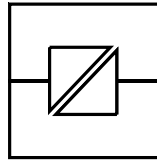# LR-11
LR-11PP

INSTALLATION MANUAL
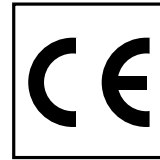
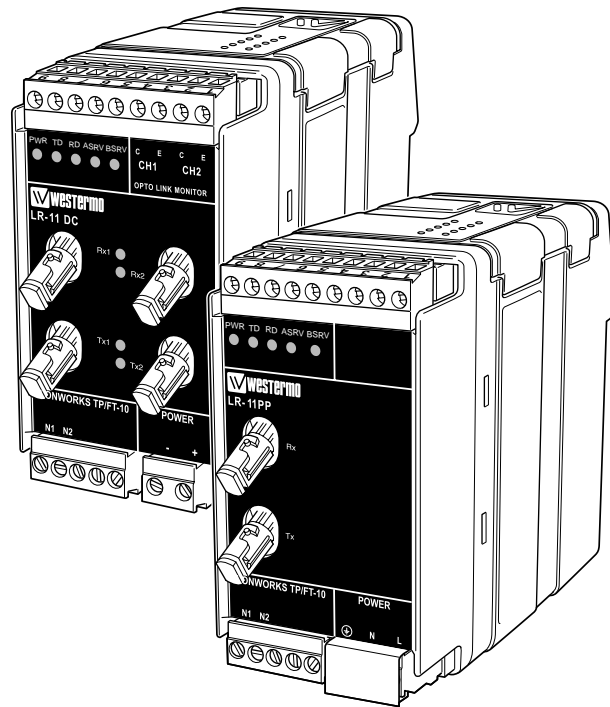## 6608-2211

Galvanic
Isolation
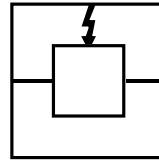
Transient
Protection

CE
Approved

C ϵ

Fibre optic router for TP/FT-10

Westermo®

www.westermo.se

Contents

1 SPECIFICATIONS LR-11/LR-11PP

GENERAL

FIBRE

Maximum fibre length	25 000 m (between two LR-11 units)

TECHNICAL DATA

Transmission	Routing of LonTalk®, packets using Echelon RTR-10 router core
Interface 1	LONWORKS® TP/FT, FTT-10A, 5-position screw block
Interface 2	See model specific data
Indicators	See model specific data
Transmission rate	LONWORKS® TP/FT 78 kbit/s
	Fibre optic 1 250 kbit/s
Weight, kg	0.3 kg
Mounting	On 35 mm DIN-rail

POWER SUPPLY ALTERNATIVES

	LR-11/LR-11PP HV	LR-11/LR-11PP LV
Model description		
Power supply	95–240 V AC ± 10%	12–45 V AC ± 10%
	110–240 V DC ± 10%	12–55 V DC ± 10%
Frequency	48–62 Hz / –	48–62 Hz / –
Fuse, F2	1 A T Wickmann	1 A T Wickmann
Power consumption	40 mA	4 W
Transient protection		
Power/Line	Yes/Yes	Yes/Yes
Isolation RMS		
Power supply	3 750 V	3 750 V

MODEL SPECIFIC DATA

	LR-11	LR-11PP
Interface 2	Fibre optic,	Fibre optic,
	4 ST-connectors,	2 ST-connectors,
	See Power budget table on page 14	See table on page 14
Indicators	PWR, TD, RD, Tx1, Tx2,	PWR, TD, RD, ASRV, BSRV
	Rx1, Rx2, ASRV, BSRV	

LED INDICATION

LED	FUNCTION
PWR	Indicates that the unit has power
TD	Indicates transmitting data on fibre side
RD	Indicates transmitting data on TP/FT side
Rx1	Indicates receiving data on fibre receiver 1
Tx1	Indicates transmitting data on fibre transmitter 1 from TP/FT side
Rx2	Indicates receiving data on fibre receiver 2
Tx2	Indicates transmitting data on fibre transmitter 2 from TP/FT side
ASRV	Indicates status on router side A (TP/FT)
	OFF: Side A configured
	ON: An unrecovered error has been detected on side A
	Flashing (1 Hz): Side A unconfigured
BSRV	Indicates status on router side B (fibre optic)
	OFF: Side B configured
	ON: An unrecovered error has been detected on side B
	Flashing (1 Hz): Side B unconfigured

2 INTRODUCTION

The LR-11 router offers an easy way to extend the distance between LONWORKS®
78 kbit/s TP/FT network segments using a high-speed 1 250 kbit/s backbone fibre optic
network link.

LR-11 is based on Echelon's RTR-10 standard router core module, this allowing
standard configuration and installation with tools such as LonBuilder® and LonMaker™.
LR-11 routers can be installed as repeaters, configured routers, or learning routers.

