Current sense optical fiber link

Features

- *Battery operated 2 channel transmission link with current sense input up to 25 A*

- *Excellent out of the box accuracy 0,5%*

- *2 independent current sense channels per link*

- *Sample rate of 200kSa/s*

- *Designed for usage in EMC test labs, ultra-low EMI behavior, exceptional immunity performance*

- *Typical operating time of 20 hours*

Product description

The **EMCgear EFL-I** is a precision **current sense analog optical fiber link**, designed for **accurate current measurement** and **complete galvanic isolation** in demanding **EMC test environments** or any place requiring the safe transfer of current signals between two electrically separated locations.

The EFL-I range is available in **six current options**, covering both **unipolar** and **bipolar** configurations to meet the diverse measurement needs of devices under test. Input current is sensed through precision shunt resistors and converted into **optically isolated analog signals**, faithfully reproduced as voltage outputs on the receiver side.

A **high-speed communication** link with a **sample rate of 200 kSa/s** and **real-time CRC protection** ensures **absolute signal integrity** and **low latency**.

The **rugged aluminum enclosure** and **embedded input/output filters** provide excellent EM immunity and emission performance, making the EFL-I an **ideal choice for harsh EMC environments, immunity test setups, and custom measurement benches**.

Featuring **two independent analog channels**, the EFL-I allows simultaneous monitoring or control of multiple current paths. Its wide input/output range, and plug-and-play operation enable **seamless integration into complex monitoring or stimulation systems** without additional modifications.

Technical parameters

General

Channels	*2*
Input voltage range	*0 to 25 A (unipolar)* *0 to 2.5 A (unipolar)* *0 to 250 mA (unipolar)* *-12.5 to 12.5 mA (bipolar)* *-1.25 to 1.25 mA (bipolar)* *-125 to 125 mA (bipolar)*

Output voltage range	*0 to 2.5 V (all unipolar variants)* *-1.25 to 1.25 V (all bipolar variants)*
Input common mode voltage	*max. ± 40 V between IN1 and IN2*
Sample rate	*200 kSa/s*
Resolution	*12 bits*
Accuracy	*±(0.5% value + 0.05% range)*
Battery	*4.2 V / 5000 mAh*
Operating time	*Typ. 20 hours*
Operating temperature	*0 to 55 °C*

Use cases

Each EFL-I current sense analog fiber link consist of two boxes – Input and Output side.

As connection medium can be used SMA-905 terminated optical fiber, widely accepted within standard EMC test types of equipment.

Following example scenarios can be used:

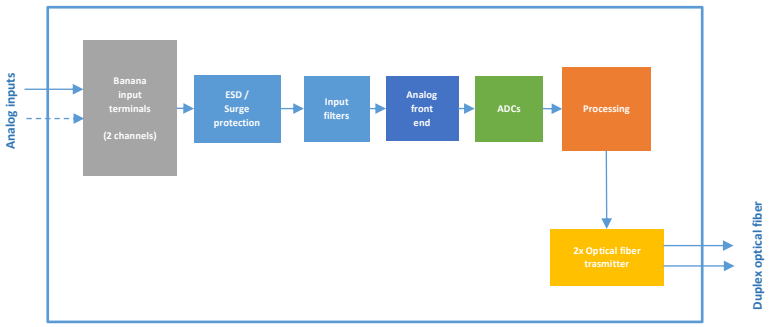
a) Input side is placed inside EMC test chamber to monitor DUT during the test.

b) Both Input / Output side are used on the test table. Analog fiber link can be used to protect measurement equipment (e.g. ESD / Surge immunity tests or general purpose galvanic isolation)

