Siemens Power Academy TD

SIEMENS

Line Differential Protection 7SD52x / 7SD610

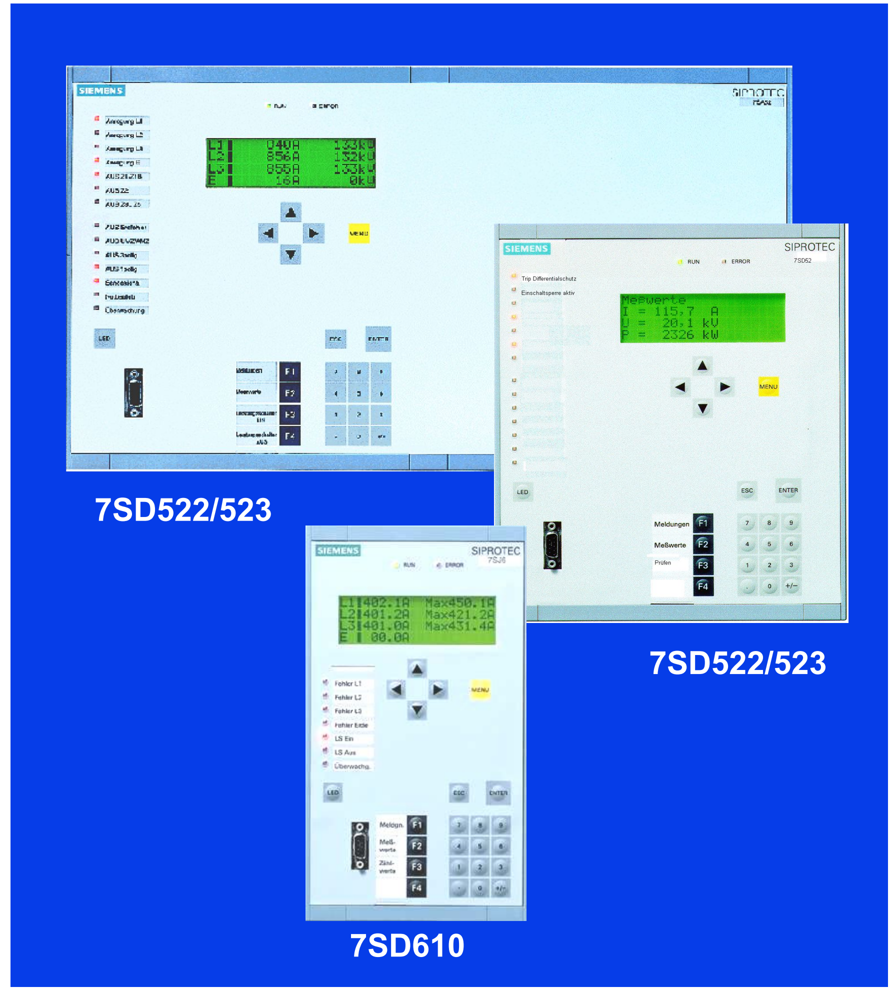
Presentation

Line differential relays 87L- SIPROTEC 4

SIEMENS

Universal
Line Differential
Relays 87L

- **7SD610**
  (2 ends)
- **7SD522**
  (2 ends , additional I/O)
- **7SD523**
  (2 up to 6 ends)



Customer Benefits

SIEMENS

- The protection adapts its characteristic by itself. Adaptive measurement reduces the setting complexity and ensures maximum sensitivity.
- Multi terminal applications up to 6 line ends and redundant Relay to Relay communication.
- A transformer inside the feeder zone of protection is fully accommodated by the feeder differential protection and configured with a few simple settings.
- Current transformer mismatch 1:8 without matching transformers. Different CT classes possible.
- Flexible protection data communication uses a variety of communication media.
- Secure operation at unsymmetrical propagation times in Communication networks.
- High speed measurement supervision
- Simplified commissioning by application of WEB- technology

Hardware options

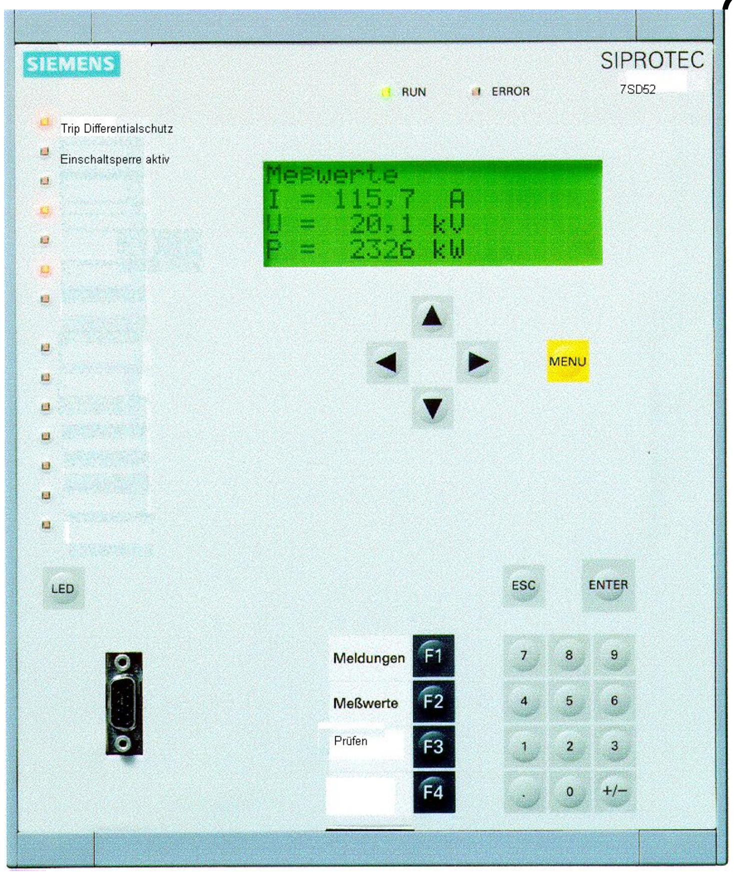
SIEMENS

Device	7SD610 1/3 19''	7SD522 ½ 19''	7SD522 1/1 19''	7SD523 ½ 19''	7SD523 1/1 19''
Current Inputs (I_{ph} / I_E)	(3 / 1)*	(3 / 1)*	(3 / 1)*	(3 / 1)*	(3 / 1)*
Voltage Inputs (U_{ph} / U_E)	3 / 1	3 / 1	3 / 1	3 / 1	3 / 1
Binary Inputs	7	8	16 // 24	8	16 // 24
Binary Outputs	5	15	(23 // 31)**	15	(23 // 31)**
Life contact	1	1	1	1	1
LC Display	4 Lines	4 Lines	4 Lines	4 Lines	4 Lines
Protection Interfaces	1	1	1	2	2

* 1A, 5A changeable (jumper position)
// depending on ordering data
** 5 high-speed relays

Protection and communication join together
Three benefits of 87L-SIPROTEC

SIEMENS



Differential protection for the universal use with easy to handle settings

Two up to six line ends , for serial and parallel compensated lines, handles transformers and compensation coils within the protection zone, **tripping time approx. 12 ms with fast high set element**

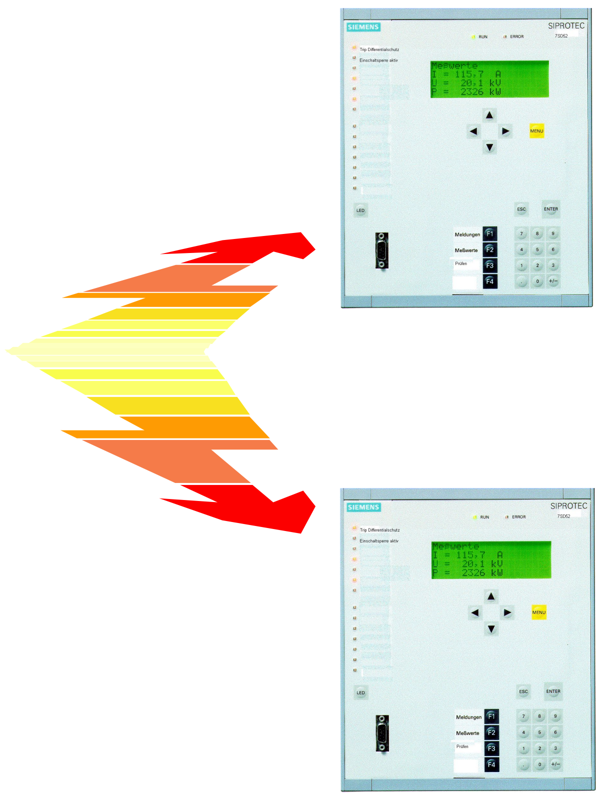
Adaptive differential measurement

Automatic consideration of CT errors and communication-errors

Increased set point during switching-on conditions

Direct and modular connection to fibre optic and digital communication networks

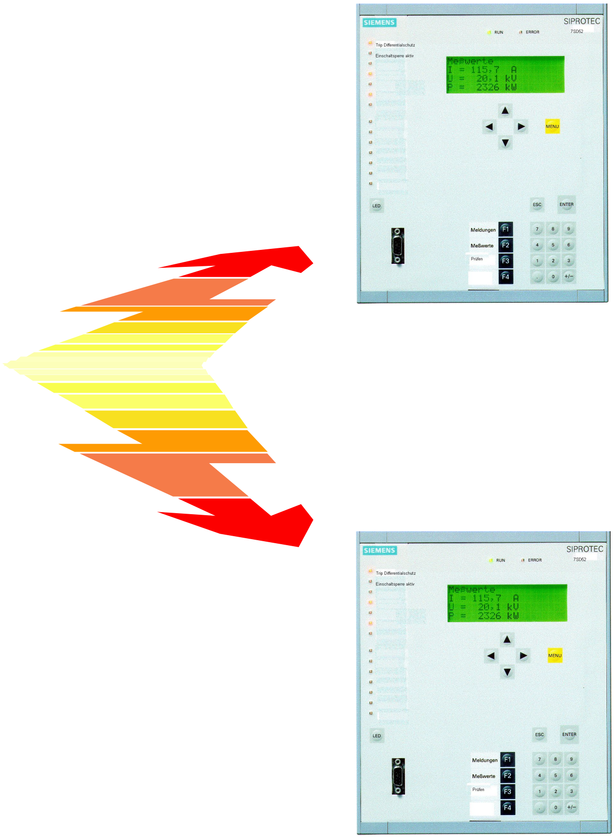
Main protection function 87: Features of the differential function



- **Phase selective multi-end differential protection (2 - 6 ends).**
- **Fundamental vector comparison for the sensitive trip stage (Setting of I_{Diff}> = 0.2- 0.3 I_N). Suppress decaying DC-components and harmonics. Therefore allows a sensitive setting.**
- **Tripping time 12 ms with fast current comparison protection (Setting of I_{Diff}>> > 1.2 $I_{Load.max}$)**
- **Dynamic increase of differential set point I_{Diff}> during switch-on of long lines / cables**
- **CT saturation detector**
  (only 5 ms saturation free time due to external faults necessary)
- **Phase selective intertrip**
- **Settable delay time for single phase faults (feature for inductive compensated networks)**
- **Transformer option: Inrush 2nd harmonic restraint with vector group adaptation. Undelayed trip for high fault currents**
- **Lockout function (Seal in of trip command)**

Additional functions in the relay

SIEMENS



- **Switch On to Fault protection (SOFT)**
  (with breaker position from remote)
- **3 stage backup- or emergency O/C protection (IEC /ANSI) 50, 50N, 51, 51N**
  Runs in parallel (backup) or in emergency mode,
  if 87L is blocked. (from external or due to communication-failure)
- **Three pole and single pole AR** (Single pole AR during 2pole fault without earth possible, Adaptive AR - Switch on from one side)
- **Breaker Failure protection 50BF**
- **Thermal Overload function** (Thermal replica with $I_{Operation}$)
- **User definable logic and control functions also with signals from remote (AND, OR, NOT, Timer, Flip-Flop)**
- **4 remote commands via binary input or logic inputs (destination relay is addressable), 24 remote signals (only 7SD522/523)**
- **Operational values: Currents I, Voltages V, Active/Reactive Power, Delay time, Differential-/Restraint current - Remote end I/V-values**
- **Exactly time synchronized fault records with voltages, currents, binary traces and differential and restraint current per phase**
- **Fast monitoring functions**
  Fast broken current-wire supervision □ blocks 87L and avoids malfunction

Communication features

RS232/RS485 electrical module

Fibre-optic module

Optical double-ring module

Flexibility due to plug in modules

Compatibility to international standards

- Front interface
  - DIGSI4
  - WEB Monitor
- Service interface (s)
  - DIGSI4 operation
  - modem connection
- System interface
  - IEC60870-5-103
  - Profibus DP
  - DNP3.0
- Time synchronising
  - IRIG-B (GPS)
  - DCF77

I_{Diff}>: Vector comparison

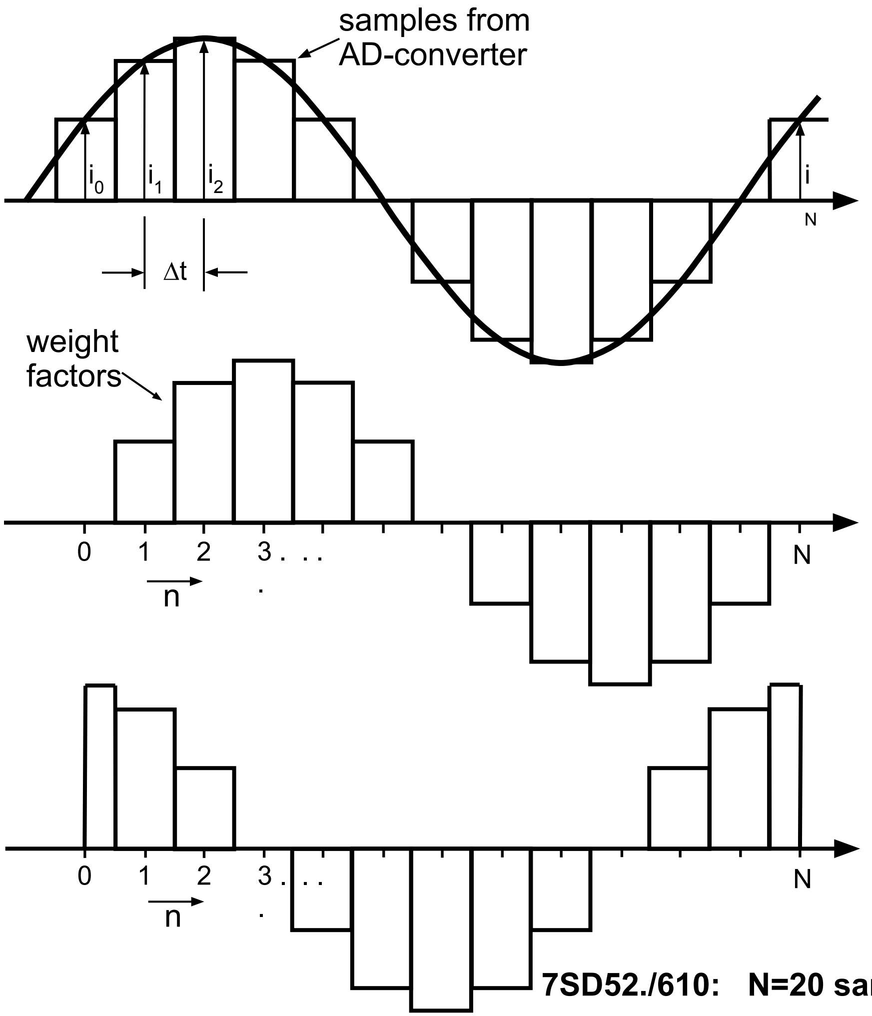
SIEMENS

Vector comparison offers high sensitivity for high-resistive faults

- DC components and harmonics are suppressed by Advanced Fourier Filters
  Suppress decaying DC-component 4 times better then a classical Fourier Filter.
- Different types of Ct´s allowed, even with a sensitive setting.
- Relative slow, because of 1 cycle (20 ms,50Hz) filtering window
  Results in a tripping time from 30-50 ms for high resistive faults (I_{Diff} < 1.2 .. 2 I_N)

I_{Diff}>: Vector comparison with Advanced Fourier filters (Basic principle)

SIEMENS



Optimized filtering coefficients for 7SD52 / 7SD610 designed for suppressing decaying DC-components 4 times better then conventional Fourier-filters.
Overcome stability problems with decaying DC-components

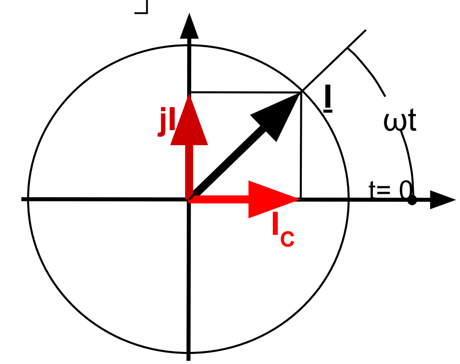
Sine component:

$$I_S = \frac{2}{N}\left[\sum_{n=1}^{N-1} \sin(\omega \cdot n \cdot \Delta t)\cdot i_n\right] \rightarrow 1 \ldots N = 20$$

Cosine component:

$$I_C = \frac{2}{N}\left[\frac{i_0}{2} + \frac{i_N}{2} + \sum_{n=1}^{N-1} \cos(\omega \cdot n \cdot \Delta t)\cdot i_n\right] \rightarrow 1 \ldots N = 20$$

