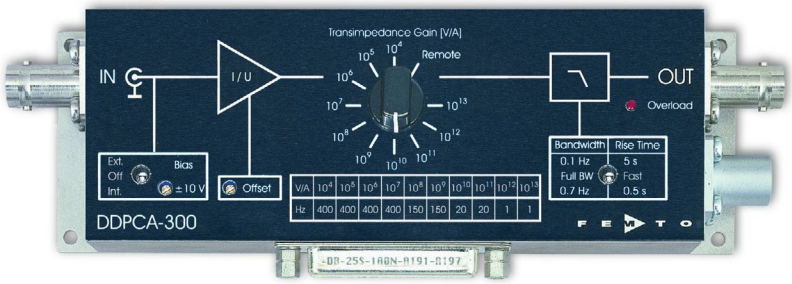
Electro Optical Components, Inc.
5460 Skylane Boulevard, Santa Rosa, CA 95403
Toll Free: 855-EOC-6300
www.eoc-inc.com | info@eoc-inc.com

Click to go to Product Selector

Datasheet DDPCA-300

Variable Gain
Sub Femto Ampere Current Amplifier



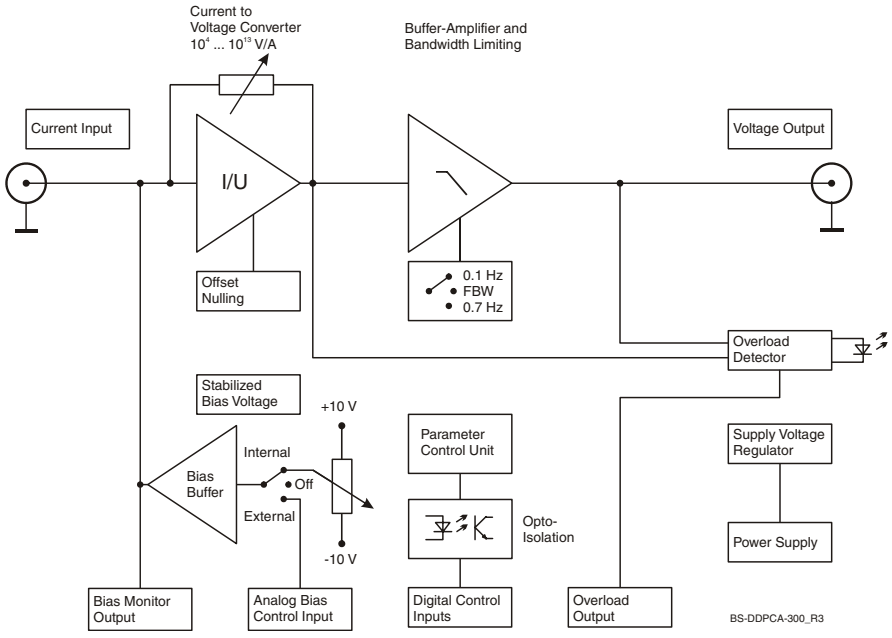
Features

- **0.4 fA Peak-Peak Noise**
- **Very High Dynamic Range: Sub-fA to 1 mA (> 240 dB)**
- **Transimpedance (Gain) Switchable from 1 x 10^4 to 1 x 10^{13} V/A**
- **Bandwidth up to 400 Hz, Rise Time Down to 0.8 ms - Independent of Source Capacitance (up to 10 nF)**
- **Adjustable Bias Voltage on Input Relative to Ground**
- **Compact Housing for Use Close to the Signal Source**
- **Local and Remote Control**
- **Easy to Use:**
  Convert Your Standard Digital Voltmeter or DAQ Board to a High-End Digital Sub Femto Amperemeter

Applications

- **Photodetector Amplifier**
- **I/V Characterization of Small MOS Structures**
- **DC Measurements of Ultra Low Currents**
- **Ionization Detectors, Mass Spectrometry, Quantum and Biotech Experiments**
- **Characterization of High Impedance Nanomaterials**
- **Spectroscopy**
- **High Resistance Measurements**