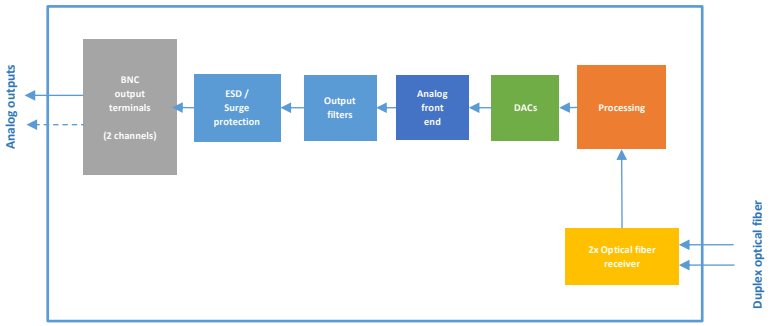
INPUT SIDE OUTPUT SIDE

Function block diagram

Input side



Output side

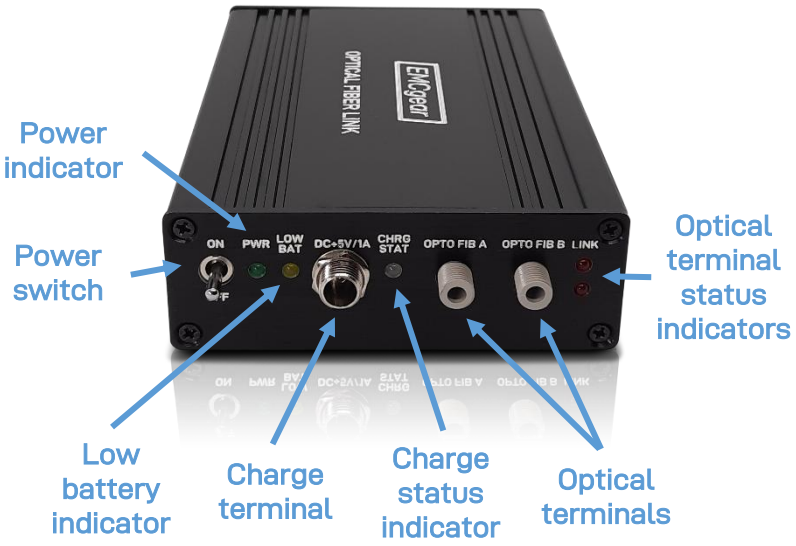


Front side terminals

2 input and output terminals

*) Variant and link side dependent. See list of available variants.

Back side terminals



Quick start guide

1.) **Check serial numbers for both Input and Output side** of the EFL-A analog fiber link. **Serial numbers must correspond.**

It's strongly recommended to always use devices with the same serial number as internal calibration data are applied for each unique pair of the devices.

2.) **Interconnect both devices with crossed duplex optical fiber with corresponding parameters.**
See chapter Technical parameters for details about optical interface.

3.) **Power on both Input and Output side with marked toggle switch.**

4.) **Analog fiber link is ready to use.**

Normal operation

Normal operation is initiated immediately after both link sides are powered on (power switch in ON state). Optical fiber have to be properly connected between both nodes.
Datalink is established automatically within few hundred milliseconds.

Successful connection is indicated with solid red light of LINK indicators on the both link sides.
From this moment is device ready for use and all analog inputs are in sync with corresponding analog outputs.

Connection problems

Wrong or missing or erroneous optical fiber connection signalized with disabled LINK indicator on the output side. Datalink is additionally protected with CRC control and eventually corrupted data are not propagated to the output side. In this case is suggested to check or replace transfer medium.

*) Please note that input side LINK indicator remains always active even with disconnected optical fiber. This indicate that input side is ready to establish connection with output side (optical transmitters are properly driven)

Battery status indication

Low battery pre-warning is indicated with solid yellow light on corresponding link side.
Active LOW BAT indicator corresponds to approx. 5% of remaining battery capacity. It's recommended to charge device immediately, nevertheless in this mode it's still possible to use device without any limitation or loss of specified accuracy.

Fully drained battery brings device into disabled state (indicated with disabled PWR indicator on the corresponding link side).
At this moment is transmission link is disabled as well as analog outputs on the output side (driven to 0 V respectively).

Remote battery status monitoring

EFL-A device offers special function for **remote monitoring of the "Input side" battery status**.
This can be especially useful during EMC tests, when Input side is placed inside anechoic chamber or out of sight of test operator.
Active low battery indicator (low battery pre-warning) on the Input side is directly propagated on the Output side with continuous flashing LINK indicators.

Charge status indication

After plugging in external charger into marked DC jack terminal charge process begins immediately. Ongoing charge process is indicated with solid red light on the CHRG STAT indicator.

Finished change process is indicated with solid green light and remains in this state until charger is removed or battery voltage drops below recharge level.

Charge in progress

Charge done

Charge while device is powered on

If necessary, EFL-A devices can be continuously charged during normal operation.
Internal charge circuitry is optimized for low EMI behavior (linear charging circuitry is used), therefore emission levels of device itself shouldn't differ from levels demonstrated in annex of this manual. Although this isn't applicable to ext. accessories as wall charger, which can emit significant amount of interference.
As countermeasure additional filtering between charger and device can be used or device can be charged from any on-site available supply voltage with corresponding parameters (typ. DC 5V / min. 1A).

