

# FB1M2LPR

## Industrial Ethernet Fiber Optic LC Transceiver



### Data Sheet

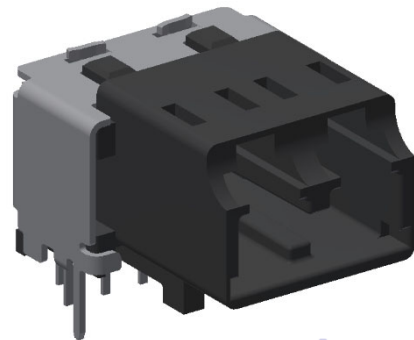


#### DESCRIPTION

Firecomms duplex LC connector for Fast Ethernet combines both transmitter and receiver fiber optic components in a small form factor LC housing. The LC connector allows termination of LC cable plugs with both standard 2.2 mm jacketed Plastic Optical Fiber (POF) and Plastic Clad Silica (PCS) multimode glass fibers used for extended distance applications. With a very simple circuit interface to any standard Ethernet PHY IC supporting 100Base-FX (IEEE 802.3), the connector provides Ethernet bandwidth of 100 Mb over POF in a point-to-point LAN.

The connector system complies with the international LC standard IEC 61754-20. This design enables the use of POF with the popular LC connector in industrial LAN applications.

The transmitter is a high-speed RCLED driven by a CMOS IC. The receiver combines a photo-diode, trans-impedance amplifier and limiting amplifier, providing a digital output on an LVPECL-type data bus compatible with all Ethernet PHY ICs.



#### FEATURES

- LC connector system for use with POF and PCS
- Compatible with IEEE 802.3u Fast Ethernet over fiber 100Base-FX data communications standard
- Red visible 650 nm Resonant Cavity LED (RCLED)
- Integrated CMOS driver IC for RCLED
- High sensitivity CMOS receiver IC and PIN diode
- Integrated optics to efficiently focus and direct light
- -40° to +85°C operating range
- RoHS compliant

#### AVAILABLE OPTIONS

Table 1

##### ORDERING INFORMATION / PART NUMBER

Industrial Ethernet LC Transceiver, 2.2 mm POF, Black	FB1M2LPR
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#### APPLICATIONS

Table 2  
APPLICATIONS

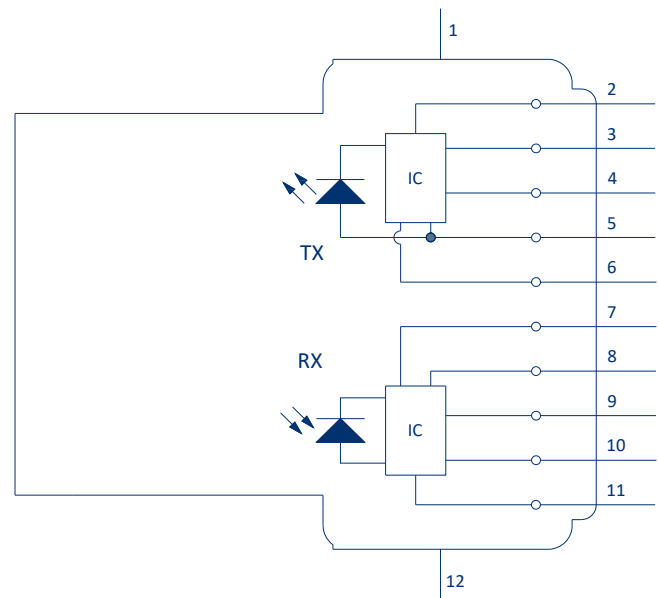
Application	Industrial Networking
Standard	IEEE 802.3 (100Base-FX) IEC 61754-20
Distance	50 meters Step Index POF 100 meters PCS <sup>[1]</sup>
Speed	10/100 Ethernet

