



EXPERT WORKSHOP SERIES

Part 4: Line Differential Protection - Compatibility of SIPROTEC 4 and SIPROTEC 5

Protection Data Interface for Distance and Line Differential Protection

Cooperation with **Distance** Protection Devices

- Exchange of binary signals for Teleprotection Schemes e.g. Echo, Faulted Phase, Fault Direction
- Commonly 2 or 3 distance relays
- Small data payload
- No device synchronization required

Supported Functionalities

- The scope of cooperation is limited by the signaling procedures available in the SIPROTEC 4 devices.
- Transmission of additional user defined signals
- Constellation measured values
- Functional logout

Cooperation with **Differential** Protection Devices

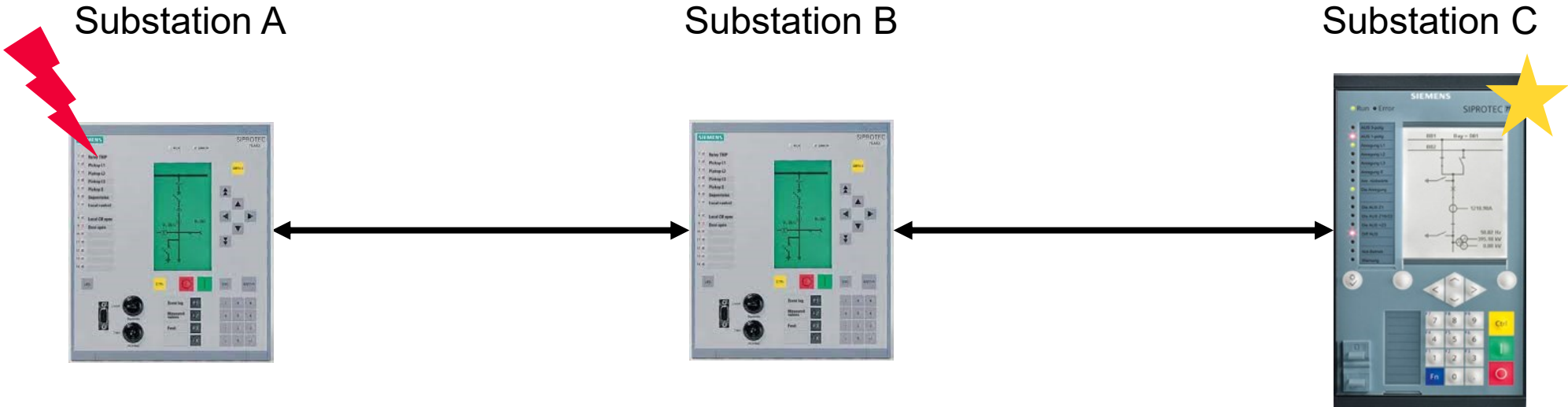
- Exchange of synchronized measured values plus binary information
- Up to 6 devices
- High data payload
- Accurate device synchronization required

Supported Functionalities

- Line differential protection, stage I-DIFF and stage I-DIFF fast
- Constellation measured values
- Functional logout
- Transmission of additional remote indications / commands

Use Cases for SIPROTEC 4 and 5

Replacement and/or Extension for Line Protection (2-End → 3-End)



