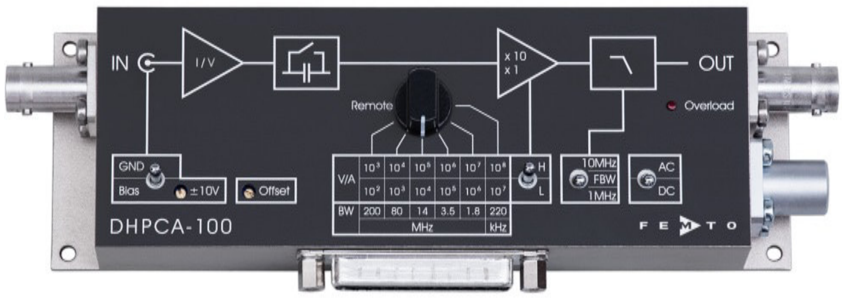
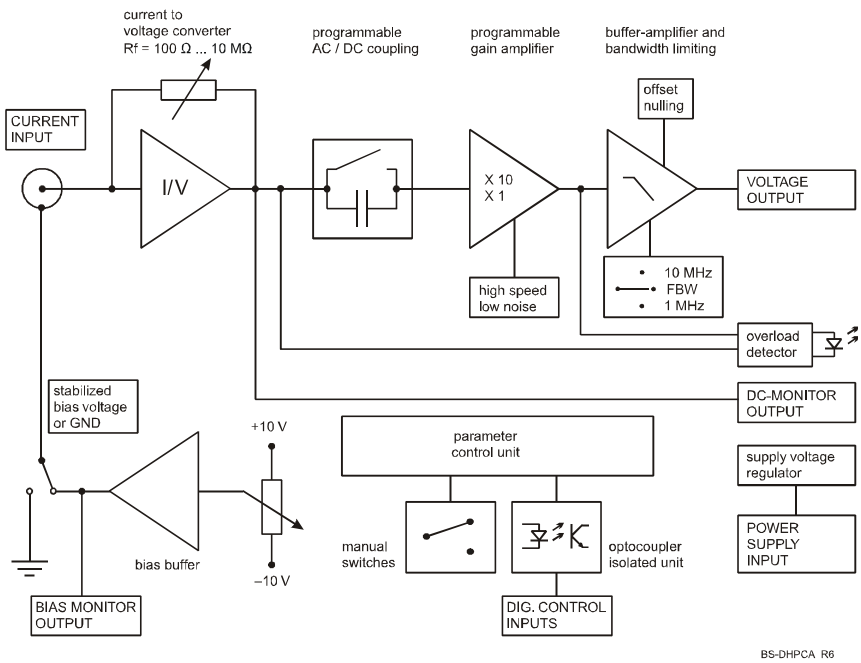
Datasheet DHPCA-100

Variable Gain
High-Speed Current Amplifier



Features	• Transimpedance (gain) switchable from 1 x 10^2 to 1 x 10^8 V/A • Bandwidth from DC up to 200 MHz • Upper cut-off frequency switchable to 1 MHz, 10 MHz or full bandwidth • Switchable AC/DC coupling • Adjustable bias voltage for use with external photo detectors • Input protection against ±1.5 kV transients • Local and remote control of all main functions
Applications	• Photodiode and photomultiplier amplifier • Spectroscopy • Beam monitoring for particle accelerators/synchrotrons • Ionisation detectors • Preamplifier for A/D converters, HF lock-ins, etc.
Block Diagram	

Variable Gain High-Speed Current Amplifier

Specifications

	Test conditions	V_S = ±15 V, T_A = 25 °C, load impedance = 50 Ω
Gain	Transimpedance	1 x 10^2 ... 1 x 10^8 V/A @ 50 Ω load
	Gain accuracy	±1 %
Frequency Response	Lower cut-off frequency	DC / 100 Hz, switchable
	Upper cut-off frequency	depending on gain setting up to 200 MHz (see table below), switchable to 10 MHz or 1 MHz
Input	Equ. input noise current	see table below
	Equ. input noise voltage	typ. 2.8 nV/√Hz
	Input bias current	typ. 20 pA

