Power Transmission and Distribution

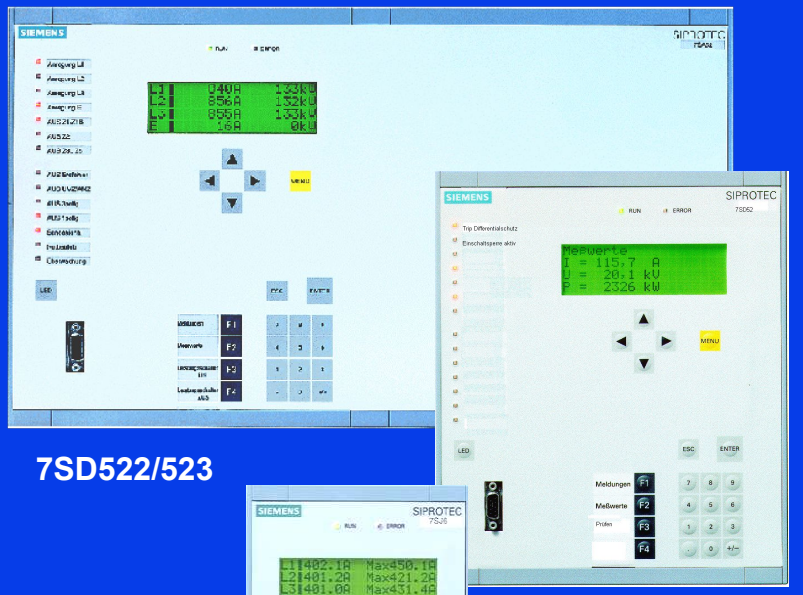
# Line Differential Protection 7SD52x / 7SD610

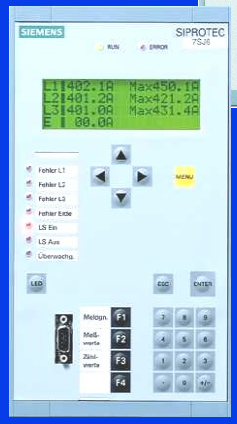
## Presentation

SIEMENS

# Universal Line Differential Relays 87L

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



# Customer Benefits

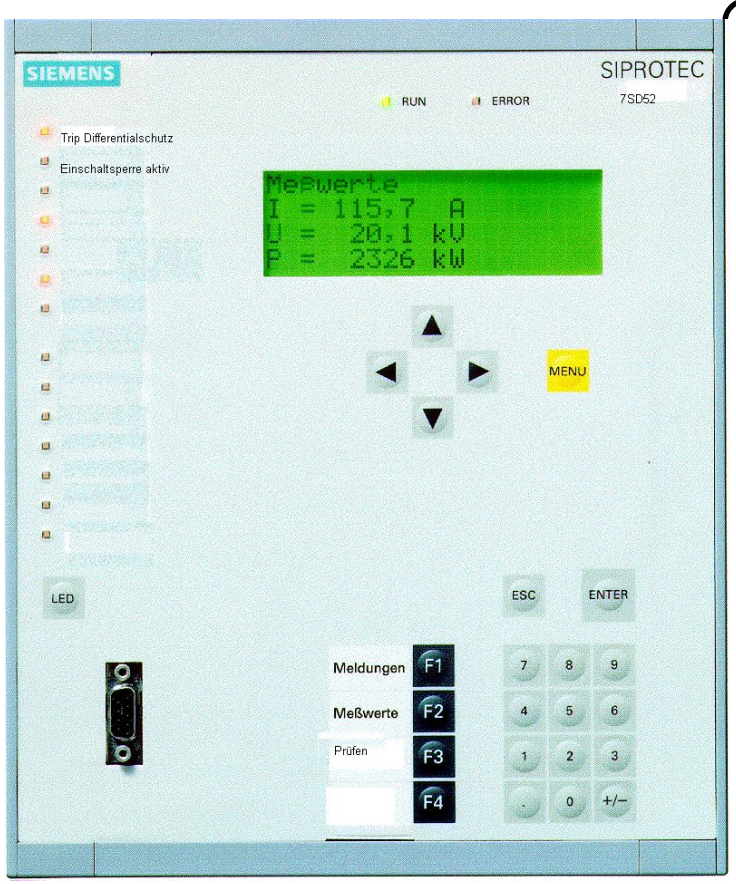
- The protection applies its characteristic by itself. Adaptive measurement reduces the setting complexity and ensures maximum sensitivity.
- Multi terminal applications up to 6 line ends and redundant Relay to Relay communication.
- A transformer inside the feeder zone of protection is fully accommodated 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

| 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




- Differential protection for the universal use with easy to handle settings

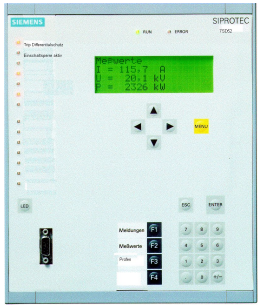
  **Two up to six line ends , for serial and parallel compensated lines, handles transformers and compensation coils within the protection zone, tripping time approx. 12 ms with fast high set element**

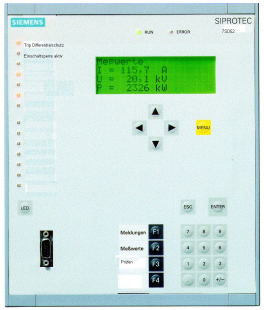
- Adaptive differential measurement

  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

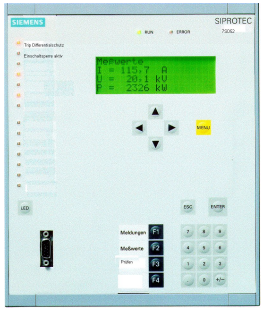
# Main protection function 87:
# Features of the differential function





- **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



- **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

**<u>Vector comparison</u> 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 $I_N$)

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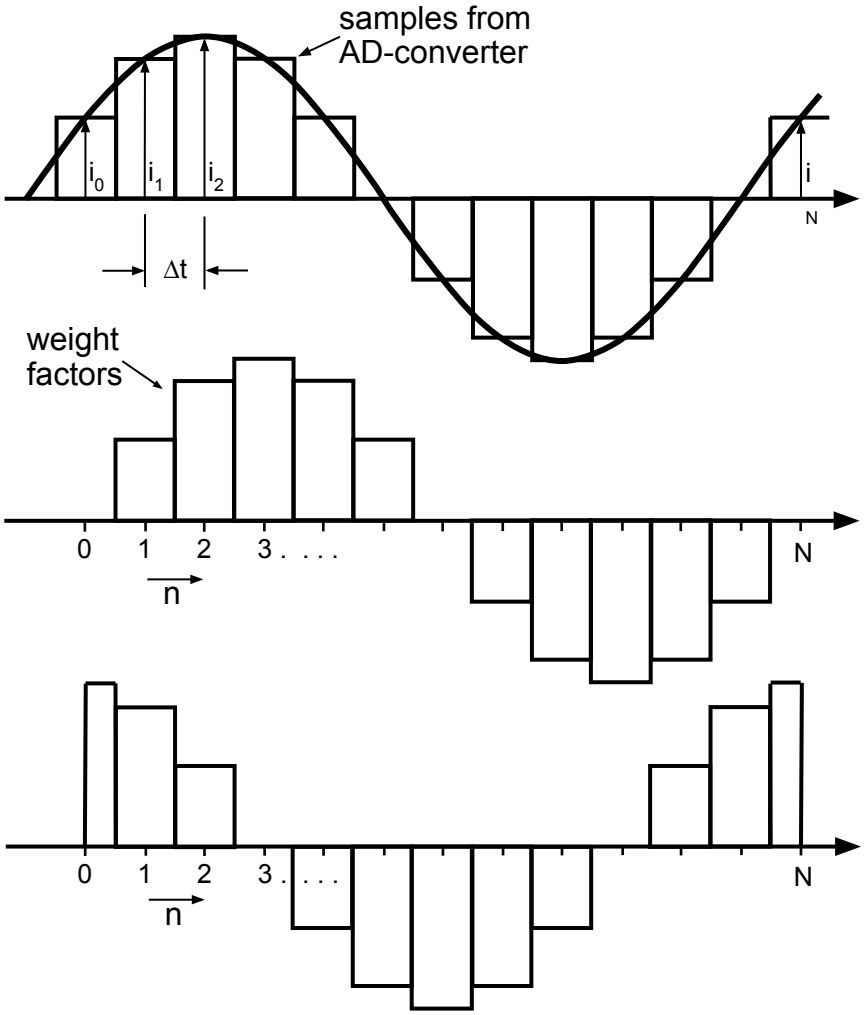
# $I_{Diff}$>: Vector comparison with Advanced Fourier filters (Basic principle)




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

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

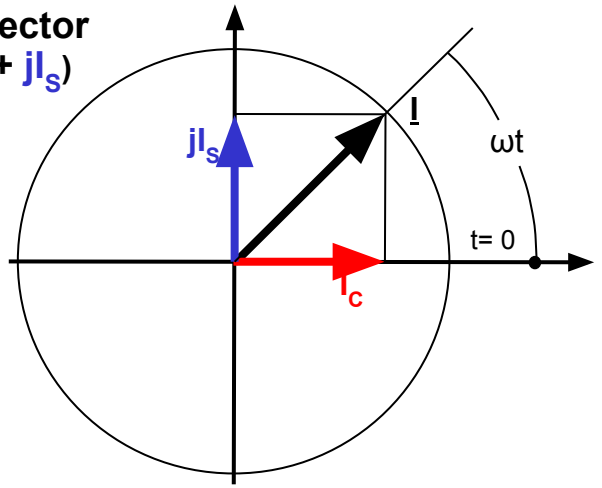
**Sine component:**

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

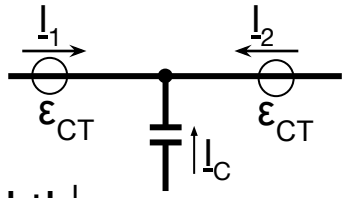
**Cosine component:**

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

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

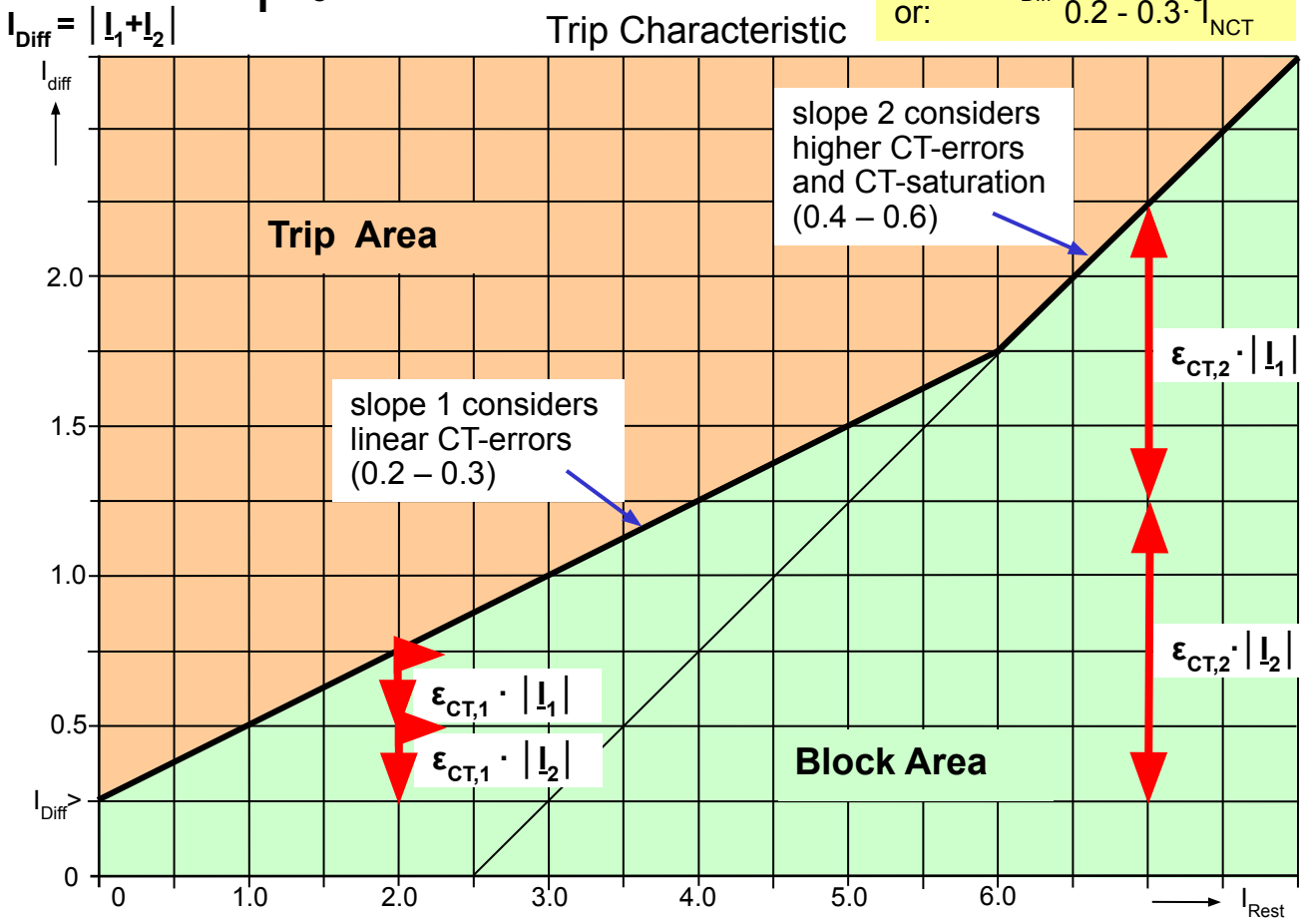


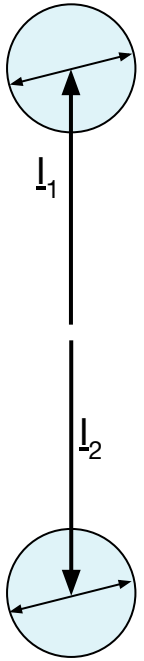
# $I_{Diff}$>: Theory of the classical differential tripping characteristic




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

Setting: $I_{Diff}> = 2 - 3 \cdot I_C$
or: $0.2 - 0.3 \cdot I_{NCT}$




**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)

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

$I_{Diff} = I_{Diff}> + \varepsilon_{CT} \cdot (|\underline{I}_1| + |\underline{I}_2|) = I_{Diff}> + \varepsilon_{CT} \cdot |I_{Rest}|$ 06_A0



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# $I_{Diff}$>: Settings for the "CT – parameters" (1 of 2)

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 ($\varepsilon_{Load}$) can be used for calculations with currents higher than the nominal current of the CT ($I_{pn}$) ! (In the example here: $\varepsilon_{Load}$ could be taken for currents up to 4·$I_{pn}$**

