

FIPIO

CE-65 / LA-66 / LE-100 FIPIO Measuring systems

- _ Safety
- _ Transportation / Assembly
- _ Hardware Installation
- _ Software integration
- _ Example: Integration under PL7
- _ Encoder Specific Disturbances

User Manual

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Revision index

Revision	Date	Index
First release	02/22/99	00
General modifications	03/31/16	01

1 Safety

1.1 General Potential for Danger

The FIPIO encoder cannot function as a stand-alone unit, i.e. it is a component part that is intended to be installed in a complete system consisting of several such components working together. This means that the FIPIO encoder does not have a direct protection device of its own.

Using the transfer log, the system can, however, output an error bit that shows an error in internal data transfer or that a parameter was assigned with an illegal value. To reset the error bit, the error must be acknowledged. It is therefore crucial to integrate the error bit into **your own safety concept**, via the evaluation software (e.g. of a PLC).

(For more information, refer to section 1.6, Protective Devices on page 12).

All the persons who are involved in the assembly, commissioning and operation of the device

- must be appropriately qualified
- must follow exactly the instructions in this manual.

This is for your own safety and the safety of your equipment!

1.2 Safety Information

This operating manual contains information that you must comply with to ensure your personal safety and to avoid damage to property. The information is emphasized by warning triangles, which have different appearances to match the level of danger:



Warning

Means that if the appropriate safety measures are ignored, death, severe injury or considerable damage to property can occur.



Caution

Means that if the appropriate safety measures are ignored, slight injury or damage to property can occur.



Note

Emphasizes important information about the product, its properties or helpful hints for using it.

1.2.1 Installation Information

Due to the fact that the FIPIO encoder is normally used as a component part of a larger system, this information is intended to provide a guideline for safe installation of the rotary encoder in its environment.



Warning

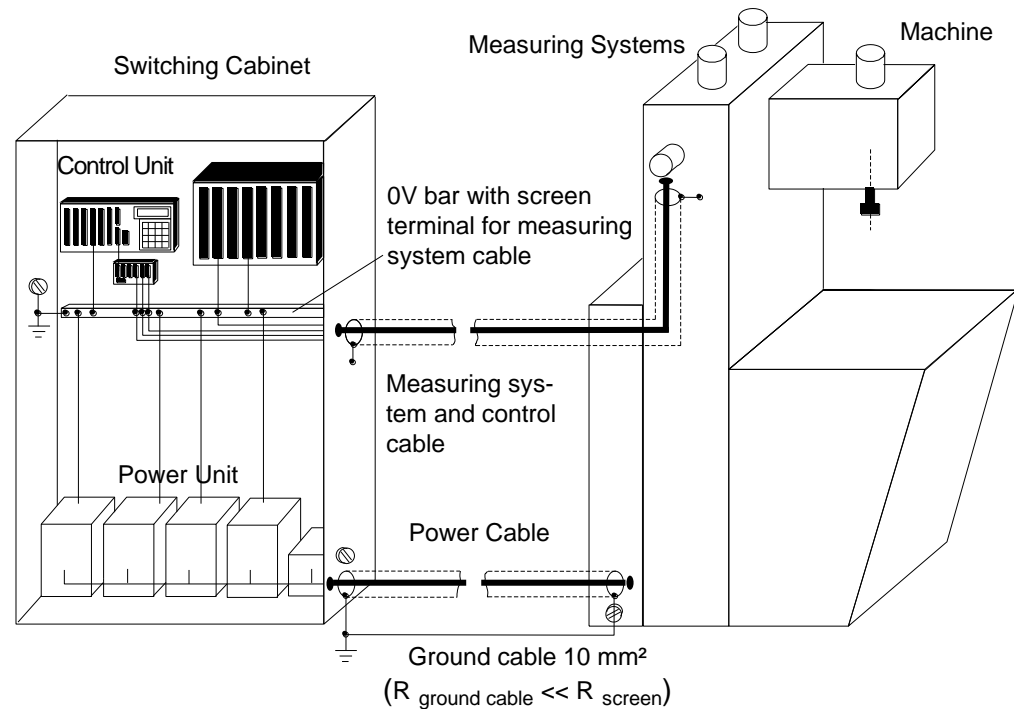
- Observe the safety and accident prevention regulations that apply to the specific application.
- In the case of equipment with a fixed connection (stationary installations/systems) without allpole mains switches and/or fuses, you must install a mains switch or a fuse in the system and connect the equipment to a protective earth.
- Before commissioning devices that are run with mains voltage, check whether the set rated voltage range matches the local mains voltage.
- With a 24-V supply, ensure safe electrical isolation of the extra-low voltage. Use only mains units that comply with IEC 364-4-41 or HD 384.04.41 (VDE 0100 Part 410) standards.
- Fluctuations in or deviations from the rated mains voltage may not exceed the tolerances stated in the technical data. If they do, functional failures of the electrical components and hazardous conditions cannot be ruled out.
- You must take precautions to ensure that, following voltage dips and failures, it is possible to restart an interrupted program in an orderly manner. In this context, no dangerous operating status conditions may occur even for a brief period of time. If necessary, you must force an **EMERGENCY STOP**.
- EMERGENCY STOP devices that comply with EN 60204/IEC 204 (VDE 0113) must remain effective in all the operating modes of the automation equipment. Unlocking the EMERGENCY STOP devices must not result in an uncontrolled or undefined restart.
- Install the connecting and signal lines such that inductive and capacitive interference does not adversely affect the automation functions.
- Install automation technology equipment and its operator input elements such that they are sufficiently protected against being operated by mistake.
- Take appropriate hardware and software measures in the I/O link to prevent possible cable or wire breakages on the signal side leading to undefined status conditions in the automation equipment.

1.2.1.1 Screening

The use of electronic sensor active systems in modern machines makes it crucial to enforce a consistent and correctly executed interference suppression and wiring concept.

These conditions are the only guarantee that systems containing electronic measuring systems will function properly.

Recommended Screened Cable Wiring



1.2.1.2 General Measures for Interference Suppression

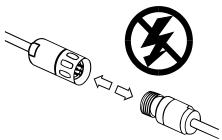
- Route (screened) lines connecting to the encoder either a long way from or completely physically separated from energy lines that carry disturbances.
- Use only completely screened lines for data transfer and ensure they are well earthed. In the case of differential data transfer, (RS422, RS485 etc.), you must additionally use twisted-pair lines.
- Use cables with a minimum cross-section of 0.22 mm² for data transfer.
- Use a ground cable with a minimum cross-section of 10 mm² to avoid equipotential bonding via the screen. In this context, you should ensure that the ground cable's resistance must be much lower than the screen's resistance.
- Wire the screen continuously keeping a large area in contact with special screen connecting terminals.
- Avoid crossing cable. If this is not possible the cables should only cross at right-angles.

1.3 Appropriate Use

The CE-FIPIO encoder is used to acquire angular movements and the LA/LE-FIPIO encoder is used for recording linear movements and processing the measured data for a controller on the output side which has a FIPIO field bus interface.



Warning

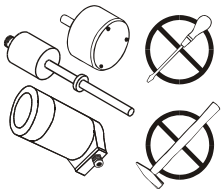


Deenergize the system before carrying out wiring or opening and closing electrical connections!

Short-circuits, voltage peaks etc. can lead to malfunctions and uncontrolled conditions in the system or to serious personal injury or damage to property.

Before switching on the system, check all the electrical connections!

Connections that are made incorrectly can lead to system malfunctions; wrong connections may result in serious personal injury or damage to property.



For safety reasons, mechanical or electrical changes to the measuring systems are prohibited!



Caution

In case of a shaft encoder (CE):

***Avoid excessive bearing loadings due to radial and axial deviations between the encoder and the drive shaft!**

At assembly, you must use couplings that can take up these forces.

***Protect the encoder from excessive vibrations, shocks and jolts, e.g. on presses!**

Use "shock modules" to cushion vibrations.

In case of a linear encoder (LA):

Do not install the encoder next to magnetic fields!

****Protect the Linear-encoder from excessive vibrations, shocks and jolts, e.g. on presses!**

In case of the LA-66 encoder it must be used shock-modules

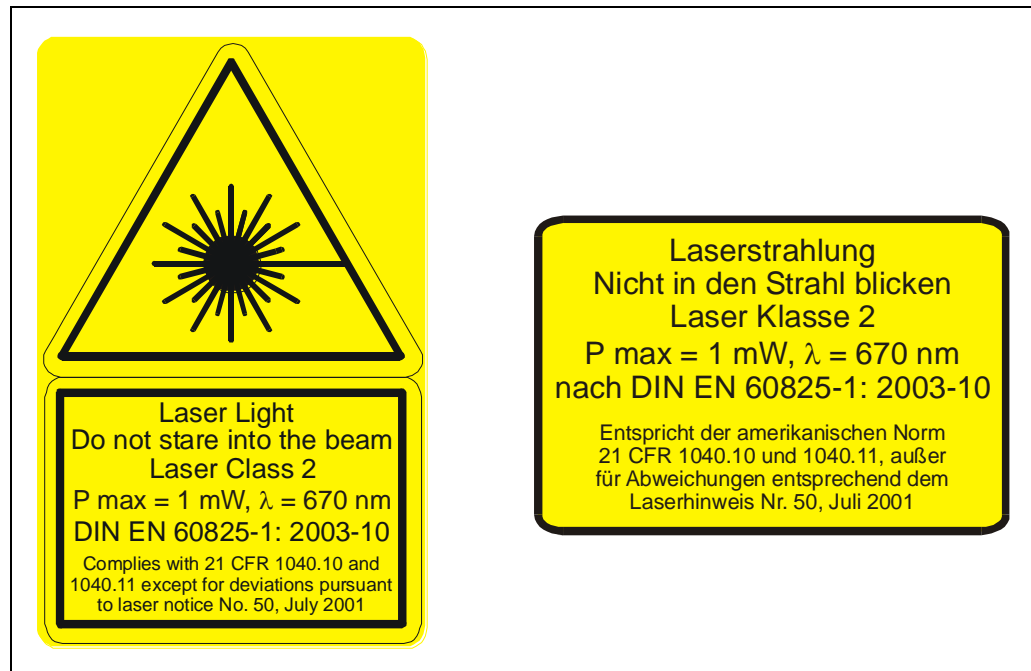
* Observe the mechanical characteristics on page 15.

** Observe the mechanical characteristics on page 17.

In case of a laser measuring device (LE):



Warning



- In the case of Class 2 laser devices, the eye is protected against brief, accidental glances at the beam by the blinking reflex. For this reason, devices of this class can be used without additional protective measures provided the operator is not required to look into the laser beam deliberately for longer periods, i.e. 0.25 s, or to look repeatedly into the laser beam itself or the directly reflected beam.

As a rule, the existence of the eyelid end reflex to the protection of the eyes may not be going out.

Therefore you should close the eyes consciously or immediately turn away!

- The device must be installed in such a way that the exposure of persons to the laser beam can only happen accidentally.
- The laser beam may only extend as far as is necessary for the range measurement. The beam must be limited at the end of the useful range by a diffusely reflecting target area in such a way as to minimise the danger from direct or diffuse reflection. For this purpose, you should use the TR-Electronic reflecting foil supplied with the device.
- The area outside the operating range where the unshielded laser beam falls should be limited as far as possible and should remain out of bounds, particularly in the area above and below eye level.
- The prevailing legal and local regulations have to be taken into account to the operation of laser facilities.

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Note

Always keep to the commissioning, operating and programming instructions specified in this manual.

1.4 Authorized Operators

This device may only be commissioned by qualified personnel. In the context of the safety-specific information in this document, qualified personnel are considered to be persons who are authorized to commission, ground and mark circuits, equipment and systems in accordance with recognized safety standards.

1.5 Safety Measures at the Place of Assembly



Warning

Do not carry out welding if the encoder has already been wired-up or is switched-on!

Potential fluctuations can destroy the encoder or adversely affect its function.

Keep to the supply voltage range

Shaft Encoder (CE):	11-27 V DC ($\pm 5\%$ residual ripple)
Linear Encoder (LA):	19-27 V DC ($\pm 5\%$ residual ripple)
Laser device (LE):	18-27 V DC ($\pm 5\%$ residual ripple)



Note

Ensure that the area around the place of assembly is protected from aggressive media (acid, etc.).