Replace existing SIP 4

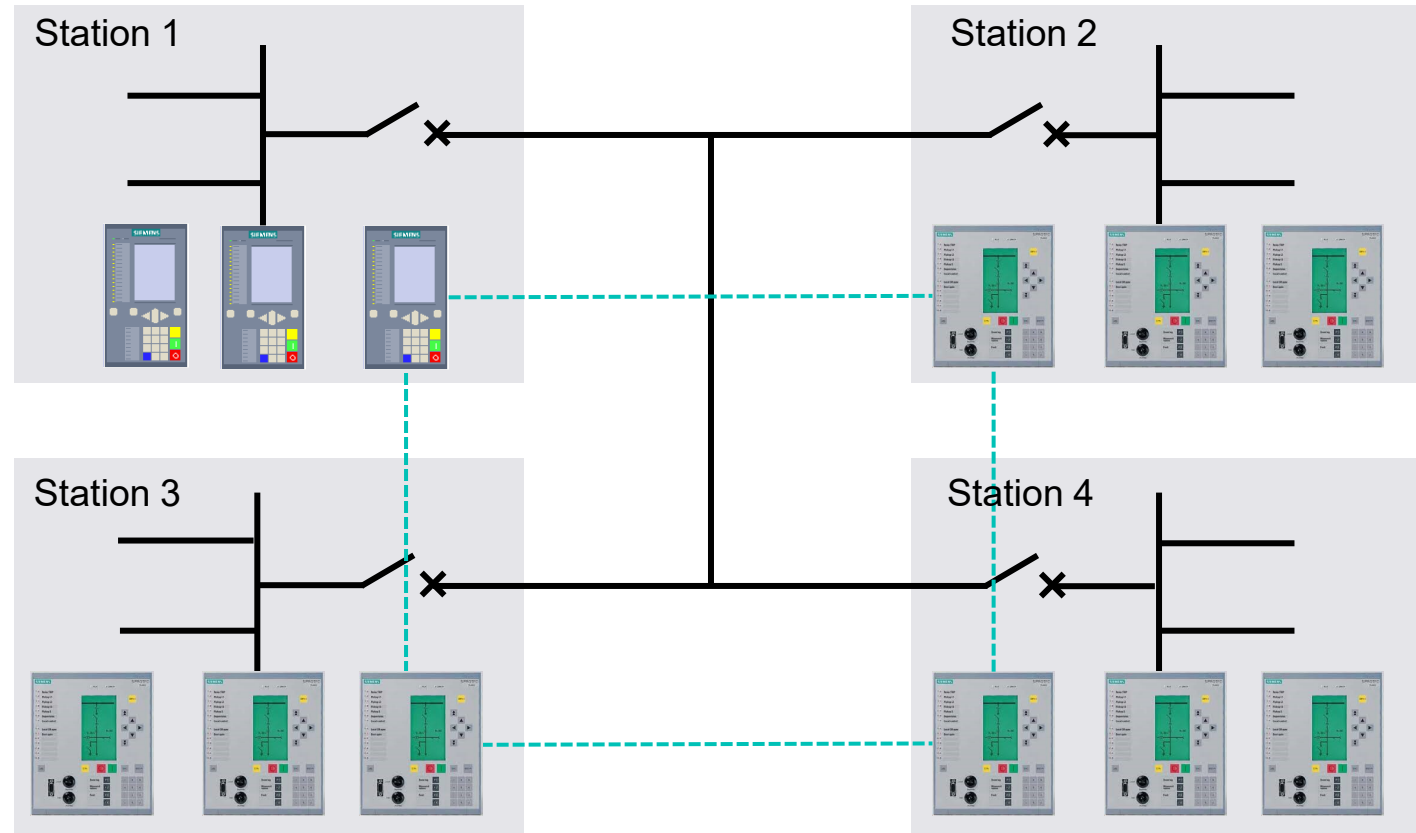
Extend existing SIP 4 with additional Terminal

Compatibility Mode

Typical Application Examples

Existing SIPROTEC 4 installation

- Extension with new station using SIPROTEC 5 protection
- The SIPROTEC 5 device must run in „Compatibility mode“



Compatibility Mode in SIPROTEC 5 Manual

- 3 System Functions
 - 3.1 Indications
 - 3.2 Measured-Value Acquisition
 - 3.3 Sampling-Frequency Tracking and Frequency Track
 - 3.4 Processing Quality Attributes
 - 3.5 Fault Recording
 - 3.6 Protection Communication
 - 3.7 Cooperation with SIPROTEC 4 Devices
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 - 3.7.2 Communication Modules for the Protection Int
 - 3.7.3 Protection Communication
 - 3.7.4 Line Differential Protection
 - 3.7.5 Remote Commands and Remote Indications
 - 3.7.6 Signaling Procedure
 - 3.7.7 Broken-Wire Detection
 - 3.7.8 Notes on Replacing a SIPROTEC 4 Device with a SIPROTEC 5 Device
 - 3.7.9 Checklist for the Parameters of the SIPROTEC 5 Device
 - 3.7.10 Checklist for Replacing All SIPROTEC 4 Devices with SIPROTEC 5 Devices