Note: 1. Depending on the installation conditions

## SPECIFICATIONS

**Table 3**  
**TRANSCEIVER PIN DESCRIPTION**

Pin	Name	Symbol
<b>Transmitter</b>		
1	EMI Shield <sup>[1]</sup>	GND
2	Signal Input (Negative)	TD-
3	Signal Input (Positive)	TD+
4	Ground Pin <sup>[1]</sup>	GND
5	DC Power Input Pin 3.3 V	Vcc
6	Ground Pin <sup>[1]</sup>	GND
<b>Receiver</b>		
7	DC Power Input Pin 3.3 V	Vcc
8	Ground Pin <sup>[1]</sup>	GND
9	Signal Detect Output	SD
10	Data Output (Negative)	RD-
11	Data Output (Positive)	RD+
12	EMI Shield <sup>[1]</sup>	GND



**FIGURE 1**  
Transceiver pin-out, top view

1. NB: EMI Shield ground pins must be connected to the signal ground plane on the PCB. This is important to prevent cross-talk between TX and RX and also to shield the FOT's from external EMI/EMC and ESD

**Table 4**  
**REGULATORY COMPLIANCE**

Parameter	Symbol	Standard	Level
Storage Compliance	MSL	J-STD-020E	2a (4-week floor life)
Restriction of Hazardous Substances Directive	RoHS	Directive 2011/65/EU	Certified compliant
Eye Safety		IEC 60825-1	LED Class 1

## APPLICATION CIRCUIT

Figure 2 is the general interface circuit. Each Ethernet PHY manufacturer recommends a termination configuration for its own design. Examples of the most commonly used PHYs are given in the Firecomms Ethernet Application Note.