1.6 Protective Devices



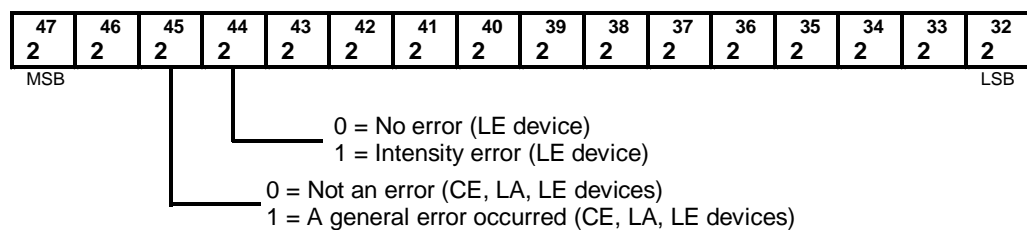
Note

For the description below, you should first have read and understood the entire operating manual.

Error Polling and Error Acknowledgement

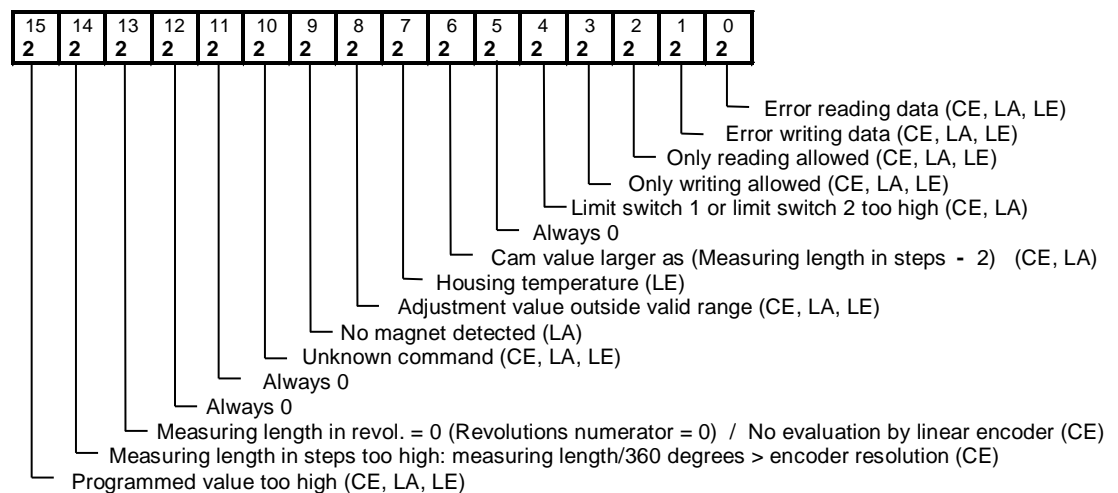
If an error occurs while one of the services is being carried out, the system sets error bit 2^{45} in the encoder's service feedback message. In the case of a laser measuring device, an intensity error is indicated additional at bit 2^{44} . The Data check service acknowledges and resets a set error bit.

IN data relative to master:



Carrying out the Data check service (008 HEX) transfers the error status to the master as an answer and this defines the error in more detail:

IN data relative to master:



Warning

As soon as error bit 2^{45} or 2^{44} (Laser device LE) is set, you must ensure that appropriate measures are taken to prevent injuries to people or damage to property, e.g. stopping the appropriate axis or system.

If necessary, you must force an **EMERGENCY STOP**.

2 Transportation / Assembly

2.1 Transportation/Storage

Transportation Information

Do not drop encoders or subject them to excessive jolting!

The shaft-encoder/laser-device contains an optical system with glass elements and the linear encoder a magnetoresistive sensor

Use only the original packaging material!

Incorrect packaging material can cause damage to the device in transit.

Storage

Storage temperature (CE, LA): -30 to +80 °C

Storage temperature (LE): -20 to +75 °C

Store in a dry place.

2.2 Technical Data

2.2.1 Shaft Encoder

2.2.1.1 Electrical Characteristic Data

Operating voltage:	11-27 V DC (\pm 5% residual ripple)
Max. current consumption:	< 200 mA at 11 V DC, < 100 mA at 27 V DC
Output capacity:	25-bit
Resolution:	8192 steps/rev (13-bit)
Measuring range:	4096 revolutions (12-bit)
Output code:	Binary
Encoder interface:	FIPIO
Special features:	Programming the following parameters via the FIPIO: <ul style="list-style-type: none">– Direction of counting– Measuring length in steps– Measuring length in revolutions– Preset adjustment– Up / Down– Overspeed– Limit switches– Cams– Tool changer
Operating temperature range:	0 to +60 °C, -20 to +70 °C on request

2.2.1.2 Mechanical Characteristic Data

Mechanically permissible speed:	6000 RPM
Permissible shaft loading:	40 N axial, 60 N radial (at end of shaft)
Minimum bearing lifetime:	3.9 x 10 ¹⁰ revolutions at:
Operating speed:	3000 RPM
Shaft loading:.....	20 N axial, 30 N radial (at end of shaft)
Operating temperature:	60 °C
Max. angular acceleration:	≤ 10 ⁴ rad/s ²
Moment of inertia:	2.5 x 10 ⁻⁶ kg m ²
Starting torque at 20 °C:	2 Ncm
Vibration loading (50-2000 Hz):	≤ 100 m/s ²
Shock loading (11 ms):	≤ 1000 m/s ²

2.2.2 Linear Encoder

2.2.2.1 Electrical Characteristic Data

Operating voltage:	19-27 V DC (+/- 5% residual ripple)
Max. current consumption:	< 250 mA (19 - 27 V DC)
Output capacity:	Max. 24 bits
Measuring length:	up to 3000 mm
Resolution:	0,01 mm
Output code:	Binary
Encoder interface:	FIPIO
Special features:	Programming the following parameters via the FIPIO: <ul style="list-style-type: none">– Direction of counting– Measuring length in steps– Preset adjustment– Up / Down– Limit switches– Cams
Operating temperature range:	0 to +60 °C, -20 to +70 °C on request

2.2.2.2 Mechanical Characteristic Data

Linear deviation:	< 0,05% of the measuring length
Reproducibility:	0,01 mm
Hysteresis:	< 0,05 mm
Temperature coefficient:	< 30 ppm/°C
Vibration loading (sinus 50-2000 Hz):	$\leq 100 \text{ m/s}^2$ (DIN IEC 68-2-6)
Shock loading (11 ms):	$\leq 1000 \text{ m/s}^2$ (DIN IEC 68-2-27)
Pressure resistance (option):	600 bar static
Rod:	Cr/Ni-alloy
Magnetic interference (at rod circumference):	< 3 mT (mili Tesla)
Displacement speed and mounting position:	as desired
Position sensor (standard):	Type T4-M33
Position sensor (option):	Type T3-U64
Rod mounting:	Option

2.2.3 Laser Measuring Device

2.2.3.1 Electrical Characteristic Data

Measuring principle:	Phase delay time measurement
Range (measurement on reflecting foil):	0,2 – 100 m
Resolution:	0,5 mm
Operating voltage:	18-27 V DC (+/- 5%)
Power consumption (no-load):	< 6 watts
Opto-transmitter:	Laser diode (red light)
Wavelength λ :	670 nm
Max. laser power:	$P \leq 1 \text{ mW}$
Laser protection class:	2 (IEC 825)
Lifetime:	50 000 h
Opto-receiver:	Photodiode
Measured value output:	$\geq 0,001 \text{ mm}$
Measured value output / refresh cycle:	1000 values / s
Reproducibility:	$\pm 2 \text{ mm}$
Output code:	Binary
Encoder interface:	FIPIO
Special features:	Programming the following parameters via the FIPIO:
	– Direction of counting
	– Measuring length in steps
	– Preset adjustment
	– Measuring initial value
	– Error value

2.2.3.2 Environmental conditions

EMC:	EN 61000-4-2 (IEC-801-2) / EN 61000-4-4 (IEC-801-4)
Operating temperature range:	0-50 °C
Option	-20 to +50 °C
Thermal drift:	1 ppm / °C
Storage temperature range:	-20 to +75 °C
Relative air humidity:	98 % (no moisture condensation)
* Degree of protection:	IP 65 (DIN 40 050)

* The degree of protection is based on the assumption that the Laser Measuring Device cables are correctly screwed in and connected.

2.3 Assembly

2.3.1 Shaft Encoder

Drive of the Encoder Shaft

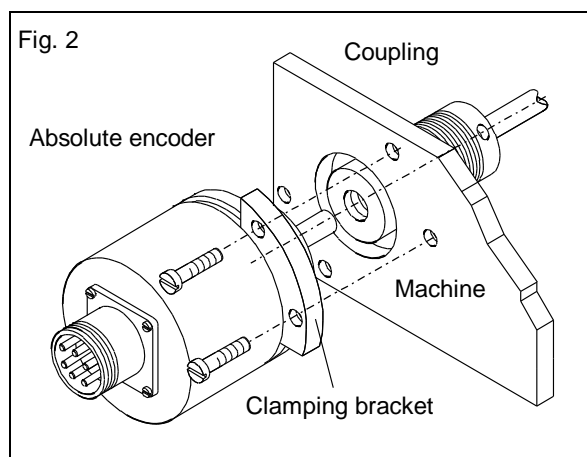
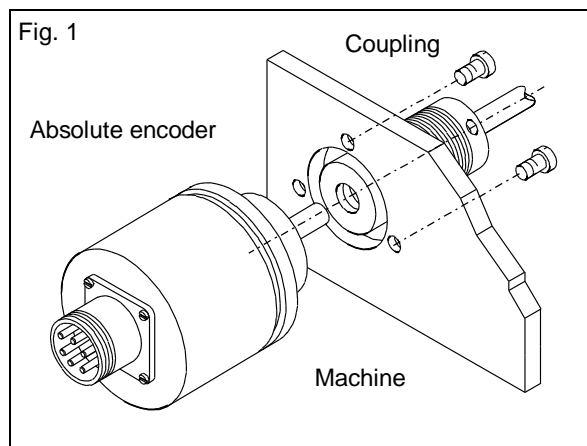
Series CE encoders are connected to the drive shaft by an elastic coupling which takes up deviations in the axial and radial directions between the encoder and the drive shaft. This prevents excessive bearing loading. You can order couplings on request.

Flange Fixing

The centring collar with fit f7 centres the encoder to the shaft. Fixing to the machine is by means of three screws in the flange (Figure 1).

Clamping Bracket Fixing

The centring collar with fit f7 centres the encoder to the shaft. Fixing of the encoder is by means of two clamping brackets (Figure 2).



2.3.2 Linear Encoder

General

When mounting LA encoders please ensure that there are no strong magnetic or electric noise fields near encoder.

Inadmissible noise fields may affect the encoder's accuracy. In the area of the measuring rod the field strength must not exceed 3 mT (mili Tesla).

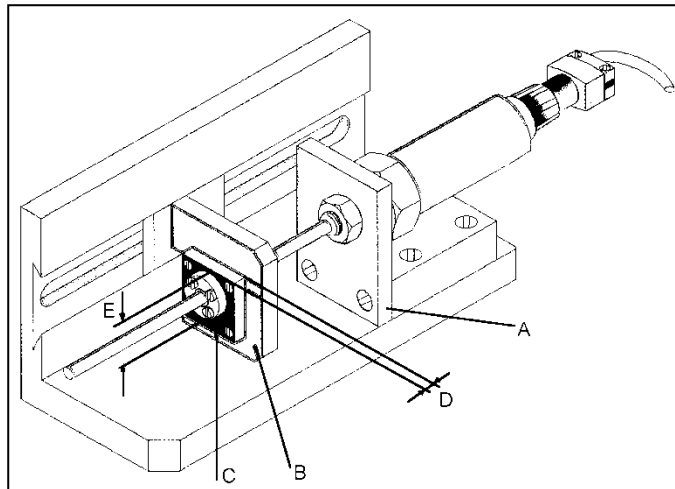
Mechanism LA-system

The measured value is determined by the displacement of the position sensor along the rod's length. There is no mechanical contact. The precision of the measured value is dependent on the symmetry of the magnetic field geometry. This means that the position sensor must be central about the rod axial parallel.