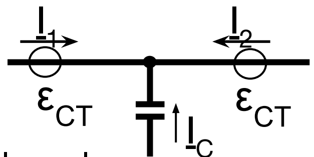
Complex vector
$\underline{I}$ = 2/N (I_C + jI_S)



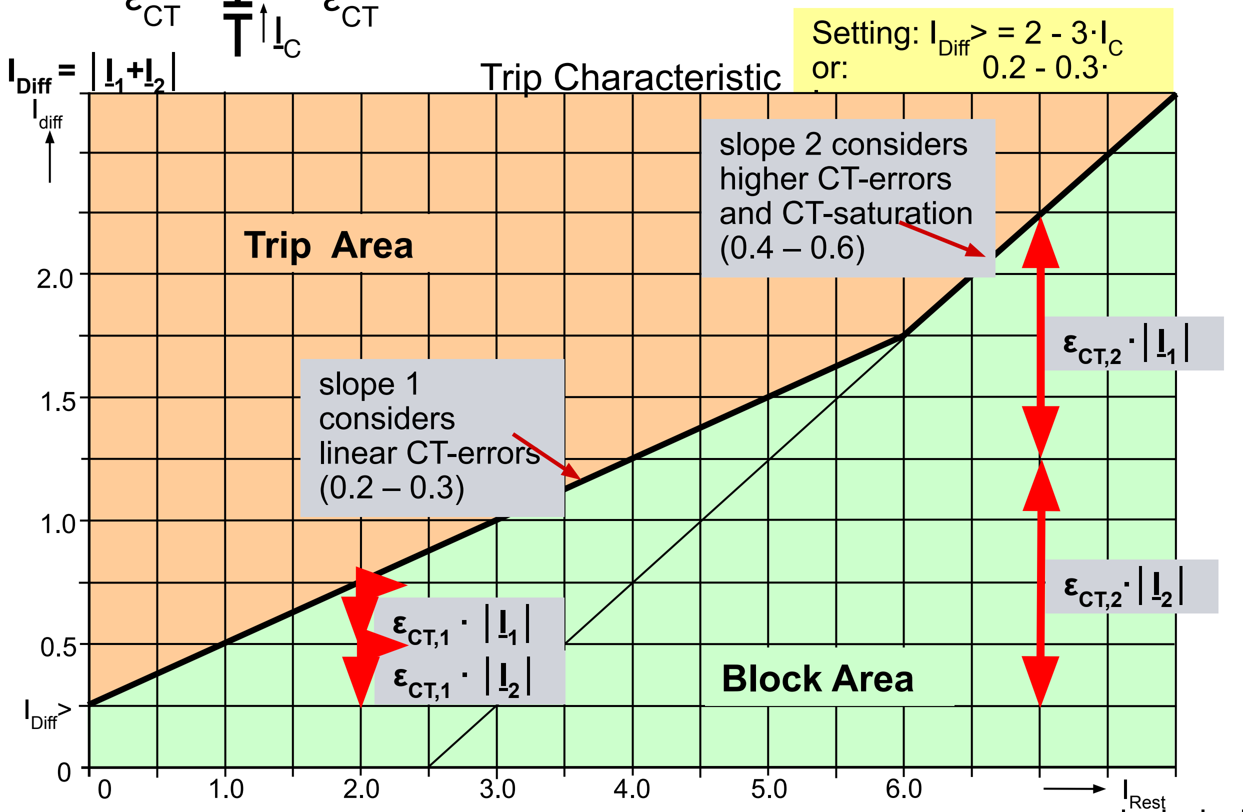
7SD52./610: N=20 samples / cycle

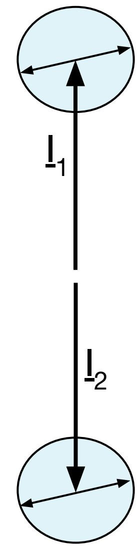
I_{Diff}>: Theory of the classical differential tripping characteristic

SIEMENS



Assumption: Equal CT type, currents are exactly synchronized (given through analogue measurement), equal CT-ratio





maximum measurement error (ε) due to CT - error

$I_{Diff} = I_{Diff}> + \varepsilon_{CT} \cdot |\underline{I}_1| + \varepsilon_{CT} \cdot |\underline{I}_2|$ ($I_{DIFF}>$ =trip threshold)

$I_{Rest} = |\underline{I}_1| + |\underline{I}_2|$

$I_{Diff} = I_{Diff}> + \varepsilon_{CT} \cdot (|\underline{I}_1| + |\underline{I}_2|) = I_{Diff}> + \varepsilon_{CT} \cdot |I_{Rest}|$

SIEMENS

Example: CT class 10P10, S_n = 10VA , I_{sn} = 1A

10% tolerance at K_{SSC} (= 10 = k_{ALF_N}) (in case of nominal burden is connected)

$$k_{ALF} = k_{ALF\_N} \cdot \frac{P_{ct} + P_b}{P_{ct} + P_b^{'}} = k_{ALF\_N} \cdot \frac{R_{ct} + R_b}{R_{ct} + R_b^{'}}$$

with:

K_{SSC}: rated symmetrical short-circuit current factor (IEC 60044-6)

K_{ALF_N}: rated Accuracy Limit Factor

K_{ALF}: actual Accuracy Limit Factor

R_{ct}: secondary winding resistance

R_b: rated resistive burden

R'_b: actual resistive burden (R_{LEADS} + R_{Relay})

Thumb rule:

$R_{ct} \approx 0.1...0.2 \cdot R_b$

Nominal burden :

$$R_b = \frac{S_n}{I_{sn}^2} = \frac{10VA}{1^2 A^2} = 10\Omega \rightarrow R_{ct} \approx 2\Omega$$

$$\frac{k_{ALF}}{k_{ALF\_N}} = \frac{2\Omega + 10\Omega}{2\Omega + 1\Omega} = 4$$

→ If less then rated burden is connected to the CT, the CT- error for load conditions (ε_{Load}) can be used for calculations with currents higher than the nominal current of the CT (I_{pn}) ! (In the example here: ε_{Load} could be taken for currents up to $4 \cdot I_{pn}$

As the I_{Diff}> step must be (very) sensitive for high resistive faults at maximum Load, for usual applications there is no need to set the parameter 0251 (k_{ALF}/K_{ALF_N}) higher than 1.5 !!

Resulting Relay Parameter (with exact calculation)

- k_{ALF} / k_{ALF_N} = 1.5 (calculation as above = 4 , 4 > 1.5 □ Setting: 1.5)

  [remains 1 if CT-data's are unknown]

- IEC 60044 -1:

  tolerance in load area up to k_{ALF} / k_{ALF_N}: <2% for 5P (TPY), <3% for 10P (TPX) Ct´s

  Recommended setting in the relay: 3% for 5P, 5% for 10P

  total error at accuracy limit k_{ALF_N} = 5% for class 5P and 10% for class 10 P

  Recommended setting in the relay: 10% for 5P, 15% for 10P

I_{Diff}>: Approximation of the CT- error

SIEMENS

Basis for the adaptive restraint current calculation (max. expected differential current due to CT-errors) is the estimated error of each CT from the CT-data's

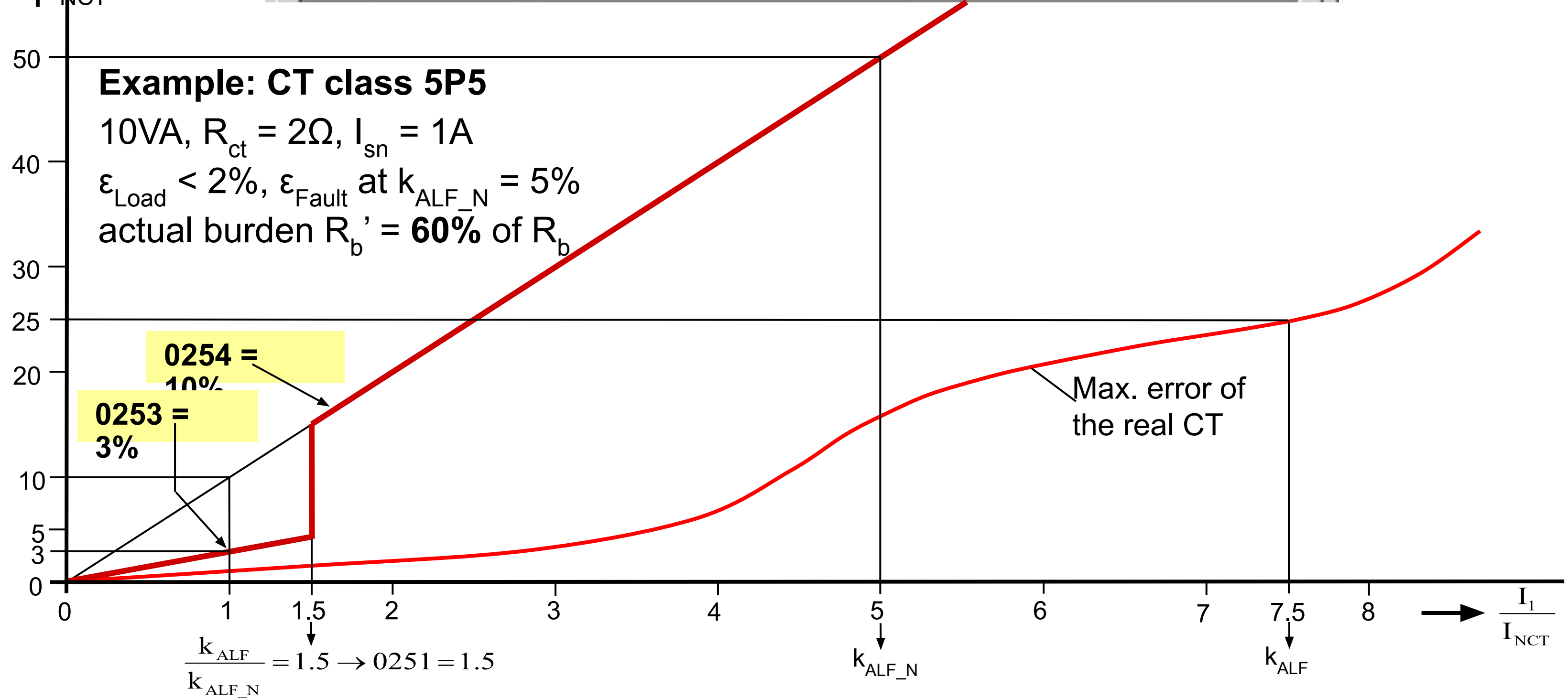
Power System Data 1

Transformers | Power System | Breaker | CT Datas

Customize:

No.	Settings	Value
0251	k_alf/k_alf nominal	1.50
0253	CT Error in % at k_alf/k_alf nominal	3.0 %
0254	CT Error in % at k_alf nominal	10.0 %

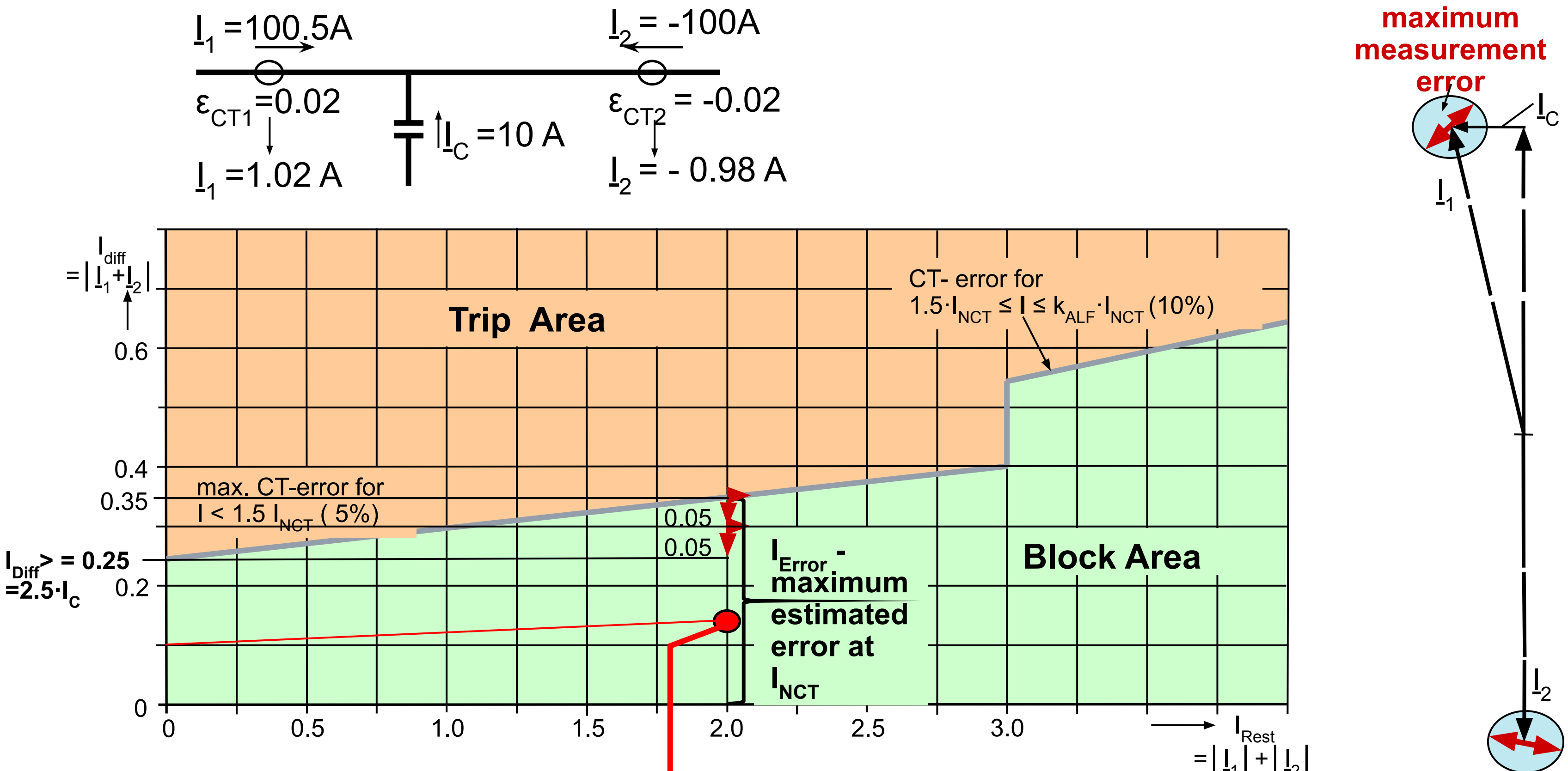
Settings in DIGSI 4



I_{Diff}>: Example for a setting at nominal current

SIEMENS

Assumption: CT-ratio is 100/1A, real error of Ct´s is 2% (0.02) up to 1.5 I_{NCT}

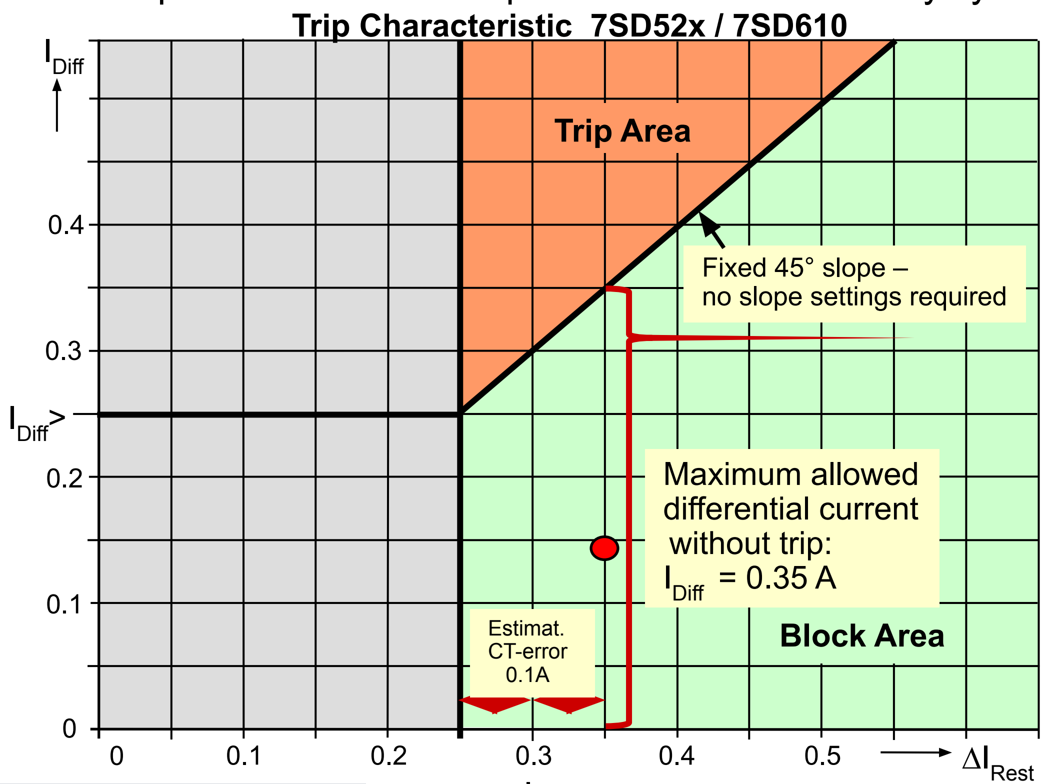


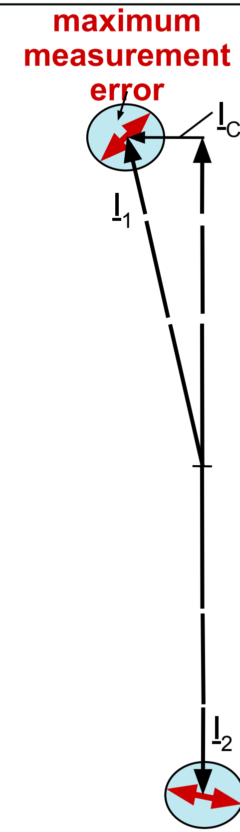
Diff. due to charge + real CT error: I_{Diff} **= 0.1 A + 0.02 • │1A│+ 0.02 ·│1A│ = 0.14 A**