# $I_{Diff}$>: Settings for the “CT – parameters” (2 of 2)

**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

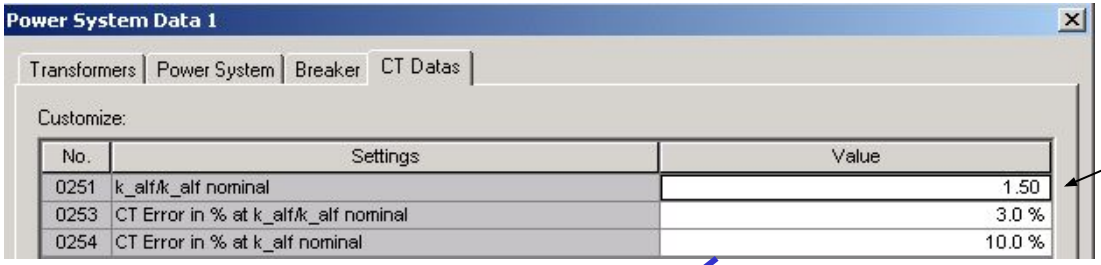
  **Recommended setting in the relay: 3% for 5P, 5% for 10P**

  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

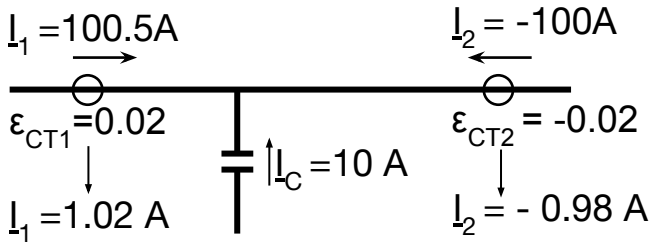
**Basis for the adaptive restraint current calculation (max. expected differential current due to CT-errors) is the estimated error of each CT from the CT-data's**

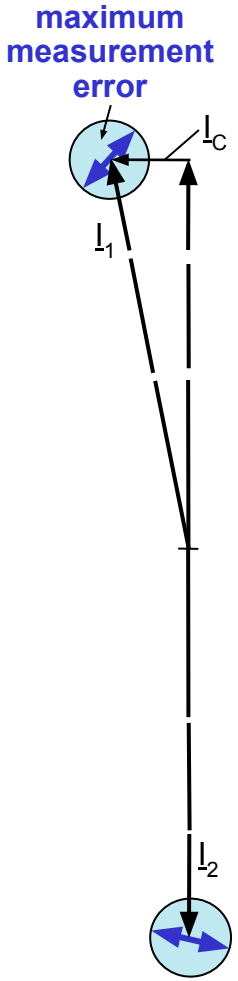


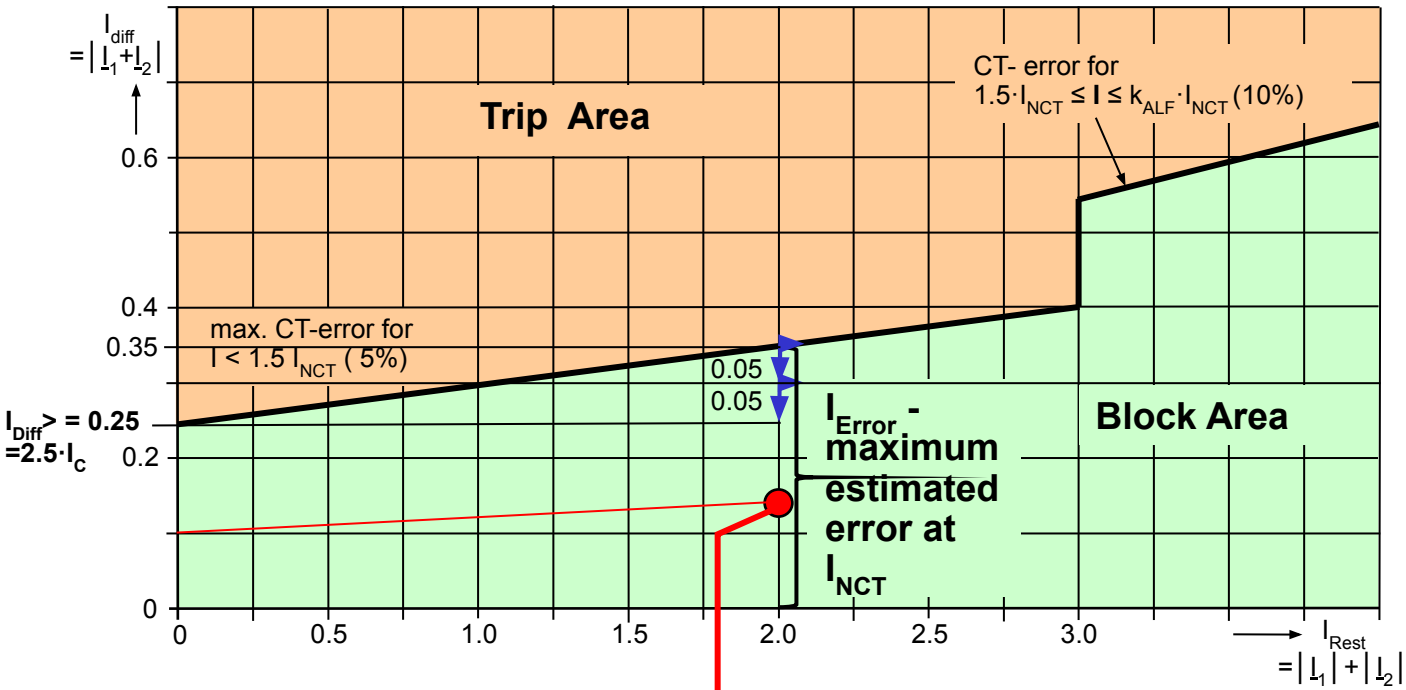

Settings in DIGSI 4

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

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:** $I_{Diff} = 0.1\ A + 0.02 \bullet |1A| + 0.02 \cdot |1A| = 0.14\ A$

**Max. estimated error = Restraint current :** $I_{Error} = 0.25\ A + 0.05 \bullet (|1A| + |1\ A|) = 0.35\ A$

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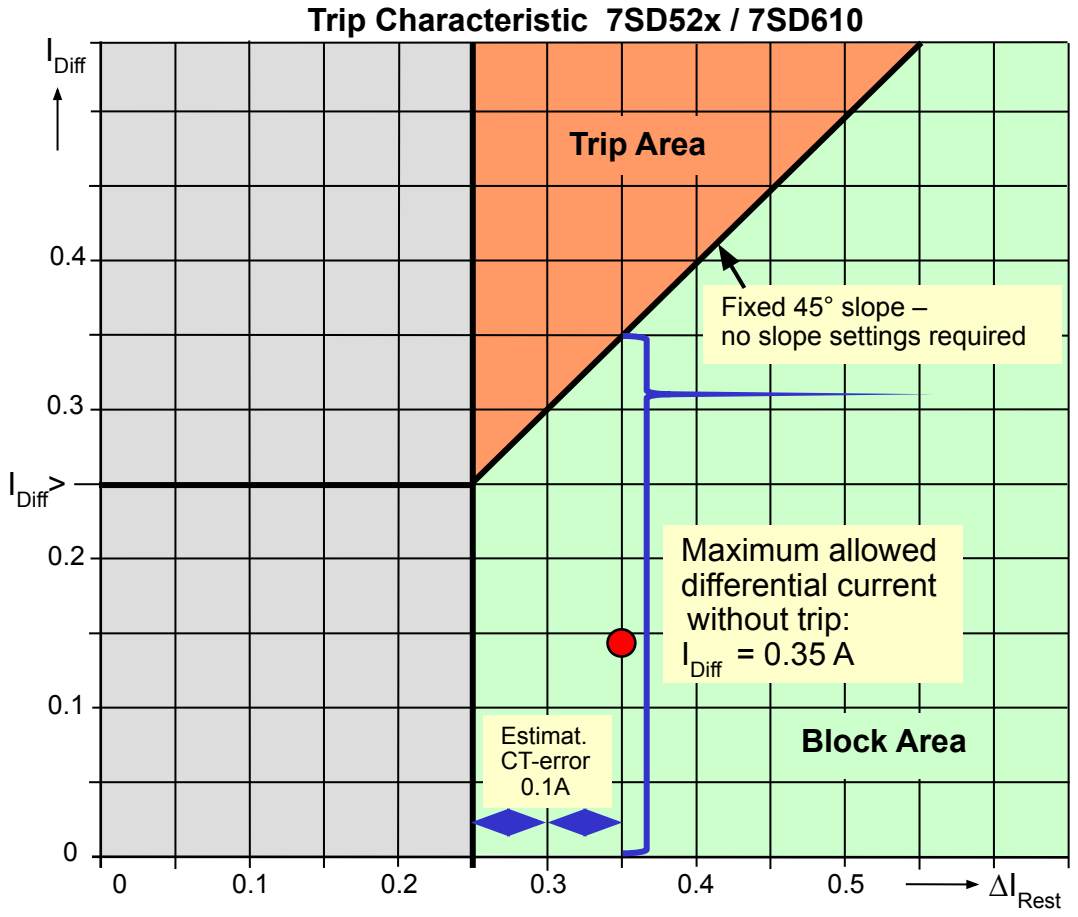
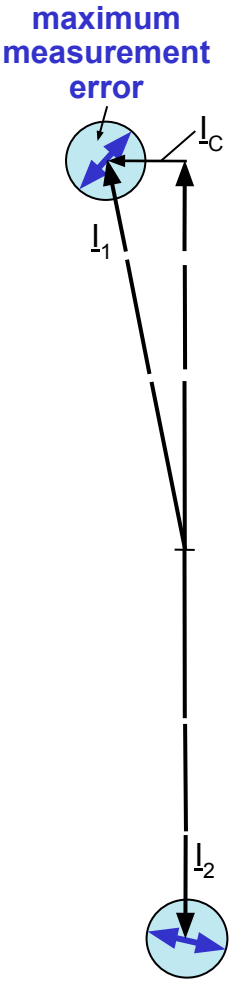
# $I_{Diff}$>: Adaptive differential relaying
# Restraint current with consideration of the CT- errors

Same example as before! Assumption: Currents are exactly synchronized




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

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

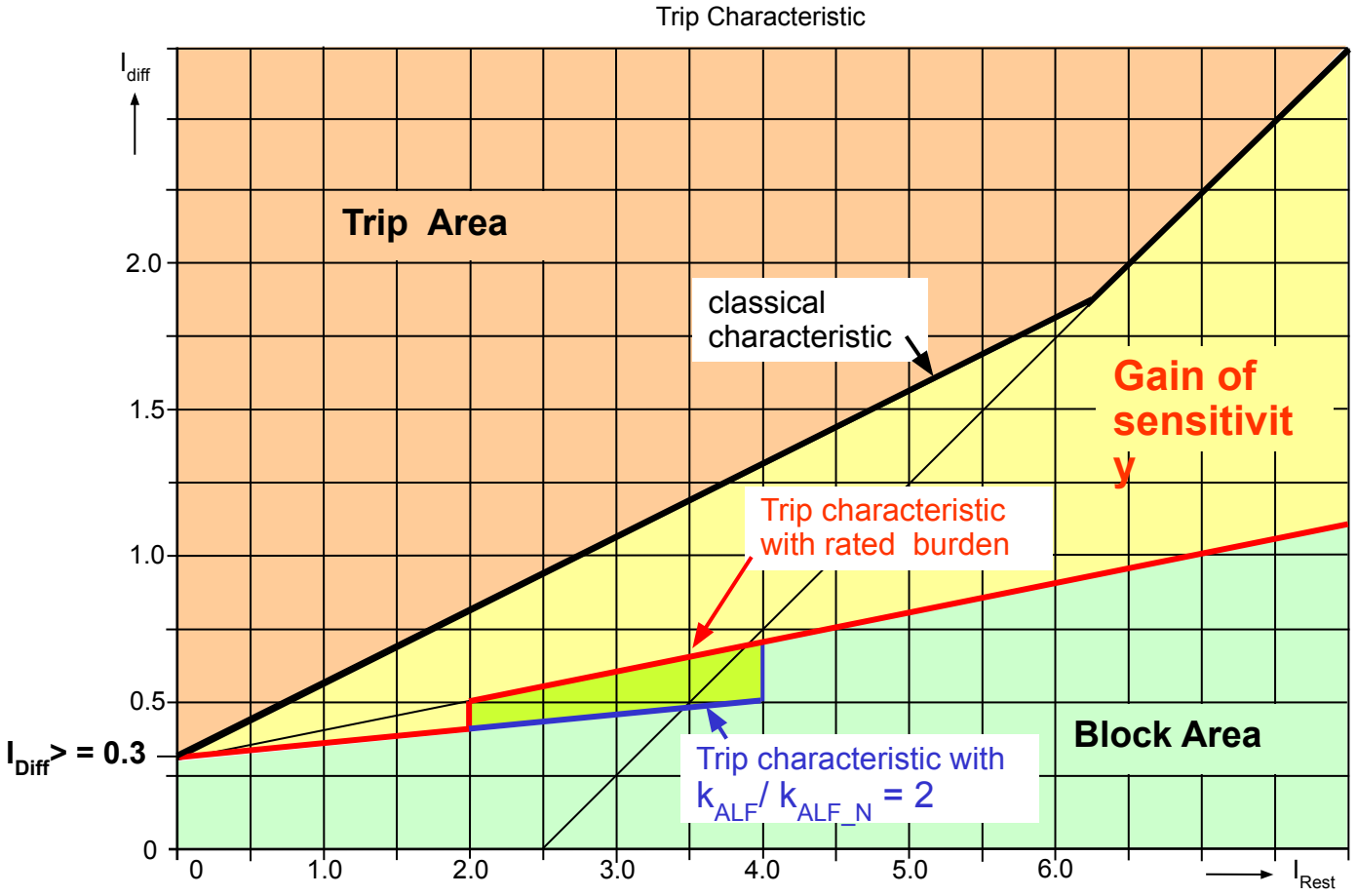
*) $\Delta I_{Rest}$ = adaptive restraint current