Important points regarding the handling of the encoder during the mounting:

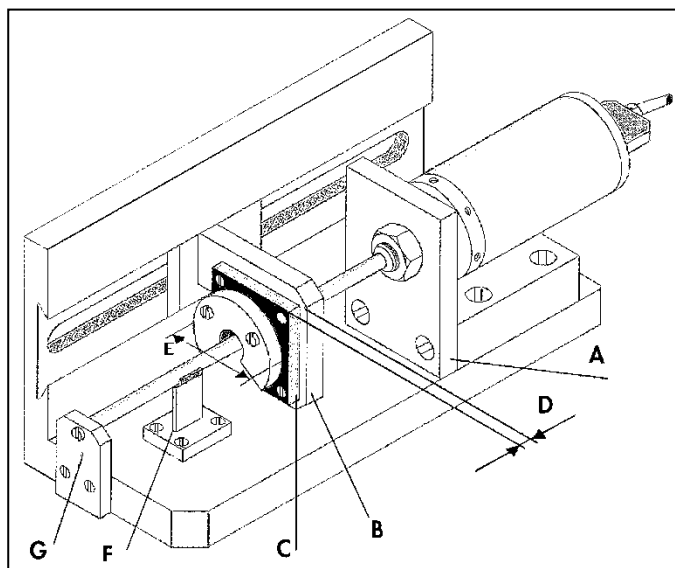
- do not open
- do not hit or knock
- do not drill or weld
- do not bend the measuring rod

Mounting framework (LA-system)



- A Mounting support of the linear absolute encoder
- B Slide
- C Spacer of the position sensor
- D If A and B are of magnetizable material, the spacer must be of non-magnetic material with a thickness of 10 mm.
- E When installing in a magnetic environment, spacing of >3 mm must be kept between the measuring rod and any metallic pieces.
It is recommended to use non-magnetizable screws to mount the encoder. (e.g. brass, aluminium, plastic etc.)

These data also apply alternatively to the LMP-38 measuring system without measuring sledge.



- F Recommended rod support for rod length >1.5 m (proposal for rod support)
- G Rod tip bracket.
Fixing types F + G if necessary.

2.3.3 Laser Measuring Device

Aligning the Laser Measuring Device

The measuring device or reflector is attached to the moving object and the reflector/sensor to the fixed remote station in such a way that the reflector always remains within the visual field of the sensor. This can be done using the light spot of the laser diode, which is still clearly visible on the reflecting foil even at long distance. When aligning the laser measuring device, the user may need to take measures to ensure that it can be mechanically adjusted.

The size of the reflecting foil must be such that the light spot cannot be displaced from the reflector by vibrations. The device comes with a reflecting foil measuring 20 x 20 [cm].

Once the Laser Measuring Device is optimally aligned with the reflecting foil, the service command 008 Hex "Data Check" must be sent for resetting and acknowledgement the error message.

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Note

Reflecting foils by other manufacturers should be used only after consultation with TR-Electronic, as all the information in the chapter "Electrical Characteristic Data" on page 18 refers to the foil already supplied with the device.

3 Hardware Installation

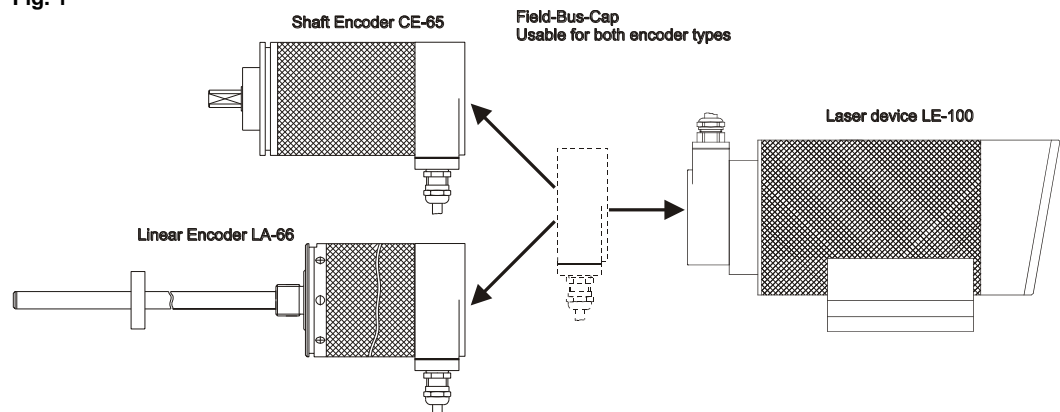
This section covers the hardware installation of the product. It contains all the information necessary for installing the product, and in particular for:

- making all the necessary connections: FIPIO bus, electrical power supply, I/O, special connections
- configuration switches: address coding etc.
- display methods: indicator LED's etc.

3.1 Physical presentation

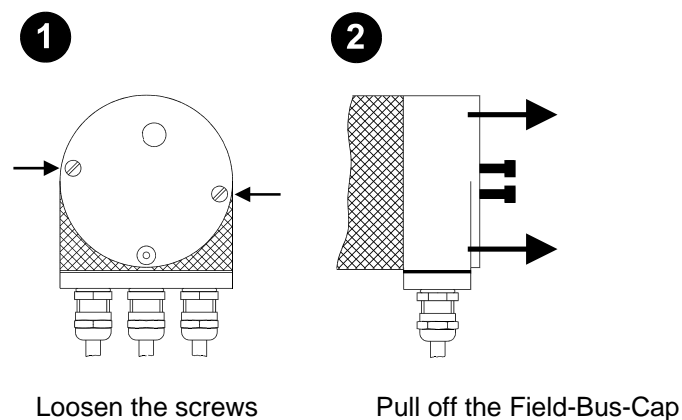
3.1.1 Encoder types

Fig. 1



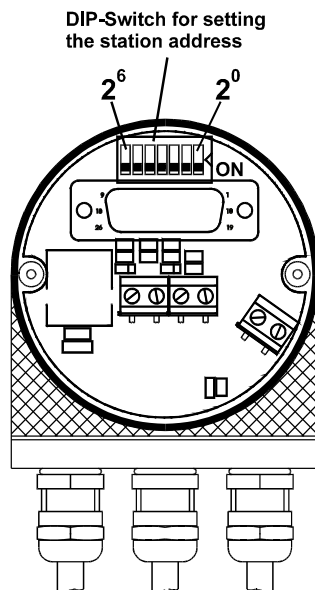
3.1.2 Fixing elements

Fig. 2



3.1.3 Method for coding the device address

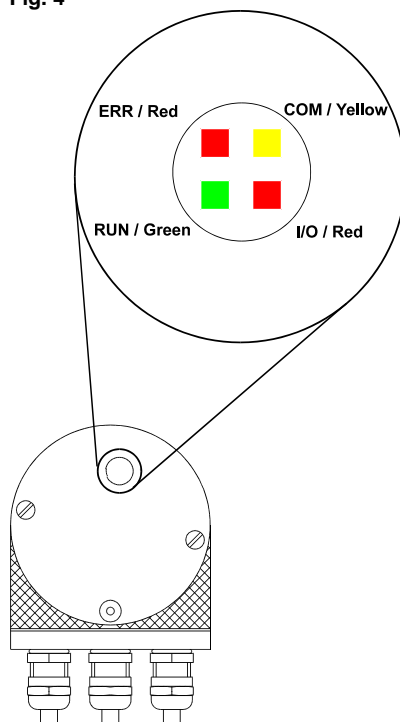
Fig. 3



see also chapter "CE-65/LA-66/LE-100 FIPIO addressing" on page 29

3.1.4 Indicator LED's

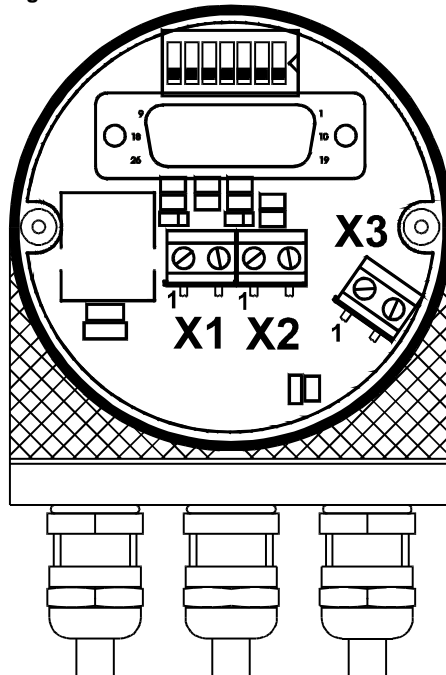
Fig. 4



see also chapter "Display block of the CE-65/LA-66/LE-100" on page 30

3.1.5 Terminal blocks

Fig. 5



Print clamps X1, X2 and X3:

2-pole, grid spacing 5,08 mm, nominal cross-section 0,14-1,5 mm² (fixed or flexible), nominal voltage 250 V, rated current 16 A, AWG 26-16

X1 - Screw clamp, FIPIO bus

Pin 1	FIPIO -
Pin 2	FIPIO +

X2 - Screw clamp, FIPIO bus

Pin 1	FIPIO -
Pin 2	FIPIO +

X3 - Screw clamp, Power supply

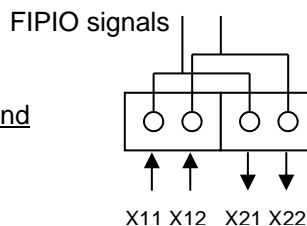
Pin 1	Supply voltage
Pin 2	0 V, GND

3.2 FIPIO cable connection

X1 and X2 screw clamps are symmetrical. We assume X1 is used for entry cable but inverting the positions would be identical.

Three possible situations :

- Two wires FIPIO cable, encoder not at line end
Entry cable : red wire -> X12 (FIPIO+)
 green wire -> X11 (FIPIO-)
Output cable : red wire -> X22 (FIPIO+)
 green wire -> X21 (FIPIO-)
- Four wires FIPIO cable
connect indifferently the red wires to X12/X22 (FIPIO+) and the green wires to X11/X21 (FIPIO-)
- Two wires cable, encoder at line end
Entry cable : red wire -> X12 (FIPIO+)
 green wire -> X11 (FIPIO-)
ACC7 resistor : connect the white wires to X21 and X22.



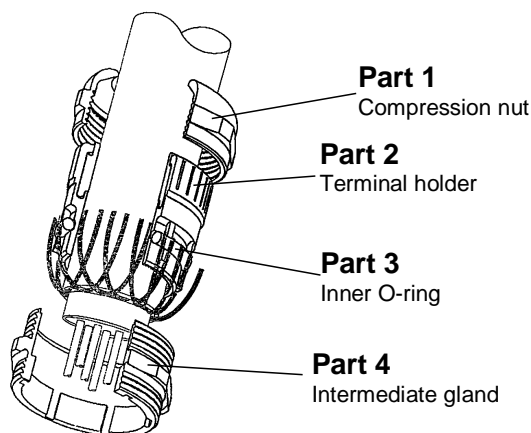
i

Note

If the terminal block is removed from the encoder, the FIPIO bus remains operational.
The ground lug of both cables should be tightly connected to the cable screw glands (encoder field bus cap) in order to keep the ground continuity along the cable.

3.2.1 Connecting the Cable Screening to the Encoder

1. Screw the cable screw gland into the housing.
2. Dismount the compression nut (1) and the terminal holder (2).
3. Push the compression nut (1) and the terminal holder (2) over the cable.
4. Strip the cable; push back the braiding around the terminal holder (2) such that the braiding goes over the inner O-ring (3) and does not lie over the cylindrical section or the torsional bars.
5. Insert the terminal holder (2) into the intermediate gland (4) such that the torsional bars fit into the intended lengthwise grooves in the intermediate gland (4).
6. Screw the compression nut (1) to the intermediate gland (4).



