

USER GUIDE

Implementing Zone Selectivity in low voltage devices using IEC 61850

Data Center



The purpose of this document is to explain how to implement Zone Selectivity in low voltage devices using IEC 61850. The procedure can be applied to

each type of user.

Equipment required

Software:

- Ekip Connect 3 (check in ABB Library for the latest version)
- PCM600 v2.9
- ABB IEC Connectivity Package Ekip Com IEC 61850 Ver. 1.44.0

Hardware:

- Ekip T&P communication tool.
- Ethernet cable

Procedure

Ekip Connect 3 settings

Step 1: identify the Circuit breaker

Open Ekip Connect 3 and scan your device using the T&P.

=	CONNECT TO DRIVERS	
₹ _a som	Scan for your devices by selecting one of the bence communication channels.	
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Step 2: Set Tag Name and Power Direction

- 1. Configuration
- 2. Tag Name
- 3. Power direction = Top \rightarrow Bottom
- 4. Apply

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Note: choose the same Tag name as that of the device in the electrical system

Step 3: Set the protection settings

This step shows how to implement directional protection D. Set all the parameters according to your data.

- 1. Protection D 67
- 2. Enable Directional overcurrent protection
- 3. Protection behavior Trip
- 4. Threshold current I7 forward

- 5. Time I7 forward
- 6. Threshold current I7 backward
- 7. Time I7 backward
- 8. Min angle of direction: We advise a greater angle than Min angle of direction (t15 preset values are available, ranging from 3.6° to 69.6°)
- 9. Apply



10.Follow the steps in the image below if directional zone selectivity is required

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Note: S, S2, G or Gext Zone Selectivity cannot be set if Directional zone selectivity has been chosen.

The software will automatically recognize whether the chosen settings are incorrect and will generate an error message

Step 4: Enable	remote zone selectivit	ty for each			
protection					
1. Modules			4. Rer	note Zone Selectivity Enal	ole
2. Communica	tion		5. Ena	able for each protection re	quired
3. IEC 61850			6. App	oly	
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Step 5: Program the send signals

The following data can be programmed:

- Programmable Status A to Dfw timing (Directional Forward)
- Programmable Status B to DBw timing (Directional Backward)
- Programmable Status C to S timing and Remote Programmable Status E (with OR function)
- 1. Classic View
- 2. Programmable status and outputs
- 3. Programmable status

- Prog Status Parameters C (for example), press on the 3 dots to access another window (Trigger) then custom
- 5. Status ZS out Remote H
- 6. S timing = 1
- 7. Trigger 2 ON
- 8. Remote Programmable Status L
- 9. Remote Programmable Status E = 1
- 10. Operation between triggers OR
- 11. OK
- 12. Apply

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Note: steps 7 to 10 are not mandatory (Remote programmable L). They have only been used for shifting some of the commands to other circuit breakers. Each IEC61850 can receive up to 6 signals so if 7 signals have to be received by one IEC 61850, one signal could be shifted to another circuit breaker.

By way of example, all the signals that circuit breaker A1 can receive are illustrated in the single-line diagram below. Solution: in this case, a signal can be shifted from D2 to D1.





Step 6: Set static IP address and .cid file in Ekip Com IEC 61850 module

- 1. Classic View
- 2. Modules
- 3. Ekip Com IEC 61850
- 4. Static IP address
- 5. Force Static IP address ON
- 6. Static IP address
- 7. Subnet Mask
- 8. Configuration

- 9. Preferred configuration file = .cid
- 10. Security
- 11. Configuration Session security level should always = On
- 12. Apply

Note: all devices in the same system must be in the same

- Note: all devices in the same system must be in the same network:
 the first 3 numbers of the static IP address must be the same (for example 192.168.2.x)
 The Static Network Mask must be the same (we suggest 255.255.255.0)

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PCM Settings

Step 1:

Firewall status of computer should = Off

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Customise settings for each type of network	
You can modify the firewall settings for each type of network that you use.	
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Step 2: Computer IP address in same network as IEC 61850 module

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Step 3: Create the project

Open PCM600, create the project and build the plant.