Please note, in this mode CHRG STAT indicator always shows "Charge in progress" with solid red light (charge done indication is disabled).

Charge in progress
remains always active

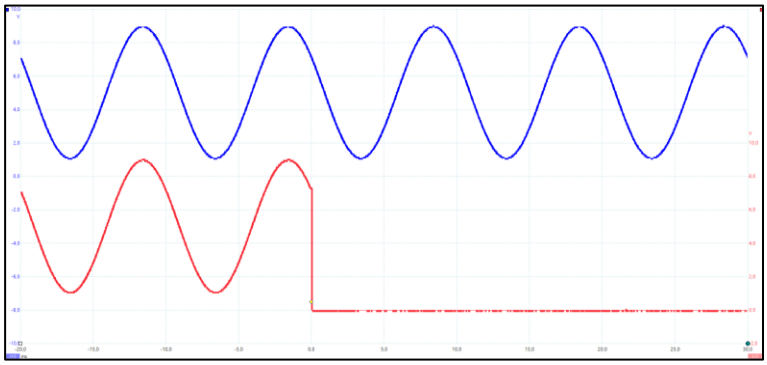
Signal integrity control

During normal operation is transmission link between both Input and Output box real-time CRC protected. This ensure that compromised data e.g., due to the corrupted optical transfer medium can not be propagated to Output side analog terminals.

Scenario no. 1)

Loss of transmission link communication

On the following picture was simulated optical fiber removal. Output box immediately acquire safe state and disable all analog outputs (outputs are forced to 0V).

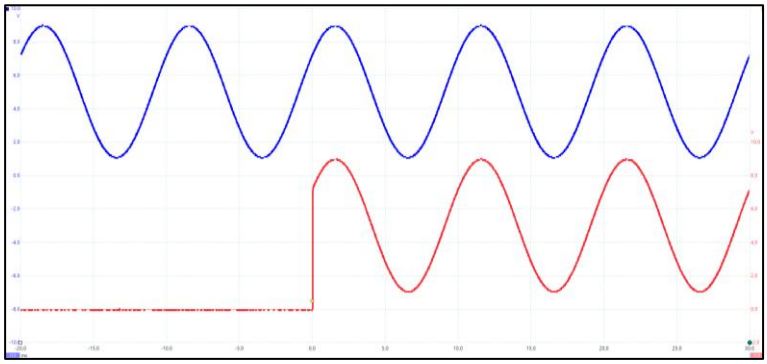


BLUE = Input terminal, RED = Output terminal

Scenario no. 2)

Communication recovery

Immediately after optical fiber reconnection transmission link is automatically restored and analog signals being propagated between Input and Output side terminals again.

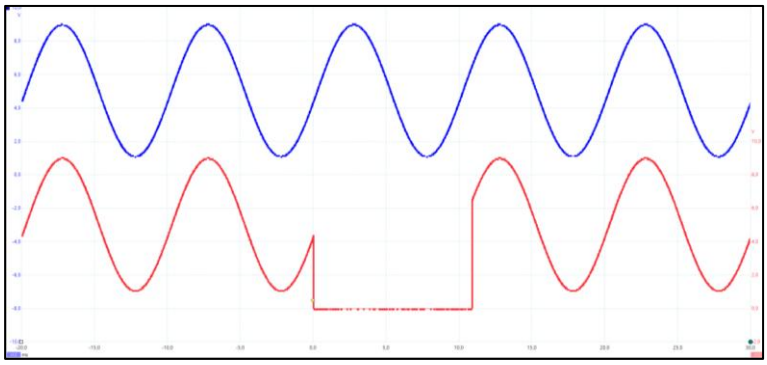


BLUE = Input terminal, RED = Output terminal

Scenario no. 3)

Single communication error (injected error)

For demonstration purposes, single bit error was injected into active communication between Input / Output box.
Communication error was safely recognized by CRC control mechanism. As shown, normal operation is recovered automatically after approx. 10 milliseconds (qualification time).



