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## Setting Example

### ABB REL 551 / 561 and Fibersystem 21-170 for G.703 E1 (2 Mbit)

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ABB Power Technologies AB

### Alternative I. Transceiver 21-170 service settings for high quality communication

Use the 21-170 technical manual as reference.

#### 1. Service settings with the port for 21-170 synchronized to the SDH system master clock (SDH system)

Alternative 1 requires that the port for 21-170 be synchronized from the actual SDH network master clock. Thus the SDH MUX must be set to fulfill this. This setting is vendor dependent, but normally the SDH MUX has to be set for retiming and the format according G.704 framed, structured, unstructured etc. See page 8.

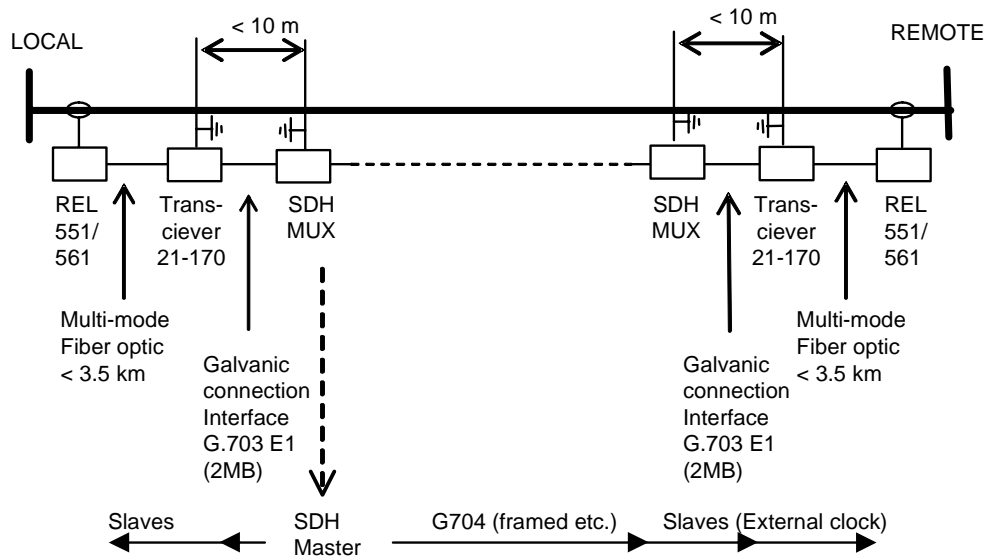
The format *transparent* cannot be used for alternative 1 because no synchronization on the 21-170 SDH ports are available.

#### 1.1 Communication structure

REL 551/561 Line differential relay

Transceiver 21-170 Optical/electrical interface converter

SDH MUX = Multiplexer in the SDH system



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#### 1.2 Setting of clock source (slave mode)

In normal operation the 21-170 at both end of a line shall be configured for External clock, thus the configuration switch at the front shall be in position 0, the led 1, 2, 4, 8 shall all be off.

## Alternative II. Service settings for normal quality communication

Use the 21-170 technical manual as reference.

### 2 Service settings with the SDH port synchronized from one of the 21-170 transceivers (PDH system)

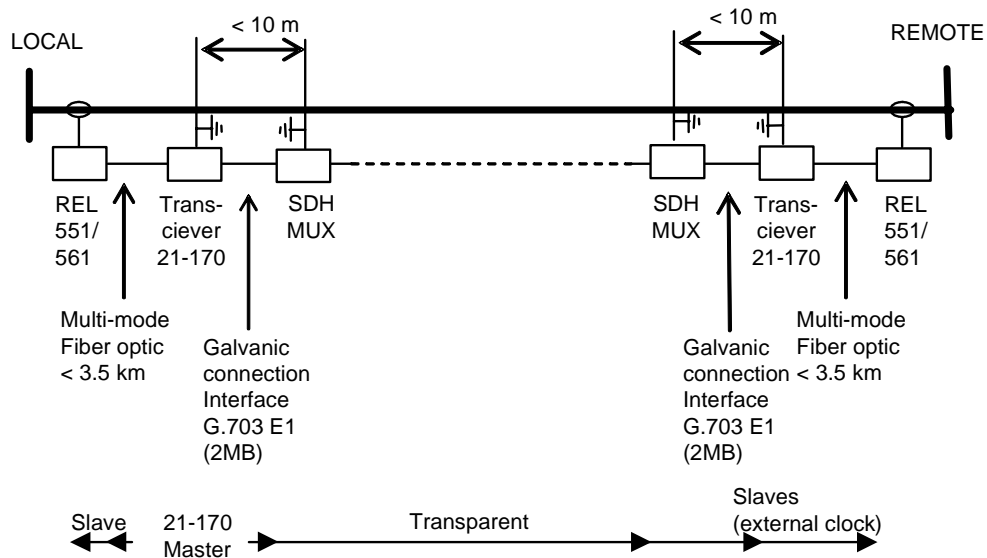
Alternative II requires that the synchronization is provided from external source, for example one of the 21-170 transceivers. Thus the SDH MUX must be set not to interfere with the synchronization. This setting is normally fulfilled by setting the SDH MUX in transparent mode, see page 8.