- 1. File new project
- 2. Project name
- 3. Right click on project name New
- 4. General
- 5. Substation

File	Edit	View	Tools	Window	Help	
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- 6. Right click on Substation
- 7. New
- 8. General
- 9. Voltage Level

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	Properties					

- 10. Right click on Voltage Level
- 11. New
- 12. General
- 13. Bay



Step 4: Insert a new device

- 1. Right click on Bay
- 2. New
- 3. LV Circuit Breaker IEDs
- 4. Ekip Com IEC61850



5. Follow the steps in the image below

Ekip Com IEC61850 - Configuration mode selection	page X
Ekip Com IEC61850 Configuration Wizard Configuration mode selector page	-
This wizard helps you to create configuration for your IED. Configuration	on
Configuration mode	
Ekip Com IEC61850 SW Version >=	3.04
O Ekip Com IEC61850 SW Version <=	2.xx (IC
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Enter chosen IP address in static IP of IEC61850 module in Ekip Connect.

Port:	Ethernet por	t	~	
IP address: 7	192 , 168 .	1 . 55		
	Cancel	< Back	Next >	
kip Com IEC61850 kip Com IEC61850 IEC 63850 version select	- IEC 61850 ve Configuration	rsion selection Wizard	×	

Ekip Com IEC618 Communication confi	50 Configuration Wizard guiation complete	-
Communicat	ion configuration is n	ow

Step 5: Dealing with the Technical Key

Change Technical Key so that it is the same as tag name of device.

0	bject Properties	→ ₽ ×
•	≜ ↓ □	
v	[000] Appearance	
	Caption	Ekip Com IEC61850
	Description	Low Voltage Air Circuit Breaker
\mathbf{v}	[020] Addresses	
	IP Address	192.168.8.20
	IP-GATEWAY	0.0.0.0
	IP-SUBNET	255.255.255.0
\sim	[030] Communicat	ion Control
	Connection Type	Fixed
\mathbf{v}	[080] Authentication	on
	Is Authentication Disabled	True
	Is Password used	False
	Password	
\mathbf{v}	[100] SCL Informa	tion
	Configuration Version	1.0
	IED Type	Generic IED
	Manufacturer	ABB
	SCL data model	Edition 1
	Technical Key	AA1J1Q01A1
\mathbf{v}	[300] Configuratio	n Version
	Last modified	2022-02-03 14:57
	System	DESKTOP-LM51M2M
	Version	2

Step 6: Enability of IEC 61850 Configuration engineering

- 1. Tools
- 2. Options
- 3. IEC 61850 Configuration
- 4. IEC 61850 Configuration engineering mode enable
- 5. OK

Local Server\Sample - PCM600 64-bit



Options



Options Options Application Configuration Disturbance Handling Rexible Product Naming IEC 61850 Configuration Log Configuration Customized Menus Template Settings Category Manager Language Settings Security Settings User Manager	Engineering Miscellaneous ✓ IEC 61850 configuration engineering mode enabled 4 Selecting this option will enable usage of the IEC 61850 Configuration tool of PCM600 and restrict further SCD file imports from other IEC 61850 system configuration tools. Automatic LNode creation enabled When this option is selected PCM600 creates automatically LNodes to the Substation section of the SCL file whenever new functions are created in PCM600.
Export Import	5 OK Cancel

Step 7: Rename Ekip Com IEC61850

For ease of use and to distinguish Ekip Com IEC61850 devices, they can be renamed by a right click on Ekip Com IEC61850, according to the tag name.



Step 8: Download the created IEC61850 settings from PCM600 to the device

- 1. Right click on Ekip Com IEC61850 (the name of which has been changed to distinguish between circuit breakers)
- 2. IEC 61850 Custom logic
- 3. IEC 61850 Custom logic

Project Explorer	→ ‡ X			
Plant Structure				
📋 Sample				
Substation	Lovel			
	ay			
4	Collapse			
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보관	IEC 61850 Configuration			
S	IED Summary			
<u> Si</u>	Account Management			
4	IEC61850 Custom Logic 2	•	4	IEC61850 Custom Logic 3
	Create Template		-	
	Import			
	Export			
	Read from IED			
	Write to IED			
	Report Parameters			

IEC61850 Custom Logic can be found at the top, in the File Menu bar.

4. Open IEC61850 Custom Logic

5. Write to IED

4	Edit Remove	ONE - 1EC61850 Custom Logic
	Write to IED	Sector Contraction of the
5	Read from IED	File name: - C.\PCMDataBases\EMax2\ONEOhurch.cid
Y	Open file Save file	
4	Advanced view	
10	Application Configuration	n

6. Choose the correct network interface:

7. Write		
Write to IED		\times
Network interface:		\sim
Module ip address:	192 . 168 . 8 . 20 Module port number: 69	
Filename:	C:\PCMDataBases\EMax2\ONEChurch.cid	6
	Write	

Repeat the procedure from Step 4 to Step 7 for each LV device in the electrical network.

