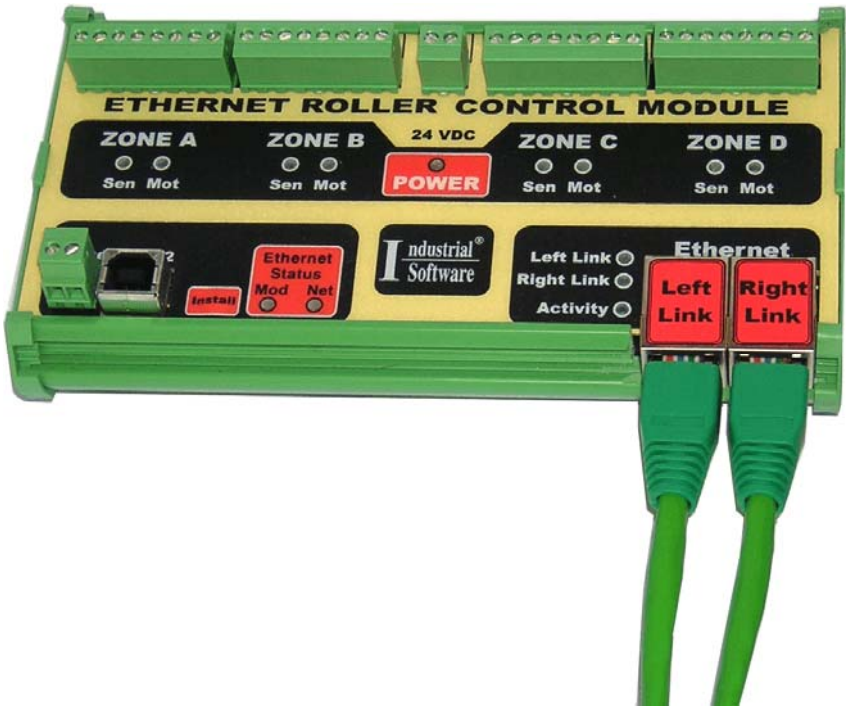
ETHERNET ROLLER CONTROL MODULE

User's Manual

Version Preliminary



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CHAPTER 1

DEFINITIONS, SAFETY AND OPERATING INSTRUCTIONS

1.1. EXPLANATION OF SYMBOLS
1.2. DEFINITIONS AND ABBREVIATIONS
1.3. NUMERICAL DATA
1.4. SAFETY AND OPERATING INSTRUCTIONS

1.1. EXPLANATION OF SYMBOLS

This symbol indicates important directions for the **proper use** of the Ethernet Roller Control Module.

This symbol provides **important notes** and/or other useful information.

This symbol indicates that special attention should be paid in order to ensure correct use as well as to avoid **dangers**.

1.2. DEFINITIONS AND ABBREVIATIONS

ERCM	-	Ethernet Roller Control Module
EDS	-	Electronic Data Sheet
EMC	-	Electromagnetic Compatibility
ESD	-	Electrostatic Discharge
Err	-	Error
HEX	-	Hexadecimal {number(s)}
ID	-	Identification/Identification Number
LED	-	Light Emitting Diode
OSI	-	Open System Interconnection
RO	-	Read Only
RW	-	Read/Write
IP	-	Internet Protocol
TCP	-	Transmit Control Protocol
DCOM	-	Distributed Component Object Model
Ethernet	-	Local Network Protocol
ARP	-	Address resolution Protocol
HTTP	-	Hipertext Transfer Protocol
FTP	-	File transfer Protocol
SWITCH	-	Device for switching Ethernet messages
Ethernet IP	-	Ethernet Industrial Protocol
CIP	-	Control and Information Protocol

1.3. NUMERICAL DATA

Decimal values are represented as figures without additional features (e.g. 1458).

Binary values are marked **b** at the end of the figures (e.g. 1011b).

Hexadecimal values are represented in two manners:

- The figures are preceded by **0x** (e.g. 0x5FA3).
- Using a mark **h** at the end of the figures (e.g. 5FA3h).

1.4. SAFETY AND OPERATING INSTRUCTIONS

The Ethernet Roller Control Modules (ERCM) are quality products, which have been manufactured according to recognized electrical engineering regulations. The modules have left the manufacturing company's premises meeting all relevant safety requirements. In order to preserve this condition and to ensure an interference-free operation of the modules, the technical specifications outlined in this documentation must be observed.

☞ Field of application: material - handling systems.

 Skilled electricians may only install the modules.

 The modules may only be operated within the limits defined in the technical data.

 The maximum operating voltages must not be exceeded.

 The neighboring parts as well as the installation of the cable system may produce a significant influence on the EMC of the modules. Therefore the electrician has to ensure the EMC of the entire system.

 In regions endangered by electrostatic discharges, a good ESD protection for the plugs and the cables to be connected should be provided.

CHAPTER 2

GENERAL INFORMATION

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2.10. GLOSSARY

This document describes the principle of operation of the Ethernet Powered Roller Control Module (ERCM) as well as the principle of its communication with the other devices of the system.

Ethernet is multimaster compatible- this means that several Ethernet stations are able to request the bus at the same time. The messages with the highest priority will be transmitted immediately.

The data transfer is managed by build-in ERCM Ethernet switch.

ERCM are designated for flexible motorized roller conveyor automation.

2.1. POWERED ROLLER CONVEYOR CONFIGURATION

A general view of a powered roller conveyor is shown in Fig. 2.1.

If a package (also referred to as **tray** or **packet**) is placed on the conveyor, it will be transported (transferred) along the conveyor due to the rotation of the conveyor rollers.

The conveyor provides one **Main Direction** of package transportation- this is the case when the conveyor is on **RUN (GO)** mode of operation. The opposite direction is referred to as **INVERSE** (or also referred to as **REVERSE**).

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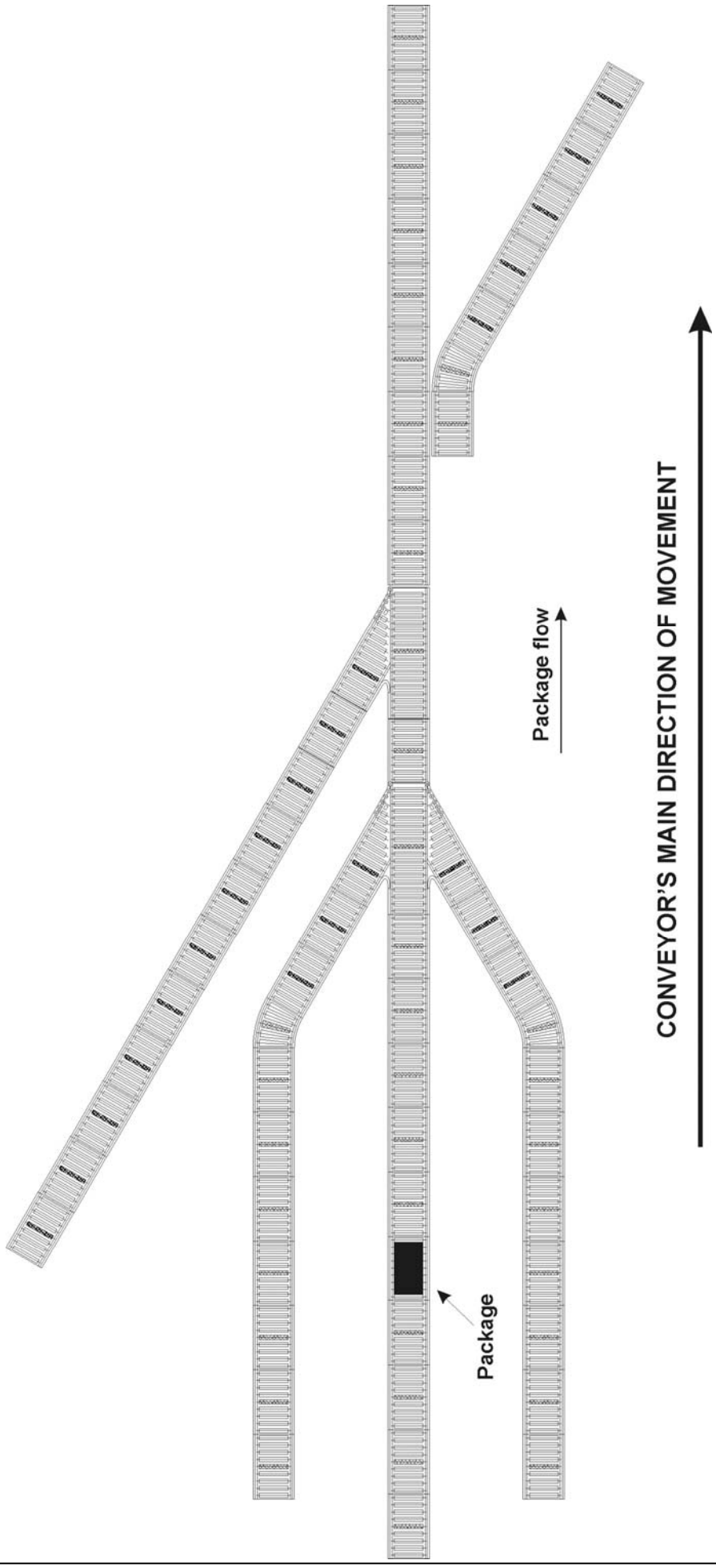
CONVEYOR'S MAIN DIRECTION OF MOVEMENT
Package flow
Package

Fig. 2.1

2.2. CONVEYOR ZONE

Basic cells referred to as zones-Fig. 2.2 assemble the conveyor. A zone consists of a set of **slave rollers** driven (by means of belts or chains) by one **Powered Roller**.

The zones are well recognized in Fig. 2.1.

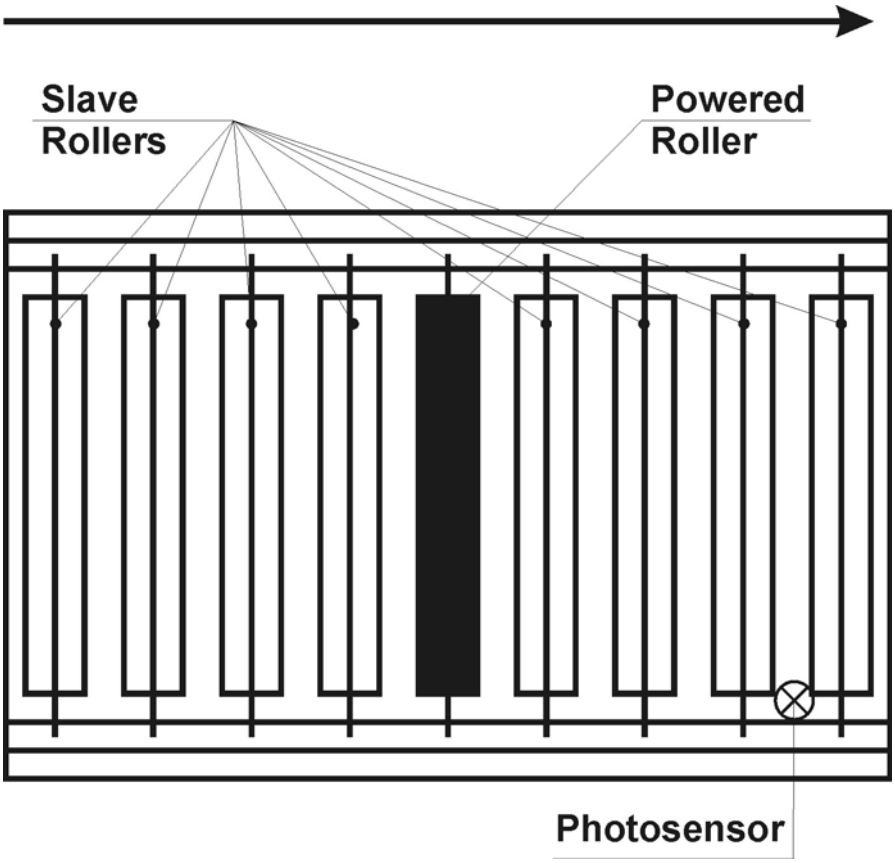

Fig. 2.2

As shown in Fig. 2.2 a zone consists of:

- One motorized (master) roller, referred to as **Powered Roller**. A DC brushless motor, usually incorporated with the roller itself (for example ITOH Powered rollers) drives the powered roller.

An interface electronic card is used as an indispensable part to serve as DC motor I/O interface, referred to as **Roller (brushless) interface**.

- A set of **slave rollers** driven by the powered roller.
- One **photosensor** used to sense the presence of the package on the zone. Both Dark-operated and Light-operated photosensors may be used.

From electronic point of view the conveyor zone may be regarded as a black box with two I/O sections: Powered Roller Interface Section and Photosensor Section-Fig.2.3.

The **ERROR** signal is generated when the DC motor is overloaded.

The **ALARM** signal is generated when the photosensor gain factor is improper.

The designations of the other terminals are self-explanatory.

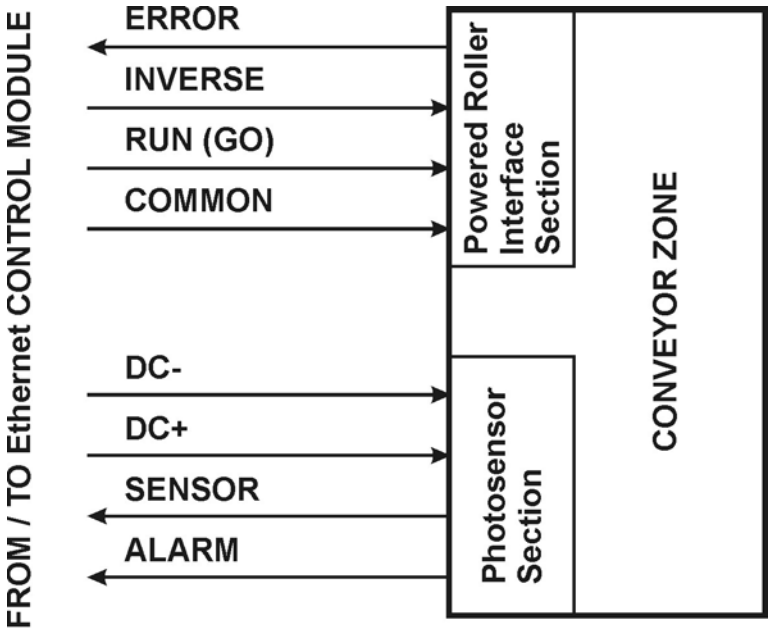

Fig.2.3

2.3. UPSTREAM/DOWNSTREAM CONVEYOR ZONES

The above terms depend upon the direction of the conveyor (packages) movement.

For the left-to-right direction of the conveyor movement (Fig. 2.4):

- Zone **N+1** is the downstream zone in relation to zone **N**
- Zone **N-1** is the upstream zone in relation to zone **N**
- Zone **N** is the upstream zone in relation to zone **N+1**
- Zone **N** is the downstream zone in relation to zone **N-1**

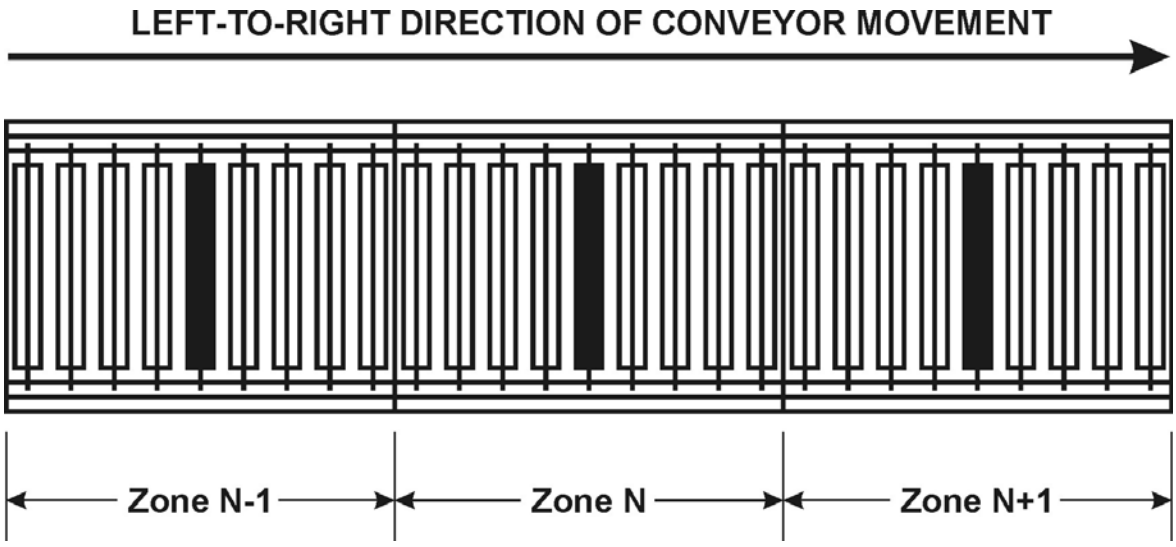

Fig.2.4

For the right-to-left direction of the conveyor movement (Fig. 2.5):

- Zone **N+1** is the upstream zone in relation to zone **N**
- Zone **N-1** is the downstream zone in relation to zone **N**
- Zone **N** is the downstream zone in relation to zone **N+1**
- Zone **N** is the upstream zone in relation to zone **N-1**

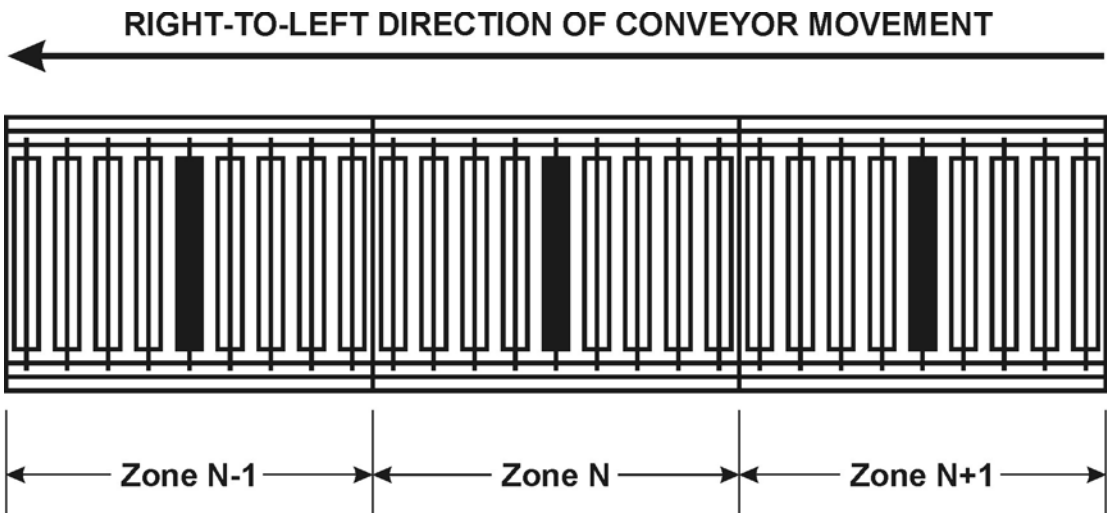

Fig. 2.5

2.4. CONVEYOR AREAS

Several typical areas may be identified on a conveyor - refer to Fig. 2.1.