3.7 Cooperation with SIPROTEC 4 Devices

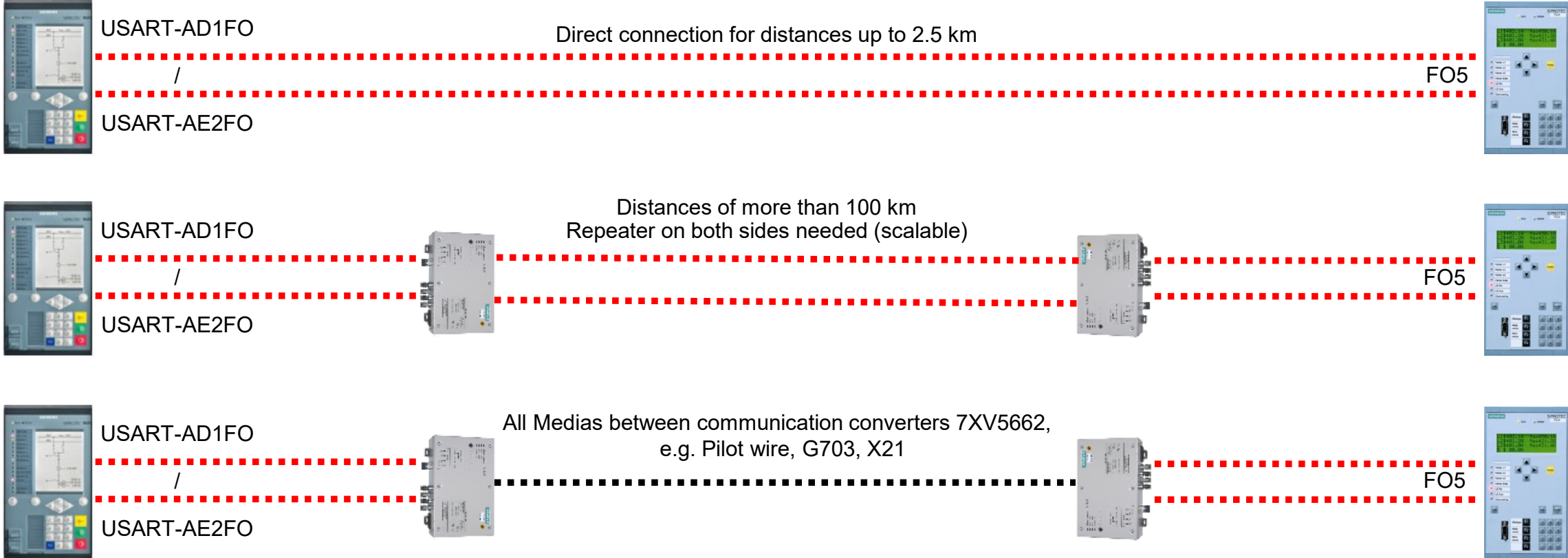
3.7.1 General Information

In the cooperation of SIPROTEC 5 and SIPROTEC 4 devices, in principle only those functionalities are supported that are available in both device families. This means that if both SIPROTEC families cooperate, at least the functionalities of the SPIROTEC 4 devices are supported.