Block Diagram



Variable Gain
Sub Femto Ampere Current Amplifier

Specifications

Test Conditions — *Vs = ± 15 V, Ta = 25°C, Relative Humidity < 35 %*

Gain

Transimpedance	1 x 10^4 ... 1 x 10^{13} V/A
Gain Accuracy	± 1 %
Gain Drift	see table below

Frequency Response

Lower Cut-Off Frequency	DC
Upper Cut-Off Frequency	up to 400 Hz (see table below)
Adjustable Low Pass Filter	switchable to 3 settings (full bandwidth, 0.7 Hz and 0.1 Hz)

Upper Cut-Off	Rise Time
Full BW (see table below)	Fast (see table below)
0.7 Hz	0.5 s
0.1 Hz	5 s

Setting the low pass filter to full bandwidth is recommended for high measurement speed. By setting the low pass filter to 0.7 Hz or 0.1 Hz the peak-peak noise performance can be improved but the signal settling time will be longer.

Input

Equ. Input Noise Current	gain setting dependent, see table below minimum input noise is 0.4 fA peak-peak (at gain setting 10^{12} or 10^{13} V/A with low pass filter switched to 0.1 Hz)
Input Bias Current	< 10 fA typ.
Input Bias Current Drift	factor 2 / 10 °C
Max. Input Current (Full Scale)	see table below (value for linear amplification)
Input Offset Compensation	adjustable by offset trimpot, ± 100 fA

Performance Depending on Gain Setting

Gain Setting (V/A)	10^4	10^5	10^6	10^7	10^8
Upper Cut-Off Frequency (- 3 dB)*	400 Hz	400 Hz	400 Hz	400 Hz	150 Hz
Rise / Fall Time (10 % - 90 %)*	0.8 ms	0.8 ms	0.8 ms	0.8 ms	2.3 ms
Integrated Input Noise Current (Peak-Peak)*	7 nA	7 nA	70 pA	70 pA	1.2 pA
Spectral Input Noise Current Density (/√Hz)	45 pA	45 pA	0.45 pA	0.45 pA	15 fA
Measured at	10 Hz	10 Hz	10 Hz	10 Hz	10 Hz
Gain Drift (/°C)	0.01 %	0.01 %	0.01 %	0.01 %	0.01 %
Max. Input Current (± Full Scale)	1 mA	0.1 mA	10 µA	1 µA	0.1 µA
DC Input Impedance (// 5 pF)	< 1 Ω	< 1 Ω	< 1 Ω	< 1 Ω	< 100 Ω

Gain Setting (continued) (V/A)	10^9	10^{10}	10^{11}	10^{12}	10^{13}
Upper Cut-Off Frequency (- 3 dB)*	150 Hz	20 Hz	20 Hz	1 Hz	1 Hz
Rise / Fall Time (10 % - 90 %)*	2.3 ms	17 ms	17 ms	350 ms	350 ms
Integrated Input Noise Current (Peak-Peak)*	1.2 pA	50 fA	50 fA	2 fA	2 fA
Spectral Input Noise Current Density (/√Hz)	15 fA	1.3 fA	1.3 fA	0.2 fA	0.2 fA
Measured at	10 Hz	1 Hz	1 Hz	0.4 Hz	0.4 Hz
Gain Drift (/°C)	0.01 %	0.03 %	0.03 %	0.03 %	0.03 %
Max. Input Current (± Full Scale)	10 nA	1 nA	0.1 nA	10 pA	1 pA
DC Input Impedance (// 5 pF)	< 100 Ω	< 10 kΩ	< 10 kΩ	< 1 MΩ	< 1 MΩ

* The values for upper cut-off frequency, rise / fall time and integrated input noise current stated in the table above are achieved with the low pass filter set to "Full BW / Fast" (full bandwidth / fast rise time). Lower peak-peak noise values can be achieved by setting the low pass filter to 0.7 Hz or 0.1 Hz. In that case the bandwidth will be lower and the signal rise / fall time will be longer though.