BLUE = Input terminal, RED = Output terminal

Technical parameters

Optical interfaces

Optical fiber terminals	*2x SMA-905 jack*
Optical transmitter wavelength	*820 nm*
Recommended optical fiber type	*1x duplex or 2x simplex*
Recommended optical fiber structure	*50 / 125 µm or 62.5 / 125 µm (core / cladding)*
Recommended optical fiber length	*0 to 900 m*

Transmission link

Data rate	*Typ. 25 Mbit/s*
Data integrity protection	*CRC-16*
Datalink initialization time	*Max. 1000 ms after device startup*
Sample rate	*200 kSa/s*
Voltage crosstalk between any two analog channels	*Max. -60 dB*

Analog inputs

Analog resolution (ADC)	*12 bits*
Input filter cut-off frequency	*Typ. 10 MHz*
Input voltage drop	*max. 130 mV (25 A range @ 25 A) max. 65 mV (2.5 A range @ 2.5 A) max. 650 mV *) (250 mA range @ 250 mA)*
Input short circuit protection (long term)	*max. 30 A (25 A / ± 12.5 A range) max. 15 A (2.5 A / ± 1.25 A range) max. 15 A *) (250 mA / ± 125 mA range)*
ESD rating (as per IEC 61000-4-2)	*± 15kV (air) ± 8 kV (contact)*
Surge protection (as per IEC 61000-4-5, 8/20 µs)	*27 A*

**) 250 mA input range variant includes onboard resettable fuses*

Analog outputs

Output impedance	*Typ. 1 kOhm || typ. 0,8 nF*
Analog resolution (DAC)	*12 bits*
Output filter cut-off frequency	*Typ. 10 MHz*
Maximum voltage attached to output terminal	*Max. ± 31 V*
ESD rating (as per IEC 61000-4-2)	*± 15kV (air) ± 8 kV (contact)*
Surge protection (as per IEC 61000-4-5, 8/20 µs)	*27 A*

Battery

Battery type	*1 cell LiPo battery*
Battery nominal voltage	*4.2 V*
Battery capacity	*Nom. 5000 mAh*
Battery protection circuit	*Overcharge and deep undercharge protection*
Battery life cycle	*Min. 500 full charge cycles*
Battery replacement	*Replacement battery kit available, ask for further information.*

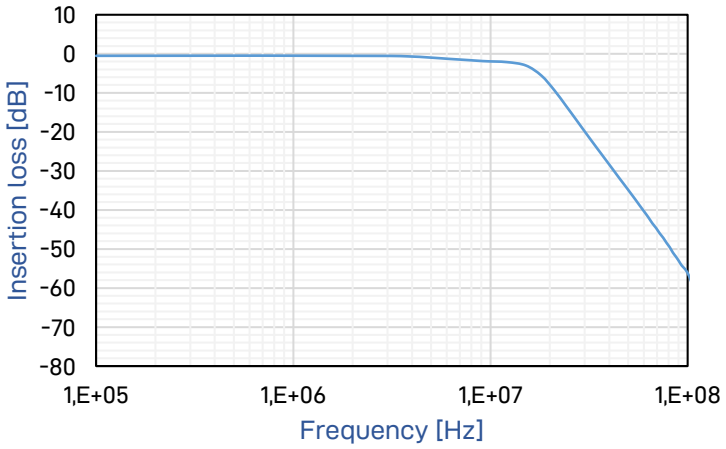
Charging

Charge current	*Typ. 1000 mA*
Charge time	*Max. 6 hours (from discharged to fully charged status)*
Operating time	*Typ. 20 hours (on fully charged battery)*
Charging terminal *)	*DC jack 5.5 / 2.1 mm with screw terminal, center pin positive (5/16-32 UNEF 2A thread)*
External charger voltage *)	*5.0 to 6.0 V DC*
External charger rating *)	*Min. 3 A*

*) See list of recommended accessories for suitable wall charger.

