LANCIER Monitoring

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Tx-Bus
Mode of operation and planning rules

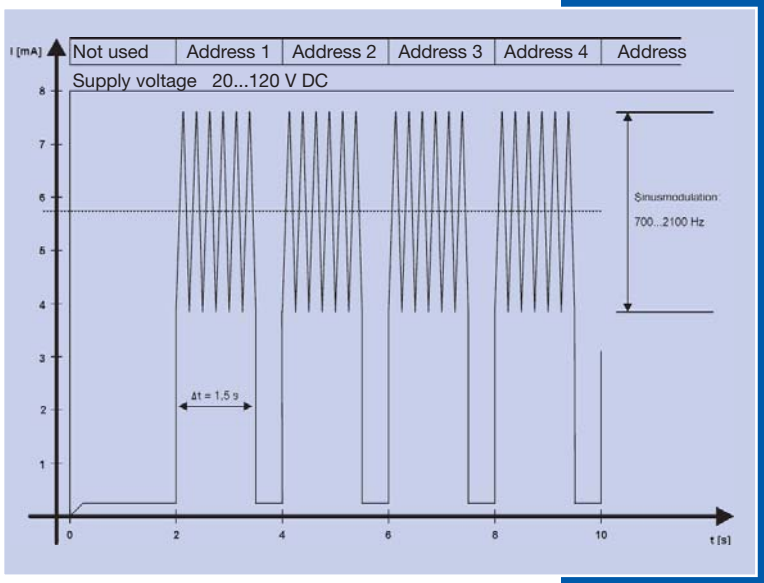
1. General operation of addressable sensors

Addressable sensors convert the physical value to be monitored into a frequency. Depending on the assigned address (coding) the frequency is transmitted in one out of 127 available time slots. Each time slot has a length of two seconds.

During the transmission the sensor modulates the currency at a frequency that corresponds to the measured value at 3.7 mA_{pp} (= 0 dBm/600 Ω) onto the DC supply current.

Therefore the used pair is power supply (direct current) and transmission media (alternate current) at the same time. With this technology it is possible to connect up to 127 sensors to a single pair (Tx-Bus) and to transmit all values within a maximum of 256 seconds. An additional power supply of the sensors is not necessary.

The current and voltage on the Tx-Bus are shown in the following figure.



2. Planning

Free pairs in the network are needed to connect the addressable sensors to the channels of the monitoring systems (RTU, DW 1005E with measurement card QE16 or DW101E). This dedicated pair used for the sensors is called "Tx-Bus". Up to 127 sensors can be connected to each Tx-Bus. The connection of sensors with different physical parameters it permitted.

On each Tx-Bus only sensors with individual addresses are allowed. The geographical location and the order of the addresses is not relevant to the function of the system.

3. Quality of the Tx-Bus pairs

The Tx-Bus pairs to which the addressable sensors are connected for use with the LANCIER monitoring system, have to comply with certain electrical qualities as shown in this chapter. Appropriate measurements must be carried out before connecting the sensors.

After the sensors have been connected to the Tx-Bus pair, insulation resistance measurements may only be carried out with the LANCIER monitoring sytem being disconnected. Measurement is to be made only against ground, and with a maximum voltage of 100 V.

Measurements of the electric strength may not be carried out when the sensors are connected to the Tx-Bus pair. If the symmetrical lines of the cables are equipped with surge arresters, such arresters must also be provided for the Tx-Bus pairs (Response voltage of the arresters 130 V … 230 V).

Insulation resistance ≥ 5 MΩ
for wires up to 200 km long, i.e. > 1 GΩ per km

Noise voltage < 50 mV_{pp}
of the free pair, terminated with 600 Ω at the far end

Electric strength **> 500 V_{eff} Wire vs. Wire**
> 2000 V_{eff} Wire vs. Ground
of the free pair

Cable attenuation **< 20 dB in main distribution cables**
< 30 dB in long distance cables
for the complete length of the pair at f = 700 ... 2100 Hz

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Tx-Bus pairs may be connected in parallel at the MDF in central exchanges or at the termination strip at the monitoring system to one channel.

The total loss of parallel connected Tx-Bus pairs shall not exceed 20 dB at 2000 Hz. For easy calculation the following rule can be used:
Add the Tx-Bus pair attenuation of pairs to be connected in parallel. The total loss shall be smaller than 20 dB at 2000 Hz. On the parallel connected Tx-Bus pairs (channel) the addressable sensors have to be coded in a way that each address exists only one time.