Variable Gain
Sub Femto Ampere Current Amplifier

Specifications (continued)

Output	Output Voltage	± 10 V (@ ≥ 1 MΩ load)
	Output Impedance	50 Ω (terminate with ≥ 1 MΩ load for best performance)
	Max. Output Current	± 30 mA
Adjustable Bias Voltage	General	An adjustable bias voltage is provided for directly biasing the device under test DUT (e.g. photodiode, high resistance semiconductor component). The bias voltage is connected to the inner conductor of the BNC input socket; the BNC-shield is always connected to analog ground. The bias voltage can be set either locally at the amplifier or through the remote interface. For measurements not requiring a bias voltage it can be fully disabled.
	Bias Voltage Range	± 10 V at inner conductor of BNC input socket
	Bias Current	max. ± 10 mA
Local Bias Adjustment	Bias Switch Setting	set bias switch to position “Int.”
	Bias Adjustment	adjust bias voltage by bias trimpot
Remote Bias Adjustment	Bias Switch Setting	set bias switch to position “Ext.”
	Bias Adjustment	adjust bias by analog control voltage fed to pin 8 of Sub-D connector (referred to AGND pin 3)
	Input Impedance of Control Pin 8	200 kΩ
	Bias Control Voltage Range	± 10 V at pin 8 (referred to AGND pin 3)
	Bias Control Polarity	inverting
	Example:	feeding a control voltage of + 2 V to pin 8 of the Sub-D connector leads to - 2 V bias voltage at the inner conductor of the BNC input socket referred to BNC shield (analog ground, AGND)
Bias Deactivation	Bias Switch Setting	set bias switch to position “Off”
Bias Monitor Output	Range	± 10 V, mirrors the adjusted bias voltage at the BNC input (inner conductor referred to AGND pin 3)
	Connector	pin 7 of Sub-D connector (referred to AGND pin 3)
	Output Impedance	50 Ω (terminate with ≥ 1 MΩ load for best performance)
Overload Indication	LED	lights when overload is detected
	Digital Output	active when overload is detected (non active: 0 V, max. -1 mA, active: 5.1 V, max. 7 mA; referred to AGND pin 3)
Digital Control	Control Input Voltage Range	LOW bit: - 0.8 ...+ 1.2 V, HIGH bit: + 2.3 ... + 12 V
	Control Input Current	0 mA @ 0 V; 1.5 mA @ + 5 V; 4.5 mA @ + 12 V
Auxiliary Power Output	Voltage	± 12 VDC, stabilized, max. ± 50 mA (at Sub-D, may be used for supplying external devices up to ± 50 mA)
Power Supply	Supply Voltage	± 15 V
	Supply Current	+ 70 mA / -15 mA typ. (depends on operating conditions, recommended power supply capability minimum ± 150 mA)
Case	Weight	320 g (0.74 lb.)
	Material	AlMg4.5Mn, nickel-plated
Temperature Range	Storage Temperature	- 40 ... + 100 °C
	Operating Temperature	0 ... + 50 °C

Variable Gain
Sub Femto Ampere Current Amplifier

Absolute Maximum Ratings	Signal Input Voltage	± 15 V relative to bias
	Transient Input Voltage	± 2 kV (discharge from 1 nF source)
	Digital Control Input Voltage	- 5 V / + 16 V
	Bias Control Input Voltage	± 12 V
	Power Supply Voltage	± 20 V

Connectors

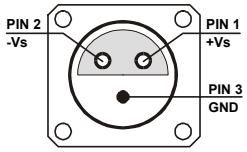
Input: BNC

Output: BNC

Bias Voltage Output: center pin of BNC input socket

Power Supply: LEMO series 1S, 3-pin fixed socket

Pin 1: + 15V
Pin 2: - 15V
Pin 3: GND



Control Port: Sub-D 25-pin, female, qual. class 2

Pin 1: +12V (stabilized power supply output)
Pin 2: -12V (stabilized power supply output)
Pin 3: AGND (analog ground)
Pin 4: NC
Pin 5: overload output (refers to AGND)
Pin 6: signal output (connected to BNC output connector)
Pin 7: bias voltage monitor output (refers to AGND)
Pin 8: bias control voltage input (refers to AGND)
Pin 9: DGND (ground for digital control pins 10 - 13)
Pin 10: digital control input: gain, LSB
Pin 11: digital control input: gain
Pin 12: digital control input: gain
Pin 13: digital control input: gain, MSB
Pin 14 - 25: NC