Step 9: Set GOOSE messages

- 1. Right click on Bay
- 2. IEC 61850 Configuration



A new window will appear. There are 3 kinds of GOOSE messages:

- Bftrip : for Back up protection
- Interlock: for CB. Status (Open, Close)
- Protection: For protection signalling
- 3. GOOSE controls
- 4. Change APP ID and MAC Address

Note: The APP ID and Mac Address must be changed. Each one should be unique. The Mac Address cannot be 0. Press enter to acquire the change and press save each time after finishing.

- 5. Cross-check the GOOSE messages according to the signalling matrix
- 6. Save



GOOSE Communication - IEC 61850 Configuration Receiving 004 (LD0) side (LD0) (LD0) (LDO) Ł A2 a 5 A1.LD0.LD0.LLN0.Brftrip A1.LD0.LD0.LLN0.Interlock ✓ ✓ ✓ A1.LD0.LD0.LLN0.Protection A2.LD0.LD0.LLN0.Brftrip A2.LD0.LD0.LLN0.Interlock ~ ~ ~ A2.LD0.LD0.LLN0.Protection D1.LD0.LD0.LLN0.Brftrip D1.LD0.LD0.LLN0.Interlock ✓ ✓ ~ D1.LD0.LD0.LLN0.Protection D3_004.LD0.LD0.LLN0.Brftrip D3 004.LD0.LD0.LLN0.Interlock D3_004.LD0.LD0.LLN0.Protection \checkmark ✓ ~

As shown, the left side of the Goose Communication is the Sender side and represents the Out side of the signalling Matrix while the Up side is the receiving side and represents the In side of the signalling Matrix. In this example, Circuit Breaker A1 is sending a Protection Signal to Circuit Breakers A2, D1 and D3_4.

Sending side

Step 10: Program the GOOSE messages

This step allows you to define which kind of GOOSE messages each device receives.

- 1. Right click on device that should receive the message
- 2. IEC 61850 Custom logic
- 3. IEC 61850 Custom logic



- 4. Click on IEC61850 Custom Logic at the top, in the File Menu bar
- 5. Edit, now select Edit to access a new window



Interfacing between PCM and Ekip Connect 3

РСМ	Ekip connect 3
PRGOUTGGIO1\$ST\$Ind1\$general	Programmable Status A
PRGOUTGGIO1\$ST\$Ind2\$general	Programmable Status B
PRGOUTGGIO1\$ST\$Ind3\$general	Programmable Status C

Important to understand

РСМ	Definition
Values	OUT of Signalling Matrix (message sent)
Output	IN of Signalling Matrix (message received)
Operator	Operating function applied to transmitted message

- 6. Enter Operator, Values and Output
- 7. Add
- 8. OK

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Example

- 1. Two supply sources (GEN2.1,GEN2.2) are feeding the plant
- 2. A1, A2 are circuit breakers with Directional protection

3. D1, D11 are circuit breakers with S protection.

The Signalling Matrix and single-line diagram with Probable Fault Points and signalling directions are shown in the figure below.



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					0	ut		
			А	1	A	12	D11	D2
			FW	BW	FW	BW	S	S
	A 1	FW				٠	•	
	AI	BW						
		FW		٠			٠	
IN	AZ	BW						
	D1	S						٠
	D11	S						

Considering Fault F0 as shown in the single-line diagram below, the current flows from G1 and G2 to feed the fault. D11 should trip and send a signal to D1.



To assign the Signal input to D1:



Test procedure

Scope: check whether the locking signals sent by the tested circuit breaker are correct in the case of a fault with zone logic discrimination feature active. The procedure will be implemented by using Ekip Connect 3.

Preliminary settings

The recorded Ekip Connect value is given below for each specific event:

- Status ZS IN Remote H S In = BE02
- Status ZS IN Remote H D FW In = BE40
- Status ZS IN Remote H D BW In = BE20

Ekip Signalling 4k

Comply with the instructions in this section if Ekip Signalling 4k is installed in the device. A general example about how to program the Signalling 4k Outputs is given below:

- 1. Modules
- 2. Signalling
- 3. O1
- 4. Connection type Normally Open
- 5. Self-latching On
- 6. Signal source click on the three dots
- 7. Custom
- 8. Status ZS IN Remote H D FW In (BE40)
- 9. OK
- 10.Apply



A general setting for one circuit breaker is given below as a standard example.