2.4.1. Standard (Linear) Area

The **standard** or **linear** conveyor **area** consists of a set of linear or curved zones as shown in Fig. 2.6. The packages are transferred along the conveyor in an ordinary way.

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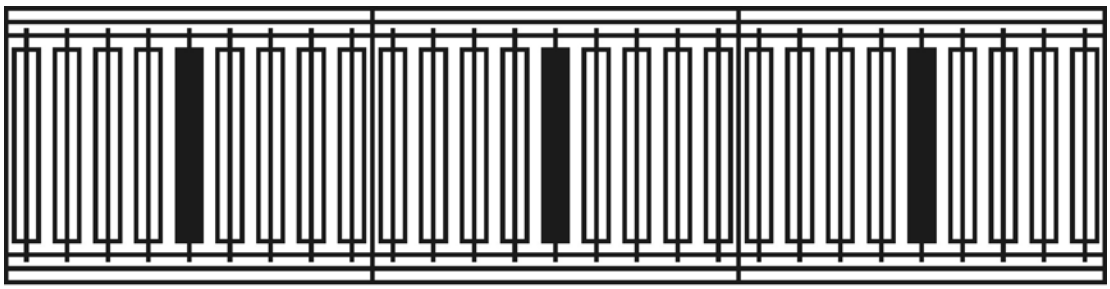

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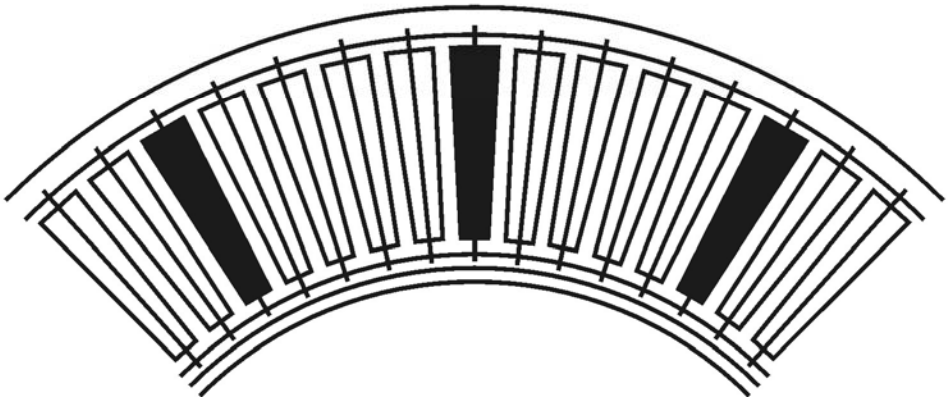

Fig. 2.6

2.4.2. Merge Area

This is the area, where the packages from two or three conveyor lanes are merged onto one conveyor lane - Fig. 2.7.

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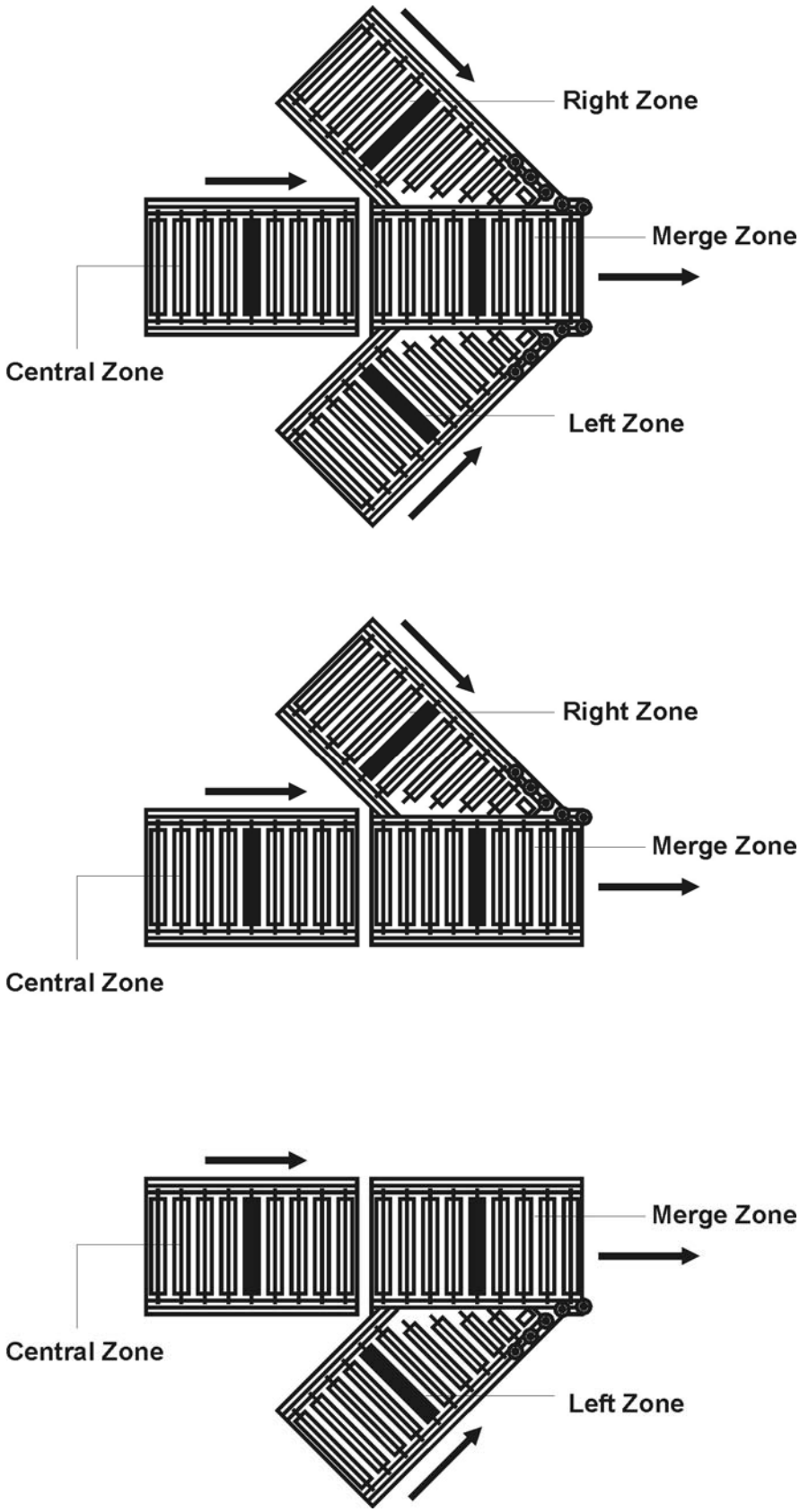


Fig. 2.7

The denomination of the Merge area zones is as shown in Fig. 2.7.

The right and left zones are physically equal. Therefore their denominations **must not** be necessarily associated with the left/right denominations of the Control Module.

The Merge zone and the Central zone **must be** strictly connected with the respective zones of the Control Module.

2.4.3. Divert Area

This is the conveyor area where the package is transferred to the left divert lane or to the right divert lane - Fig. 2.8 and 2.9.

This is example of Pusher divert area.

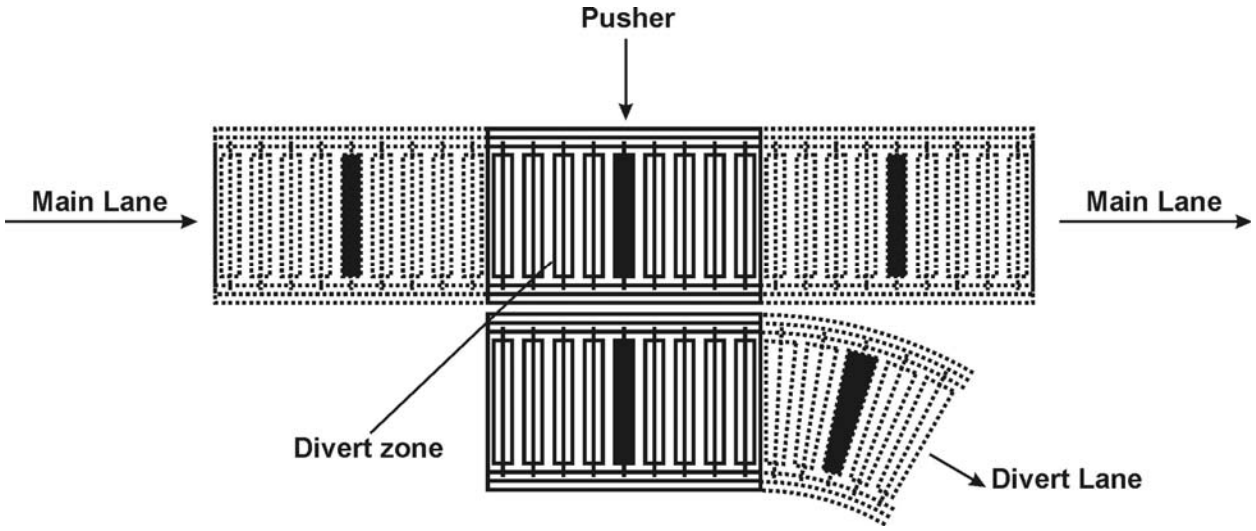


Fig. 2.8

This is example of pop-up divert area.

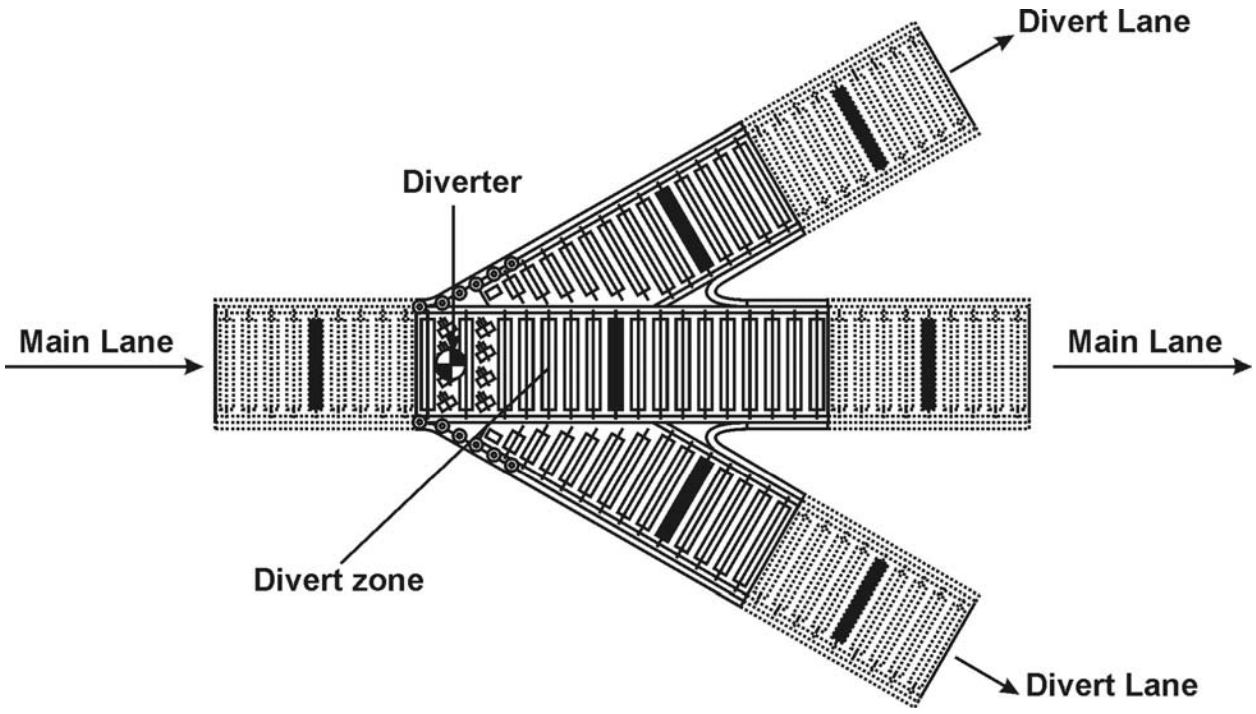


Fig. 2.9

2.5. CONVEYOR MODES OF OPERATION

Several typical conveyor modes of operation must be explained in order to facilitate the appreciation of the description to follow henceforth.

2.5.1. Regular Mode of Operation

The conveyor is transferring the packages in a ordinary way during this mode of operation.

2.5.2. Accumulation

This mode of operation is pertinent to the zone condition when the conveyor zone contains package(s) and is holding (i.e. **Full and stopped**) the package until the downstream zone is available to receive the package.

The accumulation may be caused by the operator (for maintenance or repair), by a downstream zone fault condition signal, by a merge operation signal etc.

This function overrides photosensor input.

2.5.3. Jog

One or several specified zones are forced to jog unconditionally during this mode of operation.

This function overrides all accumulation functions.

2.5.4. Train

This mode of operation defines the case when the zone transfers the packages as they come from the upstream zone without gaps between the adjacent packages.

2.5.5. Singulation

This mode of operation is relevant to the case when the zone establishes **one zone gap** between the adjacent packages, accumulating until the downstream zone is cleared. In other words the one zone gap is effected for the outgoing (from the zone) packages, while the function accumulation is valid for the incoming (into this zone) packages.

2.5.6. Purge

All zones of the conveyor are forced to operate in order to clear the conveyor completely.

2.6. "CONTROL MODULE - TO - CONVEYOR" INTERFACE

The **conveyor zone** (as described in subsection 2.2) is the basic conveyor cell to be controlled by the Control Module.

Therefore, the respective section of the Control Module is referred to as (control) **zone** also.

One Control Module can control **up to four** conveyor zones, i.e. the Control Module incorporates four similar (control) zones: Zone **D**, Zone **C**, Zone **B** and Zone **A.**

The interconnections between a Control Module zone and a conveyor zone are shown in Fig. 2.10.

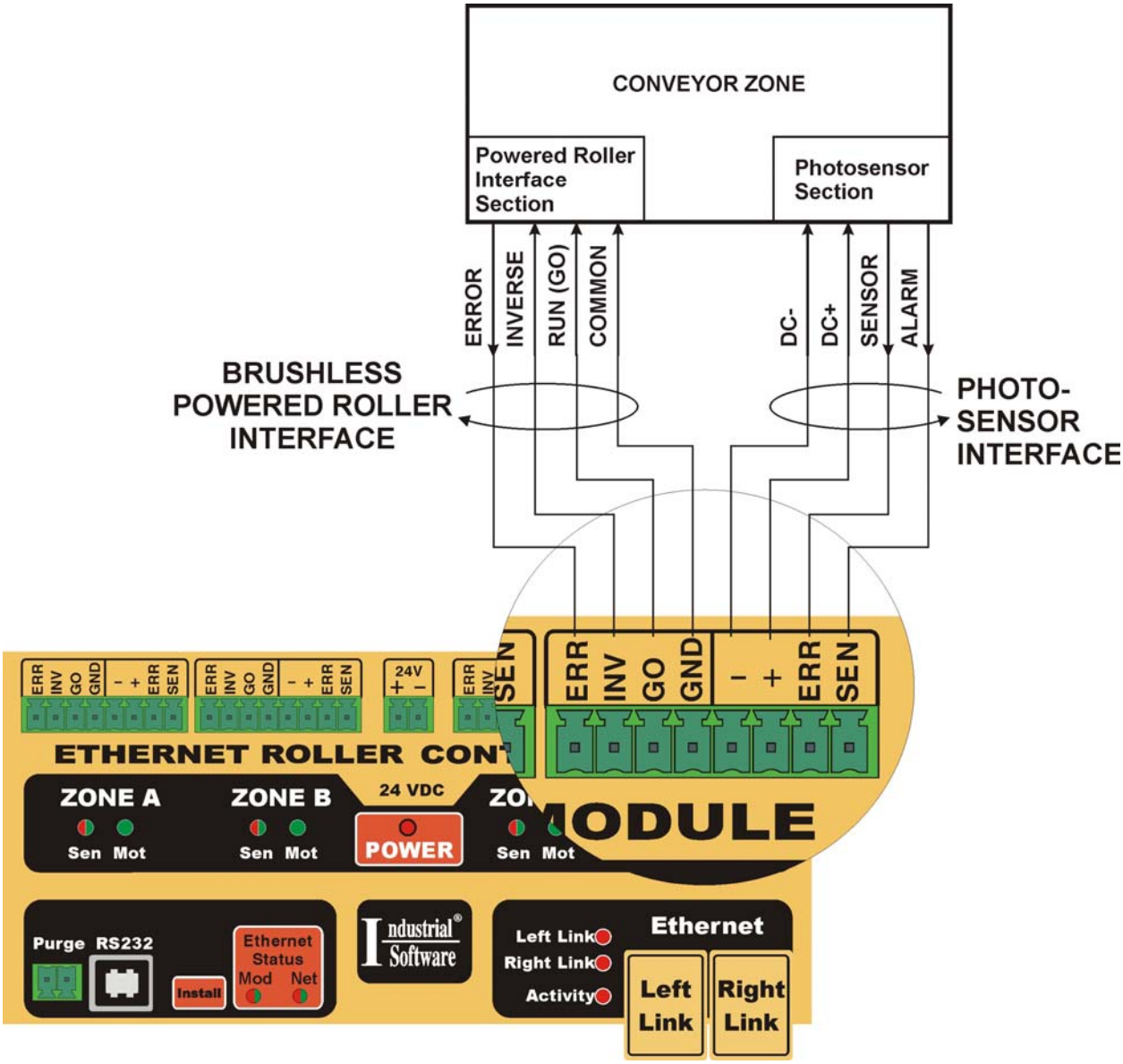


Fig. 2.10

2.6.1. Brushless Powered Roller Interface

Four terminals are available for communication between the Control Module zone and the Powered Roller interface section of the conveyor zone, namely:

- **COMMON** - self explanatory
- **RUN (GO)** - normal (forward) drive of the powered roller, hence normal operation of the conveyor zone
- **INVERSE** - inverse operation of the conveyor zone
- **ERROR** - an error signal is transmitted from the conveyor zone to the Control Module when the DC motor of the powered roller is overloaded.

2.6.2. Photosensor Interface

Four terminals are available for communication between the Control Module zone and the Photosensor section of the conveyor zone, namely:

- **DC-/DC+** - 24 V DC power supply for the photosensor is provided by the Control Module on these terminals.
- **SENSOR** - A signal for availability of package on the zone is transmitted to the Control Module via this terminal.