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

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

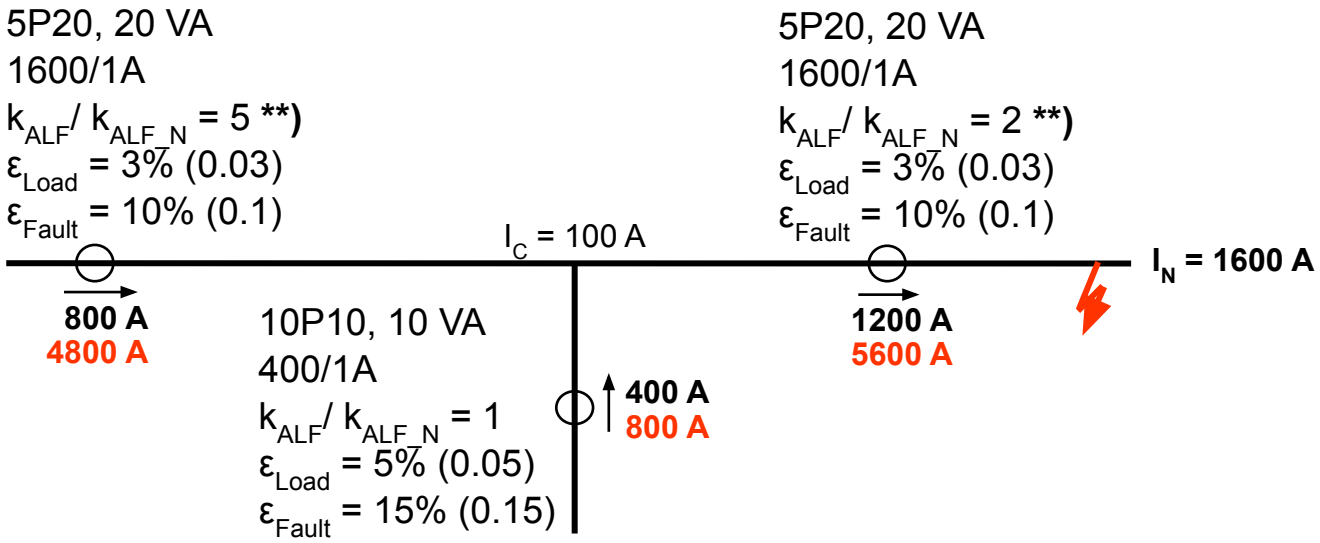
Assumption: Equal Ct´s on both side, no effects from comms-system, standard settings

- 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




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

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

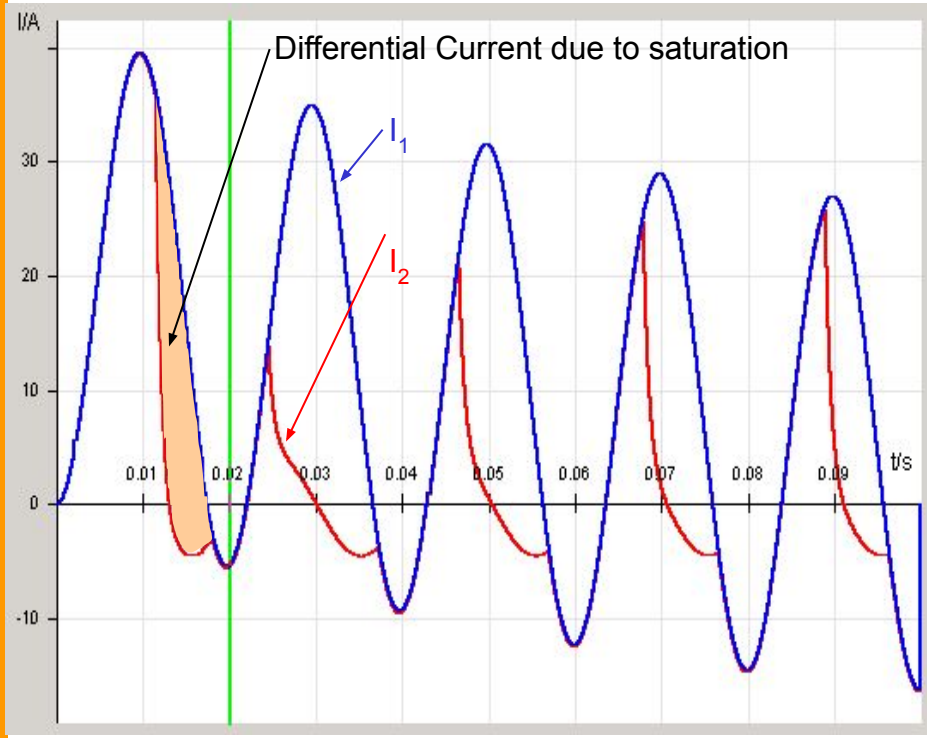
**Case 1 (normal operation)**

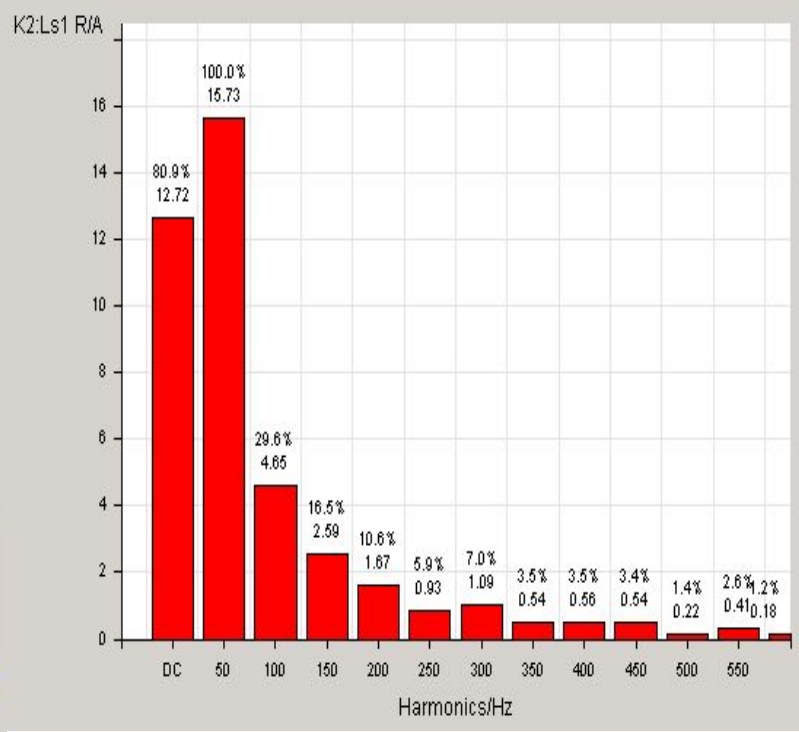
**$\Delta I_{Rest}$ = 2.5·100A + 0.03·800A + 0.03·1200A + 0.05·400A = 330A** **$\Delta I_{Rest} / I_N$ = 0.206**
**$I_{Diff}$ = 100 A (=$I_C$)** **$I_{Diff} / I_N$ = 0.0625**

**Case 2 (External Fault)**

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

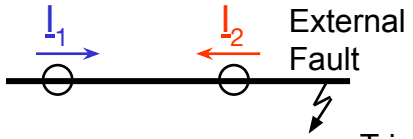
# $I_{Diff}$>: CT- saturation detector based on harmonic analysis of the current wave form - Signal analysis



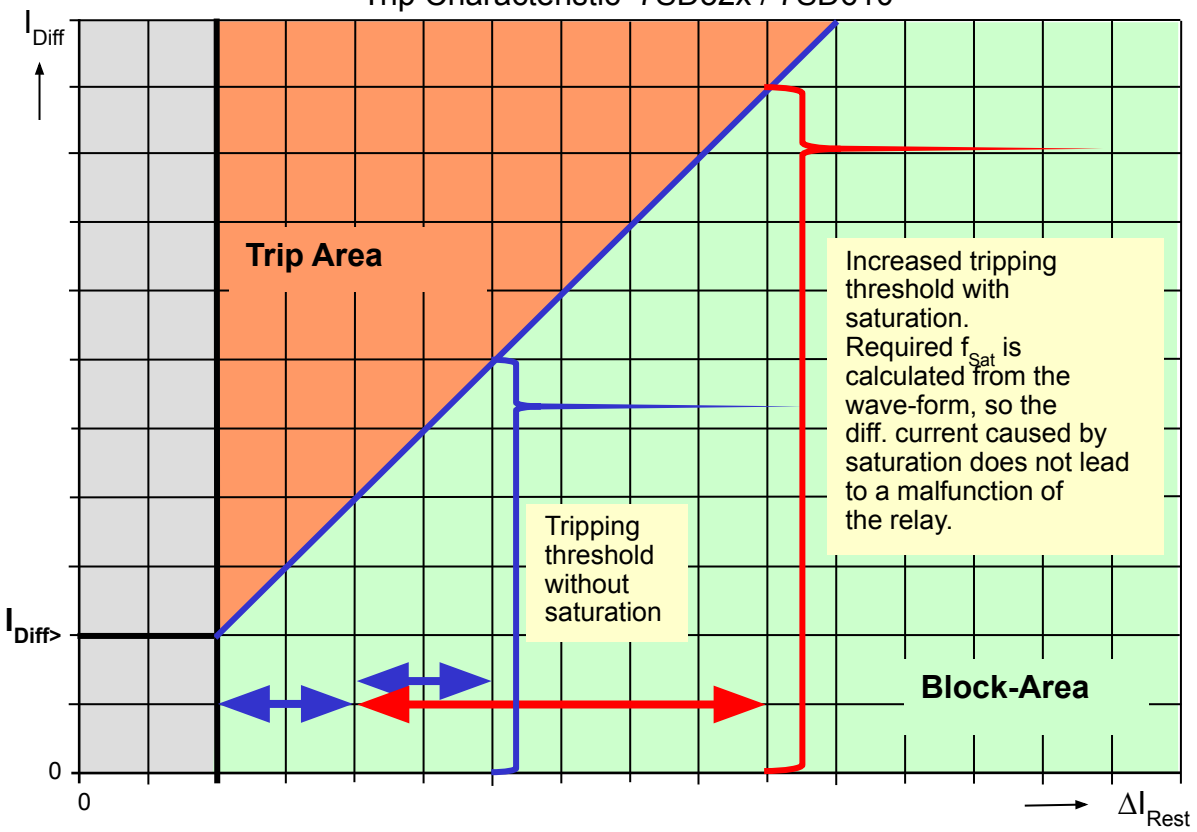



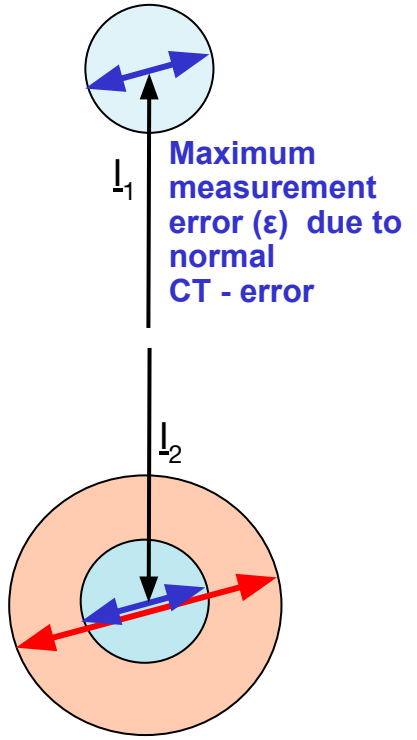

- Wave form detector recognize saturation from
  DC, $f_2$, $f_3$, $f_4$, $f_5$….  rated to the fundamental $f_1$
  Factor = 1 - no saturation
  Factor > 1 - saturation □Increase of CT- error with a factor $f_{Sat}$.
  Results in higher restraint current.
  More differential current is required for tripping.

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




Trip Characteristic 7SD52x / 7SD610



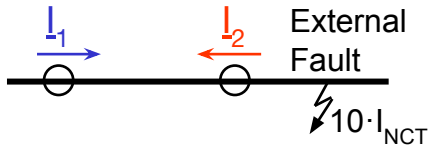




**Current summation:** $I_{Diff} = |\underline{I}_1 + \underline{I}_2|$

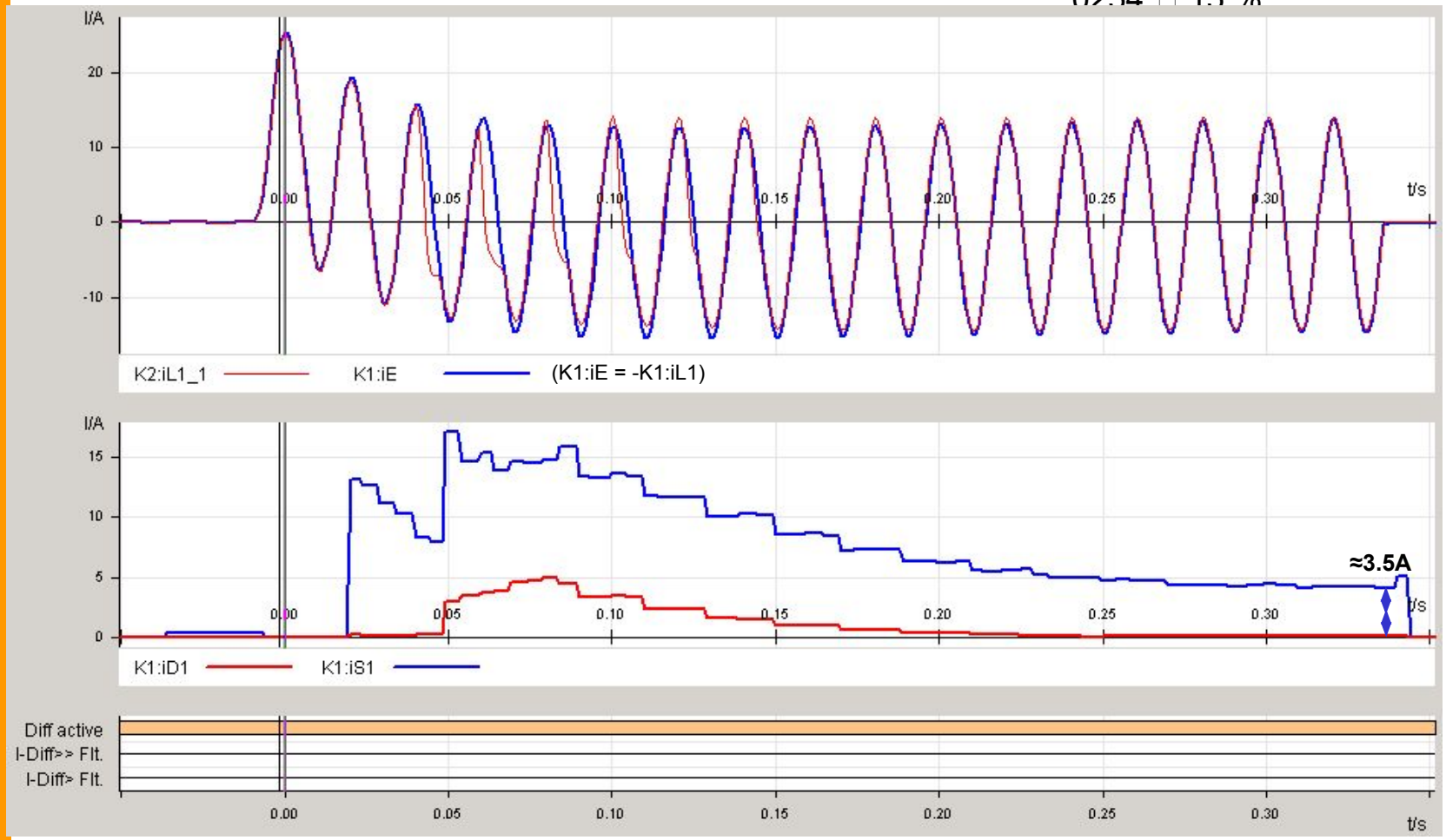
**Max. error summation:** $I_{Error} = \Delta I_{Rest} = I_{Diff>} + \varepsilon_{CT1} \cdot I_1 + f_{Sat} \cdot \varepsilon_{CT2} \cdot I_2$