You can connect SIPROTEC 5 devices to the following SIPROTEC 4 devices using the protection interface:

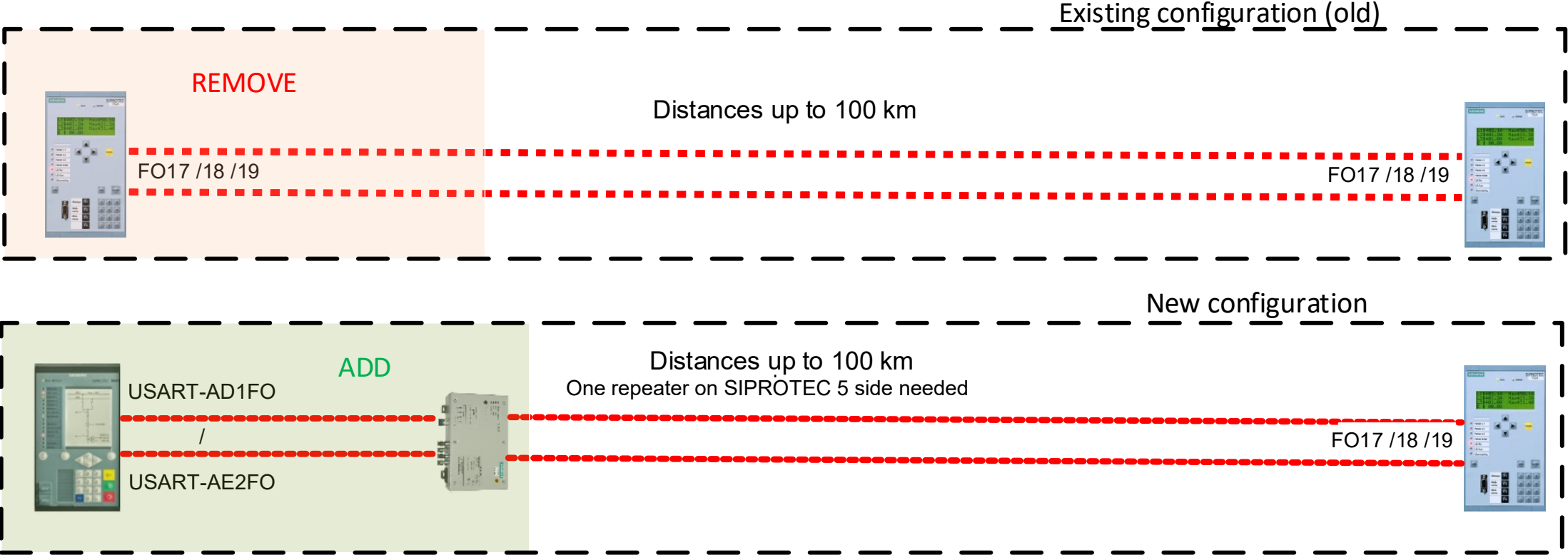
- Distance protection devices 7SA522 and 7SA6x From firmware version V4.70 and higher
- Differential protection devices 7SD5x From firmware version V4.72
- Differential protection devices 7SD610 From firmware version V4.72

Device replacement SIPROTEC 4 with short distance modules



→ SIPROTEC 5 device can be applied without any change to the communication link.

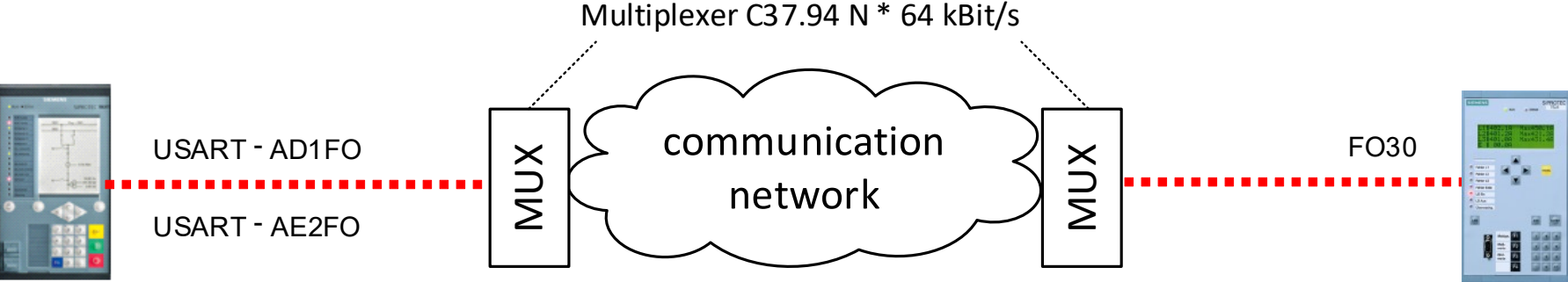
Device replacement SIPROTEC 4 with long distance modules



→ On the SIPROTEC 5 side an optical repeater 7XV5461 is required.