Max. estimated error = Restraint current : I_{Error} **= 0.25 A + 0.05 • (│1A│+ │1 A│) = 0.35 A**

I_{Diff}>: Adaptive differential relaying
Restraint current with consideration of the CT- errors

Same example as before! Assumption: Currents are exactly synchronized





Current summation: $I_{Diff} = |\underline{I}_1 + \underline{I}_2|$

Max. error $I_{Error} = \Delta I_{Rest}$ *) $= I_{Diff}> + \varepsilon_{CT1} \cdot I_1 + \varepsilon_{CT2} \cdot I_2 = I_{Diff}>$ + **estimated CT-**

***) ΔI_{Rest} = adaptive restraint current**

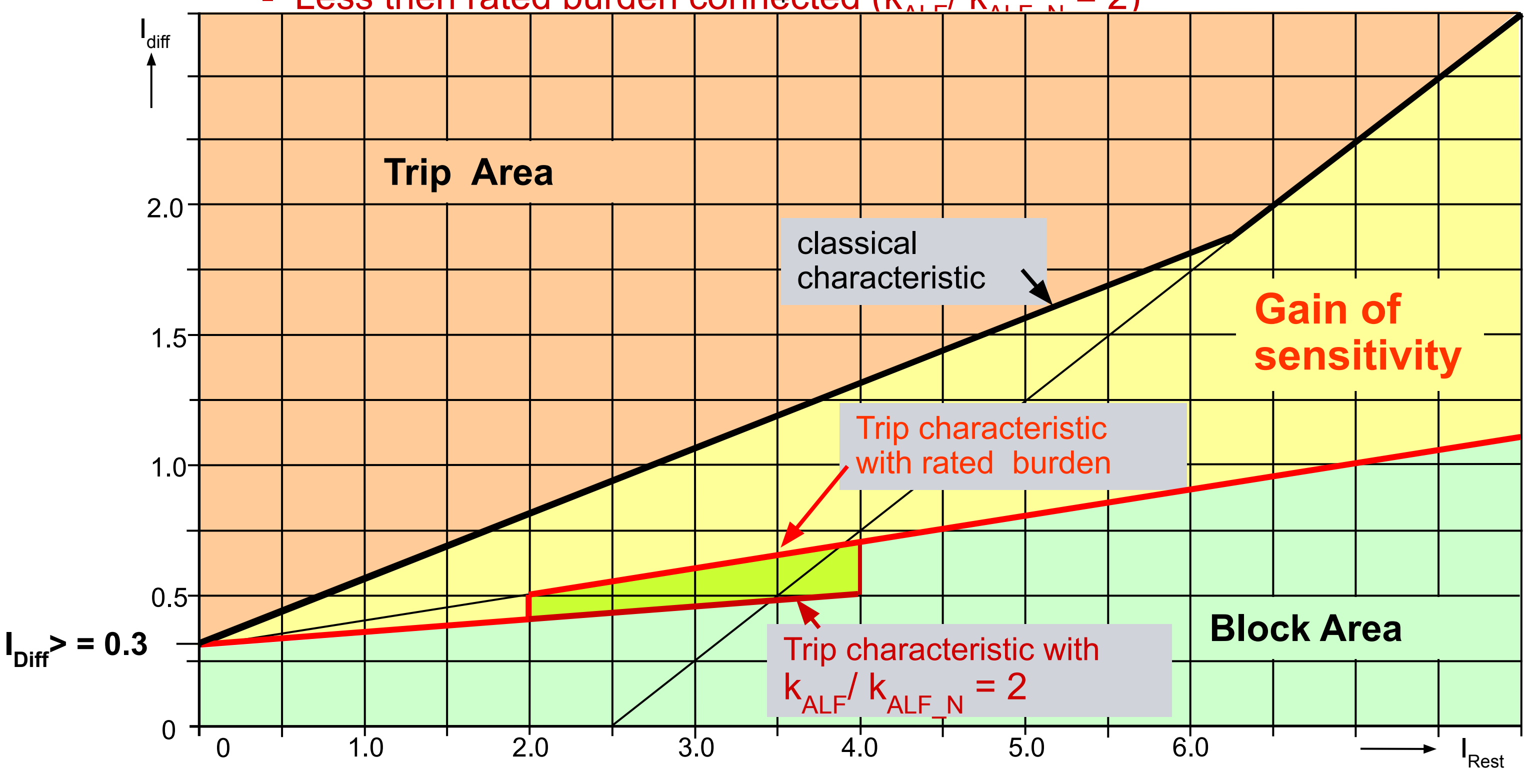
□ **Trip, if differential current I_{Diff} exceeds the restraint current (max. error)**

I_{Diff}>: New differential method compared with a classical differential characteristic

SIEMENS

Assumption: Equal Ct´s on both side, no effects from comms-system, standard settings

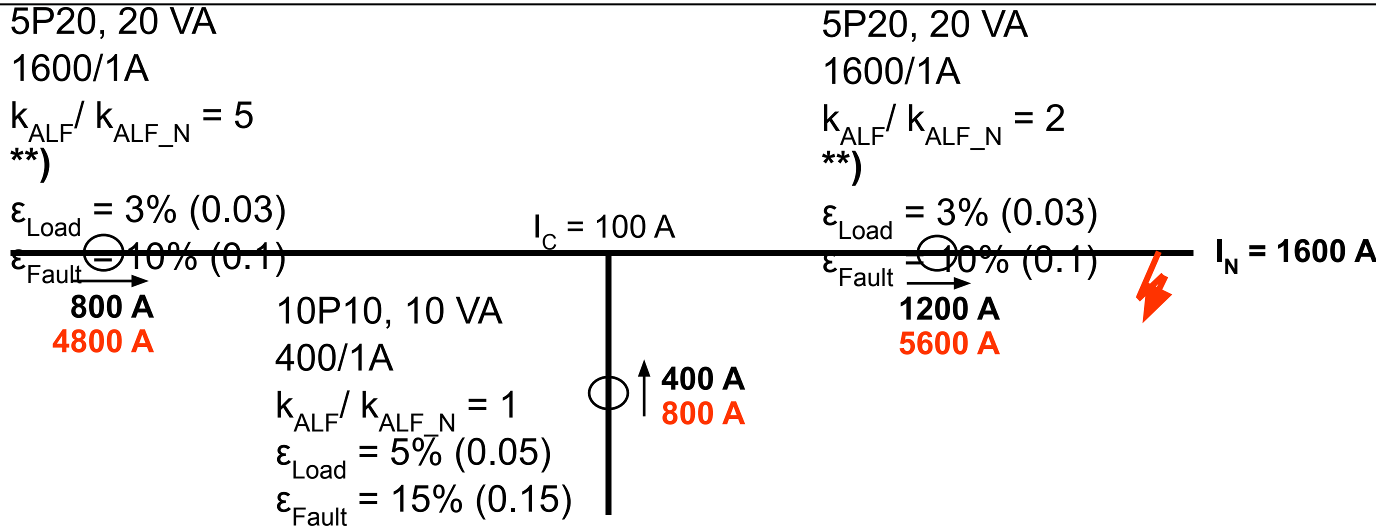
- Rated burden connected at the Ct´s
- Less then rated burden connected (k_{ALF}/k_{ALF_N} = 2)



Classical: $I_{Diff} = 0.3 + 0.25 \cdot I_{Rest} = 0.3 + 0.25 \cdot 2 = 0.8$ (sensitivity under full load)
New: $I_{Diff} = 0.3 + 0.05 \cdot I_{Rest} = 0.3 + 0.05 \cdot 2 = 0.4$ (double sensitivity under full load)

I_{Diff}>: Example 1: Adaptive (self-) restraining

SIEMENS



**) Settings for this example.
In a real case both settings would be 1.5

I_{Diff}> = Differential-Setting = 2.5 · I_C = 250 A
ΔI_{Rest} = I_{Diff}> + sum of estimated Ct- errors
I_{Diff} = Differential current due to vector summation of the individual currents

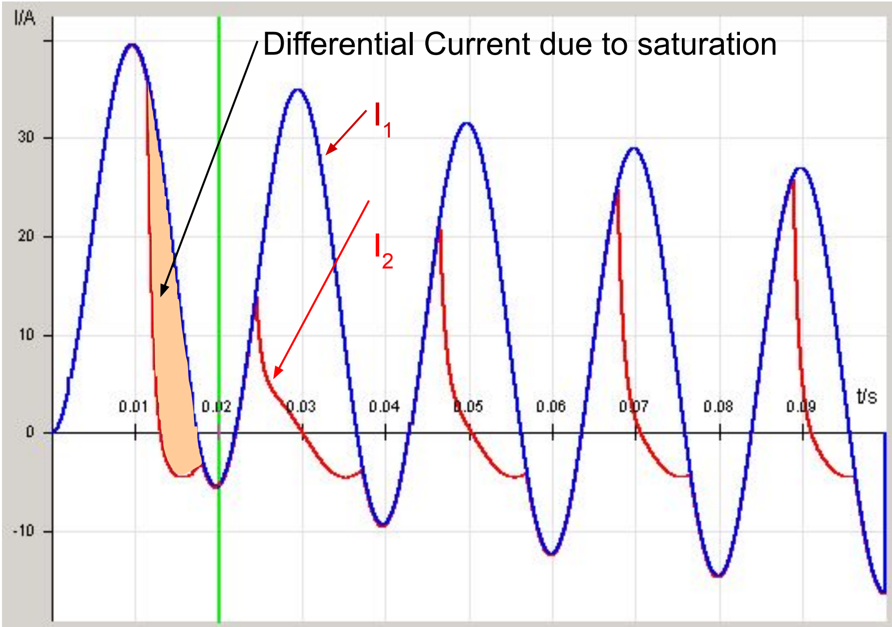
<u>Case 1</u> (normal operation)

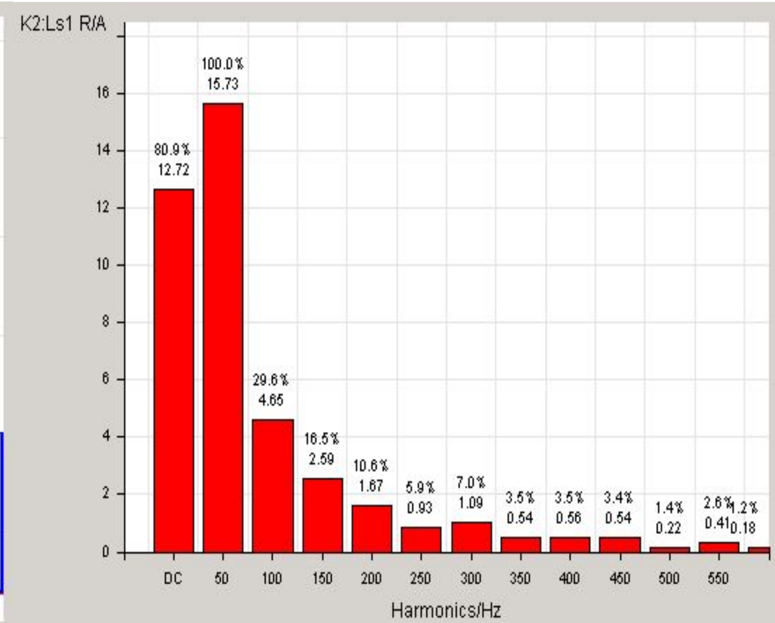
ΔI_{Rest} = 2.5·100A + 0.03·800A + 0.03·1200A + 0.05·400A = 330A — **ΔI_{Rest} / I_N = 0.206**
I_{Diff} = 100 A (=I_C) — **I_{Diff} / I_N = 0.0625**

<u>Case 2</u> (External Fault)

ΔI_{Rest} = 2.5·100A + 0.03·4800A + 0.1·5600A + 0.15·800A = 1074A — **ΔI_{Rest} / I_N = 0.671**
I_{Diff} = 40 A (due to lower voltage) — **I_{Diff} / I_N = 0.025**

I_{Diff}>: CT- saturation detector based on harmonic analysis of the current wave form - Signal analysis

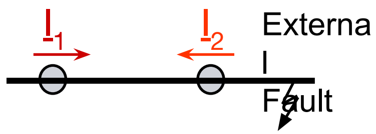


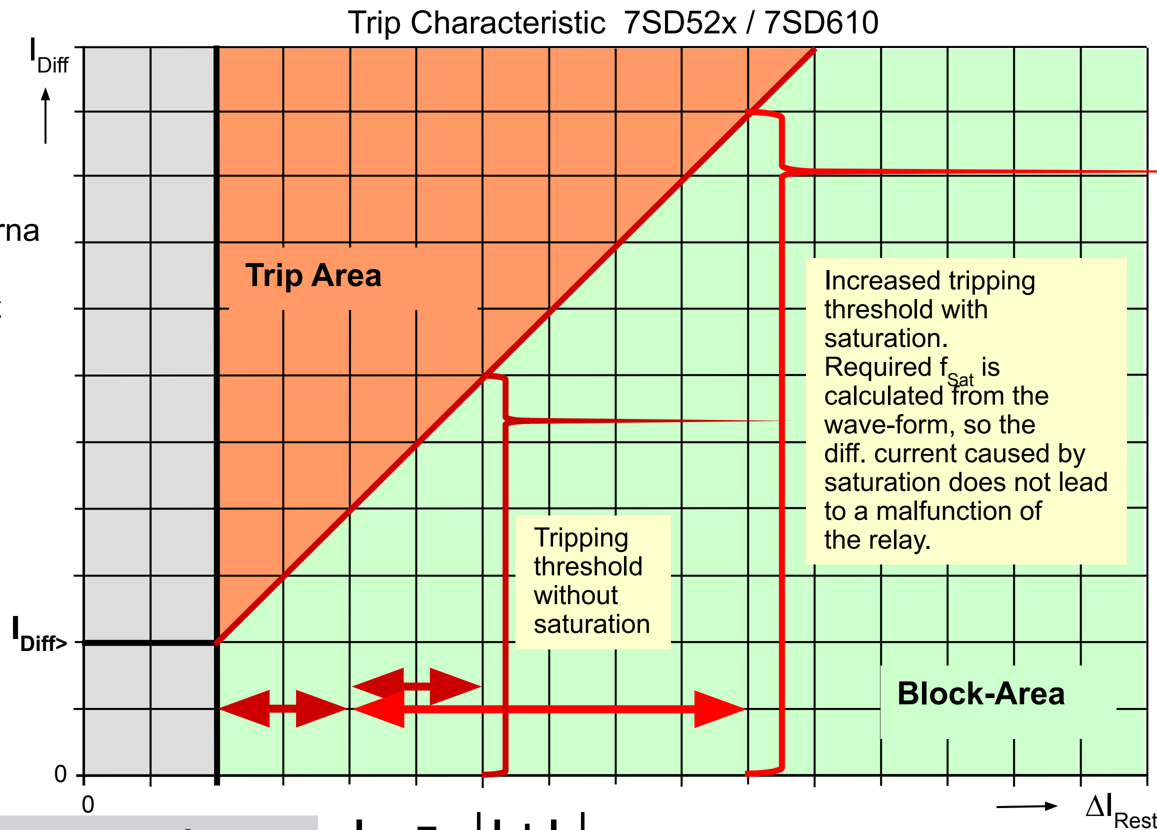


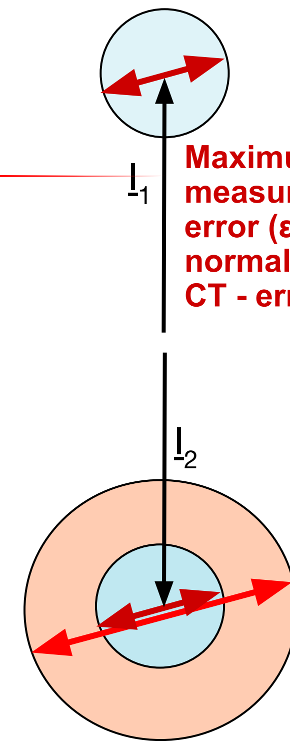
- Wave form detector recognize saturation from DC, f_2, f_3, f_4, f_5…. rated to the fundamental f_1
  Factor = 1 - no saturation
  Factor > 1 - saturation □Increase of CT- error with a factor f_{Sat}.
  Results in higher restraint current.
  More differential current is required for tripping.