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

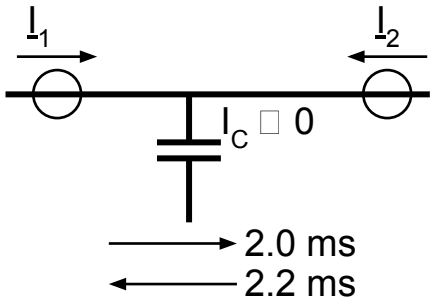
# $I_{Diff}$>: Test: max. asymmetrical offset , Ct saturation




Settings: 1210/13 □ 0.30 A
0251 □ 1.0
0253 □ 5 %
0254 □ 15 %



# $I_{Diff}$>: Adaptive consideration of a permanent time difference in transmit- and receive direction




Average delay 2.1 ms

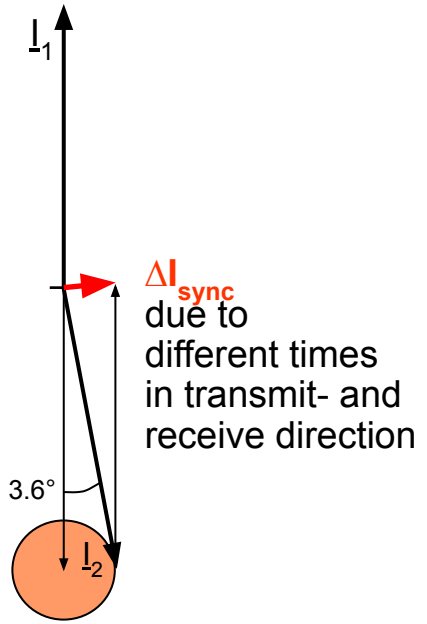
$$\Delta\Phi_{sync} \approx \frac{\Delta t \cdot 360°}{20ms} \rightarrow (50Hz)$$

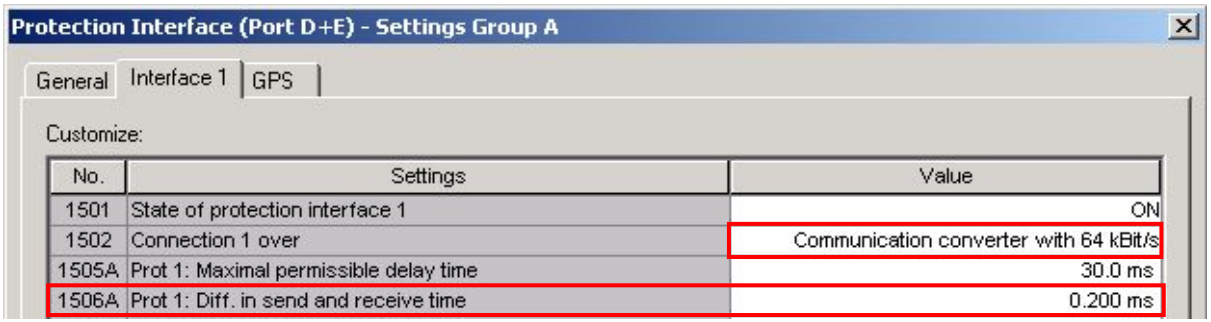
$$\text{here}: \Delta\Phi_{sync} \approx \frac{0.2ms \cdot 360°}{20ms} = 3.6°$$

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

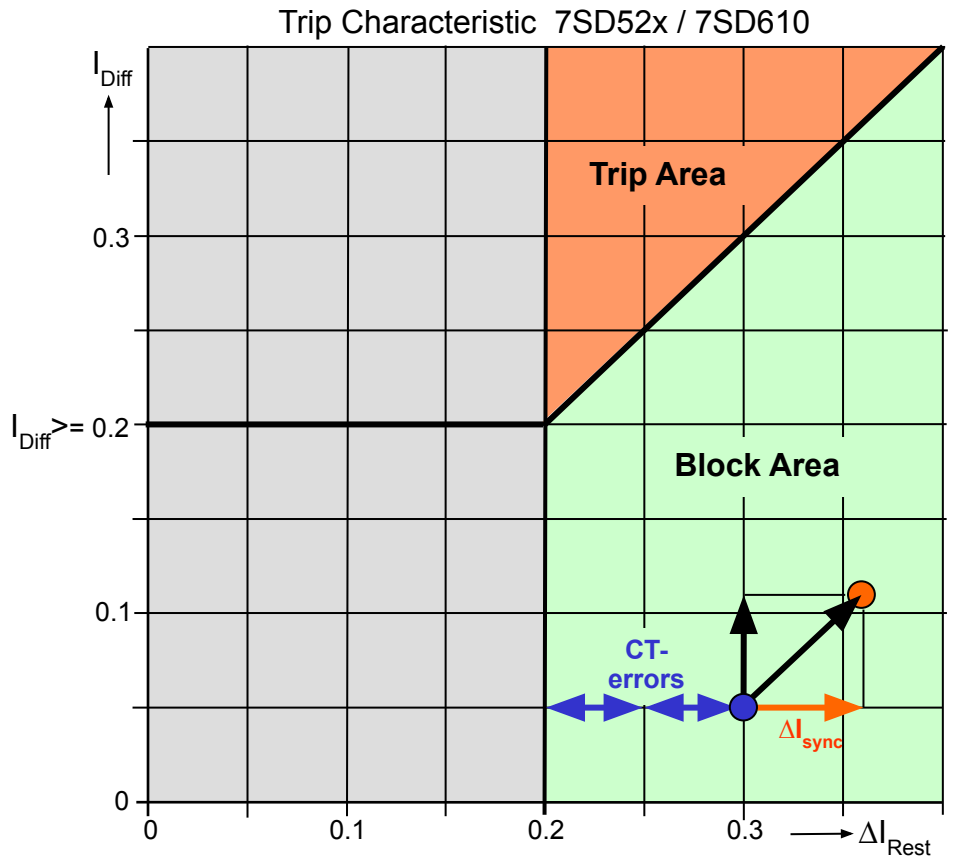
$$\Delta I_{sync} \approx \Delta\Phi_{sync} \cdot |\underline{I}_{sync}| \approx \Delta\Phi_{sync} \cdot |\underline{I}_2|$$

(For more details:
refer to 7SD52 Synchronisation)



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



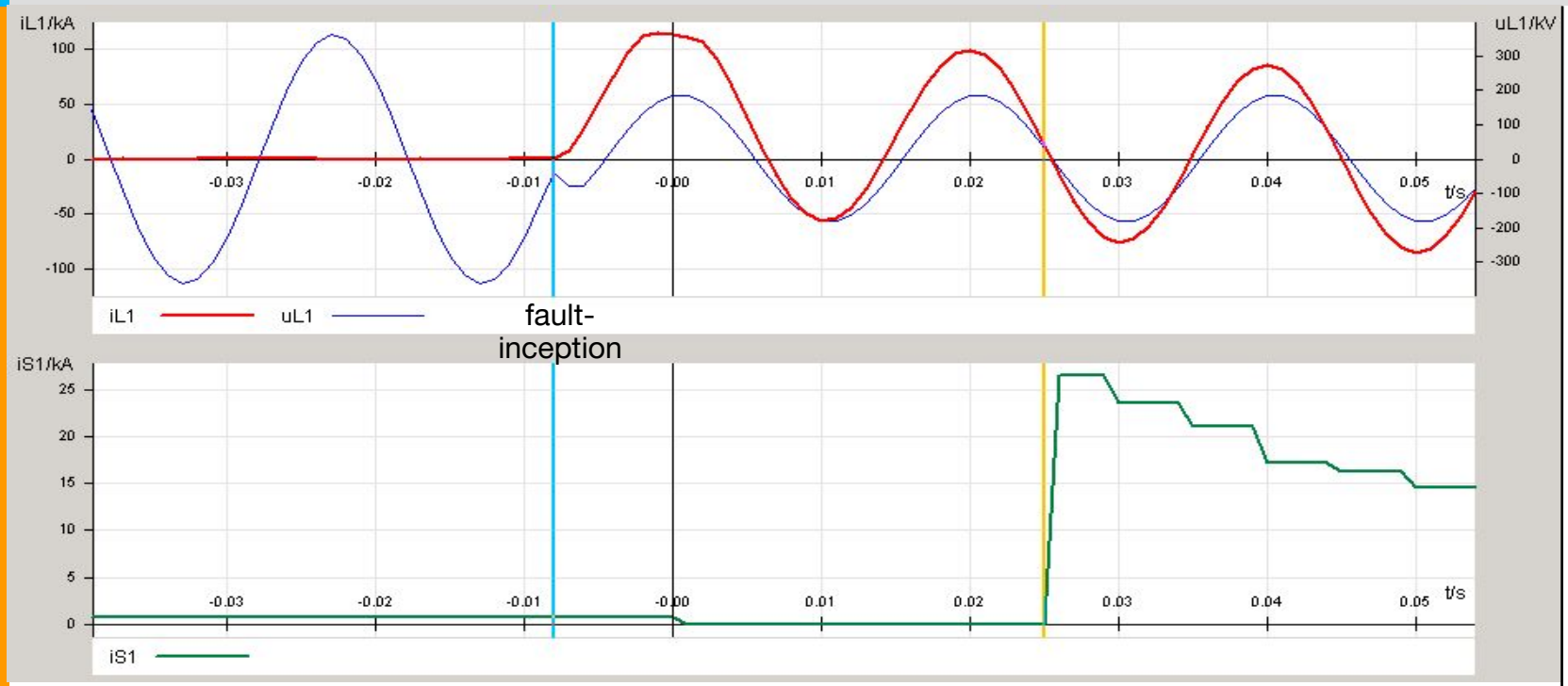

Diff. current:: $I_{Diff} = I_C + \Delta I_{sync}$

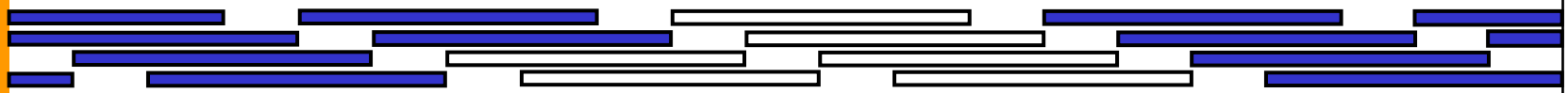
Rest. current: $\Delta I_{Rest} = I_{Diff}> + \text{CT-errors} + \Delta I_{sync}$

**Total "Restraint Current":**

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

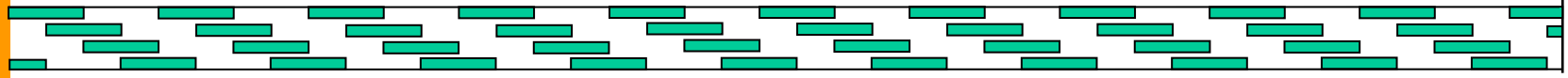
# $I_{Diff}$>: Sliding data windows after fault inception



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 it not blocks</u>!**



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

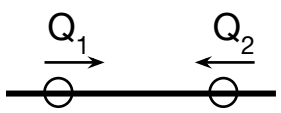
06_A0

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

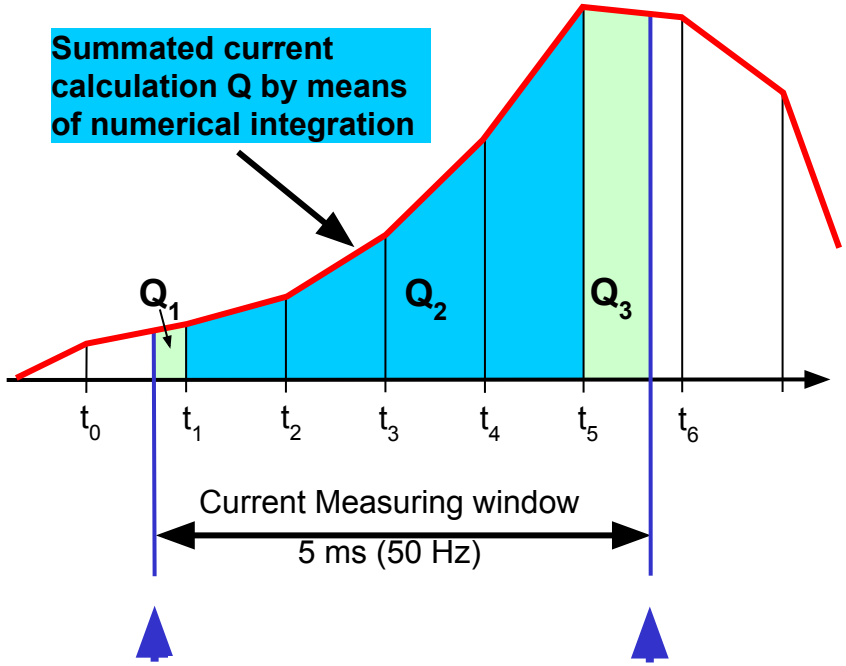
**<u>Fast Current comparison</u> offers high speed tripping and a fast decision for internal or external fault condition**

- 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.