Device replacement

Direct Optical Connection to Multiplexers with IEEE C37.94 Interface



→ Available since FW version V09.30

Hardware Requirements

Distances < 2,5 km: Direct Connection

SIPROTEC 4
FO5

SIPROTEC 5
USART-AD-1FO/ - AE-2FO

Distances < 100 km

SIPROTEC 4
FO17, FO18, FO19

SIPROTEC 5
USART-AD-1FO/ -AE-2FO + repeater (7XV5461)

Distances > 100 km

SIPROTEC 4
FO5 + repeater (7XV5461)

SIPROTEC 5
USART-AD-1FO/ -AE-2FO + repeater (7XV5461)

Software Requirements

Distance Protection Devices

SIPROTEC 4

V4.70 and higher

SIPROTEC 5

V7.90 and higher

V9.30 and higher (IEEE C37.94)

Differential Protection Devices

SIPROTEC 4

V4.72 and higher

SIPROTEC 5

V7.90 and higher

V9.30 and higher (IEEE C37.94)

Compatibility of Line Protection Devices between SIPROTEC 4 and SIPROTEC 5

Compatibility-Matrix

		SIPROTEC 5										
		7SA82	7SD82	7SL82	7SA86	7SD86	7SL86	7SA87	7SD87	7SL87	7UT85/ 86/87	7SX85
SIPROTEC 4	7SA61x	● ¹⁾	—	● ¹⁾	● ¹⁾	—	● ¹⁾	● ¹⁾	—	● ¹⁾	● ¹⁾	● ¹⁾
	7SA52x	● ¹⁾	—	● ¹⁾	● ¹⁾	—	● ¹⁾	● ¹⁾	—	● ¹⁾	● ¹⁾	● ¹⁾
	7SD610	—	● ²⁾	● ²⁾	—	● ²⁾	● ²⁾	—	● ²⁾	● ²⁾	● ²⁾	● ²⁾
	7SD52x	—	●	●	—	●	●	—	●	●	●	●
	7SD53x	—	●	●	—	●	●	—	●	●	●	●

1) Remote commands, remote indications and teleprotection

2) 87L for 2-Ends only

CT Settings in Compability Mode



NOTE

When using the Line differential protection, you must adapt the parameter **(254) E% K_ALF_N** in the SIPROTEC 4 device! Consider the following notes!

Trans- former Class	Parameter				CT error A ²³	CT error B ²³
	SIPROTEC 4 (253) E% ALF/ ALF_N	SIPROTEC 5 (_:8881:108) CT error A	SIPROTEC 4 (254) E% K_ALF_N	SIPROTEC 5 (_:8881:109) CT error B		
5P	3.0 %		12 %		3.0 %	10.0 %
10P	5.0 %		21 %		5.0 %	15.0 %
TPX	1.0 %		21 %		1.0 %	15.0 %
TPY	3.0 %		21 %		3.0 %	15.0 %
TPZ	6.0 %		28 %		6.0 %	20.0 %
PX	3.0 %		12 %		3.0 %	10.0 %
C100 to C800	5.0 %		21 %		5.0 %	15.0 %
					5.0 %	15.0 %

Remote Commands and Remote Signals

The remote commands and remote indications are specified in SIPROTEC 4 with regard to quantity and type.