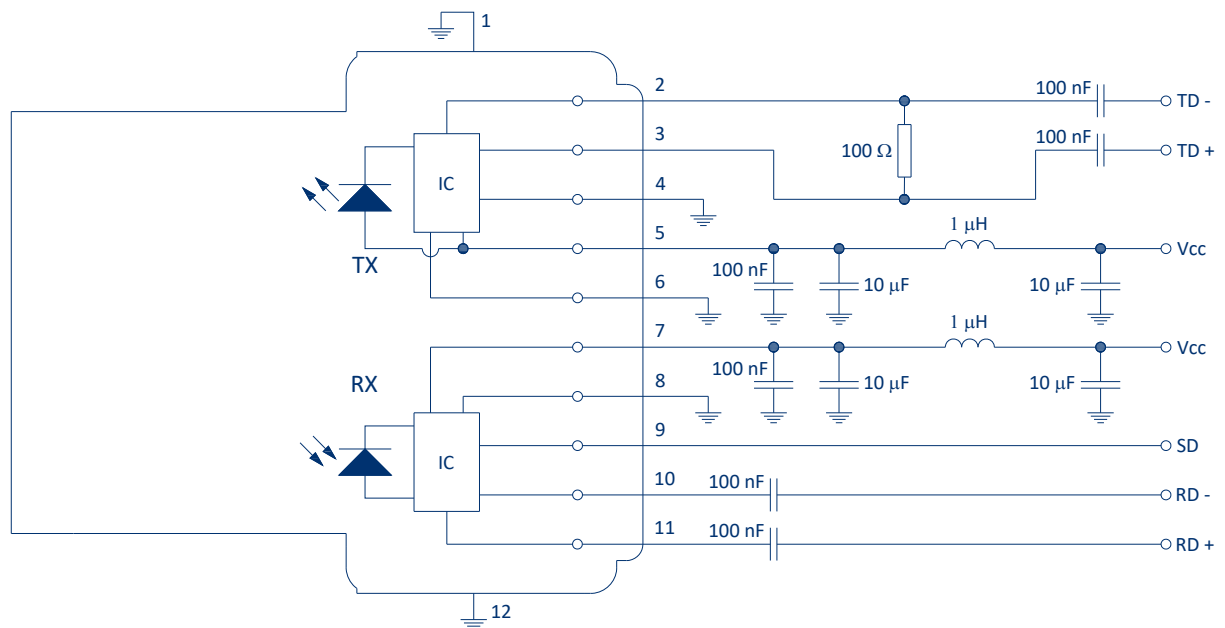


FIGURE 2  
Interface circuit schematic to AC couple to an Ethernet PHY

### Notes:

1. The transmitter (TX) and receiver (RX) are electrically shielded from each other to prevent crosstalk. To be effective this shield must be grounded
2. Both GND pins of the TX FOT must be connected to GND (they are not connected internally).
3. Power line capacitors should be located as close as possible to the FOT's DC power PINS.
4. The data lines are impedance-matched differential pairs. The PCB layout for these tracks must comply to IEEE standards for high-speed data and impedance matching.
5. Note: The RD + and RD – are already terminated with a 100 Ω resistor internally at the output stage

## ELECTRONIC BLOCK DIAGRAM

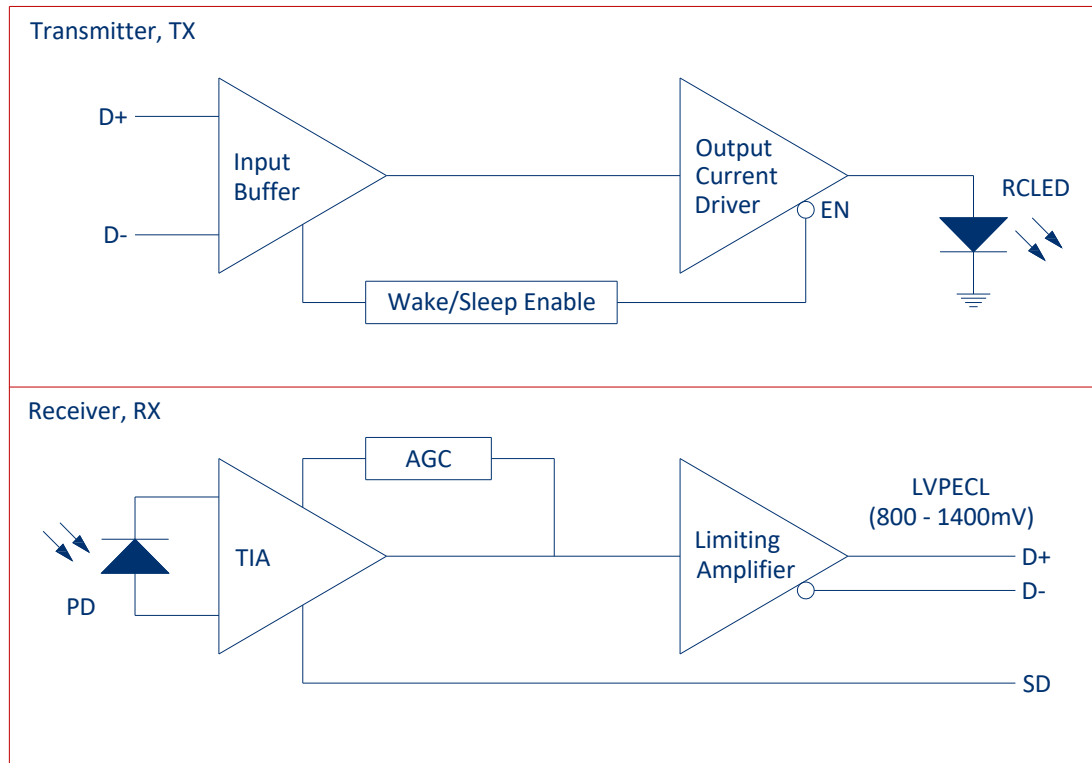


FIGURE 3  
Electronic block diagrams of the TX and RX fiber optic transceiver

## SPECIFICATIONS

**Table 5**  
**ABSOLUTE MAXIMUM RATINGS**

*These are the absolute maximum ratings at or beyond which the FOT can be expected to be damaged*

