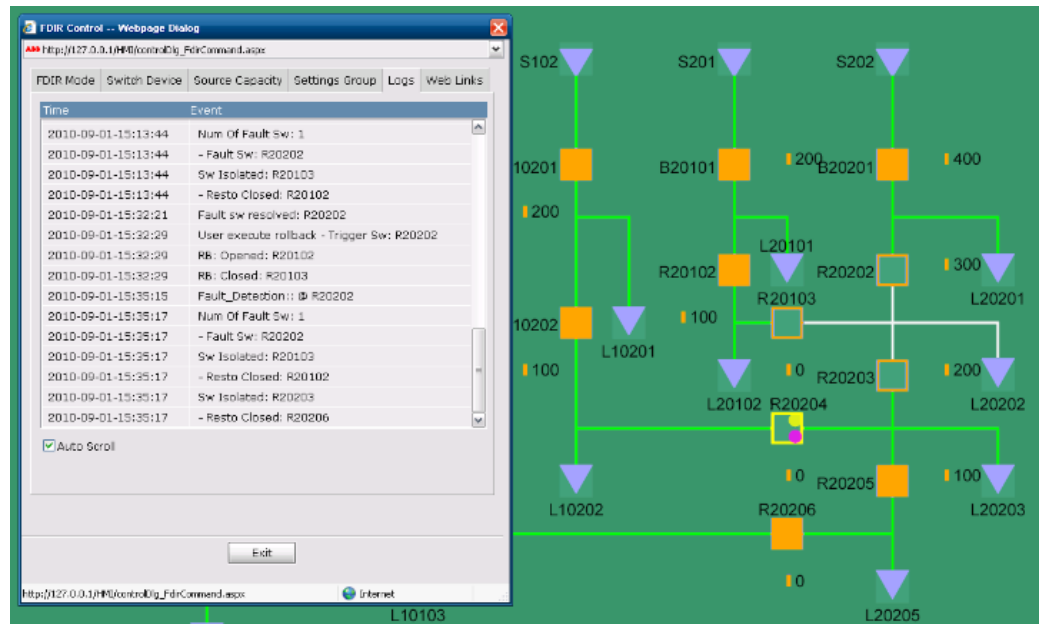
2. Select **FDIR > FDIR Control**.
3. Select **Switch ID: R20202** and click **Simulate Lockout** to simulate fault.



Simulate\_Fault\_cs.PNG

Figure 3.7.5-3 Simulating fault

4. In the **FDIR Mode** tab of the **FDIR Control** dialog, click **Execute Isolation**.
5. Restore load using a new path by clicking **Execute Restoration**.



