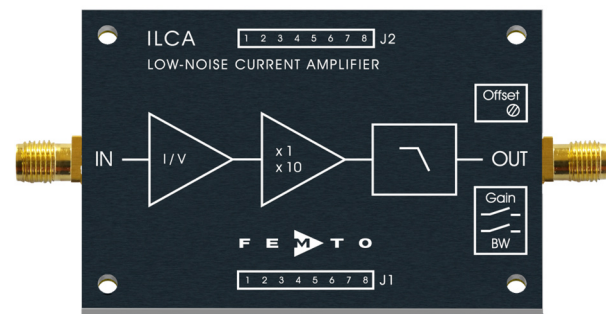


Variable-Gain
Low-Noise Current Amplifier



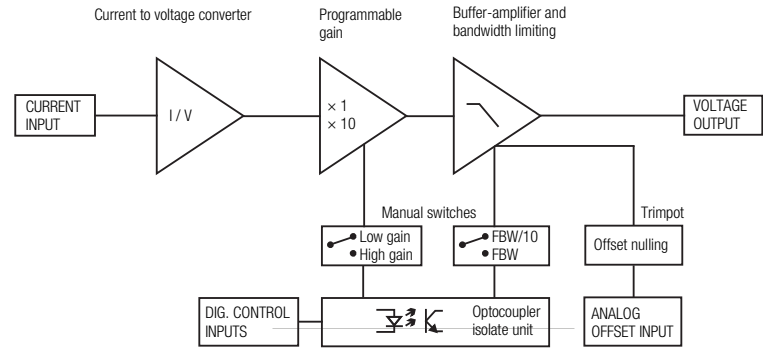
Features

- Compact, lightweight and robust
- Transimpedance (gain) ranges from 1×10^7 to 1×10^{10} V/A
- Bandwidth from DC up to 500 kHz
- Switchable gain and bandwidth (local and remote)
- Remote control signals with galvanic isolation
- Input noise current down to $7 \text{ fA}/\sqrt{\text{Hz}}$
- OEM design – ready for integration in industrial measurement systems

Applications

- Sensitive Current Measurements down to Picoampere
- Photodetector Amplifier
- Preamplifier for High Impedance Detectors (Faraday Cups, Ionization Chambers, etc.)

Block Diagram



BS-ILCA-R02

Intended Use

The ILCA current amplifier is a variable gain transimpedance amplifier, designed for OEM applications. It is designed for fast conversion of small current signals into equivalent output voltages. Operation is mostly self-explanatory. If in doubt, consult this document or contact support@femto.de.

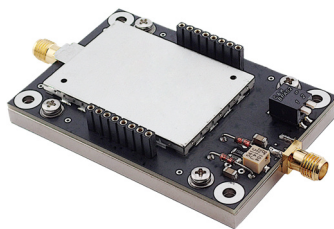
For safe operation, please refer to the damage thresholds specified in the "Absolute Maximum Ratings", "Temperature Range", "Detector Bias" and "Power Supply" sections of this document.

The operating environment must be free of smoke, dust, grease, oil, condensing moisture, and other contaminants that could affect the operation or performance.

The ILCA is designed to be used for high impedance sources. Low impedance sources will cause significant increase of noise and DC output drift. Especially high source capacity will limit the signal to noise ratio. Stancard coax cable, connecting source and amplifier, contribute with 1 pF/cm to the source impedance. Always connect the source with the shortest possible cable.