*Notes:*

1. 260°C for 10 seconds, one time only, at least 2.2 mm away from lead root

Parameter	Symbol	Minimum	Maximum	Unit
Storage Temperature	T <sub>stg</sub>	-40	+85	°C
Operating Temperature <sup>[1]</sup>	T <sub>op</sub>	-40	+85	°C
Soldering Temperature <sup>[1]</sup>	T <sub>slid</sub>		+260 <sup>[1]</sup>	°C
Supply Voltage	V <sub>R</sub>	-0.5	4.5	V
Receiver Optical Overload	P <sub>OL</sub>		0	dBm

## SPECIFICATIONS

**Table 6**  
**TRANSMITTER ELECTRICAL AND OPTICAL CHARACTERISTICS**

Parameter	Symbol	Min	Typical	Max	Unit	Test Condition
DC Supply Voltage	V <sub>CC</sub>	3.0	3.3	3.6	V	
Operating Current Consumption	I <sub>CC</sub>	30	37	52	mA	
Data Rate		10		125	Mbps	
Data Input Capacitance	C <sub>IN</sub>			5	pF	
Data Input Resistance (Single-Ended)	R <sub>IN</sub>		5		kΩ	
Input Common-Mode Range	V <sub>IN-BIAS</sub>	GND+0.8		V <sub>CC</sub> -0.8	V	
Input Voltage Swing	V <sub>IN-SWING</sub>	100		1200	mV	
Minimum Differential Voltage Swing to Ensure Wake-Up	Wake-up Input	50			mV	
Wake-Up Time Delay			5	80	μs	
Optical Power OFF Delay		0.02		20	μs	
Peak Wavelength	λ <sub>peak</sub>	640	660	670	nm	
Spectral Bandwidth (FWHM)	Δλ	18	24	27	nm	
Average Optical Power	P	-10	-5.5	-1.5	dBm	[3]
Optical Rise Time	t <sub>R</sub>	0.5	1.3	3.1	ns	20 % - 80 %
Optical Fall Time	t <sub>F</sub>	0.4	0.5	0.75	ns	80 % - 20 %
Optical Modulation Amplitude (OMA)	OMA	160	590	1250	μW	
Open Eye Width	T <sub>eye</sub>	6.5	7.4	7.9	ns	