Performance depending on Gain Setting

Gain setting (low noise) (V/A)	10^2	10^3	10^4	10^5	10^6	10^7
Upper cut-off frequency (–3 dB)	200 MHz	80 MHz	14 MHz	3.5 MHz	1.8 MHz	220 kHz
Rise/fall time (10 % - 90 %)	1.8 ns	4.4 ns	25 ns	0.1 µs	0.2 µs	1.6 µs
Input noise current density (/√Hz)	180 pA	11 pA	1.8 pA	480 fA	140 fA	45 fA
measured at	1 MHz	1 MHz	1 MHz	10 kHz	10 kHz	10 kHz
Integr. input noise current (RMS)*	2.5 µA	280 nA	25 nA	3.0 nA	0.8 nA	60 pA
Max. input current (±)	10 mA	1 mA	0.1 mA	10 µA	1 µA	0.1 µA
DC input impedance	50 Ω	50 Ω	60 Ω	100 Ω	1 kΩ	10 kΩ

Gain setting (high speed) (V/A)	10^3	10^4	10^5	10^6	10^7	10^8
Upper cut-off frequency (–3 dB)	175 MHz	80 MHz	14 MHz	3.5 MHz	1.8 MHz	220 kHz
Rise/fall time (10 % - 90 %)	2.0 ns	4.4 ns	25 ns	0.1 µs	0.2 µs	1.6 µs
Input noise current density (/√Hz)	155 pA	5.8 pA	1.5 pA	440 fA	140 fA	45 fA
measured at	1 MHz	1 MHz	1 MHz	10 kHz	10 kHz	10 kHz
Integr. input noise current (RMS)*	1.9 µA	240 nA	24 nA	3.0 nA	0.8 nA	60 pA
Max. input current (±)	1 mA	0.1 mA	10 µA	1 µA	0.1 µA	10 nA
DC input impedance	50 Ω	50 Ω	60 Ω	100 Ω	1 kΩ	10 kΩ

* The integrated input noise is measured with an open but shielded amplifier input in the full bandwidth (“FBW”) setting. The measurement bandwidth is 3 x the upper cut-off frequency at the specific gain setting; filter slope is a 1st order roll-off.

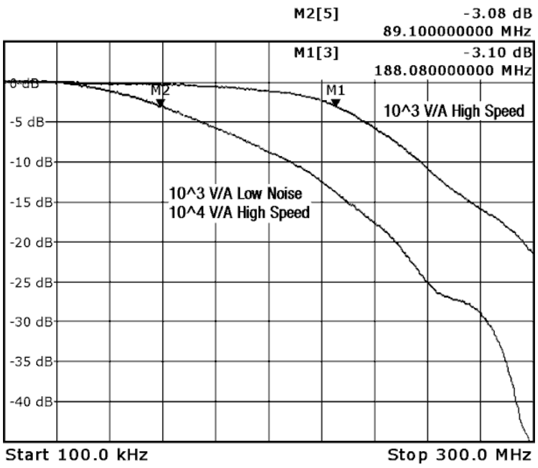
The peak-to-peak noise can be calculated from the RMS noise as follows:
Input referred peak-to-peak noise: $I_{PP} = I_{RMS} \times 6$
Peak-to-peak output noise: $U_{PP} = I_{PP} \times \text{gain}$

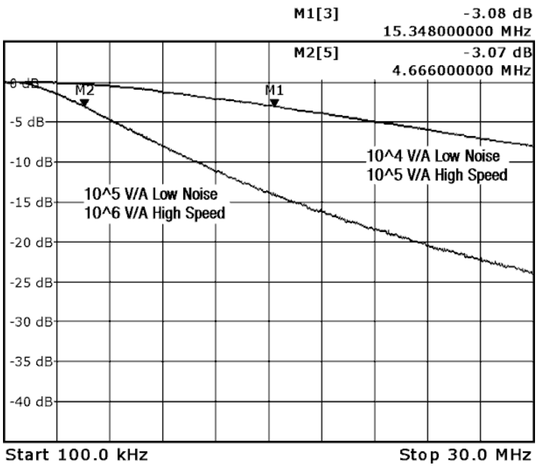
Upper cut-off frequencies and equivalent input noise currents given in this table are typical values only which will depend on the source capacitance. Keep the source capacitance as low as possible by using short cables at the input to achieve best possible bandwidth and noise performance. For the dependence of the upper cut-off frequencies on the source capacitance please see the diagrams on the next page.