The following maximum lengths are achievable per channel:

Wire diam. (mm)	Length (km) at 20 dB	Length (km) at 30 dB
0,3	9,5	14,3
0,4	12,1	18,2
0,5	15,4	23,1
0,6	18,2	27,3
0,8	25,0	37,5
0,9	30,1	46,2
1,2	44,4	66,7

The direct monitoring distance with addressable sensors can be expanded by using loaded Tx-Bus pairs. It is very important to ensure that the resonance frequency which results from the coils and the balancing capacitor does not affect the transmission signal of the sensors. Measurements with the testbox (see chapter 8) and an oscilloscope are imperative.

The whole pair length must be galvanically connected through, i.e. it may not be equipped with transformers. For the connection of galvanically separated sections to the Tx-Bus special transmission and receiving modules (RxIf module and TxIf module) are available (see chapter 6).

Wire diam. (mm)	Length (km) at 20 dB	Length (km) at 30 dB
Loading with 66 mH, distance s = 1500 yd = 1,37 km		
0,6	33,9	50,8
0,8	60,6	90,9
0,9	74,1	111,1
Loading with 88/36 mH, distance s = 2000 yd = 1,83 km		
0,8	76,9	115,8
0,9	90,9	136,4
1,2	142,9	214,3

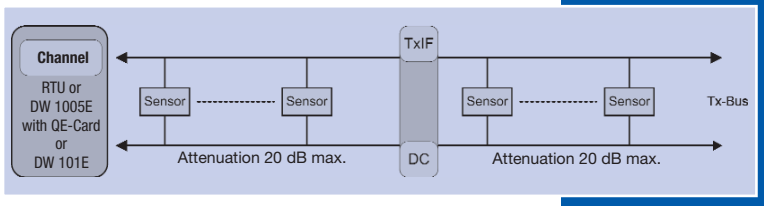
4. Branching, polarity

T-branches and crossings (a,b/b,a) of the Tx-Bus pairs in the network are allowed if the electrical qualities mentioned in chapter 2 are maintained.

The two wires of the sensors (same colour) can be connected to the Tx-Bus independently of the polarity.

5. Extending the LANCIER Tx-Bus via repeater

At greater distances additional repeaters can be used if a power supply is locally available. Not more than two repeaters should be used on the same Tx-Bus as the noise is amplified as well as the signal. Therfore a maximum range of 60 dB can be achieved.



The repeater consists of an interface module type TxIf with an output level of 0 dBm (standard) and a DC/DC converter for the power supply of the TxIf and the remote Tx-Bus. The components can be delivered readily installed and wired in a mounting box. The terminal clamps for the supply voltage of 48 to 60 VDC and the Tx-Bus are easily accessible.

A 230 V AC mains adaptor can be integrated optionally.

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6. Extending the LANCIER Tx-Bus via a speaking channel

Occasionally small parts of the cable network are not connectable with a copper cable to the LANCER Monitoring-System directly. Hence it follows that the sensor signals must be transmitted via a speaking channel.

At the beginning of an interrogation cycle a DC-voltage is switched to the Tx-Bus. It is used - on the one hand - to power-supply the sensors and on the other hand to synchronise the transmission timing (see chapter 1). The sensors on the bus answer corresponding to their coding with a current modulation in the frequency range of 700-2100 Hz representing their latest measurement.

To operate with other transmission systems the two signals have to be separated and refined.