The LR-11 is equipped with either one (PP-version) or two pairs of fibre optic receivers
and transmitters. This allows the user to build either point to point-, bus- or ring
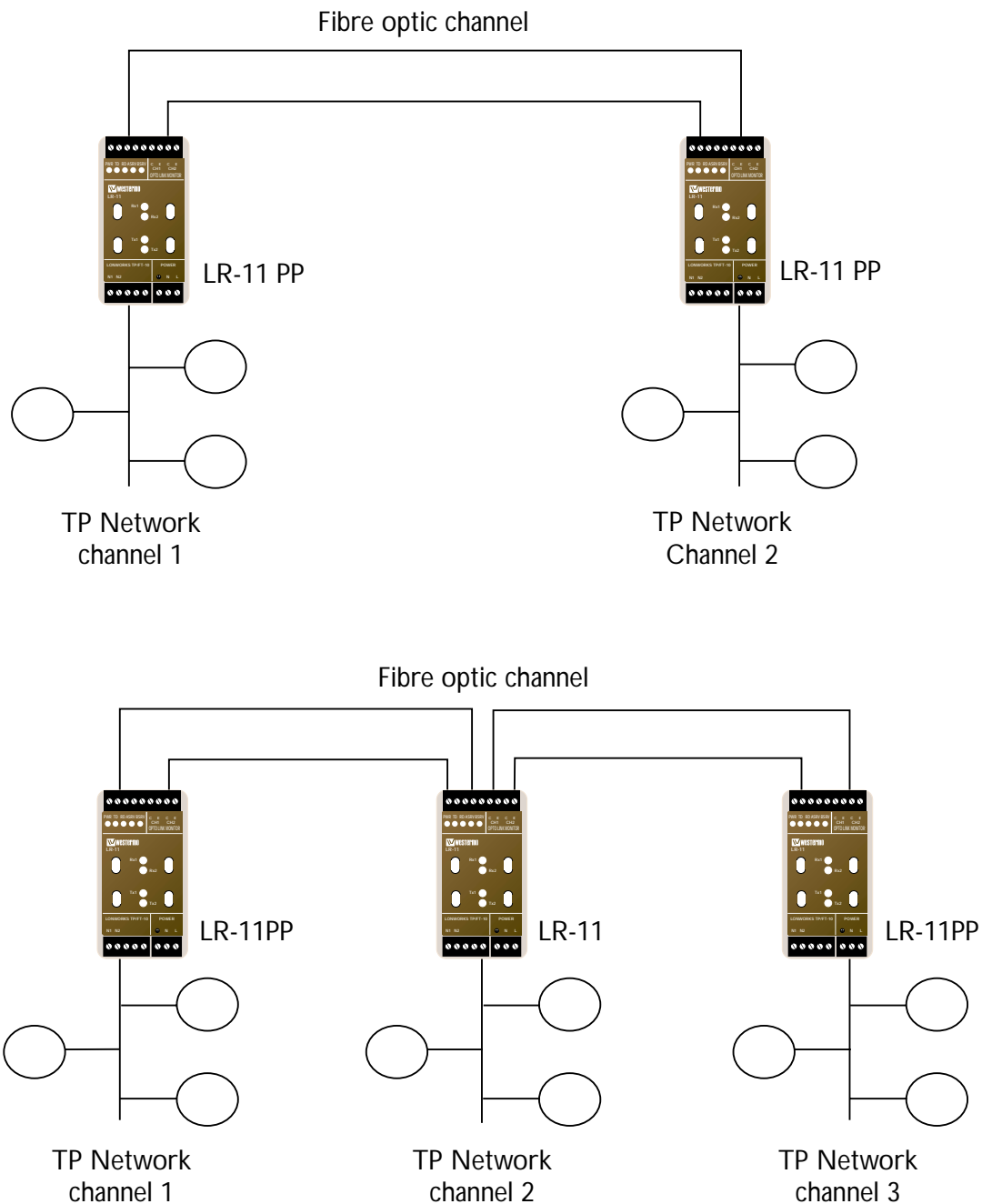topology fibre links.
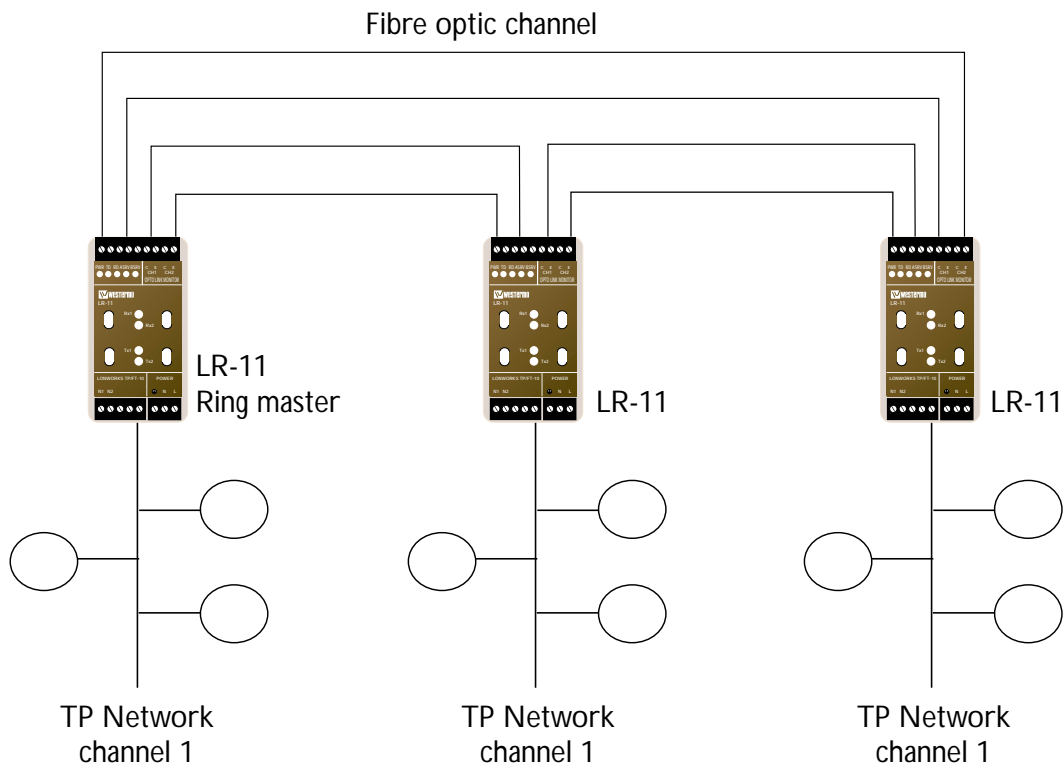

Figure 2.1 Network topologies

Figure 2.2 Network topologies

In a fibre ring, one of the LR-11 units will be assigned as a ring master and then having the responsibility to stop messages from looping around the ring. The LR-11 has a built-in redundancy scheme that provides for fault tolerances in the fibre rings. There is a maximum transmission distance on the fibre link depending on the available power budget of the LR-11 units and losses due to attenuation in cables, connectors and splice joints. With single mode fibre, distances up to 25 km can be reached.