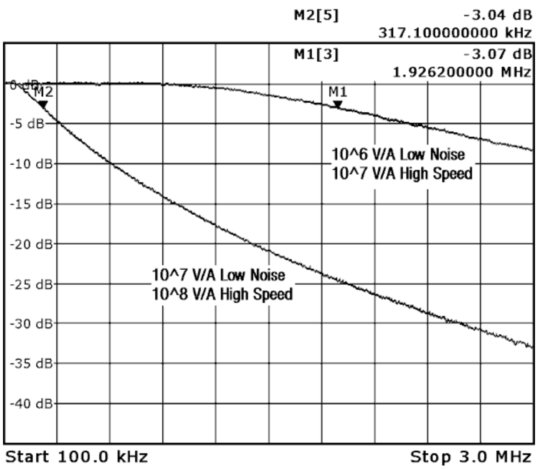
Variable Gain
High-Speed Current Amplifier

Specifications (continued)

Frequency response plots



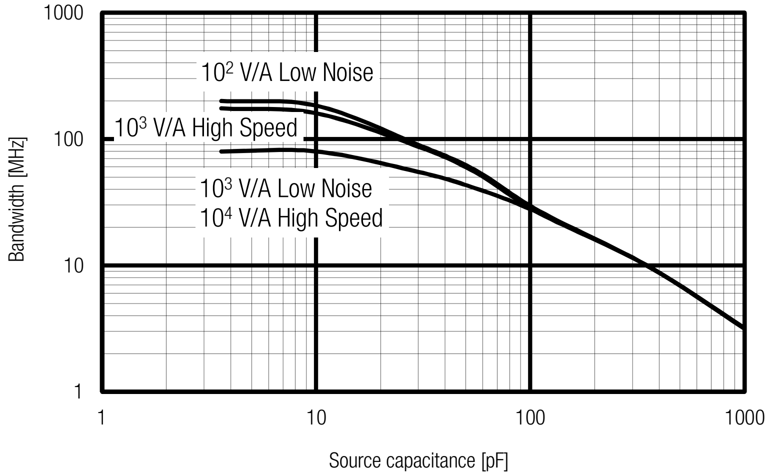


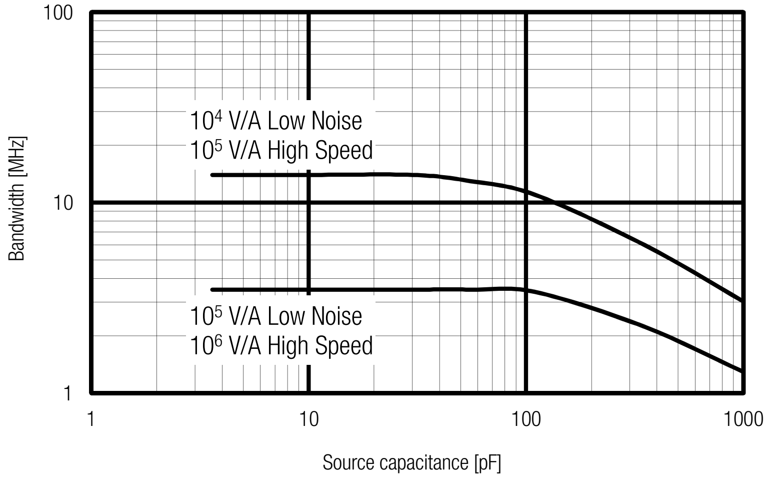


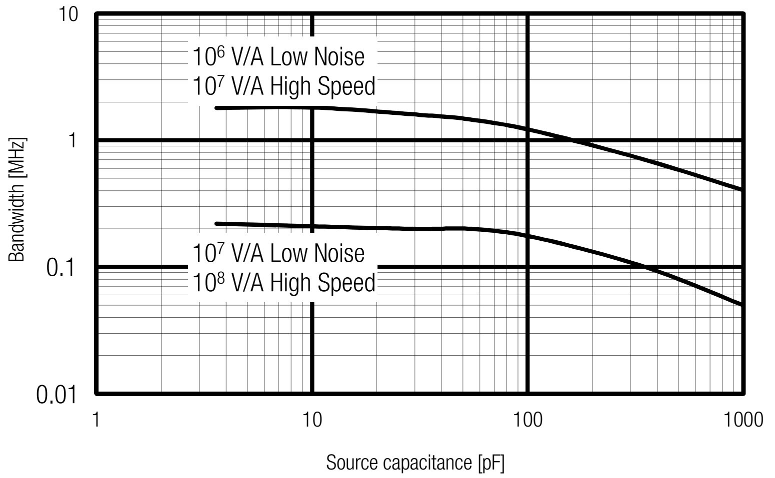
Variable Gain High-Speed Current Amplifier

