

LNA 10 Oscilloscope Preamplifier

Instructions (V 1.0.1)

The LNA 10 is usually used as a low-noise differential probe. In this mode, the In^- input should be shunted (shorted) with $100\ \Omega$ or less. (A BNC shunt is included). The input knob should be set to $In^+ - In^-$. Plug the signal into the In^+ input, using a BNC connector. In this mode, the LNA 10 will amplify both the center pin and ground (shield) of the cable connected to In^+ . Those two amplified signals (selectable 10x/100x/1000x) are then precisely subtracted from each other and routed to the output. The input and output grounds are isolated from each other through a $10\ \Omega$ resistor, which further reduces common mode noise. Input resistance of each amplifier is slightly less than $1\ M\Omega$. The output resistance is $470\ \Omega$, so when connecting to an oscilloscope, use the $1\ M\Omega$ (not the $50\ \Omega$) input setting on your oscilloscope. (The LNA 10 is used for frequencies of 1 MHz and below, so $50\ \Omega$ termination would be unnecessary if the LNA-to-oscilloscope cable is shorter than about 30 meters.)

When the "DC AC" knob is set to DC, the maximum voltage range at each input is ± 400 millivolts. Higher input voltage (up to $\pm 10\ V$ when set to DC) will not cause harm, but signals will not be amplified correctly. If either input voltage is *higher* than 400 millivolts, use the AC setting. To use as a standard dual-input differential amplifier, the shunt should be unplugged from the In^- input so signals can be connected to both inputs. Again, on DC, neither input should be > 400 millivolts from ground, and on AC, if the common mode is an AC signal, it should not be > 800 millivolts peak-to-peak. The maximum output range is $\pm 4\ V$.

The LNA10 has no internal battery, so it must be plugged into an external power supply, between 12 and 20 V DC (center positive), and less than 30 milliamps of current is used. This voltage must be "floating", because the common (ground) in the LNA 10 will be about five volts above the negative supply rail of the power supply. A low-noise power supply is included; if using a power supply other than what is included, note that most switching supplies are quite noisy and that most older magnetic transformer power supplies are usually quieter. Of course batteries will be very quiet if used (a battery adapter is not supplied, but 12 V rechargeable lithium ion packs with a 2.5 mm DC center-positive power plug are readily available).

There is a one pole low-pass filter, continuously tunable from 1 Hz to 1 MHz. The offset knob adjusts the input offset voltage and is adjustable from a -1 to 1 millivolt, referenced to the input.

Specifications

CMRR:

$>100\ dB$ at DC (amplifier gains are identical to within $\pm 0.001\%$)

95 dB at 1 KHz

73 dB at 20 KHz

62 dB at 50 KHz

57 dB at 100 KHz

CMRR response to a voltage step: full recovery (>100 dB) within 1.1 microseconds, 45 dB average CMRR during the 1.1 microseconds after a voltage step. Note that a CMRR value >40 dB (which is +/- 1% gain matching of the two amplifiers) will reduce common mode noise to <1%.

Gain accuracy: +/-1%, but the two amplifiers are matched to one part in 10^5 (DC).

Noise

Frequency Range:	Input-referenced Noise:
10^{-4} Hz to 10^{-2} Hz (freq range: inverse of 2.8 hrs to inverse of 100sec)	50 nV RMS
10^{-2} Hz to 1 Hz (freq range: inverse of 100sec to inverse of 1 sec)	20 nV RMS
1 to 10 Hz average)	18 nV RMS (6nV/ $\sqrt{\text{Hz}}$)
10 to 100 Hz	39 nV RMS (4.1nV/ $\sqrt{\text{Hz}}$)
Above 100 Hz	< 4 nV/ $\sqrt{\text{Hz}}$

Inputs: Static shock protected

On DC, maximum sustained voltage on either input is +/- 10 V with respect to ground, but the amplifier only functions properly on DC when the inputs are within +/- 400 mV of ground. If either input is > 400 mV, use AC.

On AC, maximum safe input voltage is +/- 50 V (if it is a DC offset voltage) with respect to ground. Note that only maximum 800mV peak-to-peak AC signal can be amplified. The AC coupling time constant is 1 second.

Output: 470 Ω (not intended to be connected to 50 Ω oscilloscope input, which will reduce the output voltage; instead, connect to a high-impedance oscilloscope input). Maximum output voltage is +/- 4 V. DC. Input impedance = 850 K Ω to ground (each input), In^+ to In^- impedance = 1.2 M Ω . AC is coupled through dual 1uF capacitors.

Power Supply: Min 12 VDC, max 20 VDC, at 30 milliamps. LED is green if there is sufficient voltage; red if not sufficient. If another power supply is used (other than the included one), it may contribute extra noise, especially if a switching-type power supply.

The warranty period for this device is one year from the date of delivery.