For the fibre channel communication parameters, the LR-11 is by default set with parameters used for small network. Depending on the fibre length and the number of devices the communication parameters may be changed to optimize performance. Section 4 will discuss this matter in further detail.

3 COMMUNICATIONS

The LR-11 routes LonTalk® packets between a TP/FT-10 channel and fibre optic channel. The communication channels consists of a fibre optic interface and a TP/FT-10 interface. The fibre optic interface is equipped with either one (PP-version) or two sets of fibre optic ports, each with its separate transmitter and receiver, and the TP/FT-10 channel consists of one LONWORKS® FTT-10A transceiver. Figure 3.1 illustrates the communication ports on the LR-11.
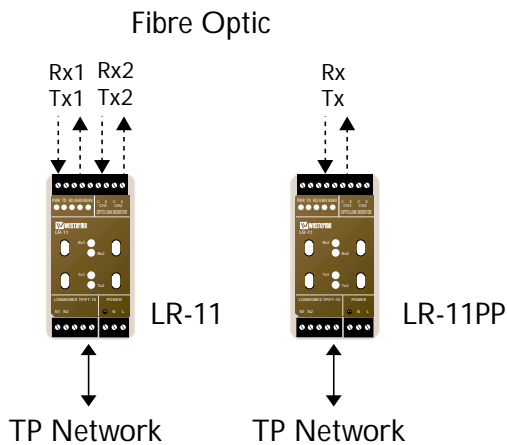
Figure 3.1 Ports on LR-11 and LR-11 PP (point to point)

If there are only two network segments that are to be connected, the point to point version of LR-11 could be used. If the network contains of more than two segments, the data needs to be retransmitted onto the fibre link to other connected network segment.

The LR-11 with its two sets of fibre optic ports can then be used to build bus or ring topology fibre links.

Figure 3.2 illustrates the general data flow when data is received and routed to the fibre side from a TP segment.
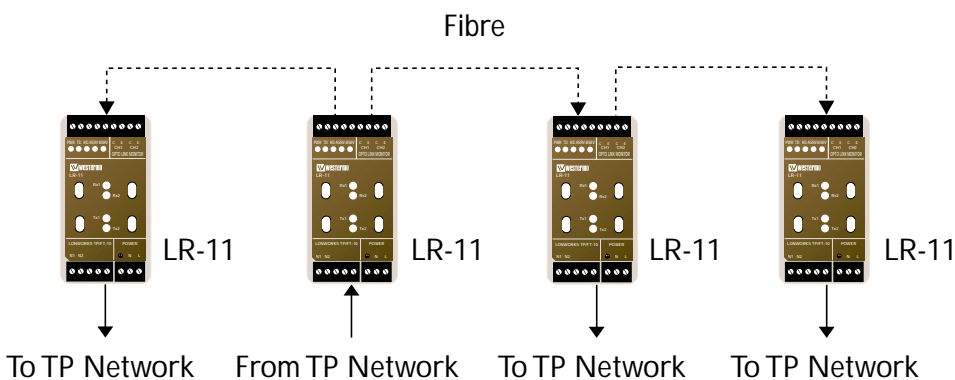
Figure 3.2 General data flow

A LonTalk®packet received on the fibre channel is always forwarded to the next unit on the fibre channel. Depending on the packets destination address and router configuration it may also be forwarded onto the TP/FT channel.

3.1 Point to point topology

With only two network segments, the most cost effective solution is to use two point to point (LR-11PP) units to create a fibre optic connection.

The user could however still choose not to use the point to point units and have the additional link unconnected. In this way the user have the possibility to easily add more units and network segments at a later time.

Figure 3.3 schematically illustrates the data flow in the point to point communication mode.
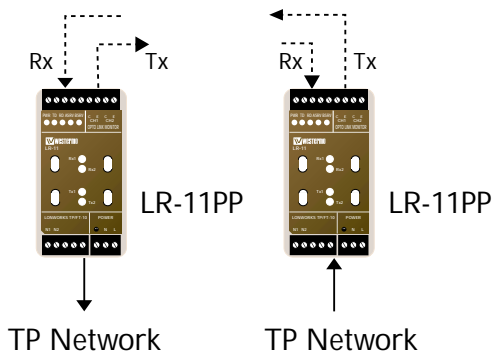

Figure 3.3 Point to point communication

3.2 Bus topology

Using the LR-11 unit gives the possibility to create a fibre optic bus topology.

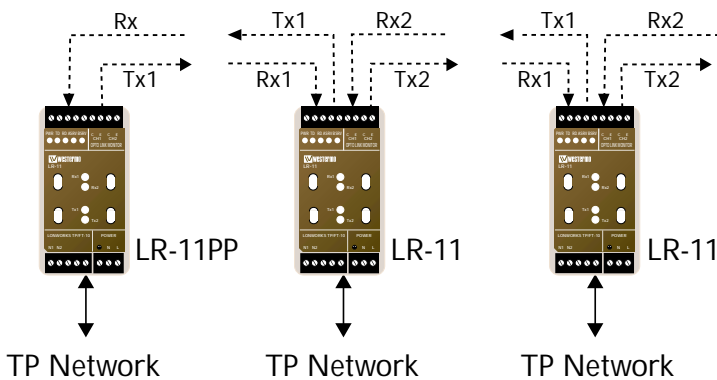The data flow is schematically illustrated in figure 3.4.

Figure 3.4 Bus communication

Data routed to the fibre network will be transmitted onto both F/O links. All data received by a LR-11 unit on either Rx1 or Rx2 is transmitted to the router module and will be transmitted over the corresponding TP network if accepted by the router algorithm. The received data on Rx1 or Rx2 will also be forwarded by the opposite transmitter, Tx2 or Tx1. The units at the endpoints does not need to forward data on both fibre links, and thus only one fibre link is required (PP version).

The bus topology provides a possibility for all LONWORKS®, nodes to send and receive data to and from all TP segments.