I_{Diff}>: Adaptive differential relaying
Consideration of nonlinear CT- errors due to saturation

SIEMENS







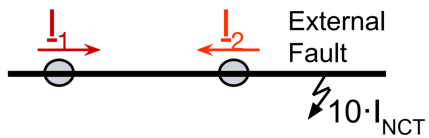
Current summation: $I_{Diff} = |\underline{I}_1 + \underline{I}_2|$

Max. error summation: $I_{Error} = \Delta I_{Rest} = I_{Diff>} + \varepsilon_{CT1} \cdot I_1 + f_{Sat} \cdot \varepsilon_{CT2} \cdot I_2$

Trip, if differential current exceeds the estimated error (= increased restraint)

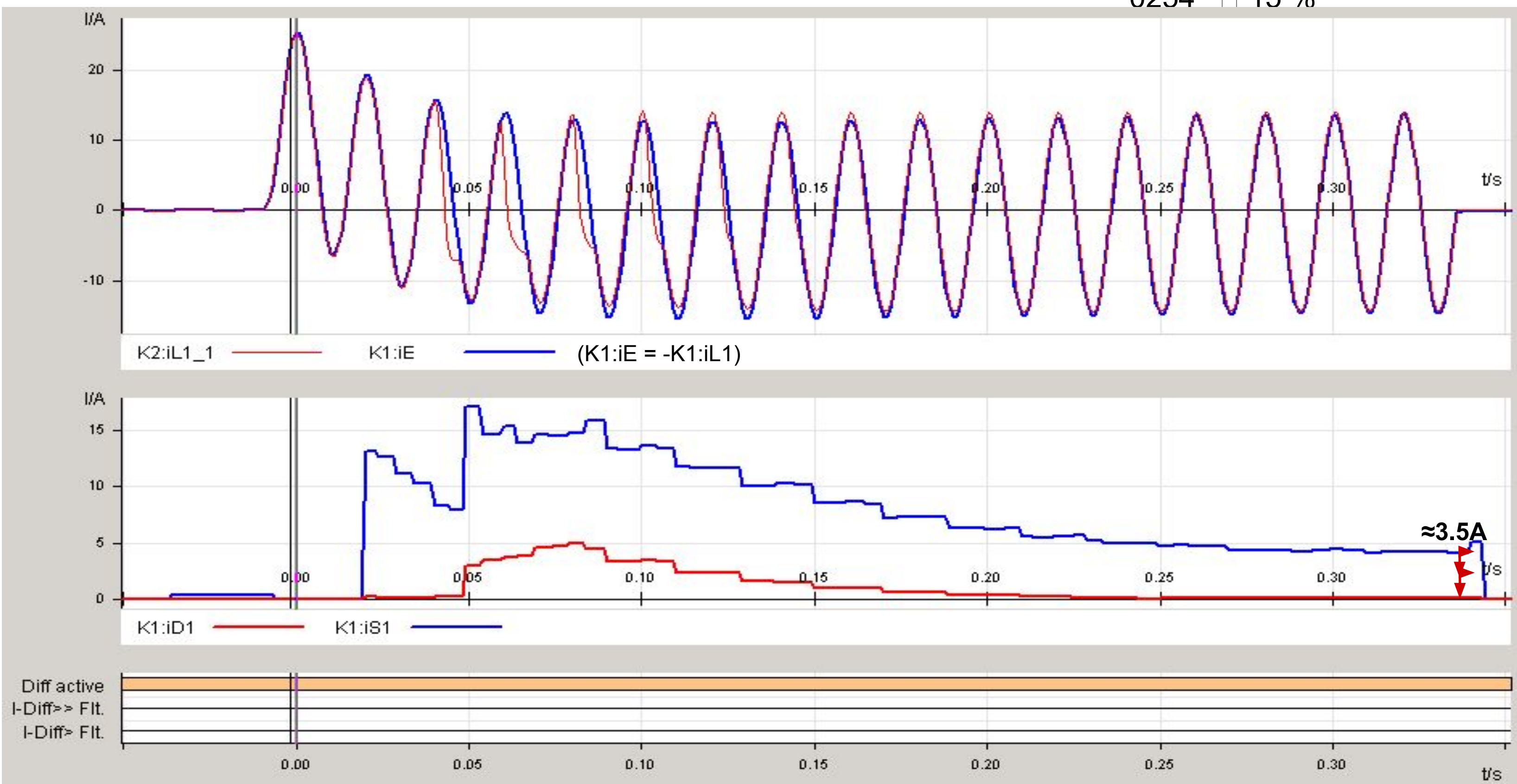
I_{Diff}>: Test: max. asymmetrical offset , Ct saturation

SIEMENS



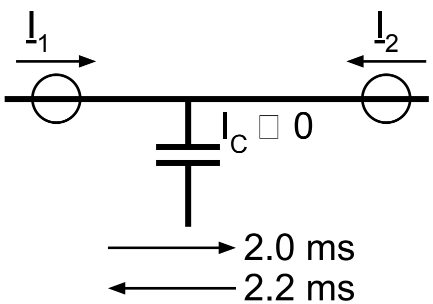
Settings: 1210/13 □ 0.30 A

0251 □ 1.0
0253 □ 5 %
0254 □ 15 %



I_{Diff}>: Adaptive consideration of a <u>permanent</u> time difference in transmit- and receive direction

SIEMENS



Average delay 2.1 ms

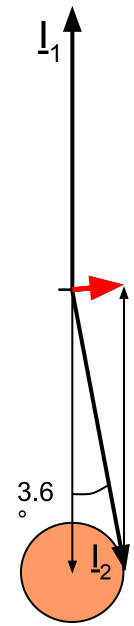
$$\Delta\Phi_{sync} \approx \frac{\Delta t \cdot 360°}{20ms} \rightarrow (50Hz)$$

$$\text{here}: \Delta\Phi_{sync} \approx \frac{0.2ms \cdot 360°}{20ms} = 3.6°$$

$$= \frac{3.6° \cdot 2\pi}{360°} = 0.06283$$

$$\Delta I_{sync} \approx \Delta\Phi_{sync} \cdot |\underline{I}_{sync}| \approx \Delta\Phi_{sync} \cdot |\underline{I}_2|$$

(For more details:
refer to 7SD52 Synchronisation)



ΔI_{sync} due to different times in transmit- and receive direction

Protection Interface (Port D+E) - Settings Group A

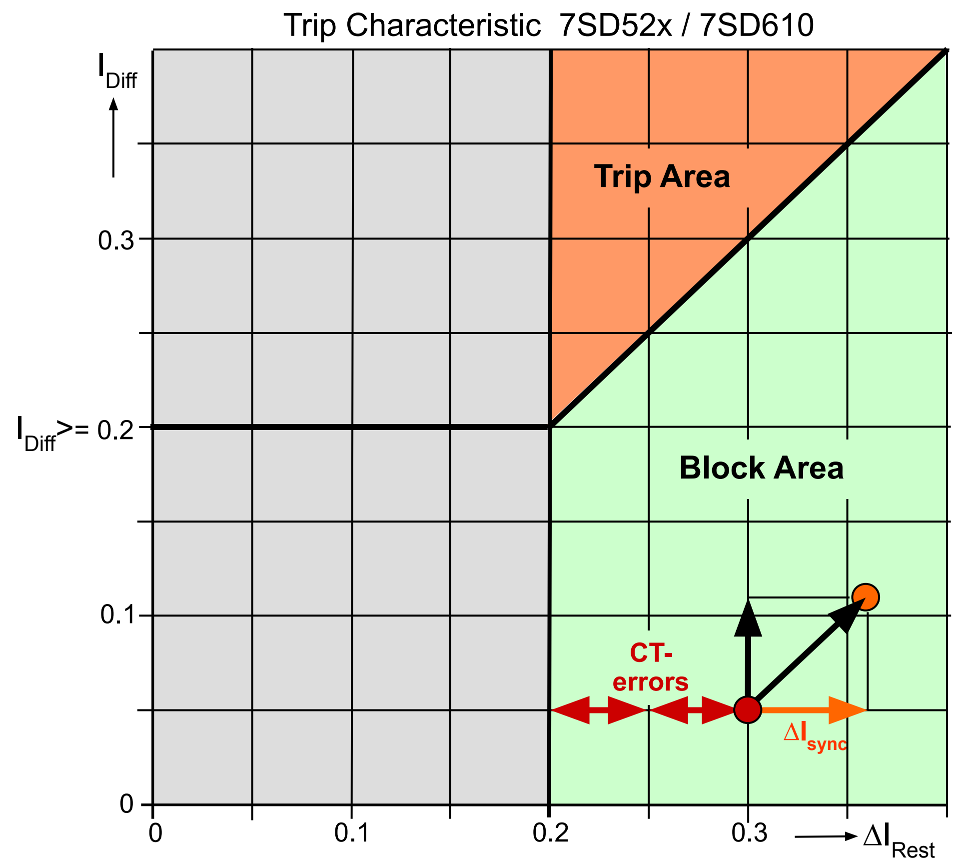
General | Interface 1 | GPS

Customize:

No.	Settings	Value
1501	State of protection interface 1	ON
1502	Connection 1 over	Communication converter with 64 kBit/s
1505A	Prot 1: Maximal permissible delay time	30.0 ms
1506A	Prot 1: Diff. in send and receive time	0.200 ms

I_{Diff}>: Adaptive consideration of a permanent time difference. Total "Restraint Current"

SIEMENS



Diff. current:: $I_{Diff} = I_C + \Delta I_{sync}$

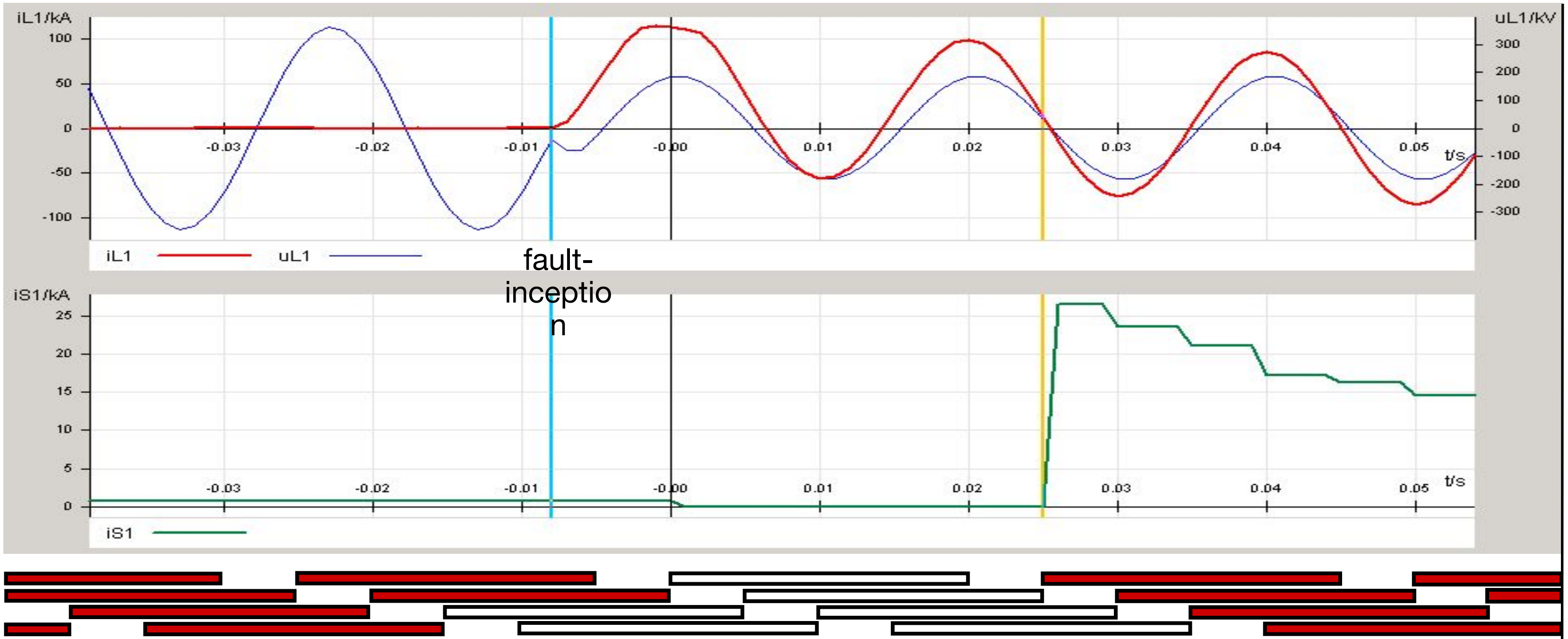
Rest. current: $\Delta I_{Rest} = I_{Diff}> +$ CT-errors + ΔI_{sync}

Total "Restraint Current":

$$\Delta I_{Rest} = I_{Diff}> + f_{Sat1} \cdot \varepsilon_{CT1} \cdot I_1 + f_{Sat2} \cdot \varepsilon_{CT2} \cdot I_2 + \Delta I_{sync}$$

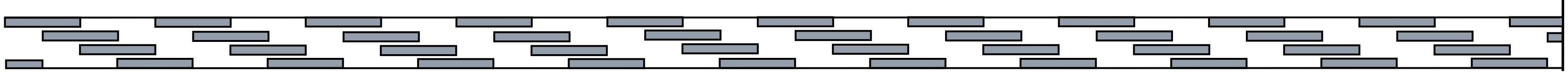
I_{Diff}>: Sliding data windows after fault inception

SIEMENS



20 ms Vector comparison (I_{Diff}>) data windows

After fault inception the I_{Diff}> step will set it's values for several data windows to zero, <u>but does not block</u>!



5 ms Fast current comparison (Q_{Diff}) data windows

I_{Diff}>> (Q_{Diff}) : Fast current comparison

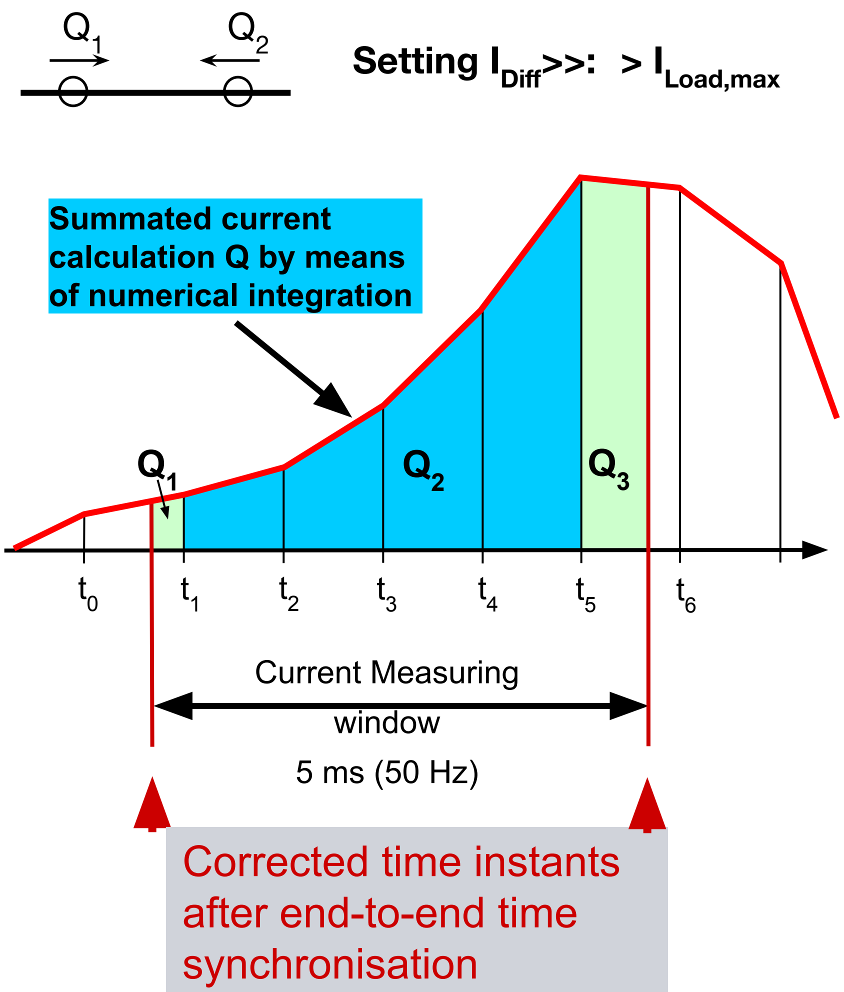
SIEMENS

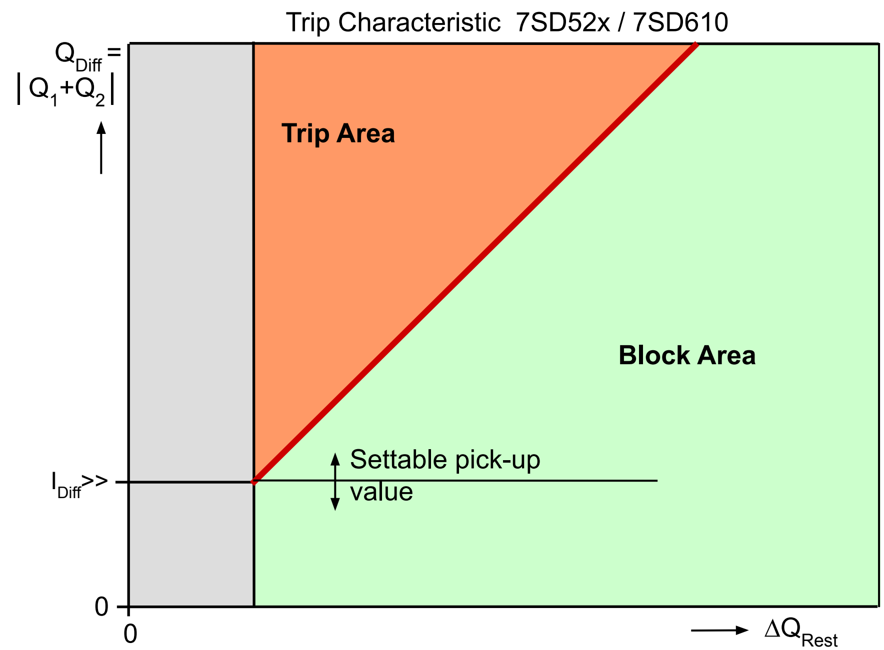
<u>Fast Current comparison</u> offers high speed tripping and a fast decision for internal or external fault condition

- Current comparison step doesn't suppress DC-components and harmonics. (simple integration)
  Therefore recommended setting is > $I_{Load,max}$ (1.2 - 2 I_N).
- Current comparison decides in 5 ms for internal or external faults (5 ms window)
  <u>Internal</u>: Immediate trip command (trip time typical 12 ms for 2 or 3 end topology) for differential currents I_{Diff} > 1.2 - 2 I_N
  <u>External</u>: If I_{Fault} > 2.5·I_{Diff}>> setting: immediate **blocking** of the current comparison.
  Reason: CT-saturation possible. Avoids any risk for stability due to differential current from current comparison.