3.3 Power supply

Standard power supply CE-65 shaft encoder : 11 - 27 V DC

Standard power supply LA-66 linear encoder : 19 - 27 V DC

Standard power supply LE-100 laser device : 18 - 27 V DC

3.4 Connection to the FIPIO bus

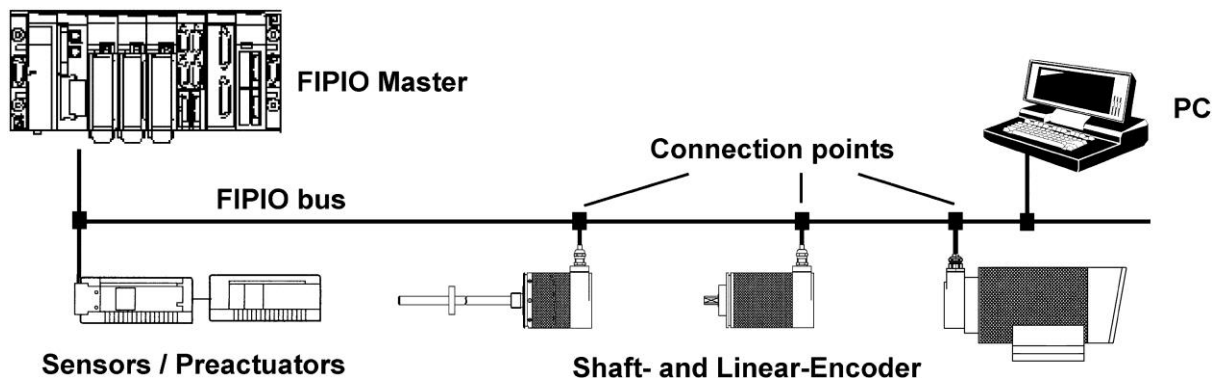
As the **CE-65/LA-66/LE-100** is integrated within a FIPIO architecture, various accessories are offered by Schneider Automation for easy connection:

- TSX FP CAxxx main cable, sold in lengths of 100, 200 or 500 m,
- TSX FP CCxxx drop cable, sold in lengths of 100, 200 or 500 m,
- TSX FP ACC4 tap junction,
- TSX FP ACC14 tap junction,
- TSX FP ACC7 line terminator,
- TSX LES 65 or TSX LES 75 connector for connecting Series 7, TSX model 40 PLCs.
- KIT5130 lead for connecting the APRIL 5000 PLC.

For further information on connections, consult the FIPIO bus/FIPWAY network reference manual – Ref. TSX DR FPW E (English version) or TSX DR FPW F (French version). Reference can also be made to this manual for details of the operating characteristics and installation of a FIPIO fieldbus.

In addition, the "Recommandations for PLC Installation Wiring" manual, TSX DG GND E (English version) or TSX DG GND F (French version), contains valuable rules and precautionary measures for wiring a FIPIO fieldbus.

Fig. 6



3.5 CE-65/LA-66/LE-100 FIPIO addressing

A **CE-65/LA-66/LE-100** on the FIPIO bus is identified by its connection point. The number of the connection point represents the physical address of the device on the FIPIO bus and its value can be between 1 and 127.

On FIPIO, address 0 is reserved for the PLC (TSX PREMIUM, TSX model 40 or APRIL 5000) which is the bus manager. Address 63 is reserved for the programming terminal. TSX model 40 and APRIL 5000 PLCs allow only addresses between 1 and 62.

The **CE65/LA66/LE-100** FIPIO address is selected via DIP-switches (see Fig. 3 on page 25). The coding is binary ($2^0 - 2^6$).

Address modification is only taken into account after the **CE-65/LA-66/LE-100** has been powered up.



Caution

Two devices on the FIPIO bus must never have the same address. If the 4 standard indicator lamps (RUN, ERR, COM and I/O) flash simultaneously for a long period of time, this indicates that the device cannot be connected to the FIPIO bus as its address is already occupied by another device.

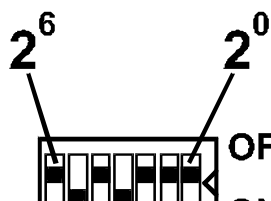
Address coding

Switch 7 = identifier 2^6	Switch 6 = identifier 2^5	Switch 5 = identifier 2^4	Switch 4 = identifier 2^3	Switch 3 = identifier 2^2	Switch 2 = identifier 2^1	Switch 1 = identifier 2^0	Encoder address = identifier
off	off	off	off	off	off	on	1
off	off	off	off	off	on	off	2
off	off	off	off	off	on	on	3
.
off	on	on	on	on	on	on	not authorized
.
on	on	on	on	on	on	on	127

Example:

Encoder address = 40 dec
= 28 hex
= 0010 1000 bin

Switch position:



3.6 Procedure for starting up the FIPIO bus

We recommend that the devices are started up one after the other. For a detailed description of the first starting up of a FIPIO application, refer to the FIPIO bus reference manual (ref TSX DR FIP E) or FIPIO bus / FIPWAY network reference manual (ref TSX DR FPW E).

3.7 Display block of the CE-65/LA-66/LE-100

The **CE-65/LA-66/LE-100** has a display block consisting of the four standard FIPIO leds (RUN, ERR, COM, I/O), which provide information on its status. The assignment you see on page 25, Fig. 4.

RUN / Green:	Device powered up <ul style="list-style-type: none">– Off if the device is not powered up or has such a major failure that it does not communicate anymore on the FIPIO bus.– On in all other cases.
COM / Yellow:	Communication function activity <ul style="list-style-type: none">– Off if there is no activity on the FIPIO bus or if the communication function is stopped.– Flashing when the device is taking part in exchanges on the FIPIO bus: flashing can be directly linked to the production/consumption of FIP frames or at a fixed frequency of approximately 5Hz.
ERR / Red:	Major fault <ul style="list-style-type: none">- Off when the device is functioning normally.- Flashing when the device is not connected to the FIPIO bus or if the outputs values are not received at least each 1 second (flashing frequency = approximately 2Hz).- On in the case of a fault which requires the replacement of the device or of one of its component modules: faulty sub-assembly, assembly of incompatible modules, etc.
I/O / Red:	Minor fault <ul style="list-style-type: none">- Off when the device is functioning normally.- On in the case of a fault originating outside the device

When the device is powered up, these four LED's flash simultaneously (frequency = approximately 2Hz) during the self-test phase of the device. If the flashing persists, this means that the address at which it has been configured is already occupied.

4 Software integration

4.1 FIPIO standard profile

The development of an application using **CE-65/LA-66/LE-100** on the FIPIO bus means that the device must be declared in the FIPIO bus configuration with the software workshop of the PLC used.

Declaring the device in the FIPIO configuration allows the software workshop to automatically generate the operating parameters of the FIPIO bus which will then be loaded into the PLC.

The **CE-65/LA-66/LE-100** belongs to the STD_P device family. This family is used to connect devices to FIPIO which conform with the FIPIO standard profiles defined in the FIPIO connection program.

A device of this type is declared by associating a reference from the STD_P family to a FIPIO bus connection point.

The reference used by the **CE-65/LA-66/LE-100** is the **FSD C8**, the characteristics of which are as follows:

- | | | |
|------------|---|--|
| <i>FSD</i> | ➔ | FIPIO -Simple Device Profile |
| <i>C</i> | ➔ | Compact Device |
| <i>8</i> | ➔ | PLC objects which are the image of the CE-65/LA-66/LE-100 I/O |
| | | - 8 words for the inputs image |
| | | - 8 words for the outputs image |

N.B.: word = 16-bit word.

A sequence of screens is used to guide the operator when configuring a device on the FIPIO bus. These screens are described in the documentation of the software workshop.

Refer also to the PLC documentation to check about the possible minimum version numbers for the PLC CPU and/or the software workshop in order to connect a device conforming to this reference

4.2 Device Configuration

4.2.1 Selection of CE-65/LA-66/LE-100

The device is configured with the PLC software workshop: refer to the workshop documentation for more details about the operating mode.

However, note that :

For PLCs managing several tasks, the task which controls the **CE-65/LA-66/LE-100** must not have a period which exceeds the **1 second**.

4.3 Programming

4.3.1 Objects available for programming

Different kinds of information exchange are possible between the PLC and **CE-65/LA-66/LE-100**.

The device I/Os are directly accessible in dedicated PLC memory zones: Access to the **CE-65/LA-66/LE-100** input values is performed by reading the corresponding memory zone. Setting the **CE-65/LA-66/LE-100** outputs is performed by writing the corresponding memory zone.

CE-65/LA-66/LE-100 diagnostic information is handled in coherence with the PLC diagnostic: see its documentation.

In the case of the **CE-65/LA-66/LE-100**, the objects exchanged with the PLC are the following:

Object	Description	Access	Format
inputs	8 words which are the image of the CE-65/LA-66/LE-100 inputs	read	16-bit words
outputs	8 words which are the image of the CE-65/LA-66/LE-100 outputs	write	16-bit words
device diagnostic information	made up of 1 byte containing the following information: bit 0: external fault 4 bit 1: external fault 3 bit 2: external fault 2 bit 3: external fault 1 bit 4: internal fault (breakdown) bit 5: hardware configuration fault (device includes modules which are not compatible with each other) or software fault (the module connected is not the one declared in the configuration) bit 6: communication fault bit 7: application fault: bad adjustment or configuration parameters, or specific command refused bits 8 à 15: reserved to 0	read	1 byte
inputs validity information	1 byte indicating a fault in CE-65/LA-66/LE-100 inputs image update. A non zero value indicates that the contents of the inputs words are not significant.	read	1 byte

4.3.2 Image of the inputs (CE-65/LA-66/LE-100->PLC)

2⁰

	SIGNIFICANCE					
word 0	Service=0 -> current encoder or cam position. Else, service feedback					
word 1	Service=0 -> current encoder or cam position. Else, service feedback					
word 2	service=0 -> special bits. Else, service feedback	reserve	error	R/W	Service	
word 3	non significant					
word 4	non significant					
word 5	non significant					
word 6	non significant					
word 7	non significant					

4.3.3 Image of the outputs (PLC-> CE-65/LA-66/LE-100)

2⁰

	SIGNIFICANCE					
word 0	Service=1 & R/W=1 -> service request data. Else non significant					
word 1	Service=1 & R/W=1 -> service request data. Else non significant					
word 2	Service=1 -> service code. Else non significant	reserve	error	R/W	Service	
word 3	non significant					
word 4	non significant					
word 5	non significant					
word 6	non significant					
word 7	non significant					

The **CE-65/LA-66/LE-100** outputs follow the PLC operating modes and are controlled in accordance with the values sent by the PLC at the end of each execution cycle of the application program.

However, if the values sent by the PLC are no more received for at **1 second**, the **CE-65/LA-66/LE-100** sends further correct data in this mode which was active at last (service or normal mode).

4.3.4 Available service codes and their function

Meaning of the OUT-Data (Data from the Master to the Encoder)

Normal Mode:

Service bit 2^{47} is set to "0".

OUT-data that the master outputs to the encoder does not have any effect and the encoder does not accept it.

As a result, in normal mode the encoder only outputs its actual position or cam data.

Service Mode:

Service bit 2^{47} is set to "1".

The encoder carries out the master's requested service (e.g. write direction of rotation or read programmed direction of rotation).

The system evaluates or ignores the remaining OUT-data 2^{31} to 2^0 in dependence on the requested service.

Bit 2^{47} :	Service bit	0 = Normal mode 1 = Service mode
Bit 2^{46} :	Read-write bit	0 = Read data 1 = Write data
Bit 2^{45} :	Error bit	1 = Error
Bit 2^{44} :	Intensity error, in case of a Laser device LE	1 = Error
Bit 2^{43} to bit 2^{32} :	Service	
Bit 2^{31} to bit 2^0 :	Data for service if bit $2^{46} = 1$, otherwise meaningless	

Meaning of the IN-Data (Data from the Encoder to the Master)

Normal Mode:

The encoder outputs the current position or cam data and writes it to bits 2^{31} to 2^0 . Bits 2^{43} to 2^{32} are actual encoder special bits. Bits 2^{47} to 2^{44} are „0“ unless there is an error; in this case, error bit $2^{45} = "1"$. If a laser device is connected, in the case of an intensity error the bit 2^{44} is set in addition.

Bit 2^{32} :	Reserve		Not for Laser devices LE !
Bit 2^{33} :	1 = Over Speed	available in encodertype 0,1,2	
Bit 2^{34} :	1 = Limit Switch 1	available in encodertype 0,1,2	
Bit 2^{35} :	1 = Limit Switch 2	available in encodertype 0,1,2	
Bit 2^{36} :	Up/Down. 0 = Up; 1 = Down	available in encodertype 0,1,2	
Bit 2^{37} :	Static Strobe	available in encodertype 2	
Bit 2^{38} to bit 2^{43} :	Reserve		

Service Mode:

If the master writes data (read-write bit = 1), the system returns the OUT-data to the IN-data (bits 2^{47} to 2^0).