Specifications (continued)

Dependence of upper cut-off frequency on source capacitance







Variable Gain
High-Speed Current Amplifier

Specifications (continued)

Output	Output voltage range	±1 V (@ 50 Ω load), for linear amplification
	Output impedance	50 Ω (designed for 50 Ω load)
	Slew rate	1,000 V/µs
	Max. output current	±40 mA
	Output offset compensation	adjustable by offset potentiometer and external control voltage, output offset compensation range min. ±100 mV
DC Monitor Output	Monitor output gain	Mode: low noise – Monitor gain: gain setting divided by –1 Mode: high speed – Monitor gain: gain setting divided by –10
	Monitor output polarity	inverting
	Monitor output voltage range	±1 V (@ ≥1 MΩ load)
	Monitor output bandwidth	DC ... 1 kHz
	Monitor output impedance	1 kΩ (designed for ≥1 MΩ load)
Detector Bias	Bias voltage range	±10 V, max. 22 mA, connected to shield of BNC input socket, adjustable by potentiometer, switchable to GND
	Warning	A bias current of 20 mA may destroy sensitive detectors. Please pay attention to the correct polarity and careful adjustment of the bias voltage to protect your detector. Put the bias switch to GND (ground) if you do not want to use the internal bias voltage. The positive and the negative supply voltage of the amplifier must be switched “on” and “off” simultaneously in order to avoid overvoltage at the bias output.
Bias Voltage Monitor Output	Description	The signal at the bias voltage monitor output (pin 7 of the Sub-D control socket) is identical to the detector bias voltage present on the shield of the input BNC socket. By monitoring the signal on pin 7 the desired bias voltage can be adjusted through the bias potentiometer. Even if the bias switch is set to “GND”, the bias voltage can be monitored and set to the desired value.
	Monitor output polarity	non-inverting
	Monitor output voltage range	±10 V (@ ≥1 MΩ load)
	Monitor output impedance	1 kΩ (designed for ≥1 MΩ load)
Indicator LED	Function	overload
Digital Control	Control input voltage range	LOW bit: –0.8 V ...+1.2 V, HIGH bit: +2.3 V ... +12 V
	Control input current	0 mA @ 0 V, 1.5 mA @ +5 V, 4.5 mA @ +12 V
	Overload output	non active: <0.4 V @ 0 ... –1 mA active: typ. 5 ... 5.1 V @ 0 ... 2 mA
Ext. Offset Control	Control voltage range	±10 V
	Offset control input impedance	15 kΩ
Power Supply	Supply voltage	±15 V
	Supply current	typ. +110 / –90 mA (depends on operating conditions, recommended power supply capability min. ±200 mA)
	Stabilized power supply output	±12 V, max. 20 mA, +5 V, max. 50 mA

Variable Gain
High-Speed Current Amplifier

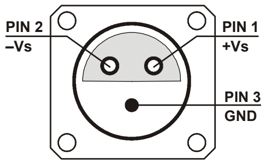
Specifications (continued)

Case	Weight	320 g (0.74 lb.)
	Material	AlMg4.5Mn, nickel-plated
Temperature Range	Storage temperature	–40 °C ... +100 °C
	Operating temperature	0 °C ... +60 °C

Absolute Maximum Ratings	Signal input voltage	±5 V
	Transient input voltage	±1.5 kV (out of a 1 nF source)
	Control input voltage	–5 V / +16 V
	Power supply voltage	±20 V

Connectors

Input	BNC, isolated, jack (female)
Output	BNC, jack (female)
Detector bias output	shield of input BNC
Power supply	Lemo® series 1S, 3-pin fixed socket (mating plug type: FFA.1S.303.CLAC52) Pin 1: +15V Pin 2: –15V Pin 3: GND