#### 2.1 Communication structure

REL 551/561 Line differential relay

Transceiver 21-170 Optical/electrical interface converter

SDH MUX = Multiplexer in the SDH system



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#### 2.2 Setting of clock source (Master - slave mode)

Master 21-170; In normal operation the 21-170 master should be set for *Internal clock*. Thus the configuration switch at the front shall be in position 1. LED 1 shall be lit. The LED 2, 4, 8 shall all be off.

Slave 21-170; In normal operation the 21-170 slave shall be configured for *External clock*. Thus the configuration switch at the front shall be in position 0. The LED 1, 2, 4, 8 shall all be off.

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### 3. Detection of communication faults

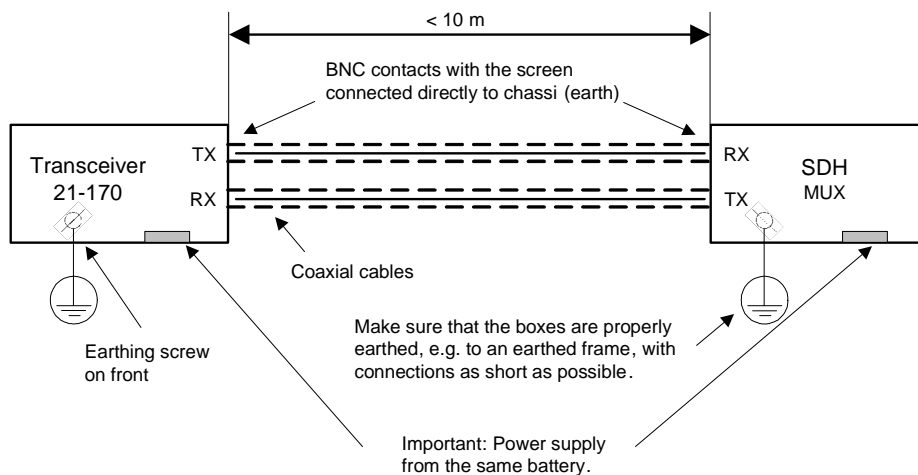
There is supervision on the 21-170, which can be used for fault tracing. There are two red light emitting diodes on the front of the 21-170, MLO, Memory Local Alarm indicating some problem in 21-170 and MRO, Memory Remote Alarm, which is supervising the fiber optic link from the 21-170 to REL 551/561.

If there is a communication fail alarm in REL 551, and there is no indication for MLO or MRO on the 21-170, then the communication interruption is in the telecommunication system.

### 4. Earthing of 21-170

The interface protection circuitry in the 21-170 is based on the requirement that the MUX interface is directly or low resistive grounded to the same ground as the grounding screw on the front of the 21-170. There is no over current protection between interface ground and functional earth so if there is a potential difference between the 21-170 ground and the MUX ground it will result in a current flowing in the outer shield of the connecting cable that may damage the cable and degrade the system functionality with bit error as a consequence.

**Thus a correct grounding is essential, with the coaxial cable's outer shield grounded to the chassi via the BNC contacts at both ends, see below.**



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### 5. Communication settings of REL 551 / 561 for 21-170 and G.703 E1 in SDH/PDH systems

The same settings are used for both alternative I and alternative II, see section 1 or 2.

**Dip-switches S2**

Located below fiber optic connector. See Figure 1.  
 (The cover plate must be removed)

	Local relay	Remote relay	
S2/Switch 1	OFF	OFF	Sw1 is not used when Sw2 = OFF
S2/Switch 2	OFF	OFF	Sw2 = OFF means no synchronization
S2/Switch 3	OFF	OFF	S4 = ON means timing recovered from the received optical signal.
S2/Switch 4	ON	ON	

MRA = Memory Remote Alarm, self supervision of fiber optical link to REL 551/ 561

MLA = Memory Local Alarm, self-supervision of 21-170.