The type of the photosensor must be taken into account: **dark operated** or **light operated** photosensor when configuring the respective ERCM!

- **ALARM** - In case the intensity of the photosensor beam is not satisfactory (i.e. the photosensor gain factor is improper) an alarm signal is transmitted to the Control Module.

An 8-pin connector is used for the above connections - Fig. 2.11.

Fig. 2.11

2.7. ERCM ZONES

Each Ethernet Roller Control Module (ERCM) incorporates up to four (programmable) zones (Fig. 2.11), hence **one ERCM may control up to four conveyor zones**.

The connection of several ERCMs to a conveyor is illustrated in Fig.2.12.

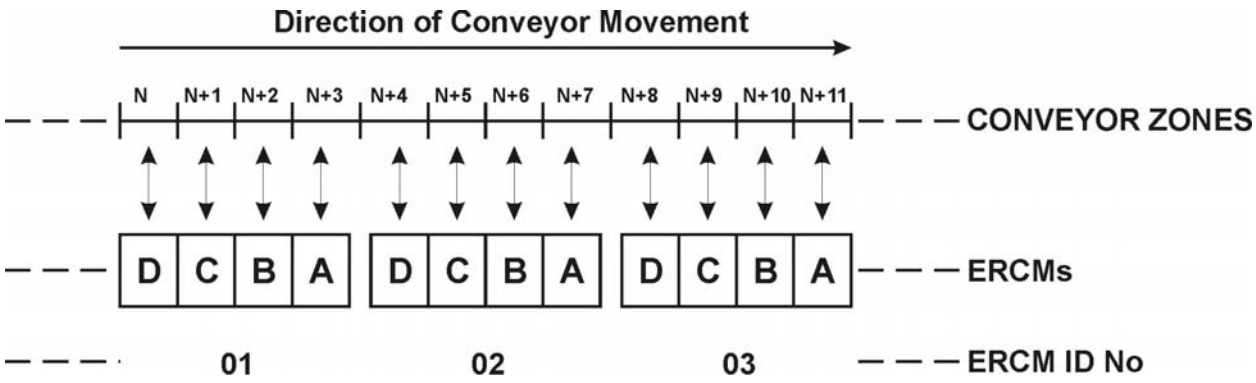


Fig. 2.12

☞ **Based on the above, ERCM zones will be considered henceforth taking into account that these ERCM zones reflect (are related to) the corresponding conveyor zones.**

2.8. LOCAL/REMOTE ZONES

The above terms reflect the fact that the zones belong to one ERCM or belong to different ERCMs.

2.8.1 Local Zones

These are the zones that belong to one ERCM - Fig.2.13.

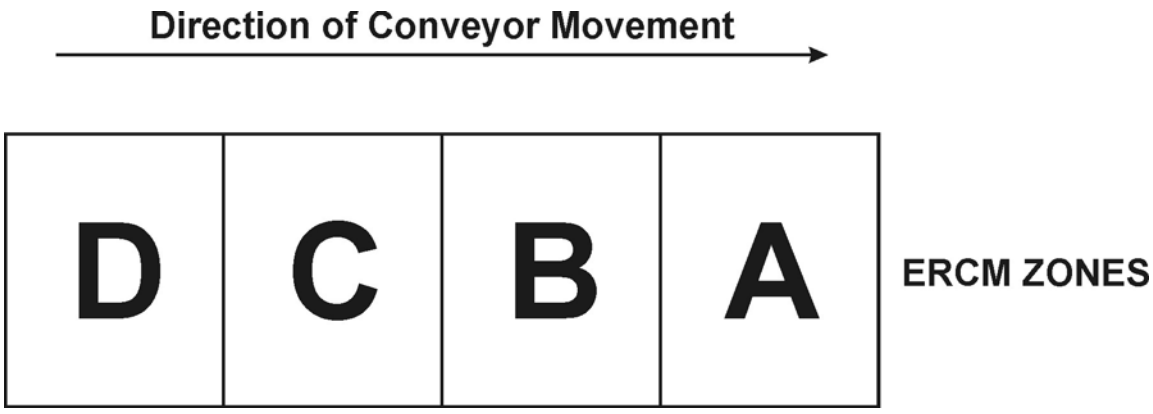


Fig. 2.13

The above zones are referred to as **local zones**.

Furthermore:

Zone **D** is the upstream zone in relation to zone **C**

Zone **C** is the upstream zone in relation to zone **B**

Zone **B** is the upstream zone in relation to zone **A**

and vice versa

Zone **A** is the downstream zone in relation to zone **B**

Zone **B** is the downstream zone in relation to zone **C**

Zone **C** is the downstream zone in relation to zone **D**

2.8.2. Remote Zones

These are the zones that belong to different ERCMs - Fig. 2.14.

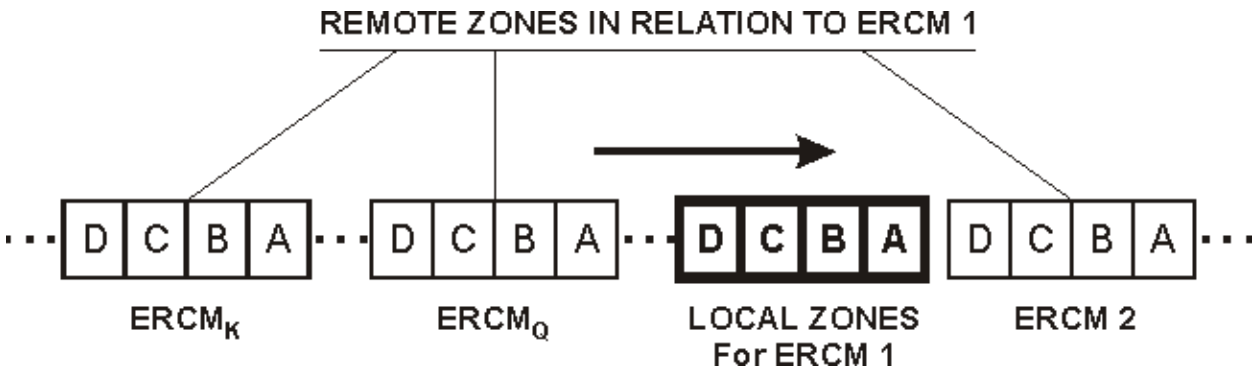


Fig. 2.14

2.9. ZONE-TO-ZONE INFORMATION FLOW

Two adjacent zones have to exchange information during the regular conveyor operation.

The downstream zone should inform the upstream zone about its state of operation, for example:

- Its powered roller is running, or
- Its powered roller is stopped, or
- Its powered roller is on inverse mode of operation, or
- Its powered roller is overloaded, or
- There is a package on the zone,or
- The photosensor gain is improper etc.

The upstream zone should inform the downstream zone about similar events.

2.9.1. Information Flow Between Two Adjacent Zones

The information flow between two adjacent zones is illustrated in Fig. 2.15.

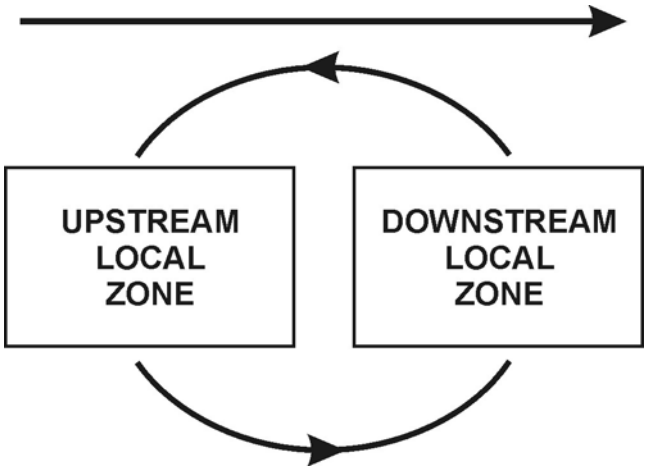


Fig. 2.15

2.9.2. Information Flow Among ERCM Zones

The information flow among the four ERCM zones is shown in Fig. 2.16.

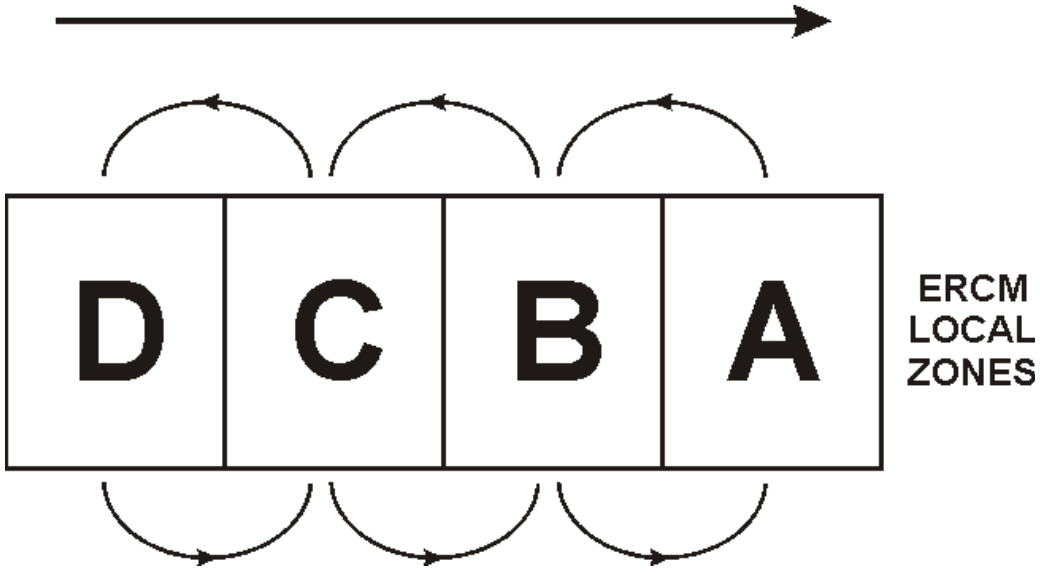


Fig. 2.16

☞ All operations between these zones are organized locally, i.e. inside the ERCM.

2.9.3. Information Flow Between Two Adjacent Remote Zones

The communication between two adjacent remote zones is illustrated in Fig. 2.17. In fact this is the communication between two ERCMs.

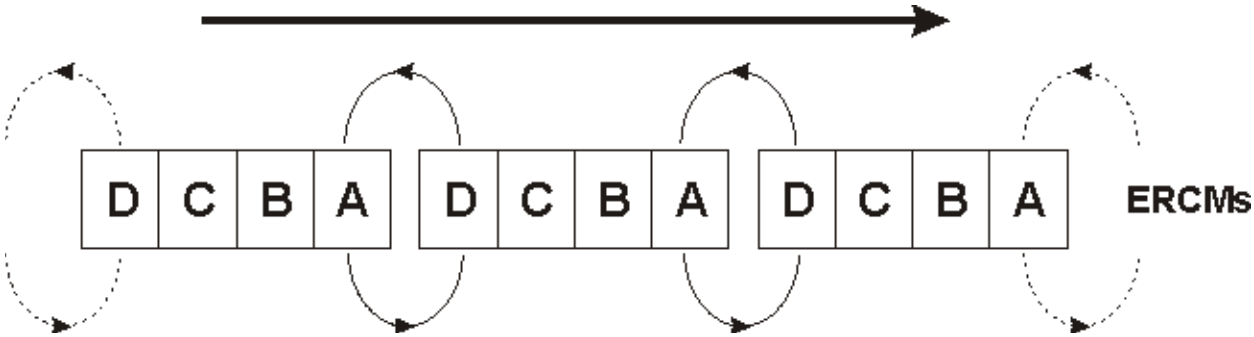


Fig. 2.17

☞ All operations between these adjacent remote zones are organized in the frame of the Ethernet Network.

2.10. GLOSSARY

Accumulation - A mode of operation when the zone contains package(s) and is holding.

Cross Transfer Area - The area where a pusher transfers the packages from one to another lane.

Direction

Main - The normal operation direction of the conveyor.

Inverse - The opposite of the main direction.

Downstream Zone - The next zone in the main direction of the conveyor movement.

Jog - Mode of operation when one or several specified zones are forced to jog unconditionally.

Linear Area - Also referred to as STANDARD AREA. A set of linear and/or curved conveyor zones.

Local Zones - The zones belonging to the same ERCM

Merge Area - The conveyor area where the packages from two or three lanes are merged into one (merge) lane.

Package - A separate (usually wrapped or boxed) object to be transported by the conveyor.

The term **tray** or the term **tote** is also used instead of the term package.

Photosensor - A device, mounted on the end of the conveyor zone to sense the presence of a package on the zone.

Powered Roller - also referred to as DRIVE ROLLER or MOTORIZED ROLLER or MASTER ROLLER. This is a roller driven by a motor. The powered roller drives the slave rollers of the zone by means of belts or chains.

Purge - Mode of operation when **all zones** are forced to move in order to clear the conveyor completely.

Remote Zones - The zones belonging to different ERCMs.

Roller Interface - The interface card of the brushless DC motor driving the Powered Roller.

Singulation - Mode of operation when the zone establishes **one zone gap** between the adjacent packages and accumulating until the downstream zone is cleared.

Slave Rollers - A set of rollers in a conveyor zone driven by the Powered Roller.

Standard Area - Also referred to as LINEAR AREA. A set of linear and/or curved conveyor zones.

Tote - A term, sometimes used instead of the term **package**.

Train - Mode of operation when the zone transfers the packages as they arrive, without gap between the adjacent packages.

Tray-A term frequently used instead of the term **package**.

Upstream Zone - The preceding zone

Zone - A basic (linear or curved) cell of the conveyor consisting of a set of slave rollers, driven by one Powered Roller.

The similar basic cell of the ERCM, dedicated to a conveyor zone.

CHAPTER 3

ETHERNET POWERED ROLLER CONTROL MODULE (ERCM)

3.1. GENERAL DESCRIPTION

3.1.1. Ethernet RJ-45 Jacks

3.1.2. Ethernet and Application Status LED Indicators

3.1.3. Left, Right Link LEDs

3.1.4. Activity LED

3.1.5. Purge Input

3.1.6. Power Supply

3.1.7. Power LED Indicator

3.1.8. Installation Push Button

3.1.9. Photosensor and Powered Roller Interfaces

3.1.9.1. Photosensor Interface

3.1.9.2. Powered Roller Interface

3.1.10. Zone Status LED Indicators

3.1.10.1. Sensor Zone Status LED Indicators

3.1.10.2. Motor Zone Status LED Indicators

3.2. ERCM SIZE AND MECHANICAL INSTALLATION

3.2.1. DIN Rail Version Sizes and Mechanical Installation

3.2.2. OEM Rail Version Sizes

3.3. ERCM TERMINALS

3.3.1. Photosensor/Powered Roller Connectors

3.3.2. ERCM Power Connector

3.3.3. Purge Connector

3.3.4. Ethernet Connector

3.4. ERCM SPECIFICATIONS

3.1 GENERAL DESCRIPTION

The Ethernet Control Module is shown in Fig. 3.1.

Fig. 3.1

The Control Module may be configured as a POWERED ROLLER CONTROL MODULE or as a MERGER CONTROL MODULE or as DIVERT CONTROL MODULE. Therefore the Control Module generally is referred to as **ETHERNET POWERED ROLLER CONTROL MODULE** or for short **ERCM**.

Each ERCM incorporates **four equal zones**. Each of 4 zones can be used as linear, merge or divert zones.

Each ERCM provides the following features:

- Two Ethernet RJ-45 jacks, internally connected with Ethernet switch.
- Two bicolor Ethernet and Application Status LED indicators.
- Two Ethernet Link LED indicators.
- One Ethernet activity LED indicator.
- 24V DC Purge input for clearing conveyor even without communication.
- Connector for 24V DC power supply, Apr. 100 mA sink current.
- Power LED indicator.
- Installation Push button.
- Photosensor and Powered Roller interfaces per zone (four zones altogether)
- Two bicolor Zone Status LED indicators per zone (four zones altogether).

The above features are illustrated in the respective group fields on the Front Panel shown in Fig. 3.2.

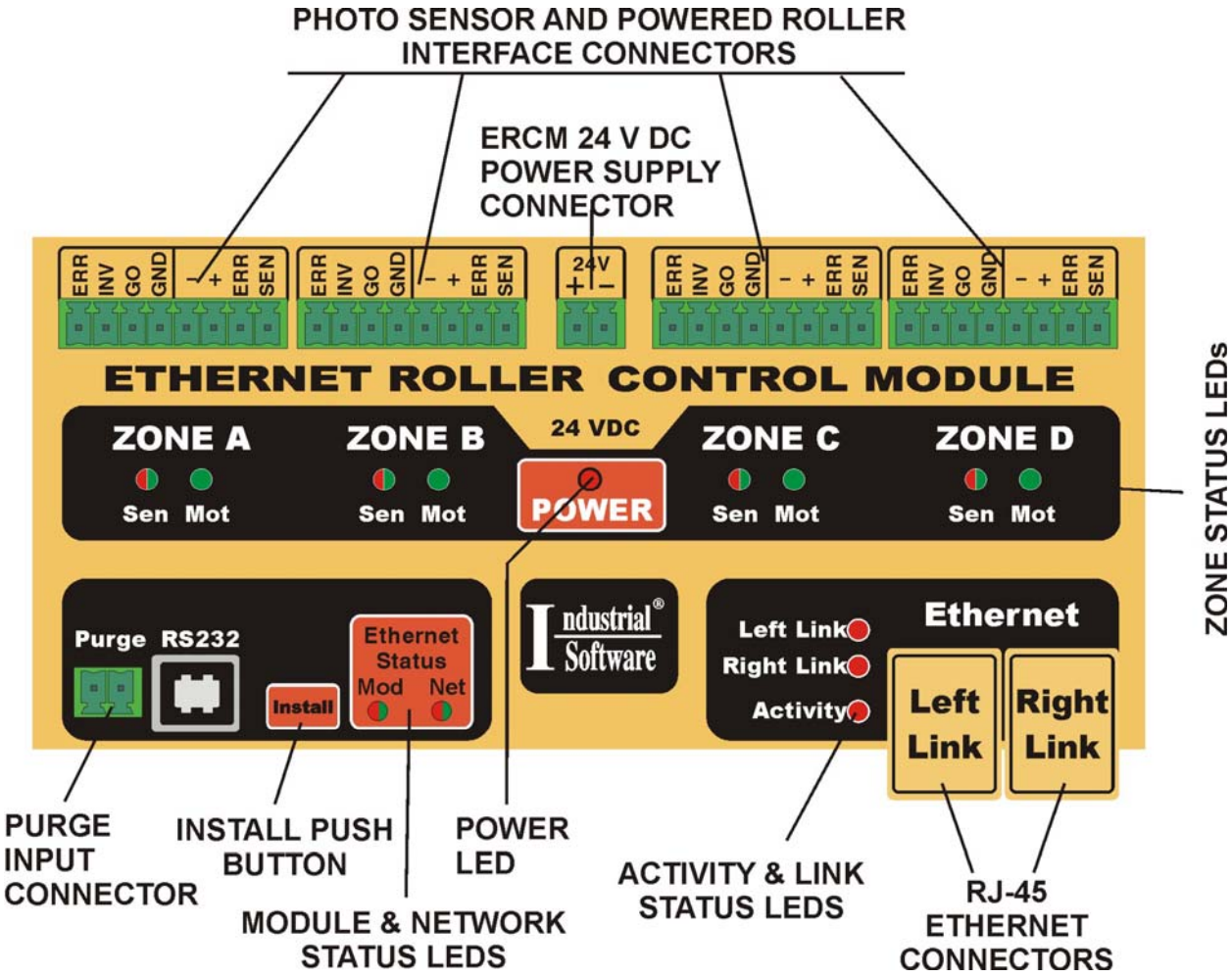


Fig. 3.2

3.1.1. Ethernet RJ-45 Jacks

Two RJ-45 connectors are used to connect to upstream and downstream modules.

