

# FL MC 2000E (SM40) LC

**IEC 61850 fiber optic converter with LC fiber optic connection (1310 nm) to convert 100Base-Tx to single or multi-mode fiberglass**



Data sheet  
3205\_en\_D

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## 1 Description

The FL MC 2000E LC and FL MC 2000E SM40 LC provide a high level of immunity to interference and long transmission range in industrial applications by converting the 100Base-Tx Ethernet interface to fiber optics (100 Mbps according to FX standard).

The converters are specifically for use in electrical power substations (IEC 61850 and IEEE 1613 applications). The RJ45 port offers an auto crossing function, which means it is not necessary to make a distinction between 1:1 and crossover cables.

## 2 Features

The FL MC 2000E (SM40) LC converters offer the following features:

- 100Base-Tx
- -40°C to 75°C operating range
- Auto crossing simplifies cabling
- Link fault pass through
- Individual LEDs at each port indicate communication activity and data rate
- Redundant power supply capable with local (LED) and remote (dry contact) alarms to indicate failure of one or both power supplies
- LC duplex connection
- Mounts on NS 35 DIN rails



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This data sheet is valid for all products listed on the following page:

### 3 Ordering data

#### Products

Description	Type	Order No.	Pcs. / Pkt.
<b>Fiber optic converter</b> , LC connection (1310 nm), for converting 100Base-Tx to multi-mode fiberglass, for IEC 61850-3 and IEEE 1613 applications	FL MC 2000E LC	2891056	1
<b>Fiber optic converter</b> , LC connection (1310 nm), for converting 100Base-Tx to single mode fiberglass, for IEC 61850-3 and IEEE 1613 applications	FL MC 2000E SM40 LC	2891156	1

#### Accessories

Description	Type	Order No.	Pcs. / Pkt.
Universal end clamp	E/NS 35 N	0800886	50
Patch cable, CAT 5, pre-assembled, 0.3 m long	FL CAT5 PATCH 0,3	2832250	10
Patch cable, CAT 5, pre-assembled, 0.5 m long	FL CAT5 PATCH 0,5	2832263	10
Patch cable, CAT 5, pre-assembled, 1.0 m long	FL CAT5 PATCH 1,0	2832276	10
Patch cable, CAT 5, pre-assembled, 1.5 m long	FL CAT5 PATCH 1,5	2832221	10
Patch cable, CAT 5, pre-assembled, 2.0 m long	FL CAT5 PATCH 2,0	2832289	10
Patch cable, CAT 5, pre-assembled, 3.0 m long	FL CAT5 PATCH 3,0	2832292	10
Patch cable, CAT 5, pre-assembled, 5.0 m long	FL CAT5 PATCH 5,0	2832580	10
Patch cable, CAT 5, pre-assembled, 7.5 m long	FL CAT5 PATCH 7,5	2832616	10
Patch cable, CAT 5, pre-assembled, 10.0 m long	FL CAT5 PATCH 10	2832629	10

### 4 Technical data

#### General data

Function	Converter, Ethernet 100Base-Tx to fiber optic; conforms to standard IEEE 802.3
Housing dimensions (width x height x depth)	30 x 130 x 100 mm
Weight, without connectors	315 g
Operating temperature	-40°C ... 75°C
Storage temperature	-40°C ... 85°C
Degree of protection	IP20, DIN 40050, IEC 60529
Protection class	Class 3 VDE 0106; IEC 60536
Humidity (operation and storage)	5% to 95%, no condensation
Air pressure (operation)	86 kPa ... 108 kPa, 1500 m above sea level
Air pressure (storage)	66 kPa ... 108 kPa, 3500 m above sea level
Mounting	NS 35 (EN 60715)
Preferred mounting position	Perpendicular to a standard mounting rail
Connection to protective earth ground	Snapped onto a grounded mounting rail
Latency	700 ns

#### Supply voltage (U<sub>S</sub>)

Connection type	Removable, screw-clamp connector
Wire size (solid/stranded/AWG)	0.2 ... 2.5 mm <sup>2</sup> / 0.2 ... 2.5 mm <sup>2</sup> / 24 ... 12 AWG
Recommended PE wire size	2.5 mm <sup>2</sup>
Nominal power supply	24 V DC, 48 V DC
Permissible ripple	3.6 V <sub>pp</sub> within the permissible voltage range
Permissible voltage range	12 V DC ... 57 V DC
Current consumption, maximum	440 mA @ 24 V DC
Inrush current	9.84 A (200 μs)
Test voltage	5 kV DC for one minute
Protection against polarity reversal	Present