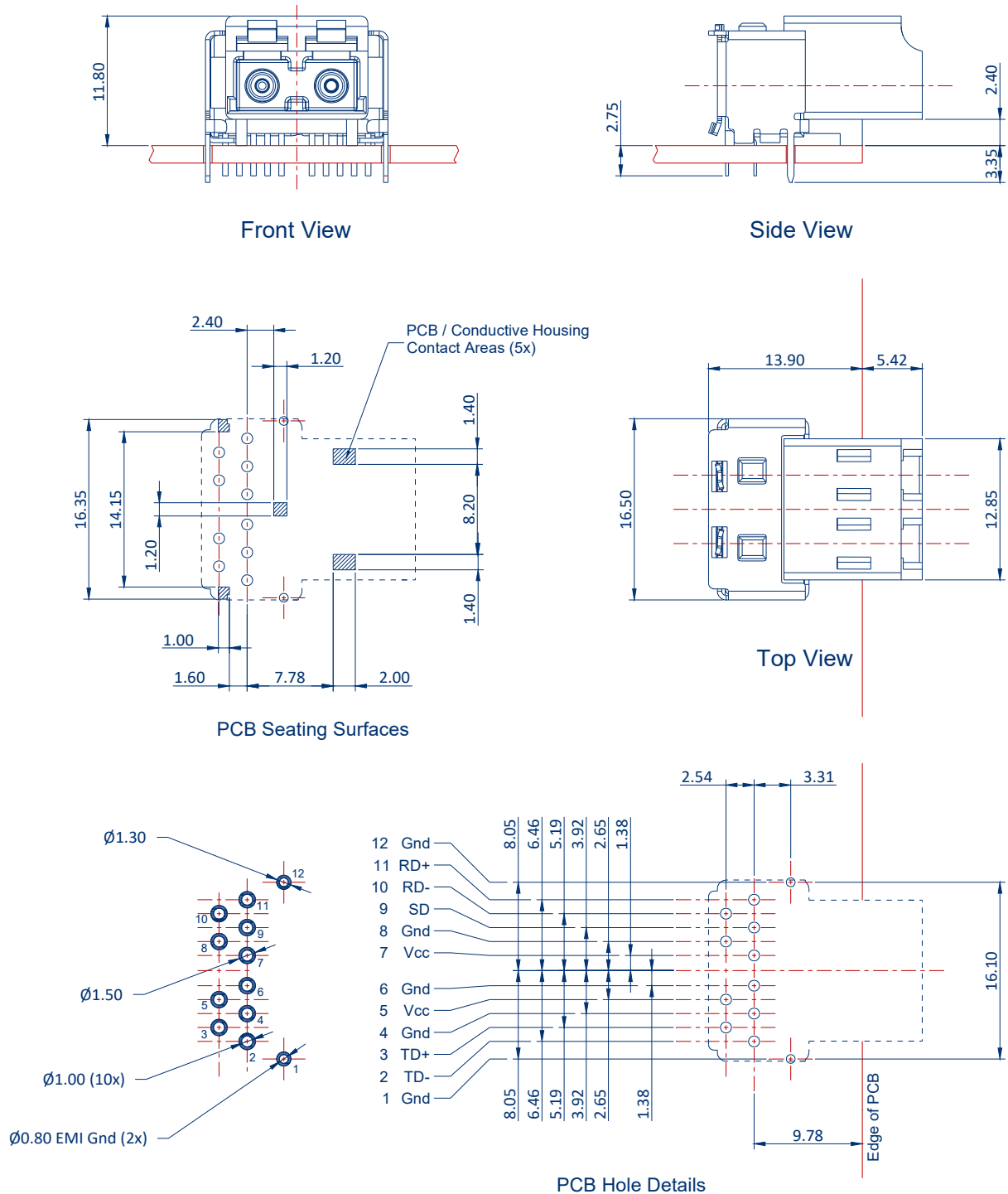
**Table 7**  
**RECEIVER ELECTRICAL AND OPTICAL CHARACTERISTICS**

*Test Conditions:*

1. Test data was validated over the full temperature range of -40 °C to +85 °C, and over the supply range of 3 V to 3.6 V
2. Test data represents operation at the maximum data rate of 125 Mbps using a PRBS7 test pattern (8B/10B encoding) unless otherwise stated
3. Optical power was coupled from a minimum 0.5 m length of 1 mm diameter core and 0.5 NA step index plastic optic fiber

Parameter	Symbol	Min	Typical	Max	Unit	Test Condition
DC Supply Voltage	V <sub>CC</sub>	3.0	3.3	3.6	V	
Operating Current Consumption	I <sub>CC</sub>	35	43	50	mA	
Output Impedance Between D and $\bar{D}$	R <sub>Diff</sub>		100		Ohm	
Offset Common Mode Voltage	V <sub>ocm</sub>		1.41		V	
Output Differential Voltage Swing		800	1150	1400	mV	
Receivable Optical Power Sensitivity			-26	-24	dBm	
Maximum Allowed Optical Power				0	dBm	
Rise Time			1.6	3.4	ns	10 % - 90 %
Fall Time			1.6	3.4	ns	90 % - 10 %
Signal Detect Assert/De-Assert time	T <sub>SD</sub>	0.1	0.3	0.6	us	
Signal Detect Optical Assert Level	P <sub>SD-AS</sub>	-32	-27	-24	dBm	
Signal Detect Optical De-Assert Level	P <sub>SD-DAS</sub>	-32	-28	-25	dBm	
Signal Detect Voltage High	V <sub>SDH</sub>	2.4	3.0	3.6	V	
Signal Detect Voltage Low	V <sub>SDL</sub>	0.0	0.05	0.1	V	
Open Eye Width	EW	5.7	7.4	7.9	ns	

## MECHANICAL DATA



**FIGURE 4**  
Mechanical dimensions of the product, and PCB footprint, which is a top view  
General dimensional tolerance is  $\pm 0.2$  mm

Note: The plastic housing of the FB2M5LVR LC connector is made from an electrically conductive fibre-filled plastic material. Electrically conductive traces on the connector seating surface of the printed circuit board should not run underneath the connector housing. If it is necessary to run electrically conductive traces underneath the connector, their positions must not coincide with the PCB seating surfaces shown above.