3.1.2. Ethernet and Application Status LED Indicators

Each ERCM has following diagnostic LED's:

- **2 Ethernet / Module Status LED's**

These 2 LEDs are specific and report the state of the module and communication as described in Ethernet / IP documentation, Chapter 9. These two LEDs are labeled as "**Module Status**" and "**Network Status**".

Module Status LED is bicolor (Green, Red)

Network Status LED is bicolor (Green, Red)

Module Status *Off* – Power not present or Module is damaged

Module Status *Green/Red Blinking* – Selftest in progress

Module Status *Green Blinking* – Module have not been configured

Module Status *Red Blinking* – Recoverable minor fault

Module Status *Steady Red* – Non- recoverable major fault

Module Status *Steady Green* – Device operating correctly

Network Status *Off* – Power not present or does not have IP address

Network Status *Green/Red Blinking* – Selftest in progress

Network Status *Green Blinking* – The device has not established connections

Network Status *Red Blinking* – At least one of the connections has timeouted

Network Status *Steady Red* – The device has detected that its IP address already is used

Network Status *Steady Green* – The device has at least one established connection and all connections are OK

3.1.3. Left, Right Link LEDs

Two Green Left, Right Link LEDs indicate that appropriate RJ-45 port is connected to a valid Ethernet node (other ERCM, PC, HUB, Switch, Gateway, Router).

On – Connected

Off – Not connected

Flickering – Data transfer on appropriate port

3.1.4. Activity LED

This Red LED indicates activity (receive or transmit) on third, internal switch port.

On – Receive or transmit in progress

Off – No activity

3.1.5. Purge Input

This is polarity insensitive input for clearing the conveyor. 24V DC on this pin will run all four Rollers (i.e. the four conveyor zones) connected to ERCM.

The 24V DC and Purge connectors of ERCM are of the same type. Error connection (24V DC on Purge connector or the Purge signal on 24V DC connector) will NOT damage the device, but may force the system into a not functioning mode until the error connection is removed.

The Purge mode of operation may be not required and is not used by the customer.

In this case the module may be configured in such a way, that to use the Purge input for other functions, such as:

- Inverse direction of conveyor's movement
- Accumulation mode of operation of specific ERCM zone

etc.

3.1.6. Power Supply

The power supply voltage of ERCM is 24 V DC (18 to 30 V). The module current consumption is 100 mA.

For more details you may refer to Table 3.5.

3.1.7. Power LED Indicator

This LED is Red.

Power LED indicator is *ON* when 24 V DC power is connected properly to ERCM.

3.1.8. Installation Push Button

The Installation Push Button is used during the configuration procedures of ERCM.

3.1.9. Photosensor and Powered Roller Interfaces

Each ERCM provides four sets of Photosensor/Powered Roller interfaces-one set per zone.

The interface for one zone is shown in Fig. 3.3.

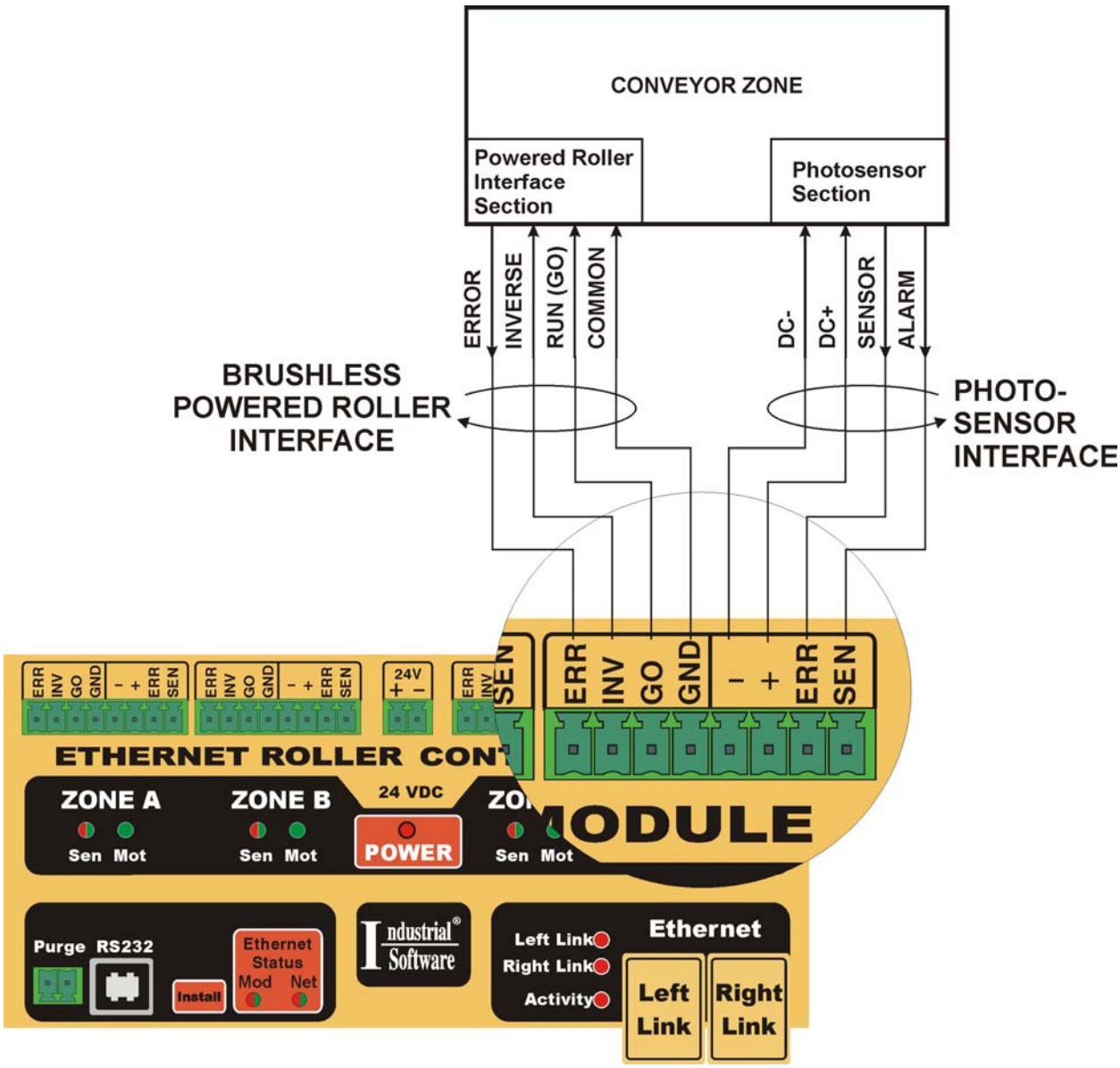


Fig. 3.3

You may refer also to subsection 2.6.

3.1.9.1. Photosensor Interface

☞ First refer to subsection 2.6.2.

☞ The power supply pins for the photosensor are internally connected to the 24 V DC power input of ERCM.

☞ If your photosensors do not have Sensor Error output, leave the Sensor Error pin **not connected**.

☞ **Sensor error input can be programmed for different functions during ERCM configuration**.

Both Sensors Input and Sensors Error inputs are intended for use with 24V DC open collector transistor outputs from sensors. For different type of sensors please call Industrial Software.

ERCM can be configured to work with Light Operated or Dark Operated sensors individually on each zone.

3.1.9.2. Powered Roller Interface

4 pins are available for Roller Interface connections. This interface can be directly connected to ITON Brushless power drive cards.

- **Common pin** - this pin have to be connected to common pin of Roller Driver card.
- **Run output pin** - open collector, 20 mA sink output, connected to Run input of Roller Driver card.
- **Direction (Inverse) output pin** - Open collector, 20 mA sink output, connected to Direction input of Roller Driver card. If reversing feature of ERCM is not used, this pin may be left not connected
- **Motor Error Input pin** - this pin is input for ERCM to receive motor error signal.

Motor error input and Direction output pin can be programmed for different functions during ERCM configuration.

Run and Direction outputs are open collector outputs, so direct connection of 24V DC to these pins may damage them!

3.1.10. Zone Status LED Indicators

The zone status LED indicators are grouped in two separate field sections: **motor** section and **sensor** section

3.1.10.1. Sensor Zone Status LED Indicators

There is one bicolor LED for sensor section labeled **Sen**.

This LED is signaling the following information:

OFF – No carton on zone, no sensing error

Flashing Green – Carton presents on the zone, but **accumulation** is forced externally (from external device via network or from internally programmed sensor error or motor error input)

Steady Green – Carton presents on the zone and there is no externally forced accumulation. Zone still can accumulate because of other conditions (singulating or upstream damaged …)

Flashing Red – Jam error on the zone. The sensor reports that a package is on the zone for a period of time **longer** than 2 s. **This time is configurable!**

Steady Red – Sensor Gain error (in sensor error input programmed for this function)

3.1.10.2. Motor Zone Status LED Indicator

There is one *Green* LED for motor section labeled **Mod**

This LED is signaling the following information:

Steady ON – ERCM is driving the roller motor on **RUN (GO)** or on **Purge** mode of operation.

Flashing – ERCM receives a **motor error** signal **Flickering** – The zone is forced on **Inverse Direction** mode of operation.

☞ This state cannot occur during normal operation of ERCM and can be forced only by the Installation/Monitoring Tool or by PLC.

3.2. ERCM SIZE AND MECHANICAL INSTALLATION

ERCM is manufactured in two versions:

– DIN rail mounting

– OEM rail mount version

3.2.1. DIN Rail Version Sizes and Mechanical Installation

The respective sizes of ERCM are shown in Fig. 3.4.

The mechanical installation of ERCM is executed in the following order:

a. Drill two clearance holes for mounting DIN rail.

b. Mount the rail.

c. Mount the module on the rail.

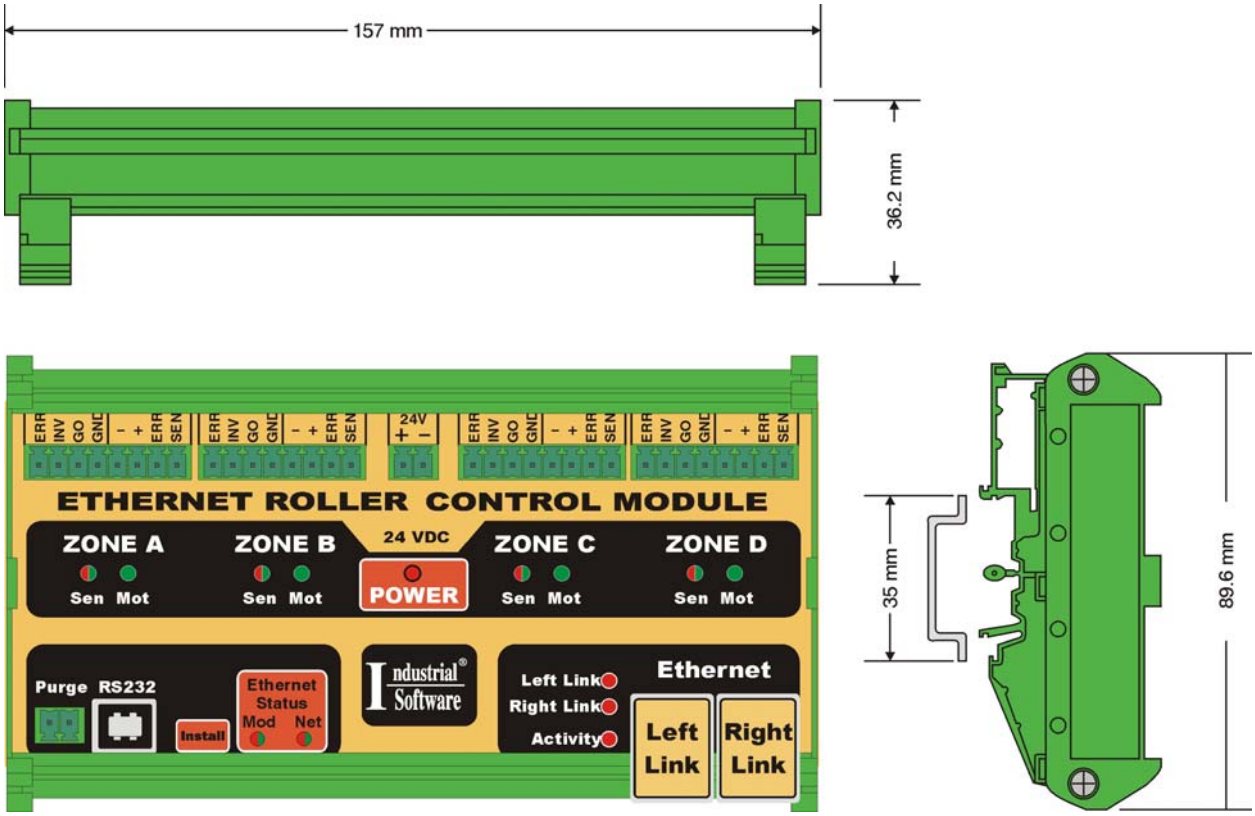


Fig. 3.4

3.2.2. OEM Rail Version Sizes

The respective sizes of ERCM are shown in Fig. 3.4.1

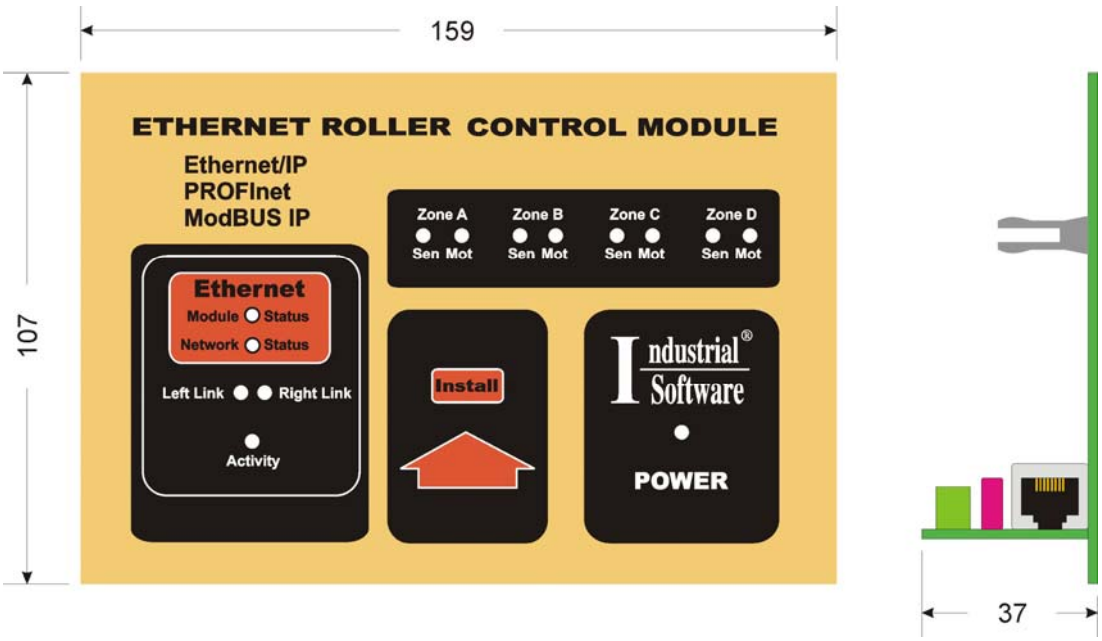


Fig. 3.4.1

3.3. ERCM TERMINALS

The connectors' layout is shown in Fig. 3.5.

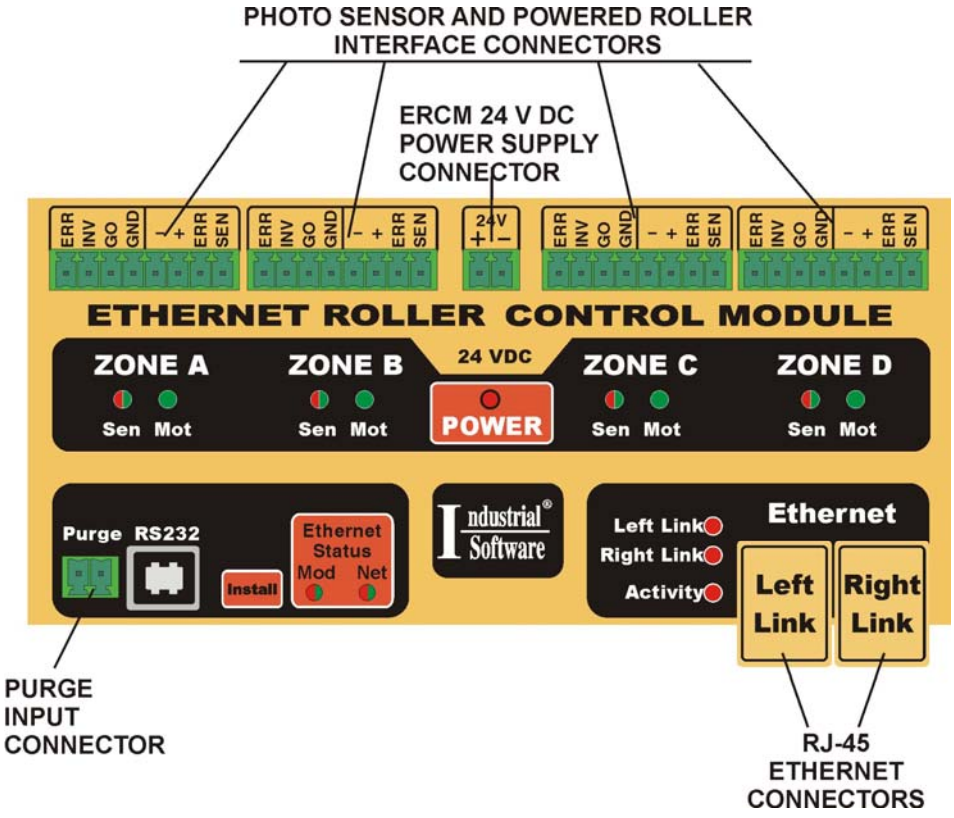
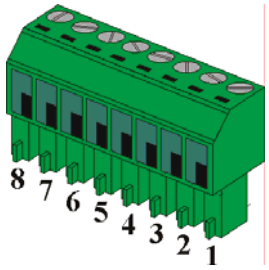


Fig. 3.5

3.3.1. Photosensor/Powered Roller Connectors

The connector pin-out information related to Photosensor/Powered Roller interface is outlined in Table 3.1.