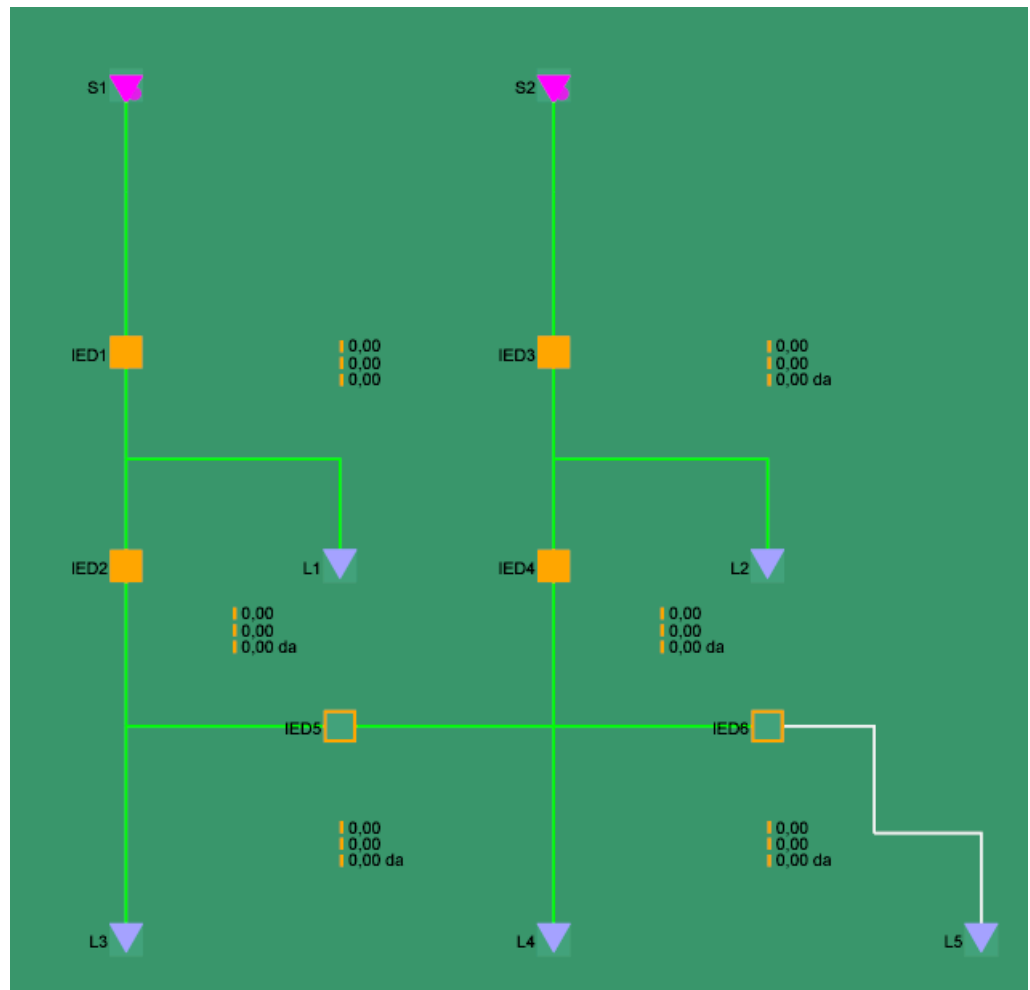
Load\_restored\_from\_one\_path\_only.png

Figure 3.7.5-4 Load restored from only one path

As a result you can see that the load is restored from only one path. The hotline-tagged path cannot be restored.

### 3.7.6. Changing Protection Settings Group

In the restoration mode, if the **Setting Group** function is enabled, the system checks the load change on the switch before the FDIR operation. If necessary, it sends a change setting group command to the switch. For more information on how to enable/disable changing of protection settings group, see 3.2.1, Enabling or disabling FDIR. The function is demonstrated with a scheme in Figure 3.7.6-1.