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

Pin 1:	+12 V (stabilized power supply output)
Pin 2:	–12 V (stabilized power supply output)
Pin 3:	AGND (analog ground)
Pin 4:	+5 V (stabilized power supply output)
Pin 5:	digital output: overload (referred to pin 3)
Pin 6:	DC monitor output
Pin 7:	bias monitor output
Pin 8:	output offset control voltage input
Pin 9:	DGND (ground for digital control pins 10 - 16)
Pin 10:	digital control input: gain, LSB
Pin 11:	digital control input: gain
Pin 12:	digital control input: gain, MSB
Pin 13:	digital control input: AC/DC
Pin 14:	digital control input: high speed / low noise
Pin 15:	upper cut-off frequency limit 10 MHz
Pin 16:	upper cut-off frequency limit 1 MHz
Pin 17 - 25:	NC

Variable Gain
High-Speed Current Amplifier

Remote Control Operation

General

Remote control input pins are opto-isolated and connected by a logical OR function to the local switch settings. For remote control set the corresponding local switches to “Remote”, “DC”, “L” (low noise mode) and “FBW”, and select the desired setting via a bit code at the corresponding digital inputs.
Mixed operation, e.g. local AC/DC setting and remote controlled gain setting, is also possible.

Switch setting “Bias / GND” is not remote controllable.

Gain setting

low noise Pin 14=LOW gain (V/A)	high speed Pin 14=HIGH gain (V/A)	Pin 12 MSB	Pin 11	Pin 10 LSB
10^2	10^3	LOW	LOW	LOW
10^3	10^4	LOW	LOW	HIGH
10^4	10^5	LOW	HIGH	LOW
10^5	10^6	LOW	HIGH	HIGH
10^6	10^7	HIGH	LOW	LOW
10^7	10^8	HIGH	LOW	HIGH

Gain settling time

<80 ms

AC/DC setting

coupling	Pin 13
DC	LOW
AC	HIGH

Low pass filter setting

upper cut-off frequ. limit	Pin 15	Pin 16
full bandwidth	LOW	LOW
10 MHz	HIGH	LOW
1 MHz	LOW	HIGH

High speed / low noise setting

mode	Pin 14
low noise mode	LOW
high speed mode	HIGH

Variable Gain
High-Speed Current Amplifier

Application Diagrams

Photo detector biasing through internal bias voltage source

Set bias switch to “Bias”. The photodiode is biased through the amplifier with the bias voltage applied to the shield of the isolated BNC input socket. The photodiode should be mounted in a metal case. For optimum shielding the metal case has to be isolated from the photodiode but connected to the housing of the DHPCA-100.

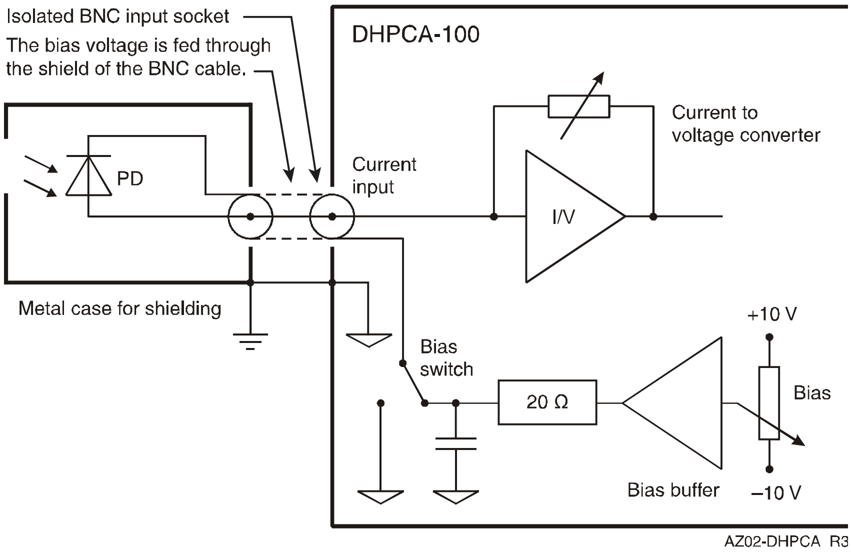
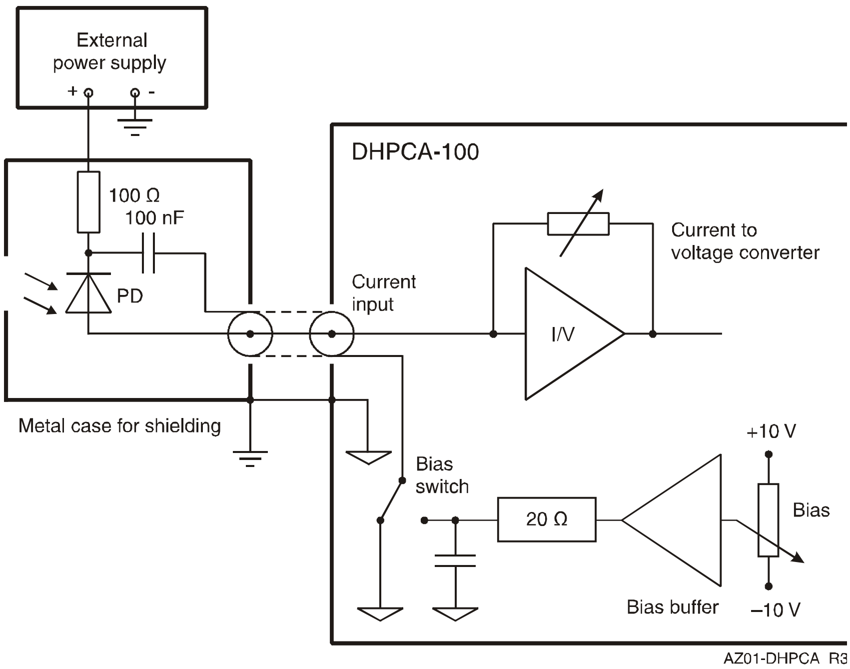