Table 3.1

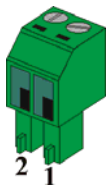
Connector	Pin No	PART OF	Descriptions
	1	**ROLLER INTERFACE**	INPUT ERROR
	2		INVERSE
	3		RUN (GO)
	4		COMMON
	5	**SENSOR INTERFACE**	DC-
	6		DC+
	7		ALARM INPUT
	8		SENSE INPUT

The connections between the module zone and the respective conveyor zone are shown already in Fig. 3.3.

3.3.2. ERCM Power Connector

The connector pin-out information related to the module power supply is outlined in Table 3.2.

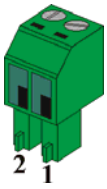
Table 3.2

Module Power Connection	Micro Pin	Function
	1	+ Power Supply (DIN rail version) - Power Supply (OEM rail version)
	2	- Power Supply (DIN rail version) + Power Supply (OEM rail version)

3.3.3. Purge Connector

The connector pin-out information related to Purge input is outlined in Table 3.3.

Table 3.3

Purge Connection	Pin No	Function
	1, 2	10- 30 V DC

3.3.4. Ethernet Connector

ERCM uses standard Ethernet cross-connect UTP cables.

3.4. ERCM SPECIFICATIONS

The main technical ERCM specifications are described in Table 3.5.

Table 3.4

Electrical		
Module Power Voltage		18 - 30 VDC Main Power Supply
Module Current Consumption		Main Power Supply - 100 mA excluding motor power and current drawn by the photosensor
Interface Capacity		4 sensors/ 4 brushless motors
Galvanic insulation		Ethernet to processor, Power to processor, Motor to motor, Sensor to sensor, motor & sensor to processor, Power to Ethernet
Network		
Topology		Ethernet with build-in switch
Media		UTP, cross-connected
Purge Input Signal		10 - 30 V DC / 4 mA
Environmental		
Temperature		
	Operational (ambient)	-20 °C to +85 °C
	Storage	-40 °C to +85 °C
Humidity		95% RH, non-condensing
Shock		10 G
Vibration		2 G, at 10 to 500 Hz
Electromagnetic compatibility		IEC801, level 3

Standards	
IEC	IEC 801, IEC1131-1, ISO 11898
Physical	
Size (max. dimensions)	157mm*90mm*36.2mm – DIN 159mm*107mm*37mm – OEM
Mounting	DIN Rail, OEM
Weight (without DIN Rail)	Approx. 170 g.
Housing / Material	Polyamide PA-F fiber reinforced Face - polycarbonate
Termination's	Plug-in direction vertical to conductor axis, connection point towards the coded side of the header, 3.81 mm step
Recommended wire size	AWG28-16 (24-14) stranded or solid
Zone Status Indicators	One bicolor, one green LED - Jam, Motor Fault, Sensor Fault, Direction, Accumulation forced, Sensor ON/Off, Roller On/Off
Additional Indicators	Power - red, Network Status – bicolor, Module Status – bicolor, Left/Right Link – green, Activity - red
Front Panel	See Fig. 3.2, 3.2.1

CHAPTER 4

ERCM EXTERNAL WIRING

4.1. INTRODUCTION
4.2. ERCM POWER SUPPLY CONNECTOR
4.3. ERCM ETHERNET INTERFACE CONNECTOR
4.4. PURGE INTERFACE CONNECTOR
4.5. PHOTOSENSOR/POWERED ROLLER INTERFACE CONNECTORS
4.6. COMPLETE SYSTEM WIRING

4.1. INTRODUCTION

The external wiring of ERCM although simple requires special attention in order to avoid commissioning troubles and/or devices' damage.

The instructions outlined below are designated to serve as guidance for the installation electricians.

The examples are based on the assumption that a ERCM is controlling linear area zones. Some particularities related to ERCMs controlling other conveyor areas will be discussed separately.

The module terminals are represented by male pin connectors assembled on the module' PCB - Fig. 4.1.

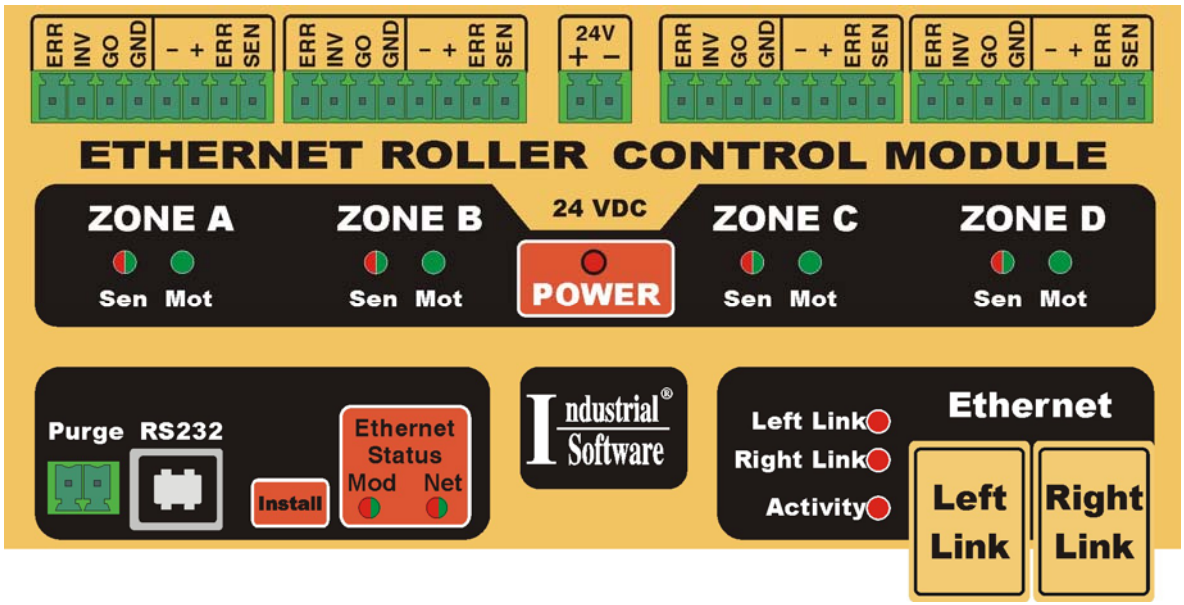


Fig. 4.1

The corresponding voltage ratings and polarity (if required) are shown on the front panel of the module (Fig. 4.1).

Each module is supplied by Industrial Software with 6 female connectors with relevant pin number. **As a matter of fact when considering the external wiring we refer to wiring of these female connectors. Therefore, the electrician must follow the guidance extended in Tables 3.1, 3.2, 3.3 and 3.4 besides the considerations outlined below.**

4.2. ERCM POWER SUPPLY CONNECTOR

This connection is polarity sensitive!

The 24 V DC power supply female 2-pin connector must be wired in accordance with Table 3.2. The correct wiring will provide the electrical connection shown in Fig. 4.2.

Please check it twice to make sure that your wiring is OK!

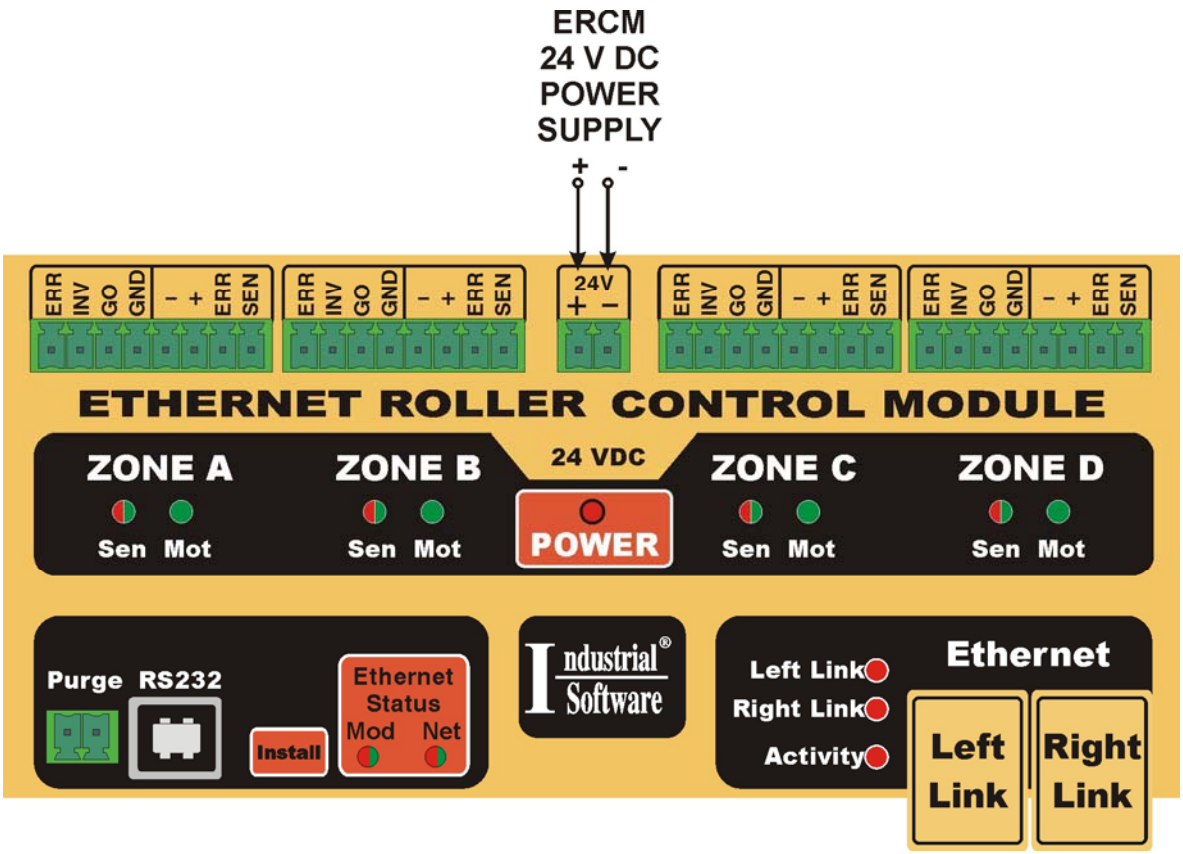


Fig. 4.2

The photosensor supply voltage is internally connected to ERCM Power Supply - Fig. 4.3. This must be taken into account during the system design.

The GROUND terminal of the Powered Roller section (Photosensor/Powered Roller Interface) is internally connected to - 24V DC ERCM Power Supply - Fig. 4.3.

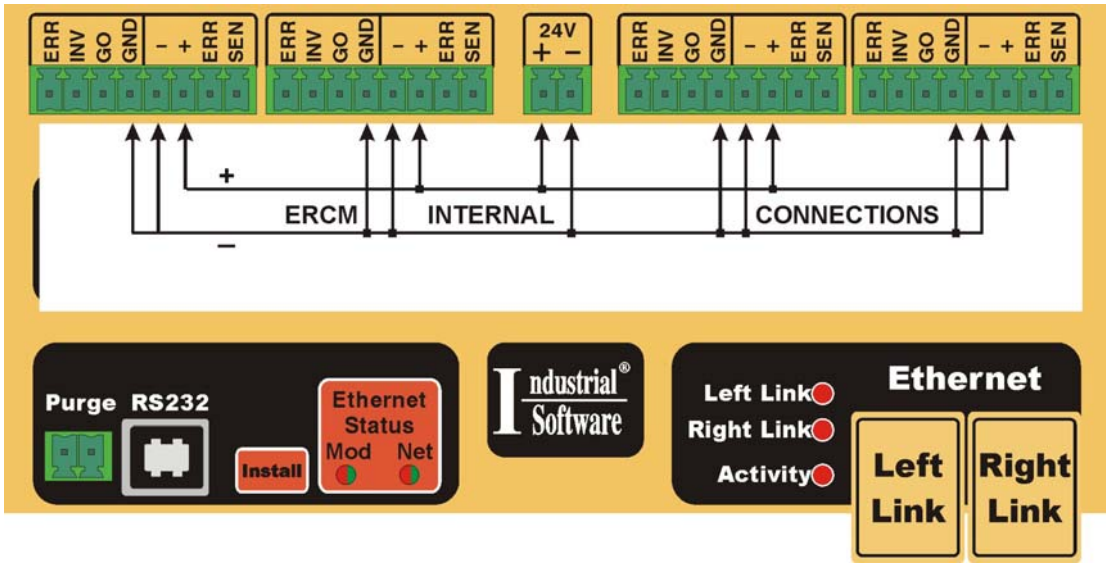


Fig. 4.3

The 24 V DC power supply connector is of the same type as the Purge connector. Wrong connection (24 V DC power supply on Purge connector or Purge signal on power supply connector) will not damage the module, but may force the system into a not functioning mode until the wrong connection is removed.

4.3. ERCM ETHERNET INTERFACE CONNECTOR

ERCM has build-in 3 port 10/100MB switch. One of the ports is connected internally, and other two ports are connected to two RJ-45 connectors. With these two RJ-45 connectors ERCM is connected to nearest upstream and downstream modules. It is not necessary that these two modules are logically upstream and downstream to the module.

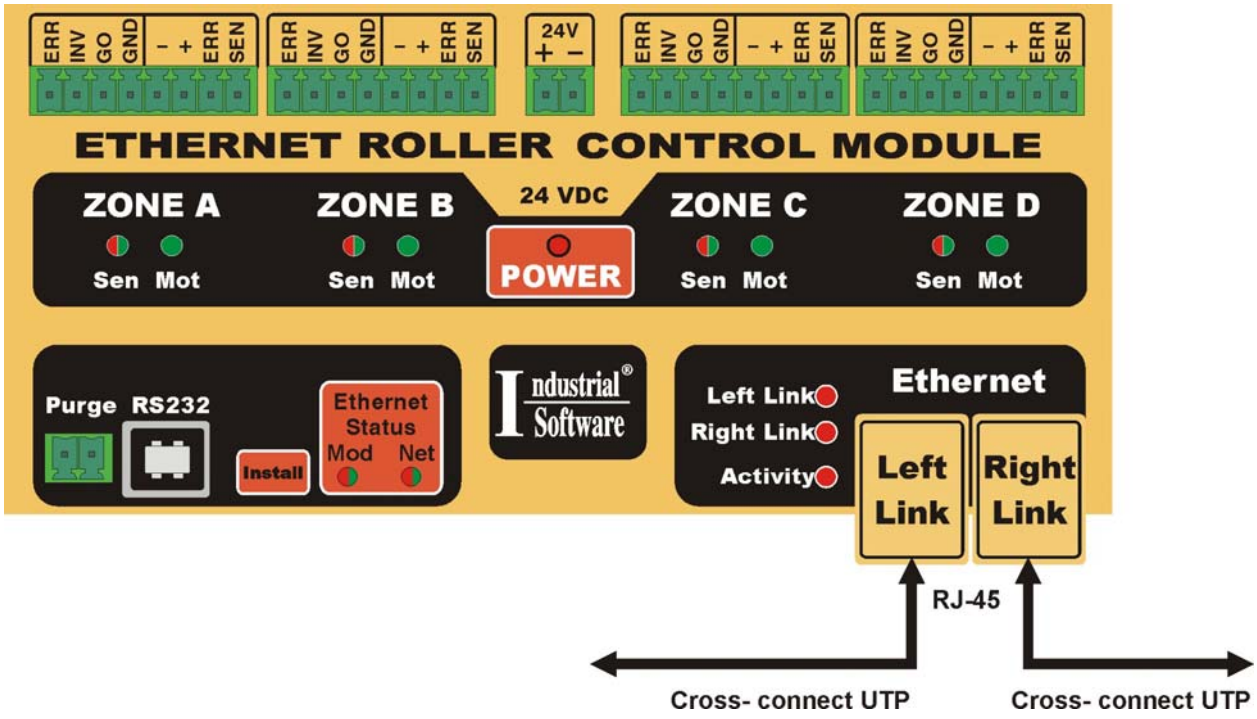


Fig. 4.4

4.4. PURGE INTERFACE CONNECTOR

This connection **is not** polarity sensitive.

The Purge signal female 2-pin connector must be wired in accordance with Table 3.3. The correct wiring will provide the electrical connection shown in Fig. 4.5.

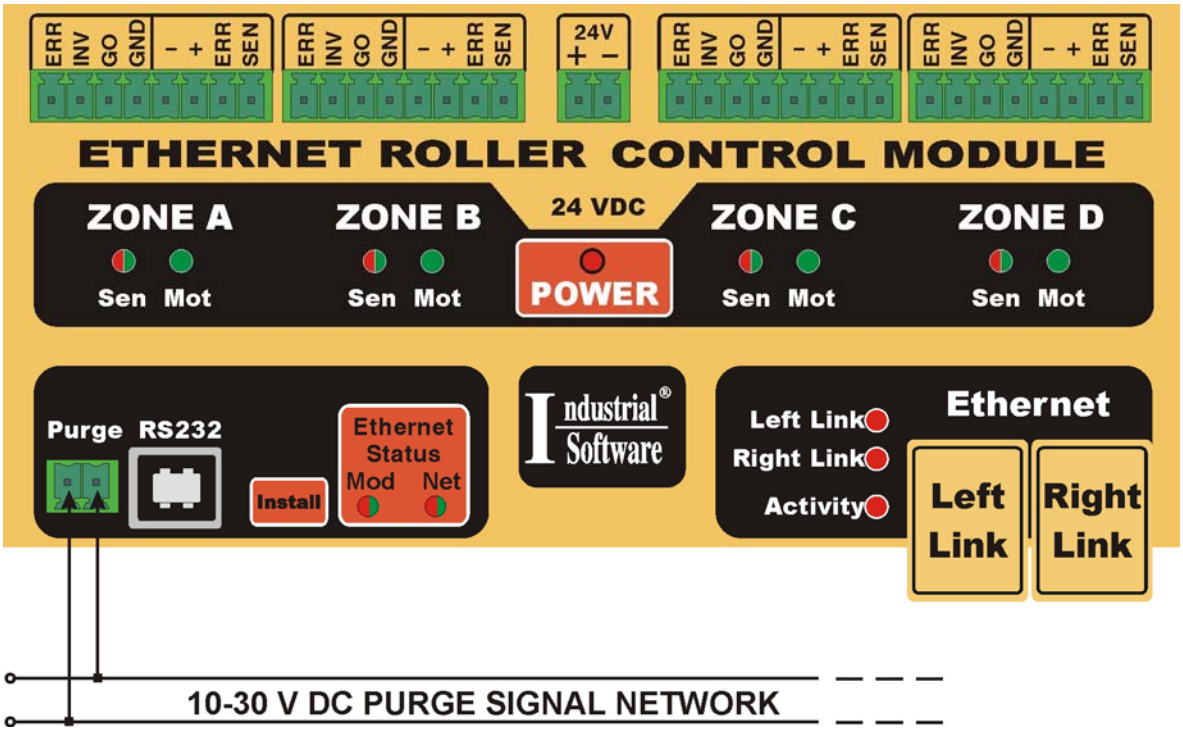


Fig. 4.5

The 24 V DC power supply connector is of the same type as the Purge connector. Wrong connection (24 V DC power supply on Purge connector or Purge signal on power supply connector) will not damage the module, but may force the system into a not functioning mode until the wrong connection is removed.