Variable-Gain Low-Noise Current Amplifier

Available Versions



ILCA-5K-1G	Transimpedance Amplifier, Gain 1×10^9 V/A / 1×10^{10} V/A, bandwidth 500 Hz / 5 kHz
ILCA-50K-100M	Transimpedance Amplifier, Gain 1×10^8 V/A / 1×10^9 V/A, bandwidth 5 kHz / 50 kHz
ILCA-500K-10M	Transimpedance Amplifier, Gain 1×10^7 V/A / 1×10^8 V/A, bandwidth 50 kHz / 500 kHz

Specifications

Test conditions	$V_S = \pm 15$ V, $T_A = 25$ °C, output load impedance 1 M Ω , warm-up 20 minutes (min. 10 minutes recommended)
Gain	Transimpedance gain $1.0 \times 10^7 \dots 1.0 \times 10^{10}$ V/A (@ output load ≥ 100 k Ω) Gain accuracy ± 2 % (electrical) Gain drift see table below
Frequency Response	Lower cut-off frequency DC (switchable AC/DC coupling on request) Upper cut-off frequency (-3 dB) up to 500 kHz (see table below), switchable to 1/10 of full BW Gain flatness ± 0.1 dB
Input	Equ. input noise current see table below Equ. input noise voltage 5 nV/ $\sqrt{\text{Hz}}$ (@ 5 kHz) Input bias current 2 pA typ. Input bias current drift factor 2 / 10K Max. input current see table below (value for linear amplification)

Performance depending on Gain Setting

Product Code ILCA-	5K-1G	50K-100M	500K-10M
Gain setting, low	1×10^9 V/A	1×10^8 V/A	1×10^7 V/A
Gain setting, high	1×10^{10} V/A	1×10^9 V/A	1×10^8 V/A
Bandwidth, FBW (-3 dB, 5 %)+	5 kHz	50 kHz	500 kHz
Bandwidth, LOW (-3 dB, 5 %)+	500 Hz	5 kHz	50 kHz
Rise/fall time, FBW (10 % - 90 %)	70 μ s	7 μ s	0,7 μ s
Rise/fall time, LOW (10 % - 90 %)	700 μ s	70 μ s	7 μ s
Input noise current density (@FBW) measured at	7 fA/ $\sqrt{\text{Hz}}$ 1 kHz	20 fA/ $\sqrt{\text{Hz}}$ 1 kHz	50 fA/ $\sqrt{\text{Hz}}$ 1 kHz
Integr. input noise current (rms)* measured with bandwidth (-3 dB)	0.8 pA 50 kHz	7 pA 500 kHz	90 pA 5 MHz
Max. input current at low gain	10 nA	100 nA	1 μ A
Max. input current at high gain	1 nA	10 nA	100 nA
DC input impedance (5 pF)	50 Ω	50 Ω	50 Ω
Max. source capacitance+	5 nF	5 nF	3 nF

+ Bandwidth independently of source capacitance up to about 1 nF

* The integrated input noise is measured with an open but shielded amplifier input in the full bandwidth ("FBW") setting. The input referred peak-peak noise can be calculated from the rms noise as follows: $I_{PP} = I_{RMS} \times 6.6$ The output noise is given by: $U_{PP} = I_{PP} \times \text{gain}$

The integrated input noise currents given in this table are typical values only which will depend on the source capacitance. Keep the source capacitance as low as possible by using short cables at the input to achieve best possible noise performance.

Variable-Gain Low-Noise Current Amplifier

Specifications (continued)