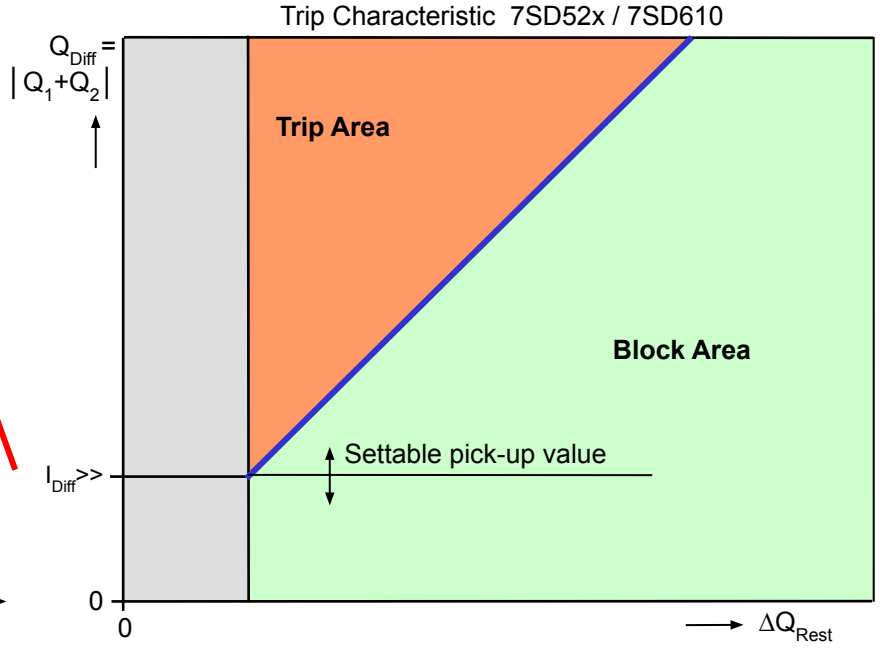
# $I_{DIFF}$>> ($Q_{Diff}$) : Fast current comparison algorithm (Basic principle)




**Setting $I_{Diff}$>>: > $I_{Load,max}$**




Corrected time instants after end-to-end time synchronisation




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



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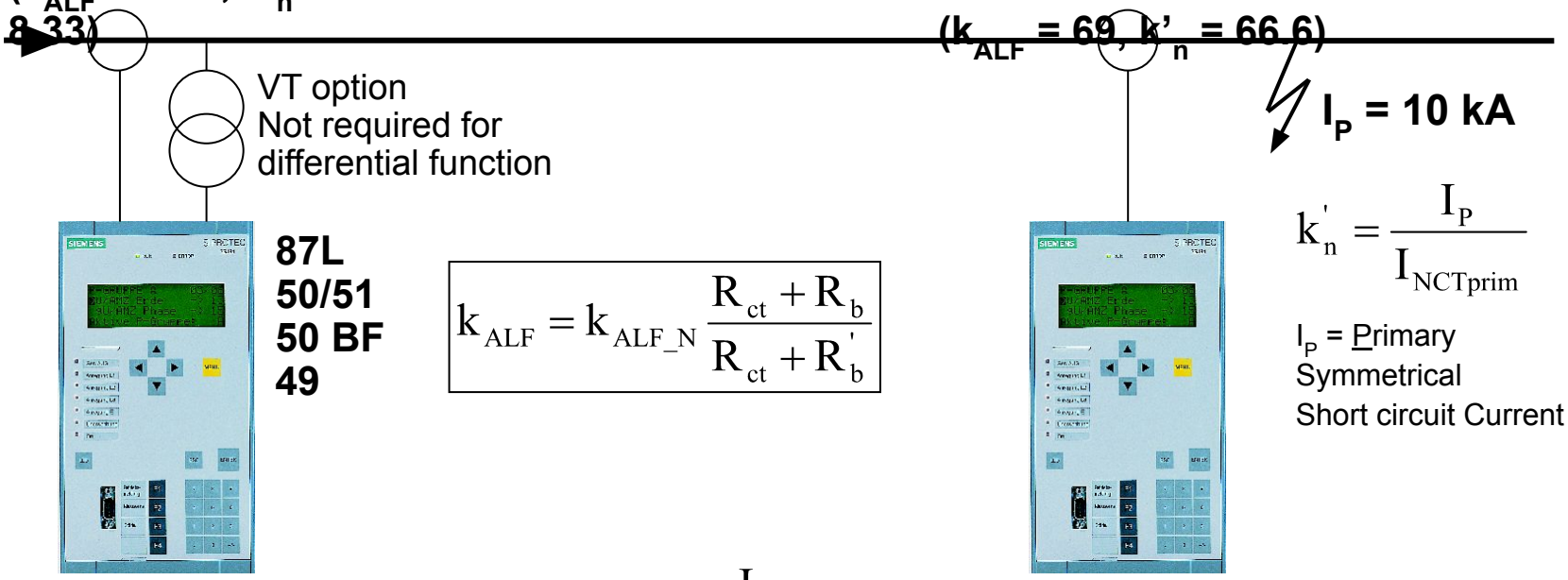
# CT- requirements , mismatch of the primary CT currents

**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, $R'_b$ = 0.4 Ω**
**($k_{ALF}$ = 69, $k'_n$ = 66.6)**




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

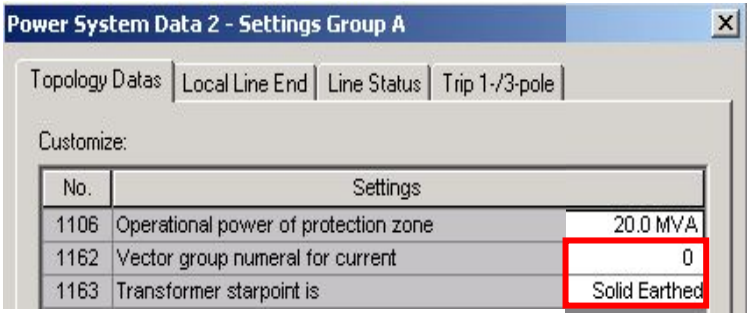
$$k'_n = \frac{I_P}{I_{NCTprim}}$$

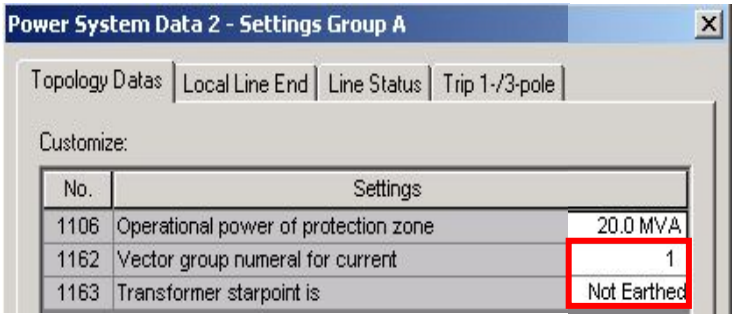
$I_P$ = Primary Symmetrical Short circuit Current

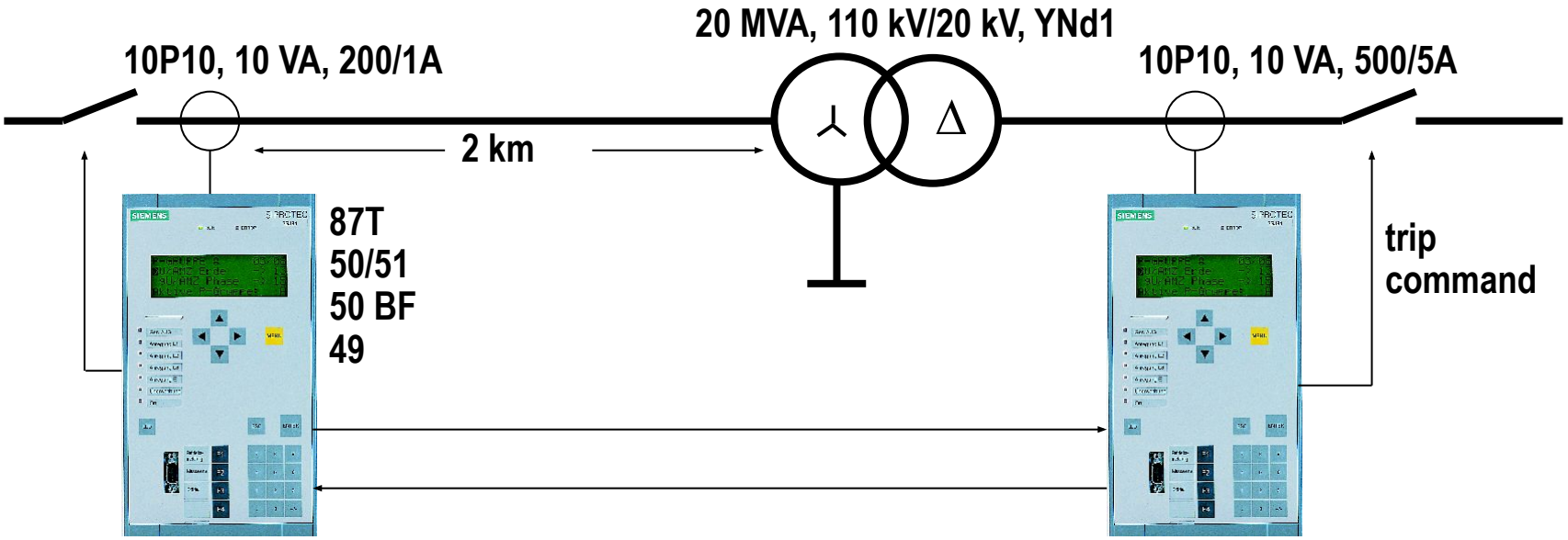
- Mismatch of the primary CT currents: $\frac{I_{CTprim(max)}}{I_{CTprim(min)}} \leq 8$
- 1A or 5A input selectable in the relay
- CT data's / errors are set in the relay and automatically considered in the restraint current calculation
- CT-requirements:
  1st condition: $k_{ALF} > k'_n$
  2nd condition: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

06_A0

# Application -
# Transformer and line/cable in the protection zone

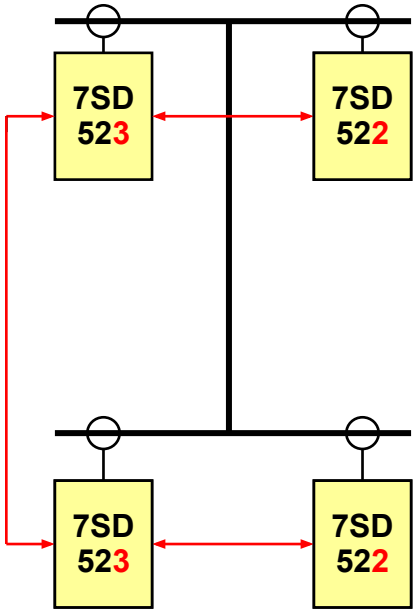


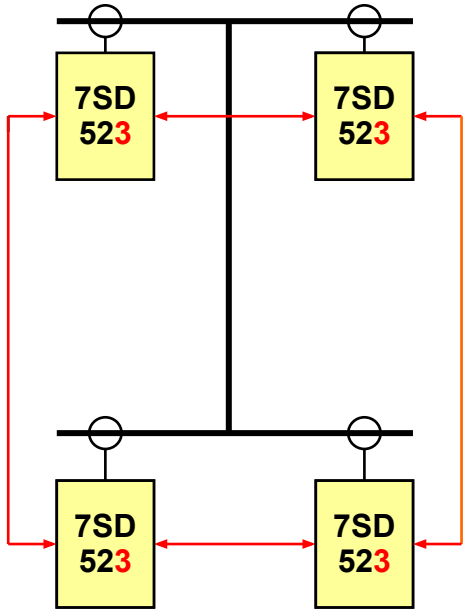




- Settings of the transformer winding data's in each relay
  with vector group matching, ratio adaptation and zero sequence elimination
- Differential set point is rated to the nominal current of the transformer
- Inrush restraint with second harmonic included (time limit for Cross block)
- High set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

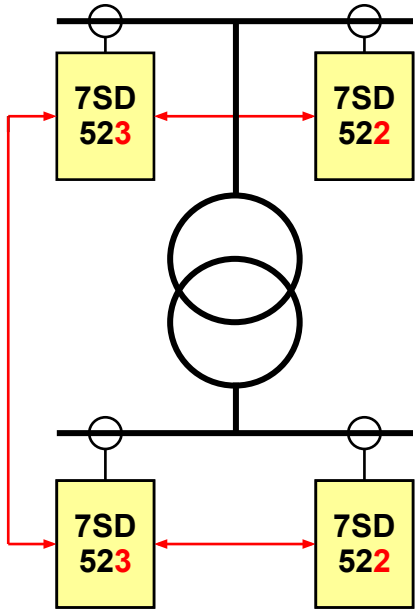
# Examples for different Topologies




Chain topology with line in the protected zone




Ring topology with line in the protected zone




Chain topology with transformer in the protected zone

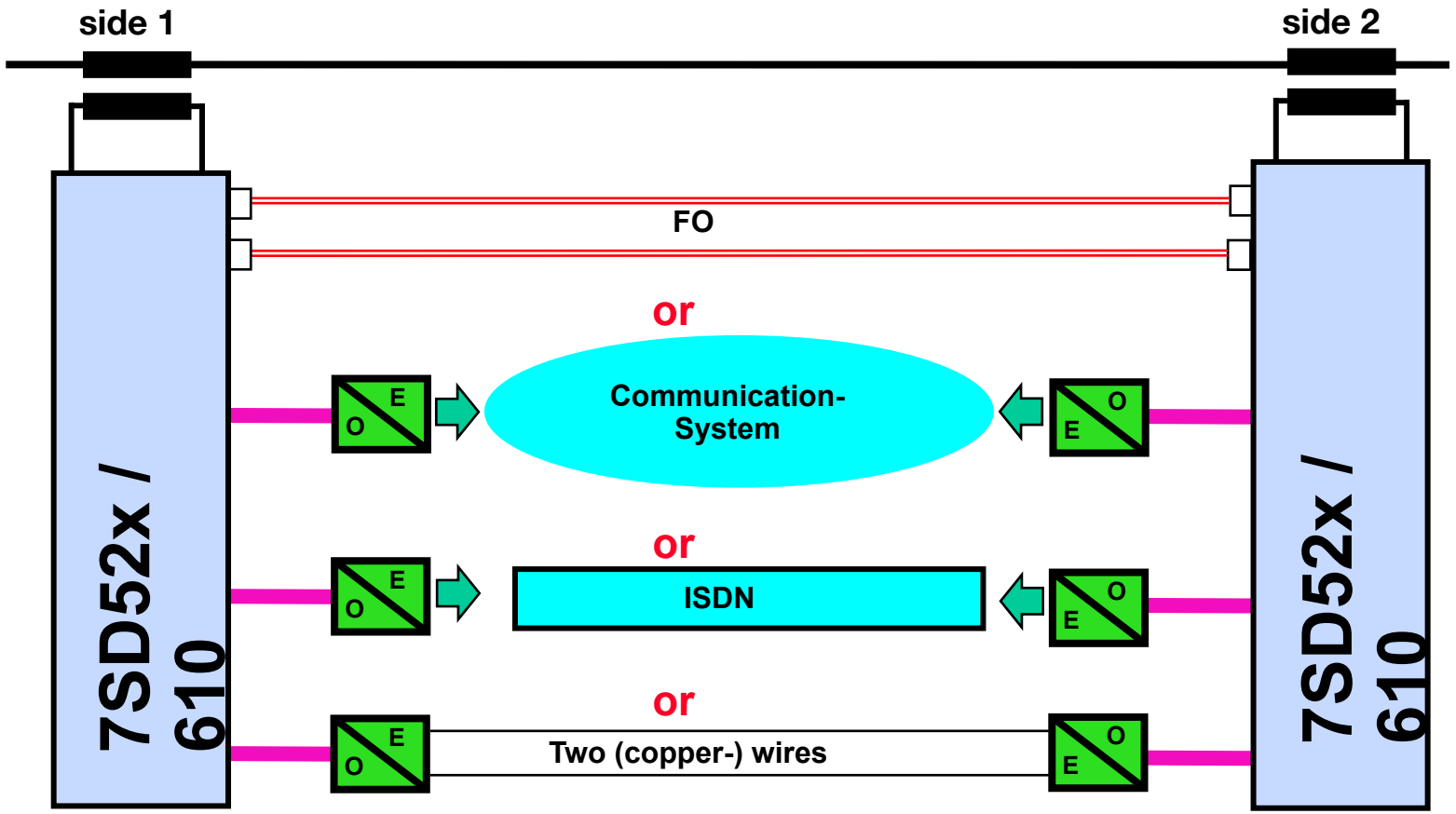
# Relay to Relay Communication
## Designed for the use of Digital Communication Networks and FO [1)]