The capacity of the System's Purge Signal power supply must be selected to meet the requirement for 4 ma per one ERCM.

For example, in case of a 1000 module system configuration the required capacity is 1000x4mA = 4 A !!!

4.5. PHOTOSENSOR/POWERED ROLLER INTERFACE CONNECTORS

These connections are polarity sensitive!

The module is supplied with four 8-pin female connectors - one per each zone.

The Photosensor/Powered Roller Interface female 8-pin connectors must be wired in accordance with Table 3.1. The correct wiring will provide the electrical connections shown in Fig. 3.3.

Please check it twice to make sure that your wiring is OK!

4.6. COMPLETE SYSTEM WIRING

The complete system wiring is illustrated in Fig. 4.6.

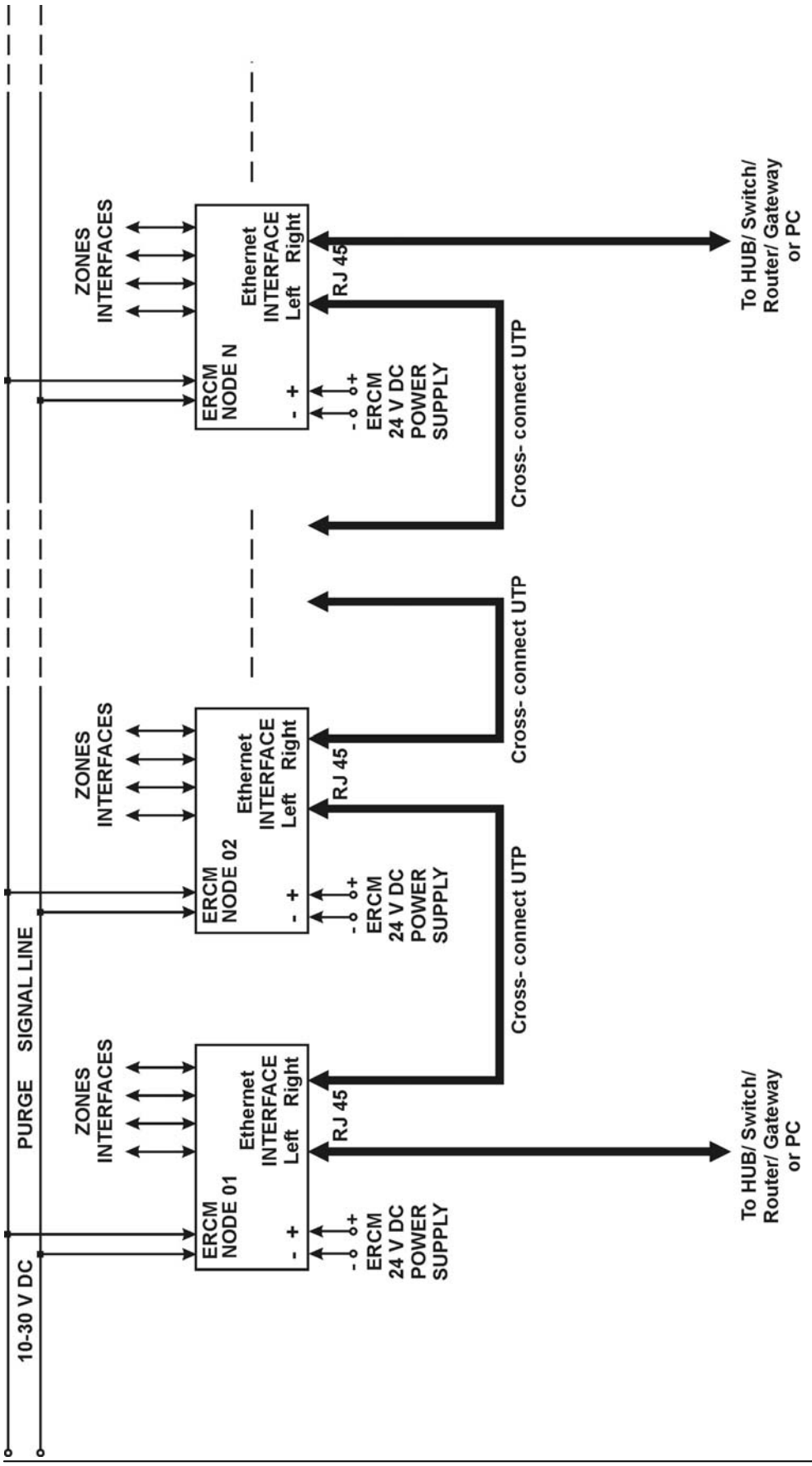


Fig. 4.6

CHAPTER 5

ERCM PRINCIPLES OF OPERATION

5.1. INTRODUCTON

5.1.1. More Objects

5.1.2. Not Only Ethernet. Ethernet/IP and PROFInet

5.1.3. Principals of Operation of Each Zone

5.1.4. Using ERCM for Linear Transfer and Merge Operation

5.1.5. Using ERCM for Divert Operation

5.1.6. Barcode Tracking

5.1.7. Working with ERCM through Ethernet IP & PROFInet

5.1.8. Configuration Properties

5.1.9. Configuring and Building Connections Between Objects through Ethernet / IP

5.1.10. Configuring and Building Connections Between Objects through PROFInet

5.1.11. Mixing Protocols in Powered Roller Control System

5.1.12. Network Throughput

5.1.13. Timings with PROFInet and Ethernet/IP Communication

5.1.14. Configuring ERCM Conveyor Control System with RollOn™ Configuration Tool

5.1.15. Older System Support and Investment Protect

5.1. INTRODUCTION

5.1.1. More Objects

ERCM design is based on modern object oriented technology. **Object** is main term in ERCM architecture. Internally ERCM implements 4 objects of type "**Zone**"

"**Zone A**"

"**Zone B**"

"**Zone C**"

"**Zone D**"

All four zones are absolutely equal in functionality. Each zone is accessible via it's properties.

Below on Fig. 5.1 is described object presentation of one zone. All properties on left are inputs for the zone. All properties on right are inputs for the zone and are driven by internal implementation of the zone's software.

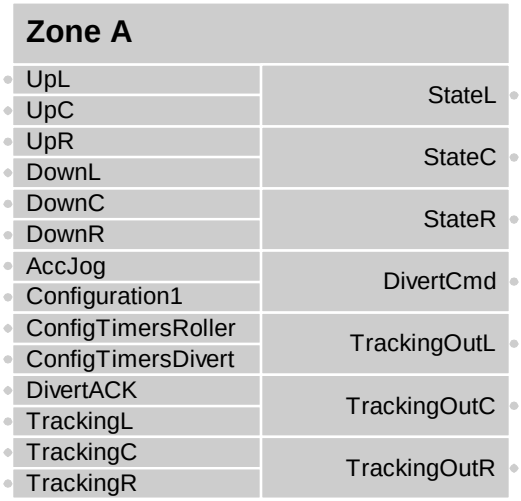


Fig. 5.1

5.1.2. Not Only Ethernet. Ethernet/IP and PROFInet

Ethernet is most popular media for communication in the business world. **TCP/IP** (Transmission Control Protocol/Internet Protocol), which most people are familiar with, is the network and transport – layer protocols at the Internet. The TCP/IP protocol suite provides a set of services that two devices may use to communicate with each other over Ethernet LAN or over a wide area network that spans the globe. But this is not enough for industrial automation interoperability Standardization of upper layer protocols in needed, so devices from different vendors can communicate each to other.

Two of the most popular and broad used protocols for Industrial Automation are **Ethernet IP** and **PROFInet**.

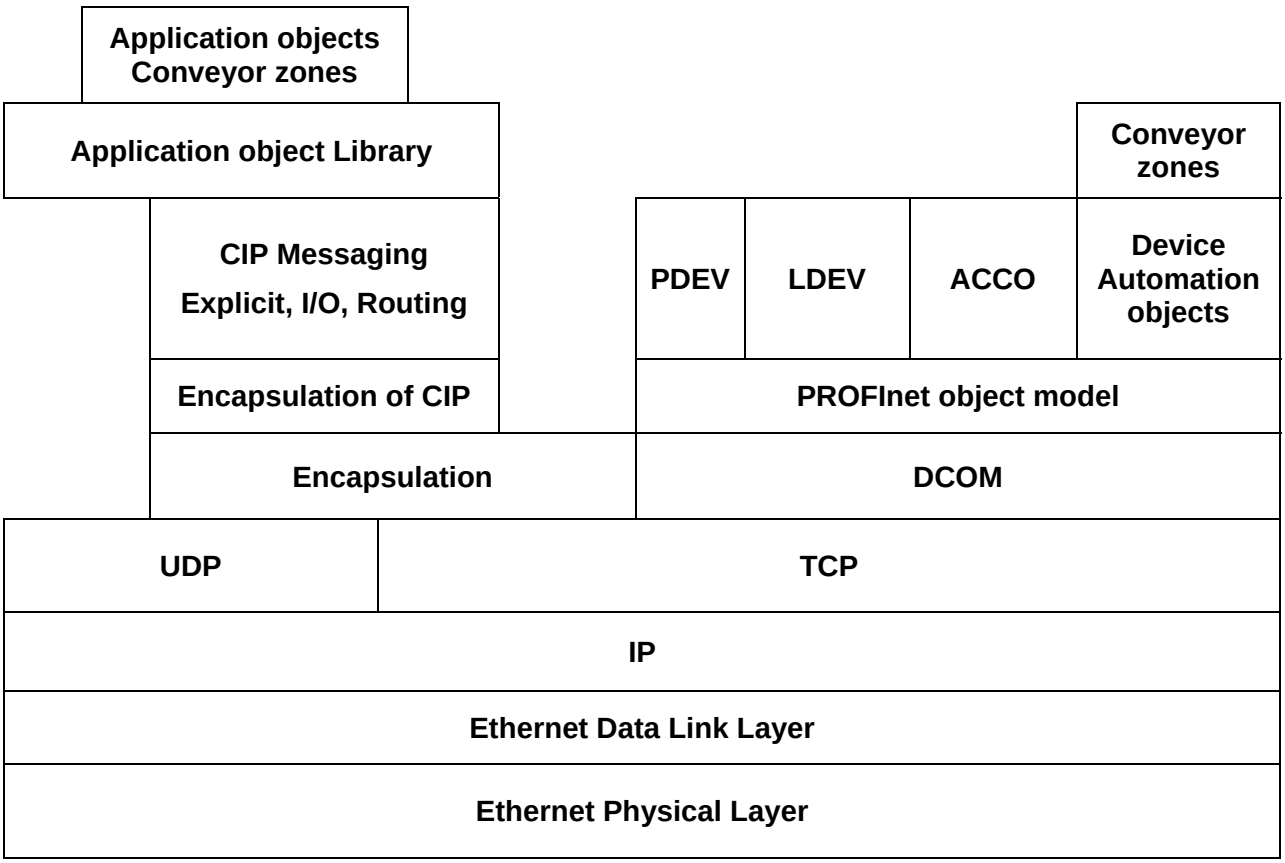


Fig. 5.2

Both protocols are object oriented and well suited for use in conveyor controls. Both protocols provide fundamental term "**Connection**" between object properties between modules. PROFInet also provides term "**Local Connection**" between properties **inside** module and "**Constant Connection**", which puts constants on input properties of objects.

Ethernet IP provides same service via **Parameter Object**.

Further in this manual we will use term "**Object**", "**Connection**", "**Properties**" independently for the protocol used, as both protocols provide services for those terms.

5.1.3. Principals of Operation of Each Zone

Each zone object inside ERCM has a set of input properties to receive data from up to 3 upstream zones and 3 downstream zones.

Properties "**UpL**", "**UpC**", "**UpR**" (for Upstream Left, Upstream Central and Upstream Right) are used to receive status information from upstream zones.

Properties "**DownL**", "**DownC**", "**DownR**" (for Downstream Left, Central, Right) are used to receive information from downstream zones.

Output properties "**StateL**", "**StateC**", "**StateR**" are used to propagate Zone's status to both upstream and downstream lanes (Left, Central and Right).

Functioning of the ERCM mainly depends on how it's zones are connected.

Note, that connections between zones can be either "local", inside module or via Ethernet. There is no difference in operation of zone object with both types of the connection. Most easy way to use a zone object from ERCM for linear transfer is described on Fig. 5.3.

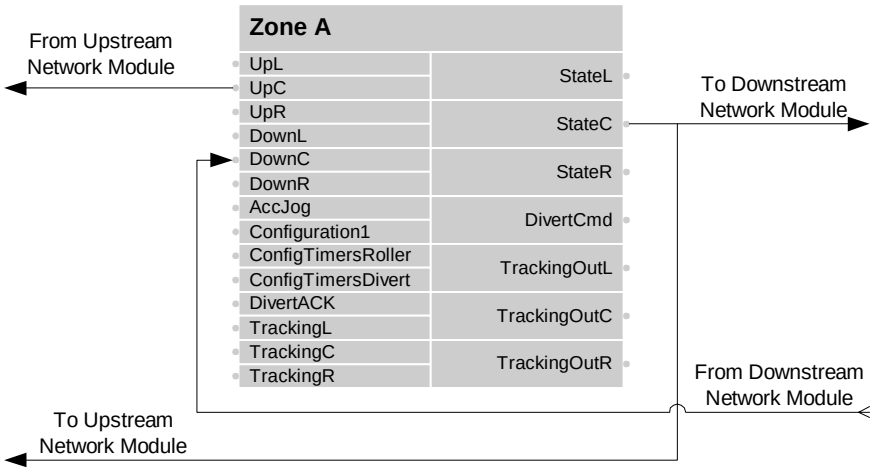


Fig. 5.3

5.1.4. Using ERCM for Linear Transfer and Merge Operation

Example connections inside module for 2, 3, 4 zone linear transfer operations are described on Fig. 5.4, Fig. 5.5, Fig.5.6 and Fig. 5.7.

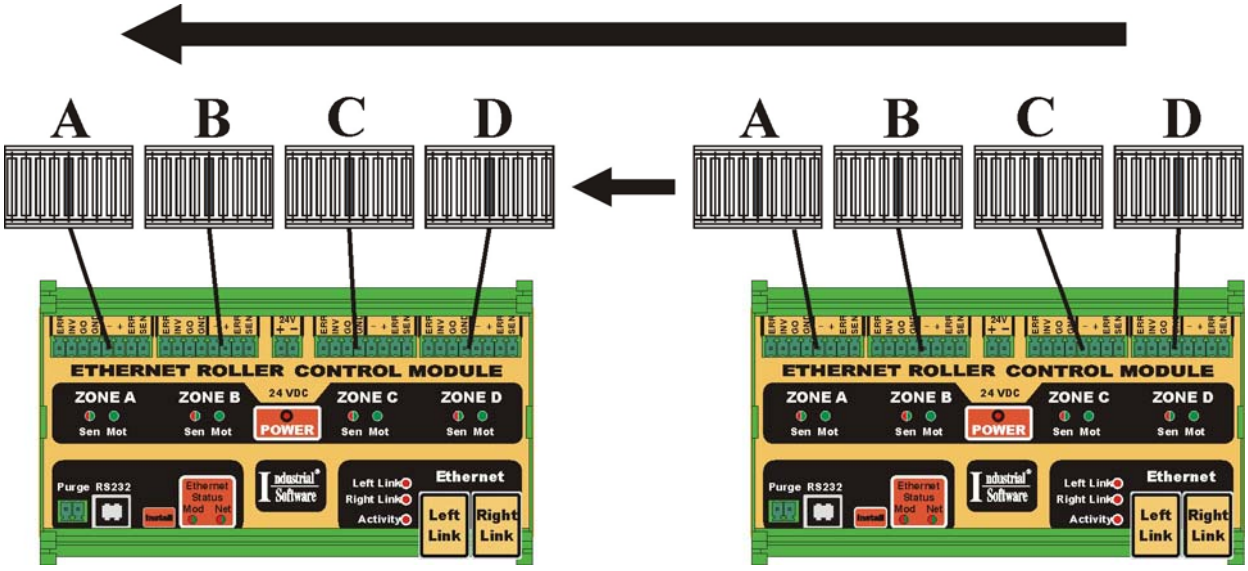
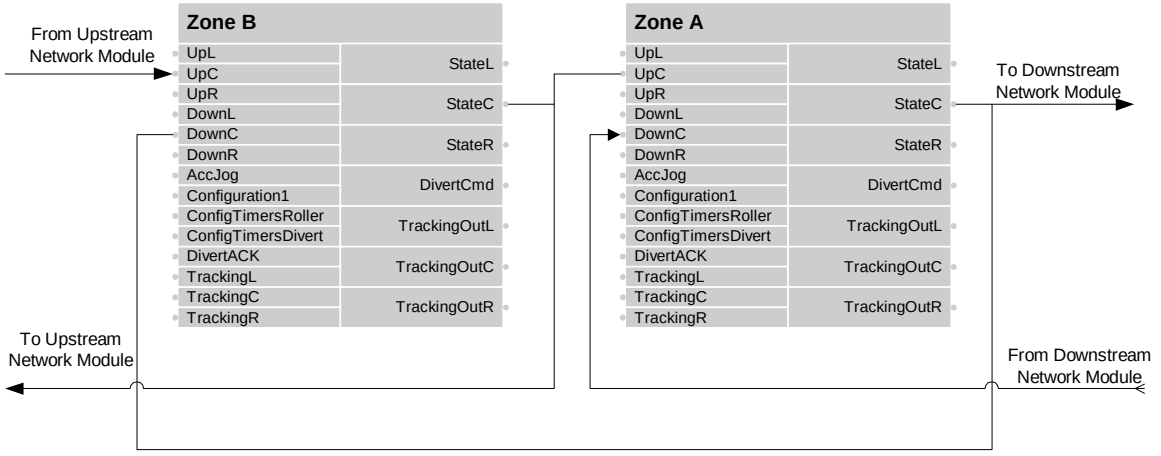
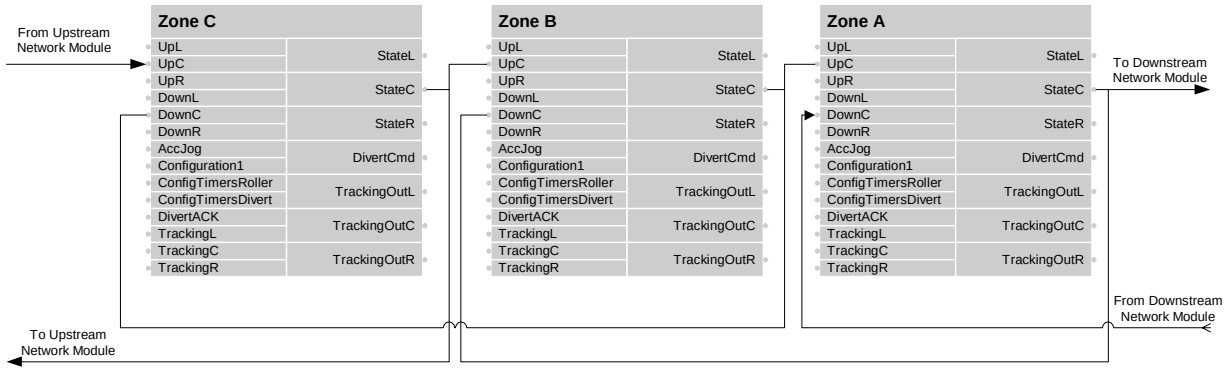