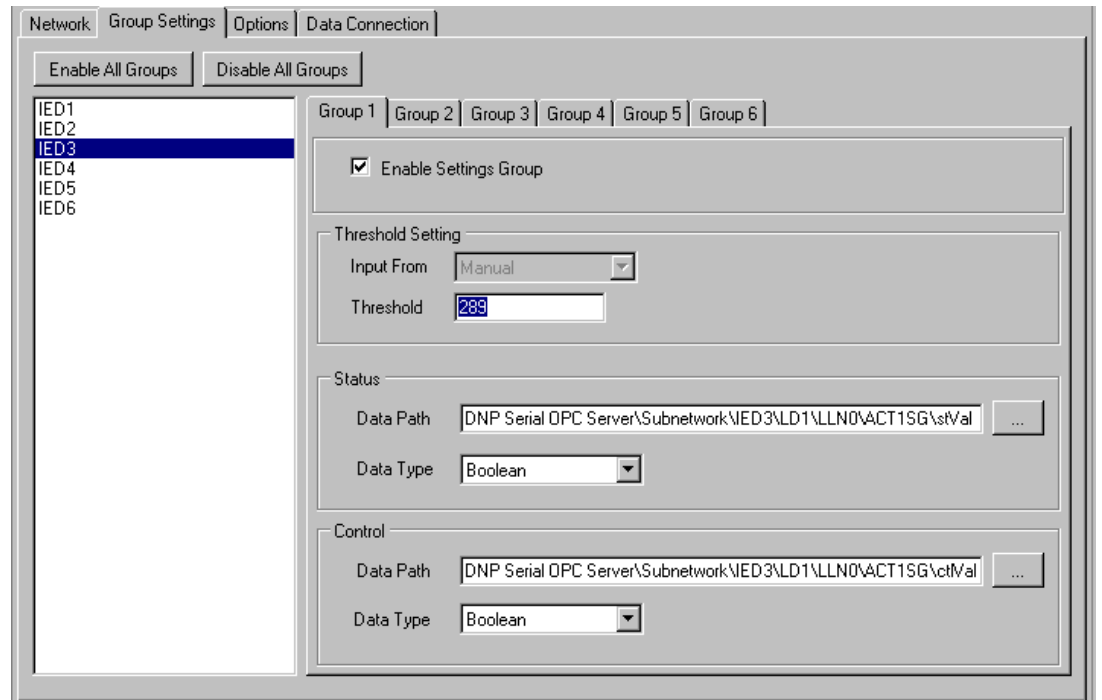


protection\_settings\_group\_scheme

Figure 3.7.6-1 Scheme for changing protection settings group

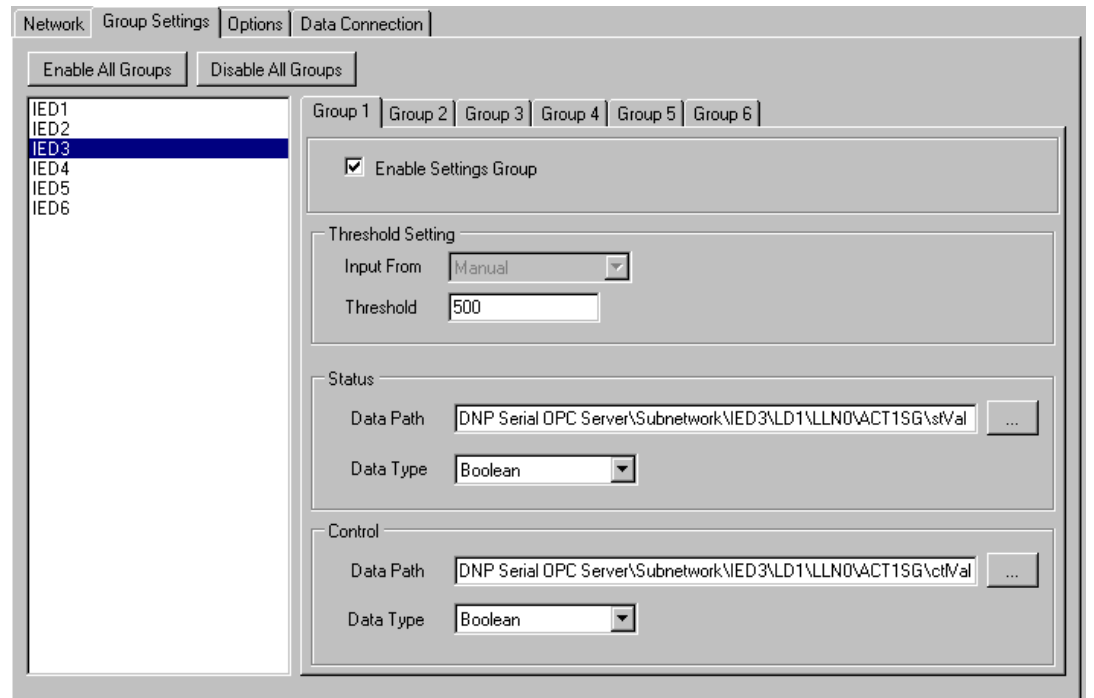
#### Example case

In Figure 3.7.6-1, if the fault is detected in IED1, FDIR attempts to isolate the switch IED2 and restore the switch IED3. When IED3 is closed, the load exceeds the threshold setting for the current group, see Figure 3.7.6-2. For more information on configuring the protection settings group, see FDIR Configuration Manual.