Variable Gain
Sub Femto Ampere Current Amplifier

Remote Control Operation

General

Remote control input bits are opto-isolated. For remote control operation set the rotary gain switch to the “Remote” position and select the desired gain setting via a bit code at the digital inputs.

Switch settings “0.1 Hz / Full BW / 0.7 Hz” and "Bias Ext. / Off / Int.” are not remote controllable.

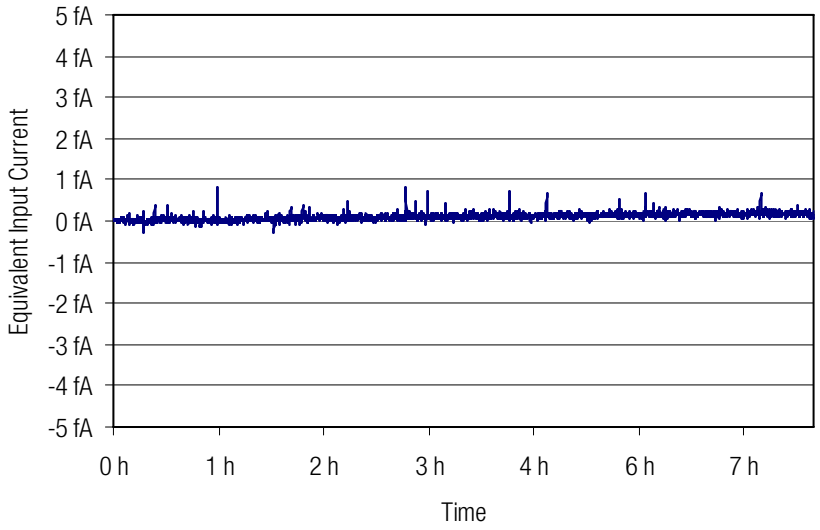
Gain Setting

Gain (V/A)	Pin 13 MSB	Pin 12	Pin 11	Pin 10 LSB
10^4	LOW	LOW	LOW	LOW
10^5	LOW	LOW	LOW	HIGH
10^6	LOW	LOW	HIGH	LOW
10^7	LOW	LOW	HIGH	HIGH
10^8	LOW	HIGH	LOW	LOW
10^9	LOW	HIGH	LOW	HIGH
10^{10}	LOW	HIGH	HIGH	LOW
10^{11}	LOW	HIGH	HIGH	HIGH
10^{12}	HIGH	LOW	LOW	LOW
10^{13}	HIGH	LOW	LOW	HIGH

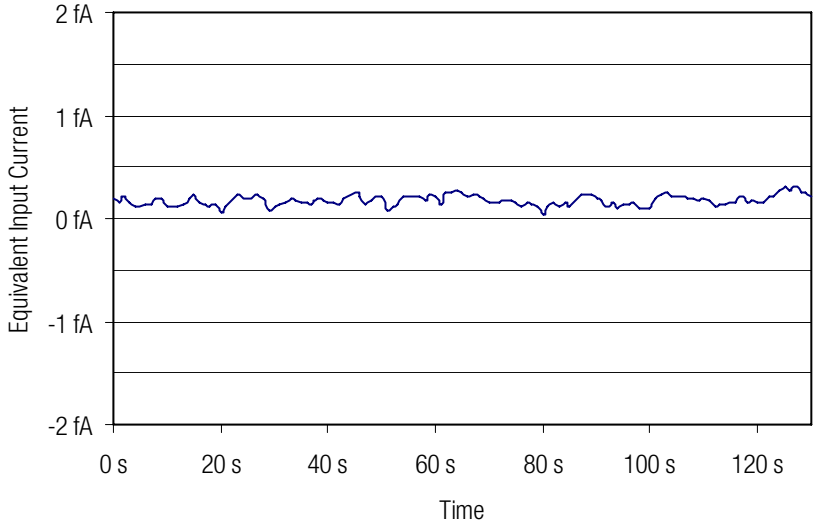
Variable Gain
Sub Femto Ampere Current Amplifier