The following signals are supported in SIPROTEC 4:

- 4 remote commands of the SPS type
- 24 remote indications of the SPS type

SIPROTEC 5		SIPROTEC 4
Bit	Priority	
1 to 4	PRIO 1	Remote commands 1 to 4
5	PRIO 1	InterOn signal
6	PRIO 1	Manual Close of the 7SD5x/7SD610
1 to 24	PRIO 2	Remote indications 1 to 24

Restrictions

Common compatibility issues:

- No compatible Two-Endend Fault Locator

Only in SIPROTEC 5:

- Differential current supervision
- Extended frequency range of +/-10% (+/-5% in SIPROTEC 4)
- I-DIFF fast 2 (improved CT saturation detection)
- IN-DIFF
- I2-DIFF

Only in SIPROTEC 4:

- The detection of a simultaneous broken wire on all 3 phases, available in SIPROTEC 4 is not supported. The detection of a broken wire in one phase is supported as before

DIGSI Live Demo

Configuration: Rated Line Current & Frequency

Power System Data 2 - Setting Group A

Local Line End | Line Status | Trip 1-/3-pole

Parameter:

Nr.	Parameter	Wert
1103	Measur:FullScaleVoltage(Equipm.rating)	400,0 kV
1104	Measur:FullScaleCurrent(Equipm.rating)	1000 A
1105	Line Angle	85 °
1511	Angle of inclination, distance charact.	85 °
1107	P,Q operational measured values sign	not reversed
1116	Zero seq. comp. factor RG/RL for Z1	1,00
1117	Zero seq. comp. factor XG/XL for Z1	1,00
1118	Zero seq. comp.factor RG/RL(> Z1)	1,00
1119	Zero seq. comp.factor XG/XL(> Z1)	1,00

Weitere Parameter anzeigen

Info

OK Übernehmen DIGSI -> Gerät Abbrechen Hilfe

General

Rated values

21.9001.101	Rated current:	1000	A
21.9001.102	Rated voltage:	400.00	kV
21.9001.103	Rated apparent power:	692.8	MVA

Power System Data 1

Transformers | Power System | Breaker | CT Data

Parameter:

Nr.	Parameter	Wert
0207	System Starpoint is	Solid Grounded
0208A	1-1/2 Circuit breaker arrangement	NO
0230	Rated Frequency	50 Hz
0237	Setting format for zero seq. comp. format	Zero seq. comp. factors RG/RL and XG/XL

General

Device

91.101	Rated frequency:	50 Hz
91.102	Minimum operate time:	0.00 s
91.115	Set. format residu. comp.:	Kr, Kx
91.138	Block monitoring dir.:	off

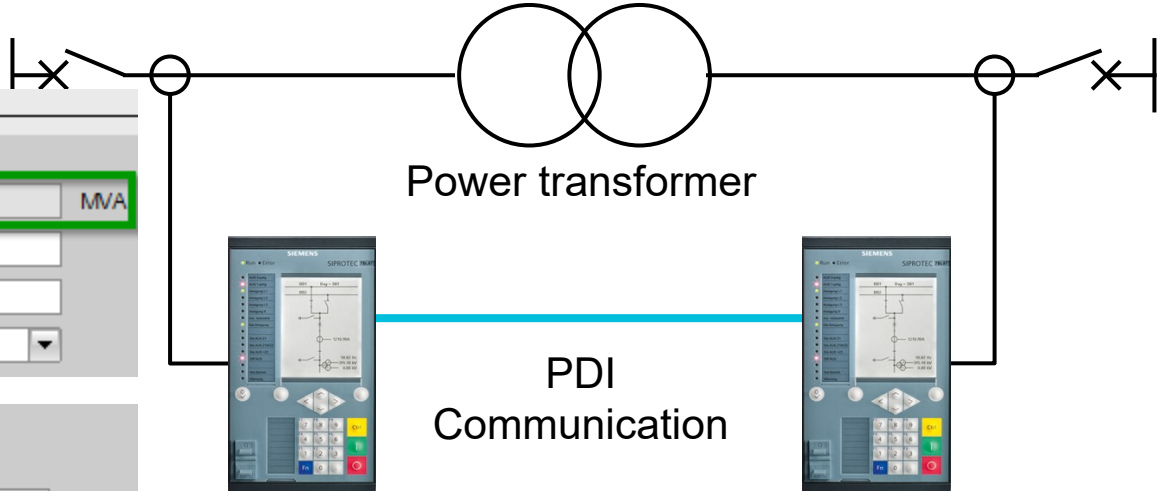
Configuration: Transformer in the Protected Zone