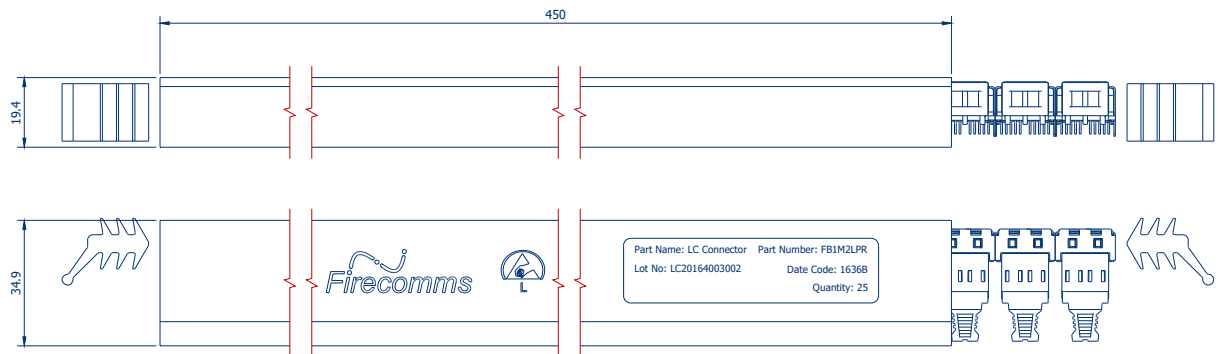


FIGURE 5  
Packing tube for Firecomms FB1M2LPR Optical LC Transceivers

## PART HANDLING

The transceivers are tested for handling in static-controlled assembly processes (HBM). Cleaning, degreasing and post solder washing should be carried out using standard solutions compatible with both plastics and the environment. For example, recommended solutions for degreasing are alcohols (methyl, isopropyl and isobutyl). Acetone, ethyl acetate, phenol or similar solution based products are not permitted.

In the soldering process, non-halogenated water soluble fluxes are recommended. These connectors are not suitable for use in reflow solder processes (infrared/vapor-phase reflow). The dust plug should remain in place during soldering, washing and drying processes to avoid contamination of the active optical area of each connector.

The Moisture Sensitivity Level (MSL) classification of this device is 2a according to JEDEC J-STD-020E. The shelf life of an unopened MBB (Moisture Barrier Bag) is 24 months at < 40 °C and < 90 % R.H. Once the Moisture Barrier Bag is opened the devices can be either

- a) Stored in normal factory conditions < 30 °C and < 60 % R.H. for a maximum of 672 hours (4 Weeks) prior to soldering.
- b) Stored at < 10 % R.H. (Dry Cabinet).



## PACKING INFORMATION

Components are packed in PVC anti-static tubes in moisture barrier bags. Bags should be opened only in static-controlled locations, and standard procedures should be followed for handling moisture sensitive components

Components per Tube	25
Tube Length	450 mm
Tube Width	34.9 mm
Tube Height	19.4 mm
Tubes per Bag	10
Bags per Inner Carton	1
Inner Carton Length	588 mm
Inner Carton Width	147 mm
Inner Carton Height	82 mm
Weight per Inner Carton, Complete	1.95 kg
Components per Inner Carton	250
Inner Cartons per Outer Carton	4
Outer Carton Length	600 mm
Outer Carton Width	310 mm
Outer Carton Height	195 mm
Weight per Outer Carton, Complete	8.10 kg
Components per Outer Carton	1,000

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