Typical Performance Characteristics

Long Term Drift



Short Term Drift

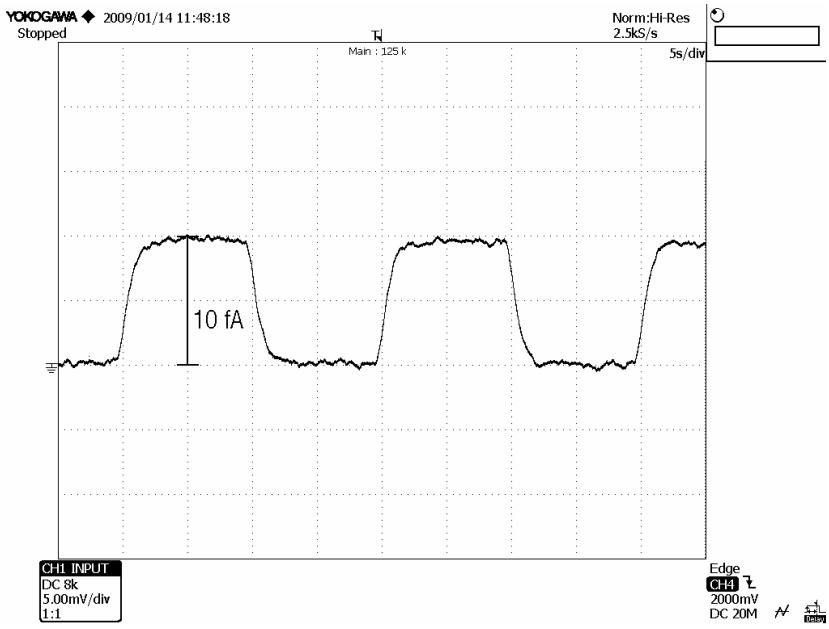


Both drift curves were recorded with shielded input in the gain setting 10^{12} V/A, filter setting 0.1 Hz.

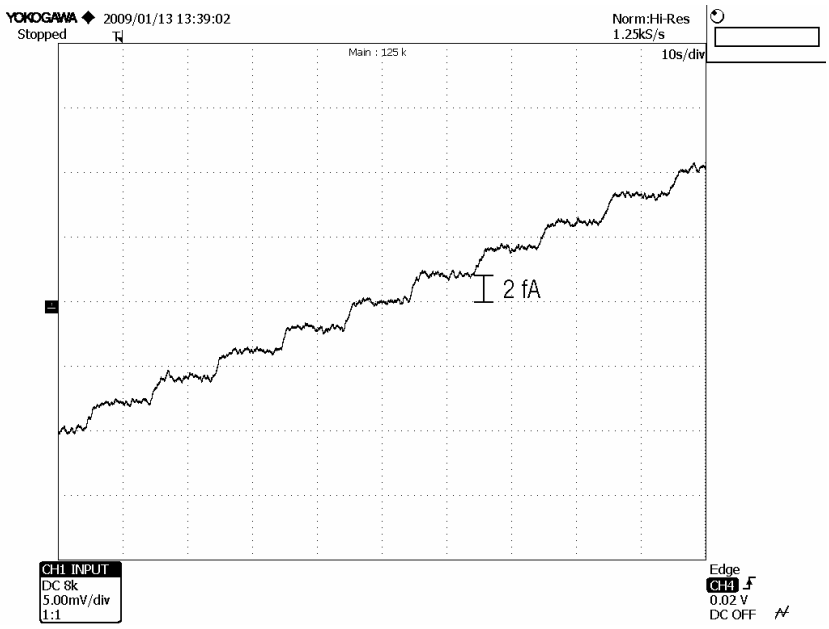
Variable Gain
Sub Femto Ampere Current Amplifier