## 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
- **<u>Option</u>: Microsecond exact time synchronisation via GPS 1s pulse input**
  Independent measurement of transmit and receive delay time
  Hardware prepared for this feature

[1)] Fibre optic cables

# Relay to Relay Communication (Overview)




**Communication according existing possibilities,**
**the relay remains the same !**

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

## Options for the Protection Interface

**FO 5** — O — **ST-connector** — 1.5 km, 820 nm, Multimode
internal

**FO 6** — O — **ST-connector** — 3.5 km, 820 nm, Multimode
internal

**FO 7** — O — **ST-connector** — 10 km, 1300 nm, Monomode
internal

**FO 8** — O — **FC-connector** — 35 km, 1300 nm, Monomode
internal

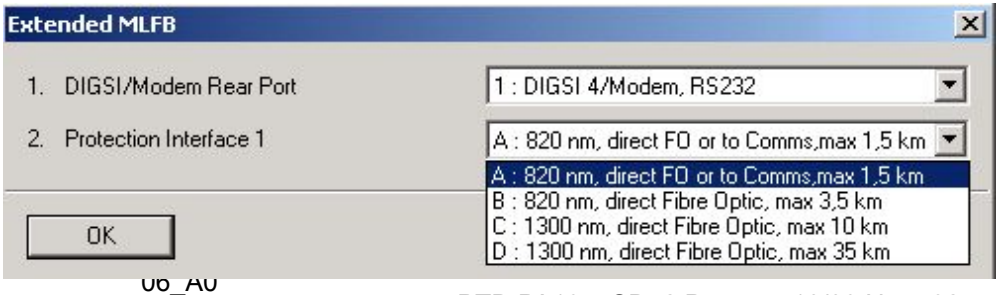

**Protection interface 2**
Port E (7SD523 only)
Synchronous N x 64kB/sec

**Remote line end 2**

**Plug in modules**

**Protection interface 1**
Port D
Synchronous N x 64kB/sec

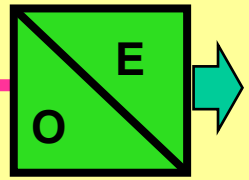
**Remote line end 1**



# Relay to Relay Communication
# - Communication converter

**FO – Communication Net**
**7XV5662-0AA00**

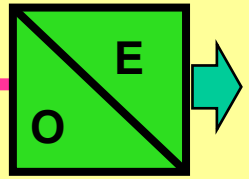
FO 5
820nm




X.21
or
G703.1


**FO - ISDN**
**7XV5662-0AB00**

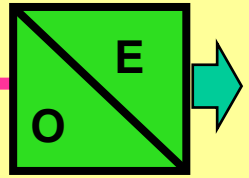
FO 5
820nm




ISDN


**FO – Copper wires**
**7XV5662-0AC00**

FO 5
820nm

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r


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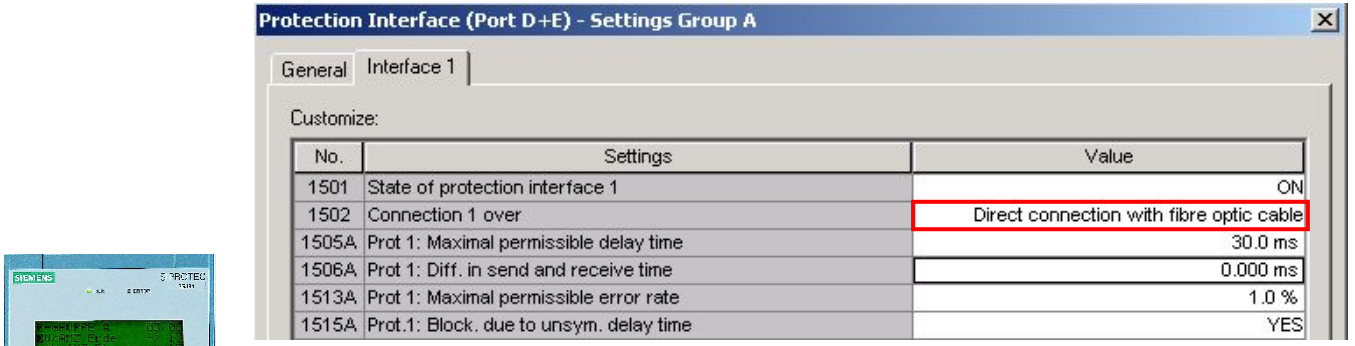
# Relay to Relay Communication
# - Application: Fibre optic connection

## Direct connection with fibre optic (FO) cables

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



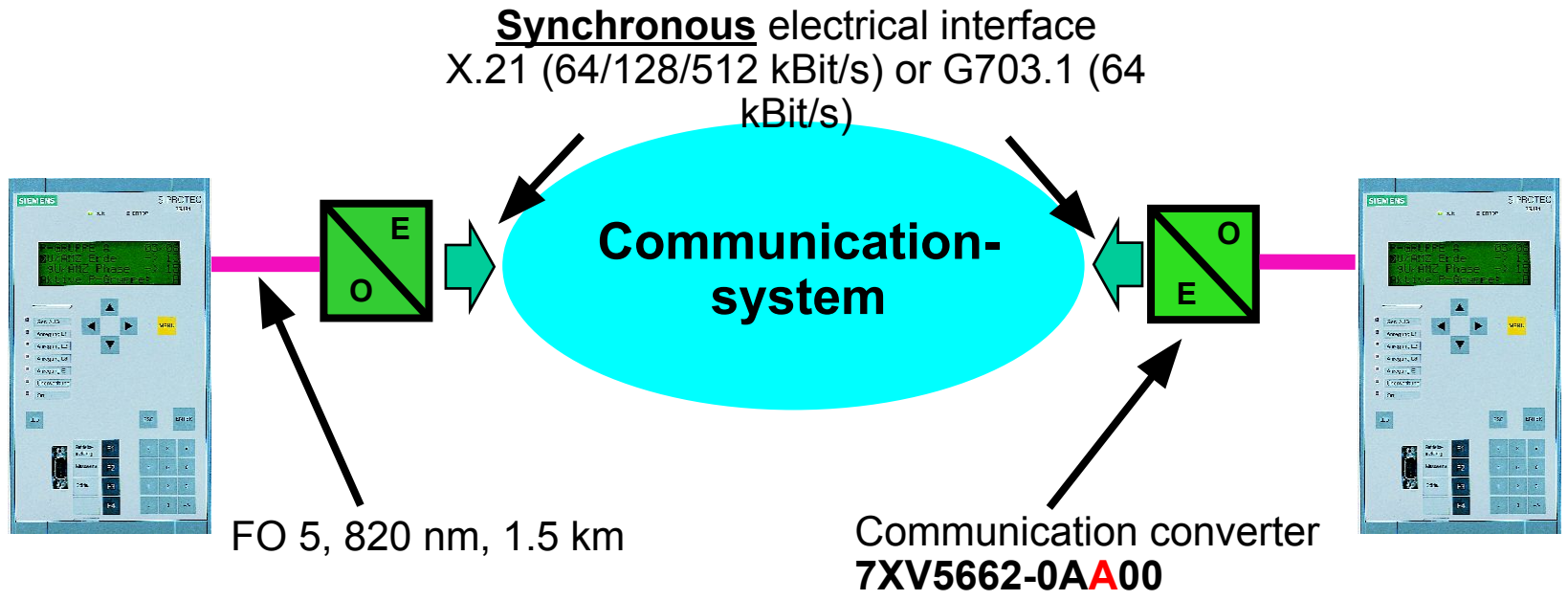

| Module in device | Type of connector | Type of fibre | Optical wavelength | Perm. path attenuation | Distance, typical |
|---|---|---|---|---|---|
| FO5 [1]) | ST | Multimode 62.5/125 µm | 820 nm | 8 dB | 1.5 km 0.95 miles |
| FO6 [2]) | ST | Multimode 62.5/125 µm | 820 nm | 16 dB | 3.5 km 2.2 miles |
| 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 |

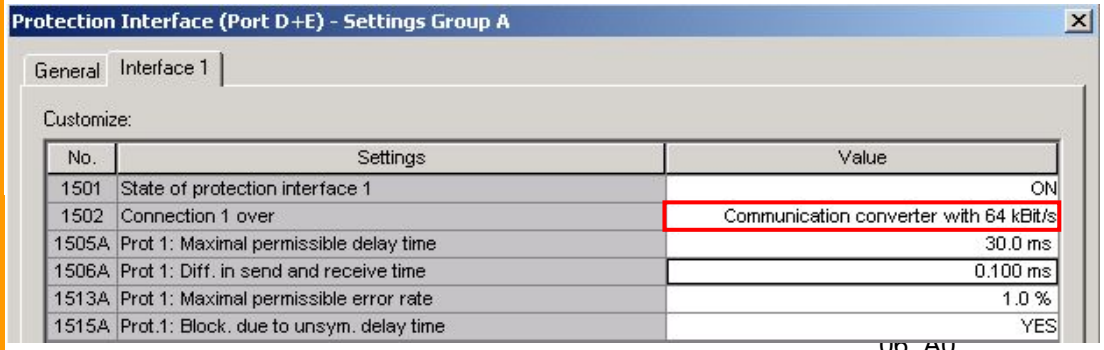
06_A0

# 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




| 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 |

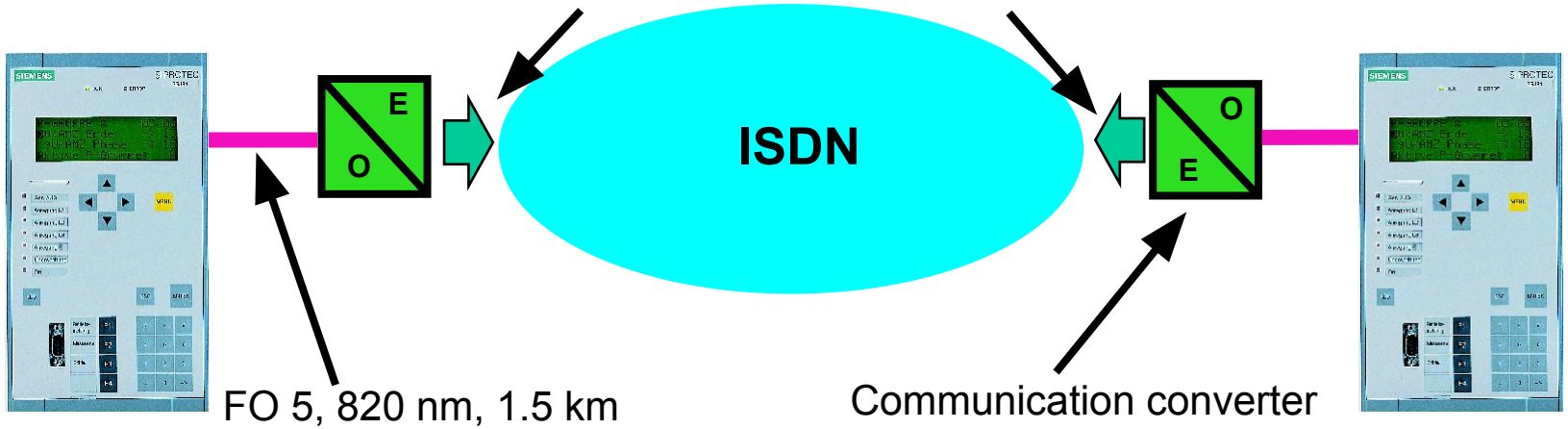
06_A0

# Relay to Relay Communication
# - Application: ISDN network

## Connection via an ISDN Network

- 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
S0 interface (2·64kBit/s)




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

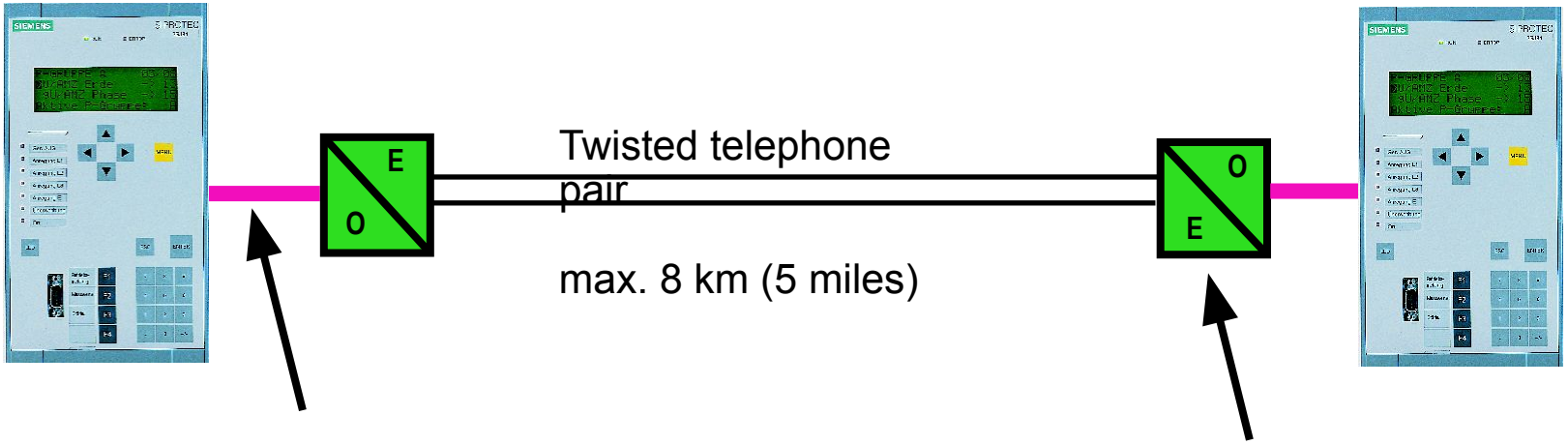
General | Interface 1

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)

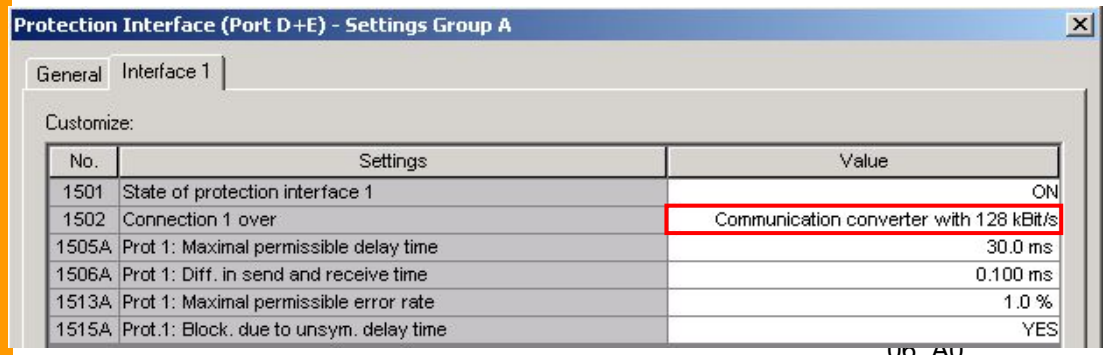
Leased telephone line (standby or dial-up)
- 2 wire telephone cable (max. 8 km)




FO 5, 820 nm, 1.5 km

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

20 kV Isolation-transformer
**7XR9516** available!