3.3 Ring topology

Another possibility with the LR-11 units is to use it in a fibre optic ring topology. The ring topology requires one dedicated LR-11 unit (ring master) to stop all messages on the fibre ring, thus preventing message looping.

With ring topology, a built-in redundancy scheme offers communication fault tolerance. If a fault is detected on one of the fibre links, the data flow will automatically be re-configured to make a new communication path that reaches all units in the ring. The time to set-up the new communication path could take up to 4ms. Any data that is transmitted during that time is lost and needs to be resent. The LR-11 can handle a fault on one fibre or a fibre pair and still be able to communicate. The LR-11 unit has two alarm outputs for fault detection, one for each fibre link.

The redundancy scheme requires the fibre optic links to be connected as follow:

F/O Link 1: Tx2 ⊳ Rx1 ⊳ Tx2 ⊳ Rx1 ⊳ Tx2 etc.

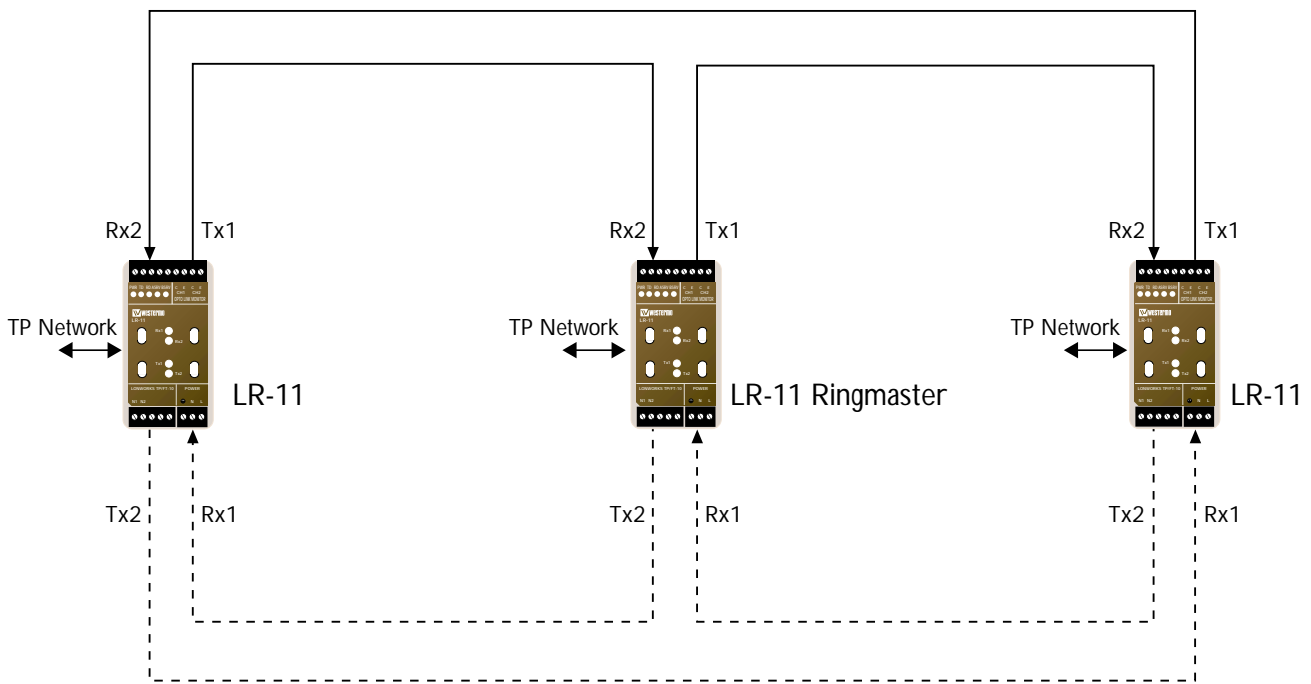F/O Link 2: Tx1 ⊳ Rx2 ⊳ Tx1 ⊳ Rx2 ⊳ Tx1 etc.

Figure 3.5 schematically illustrates how the fibre links are connected to form two rings.
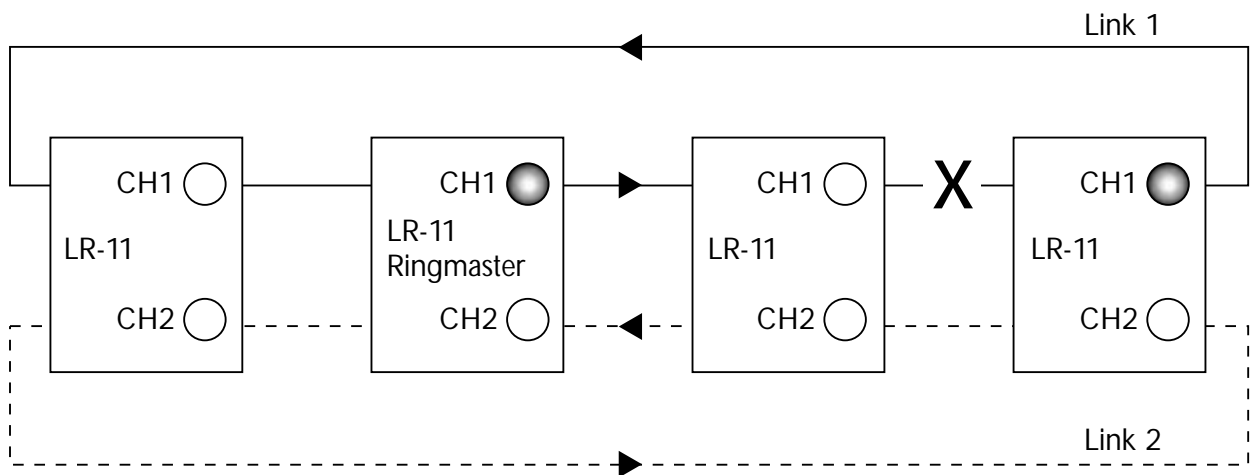
3.3.1 Alarm indications

The LR-11 unit has two alarm outputs marked as CH1 and CH2. When a unit detects a fault on a fibre optic link the circuit between contacts "C" and "E" is opened. See section 6.2 and 6.3 for an example how to connect the alarm output to an external relay.