Threshold\_Setting\_Group1.png

Figure 3.7.6-2 Setting Group 1 – Threshold is set at 289



Threshold\_Setting\_Group2.png

Figure 3.7.6-3 Setting Group 2 – Threshold is set at 500

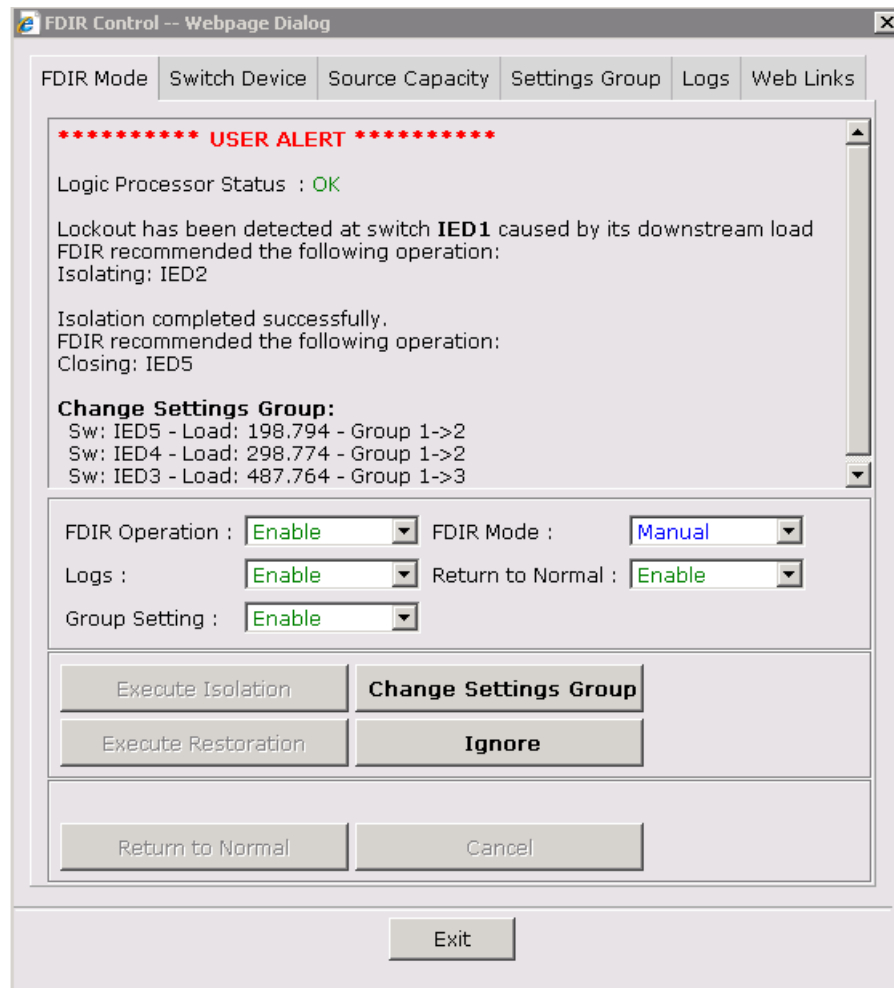
### 3.7.7. Simulating protection settings group change

#### 3.7.7.1. Simulating protection settings group change in Manual mode

To simulate the protection settings group change in Manual mode:

1. Enable changing of the protection settings group.
2. Use FDIR Configuration Tool to configure the protection settings group for the switch IED3.
3. Simulate the fault at the switch IED1.
4. Isolate IED2 as recommended by FDIR.
5. FDIR detects that protection settings group needs to be changed and recommends changing from Group 1 to Group 2.