LO = Link Opto, fiber optic link to REL 551/561 is OK

LA = Local Alarm, 21-170 Error

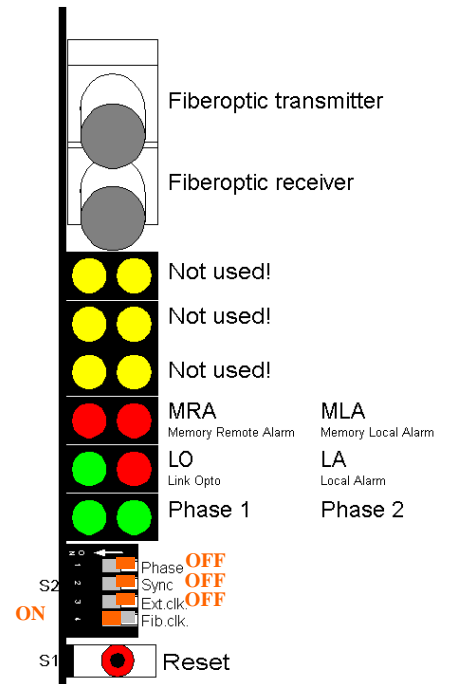


Figure 1: Communication setting in REL 551/561 for built-in short range fiberoptic modem

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**5.1 Jumper location on the built-in short range optical modem**

The jumpers are normally factory set in the correct position. For fault tracing it can be necessary to check the jumper positions.

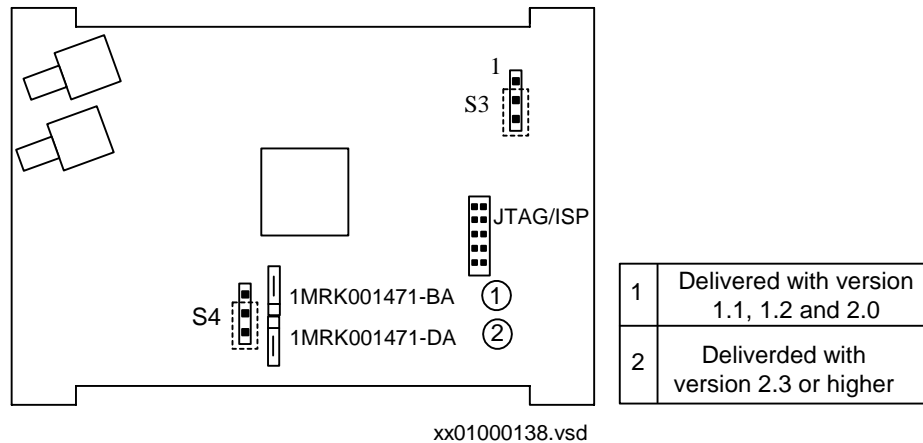
The jumpers are accessible after the modem has been pulled out. This is done by first removing all green 18-pin connectors at the back, and then remove all screws holding the back plate. After the back plate has been removed the modem can be pulled out.

There are some jumpers on the circuit board that have to be correctly set. One, S4 is for changing the functionality between 1MRK 001 370-BA delivered with version 1.1, 1.2 and 2.0 (marked 1MRK 001 471-BA) and 1MRK 001 370-DA delivered with version 2.3 and higher (marked 1MRK 001 471-DA). The difference between these two is that the transmitted and received signal is inverted in one compared to the other.

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When a terminal of version 1.1, 1.2 or 2.0 is to communicate with a terminal of version 2.3 or higher it is recommended that the jumper is changed to 1MRK 001 370-BA in the version 2.3 terminal. This is due to that older versions of this module lacks the possibility to set article number, they are fixed set at 1MRK 001 370-BA. If both terminals however included modules with possibility to change article number it actually doesn't matter what article number is used as long as the same number is used in both terminals.

The other jumper is S3 that has to be in bottom position.

On JTAG/ISP there shall be no jumpers inserted (used only for factory testing).

#### Note!

When using a set up only at one end and for example a built-in G.703 modem the other end a short-range fiber optical modem according to 1MRK 001 370-DA must be used.

## 5.2. Channel requirements

There is a short delay in alarm time in the REx551/561, 100 ms, for the communication fail in the relay, derived from dependability of the differential protection function. This will require a communication system with satisfactory quality. If the communication system is disturbed more than 100 ms, for example from the operation of an isolator or for route switching, an alarm will be correctly issued.

If route switched networks are used, special measures have to be taken to ensure that the communication has the same route in both directions within 0,2-0,5 ms. Different routes can be tolerated during route switching for < 2 seconds.