## Interfaces

### Properties of RJ45 port

Total number of RJ45 Ethernet interfaces	1
Connection format	RJ45 female
Connection medium	Twisted-pair cable with a conductor cross section of 0.14 mm <sup>2</sup> to 0.22 mm <sup>2</sup>
Cable impedance	100 Ω
Transmission speed	100 Mbps
Maximum network segment length	100 m
Link through	Link fault pass through (LFP)
MDI/MDIX switchover	Automatic (auto MDI/MDIX)

### Properties of fiber optic port

Total number of FO ports	1
Connection format	LC
Wave length	1310 nm
Transmission speed	100 Mbps
Transmission length	
FL MC 2000E LC	8 km with F-G 62.5/125 0.7 dB/km F1000 3.3 km with F-G 62.5/125 2.6 dB/km F600 9.6 km with F-G 50/125 0.7 dB/km F1200 5.3 km with F-G 62.5/125 1.6 dB/km F800 2 km with HCS GI fiber with F-GK 200/230
FL MC 2000E SM40 LC	40 km with F-G 9/125.0 0.36 dB/km 36 km with F-G 9/125.0 0.4 dB/km 29 km with F-G 9/125.0 0.5 dB/km

### Alarm Contacts

Voltage, maximum	250 V AC
Current carrying capacity, maximum	1 A (including inrush)

### Mechanical tests

Vibration resistance according to IEC 60068-2	7 mm 2...9 Hz 20 m/s <sup>2</sup> 9...200 Hz 15 m/s <sup>2</sup> 200...500 Hz
Shock test according to IEC 60068-2	300 m/s <sup>2</sup> 11 ms
Temperature according to IEC 60068-2-32	

### Conformance

IEC 61000-6.2

### Developed in accordance to IEC 61850

IEC 61000-4-2 (ESD)	Contact: ±6 kV Air: ±8 kV
IEC 61000-4-3 (radiated-noise immunity)	10 V/m
IEC 61000-4-4 (burst)	Ports: ±4 kV DC power: ±2 kV
IEC 61000-4-5 (surge)	Ports: ±4 kV DC power: ±2 kV
IEC 61000-4-6 (conducted noise immunity)	Ports: 10 V DC power 10 V
IEC 61000-4-8 (noise immunity against magnetic fields)	100 A/m continuous 1000 A/m for 3 s
IEC 61000-4-10 (damped oscillatory magnetic field immunity)	30 A/m
IEC 61000-4-16 (immunity to conducted common mode disturbances)	Ports and DC power: 30 V <sub>rms</sub> continuous 300 V <sub>rms</sub> for 1 s (50 Hz)
IEC 61000-4-17 (ripple on DC power supply)	10%
IEC 61000-4-18 (oscillatory waves)	2.5 kV common mode (100 kHz, 1 MHz) 1 kV differential mode (100 kHz, 1 MHz)

**Developed in accordance to IEC 61850**

IEC 61000-4-29 (voltage dips and voltage interruptions)	30% reduction 0.1 s 60% reduction (dips) 0.1 s 100% interruptions 0.05 s
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EN 55022 (radiated RF emissions)	Class A and B
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EN 55022 (noise emission)	Class A and B
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**Developed in accordance to IEEE 1613**

IEEE C37.90.3 (ESD)	Contact: $\pm 8$ kV Air: $\pm 15$ kV
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IEEE C37.90.2 (RF susceptibility)	Ports: 20 V/m
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IEEE C37.90.1 SWC (fast transient)	Ports: $\pm 4$ kV, 2.5 kHz DC power: $\pm 4$ kV
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IEEE C37.90.1 SWC (oscillatory)	Ports: $\pm 2.5$ kV common mode, 1 MHz DC power: $\pm 2.5$ kV common mode, $\pm 2.5$ kV differential mode, 1 MHz
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IEEE C37.90 (dielectric power frequency test)	Ports: 2 kV DC power: 2 kV
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IEEE C37.90 (impulse voltage test)	DC power: 5 kV
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IEEE 1613 Clause 9 vibration	30 mm/s 1...150 Hz
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IEEE 1613 Clause 9 shock	250 mm
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**Approvals**

General	CE ROHS WEEE 2002/96/EC
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## 5 Dimensions