	0 01	0 02	O 03
Circuit breaker	BE40	BE20	BE02

Ekip Signalling 10k-1

There is no need to install an external Ekip Signalling 10k device. It can be set and checked from the Outputs page.

A brief example about how to program Signalling 10k-1 Outputs is given below:

- 1. Classic View
- 2. Programmable Status and Outputs
- 3. Outputs

- 4. (10k-1) Out1 parameters
- 5. Contact type Normally open
- 6. Latched ON
- 7. Signal Source click on the 3 dots
- 8. Custom
- 9. Status ZS IN Remote H S In (BE02)
- 10.OK
- 11. Apply



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All the settings for one circuit breaker are given below, as a standard example.

	OUT1	OUT2	OUT3
Circuit breaker	BE02	BE40	BE20

Example with 10 Circuit breakers:

A brief explanation is given about the network below, with a with table showing the signalling setting using the 4K

- F0, F1, F2, F3, F4, F5, F6, F7, F8, F9 \rightarrow fault probability
- A1, A2, A3, A4 \rightarrow circuit breakers with Directional protection
- GEN 2.1, GEN 2.2, GEN 2.3, GEN 2.4 \rightarrow power supply
- D1, D2, D3_002, D4, D3_004, D11 → circuit breakers with S protection



Circuit breaker	0 01	0 02	O 03
A1	BE40	BE20	BE02
A2	BE40	BE20	BE02
A3	BE40	BE20	BE02
D1	-	-	BE02
D2	-	-	BE02
D3_002	-	-	BE02
D4	-	-	BE02
D11	-	-	BE02
D3_004	-	-	BE02

Test with fault simulation sequence

Inject the digital signal that simulates the fault into the release to find out whether tripping in the tested unit is correct.

Test area

1. Tools





3. Add Test Session

Area Test				
3 + Add test session + E	recute test	+ Execute ter	It sequence	+ Execute trip test
TEST SESSIONS				
DEFAULT SESSION à feat Tast benaine le emans 1	- 1746 2000			
4 Fill in the data				
5. OK				
5. OK Add new test session			x	
5. OK Add new test session			×	
5. OK Add new test session			×	
Add new test session			×	
Add new test session Name Location			×	
S. OK Add new test session Name Location Customer			×	
Add new test session Name Location Customer Operator			×	

6. Add Test

7. Fill the data 8. OK	3		
Test name			
Test name BackWard			
	8	ок	Cancel

- 9. Phase change mode balanced at 120°
- 10. Shows relative amplitudes
- 11. Same amplitudes for currents
- 12. Same amplitudes for voltages
- 13. Select Relative amplitude for currents and voltages
- 14. Select phase for currents and voltages



Completed

10:04:09	0	evaluating test preconditions	
10:04:09	\odot	Opening test session	
10:04:11	\odot	injecting signal waveforms	
10:04:11	\odot	Start text.	
10:04:12	\odot	Protection D Backward tripped in 130 ms	
0.04.12	\odot	Stop test.	
21.80-01	0	Close test session.	

17. Save file in a specific folder

Suggested Test Session conditions

Test	Signal	Relative amplitude	Phase	Power Direction
1	IL1	2.50In	30.00°	Backward
	V1	1.00Un	0.00°	-
2	IL1	2.50In	-30.00°	Forward
	V1	1.00Un	0.00°	

Using the Test feature in the Ekip connect software define a test current that simulates the fault. The value of this current must be higher than the protection settings (at least +20%) and the angle between voltage and current must be defined according to the fault direction.

Note:

- To recognize the power direction, the phase difference between I and V
- must be higher than the minimum angle of direction set in D protection.
 It is backward if the phase is 30.00°, considering the voltage with reference to the current

Locking Signal check

Check the Signalling 4K or Signalling 10k-1 Outputs status to make sure, in all the connected release units, that the state of the sent and received messages is correct.

In the case of Ekip Signalling 4k, you can see this directly on the device without using Ekip Connect, by checking the status of its leds.

Each output refers to the messages programmed in in the section on Ekip Signalling 4k.

In the case of Ekip Signalling 10k-1:

- 1. Classic View
- 2. Programmable Status and Outputs
- 3. Ouputs
- 4. (10K-1) Output Status



Each output refers to the messages programmed in the section on Ekip Signalling 10k-1. To reset the Ekip Signalling 4k and 10k-1 contacts click on Signal Reset from the classic view or press and hold the i button on the HMI for at least 5 sec.

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