Fig. 5.4



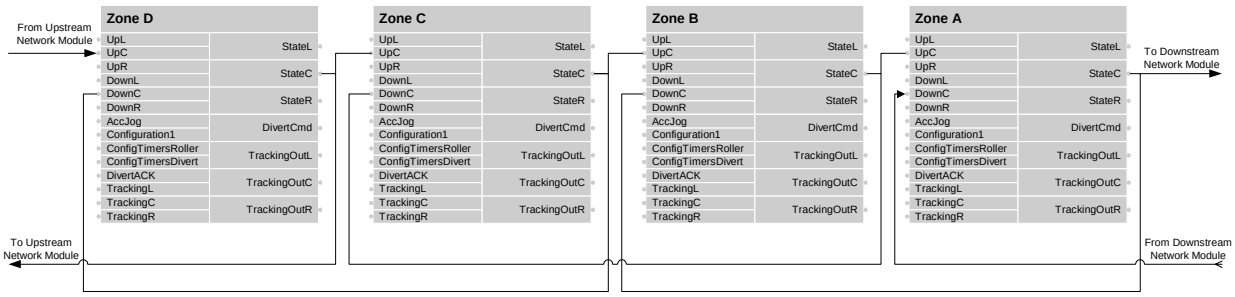
Two Zone Controller

Fig. 5.5



Three Zone Controller

Fig. 5.6



Four Zone Controller

Fig. 5.7

Example of how to use ERCM for merge operation is described on Fig. 5.8. and Fig. 5.9

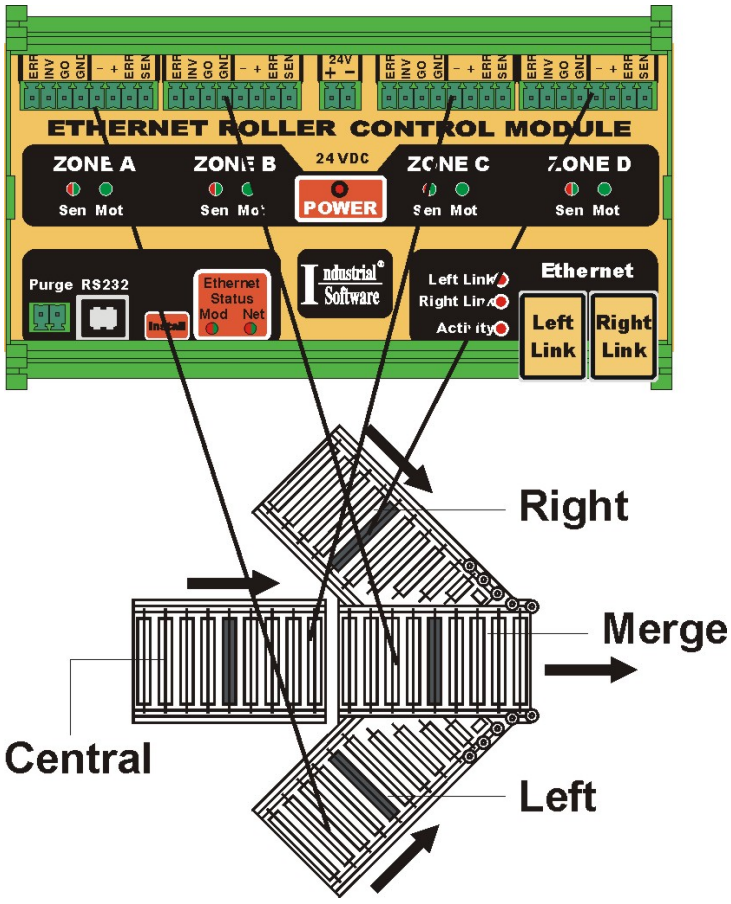


Fig. 5.8

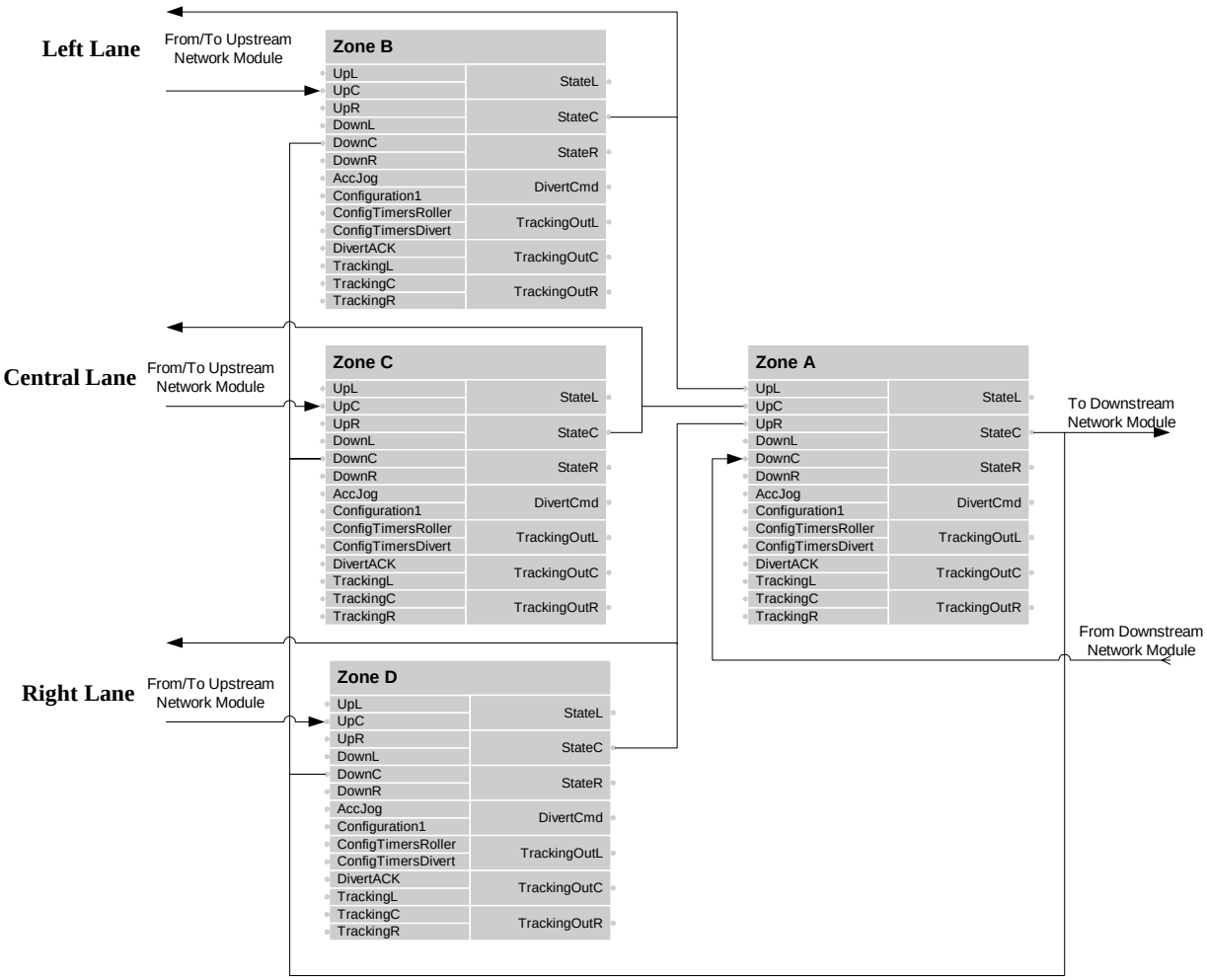


Fig. 5.9

5.1.5. Using ERCM for Divert Operation

The idea of using Zone object to control divert operations is to use ERCM to control zones before and after the divert area, the divert area itself and use external control (PLC or I/O module) to control diverter's actuator.

Communication between ERCM's diverter zone and Actuator control PLC us done via "**DivertCmd**" (for Divert command) and "**DivertAck**" (for Divert Acknowledge) Properties.

ERCM sends commands and receives acknowledges to/from actuator control. This is very flexible mechanism, as you may use same design for different type of diverter devices, only changing PLC program for actuator control and few settings of ERCM.

Example how to use ERCM for divert operations is shown on Fig. 5.10. It can be both two way pusher or pop-up diverter. Here Zone A is a divert zone with 3 downstream zones – Zone B is zone without diverting of cartons and Zones A and C on which cartons are diverted.

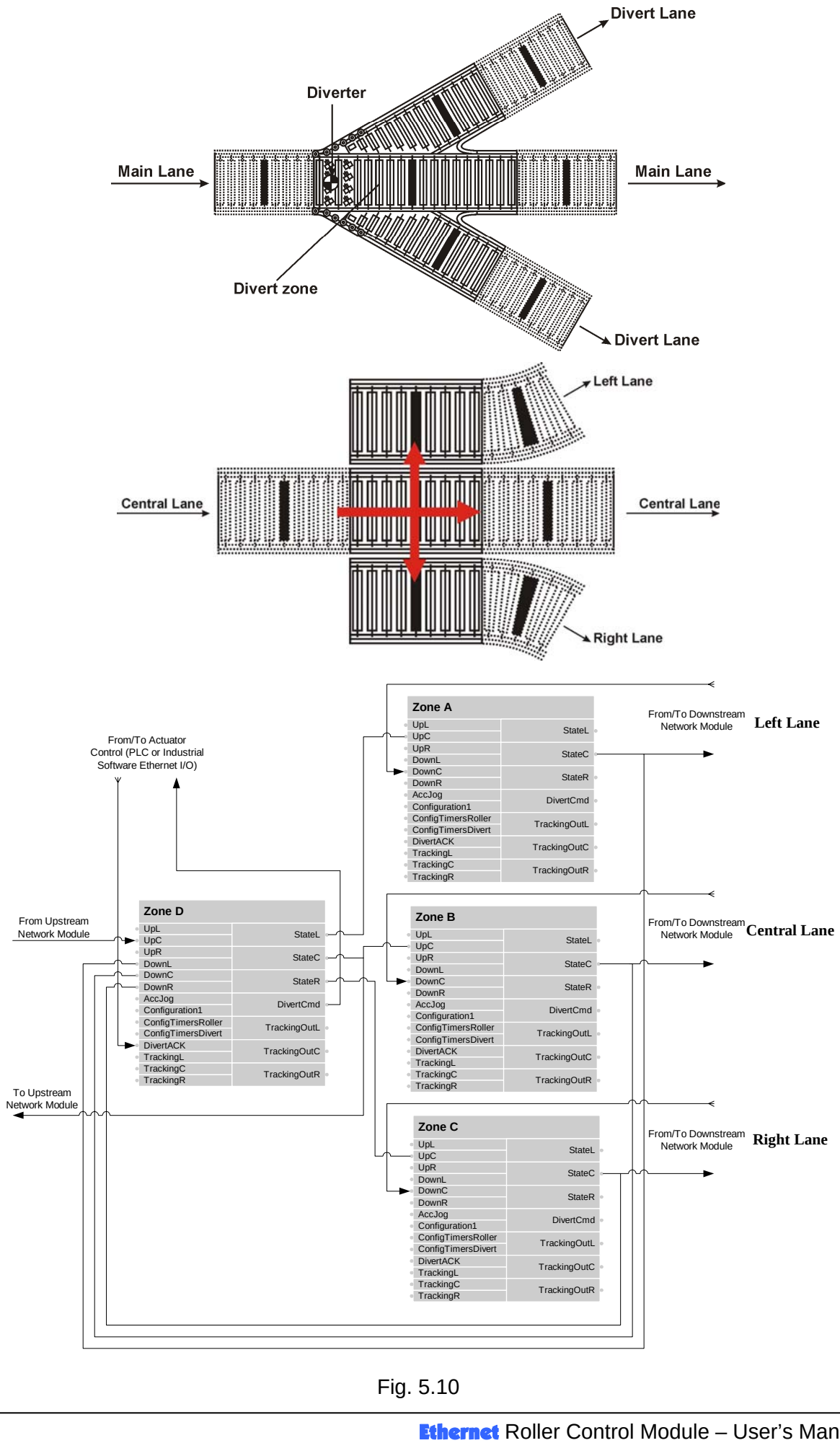

Divert Lane
Diverter
Main Lane
Main Lane
Divert zone
Divert Lane
Left Lane
Central Lane
Central Lane
Right Lane
From/To Actuator
Control (PLC or Industrial
Software Ethernet I/O)
From Upstream
Network Module
To Upstream
Network Module
Zone A
Zone B
Zone C
Zone D
UpL
UpC
UpR
DownL
DownC
DownR
AccJog
Configuration1
ConfigTimersRoller
ConfigTimersDivert
DivertACK
TrackingL
TrackingC
TrackingR
StateL
StateC
StateR
DivertCmd
TrackingOutL
TrackingOutC
TrackingOutR
From/To Downstream
Network Module
Left Lane
From/To Downstream
Network Module
Central Lane
From/To Downstream
Network Module
Right Lane

Fig. 5.10

ZoneA object sends commands to Diverter actuator control PLC via DivertCmd/DivertAck pair of properties.

Divert request can be placed by PLC via DivertAck properties, by other devices via **UpL**/**UpR** properties (for example size sensor can be connected to other ERCM's sensor input, and it State property can be used as request signal for divert zone), or by barcode tracking algorithm – see next chapter.

Note that command sequence and timing are configured in ConfigTimersDivert and Config1 properties of Zone A.

Each command (32 bit unsigned integer) encapsulates inside also configured in ERCM operation timeouts. So you don't need to configure your timings in 2 devices – ERCM and PLC. When ERCM sends a command, it also sends timeout/timing information for it.

For Example, if your divert device is two way pusher, when Zone D sends "Prepositioning" command, it also sends configured in it timeout for this operation.

You may use schematics 5.10 to control both two-way pusher or pop-up diverter. You have to simply configure "**Silent**" receive bit=1 in **Configuration1** property for zone transfer from Zone D □ C and D □ A for pusher (so zones C and A don't rotate rollers during receipt of cartons). When use with pop-up transfers, you configure this bit to 0, so rollers are rotating when receiving cartons from divert area.

More complicated schematic for divert area is described on Fig. 5.11 and 5.12.