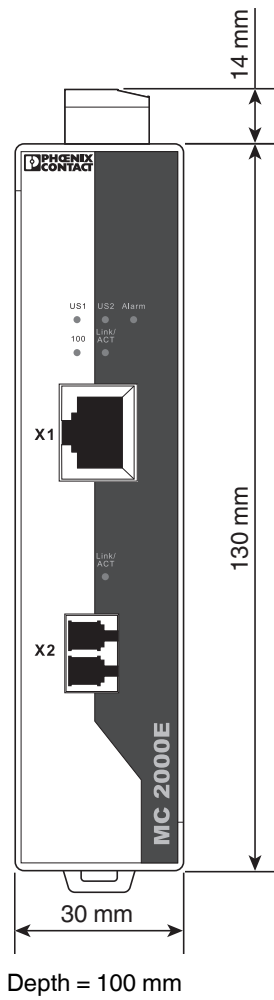


Figure 1 Housing dimensions

## 6 Overview

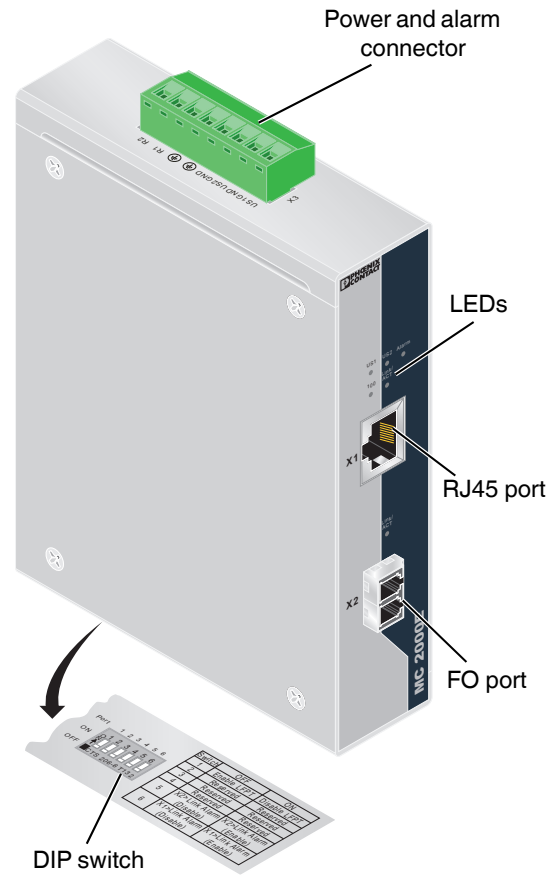


Figure 2 Connectors and LEDs

### 6.1 Diagnostic and status indicators

Des.	Color	Status	Meaning
US1 and US2	green	On	Supply voltage (US) in the tolerance range
		Off	Supply voltage (US) too low
Alarm	red	On	US1 or US2 is too low or missing
			Port link failure
		Off	Normal operation

6.2 Data transmission LEDs

LED	Status	Meaning
LNK/ACT	On	Indicates an electrical link
	Flashing	Data transmission is in process
100 (RJ45 port only)	On	Port is operating at 100 Mbps

**i** LNK/ACT LED:  
 ON: indicates an electrical link  
 Flashing: indicates network traffic (at high data rates the blinking is in a constant rate)

7 Installation



**CAUTION:**  
 Only qualified personnel may start up and operate this device. Qualified personnel are persons authorized to start up, ground and mark devices, systems and equipment according to the standards of safety technology.



**NOTE:**  
 The FL MC 2000E (SM40) LC module is designed for SELV and PELV operation according to IEC 61140/EN 61140.

Install the module on a clean NS 35 rail. To avoid contact resistance use only clean, corrosion-free rails that meet the EN 60715 standard. End clamps can be mounted on both sides of the module to stop the modules from slipping on the rail.



**NOTE:**  
 Connect the mounting rail to protective earth ground using a grounding terminal block. The modules are grounded when they are snapped onto the rail. Connect protective earth ground with low impedance.

7.1 Assembly

- Place the module onto the rail from above. The upper holding keyway must be hooked onto the top edge of the rail.
- Push the module from the front towards the mounting surface.
- Once the module has been snapped on properly, check that it is fixed securely on the rail.

7.2 Removal

- Insert a suitable tool (e.g., screwdriver) into the arresting latch and pull it down.
- Pull the module slightly away from the mounting surface.
- Lift the module from the rail.

7.3 Power connection

The device is designed for SELV and PELV operation at +24 V DC according to IEC 61140/EN 61140. Only SELV and PELV according to the defined standards may be used for supply purposes.

Snapping the device onto a grounded rail connects it to the ground potential.