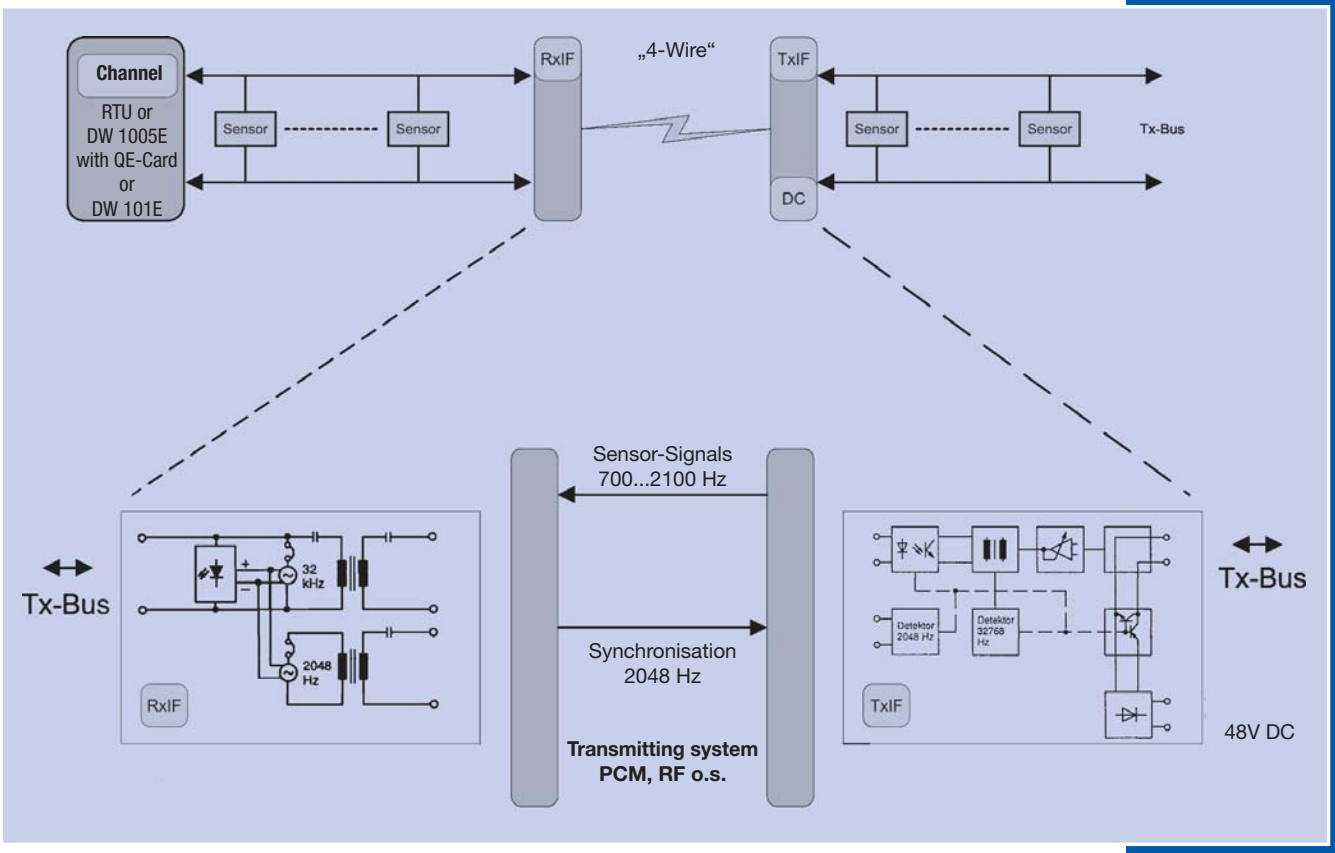
- A synchronisation-signal generated from the DC-voltage is transmitted from the directly monitored Tx-Bus to the derived circuit.
- The sensor signals instead have to be transmitted vice versa from the derived circuit to the directly monitored Tx-Bus.

The principle of the transmission is shown below. The RxIf module cares for the decoupling of the 2048 Hz- Sync signal and for the coupling of the received sensor signals.

The TxIf module switches the power-supply for the sensors to the derived Tx-Bus when it receives the synchronisation signal and couples the sensor signals to the transmission system.

The remote monitoring via non- galvanically connected lines requires a transmission system with a permanent 4-wire-connection with transmission and receiving speaking channel. All digital systems via copper (e.g. PCM) or fiber optical cables are usable. Radio links can also be used.

The interface modules RxIf and TxIf as well as the DC/DC - converter for physically separated DC-supply are delivered in plastic snap-on housings. The modules are mounted in a wall housing depending on the required protection class.



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7. Coding of addressable Sensors

The sensor addresses 1 to 127 are created by means of the binary system with the numbers 2^0 to 2^6 (decimal 1, 2, 4, 8, 16, 32, 64). The sum of the coded values is the respective address of the sensor. The table shows some examples:

The coding is done - depending on the type of sensor - by coding bridges or jumpers. A detailed description can be found in the mounting instructions of the sensor. The correct coding should be checked with the LANCIER Testbox (see below).

Address	Values	2^0	2^1	2^2	2^3	2^4	2^5	2^6
4	4			X				
11	1+2+8	X	X		X			
57	1+8+16+32	X			X	X	X	

8. Testbox

The LANCIER-Testbox is a test control unit, that has been purpose-built for testing the function of addressable sensors. It is used to check the correct coding of the sensors. The Tesbox can also be connected to the Tx-Bus pair to find out which addresses are already in use. Furthermore it is used to check the designated Tx-Bus pair before the installation of sensors (see also „Technical Information Testbox“).

Ordering Data

TxIf 0 dBm	**Order-no. 050527.000**
TxIf -14 dBm	**Order-no. 050527.014**
RxIf 0 dBm	**Order-no. 050528.000**
RxIf -14 dBm	**Order-no. 050528.014**
DC/DC Transducer	**Order-no. 052473.000**
230 V AC Power supply unit	**Order-no. 071662.000**
Mounting case	**Order-no. 065076.000**
Testbox	**Order-no. 050833.000**