Typical Performance Characteristics

10 fA square wave



2 fA step curve

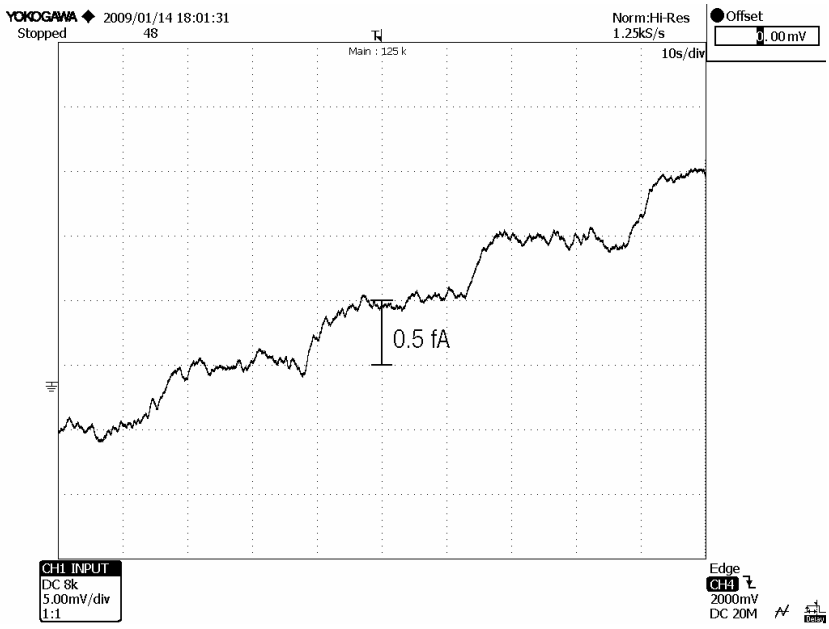


Both curves were recorded in the gain setting 10^{12} V/A, filter setting 0.7 Hz, no external averaging.

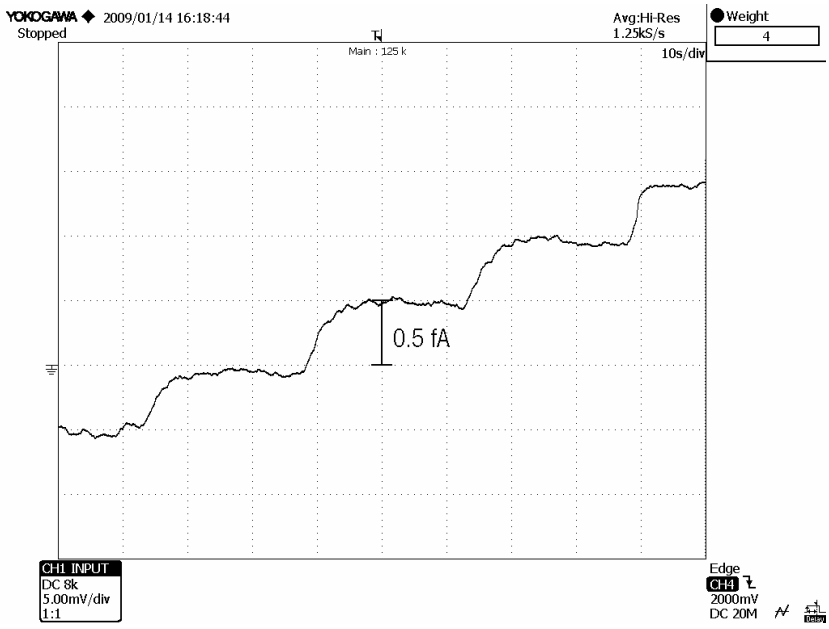
Variable Gain
Sub Femto Ampere Current Amplifier