I_{Diff}>> (Q_{Diff}) : Fast current comparison algorithm (Basic principle)

SIEMENS



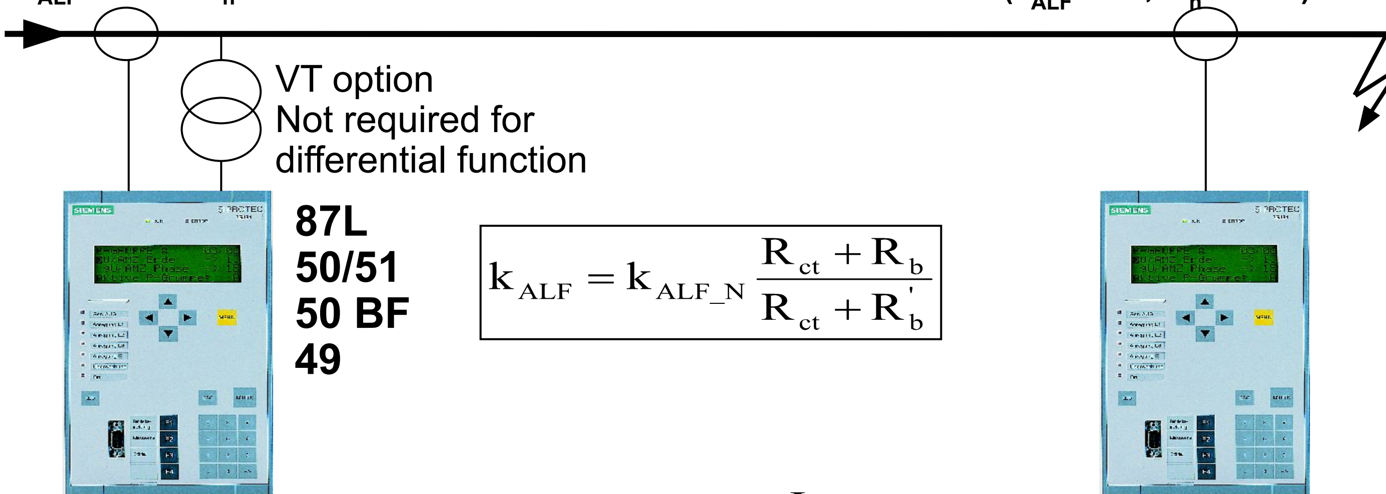


Calculated restraint values from CT-errors (always higher CT-error is taken).
Similar principal as vector comparison for restraint current calculation.

CT- requirements, mismatch of the primary CT currents

1200/1A, 10P10, 10VA
R_{ct} = 2.5Ω, R'_b = 1.1Ω
(k_{ALF} = 34.7, k'_n = 8.33)

150/5A, 5P20, 50VA
R_{ct} = 0.25Ω, R'_b = 0.4Ω
(k_{ALF} = 69, k'_n = 66.6)



$$k_{ALF} = k_{ALF\_N} \frac{R_{ct} + R_b}{R_{ct} + R'_b}$$

I_P = 10 kA

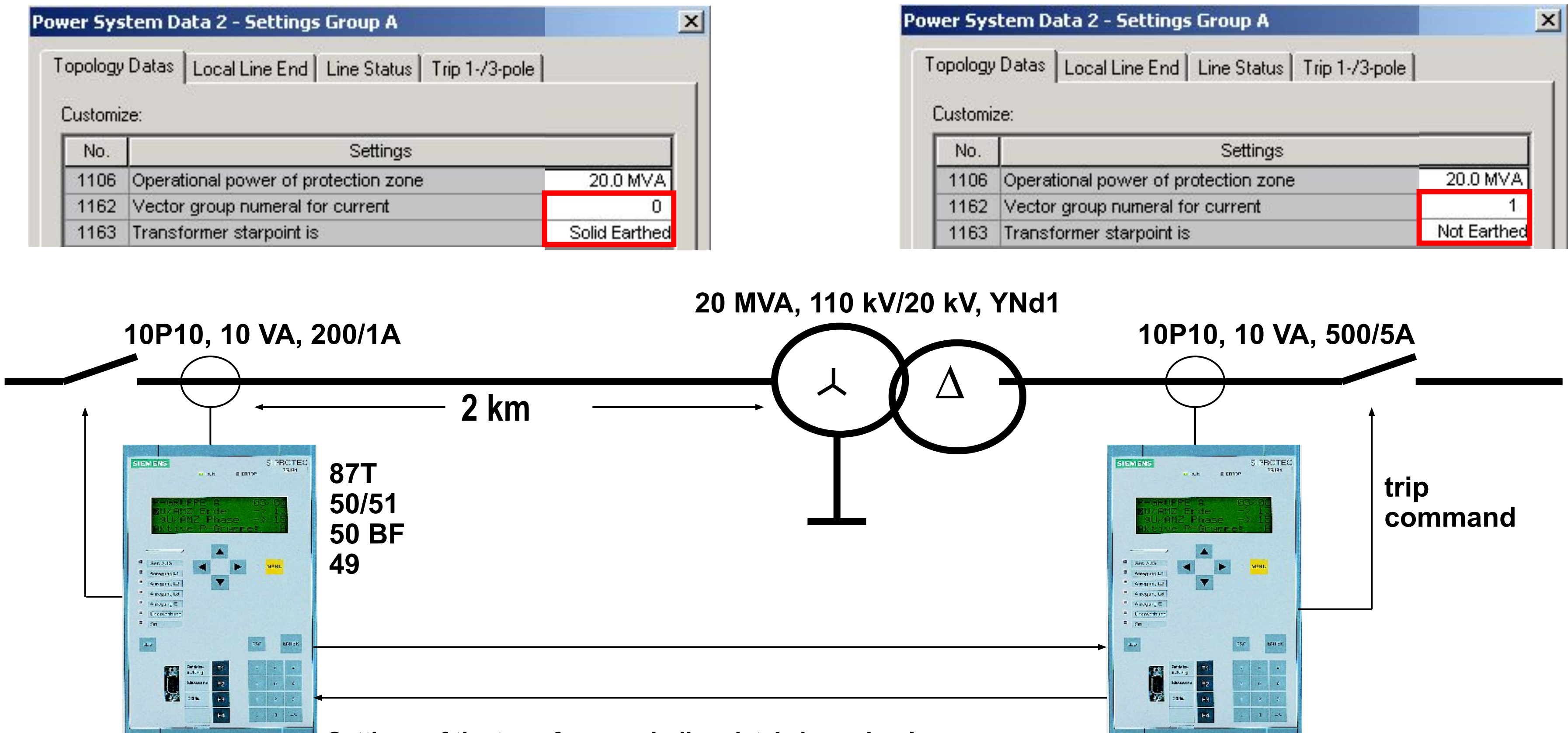
$$k'_n = \frac{I_P}{I_{NCTprim}}$$

I_P = Primary Symmetrical Short circuit Current

- Mismatch of the primary CT currents: $\frac{I_{CTprim(max)}}{I_{CTprim(min)}} \leq 8$
- 1A or 5A input selectable in the relay
- CT data's / errors are set in the relay and automatically considered in the restraint current calculation
- CT-requirements:
  1st condition: $k_{ALF} > k'_n$
  2nd condition: $k_{ALF} \geq 30$ **or** ¼ AC cycle saturation free time (5ms for 50Hz)

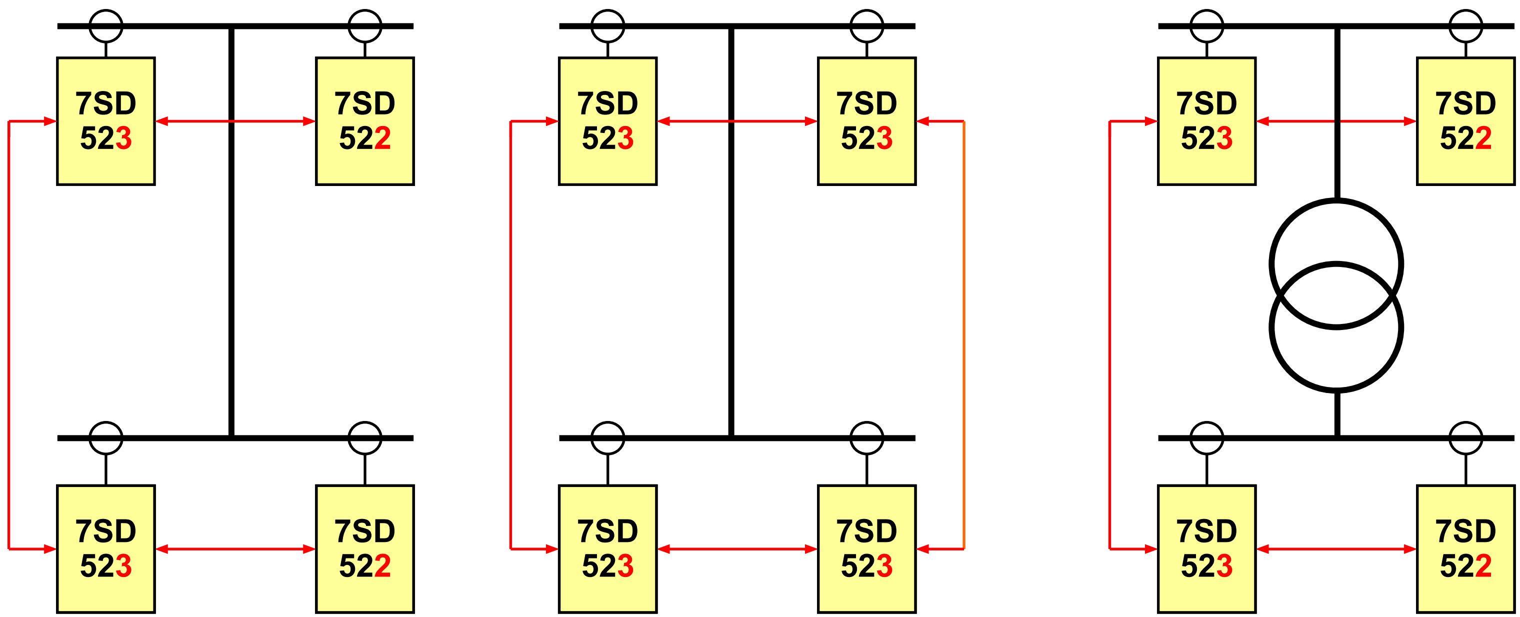
Application - Transformer and line/cable in the protection zone

SIEMENS



- Settings of the transformer winding data's in each relay with vector group matching, ratio adaptation and zero sequence elimination
- Differential set point is rated to the nominal current of the transformer
- Inrush restraint with second harmonic included (time limit for Cross block)
- High set element for immediate trip (12 ms) through heavy internal fault currents

Examples for different Topologies



Chain topology with line in the protected zone

Ring topology with line in the protected zone

Chain topology with transformer in the protected zone

Relay to Relay Communication Designed for the use of Digital Communication Networks and FO [1)]

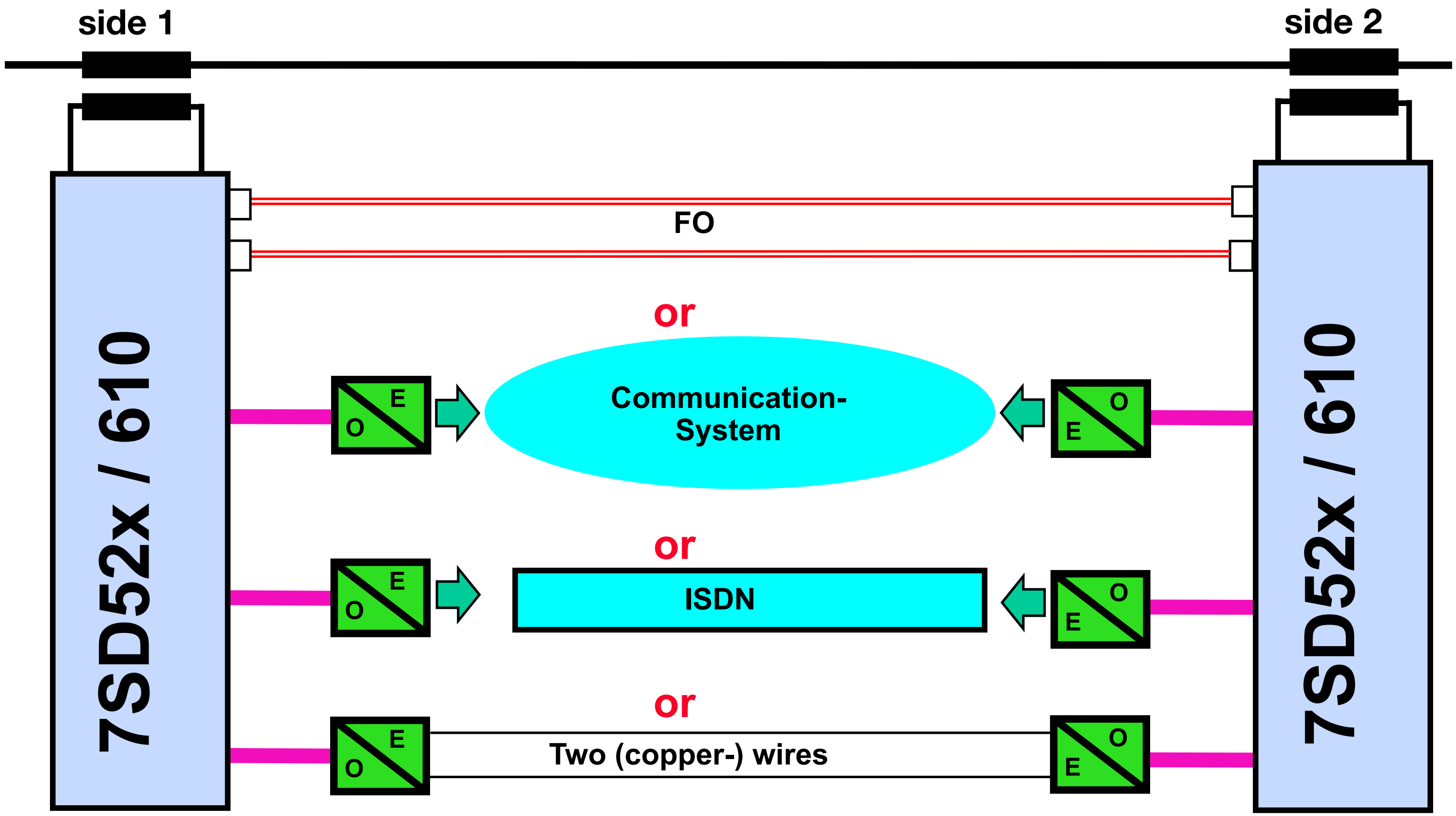
[1)] Fibre optic cables

Main features of the relay to relay communication

- **Synchronous data exchange with HDLC- protocols**
  Very save through 32 bit CRC-checksum
- **Permanent supervision of the data transmission**
  Indication of disturbances and loss of connection
- **Measurement and compensation of the telegram delay time**
  Max. 30 ms per connection, automatic adaptation in that range
  Immediate detection of delay time changes through switching effects
- **Monitors availability of the data connection**
- **Easy settings according the data link (FO or comms-system)**
  (N·64 kBit/s, N settable from 1 - 8 for comms-system, N=8 for FO)
- **Communication device addresses**
  Protection devices are clearly assigned to a defined protection section. Each relay knows the addresses of remote.
- **Detection of reflected telegrams in a loop back in a comms- network -** Immediate blocking of 87L function
- **Option: Microsecond exact time synchronisation via GPS 1s pulse input**
  Independent measurement of transmit and receive delay time
  Hardware prepared for this feature

Relay to Relay Communication (Overview)

SIEMENS

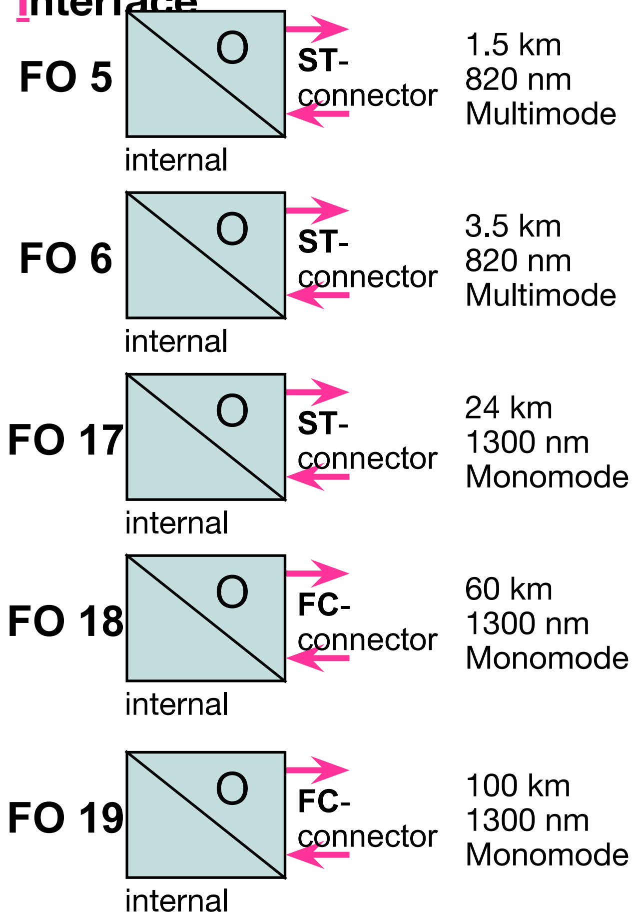


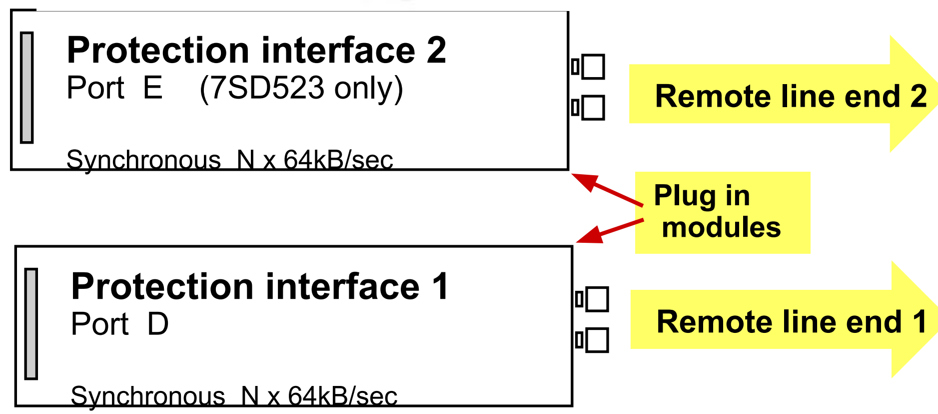
Communication according existing possibilities, the relay remains the same !