In case of a fault on a fibre link, the receiver on the closest downstream unit will detect the fault and assert a receive failure alarm. The ring master will also be aware of the fault and assert the link failure alarm corresponding to the faulty fibre link. In that way a monitoring system only needs to monitor the ring master to obtain the over-all status of the two fibre links. To find which segment that is broken the alarm status on each unit must be investigated.
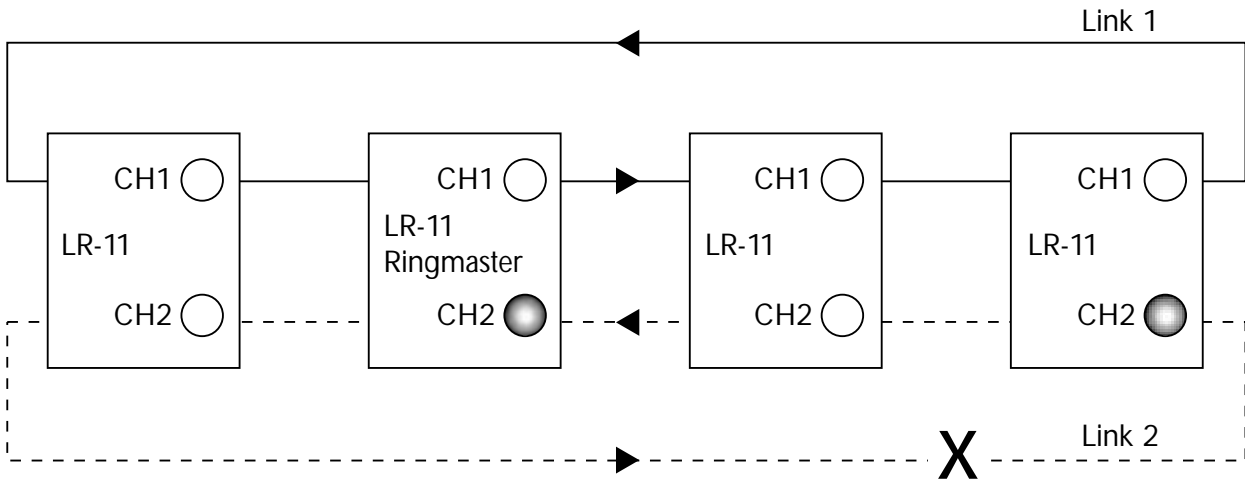
Below are some examples of LR-11 alarm indications when a fault is detected on the fibre link. The break is indicated with a **X** and an asserted alarm output with a filled circle. The faults showed in these examples are recovered by the built-in redundancy scheme within 4 ms. An alarm will remain asserted until the fault is repaired, i.e. when communication on both fibre links operates normally.
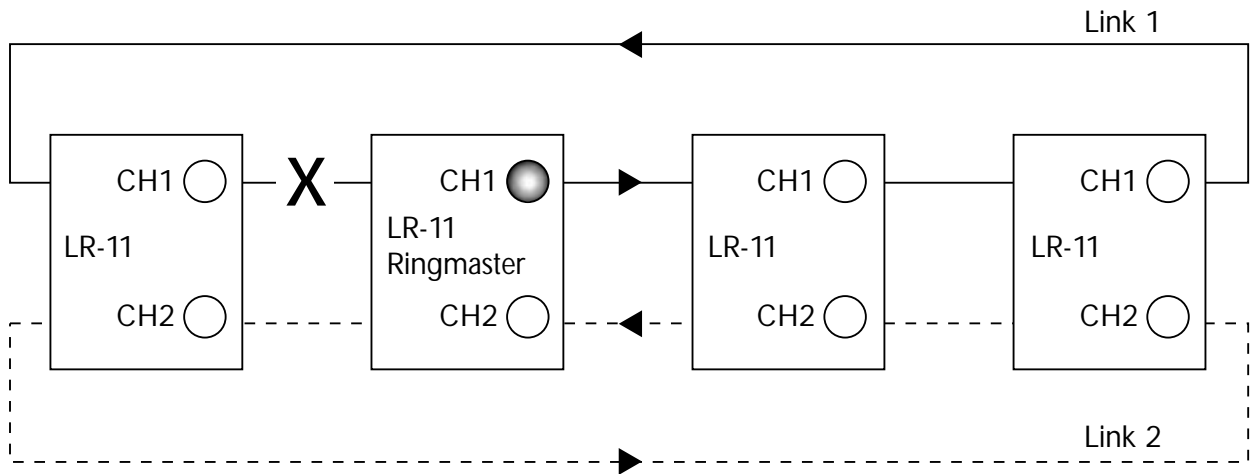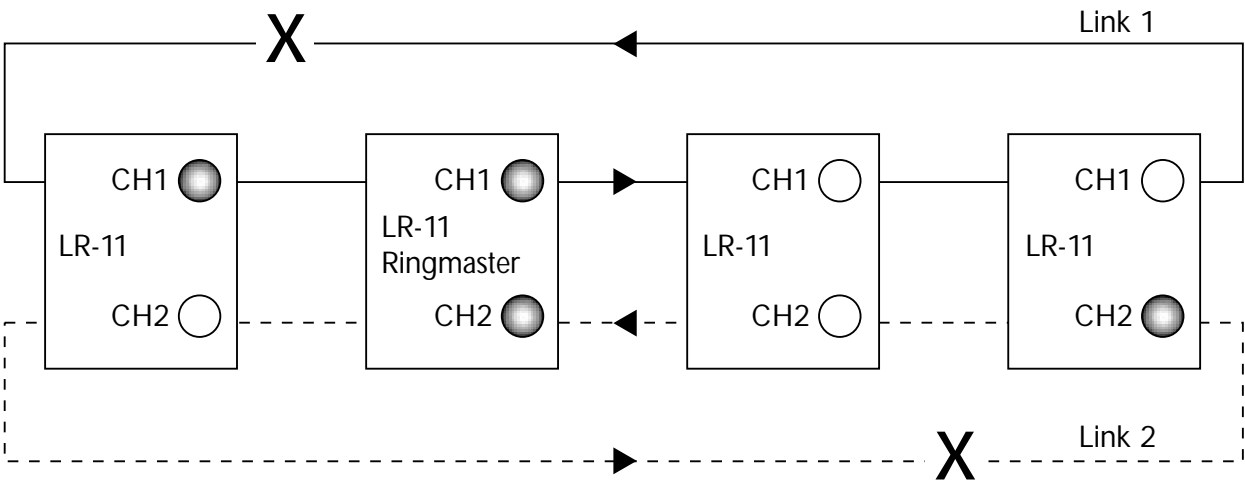