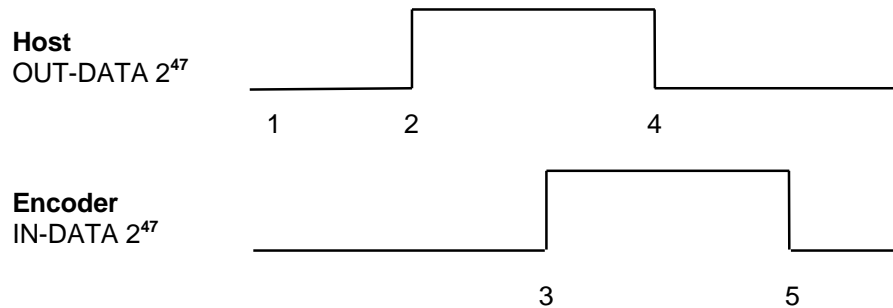
If the master reads data (read-write bit = 0), bits 2^{31} to 2^0 contain the requested data and bits 2^{47} to 2^{32} contain the acknowledgement of the requested service.

If the system could not carry out the service without errors, the error bit is "1". It is only possible to clear a set error bit by carrying out a data check service.

4.3.4.1 Callable Services

The system processes all service requests from the host to the encoder by means of a handshake of the service bit.

Handshake of service bit 2^{47}



1. The host is in normal mode, service bit 2^{47} is 0. The IN-data contains the encoder's actual position or cam data.
2. The host outputs the data and the service number and sets the service bit to 1.

Note:

To guarantee data consistency between the commissioning card and the host, the data and the service number must be output first. One host cycle later, the service bit must be set from 0 to 1.

With a read service, OUT data 2^{31} to 2^0 is meaningless.

3. The encoder detects and processes the service request, provides the appropriate data and reports back to the host system by setting service bit 2^{47} . With a write service, the system returns the OUT data to the IN data.
4. The host system detects execution and ends the service request. The host system resets service bit 2^{47} and switches back to normal mode.
5. The encoder also detects the end of the service request and also switches to normal mode by resetting service bit 2^{47} . Afterwards, the system continues with the encoder's actual value output.

4.3.4.1.1 Direction of Counting - Service 001 Hex (CE, LA, LE)

Service Request from Master (OUT Data)

- | 2^{47} to 2^{32} | 2^{31} to 2^0 | |
|----------------------|-------------------|------------|
| a) 8001 Hex | No effect | Read data |
| b) C001 Hex | * 0 or 1 | Write data |

Shaft-Encoder (CE)

- * 0 = Data increasing clockwise looking towards the shaft
- ≠ 0 = Data decreasing clockwise looking towards the shaft

Linear-Encoder (LA)

- * 0 = Data increasing, movement of the position sensor toward the end of the rod
- ≠ 0 = Data decreasing, movement of the position sensor toward the end of the rod

Laser-Encoder (LE)

- * 0 = From the laser away, values increasing
- ≠ 0 = To the Laser, values increasing

Service Feedback Message from Encoder (IN Data)

- | 2^{47} to 2^{32} | 2^{31} to 2^0 | |
|----------------------|-------------------|--------------------------|
| a) 8001 Hex | 0 or 1 | Depending on programming |
| b) C001 Hex | 0 or 1 | Depending on programming |

4.3.4.1.2 Measuring Length in Steps - Service 002 Hex (CE, LA, LE)

Here, you specify the total length in steps for the CE and LA system. For the LE system this service corresponds to the resolution of the measuring system:

Shaft-Encoder:

Measuring length in steps = (resolution/360 degrees x measuring range in revs)

Linear-Encoder:

Standard value: The given measuring length on the rating plate multiplied with 100 corresponding to the resolution of 0,01 mm

Measuring length in steps = measuring length [mm] / resolution [mm]

Laser-Encoder:

Measuring length / steps = Input in 1/1000 mm,

Service Request from Master (OUT Data)

2 ⁴⁷ to 2 ³²	2 ³¹ to 2 ⁰	
a) 8002 Hex	No effect	Read data
b) C002 Hex	2 00 00 00 Hex to 10 Hex Depending on rod length 1 to 186A0	(CE-Encoder) (LA-Encoder) (LE-Encoder) Write data

Service Feedback Message from Encoder (IN Data)

2 ⁴⁷ to 2 ³²	2 ³¹ to 2 ⁰	
a) 8002 Hex	2 00 00 00 Hex to 10 Hex Depending on rod length 1 to 186A0	(CE-Encoder) (LA-Encoder) (LE-Encoder) Depending on programming
b) C002 Hex	2 00 00 00 Hex to 10 Hex Depending on rod length 1 to 186A0	(CE-Encoder) (LA-Encoder) (LE-Encoder) Depending on programming

4.3.4.1.3 Measuring Length in Revolutions Numerator - Service 003 Hex (CE)

Relevant only in the case of a Shaft Encoder!

Service Request from Master (OUT Data)

2^{47} to 2^{32}	2^{31} to 2^0	
a) 8003 Hex	No effect	Read data
b) C003 Hex	00 FF FF Hex to 1 Hex	Write data

Service Feedback Message from Encoder (IN Data)

2^{47} to 2^{32}	2^{31} to 2^0	
a) 8003 Hex	00 FF FF Hex to 1 Hex	Depending on programming
b) C003 Hex	00 FF FF Hex to 1 Hex	Depending on service request

4.3.4.1.4 Preset Adjustment - Service 006 Hex (CE, LA, LE)

Service Request from Master (OUT Data)

2^{47} to 2^{32}	2^{31} to 2^0	
C006 Hex	Measuring length in steps to 0 Hex	Write data

Service Feedback Message from Encoder (IN Data)

2^{47} to 2^{32}	2^{31} to 2^0	
C006 Hex	Measuring length in steps to 0 Hex	Depending on service request

4.3.4.1.5 Data Check - Service 008 Hex (CE, LA, LE)

Service Request from Master (OUT Data)

2^{47} to 2^{32}	2^{31} to 2^0	
8008 Hex	No effect	Read data

Service Feedback Message from Encoder (IN Data)

2^{47} to 2^{32}	2^{31} to 2^0	
8008 Hex	2^{31} to 2^{16} always "0"	2^{15} to 2^0 error status

4.3.4.1.6 Measuring Length in Revolutions Denominator - Service 009 Hex (CE)

Relevant only in the case of a Shaft Encoder!

Service Request from Master (OUT Data)

2^{47} to 2^{32}	2^{31} to 2^0	
a) 8009 Hex	No effect	Read data
b) C009 Hex	0000 63 Hex to 1 Hex	Write data

Service Feedback Message from Encoder (IN Data)

2^{47} to 2^{32}	2^{31} to 2^0	
a) 8009 Hex	0000 63 Hex to 1 Hex	Depending on programming
b) C009 Hex	0000 63 Hex to 1 Hex	Depending on service request

4.3.4.1.7 Over Speed - Service 010 Hex (CE)

Relevant only in the case of a Shaft Encoder!

Over Speed = revolutions per minute

Over Speed \leq encoder speed (revolutions per minute) -> encoder special bit "over speed" will be set to "1"

Service Request from Master (OUT Data)

2^{47} to 2^{32}	2^{31} to 2^0	
a) 8010 Hex	No effect	Read data
b) C010 Hex	17 70 Hex to 1 Hex	Write data

Service Feedback Message from Encoder (IN Data)

2^{47} to 2^{32}	2^{31} to 2^0	
a) 8010 Hex	17 70 Hex to 1 Hex	Depending on programming
b) C010 Hex	17 70 Hex to 1 Hex	Depending on programming

4.3.4.1.8 Measuring Initial Value - Service 011 Hex (LE)

Relevant only in the case of a Laser device!

Service Request from Master (OUT Data)

2^{47} to 2^{32}	2^{31} to 2^0	
a) 8011 Hex	No effect	Read data
b) C011 Hex	FF FF FF Hex to 0 Hex	Write data

Service Feedback Message from Encoder (IN Data)

2^{47} to 2^{32}	2^{31} to 2^0	
a) 8011 Hex	FF FF FF Hex to 0 Hex	Depending on programming
b) C011 Hex	FF FF FF Hex to 0 Hex	Depending on programming

4.3.4.1.9 Clear Preset - Service 012 Hex (LE)

Relevant only in the case of a Laser device!

Via this service, the zero-point correction calculated under the service 006 Hex "Preset Adjustment" is deleted. The correction arises from the difference of the desired preset value to the physical laser position. That means, after deletion of the zero-point correction the laser outputs his "real" physical position.

Service Request from Master (OUT Data)

2^{47} to 2^{32}	2^{31} to 2^0	
a) 8012 Hex	No effect	Read data
b) C012 Hex	* 0 or 1	Write data
* 0 = Clear Preset 1 = No clearing		

Service Feedback Message from Encoder (IN Data)

2^{47} to 2^{32}	2^{31} to 2^0	
a) 8012 Hex	0 or 1	Depending on programming
b) C012 Hex	0 or 1	Depending on programming

4.3.4.1.10 Error Value - Service 013 Hex (LE)

Relevant only in the case of a Laser device!

Determination of the error value which is output instead of the actual value at a beam interruption.

Service Request from Master (OUT Data)

2^{47} to 2^{32}	2^{31} to 2^0	
a) 8013 Hex	No effect	Read data
b) C013 Hex	FF FF FF FF Hex to 0 Hex	Write data

Service Feedback Message from Encoder (IN Data)

2^{47} to 2^{32}	2^{31} to 2^0	
a) 8013 Hex	FF FF FF FF Hex to 0 Hex	Depending on programming
b) C013 Hex	FF FF FF FF Hex to 0 Hex	Depending on programming

4.3.4.1.11 Save Parameters - Service 014 Hex (LE)

Relevant only in the case of a Laser device!

Service Request from Master (OUT Data)

Via this service all programmed parameters are saved permanently. The parameters are also available after switch on the laser again. After adjusting (service 006 Hex) not necessary. The zero-point is saved permanently automatically.

2^{47} to 2^{32}	2^{31} to 2^0	
C014 Hex	0 Hex	Write data

Service Feedback Message from Encoder (IN Data)

2^{47} to 2^{32}	2^{31} to 2^0
C014 Hex	0 Hex

4.3.4.1.12 Limit Switch 1- Service 01C Hex (CE, LA)

Limit Switch 1 \leq current encoder position \rightarrow encoder special bit "limit switch 1" will be set to "1".

Service Request from Master (OUT Data)

2^{47} to 2^{32}	2^{31} to 2^0	
a) 801C Hex	No effect	Read data
b) C01C Hex	Measuring Length in Steps -2 to 0 Hex	Write data

Service Feedback Message from Encoder (IN Data)

2^{47} to 2^{32}	2^{31} to 2^0	
a) 801C Hex	Measuring Length in Steps -2 to 0 Hex	Depending on programming
b) C01C Hex	Measuring Length in Steps -2 to 0 Hex	Depending on programming

4.3.4.1.13 Limit Switch 2- Service 01D Hex (CE, LA)

Limit Switch 2 <= current encoder position -> encoder special bit "limit switch 2" will be set to "1".

Service Request from Master (OUT Data)

2^{47} to 2^{32}	2^{31} to 2^0	
a) 801D Hex	No effect	Read data
b) C01D Hex	Measuring Length in Steps -2 to 0 Hex	Write data

Service Feedback Message from Encoder (IN Data)

2^{47} to 2^{32}	2^{31} to 2^0	
a) 801D Hex	Measuring Length in Steps -2 to 0 Hex	Depending on programming
b) C01D Hex	Measuring Length in Steps -2 to 0 Hex	Depending on programming

4.3.4.1.14 Encoder Type- Service 020 Hex (CE, LA)

The laser outputs only his actual position.