**A sample specification of communication requirements for REL 551/561, see page 8.**

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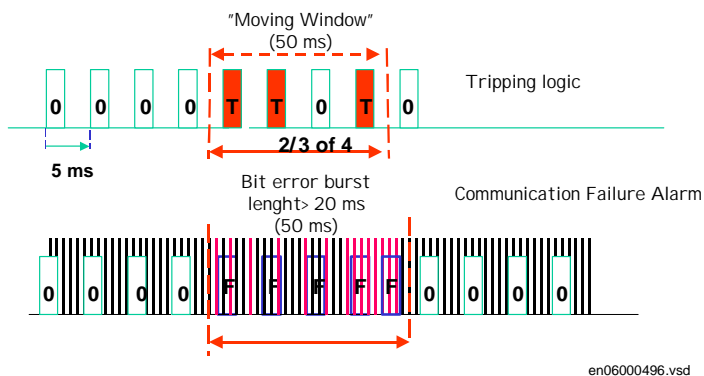
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### 5.3 Check of settings on the HMI

After making these settings, check the result on the HMI of the REL 551 / 561. Look under Service Report / Functions / Differential / DiffCom on both end terminals and verify that the communication is OK.

### 5.4 Detection of communication interruptions

- Message between the two terminals for evaluation every 5 ms/phase
- Trip at 2 or 3 "trip" evaluations out of 4 evaluations
- a and b are transmitted together with check bits
- Communication fail alarm after five consecutive corrupted messages (20 ms)



#### Messages on HMI ( not COM\_FAIL)

Short interruptions 20-50 ms  
 Medium interruptions 50-150 ms  
 Long interruptions > 150 ms

TransmDelay:	= 0 us
NoOfShInterr	= 0
NoOfMedInterr	= 0
NoOfLongInterr	= 0
CommStatus	= OK
NoOfTXD	= 100%
NoOfRXD	= 100%
Sync Error	= 0 us

### 6. Communication structure for laboratory testing

During laboratory testing the 21-170 can be connected back-to-back. One of the 21-170 has to provide the timing. This is done by turning the configuration switch to pos 1 "EXT CLK" on one of them, led 1 shall be lit and led 2, 4, 8 shall be off.

### 7. Disassembling of electronic equipment

Before disassembling any electronic equipment, remember the consequences of the ESD phenomenon. Most electronic components are sensitive to electrostatic discharge and latent damage may occur. Please observe usual procedures for handling electronics and also use an ESD wrist strap. A semi-conducting layer must be placed on the workbench and connected to earth.

Disassemble and reassemble the electronic devices according to the applicable manuals.

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## **Sample specification of communication requirements for differential protection REL 551/561 in digital telecommunication networks**

The communication requirements are based on echo timing.

### **Bit Error Rate (BER) according to ITU-T G.821, G.826 and G.828**

- $< 10^{-6}$  according to the standard for data and voice transfer

### **Bit Error Rate (BER) for high availability of the differential protection**

- $< 10^{-8}$  -  $10^{-9}$  during normal operation
- $< 10^{-6}$  during disturbed operation

During disturbed conditions, the trip window function in REL 551/561 can cope with high bit error rates up to  $10^{-5}$  or even up to  $10^{-4}$ . The trip window can be configured to be independent of COMFAIL from the differential protection supervision, or blocked when COMFAIL is issued after receive error  $> 100$ ms

### **Synchronization in SDH systems with G703 E1**

according to ITU-T G.803, G.810-13

- One master clock for the actual network
- The actual port Synchronized to the SDH system clock at 2048 kbit
- Synchronization; bit synchronized, synchronized mapping
- Maximum clock deviation  $< \pm 50$  ppm nominal,  $< \pm 100$  ppm operational
- Jitter and Wander according to ITU-T G.823 and G.825
- Buffer memory  $< 250 \mu\text{s}$ ,  $< 100 \mu\text{s}$  asymmetric difference
- Format. G 704 frame, structured etc

### **Synchronization in PDH systems connected to SDH systems with G703 E1**

- Independent synchronization, asynchronous mapping.
- The actual SDH port synchronized from external master clock, i.e. from the 21-170 modems in Master-Slave mode
- Maximum clock deviation  $< \pm 50$  ppm nominal,  $< \pm 100$  ppm operational
- Jitter and Wander according to ITU-T G.823 and G.825
- Buffer memory  $< 100 \mu\text{s}$
- Format: Transparent

### **Maximum channel delay**

- Loop time  $< 30$  ms continuous (2x 15 ms)
- Both channels must have the same route with maximum asymmetry of 0,2-0,5 ms, depending on set sensitivity
- A fixed asymmetry can be compensated (Setting of asymmetric delay in built in HMI or the parameter setting tool PST.)



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**Interruptions/route switching etc**

- Protection requirement: Route switching/interruptions should be < 20- 50 ms.
- Communication requirement for maintained synchronization of the protection terminals is interruptions < 2 seconds. For longer interruptions, resynchronization will take place.

**Selectivity planning**

A missed protection message due to for example a bit error, prolongs the tripping time 5 ms. (Maximum interruption time/ bit error rate should be part of the selectivity planning.)

More detailed information

[REL 551 documentation](#)

[REL 561 documentation](#)

[Fibersystem 21-170 documentation](#)