The receiver Rx1 on the ring master unit detects a break on Link 1.
Alarm CH1 is asserted on the ring master unit.

The receiver Rx1 on the rightmost LR-11 unit detects a break on Link 1.
Alarm CH1 is asserted on both local unit and the ring master unit.

Link 1

CH1 ○   LR-11   CH2 ○

CH1 ○   LR-11 Ringmaster   CH2 ◉

CH1 ○   LR-11   CH2 ○

CH1 ○   LR-11   CH2 ◉

X   Link 2

The receiver Rx2 on the rightmost LR-11 unit detects a break on Link 2.
Alarm CH2 is asserted on both local unit and the ring master unit.

X   Link 1

CH1 ◉   LR-11   CH2 ○

CH1 ◉   LR-11 Ringmaster   CH2 ◉

CH1 ○   LR-11   CH2 ○

CH1 ○   LR-11   CH2 ◉

X   Link 2

The receiver Rx2 on the rightmost LR-11 unit detects a break on Link 2, which results in an assertion of CH2. The receiver Rx1 on the leftmost LR-11 unit detects a break on Link 1,
which results in an assertion of CH1. The ring master asserts both CH1 and CH2.

Link 1

CH1 ◉   LR-11   CH2 ○

CH1 ◉   LR-11 Ringmaster   CH2 ◉

CH1 ○   LR-11   CH2 ◉

CH1 ○   LR-11   CH2 ○

Link 2
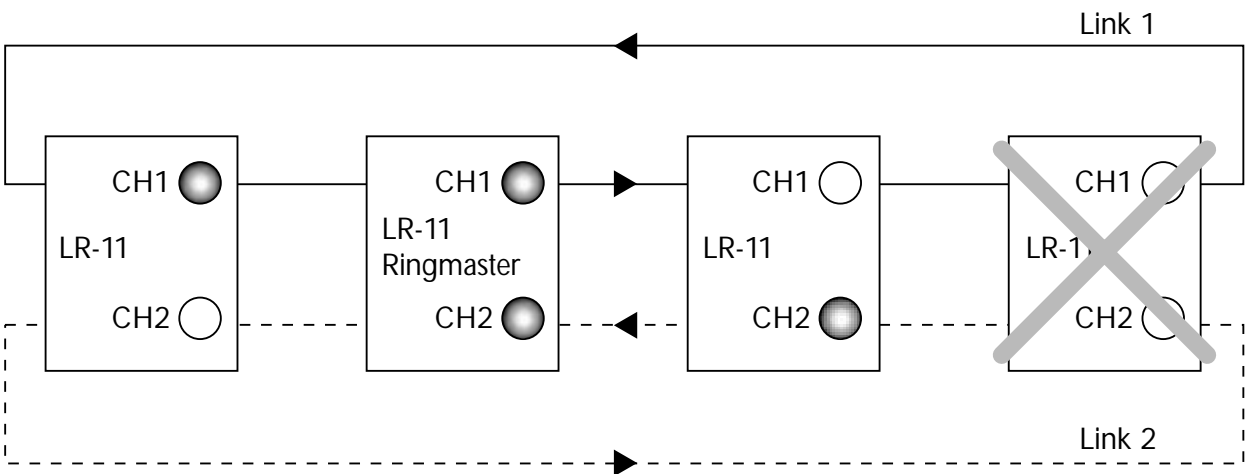
The rightmost LR-11 unit does not function due to power loss or some internal error.
Receivers on the LR-11 units one step downstream the broken unit will detect a fault on the fibre links.
They will both assert their corresponding alarm output. The ring master asserts both CH1 and CH2.

4 FIBRE CHANNEL

4.1 Introduction

On the fibre channel the devices are attached in a daisy-chain fashion. The signal path is through each device, that is the packet passes through each device on its way. The signal is regenerated each time it passes through a device, thus very long distances network could be built.

Fibre Optic channel

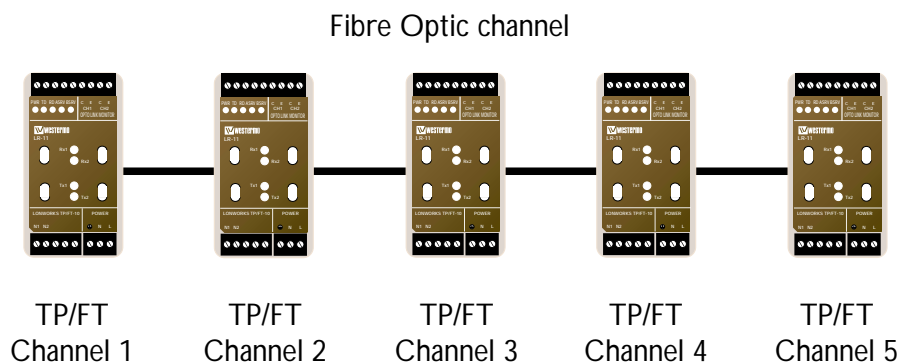| TP/FT | TP/FT | TP/FT | TP/FT | TP/FT |
| Channel 1 | Channel 2 | Channel 3 | Channel 4 | Channel 5 |

Figure 4.1 One fibre channel and multiple TP/FT channels.