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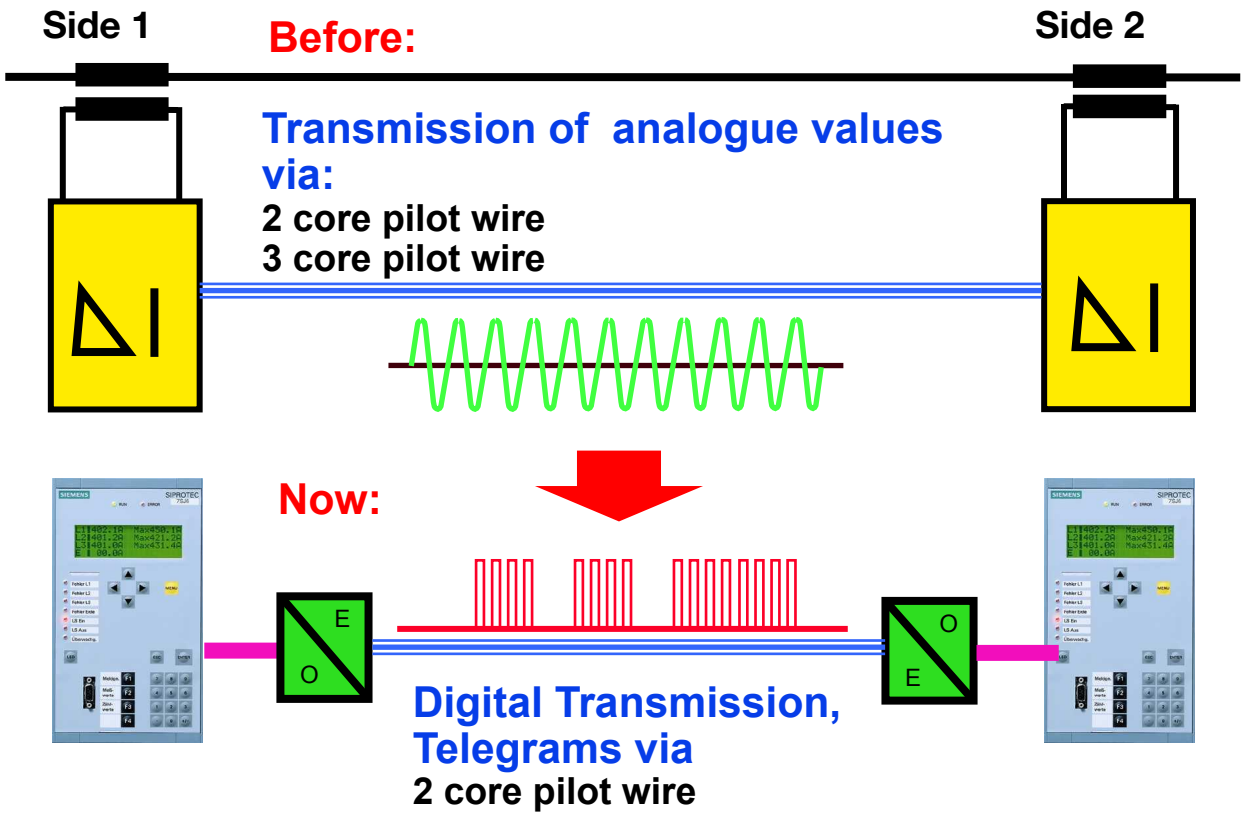
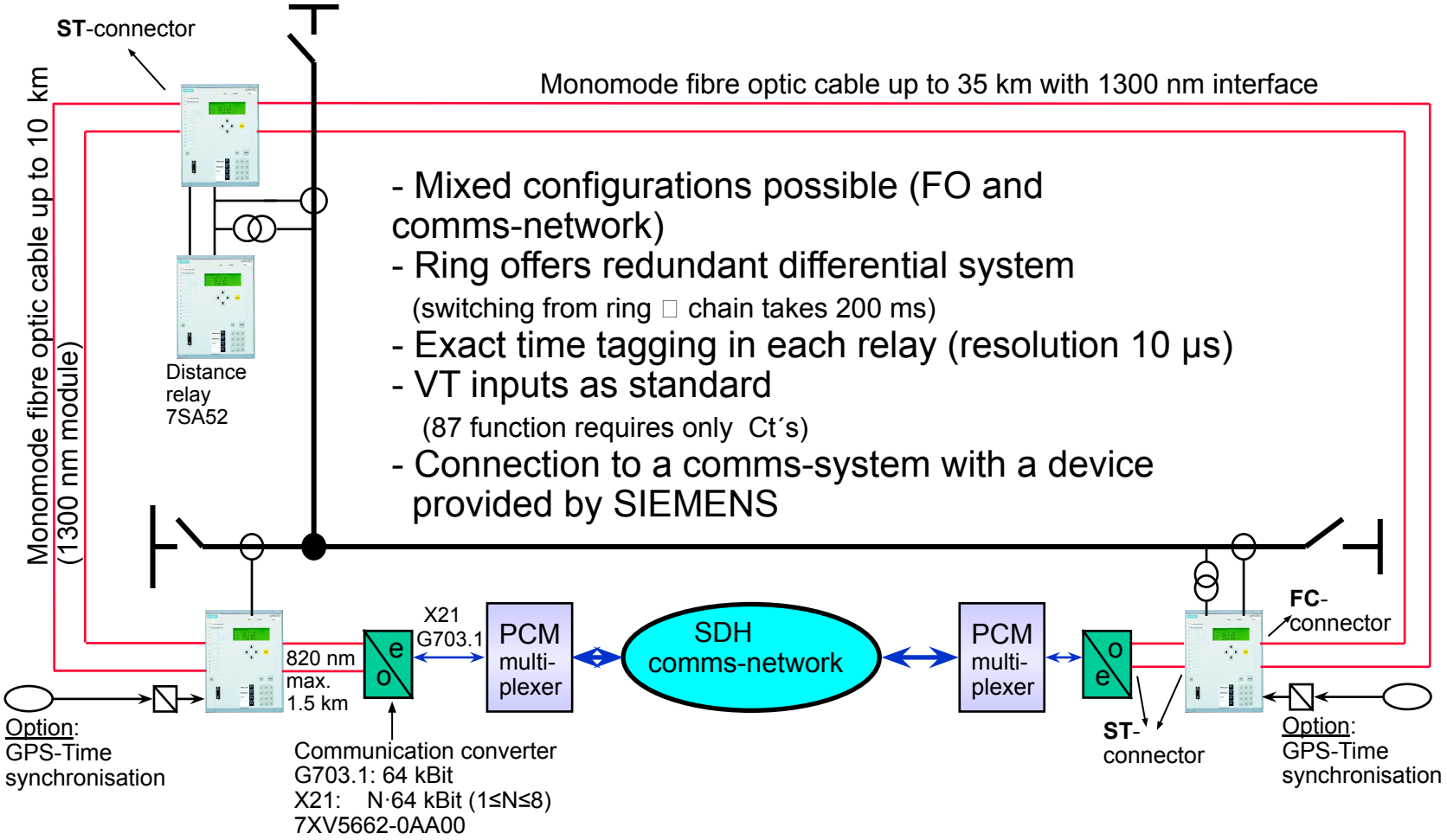
# Relay to Relay Communication
# - Application: Leased telephone line or Pilot wire (2 of 2)

## Serial communication

### New technology on existing (copper-) connection

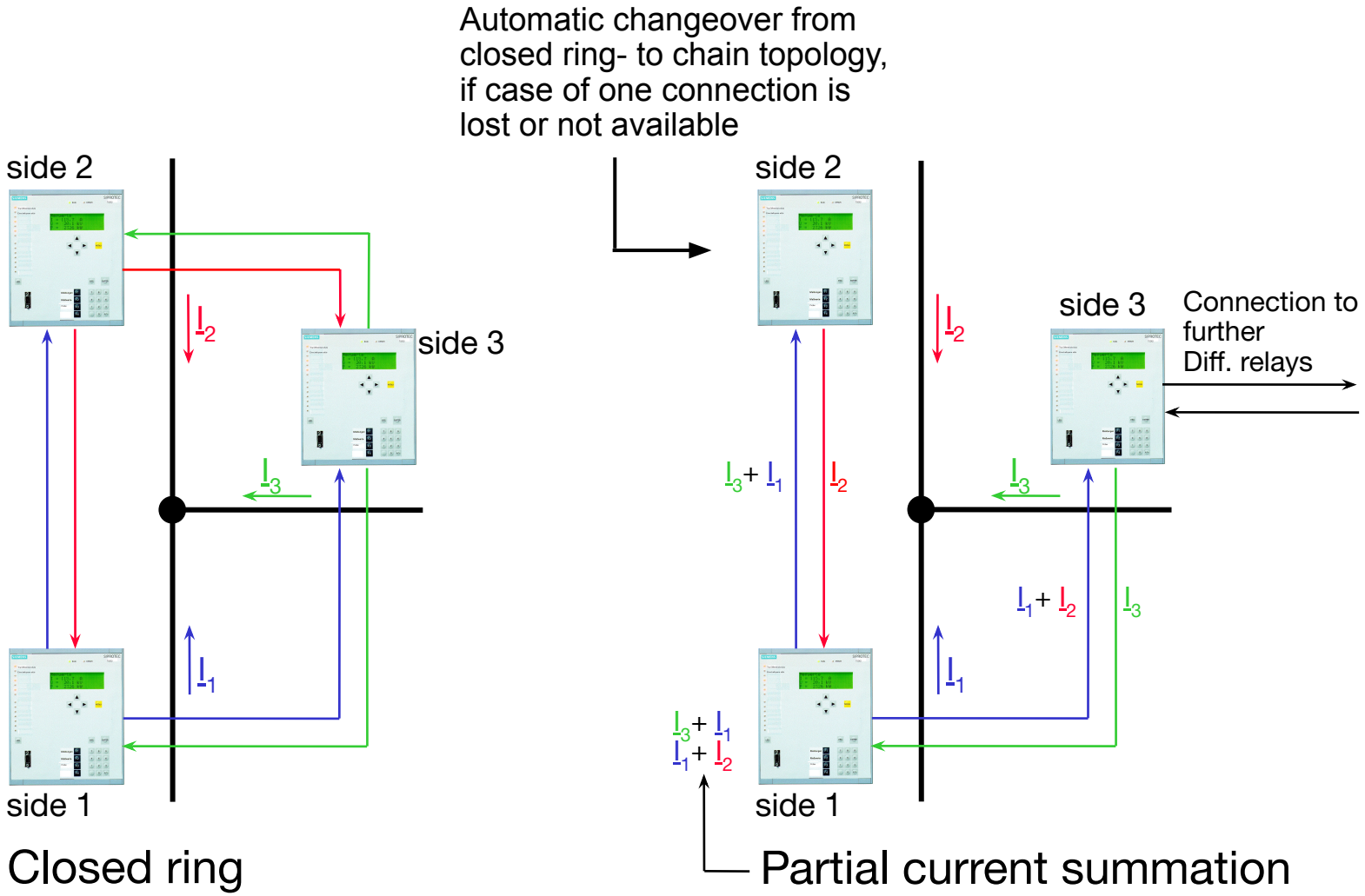


# Relay to Relay Communication
# - Application for a three terminal configuration with 7SD523

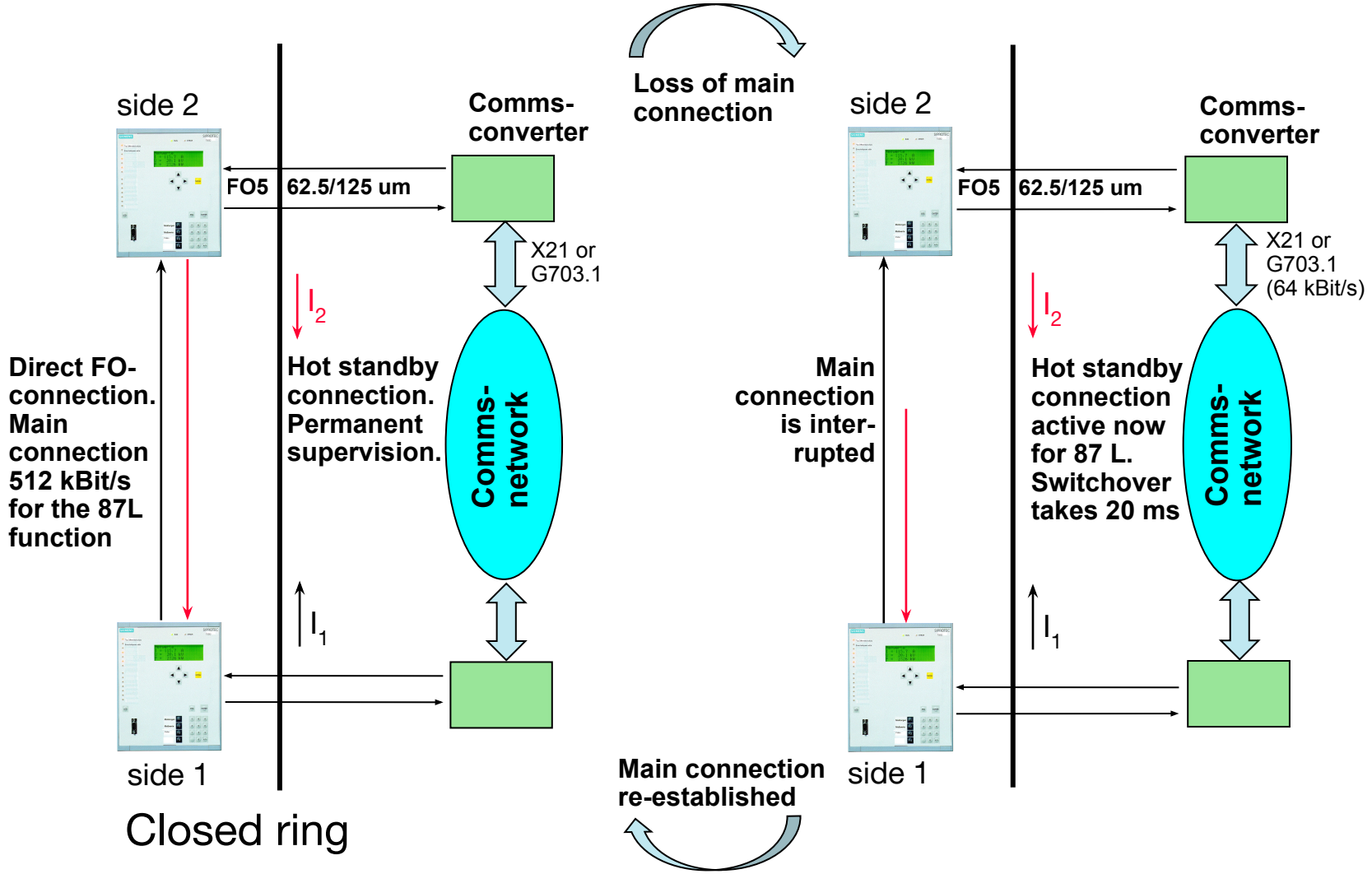


# Relay to Relay Communication

## - Ring- and Chain topology, loss of one data connection tolerated



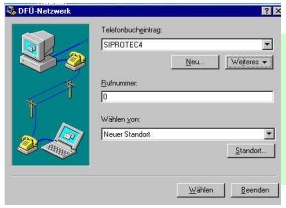
# Relay to Relay Communication
# - Hot - Standby connection in a two terminal configuration