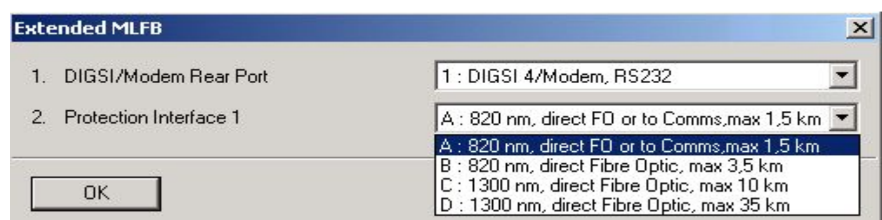
Relay to Relay Communication
- Communication modules, Protection Interface (PI)

SIEMENS

Options for the Protection Interface






Extended MLFB

1. DIGSI/Modem Rear Port — 1 : DIGSI 4/Modem, RS232
2. Protection Interface 1 — A : 820 nm, direct FO or to Comms,max 1,5 km

A : 820 nm, direct FO or to Comms,max 1,5 km
B : 820 nm, direct Fibre Optic, max 3,5 km
C : 1300 nm, direct Fibre Optic, max 10 km
D : 1300 nm, direct Fibre Optic, max 35 km

OK

Relay to Relay Communication
- Communication converter

FO – Communication Net
7XV5662-0AA00

FO 5 820nm → E/O → X.21 or G703.1

FO - ISDN
7XV5662-0AB00

FO 5 820nm → E/O → ISDN

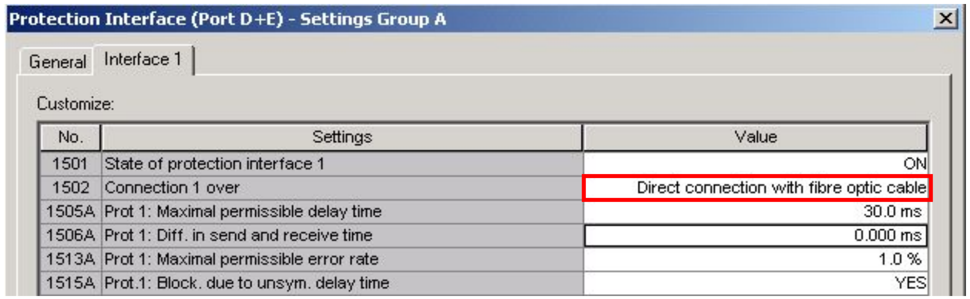
FO – Copper wires
7XV5662-0AC00

FO 5 820nm → E/O → Copper

Relay to Relay Communication
- Application: Fibre optic connection

<u>Direct connection with fibre optic (FO) cables</u>

- Offers high speed tripping (12 ms), baud rate is 512 kBit/s
- Flexible plug in modules for different fibre cables or distances

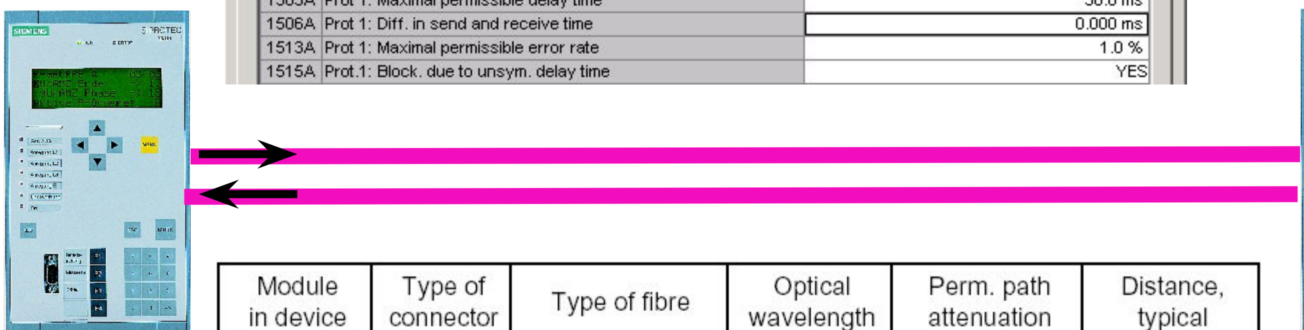


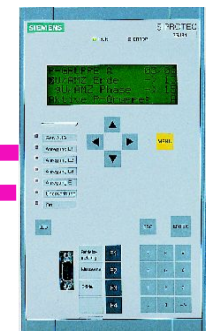
Protection Interface (Port D+E) - Settings Group A

General | Interface 1

Customize:

No.	Settings	Value
1501	State of protection interface 1	ON
1502	Connection 1 over	Direct connection with fibre optic cable
1505A	Prot 1: Maximal permissible delay time	30.0 ms
1506A	Prot 1: Diff. in send and receive time	0.000 ms
1513A	Prot 1: Maximal permissible error rate	1.0 %
1515A	Prot.1: Block. due to unsym. delay time	YES



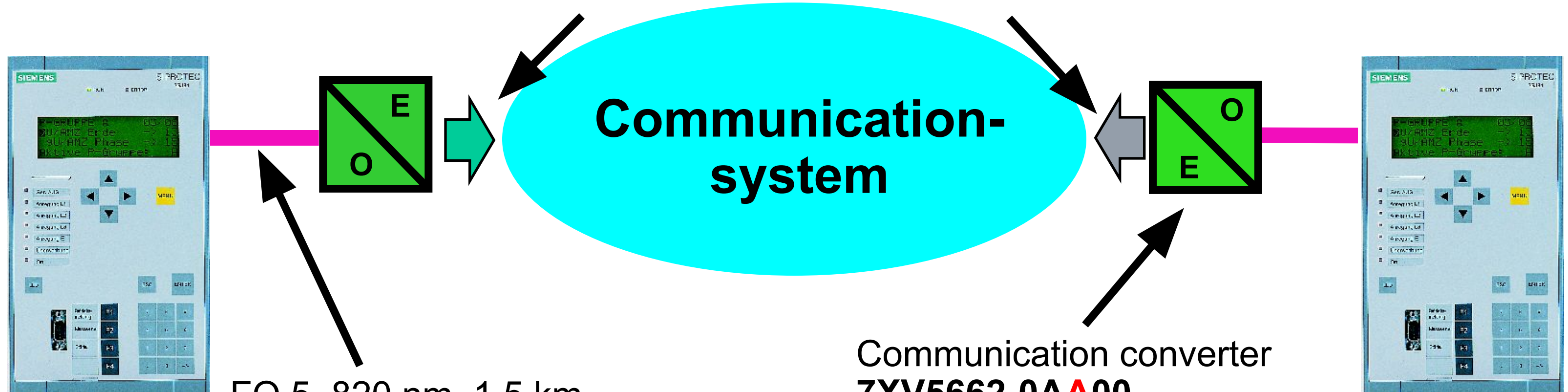


Module in device	Type of connector	Type of fibre	Optical wavelength	Perm. path attenuation	Distance, typical
FO5 1)	ST	Multimode 62.5/125 µm	820 nm	8 dB	1.5 km 0.95 miles
FO6 2)	ST	Multimode 62.5/125 µm	820 nm	16 dB	3.5 km 2.2 miles
FO7 2)	ST	Monomode 9/125 µm	1300 nm	7 dB	10 km 6.25 miles
FO8 2)	FC	Monomode 9/125 µm	1300 nm	18 dB	35 km 22 miles

Relay to Relay Communication
- Application: Digital communication network

Connection via a communication system with multiplexers
- Automatic delay time measurement (adaptive correction from 0 ms - 30 ms)
- Immediate detection of split-path condition in the transmit or receive path
- Communication addresses clearly identify the relays

Synchronous electrical interface
X.21 (64/128/512 kBit/s) or G703.1 (64 kBit/s)



FO 5, 820 nm, 1.5 km

Communication converter
7XV5662-0AA00

Protection Interface (Port D+E) - Settings Group A

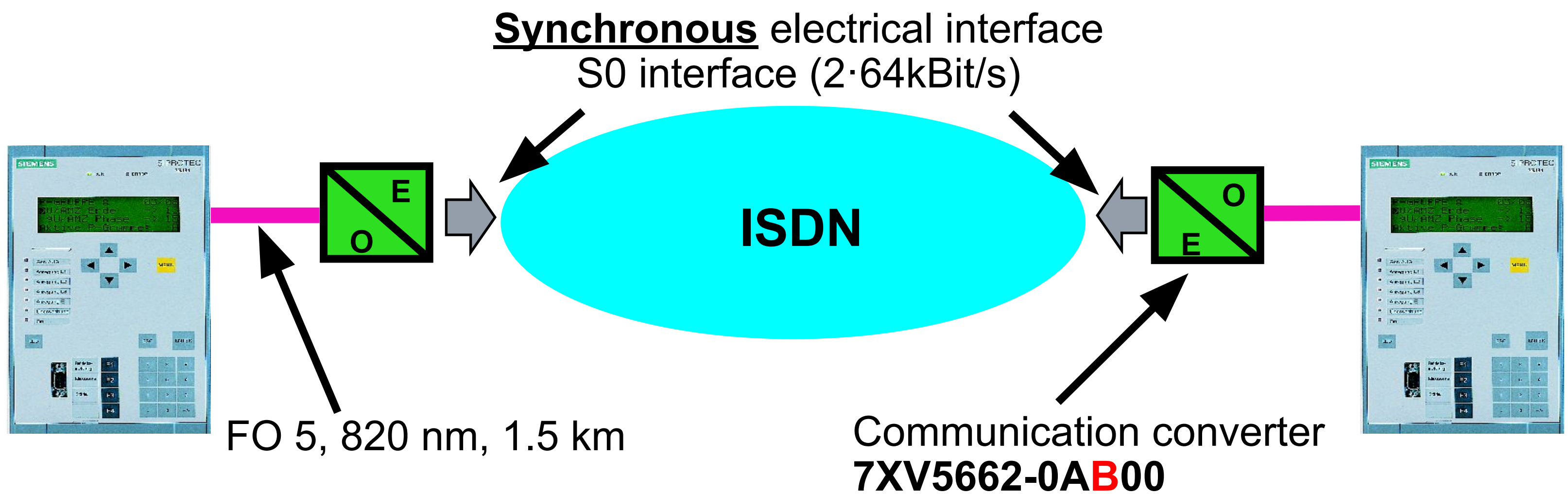
General | Interface 1

Customize:

No.	Settings	Value
1501	State of protection interface 1	ON
1502	Connection 1 over	Communication converter with 64 kBit/s
1505A	Prot 1: Maximal permissible delay time	30.0 ms
1506A	Prot 1: Diff. in send and receive time	0.100 ms
1513A	Prot 1: Maximal permissible error rate	1.0 %
1515A	Prot.1: Block. due to unsym. delay time	YES

Relay to Relay Communication
- Application: ISDN network

<u>Connection via an ISDN Network</u>
- Automatic delay time measurement (adaptive correction from 0 ms - 30 ms)
- Immediate detection of split-path condition in the transmit or receive path
- Communication addresses clearly identify the relays



Protection Interface (Port D+E) - Settings Group A

General | Interface 1

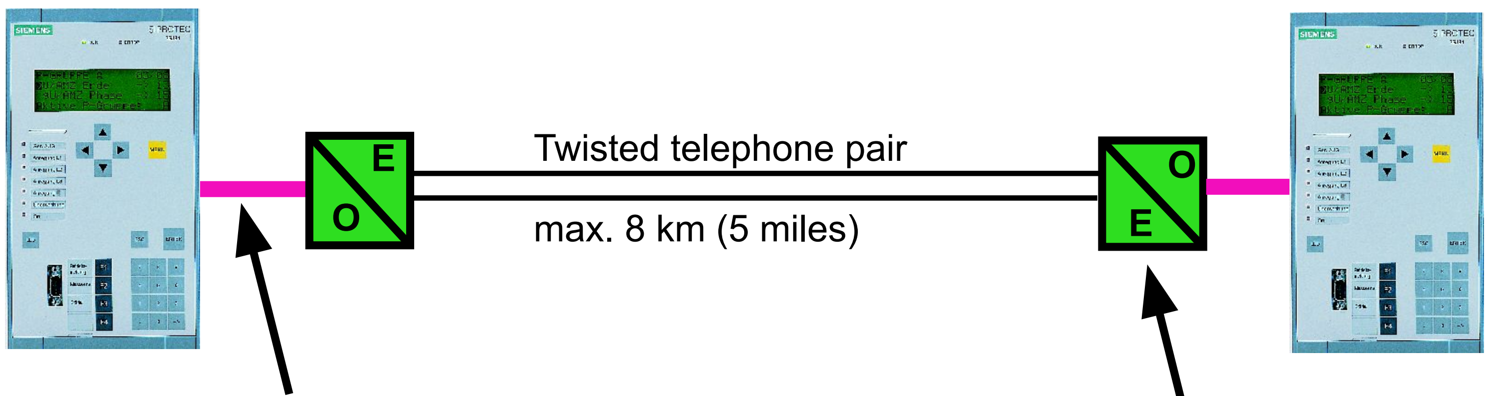
Customize:

No.	Settings	Value
1501	State of protection interface 1	ON
1502	Connection 1 over	Communication converter with 64 kBit/s
1505A	Prot 1: Maximal permissible delay time	30.0 ms
1506A	Prot 1: Diff. in send and receive time	0.100 ms
1513A	Prot 1: Maximal permissible error rate	1.0 %
1515A	Prot.1: Block. due to unsym. delay time	YES

Relay to Relay Communication
- Application: Leased telephone line or Pilot wire (1 of 2)

SIEMENS

Leased telephone line (standby or dial-up)
- 2 wire telephone cable (max. 8 km)



FO 5, 820 nm, 1.5 km

Communication converter
7XV5662-0AC00
5 kV insulation integrated,

20 kV Isolation-transformer
7XR9516 available!