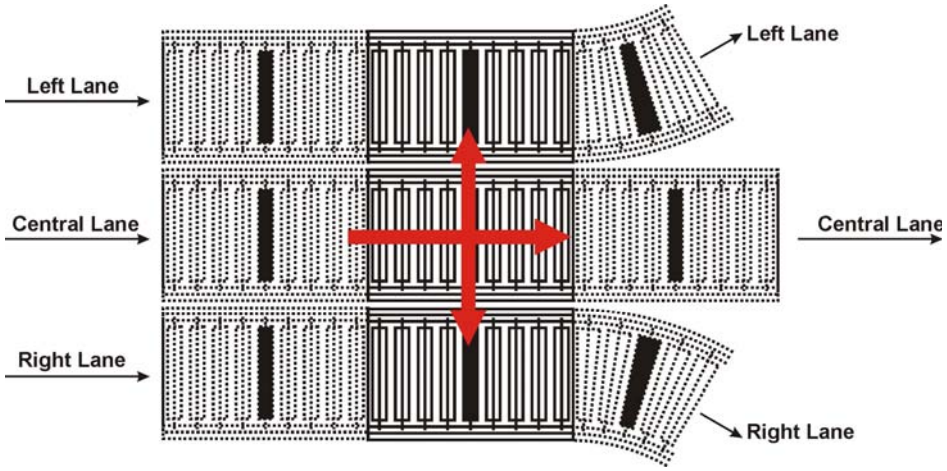


Fig. 5.11

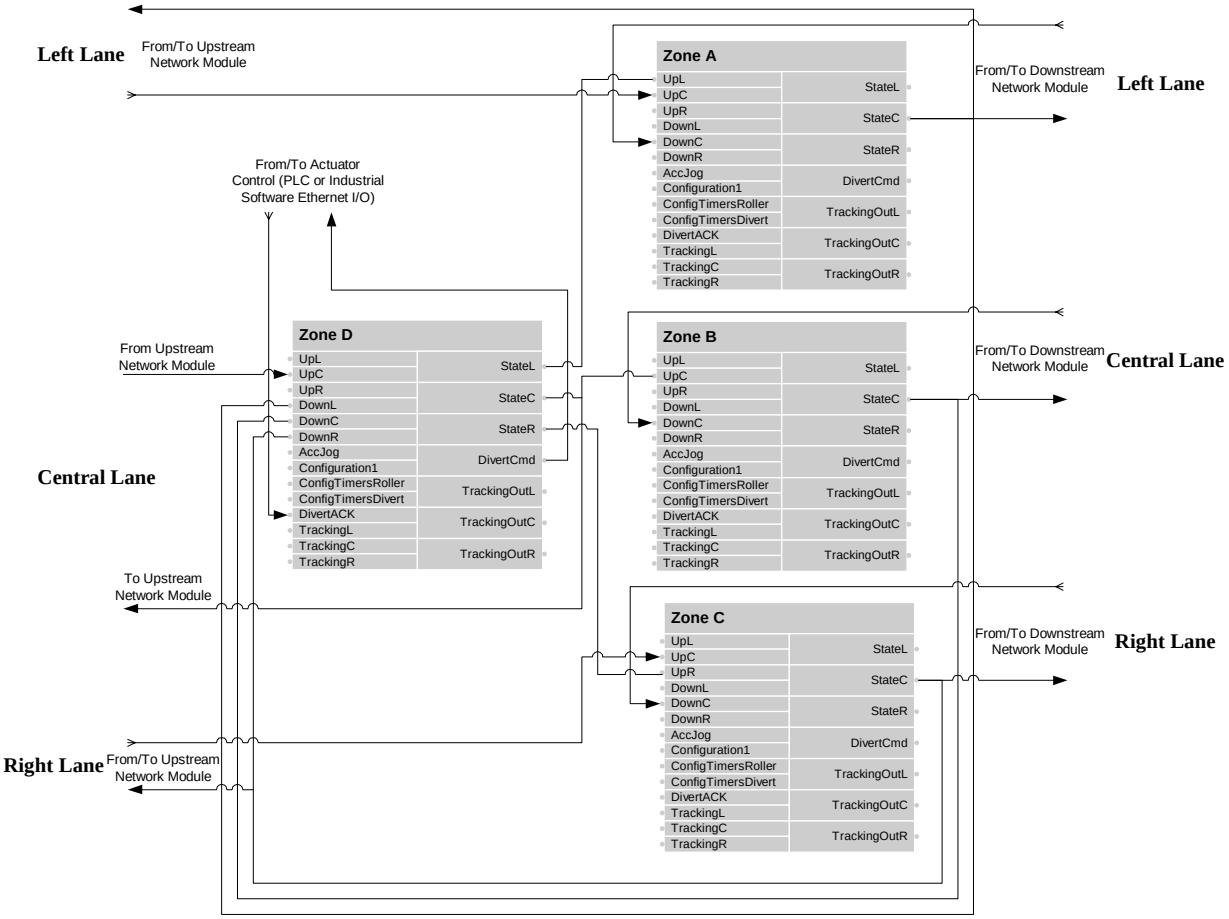


Fig. 5.12

5.1.6. Barcode Tracking

ERCM has build-in algorithm for distributed Barcode Tracking. When a carton is scanned, barcode information together with desired divert point (**IP address** of diverter zone device) is written by external PC or PLC in TrackingL or C or R property. This information is tracked along with cartons. When carton arrives at desired diverting point, it's diverted by ERCM. Carton continue downstream with it's tracking information and can be monitored for "Successful Arrival" on arrival points. Using ERCM Barcode Tracking requires only 1 bar code scanner on the common lane. Diverting points & arrival points doesn't require additional barcode scanners.

5.1.7. Working with ERCM through Ethernet IP & PROFInet

Ethernet IP, **PROFInet** and **Modbus TCP** protocols are running **concurrently** at same time in ERCM, so you may use any of them to Read/Write Properties of Zone objects in ERCM and monitor it's state. Only Ethernet IP or PROFInet can be used to configure devices or build connections (both local or between devices)

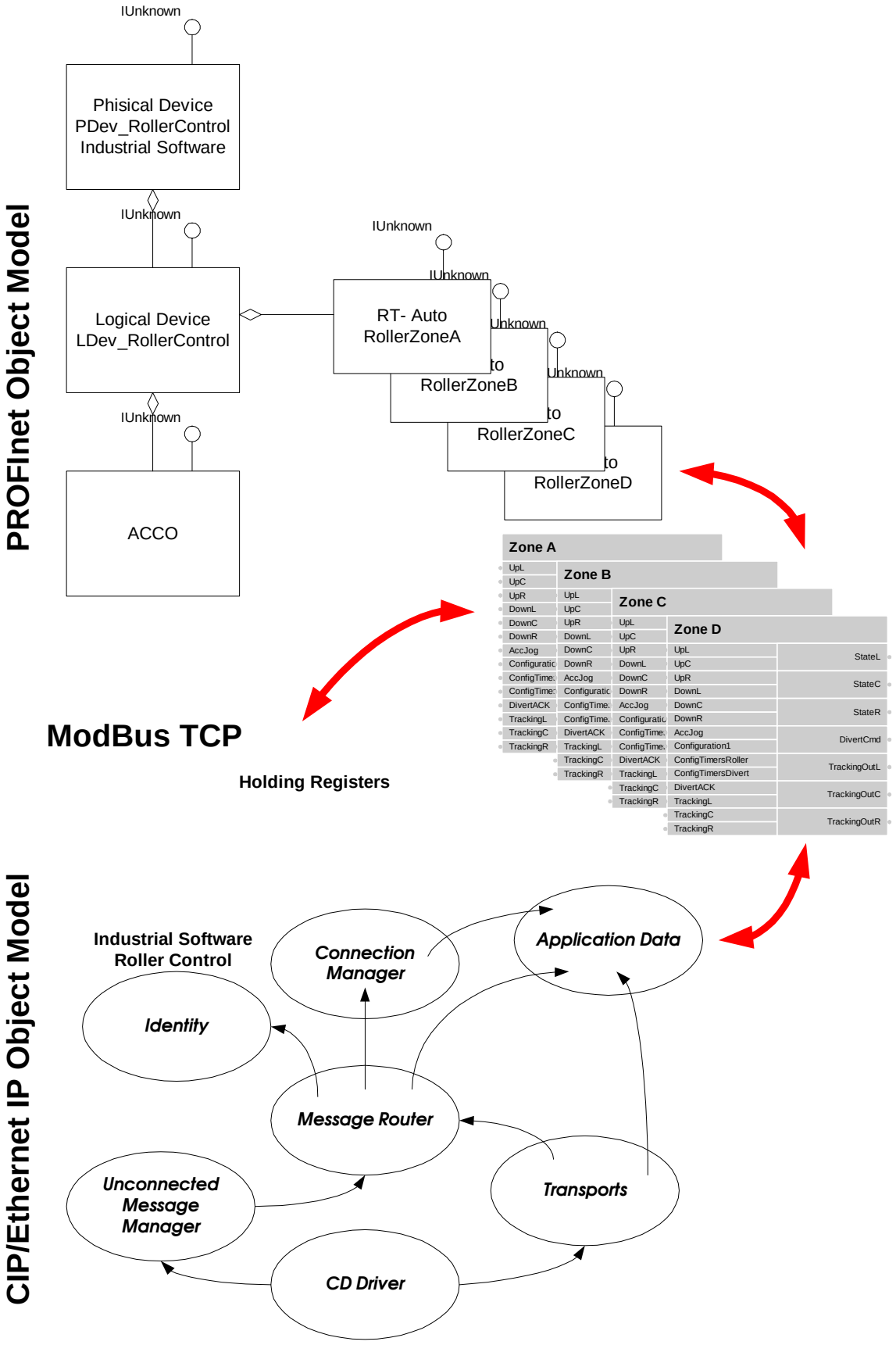

PROFInet Object Model
IUnknown
Phisical Device
PDev_RollerControl
Industrial Software
IUnknown
Logical Device
LDev_RollerControl
IUnknown
ACCO
IUnknown
RT- Auto
RollerZoneA
RollerZoneB
RollerZoneC
RollerZoneD
Zone A
Zone B
Zone C
Zone D
UpL
UpC
UpR
DownL
DownC
DownR
AccJog
ConfigTime.
DivertACK
TrackingL
TrackingC
TrackingR
StateL
StateC
StateR
DivertCmd
TrackingOutL
TrackingOutC
TrackingOutR
Configuration1
ConfigTimersRoller
ConfigTimersDivert
ModBus TCP
Holding Registers
CIP/Ethernet IP Object Model
Industrial Software
Roller Control
Connection Manager
Application Data
Identity
Message Router
Unconnected Message Manager
Transports
CD Driver

Fig. 5.13

5.1.8. Configuration Properties

Each zone has few configuration properties. Each property is divided in fields, which configure different functionality of the device.

For example **Configuration1** Property has following fields:

- **Sensor Type** Field (Light/Dark operated)
- **Zone Mode** Field (train/singulation)
- **Sensor Error Usage** Field (Sensor Error, or External Infeed Input, or External Accumulation Field force, or Push Request)
- **Motor Error Usage** Field (Motor Error, or External Accumulation Field force, or Push Request)
- **Inverse Output Usage** Field (Field Inverse, Infeed End Output, Discharge End Output)
- **Silent Receive** Field – can configure “Silent” (rollers not rotating) receive of cartons for any of upstream incoming lanes
- **Purge Input** Usage (Purge, Change Direction Input)
- **Divert Command Set** Field (developer can choose between 8 different command sets, send to/acknowledged from Actuator Control PLC)

All configuration properties are saved on flash, when appropriate service is invoked from Ethernet/IP or PROFInet.

5.1.9. Configuring and Building Connections Between Objects through Ethernet/IP

All run time properties of ERCM are mapped to instances of **Assembly Object** of implementation of **CIP** protocol. All configuration properties (Configuration1, ConfigTimersRoller, ConfigTimersDivert) are mapped to instances of **Parameter Object** and stored on internal flash memory when service “**Save**” (**service code 16_{hex}**) is executed. All internal (local) connections are also stored in **Parameter Object** Instances and stored to Flash Memory.

5.1.10. Configuring and Building Connections Between Objects through PROFInet

ERCM implements **PROFInet ver. 1.0**. It uses PROFInet connection model with **DCOM** channel. Configuration of module is done by adding “**Constant Connections**” to configuration properties. Internal connections are done by adding “**Local Connections**”. Intermodule connections are done by adding “**Connections**”.

All; 3 type of connections are added using **ICBAccoMgt::AddConnection** method. All connections and configuration are stored on Flash on **ICBAPersist::Save** method.

5.1.11. Mixing Protocols in Powered Roller Control System

When you use ERCM to build conveyor system, you can mix devices with different network protocols. On the Fig. 5.14 ERCMs are configured with PROFInet tool, but Allen Bradley PLC SLC5/05 is used to control diverter actuator.

SLC5/05 can make connection to Message Router object and Read/Control Zone’s object “DivertCmd” and “DivertAck” properties. Also Modbus TCP monitoring tool can be used on same devices.

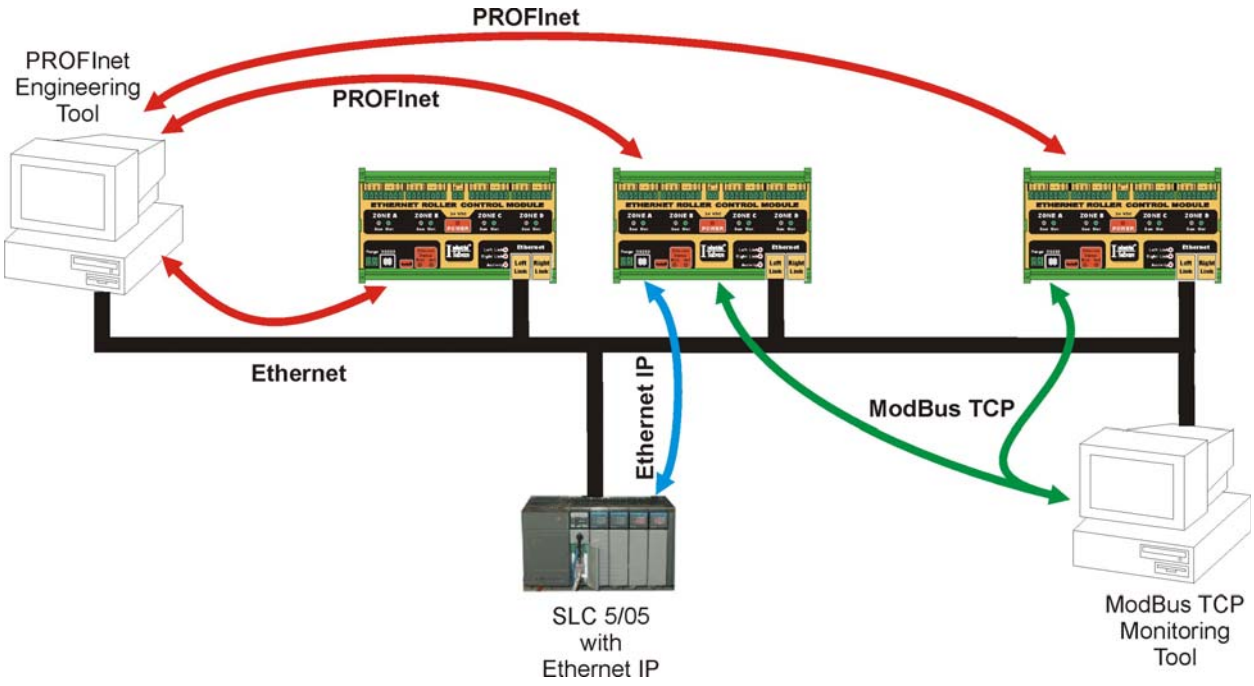


Fig. 5.14

5.1.12. Network Throughput

Conveyors are very suitable for using Ethernet for communication between devices in distributed control system.

Main reason is that network traffic is mainly between upstream and downstream device. Fig. 5.15 illustrates this:

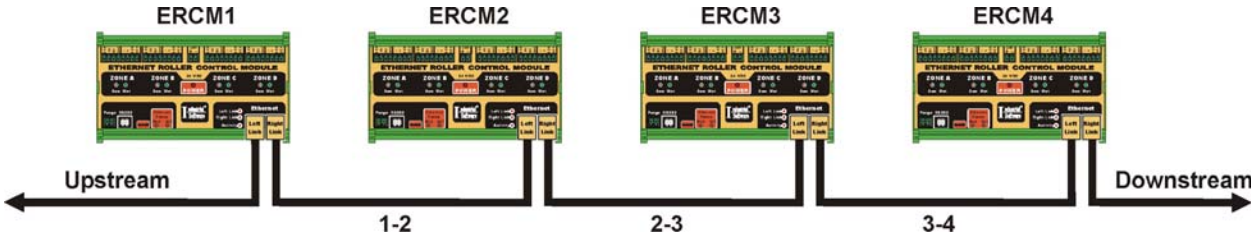


Fig. 5.15

When a carton is released from ERCM2, messages are generated to ERCM1 and ERCM3. Build-in ERCM3 switch recognizes network packet and transfers it to ERCM3, but not to ERCM4. So in this situation part of the network 3-4 (and downstream it) and upstream ERCM1 are silent and free of traffic. Switches in ERCM can operate at **100MB/s**, so system with very heavy traffic of cartons can be created.

5.1.13. Timings with PROFInet and Ethernet/IP Communication

ERCM can support **QoS** (Quality of Service) down to **8 mS** when PROFInet is used and **10ms** reaction time when Ethernet/IP is used. **Although ERCM supports Ethernet/IP cyclic I/O connections with multicasting, it's not good idea to use such connections for distributed conveyor applications**. The reason is that in this case build-in ERCMs switches will retransmit multicast messages all over the subnet, thus dramatically decrease maximum traffic throughput of the system. If cyclic I/O connections are used, it's better to configure them with unicast addresses.

5.1.14. Configuring ERCM Conveyor Control System with RollOn™ Configuration Tool

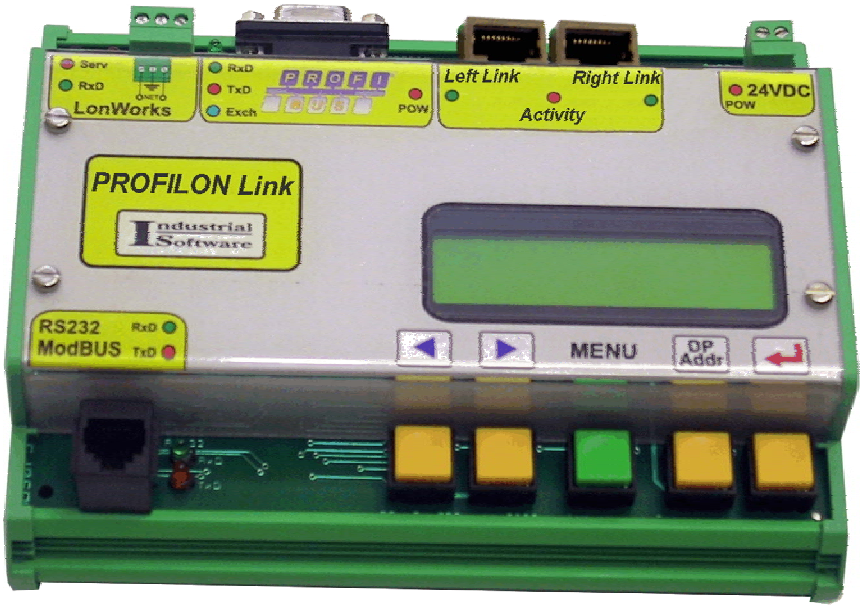
Although ERCM can be configured with Ethernet/IP configuration tools or PROFInet iMap configuration tool, easiest way to build conveyor system is **RollOn** configuration tool.

Engineering of the system is like "**LEGO**" play with easy drag&drop interface. Commissioning is few minutes process with "**Walk and press**" functionality. RollOn takes care about all internal connections configuration and inter-module connections. Additionally each ERCM has simple web server with configuration **Java Applet**, so you may configure simple systems without any configuration tool.

Build in ftp server takes care for firmware upgrade, web page upgrade, eds files and XML interface description.

5.1.15. Older System Support and Investment Protect

Industrial Software manufactures **Ethernet/LonWorks Gateway** module and RollOn plug-in for it to enable building/upgrading older LonWorks based conveyor control systems with ERCM Devices.



CHAPTER 6

ERCM AND GATEWAY ELECTRONIC DATA SHEETS

6.1. GENERAL

6.2. ERCM EDS FILE (ETHERNET IP)

6.3. ERCM XML INTERFACE DESCRIPTION (PROFINET)

6.4. PROFILON GATEWAY XML INTERFACE DESCRIPTION (PROFINET)

6.1. GENERAL

The usage of devices in a communication network requires configuration of the device parameters and communication facilities. Ethernet IP defines a standardized way to access these parameters via the Objects, described by Electronic Data Sheet.

PROFInet uses XML files to describe object interfaces

6.2. ERCM EDS FILE (ETHERNET IP)

6.3. ERCM XML INTERFACE DESCRIPTION (PROFINET)

6.4. PROFILON GATEWAY XML INTERFACE DESCRIPTION (PROFINET)

CHAPTER 7

CONFIGURING POWERED ROLLER CONVEYOR WITH SIMPLE APPLET, USING ETHERNET ROLLER CONTROL MODULE

CHAPTER 8

VERSIONS / REVISIONS HISTORY

1. Version Preliminary, Rev. March 2004