Typical Performance Characteristics

0.5 fA step curve, no averaging



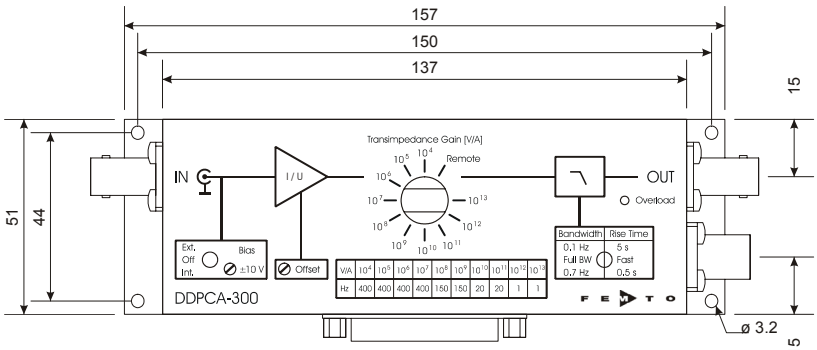
0.5 fA step curve, 4 times external averaging

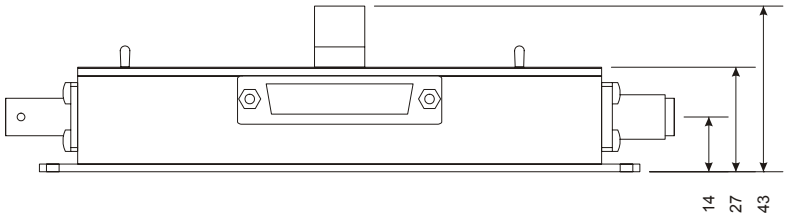


Both curves were recorded in the gain setting 10^{13} V/A, filter setting 0.1 Hz.

Variable Gain
Sub Femto Ampere Current Amplifier

Dimensions





all measures in mm unless otherwise noted

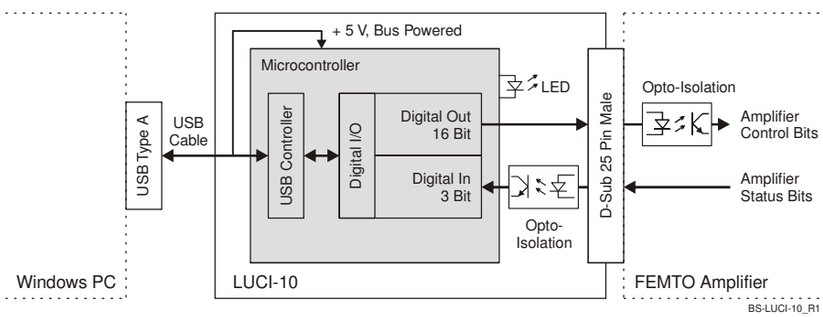
DZ-DDPCA-300_R3

FEMTO Messtechnik GmbH
Klosterstr. 64
D-10179 Berlin · Germany
Tel.: +49-(0)30-280 4711-0
Fax: +49-(0)30-280 4711-11
e-mail: info@femto.de
http://www.femto.de

Electro Optical Components, Inc.
5460 Skylane Boulevard, Santa Rosa, CA 95403
Toll Free: 855-EOC-6300
www.eoc-inc.com | info@eoc-inc.com

Datasheet LUCI-10

USB to D-Sub Control Interface for FEMTO Amplifiers

Features	• **Compact digital I/O interface for USB remote control of FEMTO amplifiers** • **Supports opto-isolation of amplifier signal path from PC USB port** • **16 digital outputs, 3 opto-isolated digital inputs** • **Bus-powered operation** • **System driver, application software and VI's for use with LabVIEW™ included**
Applications	• **Remote control of FEMTO® amplifiers and photoreceivers directly from a PC**
Block Diagram	