The time of propagation depends on the distance and the number of devices to pass through. The propagation delay affects the channel communication parameters. By default the LR-11 has been programmed with communication parameters suitable for a relative small to medium fibre network that follows the below equation:

Fibre distance (m) / 200 + N < 72

For example the above equation would allow 4 LR-11 units to use maximum fibre optic cable length of 13.6 km.

For larger networks the LR-11 can be programmed with communication parameters compensating for longer propagation delays. With parameters for large network the following equation can be used.

Fibre distance (m) / 200 + N < 576

For example, the above equation would allow 8 LR-11 units to use maximum fibre optic cable length of 113.6 km. Observe however that the maximum allowed fibre length between two LR-11 units is 25 km (using single mode) depending on the performance of the fibre optic transmitter and receiver.

See section 4.2 for power budget tables.

See application note AN-01201B for more details about channel performance and changing the communication parameters.

4.2 Power budget

<table>
<tr><th colspan="4">Min. budget</th></tr>
</table>

	Unit		
Fibre	**820 nm**	**1300 nm**	**single mode**
50/125	10.7 dB	8.1 dB	
62,5/125	14.5 dB	11.6 dB	
100/140	20.6 dB		
9/125			6.3 dB

Typ. budget

	Unit		
Fibre	**820 nm**	**1300 nm**	**single mode**
50/125	16.6 dB	14.6 dB	
62,5/125	18.6 dB	15.1 dB	
100/140	25.9 dB		
9/125			12.3 dB

"Min. budget" states the minimum guaranteed power budget. Experience shows however that the typical value is in the range of the indicated "Typ. budget".

Attenuation in fibre cable

The values below can differ depending on quality and manufacturer of the fibre optic cable.

Fibre	Attenuation at 820 nm	Attenuation at 1300 nm	Attenuation at single mode (1300 nm)
50/125 µm	3.0 dB/km	1.0 dB/km	
62,5/125 µm	3.5 dB/km	1.2 dB/km	
100/140 µm	4.0 dB/km		
9/125 µm			0.5 dB/km

Attenuation in connectors

0.2–0.4 dB

Attenuation in splice

| Fusion	0.1 dB
Mechanical	0.2 dB

5 NETWORK INSTALLATION

The LR-11 is installed in the network as any standard LONWORKS® router.
The FO-10 standard channel may be used when creating a channel object.

6 SETTINGS AND CONNECTIONS

6.1 Settings

The LR-11 can through different switch settings be adapted to a variety of operating conditions. To set the switches, open the plastic case by removing the top cover.
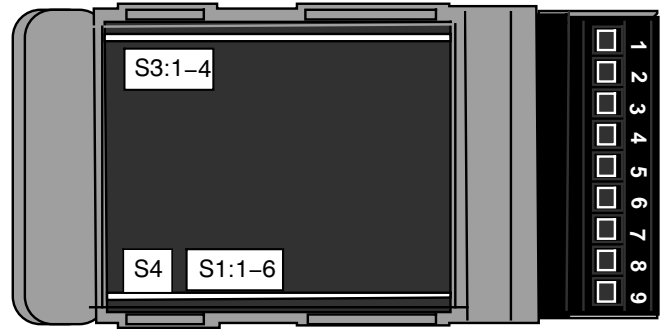
The following switch settings will be used:

Bus/Ring configuration (not PP version)

S1   Ring

S1   Bus

Transmitted power link 1

S1   Low power

S1   High power

S1: 3, 4 and 5 is not used.
Low power is only recommended with fibre distances shorter than 100 metres.

Ring master/Slave-mode (not PP version)

(only possible when ring configuration is selected with S1:1)

S1   Ring master

S1   Slave

Transmitted power link 2 (not PP version)

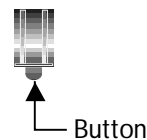S3   Low power

S3   High power

S3: 2–4 is not used.
Low power is only recommended with fibre distances shorter than 100 metres.

Service request button S4

Pressing this button generates service request messages from each side of the router.
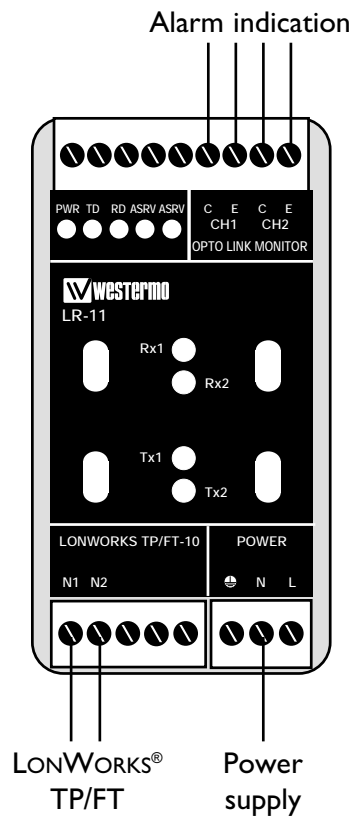The service button is used for installation in a network management tool.

Button

Factory settings

S1   S3

6.2 Connections

Network connection (LONWORKS® TP/FT)

(5-position screw terminal)

Connection no.	Description
1	N 1
2	N 2

Alarm indication

LONWORKS® TP/FT

Power supply

Power connection LV

(2-position screw terminal)

Connection	Description
1	– low voltage
2	+ low voltage

Power connection HV

(3-position screw terminal)

Connection	Description
L	– high voltage
N	+ high voltage
⏚	protective earth

Alarm connection

(9-position screw terminal)