Transformer

21.821.3541.101	Rated apparent power:	692.8	MVA
21.821.3541.103	Voltage vector group nb.:	0	
21.821.3541.104	Current vector group nb.:	0	
21.821.3541.105	Residual curr. elimination:	yes	

Rated values

21.9001.101	Rated current:	1000	A
21.9001.102	Rated voltage:	400.00	kV
21.9001.103	Rated apparent power:	692.8	



Topology Datas | Local Line End | Line Status

Settings:

No.	Settings	Value
1106	Operational power of protection zone	692,8 MVA
1161	Vector group numeral for voltage	0
1162	Vector group numeral for current	0
1163	Transformer starpoint is	Solid Earthed

Configuration: Differential Protection Settings

87 Differential Protection - Setting Group A

General | 87 Diff. Prot. | Innush

Parameter:

Nr.	Parameter	Wert
1201	State of differential protection	ON

87 Differential Protection - Setting Group A

General | 87 Diff. Prot. | Innush

Parameter:

Nr.	Parameter	Wert
1210	87-1 Pickup	0,30 A
1213	87-1 Value under switch on condition	0,30 A
1217A	87-1 Trip time delay	0,00 sec
1219A	87-1 Min. local current to release Trip	0,00 A
1233	87-2 Pickup	1,0 A
1235	87-2 Value under switch on condition	1,0 A

Weitere Parameter anzeigen

OK | Übernehmen | DIGSI -> Gerät | Abbrechen | Hilfe



SIPDCOM > LDIF_Dev_1_3 > Settings > Line 1 > 87 Line diff. prot.

Edit mode: primary | Active: settings group 1

General

21.821.2311.1 Mode: on

21.821.2311.102 Min. current for release: 0 A

21.821.2311.104 Supervision Idiff: yes: block diff. prot.

Add new stage | Delete stage

Remote trip.

General

21.821.5551.100 Transmitting: yes

21.821.5551.101 Receiving: yes

External trip

21.821.5551.103 Send delay: 0.02 s

21.821.5551.104 Send prolongation: 0.00 s

Add new stage | Delete stage

I-DIFF

21.821.3451.1 Mode: on

21.821.3451.2 Operate & ft.rec. blocked: no

21.821.3451.3 Threshold: 300 A

21.821.3451.101 Thresh. switch onto fault: 300 A

21.821.3451.6 Operate delay: 0.00 s

Add new stage | Delete stage

I-DIFF fast

21.821.3481.1 Mode: on

21.821.3481.2 Operate & ft.rec. blocked: no

21.821.3481.3 Threshold: 1000 A

21.821.3481.101 Thresh. switch onto fault: 1000 A

Add new stage | Delete stage

Configuration: Protection Topology settings

Differential Topology - Setting Group A

Parameter:

Nr.	Parameter	Wert
4701	Identification number of relay 1	101
4702	Identification number of relay 2	102
4710	Local relay is	relay 2