Encoder Types: 0x0000 = output actual encoder position
 0x0001 = output actual cam position
 0x0002 = tool changer (available only for CE-65)

Service Request from Master (OUT Data)

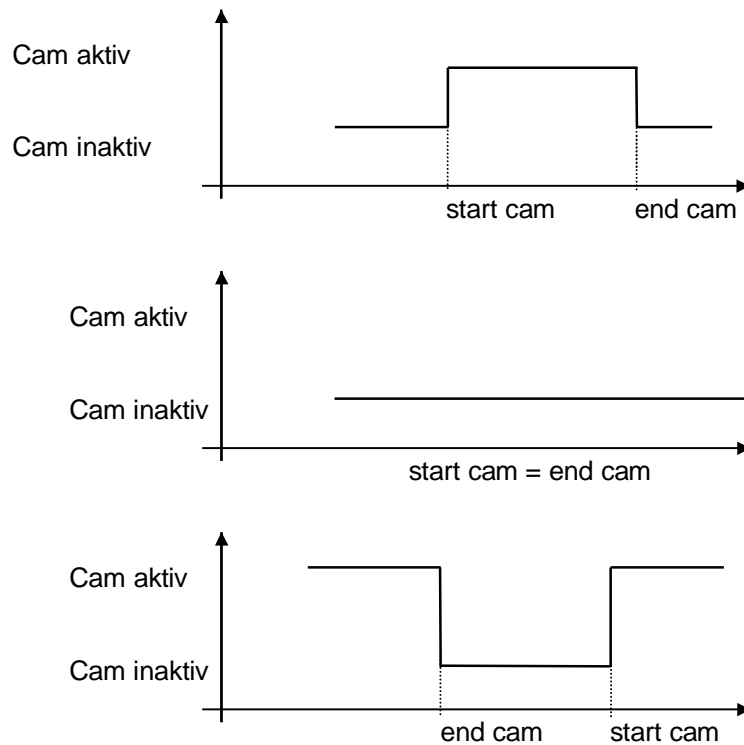
2^{47} to 2^{32}	2^{31} to 2^0	
a) 8020 Hex	No effect	Read data
b) C020 Hex	2 to 0 Hex	Write data

Service Feedback Message from Encoder (IN Data)

2^{47} to 2^{32}	2^{31} to 2^0	
a) 8020 Hex	2 to 0 Hex	Depending on programming
b) C020 Hex	2 to 0 Hex	Depending on programming

4.3.4.1.15 Encoder Cam's (Encoder Type 0x0001) [CE, LA]

24 cam position channels with 1 cam each channel can be supported by the encoder. Each cam has 2 parameters: start cam, end cam



4.3.4.1.16 Start Cam's 01 to 24- Service XXX Hex (CE, LA)

Start Cam 01- Service 030 Hex
 Start Cam 02- Service 032 Hex
 Start Cam 03- Service 034 Hex
 Start Cam 04- Service 036 Hex
 Start Cam 05- Service 038 Hex
 Start Cam 06- Service 03A Hex
 Start Cam 07- Service 03CHex
 Start Cam 08- Service 03E Hex
 Start Cam 09- Service 040 Hex
 Start Cam 10- Service 042 Hex
 Start Cam 11- Service 044 Hex
 Start Cam 12- Service 046 Hex
 Start Cam 13- Service 048 Hex
 Start Cam 14- Service 04A Hex
 Start Cam 15- Service 04C Hex
 Start Cam 16- Service 04E Hex
 Start Cam 17- Service 050 Hex
 Start Cam 18- Service 052 Hex
 Start Cam 19- Service 054 Hex
 Start Cam 20- Service 056 Hex
 Start Cam 21- Service 058 Hex
 Start Cam 22- Service 05A Hex
 Start Cam 23- Service 05C Hex
 Start Cam 24- Service 05E Hex

Service Request from Master (OUT Data)

2^{47} to 2^{32}

2^{31} to 2^0

a) 8XXX Hex No effect Read data

b) CXXX Hex Measuring Length in Steps -2 to 0 Hex Write data

XXX = Service Number

Service Feedback Message from Encoder (IN Data)

2^{47} to 2^{32}

2^{31} to 2^0

a) 8XXX Hex Measuring Length in Steps -2 to 0 Hex Depending on programming

b) CXXX Hex Measuring Length in Steps -2 to 0 Hex Depending on programming

XXX = Service Number

4.3.4.1.17 End Cam's 01 to 24- Service YYY Hex (CE, LA)

End Cam 01- Service 031 Hex
End Cam 02- Service 033 Hex
End Cam 03- Service 035 Hex
End Cam 04- Service 037 Hex
End Cam 05- Service 039 Hex
End Cam 06- Service 03B Hex
End Cam 07- Service 03D Hex
End Cam 08- Service 03F Hex
End Cam 09- Service 041 Hex
End Cam 10- Service 043 Hex
End Cam 11- Service 045 Hex
End Cam 12- Service 047 Hex
End Cam 13- Service 049 Hex
End Cam 14- Service 04B Hex
End Cam 15- Service 04D Hex
End Cam 16- Service 04F Hex
End Cam 17- Service 051 Hex
End Cam 18- Service 053 Hex
End Cam 19- Service 055 Hex
End Cam 20- Service 057 Hex
End Cam 21- Service 059 Hex
End Cam 22- Service 05B Hex
End Cam 23- Service 05D Hex
End Cam 24- Service 05F Hex

Service Request from Master (OUT Data)

2^{47} to 2^{32}

2^{31} to 2^0

a) 8YYY Hex No effect Read data

b) CYYY Hex Measuring Length in Steps -2 to 0 Hex Write data

YYY = Service Number

Service Feedback Message from Encoder (IN Data)

2^{47} to 2^{32}

2^{31} to 2^0

a) 8YYY Hex Measuring Length in Steps -2 to 0 Hex Depending on programming

b) CYYY Hex Measuring Length in Steps -2 to 0 Hex Depending on programming

YYY = Service Number

4.3.4.2 Short Description of most important Executable Services

4.3.4.2.1 Direction of Counting – Service 001 Hex

Here, you specify the direction of counting:

Shaft-Encoder

Value 0 Hex (2^{31} to 2^0) = encoder position rising clockwise (looking towards shaft)

Value $\neq 0$ (2^{31} to 2^0) = encoder position falling clockwise (looking towards shaft)

Linear-Encoder

Value 0 Hex (2^{31} to 2^0) = increasing, movement of the position sensor toward the end of the rod =

Value $\neq 0$ (2^{31} to 2^0) = decreasing, movement of the position sensor toward the end of the rod =

Laser-Encoder

Value 0 Hex (2^{31} to 2^0) = increasing, the distance between laser and object becomes less =

Value $\neq 0$ (2^{31} to 2^0) = increasing, the distance between laser and object becomes larger =

Reading and writing are possible.

The value range in each case is 0 to FF Hex.

4.3.4.2.2 Measuring Length in Steps – Service 002 Hex

Here, you specify the total length in steps for the CE and LA system. For the LE system this service corresponds to the resolution of the measuring system:

Shaft-Encoder

Measuring length in steps = (measuring length / 360 degrees x measuring length in revs)

Linear-Encoder

Standard value: The given measuring length on the rating plate multiplied with 100 corresponding to the resolution of 0,01 mm

Measuring length in steps = measuring length [mm] / resolution [mm]

Laser-Encoder

Input value in 1/1000 mm

1 mm for example corresponds to the input value 1000, that means the laser outputs 1 step/mm.

Reading and writing are possible.

The value range is:

2 00 00 00 Hex to 10 Hex (CE-Encoder)

Depending on rod length (LA-Encoder)

1 to 186A0 (LE-Encoder)

4.3.4.2.3 Measuring Length in Revolutions (Numerator) – Service 003 Hex, Measuring Length in Revolutions (Denominator) – Service 009 Hex

Relevant only in the case of a Shaft Encoder!

Here, you specify the number of revolutions that the encoder carries out within the total number of steps. If the number of revolutions is an integer, you should always program the denominator to the value "1". If the number of revolutions is a decimal number, program the denominator with the digits after the decimal point.

Example:

The encoder is intended to resolve 3.5 revolutions.

⇒ Revolutions numerator = 35 (service 03 Hex)

⇒ Revolutions denominator = 10 (service 09 Hex)

If you program a number of revolutions that is not a power of two, the zero point can be lost if the encoder traverses more than 512 revolutions in a deenergized state.

Reading and writing are possible.

Value range of numerator: 1 - FF FF Hex

Value range of denominator: 1 - 63 Hex

4.3.4.2.4 Preset Adjustment – Service 006 Hex

Using preset adjustment, you can adjust the encoder to a specific value via the FIPIO bus.

Only writing is possible.

For the CE and LA system is valid:

Value range: 0 to the programmed measuring length in steps – 1
(value from service 02 Hex - 1)

For the LE system is valid:

Value range: The value must be within the measurement range of 100 m.

4.3.4.2.5 Data Check – Service 008 Hex

After programming the encoder, you must call the data check service. This call checks the validity of the programmed data and accepts it. Without this call, the encoder continues to run with the old parameters until you switch the power off and on again.

Only reading is possible.

On 2^0 to 2^{15} of the IN data the master receives the error status as the response.

Bits 2^{16} to 2^{31} of the IN data are "0".

Bits 2^{32} to 2^{47} of the IN data feed back the requested service.

Error Status

2^0	Error reading data (CE, LA, LE)
2^1	Error writing data (CE, LA, LE)
2^2	Only reading allowed (CE, LA, LE)
2^3	Only writing allowed (CE, LA, LE)
2^4	Limit switch 1 or limit switch 2 too high (CE, LA)
2^5	Always 0
2^6	Cam value larger as (Measuring length in steps - 2) [CE, LA]
2^7	Housing temperature (LE)
2^8	Adjustment value outside valid range (CE, LA, LE)
2^9	No magnet detected (LA)
2^{10}	Unknown command (CE, LA, LE)
2^{11}	Always 0
2^{12}	Always 0
2^{13}	Measuring length in revol. = 0 (Revolutions numerator = 0) / No evaluation by linear encoder (CE)
2^{14}	Measuring length in steps is too high. Measuring length/360 degrees > encoder resolution same as on encoder's rating plate (CE)
2^{15}	Programmed value too large (CE, LA, LE)

If an error occurs at execution of a service (error bit set in encoder's service feedback message), you can determine the error exactly by carrying out the data check service.

4.3.4.3 Example of Programming the Measuring Length in Steps for a CE system

Service 002 Hex

Specifications:

Resolution/360 degrees	= 3E8 Hex
Measuring length in revolutions numerator	= 0A Hex
Measuring length in revolutions denominator	= 1 Hex

$$\begin{aligned}
 \text{Measuring length in steps} &= \left[\text{Resolution/360 degrees} \times \frac{\text{Measuring length in revolutions numerator}}{\text{Measuring length in revolutions denominator}} \right] \\
 &= 3E8 \times \frac{0A}{1} \\
 &= \underline{\underline{27\ 10\ \text{Hex}}}
 \end{aligned}$$

Carry out the following steps:

Service Request from Master (OUT Data)

2^{47} to 2^{32}	2^{31} to 2^0	
C002 Hex	0 00 27 10 Hex	Write data/start of handshake

Service Feedback Message from Encoder (IN Data)

2^{47} to 2^{32}	2^{31} to 2^0	
C002 Hex	0 00 27 10 Hex	Data feedback message/confirm handshake

End Service Request from Master (OUT Data)

2^{47} to 2^{32}	2^{31} to 2^0	
Bit 2^{47} to "0"	Rest have no effect/deactivate handshake	

Service Feedback Message from Encoder (IN Data)

2^{47} to 2^{32}	2^{31} to 2^0	
Value "0"	Current encoder position/deactivate handshake	

For the system to accept the new Measuring length in steps parameter, a data check must be carried out first. If you still have other parameters to program, do not carry out the data check until you have completed programming them.

4.4 PLC diagnostics

4.4.1 System bits and words

The PLC system handles as a standard objects in order to indicate fault appearance. Report to the workshop documentation for a full description of these objects in the case of devices conforming to FIPIO standard profiles.

The **CE-65/LA-66/LE-100**, proposes the diagnostic information described in the following paragraphs (report also to the workshop documentation to know how to access this information):

4.4.2 Module Diagnostic

A module diagnostic byte allows the device to indicate its faults.

Status generated by the CE-65/LA-66/LE-100		
0	external fault 4: not used	see page 34: Meaning of the IN-Data: Bit 2 ³³ - Bit 2 ³⁶ Over speed, Limit switch 1+2, Up/Down
1	external fault 3: not used	
2	external fault 2: not used	
3	external fault 1: not used	
4	Internal module fault (breakdown)	
5	Hardware configuration fault	
6	Communication fault with the PLC	
7	Application fault	

4.4.3 Inputs validity

A byte is set by the **CE-65/LA-66/LE-100** to indicate if the input values are valid or not. If the byte equals 0, then the **CE-65/LA-66/LE-100** input values are valid and may be used by the PLC program. Otherwise, the inputs image in the PLC memory may consist of old and wrong values and should be ignored by the PLC application program.

4.5 TSX PREMIUM, Serie 7 model 40 and APRIL 5000 objects

This paragraph gives a correspondance table for langage objects corresponding to the different objects exchanged by the **CE-65/LA-66/LE-100** and whose list has been given in the previous paragraphs.

**Note**

"explicit", in the table below indicates that the concerned information is automatically updated by the PLC system without explicit action through a PLC language instruction.