# WEB-Technology

IBS-Tool

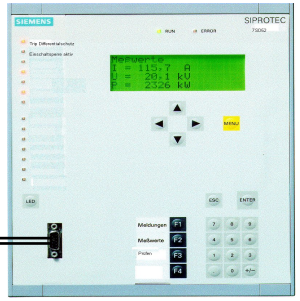
**Help system** in
INTRANET / INTERNET
http://www.siprotec.com



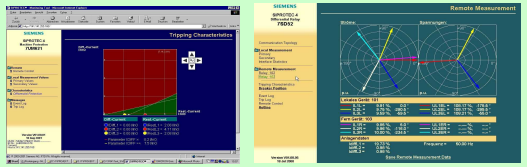

**1. Serial connection**
Direct or via modem with a standard DIAL-UP Network

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

## 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



**WEB server in the relays firmware**

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

# Commissioning and operating aids (2 of 5)

SIEMENS

SIPROTEC 4
Differential Relay
7SD523

Communication Topology

**Local Measurement**
Primary
**Secondary**
Interface Statistics

**Remote Measurement**
*Relay: 2*

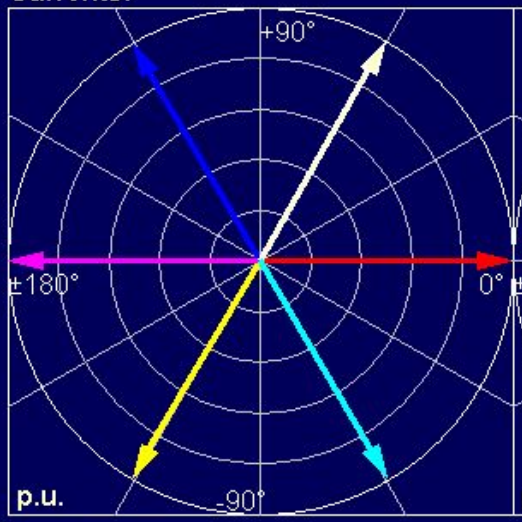
Tripping Characteristics
Breaker Position

**Event Log**
**Trip Log**
**Remote Control**
**Hotline**

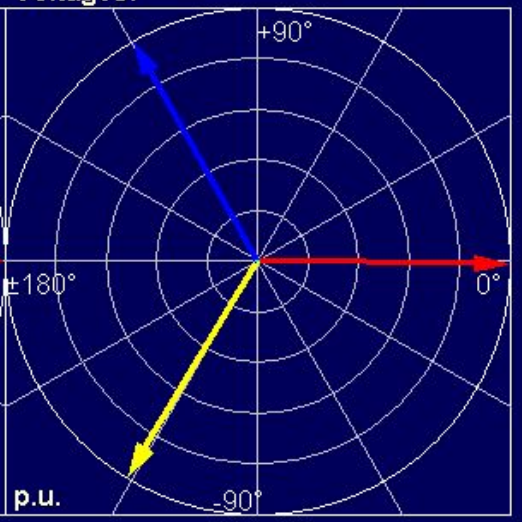
**Version V01.03.01**
**14 Feb 2003**
MLFB: 7SD52315AB399CN1-----1A3A-----
BF-Nr.: 0002056045
Connect
Host is:141.142.255.150

## Remote Measurement

Currents:




Voltages:




**Local Address: 1**

| | | | | | |
|---|---|---|---|---|---|
| IL1L = | 99.79 %, | 0.0 ° | VL1EL = | 99.01 %, | -1.0 ° |
| IL2L = | 99.72 %, | -120.5 ° | VL2EL = | 99.03 %, | -121.0 ° |
| IL3L = | 99.72 %, | 120.5 ° | VL3EL = | 99.06 %, | 119.5 ° |

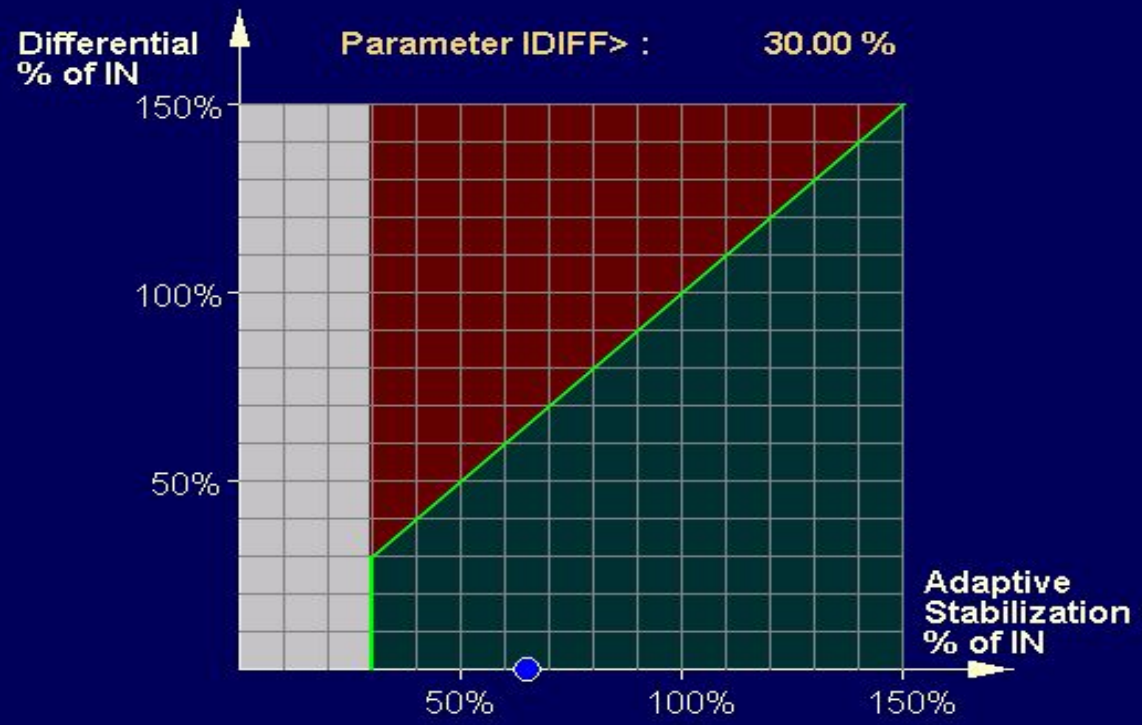
**Remote Address: 2**

| | | | | | |
|---|---|---|---|---|---|
| IL1R = | 99.89 %, | -180.0 ° | VL1ER = | –.— %, | –.– ° |
| IL2R = | 99.91 %, | 60.0 ° | VL2ER = | –.— %, | –.– ° |
| IL3R = | 99.87 %, | -59.5 ° | VL3ER = | –.— %, | –.– ° |

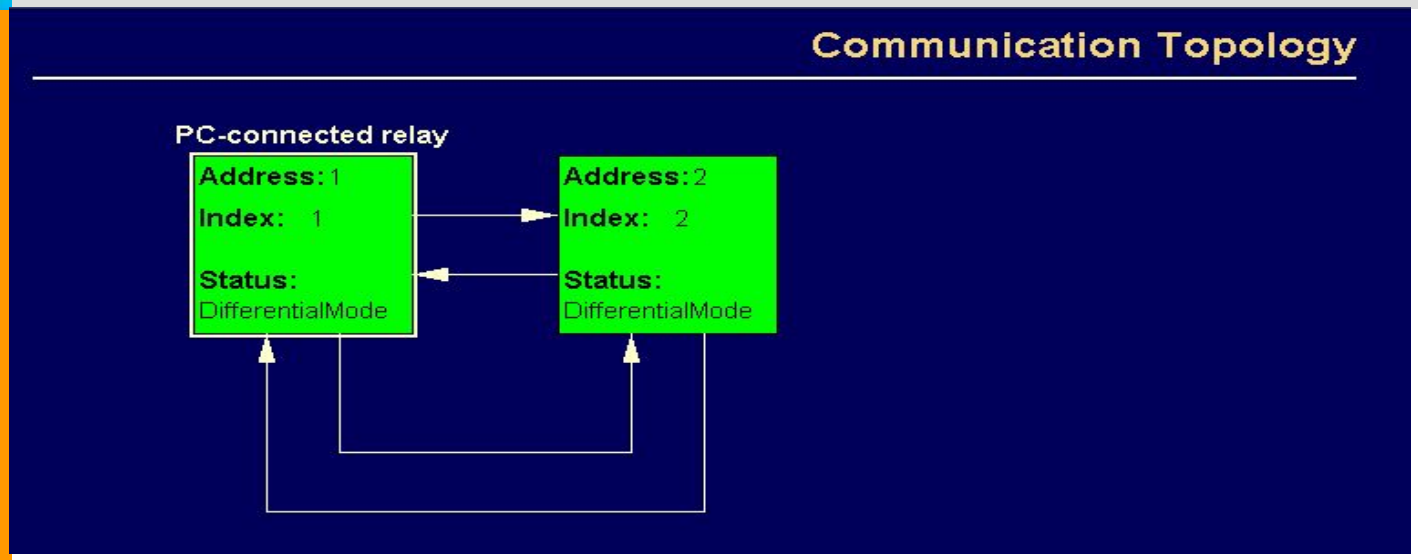
**Constellation Data:**

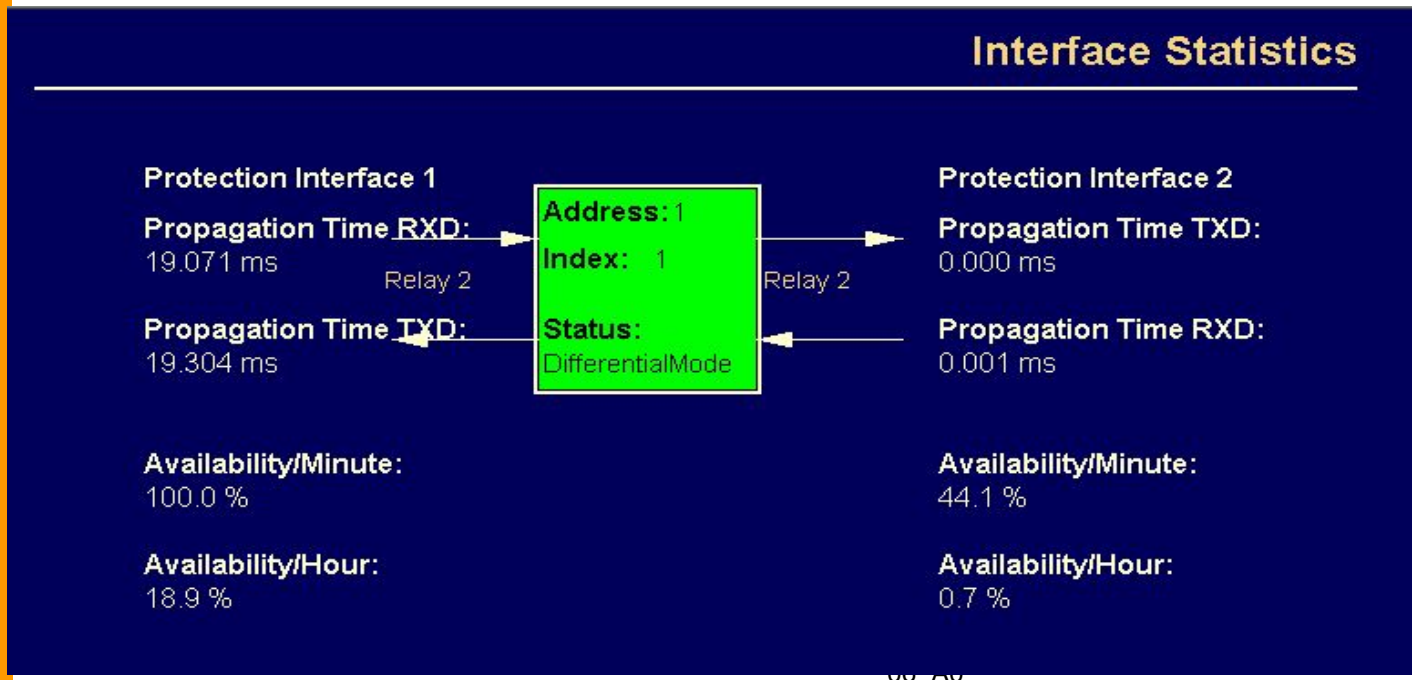
| | | | |
|---|---|---|---|
| IdiffL1 = | 0.00 % | Frequency = | 50.00 Hz |
| IdiffL2 = | 0.00 % | | |
| IdiffL3 = | 0.00 % | | |

## Tripping Characteristics



# Commissioning and operating aids (4 of 5)



# Commissioning and operating aids (5 of 5)