Hardware Specifications

General Characteristics	Bus interface	USB 2.0 (full-speed)
	Digital I/O channels	16 output lines 3 opto-isolated input lines
	Supply	PC USB port, +5 V, typ. 100 mA, bus-powered (no auxiliary power supply required)
	Connectors	USB type A D-Sub, 25 pin, male
	Cable	AWG 28, length 1.8 m
Output	Number of channels	16 output lines, supporting opto-isolation inside FEMTO amplifiers and photoreceivers
	Output voltage range	LOW bit: 0 … +0.5 V (@ 0 … 2 mA output current) HIGH bit: +4 … +5.5 V (@ 0 … 2 mA output current)
	Max. current	6 mA per channel
	Writing rate	max. 600 operations per second

USB to D-Sub Control Interface for FEMTO Amplifiers

Input	Number of channels	3 opto-isolated input lines
	Input voltage range	LOW bit: –20 … +1.5 V HIGH bit: +3 … +20 V
	Switching current	1 mA typ. @ 5 V
	Reading rate	max. 300 operations per second
Power Supply	USB port, bus powered	+4.5 … +5.5 V DC
	Active current	max. 200 mA / typ. 100 mA
	Suspend current	<0.5 mA (standby mode of Windows®)
Case	D-Sub case	metal hood (EMI/RFI shielding), with jack screws
	Weight	130 g (0.3 lb.)
	Material	zinc die-cast, nickel plated
Temperature Range	Storage temperature	–40 … +100 °C
	Operating temperature	0 … +50 °C
Absolute Maximum Ratings	Max. voltage at input	±30 V
	Max. short-circuit output current	±20 mA per channel, 200 mA total
	Max. isolation voltage	±60 V (input ground to output ground)
Connectors	Device port	D-Sub, 25 pin, male Pin 1: NC Pin 2: NC Pin 3: GND (IN) Pin 4: NC Pin 5: Digital IN Pin 6: Digital IN Pin 7: Digital IN Pin 8: NC Pin 9: GND (OUT) Pin 10: Digital OUT Low Byte, LSB Pin 11: Digital OUT Low Byte Pin 12: Digital OUT Low Byte Pin 13: Digital OUT Low Byte Pin 14: Digital OUT Low Byte Pin 15: Digital OUT Low Byte Pin 16: Digital OUT Low Byte Pin 17: Digital OUT Low Byte, MSB Pin 18: Digital OUT High Byte, LSB Pin 19: Digital OUT High Byte Pin 20: Digital OUT High Byte Pin 21: Digital OUT High Byte Pin 22: Digital OUT High Byte Pin 23: Digital OUT High Byte Pin 24: Digital OUT High Byte Pin 25: Digital OUT High Byte, MSB
	PC port	USB type A

USB to D-Sub Control Interface for FEMTO Amplifiers

Software Specifications

Software (included on CD)

Device driver	dynamic link library (DLL) for integration in Microsoft Windows® 32 bit & 64 bit operating system for use with C/C++, LabWindows™ /CVI™ or LabVIEW™
Application software	GUI (graphical user interface) programs for simple remote control of FEMTO amplifiers and photoreceivers provided as executable programs and LabVIEW projects
LabVIEW programs	sample programs to control and test the LUCI-10 hardware (including front panel and block diagram)
LabVIEW library	special VI toolkit for integration in LabVIEW 32 bit & 64 bit development environment

Note: A National Instruments LabVIEW™ license is not included in this software package. For use of the GUI application programs the LabVIEW Run-Time Engine is required. If not detected on the host PC during the installation process the LabVIEW Run-Time Engine will be installed automatically from the CD.

System Requirements

Operating system	Microsoft Windows XP with Service Pack 3, or higher
Processor	Intel Pentium III or AMD Athlon, or better
System memory	1 GB of RAM, or more
Hard disk space	about 5 GB
Interface port	USB 1.1 or USB 2.0
Supported FEMTO modules	any standard FEMTO amplifier or photoreceiver with 25 pin D-Sub socket, except model HLVA-100

Optional Requirements

For development of own application programs an additional development environment like LabVIEW Version 2012 (or higher) or C/C++ is required.

Legal Notice

USB to D-Sub Control Interface for FEMTO Amplifiers

Dimensions