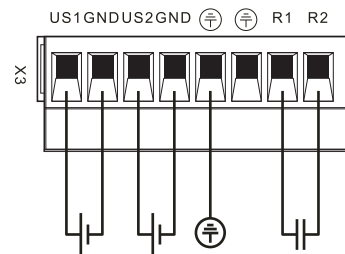


Figure 3 Power connections for redundant power supply

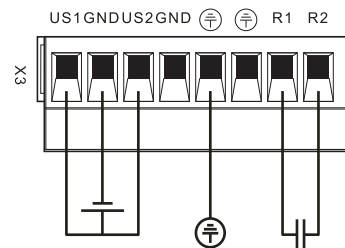


Figure 4 Power connections for single power supply



Reversed polarity may result in incorrect power LED and alarm indications.

Use power conductors between 0.2 - 2.5 mm<sup>2</sup> (24 - 12 AWG). Torque connection screws to 0.5 - 0.6 Nm (5 - 7 lb-in.).

### 7.4 Alarm contact

The FL MC 2000E (SM40) LC provides contacts (R1, R2) for a remote alarm if a failure is detected. The alarm is triggered if one or both power supplies fail. An alarm can be triggered if a port fails. Individual port alarms can be enabled via a DIP switch located on the bottom of the device.

The alarm relay is a normally closed type. When there are no faults, the contact is held open. When a fault occurs, the relay is de-energized to close the contact.



In addition to the remote alarm, failure is also indicated by turning the alarm LED on.

### 7.5 Ethernet interface

The FL MC 2000E (SM40) LC has one Ethernet port on the front in RJ45 format to which a twisted-pair cable with an impedance of 100 Ω can be connected. The data transmission speed is 100 Mbps. This port has an auto crossing function: it is not necessary to make a distinction between 1:1 or crossover Ethernet cables.

- Connect the twisted-pair cable to the RJ45 connector.
- Ensure the connection is secure by gently pulling it.

### 7.6 Fiber optic interface



**WARNING:**  
During operation, do not look directly into transmitter diodes or use visual aids to look into the glass fibers. The infrared light is not visible.



**NOTE:**  
Do not remove dust protection caps until just before the plug-in connectors are connected. They prevent contamination of the transmit and receive elements.



**NOTE:**  
Observe the cable manufacturer's technical data when handling the various fiber optic cables. In order for the communication path to be immune to interference, the permissible values for bending radius, tensile force and pressure force must not be exceeded.

- Connect the fiber optic cable to the LC duplex plug-in connector for the transmit and receive channel. Make sure the keying is in the correct position.
- Ensure the connection is secure by gently pulling it.

## 8 Configuration

A six-position DIP switch on the bottom surface of the FL MC 2000E (SM40) LC allows configuration of operating characteristics.

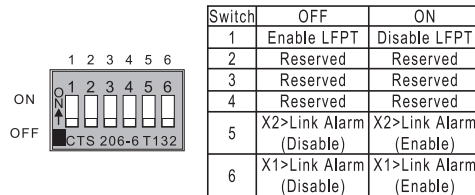


Figure 5 DIP switch

### 8.1 Link fault pass through (DIP 1)

Link fault pass through is a function that allows diagnostics from one port to pass through to the other port.

The link status of the RJ45 port is always forwarded to the fiber optic port. However, link fault pass through from the fiber optic port to the RJ45 port is selectable (via DIP 1). When link fault pass through is disabled, devices may not be able to detect that the fiber optic network connection is interrupted. The connected device either doesn't know it is not communicating (diagnostics cannot be generated) or it continually attempts to re-establish communication, increasing the network load and application response time.

When enabled, a link loss at the fiber optic port is forwarded to the RJ45 port so both ports of the converter are disabled.



Link fault pass through should only be used when two media converters are connected in series.

DIP 1 can be used to specify whether the network is disabled locally or globally.

DIP	Position	Function
1	ON	Local: in the event of a fault, only the interrupted part is disabled. This is useful during startup and in the event of an error.
	OFF	Global: in the event of a fault, the entire connection is disabled.

## 8.2 Alarm enabling (DIP 5 and 6)

The alarm contacts are configurable on a port basis. DIP 5 controls port X2 (fiber optic) and DIP 6 controls port X1 (RJ45).

DIP	Position	Function
5	ON	In the event of a fault on the fiber optic port, the Alarm LED lights and the alarm relay is closed, generating a remote alarm.
	OFF	Faults are not monitored on the fiber optic port.
6	ON	In the event of a fault on the RJ45 port, the Alarm LED lights and the alarm relay is closed, generating a remote alarm.
	OFF	Faults are not monitored on the RJ45 port.



DIP switch positions 3, 4 and 5 are reserved for future use.



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