Photo detector biasing through external voltage source

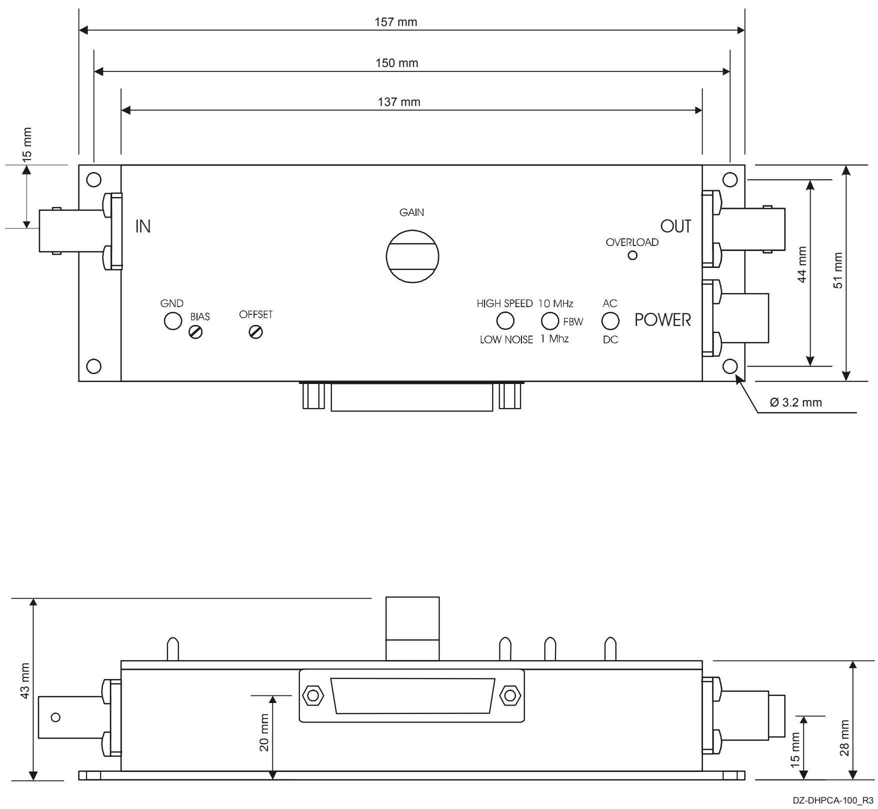
Set bias switch to “GND”. The photodiode is biased through an external voltage source. The shield of the isolated BNC input socket is internally set to amplifier GND. The photodiode should be mounted in a metal case. For optimum shielding the metal case has to be isolated from the photodiode but connected to the housing of the DHPCA-100.



Datasheet DHPCA-100

Variable Gain
High-Speed Current Amplifier

Dimensions



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