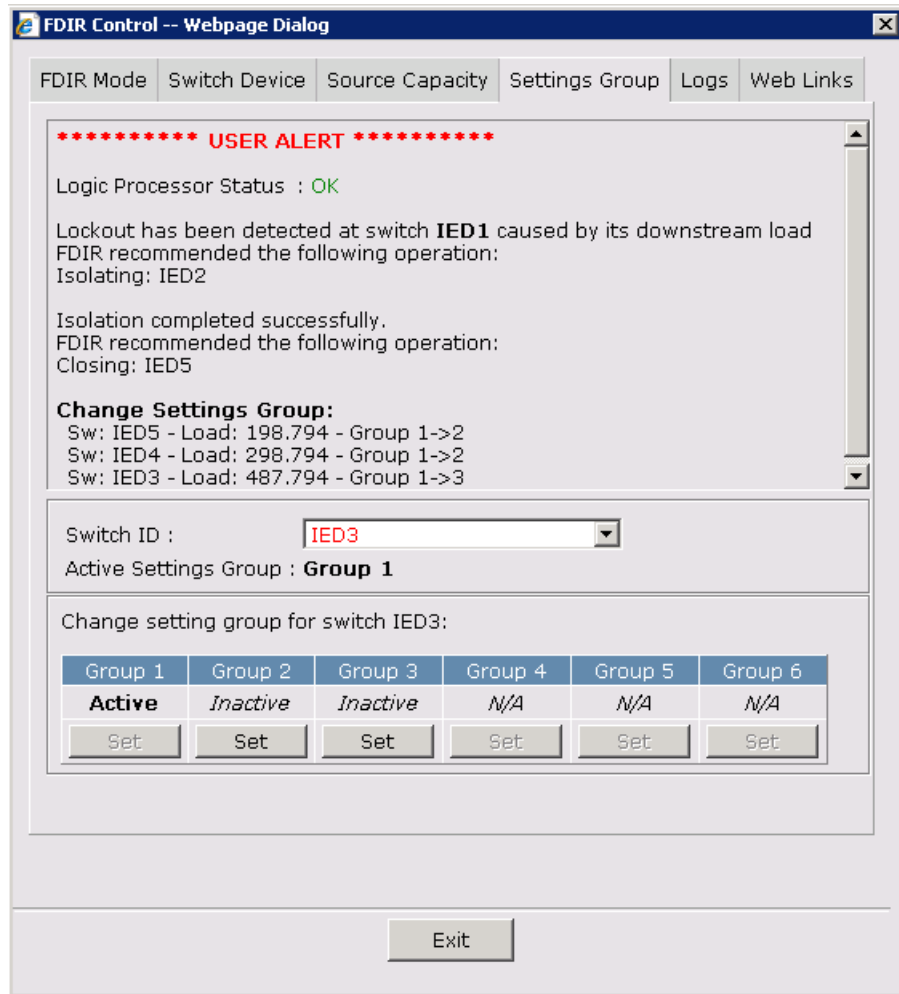
Click the **Change Setting Group** button or the **Setting Group** tab to view the protection settings group options.



change\_settings\_group.png

Figure 3.7.7.1-1 Changing protection settings group detected

6. On the **Settings Group** tab, click **Set** below the desired group to change the group.



change\_settings\_group\_options

Figure 3.7.7.1-2 Settings group options

7. After the protection settings group is changed, restore IED3 as recommended by FDIR.

### 3.7.7.2. Simulating changing protection settings group in Auto mode

When FDIR is in Auto mode and changing protection settings group is enabled, the system checks the load change on the switch and attempts to send a command to change the setting group on the switch based on the configured threshold setting. Changing protection settings group can be demonstrated using the same example scheme as in Figure 3.7.6-1.





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