Output	Output voltage Output compensation range Output impedance Max. output current	$\pm 10\text{ V}$ (@ $\geq 100\text{ k}\Omega$ output load) $\pm 1\text{ V}$ (set by internal trimpot) $50\text{ }\Omega$ (terminate with $\geq 100\text{ k}\Omega$ load) $\pm 30\text{ mA}$ (short-circuit proof)									
Dip-Switch Settings		<table> <tr> <th>Dip-Switch</th><th>OFF</th><th>ON</th></tr> <tr> <td>Gain Setting</td><td>1</td><td>Low Gain x1</td></tr> <tr> <td>Bandwidth Setting</td><td>2</td><td>Full Bandwidth (FBW)</td></tr> </table>	Dip-Switch	OFF	ON	Gain Setting	1	Low Gain x1	Bandwidth Setting	2	Full Bandwidth (FBW)
Dip-Switch	OFF	ON									
Gain Setting	1	Low Gain x1									
Bandwidth Setting	2	Full Bandwidth (FBW)									
Digital Control	Control input voltage range Control input current	LOW bit: $-0.8\text{ V} \dots +1.2\text{ V}$, HIGH bit: $+2.3\text{ V} \dots +12\text{ V}$ 0 mA @ 0 V , 1.5 mA @ $+5\text{ V}$, 4.5 mA @ $+12\text{ V}$									
External Offset Control	Control voltage range Offset control input impedance Ext. offset control range Ext. offset control set time	$\pm 10\text{ V}$ $90\text{ k}\Omega$ $\pm 1\text{ V}$ $> 300\text{ ms}$									
Power Supply	Supply voltage Supply current	$\pm 15\text{ V}$ ($\pm 14.75\text{ V} \dots \pm 16.5\text{ V}$) max. $\pm 45\text{ mA}$ (depends on operating conditions, recommended power supply capability min. $\pm 60\text{ mA}$)									
Case	Weight Material	40 g (0.088 lbs) frond cap: AlMg4,5Mn rear shielding: Steel Zn galvanized									
Temperature Range	Storage temperature Operating temperature	$-40\text{ }^{\circ}\text{C} \dots +80\text{ }^{\circ}\text{C}$ $0\text{ }^{\circ}\text{C} \dots +40\text{ }^{\circ}\text{C}$									

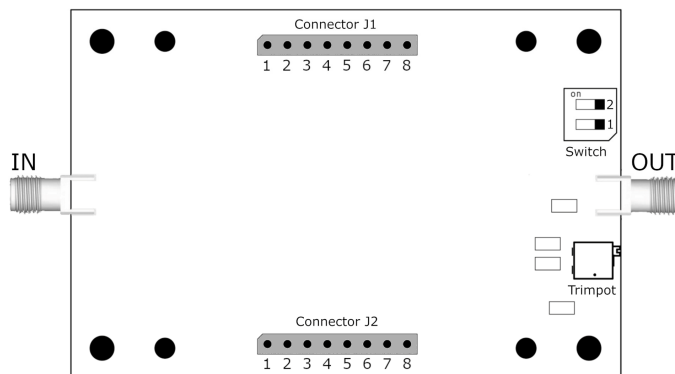
Absolute Maximum Ratings (Damage Threshold)

Signal input voltage	$\pm 5\text{ V}$
Transient input voltage	$\pm 6.5\text{ V}^{**}$
Digital control input voltage	$-5\text{ V}/+16\text{ V}$ relative to digital ground DGND
Analog control input voltage	$\pm 10\text{ V}$ relative to analog ground AGND
Power supply voltage	$\pm 20\text{ V}$

****** Optional surge protection with 750 V (HBM) and 2000 V (CDM) available. This may reduce the specified performance. Contact FEMTO for further information.

Variable-Gain Low-Noise Current Amplifier

Connectors



Input SMA jack (female)
Output SMA jack (female) and connector J2, Pin 8
Power and ext. offset Connector J1

Pin 1: ground for power supply, GND
Pin 2: external offset
Pin 3: ground for power supply, GND
Pin 4: ground for power supply, GND
Pin 5: ground for power supply, GND
Pin 6: positive supply voltage, +15V
Pin 7: ground for power supply, GND
Pin 8: negative supply voltage, -15V

In/Out and ext. control

Connector J2
Pin 1: not connected (optional current input)***
Pin 2: GND
Pin 3: digital control input, LP-Bit (low pass)
Pin 4: digital control input, GAIN-Bit (gain setting)
Pin 5: ground for digital control pins, P_DGND
Pin 6: GND
Pin 7: GND
Pin 8: Voltage OUTPUT

*** Current input via J2, pin 1
can be ordered as a custom version

J1 / J2 specification:

Connector type: 2 x 1x8-pin header (single row, straight)
Pin pitch (spacing): 2.54 mm / 100 mil
Pin dimensions: 0.64 mm / 25 mil square post
Row-to-row distance: 38,1 mm / 1500 mil (center-to-center)
Total footprint length: 17.78 mm / 700 mil (from pin 1 to pin 8)
Recommended finished hole size: 1.0 mm (approx. 40 mil)
Recommended pad diameter: 1.6 mm to 1.8 mm (63 to 70 mil)

Variable-Gain Low-Noise Current Amplifier

Remote Control Operation

General

Remote control inputs are opto-isolated and connected by logical OR function to local switch settings. For remote control set the local dip-switches to full bandwidth and low gain, then select the wanted setting at the corresponding digital inputs.

Mixed operation, e.g. local bandwidth setting and remote controlled gain setting setting, is also possible.

Gain setting

Gain	Connector J2 Pin 4
------	--------------------

Low gain (LG)	LOW
High gain (LG x 10)	HIGH

Bandwidth setting

Bandwidth	Connector J2 Pin 3
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Full bandwidth (FBW)	LOW
Low bandwidth (FBW/10)	HIGH

Settling time

< 100 ms

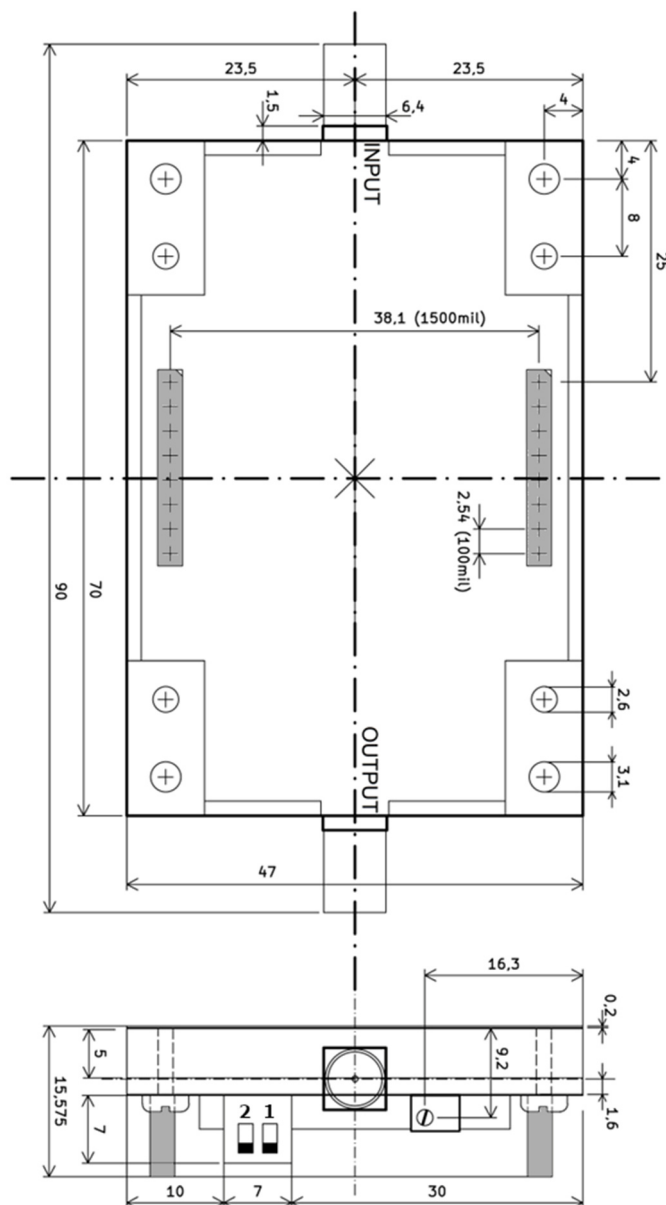
Scope of Delivery

ILCA, datasheet, transport package

Variable-Gain Low-Noise Current Amplifier

Dimensions

ILCA



all dimensions in mm unless otherwise noted

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