Connection	Description	Polarity
1	CH2, E	–
2	CH2, C	+
3	CH1, E	–
4	CH1, C	+

Alarm signals
Upon failure the circuit between the contacts "C" and "E" is opened. This circuit can be used to generate an external alarm signal by connecting an external relay as shown on page 17. Please note that the maximum allowed voltage/current is 30 V/80 mA.
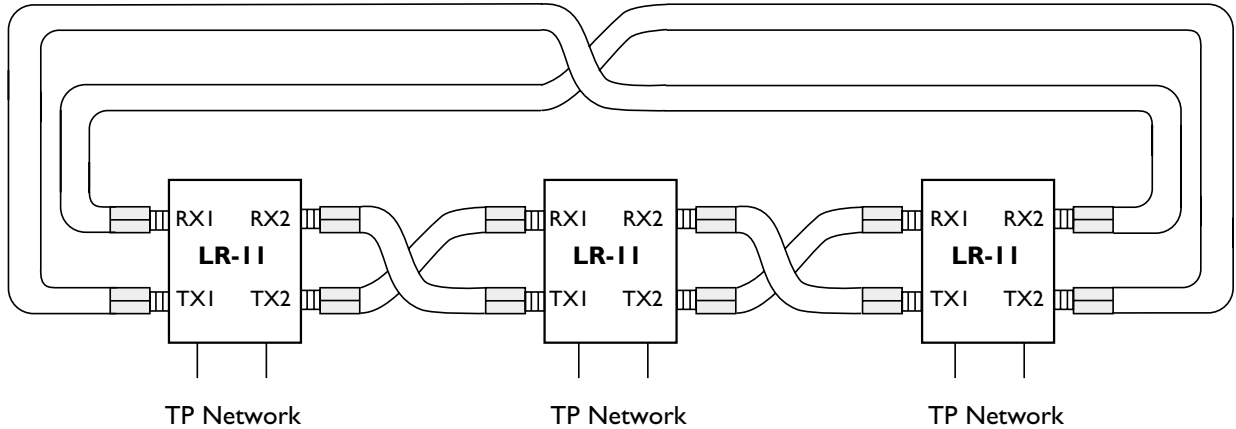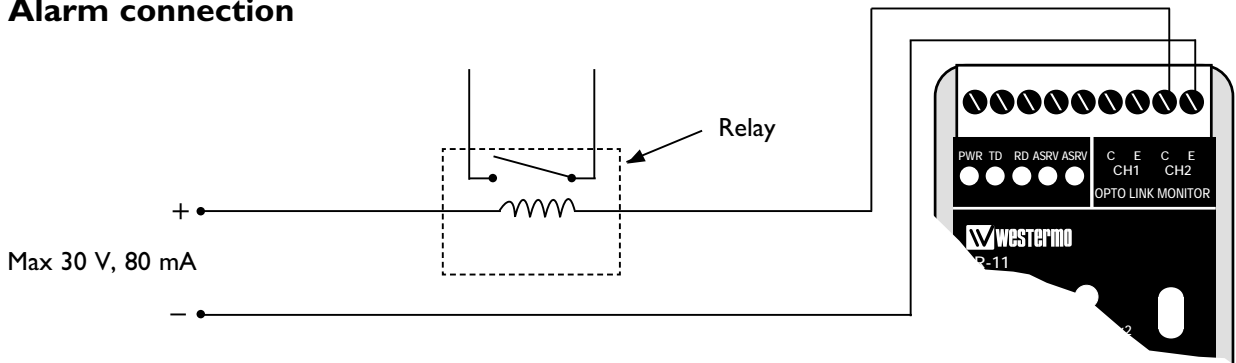
⚠ Note
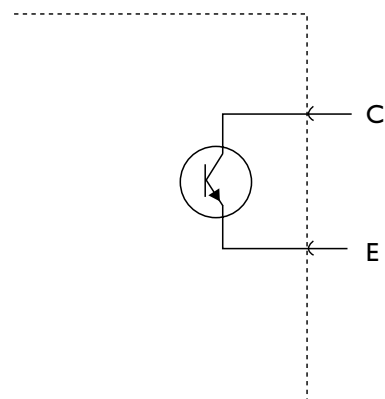
Alarm connectors are polarity depended.

6.3 How to connect

Fibre connection (Ring configuration)

Alarm connection

Relay

+

Max 30 V, 80 mA

−

In this example only channel 2 is connected.
Under normal operation channel 1 **and** channel 2 should be connected

Network connection

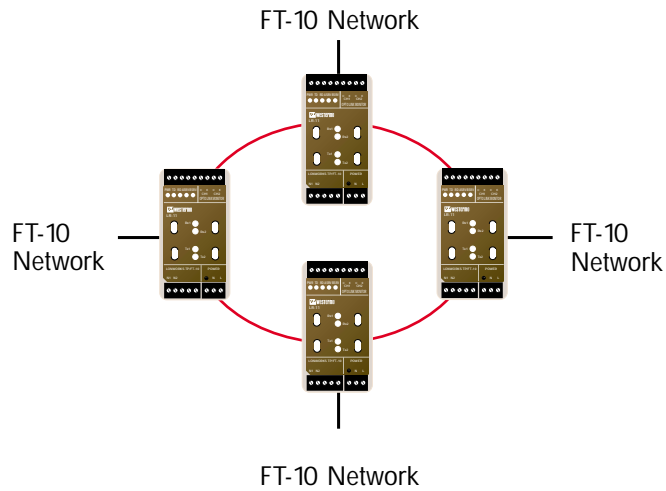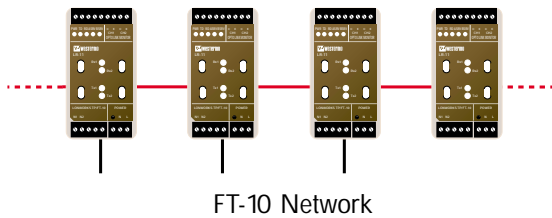LONWORKS®
TP/FT-10

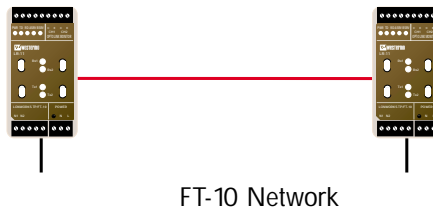# OWN COMMENTS

Application examples

Redundant fibre ring

FT-10 Network

FT-10
Network

FT-10
Network

FT-10 Network

Multidrop

FT-10 Network

Point to point

FT-10 Network

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