Protection Interface (Port D+E) - Settings Group A

General | Interface 1

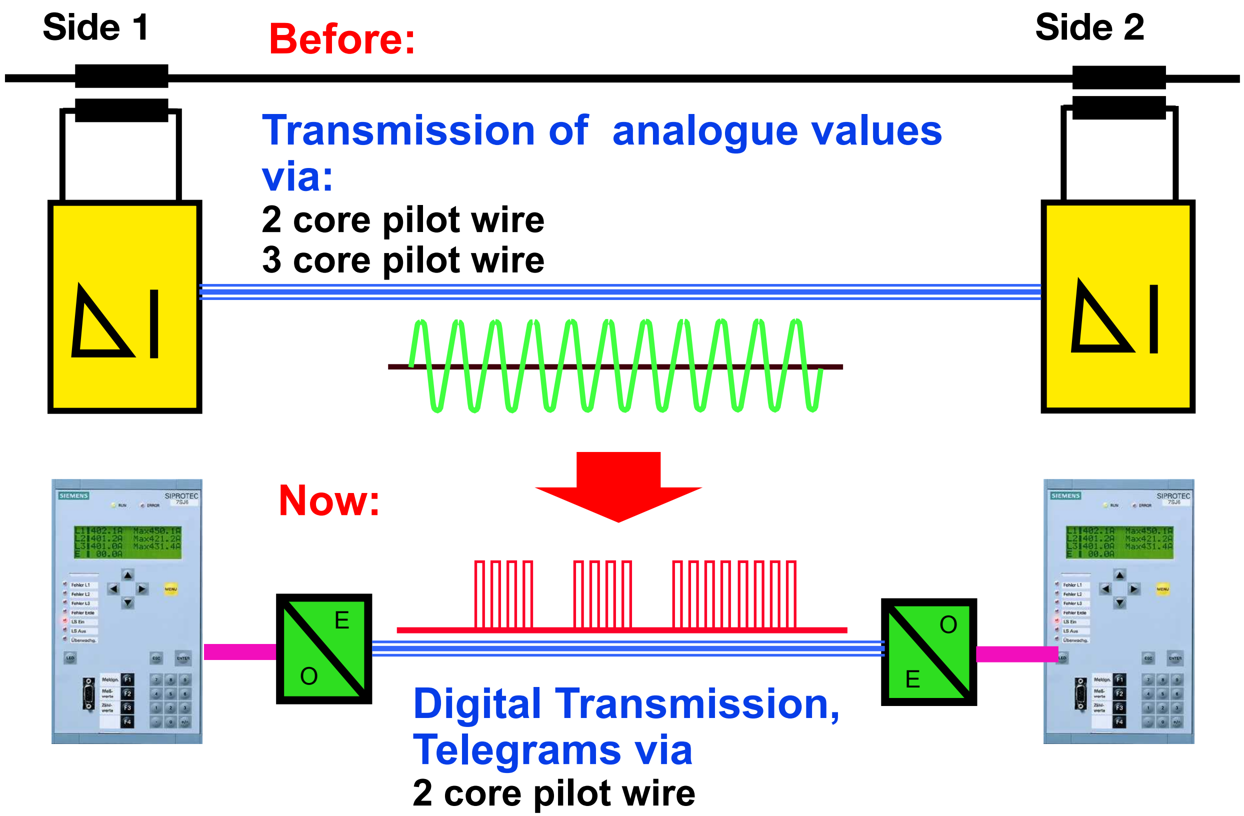
Customize:

No.	Settings	Value
1501	State of protection interface 1	ON
1502	Connection 1 over	Communication converter with 128 kBit/s
1505A	Prot 1: Maximal permissible delay time	30.0 ms
1506A	Prot 1: Diff. in send and receive time	0.100 ms
1513A	Prot 1: Maximal permissible error rate	1.0 %
1515A	Prot.1: Block. due to unsym. delay time	YES

Relay to Relay Communication
- Application: Leased telephone line or Pilot wire (2 of 2)

Serial communication

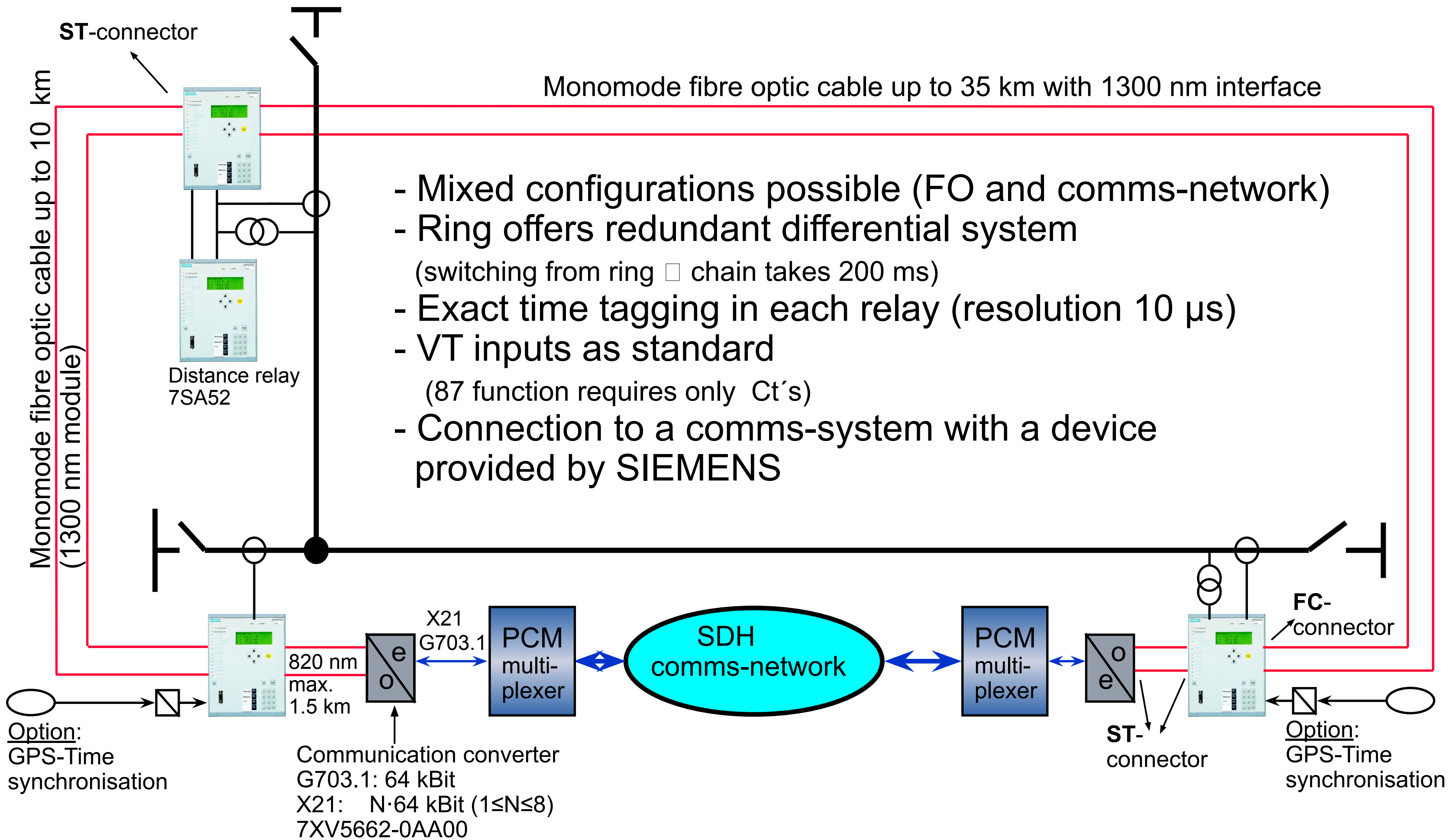
New technology on existing (copper-) connection



Relay to Relay Communication
- Application for a three terminal configuration with 7SD523

SIEMENS

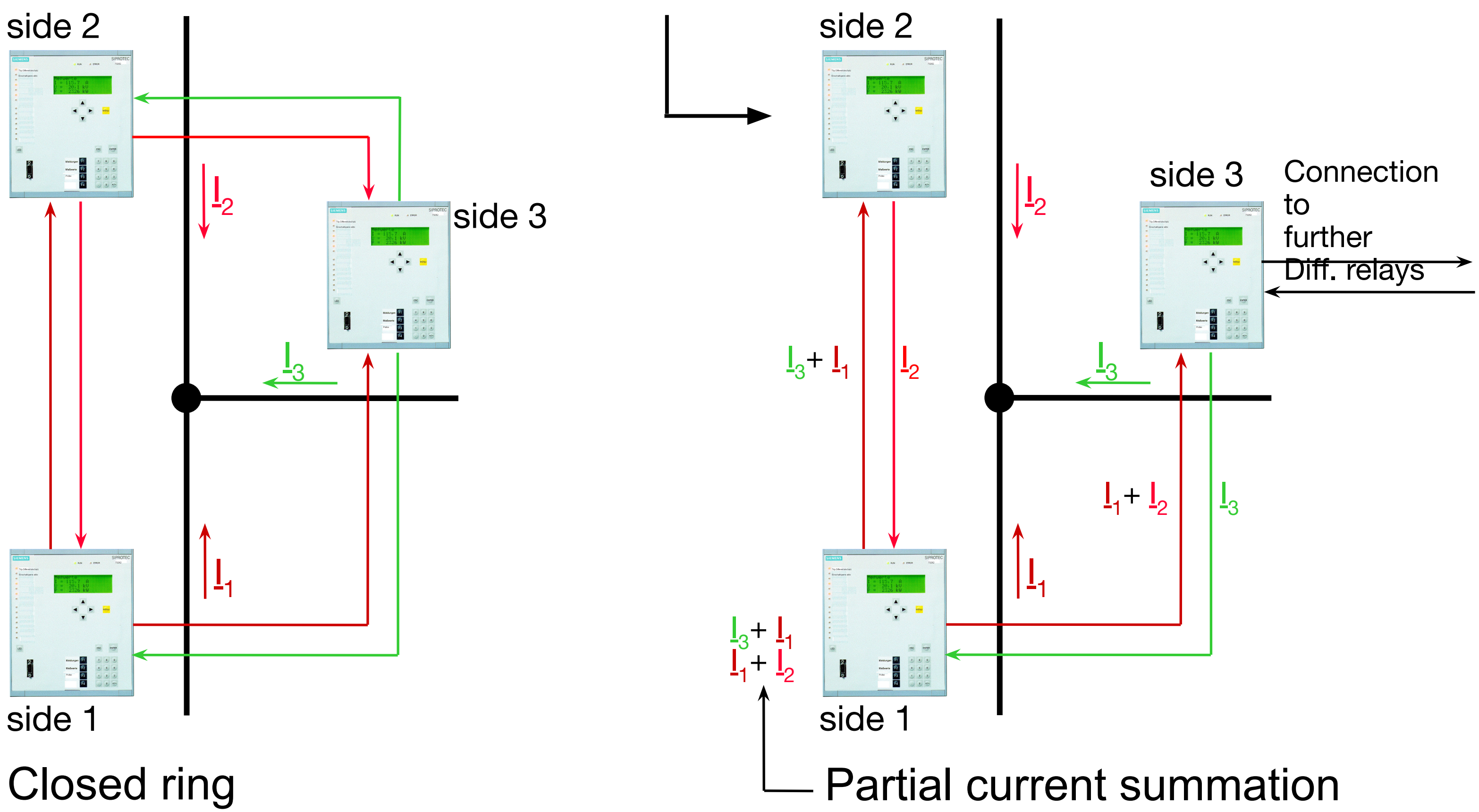
- Mixed configurations possible (FO and comms-network)
- Ring offers redundant differential system
  (switching from ring □ chain takes 200 ms)
- Exact time tagging in each relay (resolution 10 µs)
- VT inputs as standard
  (87 function requires only Ct´s)
- Connection to a comms-system with a device provided by SIEMENS



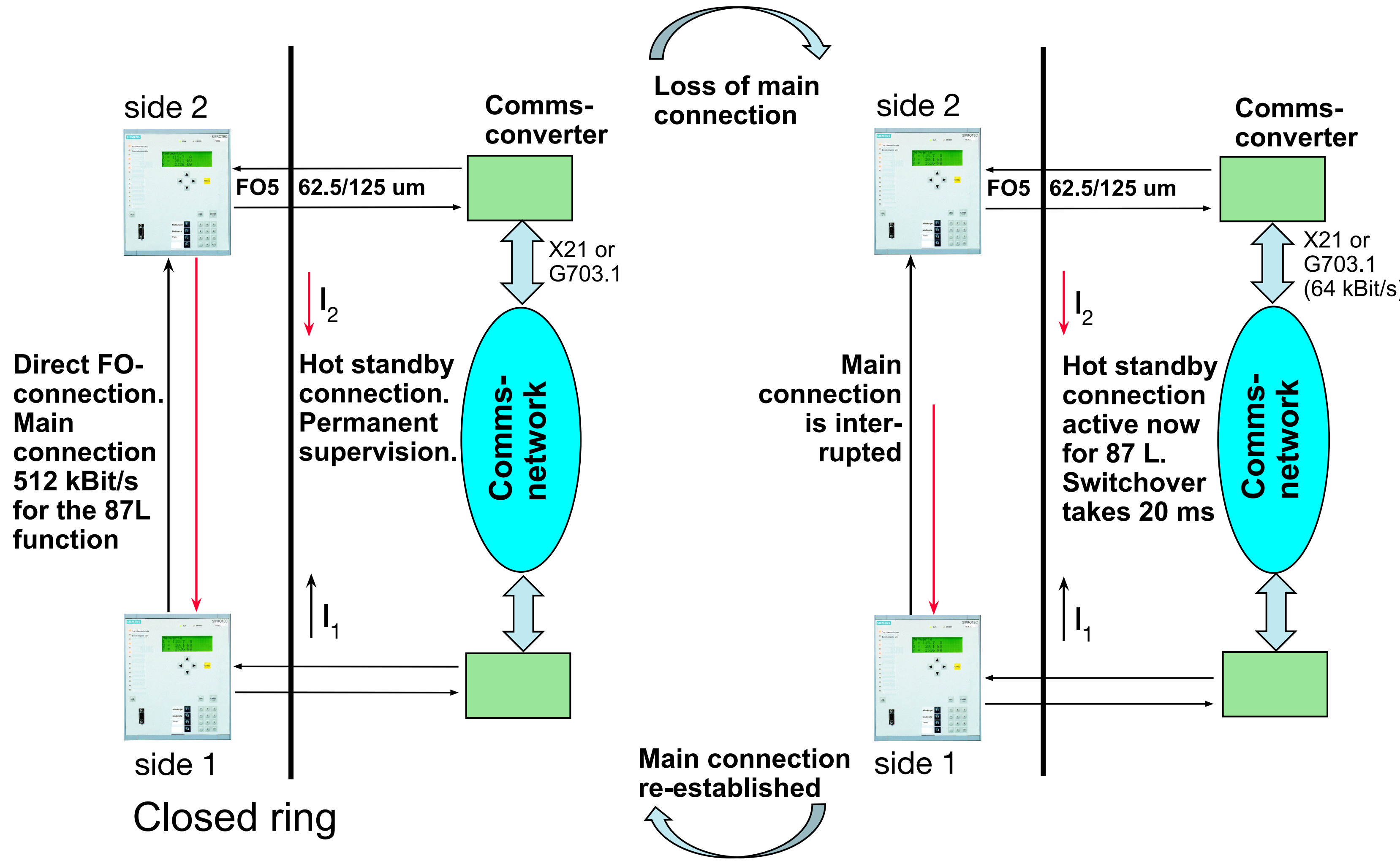
Relay to Relay Communication
- Ring- and Chain topology, loss of one data connection tolerated

SIEMENS

Automatic changeover from closed ring- to chain topology, if case of one connection is lost or not available



Relay to Relay Communication
- Hot- Standby connection in a two terminal configuration



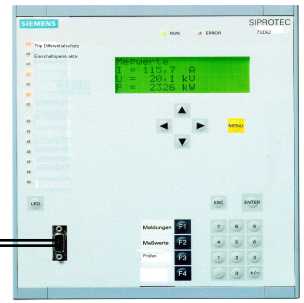
SIEMENS

WEB-Technology

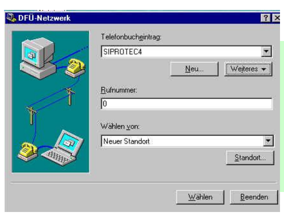
IBS-Tool

Help system in
INTRANET / INTERNET
http://www.siprotec.com

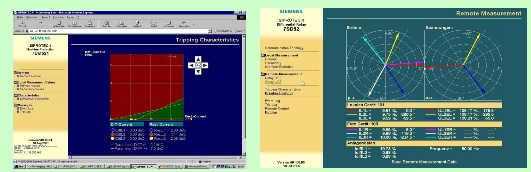
Access to the relay with a WEB Monitor



The homepage of the relay
is:http://141.142.255.150
IP-address is set with DIGSI 4
on front- or rear service port