Weitere Parameter anzeigen

Info

OK Übernehmen DIGSI -> Gerät Abbrechen Hilfe



Channel 1 protocol settings

Communication protocols

Selected protocol: Protection interface

Default communication mapping: None

Protection interface

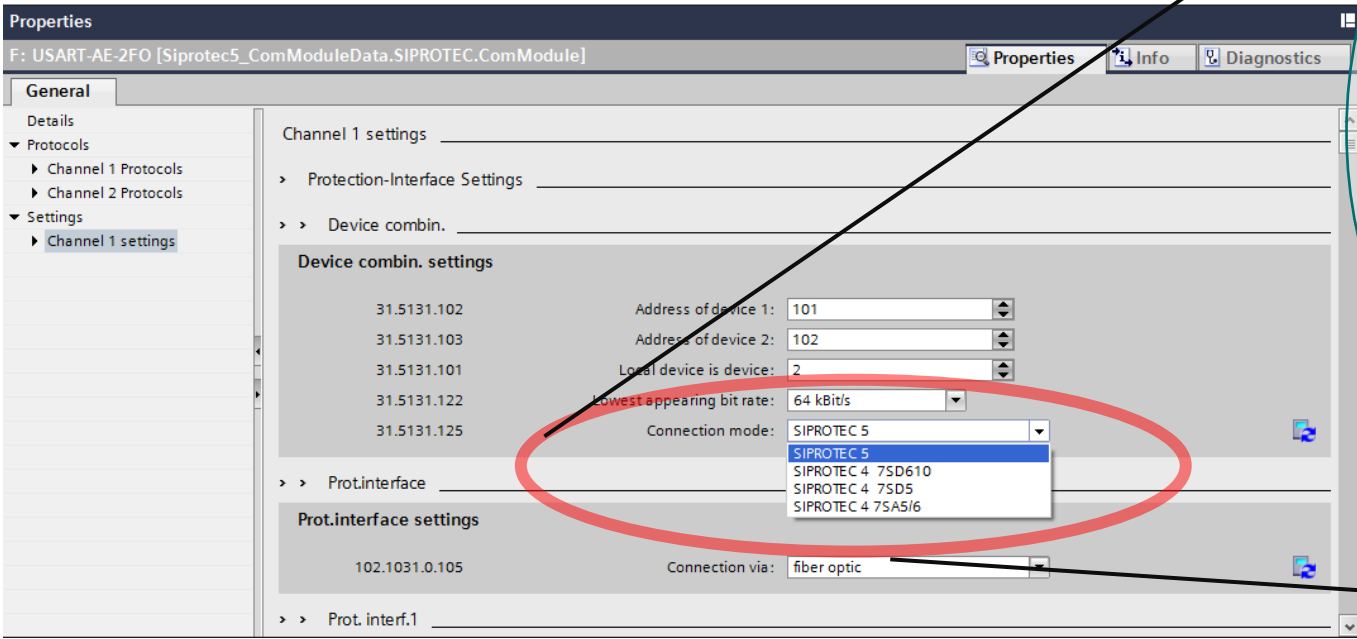
Select constellation: 2 device prot. com.

Device combin.

Device combin. settings

31.5131.102	Address of device 1:	101
31.5131.103	Address of device 2:	102
31.5131.101	Local device is device:	1
31.5131.122	Lowest appearing bit rate:	64 kBit/s
31.5131.125	Compatibility:	Mixed SIP 5/4 7SD5

Configuration: Select the Compatibility Mode



7SD610: SIP4 Two-End line differential

7SD5: SIP4 Multi-End line differential

7SA5/6: SIP4 Distance protection utilizing teleprotection schemes

Line Differential Protection webinar series

Links to all webinars of the series

- **Part 1: Line Differential Protection - Basics**
<https://smartinfrastucture.webinar.siemens.com/line-differential-protection-part/b1f36e4f86751bac5b5b>
- **Part 2: Line Differential Protection - Interfaces**
<https://smartinfrastucture.webinar.siemens.com/line-differential-protection-part-1/5101ce29a70e0f2f0c95>
- **Part 3: Line Differential Protection - Configuration and Testing**
<https://smartinfrastucture.webinar.siemens.com/line-differential-protection-part-2/a155d5a3afa6d0d61295>
- **Part 4: Line Differential Protection - Compatibility of SIPROTEC 4 and SIPROTEC 5**
<https://smartinfrastucture.webinar.siemens.com/line-differential-protection-part-3/a582c41832151fbce672>
- **Bonus Live Q&A Session - Line Differential Protection**
<https://smartinfrastucture.webinar.siemens.com/live-qa-session-line-differential/478dbe71dc403bfb8940>

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