Object	TSX PREMIUM PL7	Serie 7 model 40 XTEL	APRIL 5000 ORPHEE
inputs	%IW\p.2.c\0.0.0 to %IW\p.2.c\0.0.7	RIWc,0,0 to RIWc,0,7	table of 8 %MW defined in the configuration
outputs	%QW\p.2.c\0.0.0 to %QW\p.2.c\0.0.7	ROWc,0,0 o ROWc,0,7	table of 8 %MW defined in the configuration
device error	%I\p.2.c\0.0.ERR	ERRORc,0,0	not directly
device status	%MW\p.2.c\0.0.2	STATUSAc,0,0	accessible: fault appearance generates the action defined in the diagnostic configuration screen associated to the device (continue/stop/trigger %TD)
inputs validity	%MW\p.2.c\0.0.3	RDc,0,0	1 %MW defined in the configuration
status reading instruction	READ_STS	implicit	same as above for the status

5 Example: Integration under PL7

5.1 Restrictions

The PL7 software and the processors TSX P 57252 / 352 / 452, TPCX P 573512 and TPMX 57352 / 452 allow to connect and configure devices on the FIPIO bus. Configuration of the **CE-65/LA-66/LE-100** is performed using PL7 V3.0 software workshop.

The following paragraphs describe the operating mode which allows the **CE-65/LA-66/LE-100** to be used on the FIPIO bus controlled by a TSX PREMIUM PLC.

For further information on the principles for connecting and configuring devices on the FIPIO bus, see section H of the PL7 communication functions set-up manual (ref. TSX DSCOMPL7).

5.2 FIPIO standard profile

The development of an application using **CE-65/LA-66/LE-100** on the FIPIO bus means that the device must be declared in the FIPIO bus configuration screen. This screen is activated by selecting "hardware configuration" in the PL7 workshop browser.

Validation of the configuration entered through this screen will automatically generate the operating parameters of the FIPIO bus which will then be loaded into the PLC.

The **CE-65/LA-66/LE-100** belongs to the STD_P device family. This family is used to connect devices to FIPIO which conform with the FIPIO standard profiles defined in the Schneider Alliances program.

A device of this type is declared by associating a reference from the STD_P family to a FIPIO bus connection point.

The reference used by the **CE-65/LA-66/LE-100** is the **FSD C8**, the characteristics of which are as follows:

<i>FSD</i>	→	FIPIO Simple Device Profile
<i>C</i>	→	Compact device
<i>8</i>	→	CE-65/LA-66/LE-100 I/O size (in 16 bits words) <ul style="list-style-type: none">• 8 words for the image of the inputs• 8 words for the image of the outputs

N.B.: word = 16-bit word.

A sequence of screens is used to guide the operator when configuring a device on the FIPIO bus. These screens are described in the remainder of this section, for the PL7 software workshop.

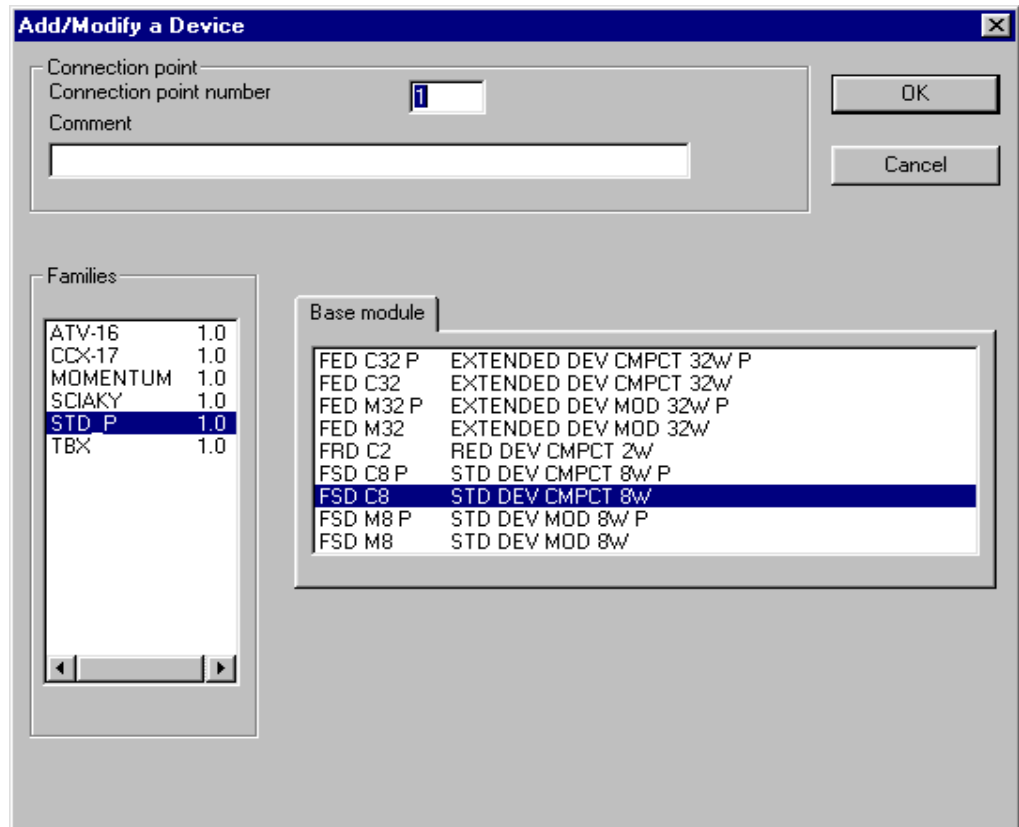
5.3 Device Configuration

5.3.1 Selection of CE-65/LA-66/LE-100

The **CE-65/LA-66/LE-100** can be accessed in the STD_P family of the FIPIO bus configuration screen.

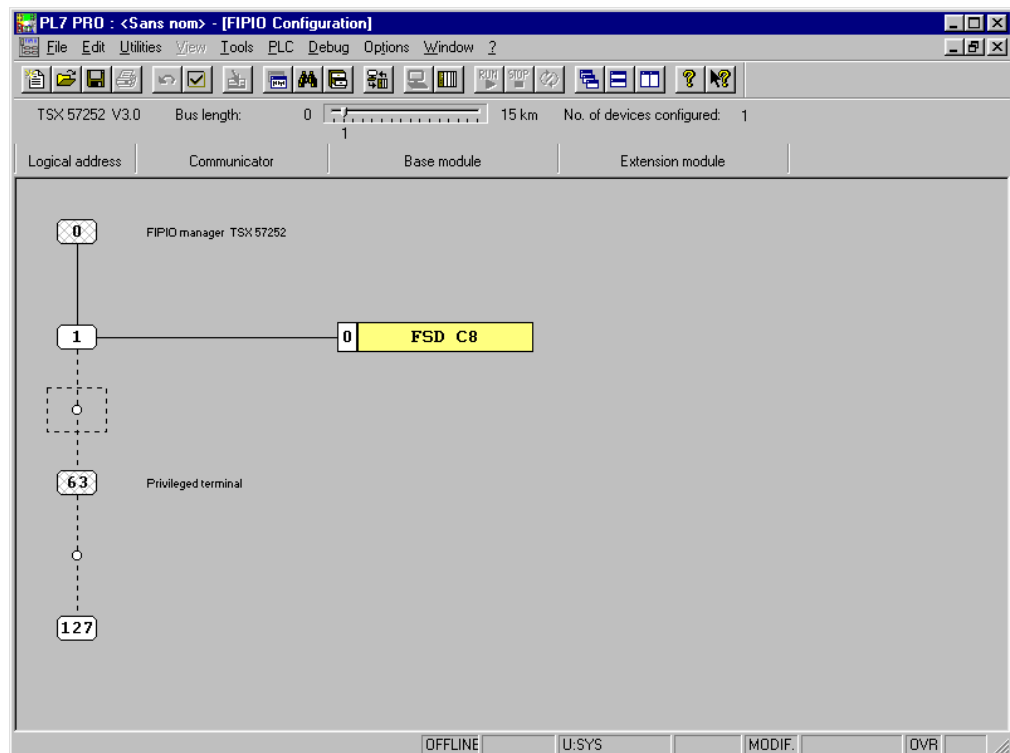
To connect a **CE-65/LA-66/LE-100** on FIPIO, activate the "Add/Modify device" screen, select the STD_P family then the **FSD C8** and enter the connection point number (1 to 127) and optionally a comment.

The connection point number defined in the PL7 application program must be identical to the address defined on the DIP switches of the coder.

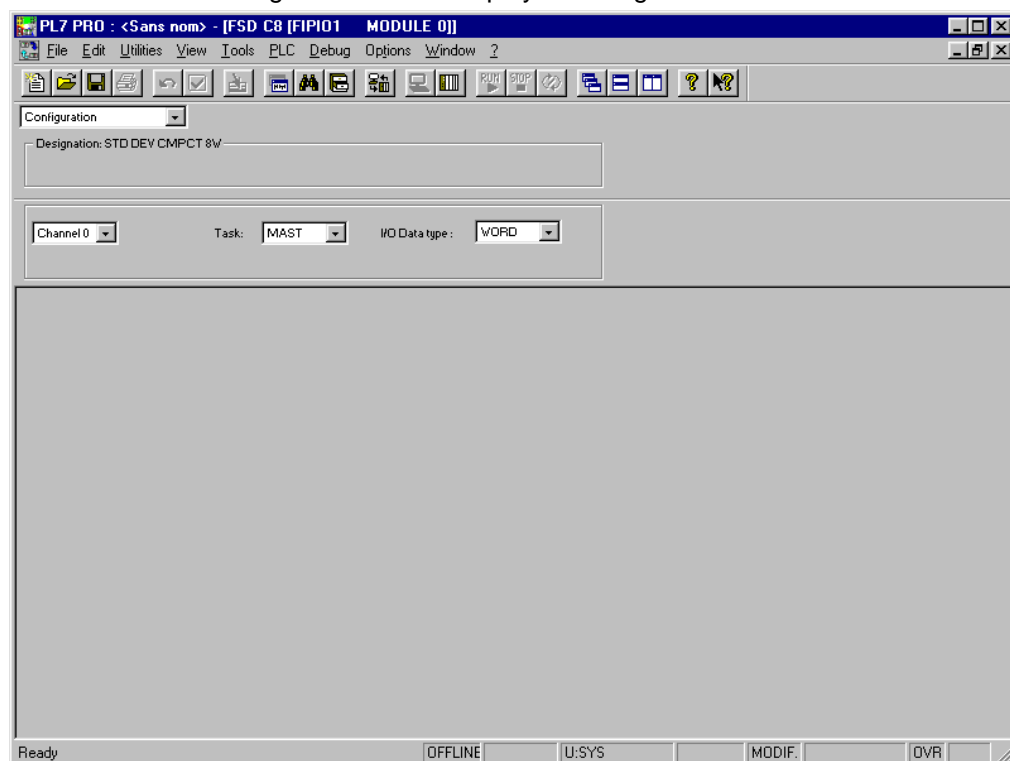


5.3.2 Configuration of the CE-65/LA-66/LE-100

The **CE-65/LA-66/LE-100** then appears in the form of the reference **FSD C8** in the list of connected devices:



Double-click on it using the mouse to display its configuration screen:



In configuration mode, this screen proposes:

Channel 0 :

information zone non modifiable for a standard profile device: indicates that the device inputs/outputs are accessed on channel 0 (cf. next paragraph for the device I/Os addressing).

Task :

data entry field used to select the task (FAST or MAST) in which **CE-65/LA-66/LE-100** is located (default is MAST task).

The task which controls the **CE-65/LA-66/LE-100** must not have a period which exceeds the **1 second**

I/O data type:

data entry field used to select the type of language objects used to exchange the device I/Os.

5.4 Programming

5.4.1 Objects available for programming

The user accesses the **CE-65/LA-66/LE-100** inputs and positions the **CE-65/LA-66/LE-100** outputs through registers which can be used directly in the PLC program (implicit exchanges)

Other exchanges require the use of specific instructions in order to trigger information exchange between registers accessible by the PLC program and the device:

- access to status information using READ_STATUS

Report to the PL7 documentation for how to use these instructions.