1. Serial connection
Direct or via modem with a
standard DIAL-UP Network

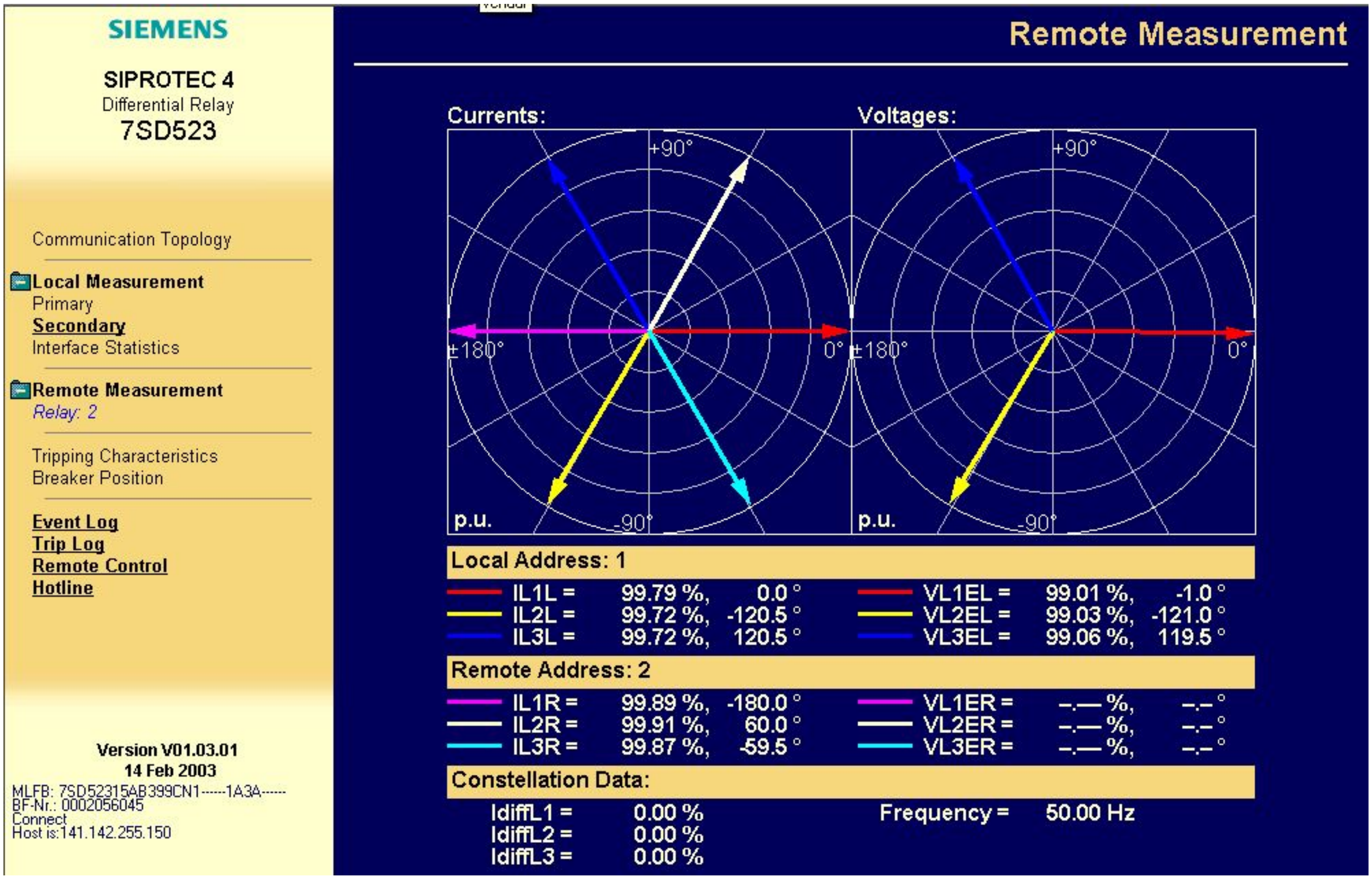


WEB server in the relays firmware

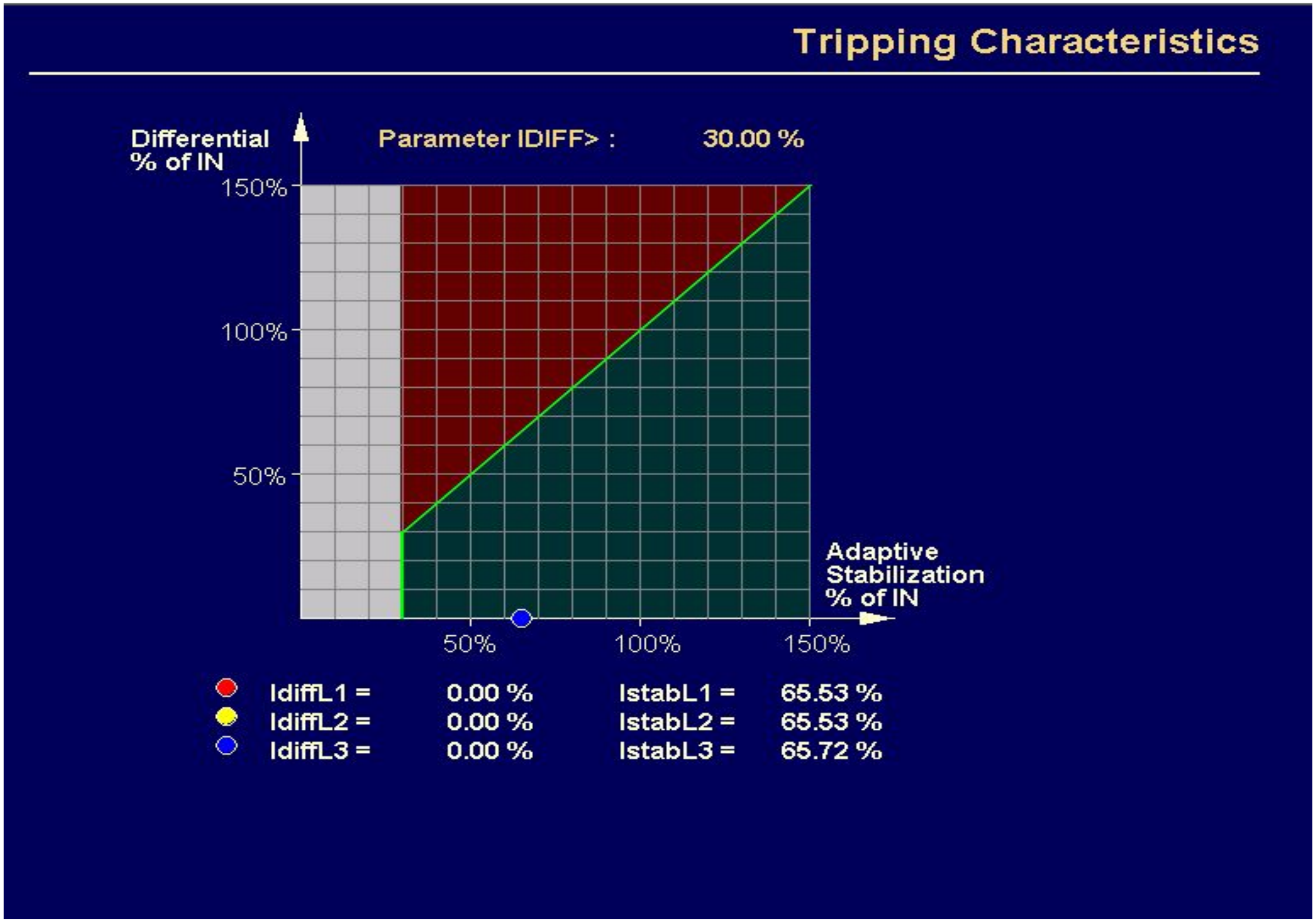
Server sends it´s HTML-pages
and JAVA-code to the WEB Monitor
after a DIAL-UP connection

2. HTML page view in a WEB Monitor
with the IP-address of the relay
http://141.142.255.150

SIEMENS

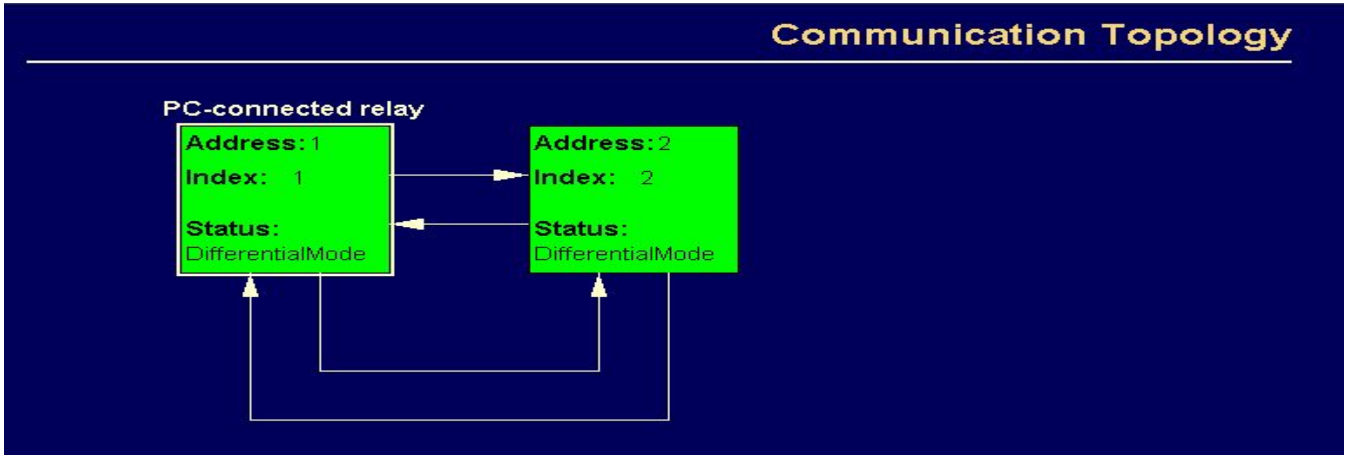

SIEMENS
SIPROTEC 4
Differential Relay
7SD523
Communication Topology
Local Measurement
Primary
Secondary
Interface Statistics
Remote Measurement
Relay: 2
Tripping Characteristics
Breaker Position
Event Log
Trip Log
Remote Control
Hotline
Version V01.03.01
14 Feb 2003
MLFB: 7SD52315AB399CN1------1A3A------
BF-Nr.: 0002056045
Connect
Host is:141.142.255.150
Remote Measurement
Currents:
Voltages:
+90°
±180°
0°
-90°
p.u.
Local Address: 1
IL1L = 99.79 %, 0.0 °
IL2L = 99.72 %, -120.5 °
IL3L = 99.72 %, 120.5 °
VL1EL = 99.01 %, -1.0 °
VL2EL = 99.03 %, -121.0 °
VL3EL = 99.06 %, 119.5 °
Remote Address: 2
IL1R = 99.89 %, -180.0 °
IL2R = 99.91 %, 60.0 °
IL3R = 99.87 %, -59.5 °
VL1ER = -.-- %, -.- °
VL2ER = -.-- %, -.- °
VL3ER = -.-- %, -.- °
Constellation Data:
IdiffL1 = 0.00 %
IdiffL2 = 0.00 %
IdiffL3 = 0.00 %
Frequency = 50.00 Hz

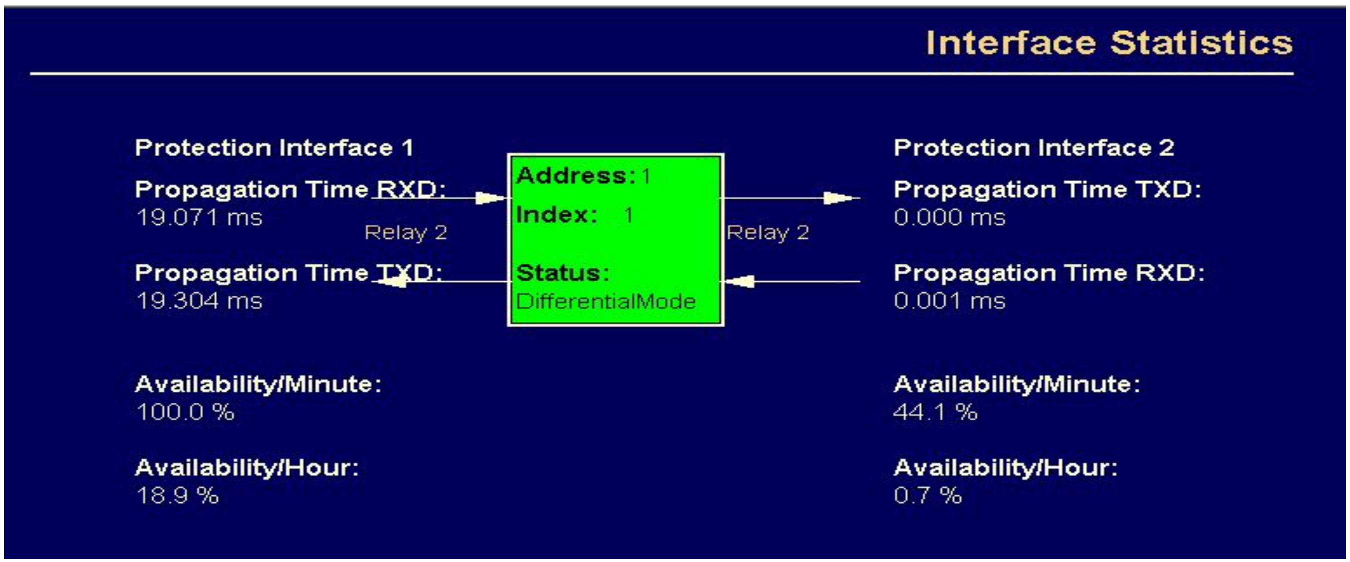
SIEMENS


Tripping Characteristics
Differential
% of IN
Parameter IDIFF> :
30.00 %
150%
100%
50%
Adaptive
Stabilization
% of IN
50%
100%
150%
IdiffL1 =
0.00 %
IstabL1 =
65.53 %
IdiffL2 =
0.00 %
IstabL2 =
65.53 %
IdiffL3 =
0.00 %
IstabL3 =
65.72 %

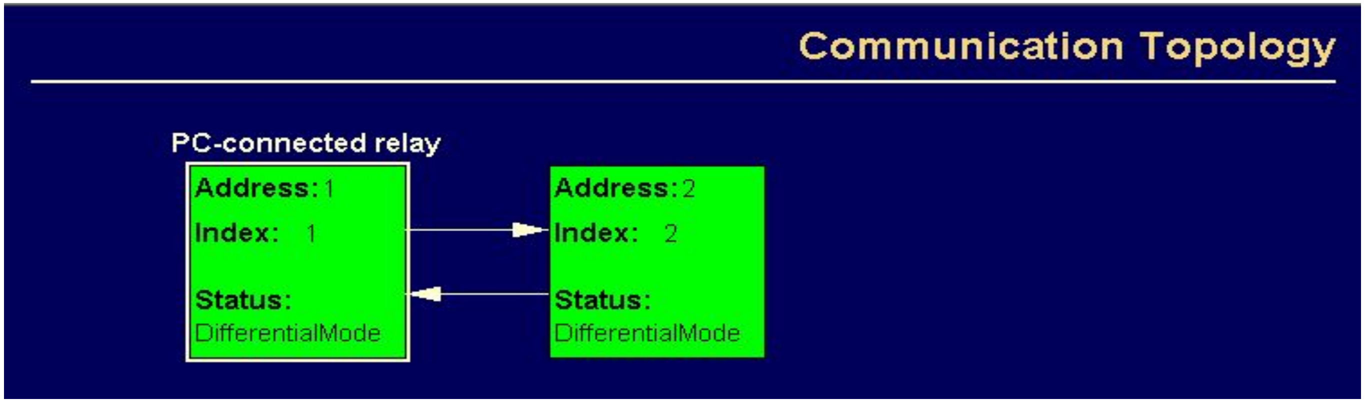
Commissioning and operating aids (4 of 5)

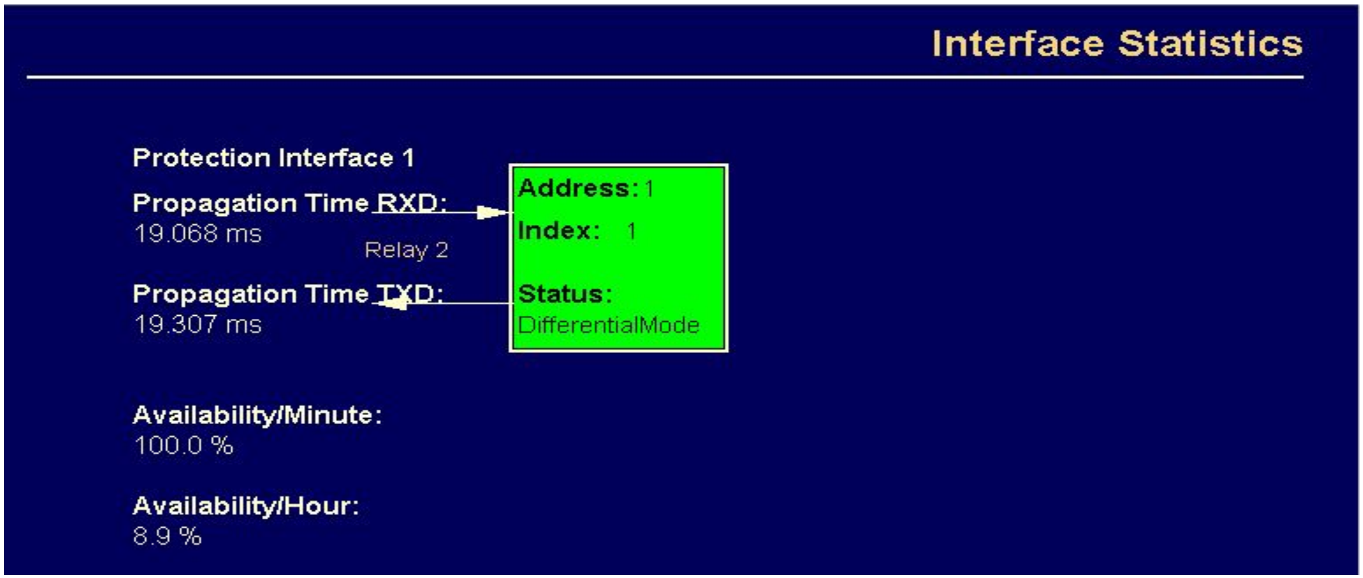
SIEMENS





SIEMENS


Communication Topology
PC-connected relay
Address: 1
Index: 1
Status:
DifferentialMode
Address: 2
Index: 2
Status:
DifferentialMode


Interface Statistics
Protection Interface 1
Propagation Time RXD:
19.068 ms
Relay 2
Propagation Time TXD:
19.307 ms
Address: 1
Index: 1
Status:
DifferentialMode
Availability/Minute:
100.0 %
Availability/Hour:
8.9 %