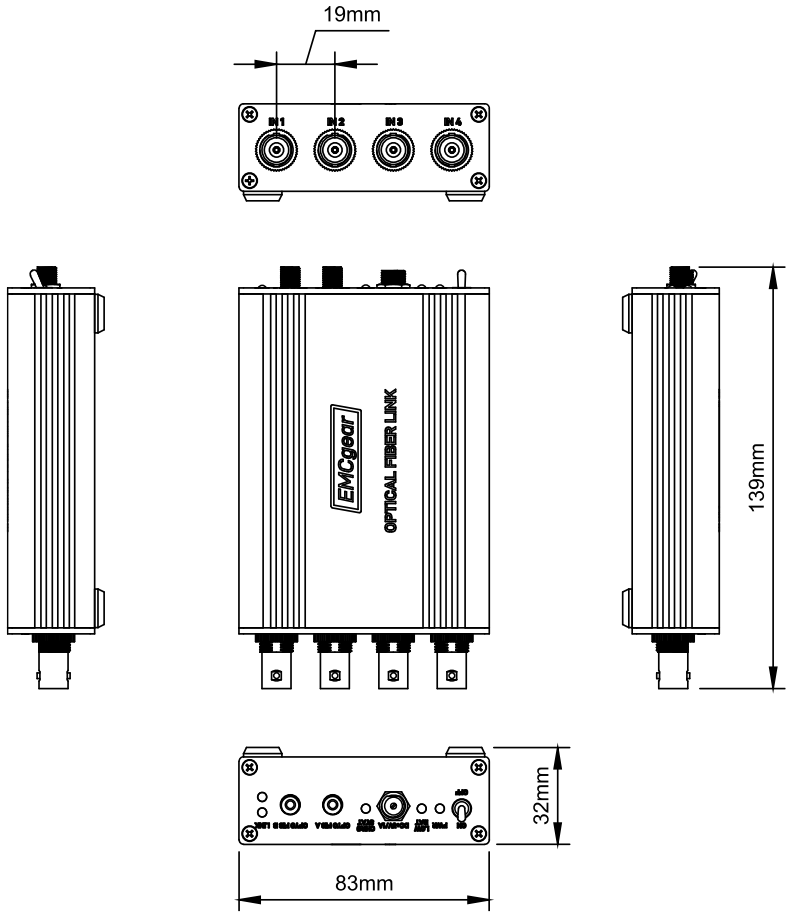
Input / output filter characteristics

Insertion loss
100kHz – 100 Mhz



*) Measured on actual EFL-I link device using VNA (50Ω impedance S21 measurement)

Mechanical dimensions



*) Mechanical dimensions for INPUT and OUTPUT side are equal.

Scope of delivery
(per EFL-I link kit)

EFL-I Analog fiber link – Input side box	*1 pc*
EFL-I Analog fiber link – Output side box	*1 pc*
Foam lined transport box	*1 pc*

Warranty

2-year manufacturer warranty

Conformity

Conform with EMC Directive 2014/30/EU

EN 61326-1 IEC 61000-4-2 IEC 61000-4-3 IEC 61000-4-5 IEC 61000-4-6	

Variant list	Description	Order code
2-channel link (unipolar)	**Channels: 2** **Input range: 0 to 25A** (unipolar) Output range: 0 to 2.5V (unipolar) Sample rate: 200 kSa/s	**EFL-I-25U-2**
	Channels: 2 **Input range: 0 to 2.5A** (unipolar) Output range: 0 to 2.5V (unipolar) Sample rate: 200 kSa/s	**EFL-I-2U5-2**
	Channels: 2 **Input range: 0 to 250mA** (unipolar) Output range: 0 to 2.5V (unipolar) Sample rate: 200 kSa/s	**EFL-I-U25-2**
2-channel link (bipolar)	**Channels: 2** **Input range: -12.5 to 12.5A** (bipolar) Output range: -1.25 to 1.25V (bipolar) Sample rate: 200 kSa/s	**EFL-I-12B5-2**
	Channels: 2 **Input range: -1.25 to 1.25A** (bipolar) Output range: -1.25 to 1.25V (bipolar) Sample rate: 200 kSa/s	**EFL-I-1B25-2**
	Channels: 2 **Input range: -125 to 125mA** (bipolar) Output range: -1.25 to 1.25V (bipolar) Sample rate: 200 kSa/s	**EFL-I-B125-2**

Recommended accessories	Description	Order code
Charger adaptor	**Power Adaptor 100-240V to 5V 3A 2.1mm** Screw Lock UK/EU/US/AU plug	**EFL-A-AD1** (2 pcs are recommended)
Fiber patch cables	**Fiber patch cable SMA905-SMA905 10m** Duplex fiber Termination: 2x SMA905 on both ends Optical mode: OM1 Cladding: 62.5/125 µm Length: 10m	**EFL-A-FPC10**
	Fiber patch cable SMA905-SMA905 20m Duplex fiber Termination: 2x SMA905 on both ends Optical mode: OM1 Cladding: 62.5/125 µm Length: 20m	**EFL-A-FPC20**