The table below explains the mnemonics of the objects available for the application :

Object	Description	Access	Format
%IW\p.2.c\0.0.0 to %IW\p.2.c\0.0.7	8 words which are the image of the CE-65/LA-66/LE-100 inputs	read implicit	16 bits words
%QW\p.2.c\0.0.0 to %QW\p.2.c\0.0.7	8 words which are the image of the CE-65/LA-66/LE-100 outputs	write implicit	16 bits words
%MW\p.2.c\0.0.2	1 word containing diagnostic information about CE-65/LA-66/LE-100 or the communication between the PLC and CE-65/LA-66/LE-100 .	read explicit	1 16 bits word
%MW\p.2.c\0.0.3	1 word indicating a fault in updating the image of CE-65/LA-66/LE-100 inputs. A non-zero value indicates that the values contained in the %IW words are not significant.	read explicit	1 16 bits word

...

...

READ_STATUS	Activation of this instruction triggers reading of the current diagnostic information in the CE-65/LA-66/LE-100 and updating of the words %MW\p.2.c\0.0.2 to %MW\p.2.c\0.0.3.	instruction
--------------------	--	-------------

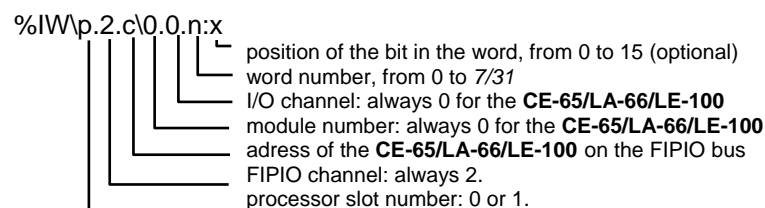
In addition, bits %I\p.0.c\0.0.ERR and %I\p.0.c\0.MOD.ERR, updated in the implicit mode, indicate appearance of a fault on the **CE-65/LA-66/LE-100** : the READ_STATUS instruction then allows access to detailed diagnostic information on the device.

A detailed description of I/O is given in the next paragraphs.

A detailed description of all diagnostic information (%MW\p.2.c\0.0.2, %MW\p.2.c\0.0.3) is given in paragraph "PLC diagnostic".

5.4.2 Image of the CE-65/LA-66/LE-100 inputs

Access to the **CE-65/LA-66/LE-100** inputs is obtained in the %IW/%I registers according to the following principle:



The PLC cyclically updates all the %IW/%I at the beginning of the program task in which the **CE-65/LA-66/LE-100** features.

The distribution is as follows:

	SIGNIFICANCE				
%IW\p.2.c\0.0.0	Service=0 -> current encoder or cam position. Else, service feedback				
%IW\p.2.c\0.0.1	Service=0 -> current encoder or cam position. Else, service feedback				
%IW\p.2.c\0.0.2	service=0 -> special bits. Else, service feedback	reserve	error	R/W	Service
%IW\p.2.c\0.0.3	non significant				
%IW\p.2.c\0.0.4	non significant				
%IW\p.2.c\0.0.5	non significant				
%IW\p.2.c\0.0.6	non significant				
%IW\p.2.c\0.0.7	non significant				

Each word or word bit can be represented by a symbol if the latter has been defined beforehand.

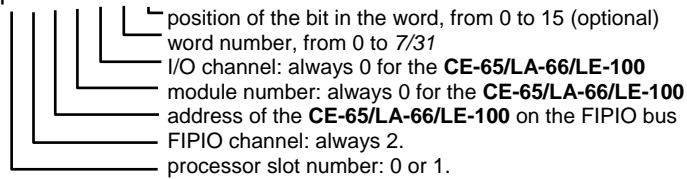
Details about services available are described in section "available service codes".

The content of the %IW words / %I bits must only be considered significant if the %I\p.2.c\0.0.ERR bit is 0.

5.4.3 Image of the CE-65/LA-66/LE-100 outputs

Access to the **CE-65/LA-66/LE-100** outputs is obtained in %QW/%Q registers, according to the following principle:

%QW\p.2.c\0.0.n:x



The PLC cyclically updates all the %QW/%Q at the end of execution of the program task in which the **CE-65/LA-66/LE-100** features.

The distribution is as follows:

	SIGNIFICANCE				
%QW\p.2.c\0.0.0	Service=1 & R/W=1 -> service request data. Else non significant				
%QW\p.2.c\0.0.1	Service=1 & R/W=1 -> service request data. Else non significant				
%QW\p.2.c\0.0.2	Service=1 -> service code. Else non significant	reserve	error	R/W	Service
%QW\p.2.c\0.0.3	non significant				
%QW\p.2.c\0.0.4	non significant				
%QW\p.2.c\0.0.5	non significant				
%QW\p.2.c\0.0.6	non significant				
%QW\p.2.c\0.0.7	non significant				
E T C					

Each bit or word bit may be represented by a symbol, if the latter has been defined beforehand.

Details about services available are described in section "available service codes".

The **CE-65/LA-66/LE-100** outputs follow the PLC operating modes and are controlled in accordance with the values sent by the PLC at the end of each execution cycle of the application program.

However, if the values sent by the PLC are no more received for at **1 second**, the **CE-65/LA-66/LE-100** sends further correct data in this mode which was active at last (service or normal mode).

5.5 PLC Diagnostic

The diagnostic data contained in the table below is not specific to the **CE-65/LA-66/LE-100**, but is general at PLC level.

System bits and words	Description	Function
%S10	General I/O fault	Normally at 1, this bit is set to 0 in the event of a fault on an in-rack I/O module or a device connected on FIPIO. When the fault disappears this bit is set back to 1 by the system.
%S16	I/O or FIPIO device fault in the task	Normally at 1, this bit is set to 0 in the event of a fault on an in-rack I/O module or a device connected on FIPIO configured in the task. This bit must be set back to 1 by the user program. A %S16 bit is assigned to each of the configured tasks. For this reason, it is only significant for the task in which it is tested.
%S118	FIPIO I/O fault	Normally at 1, this bit is set to 0 in the event of a fault on a device connected on FIPIO. When the fault disappears this bit is set back to 1 by the system.
%SW116	FIPIO I/O fault in the task	This word indicates a communication fault on FIPIO, between the processor and a device, in the task. Each bit (0 to 7) signifies a fault. This bit is set back to 0 by the user. bit 0: explicit exchange error bit 1: explicit exchange time-out bit 2: max number of simultaneous explicit exchanges reached bit 3: one frame is not correct bit 4: frame received with a length more than the one declared bit 5: reserved to 0 bit 6: invalid frame, or a FIPIO device is currently initializing bit 7: a configured device is missing bit 8: the device channel has a fault bits 9 à 15: reserved to 0
%SW128 à %SW143	FIPIO device fault	Each bit of this group of words signifies the status of a FIPIO address. Normally at 1, the presence of a bit at 0 indicates the occurrence of a fault on the device: %SW118:x0 for address 0, etc. For an address with no device configured, the bit is always 1.
%\p.2.c\0. MOD.2	module fault	This error bit is managed by the processor in the implicit mode. Normally at 0, it is set to 1 in the event of a fault on the device at the address (or point of connection) c.

...

...

%MW\p.2.c\0.MOD.2	module status	<p>updated in the explicit mode by the READ_STS instruction. Only low order byte is significant:</p> <p>bit 0: internal fault</p> <p>bit 1: communication fault between the PLC and the device</p> <p>bit 2 à 4: not used</p> <p>bit 5: hardware configuration fault (device includes modules which are not compatible with each other) or software fault (the module connected is not the one declared in the configuration)</p> <p>bit 6: module missing</p> <p>bit 7: reserved to 0</p> <p>bits 8 à 15: reserved to 0</p>	
%I\p.2.c\0.0.ERR	I/O fault	<p>This error bit is managed by the processor in the implicit mode whatever the operation mode. Normally at 0, it is set to 1 in the event of a fault on the device at address (or point of connection) c.</p>	
%MW\p.2.c\0.0.2	I/O standard fault	<p>updated in the explicit mode by the READ_STS instruction. Only low order byte is significant:</p> <p>bit 0: not used</p> <p>bit 1: not used</p> <p>bit 2: not used</p> <p>bit 3: not used</p>	<p>see page 34: Meaning of the IN-Data: Bit 2³³ - Bit 2³⁶ Over speed, Limit switch 1+2, Up/Down</p>
		<p>bit 4: internal fault (breakdown)</p> <p>bit 5: hardware configuration fault (device includes modules which are not compatible with each other) or software fault (the module connected is not the one declared in the configuration)</p> <p>bit 6: communication fault</p> <p>bit 7: application fault: bad adjustment or configuration parameters, or specific command refused</p> <p>bits 8 à 15: reserved to 0</p>	
%MW\p.2.c\0.0.3	inputs validity	<p>updated in the explicit mode by the READ_STS instruction. Equals 0 if no fault. Only the low order byte is significant.</p>	

6 Encoder Specific Disturbances

6.1 Causes of Faults and Remedies

Disturbance	Cause	Remedy
Encoder step changes	Loose contacts in the wiring	Check all the cabling and wiring used for connecting the encoder.
	Severe vibrations	"Shock modules" are used to cushion vibrations shocks and jolts on presses, for example. If the fault keeps occurring despite these measures, you must replace the encoder.
	Electrical disturbances	Insulating flanges and couplings and cables with twisted-pair wires for data and supply are useful against electrical disturbances. The cable screens should be grounded on both ends. You should only ground the screen on one end in the switching cabinet if the machine ground has more disturbances compared to the switching cabinet ground.
	Only Shaft-Encoder: Excessive axial and radial loading of the shaft or a sampling defect.	Plastic couplings prevent mechanical loading of the shaft. If the fault keeps occurring despite these measures, you must replace the encoder.
Error reading data (Status bit $2^0=1$)	Defective memory area in the EEPROM	If the error occurs when you try to execute the service again, you must replace the encoder.
Error writing data (Status bit $2^1=1$)	Defective memory area in the EEPROM	If the error occurs when you try to execute the service again, you must replace the encoder.
Only reading allowed (Status bit $2^2=1$)	The system tried to carry out a write command.	Set bit 2^{46} (read-write bit) to 0.
Only writing allowed (Status bit $2^3=1$)	The system tried to carry out a read command.	Set bit 2^{46} (read-write bit) to 1.
Limit switch 1 or 2 too high (Status bit $2^4=1$)	While programming the switch point, the permissible range was exceeded	Carry out new programming Permissible range: $0 \leq \text{Limit switch value} \leq (\text{measuring length}/360 \text{ degrees} \times \text{measuring length in revolutions}) - 2$
Cam value too high (Status bit $2^6=1$)	While programming the switch point, the permissible range was exceeded	Carry out new programming Permissible range: $0 \leq \text{Cam value} \leq (\text{measuring length}/360 \text{ degrees} \times \text{measuring length in revolutions}) - 2$
Housing temperature [only laser device] (Status bit $2^7=1$)	The temperature has exceeded or fallen short of the range of 0 - 50°C in the housing of the device	Appropriate measures must be taken to prevent the device from overheating or undercooling.
Preset adjustment value outside valid range (Status bit $2^8=1$)	While programming the adjustment value, the permissible range was exceeded	Carry out new programming Permissible range: $0 \leq \text{Preset adjustment value} \leq (\text{measuring length}/360 \text{ degrees} \times \text{measuring length in revolutions}) - 1$

...

...

No magnet detected [only LA encoder] (Status bit $2^9=1$)	No magnet is available or the measuring system is faulty	<ul style="list-style-type: none"> - Guarantee, that the magnet is on the measuring rod - Replace the encoder
Unknown command (Status bit $2^{10}=1$)	You entered the wrong service number.	Check the executed service number and correct it.
Revolutions numerator = 0 (Status bit $2^{13}=1$)	You entered a "0" when programming the measuring length in revolutions numerator (service 003 HEX).	Allowed value range: 00 FF FF HEX to 1 HEX
Measuring length in steps too high (Status bit $2^{14}=1$)	The revolutions fraction (numerator/denominator) was programmed too low.	The number of steps per revolution must not exceed the encoder resolution stated on the rating plate. Program a higher setting for the revolutions fraction (numerator/denominator).
Programmed value too high (Status bit $2^{15}=1$)	While programming a value the permissible range was exceeded	A programmed value which is not performed in this list exceeded the permissible value range. Check all parameters which are not performed in this list.
Intensity error [only laser device] (Error bit $2^{44}=1$)	The device checks the intensity of the received laser signal continuously, it was detected a below-minimum intensity	<ol style="list-style-type: none"> 1. Clean measuring system optics 2. Clean reflecting foil 3. Rule out an interruption of the laser beam <p>If the possibility of soiling or interruption of the laser signal can be ruled out, the device must be replaced.</p>