

# Preamplifiers

The output from a condenser microphone is a very high impedance signal and is therefore very sensitive to the capacitive loads of cables. This makes it necessary to introduce a driver with a high input impedance and a low output impedance. Such a driver is called a preamplifier.

The frequency range of a preamplifier is determined by its electronic circuit and is typically more than 200 kHz at the high end and 1 - 10 Hz at the lower end. The lower end is determined by the input impedance of the preamplifier and the capacitance of the microphone. High microphone capacitance gives a low cut-off frequency.

The dynamic range of a preamplifier is defined as the range between the highest level the preamplifier can handle without distortion, and the lowest level it can measure. The highest level is related to the preamplifiers supply voltage, whereas the lowest level is related to the electrical noise generated by the preamplifier itself.

Today there are two different preamplifier principles in the world of acoustics.

One is the traditional type for externally polarized microphones often referred to as the "LEMO" type because of its 7-pin connector which has become an industry standard. It is voltage driven and can handle high voltage signals up to 50 V<sub>peak</sub>.

The other principle uses a Constant Current Power (CCP) supply and was introduced around 1996 to the world of high-precision acoustics. Before that, the quality of CCP preamplifiers was not as good as the voltage driven LEMO types, but that is not the case today. A CCP preamplifier uses a Constant Current Power supply, which must lie between 2 mA and 20 mA (nominally 4 mA), to produce a constant nominal voltage level of 12 V DC (referred to as the bias voltage).

The output signal from the microphone superimposes fluctuations around this DC level. The great advantage of CCP preamplifiers is that they use a two wire system where the signal is superimposed on the wire through which the current is kept constant. This means that simple coaxial cables can be used instead of the more complex 7-core cables used with the voltage driven LEMO types. This is traded off by accepting a lower upper limit in dynamic range (due to the lower driving voltage of a constant-current source) which limits the maximum output signal to approximately 8 V<sub>peak</sub>, and the necessity of having to use prepolarized microphones. The range of available prepolarized microphones is still not as wide as for externally polarized microphones, although GRAS was the first in the world to introduce 1/4" and 1/8" prepolarized microphones.

GRAS microphone preamplifiers are all small robust units optimized for acoustical measurements with condenser microphones. They are all compatible with measurement microphones as defined in the international standard IEC 61094 "Measurement Microphones, Part 4: Specifications for working standard microphones".

All GRAS preamplifiers are built around a small, thick-film precision amplifier with very high input impedance. The casings are made of stainless steel for maximum strength and durability with minimal sensitivity to vibration and microphonics.

They will work within their specifications up to a temperature of 70 °C. Special versions for use at temperatures up to 120 °C are available on request. The effect of elevated temperature is a slight increase in inherent noise level. This will change the lower limit of the dynamic range of the microphone/preamplifier combination, thus limiting the ability to measure very low sound pressure levels.

CCP (Constant Current Power) is the same as IEPE (Integrated Electronic Piezo-Electric) and CCLD (Constant Current Line Drive) and is compatible with many other constant current driven products such as Deltatron® (Brüel & Kjaer), Isotron® (Endevco Corp.), ICP® (PCB Group, Inc.).

## GRAS 26AG

### 1/2" LEMO Insert Voltage Preamplifier



▼ Preamplifier with an integrated 7-pin LEMO connector. Configured to permit use of the insert voltage technique for determining the open-circuit sensitivity of a microphone. Cable (not included) is available in various lengths (see under Accessories).

## GRAS 26AK

### 1/2" LEMO Preamplifier



▼ General purpose preamplifier with an integrated 7-pin LEMO connector. Cable (not included) is available in various lengths (see under accessories).

## GRAS 26AJ

### 1/2" LEMO Preamplifier with SysCheck



▼ General purpose preamplifier with an integrated 7-pin LEMO connector. Includes built-in SysCheck facility for enabling easy system checks to be made. Cable (not included) is available in various lengths (see under accessories).

## GRAS 26AH

### 1/2" LEMO Preamplifier with SysCheck



▼ General purpose preamplifier with an integrated 3 meter cable terminating in a 7-pin LEMO connector. Includes built-in SysCheck facility for enabling easy system checks to be made. *Also available in a 1/4" version, 26AL. It looks like 26AN on page 33. Data are listed below.*

## GRAS 26AM

### 1/2" LEMO Preamplifier



▼ General purpose preamplifier with an integrated 3 m cable terminating in a 7-pin LEMO connector.

Specifications	26AH, AM	26AG, AJ, AK	26AL
Frequency Range	2.5 Hz - 200 kHz ( $\pm 0.2$ dB)	2.5 Hz - 200 kHz ( $\pm 0.2$ dB)	2.5 Hz - 200 kHz ( $\pm 0.2$ dB)
Input Impedance	20 G $\Omega$ , 0.4 pF	20 G $\Omega$ , 0.4 pF	20 G $\Omega$ , 0.4 pF
Output impedance (typical)	75 $\Omega$	75 $\Omega$	75 $\Omega$
Output Connector	7-pin LEMO male	7-pin LEMO male	7-pin LEMO male
Power Supply, Single	28 V, 0.7 mA to 120 V, 2.5 mA	28 V, 0.7 mA to 120 V, 2.5 mA	28 V, 0.7 mA to 120 V, 2.5 mA
Power Supply, Dual	$\pm 14$ V, 0.7 mA to $\pm 60$ V, 2.5 mA	$\pm 14$ V, 0.7 mA to $\pm 60$ V, 2.5 mA	$\pm 14$ V, 0.7 mA to $\pm 60$ V, 2.5 mA
Noise: A-weighted	$\leq 2.5$ $\mu$ Vrms (typically 1.8 $\mu$ V)	$\leq 2.5$ $\mu$ Vrms (typically 1.8 $\mu$ V)	$\leq 2.5$ $\mu$ Vrms (typically 1.8 $\mu$ V)
Noise: linear (20 Hz - 20 kHz)	$\leq 6$ $\mu$ Vrms (typically 3.5 $\mu$ V)	$\leq 6$ $\mu$ Vrms (typically 3.5 $\mu$ V)	$\leq 6$ $\mu$ Vrms (typically 3.5 $\mu$ V)
Gain	-0.25 dB (typical)	-0.35 (typical)	-0.29 dB (typical)
Operating Temperature	-30 $^{\circ}$ C to +70 $^{\circ}$ C	-30 $^{\circ}$ C to +70 $^{\circ}$ C	-30 $^{\circ}$ C to +70 $^{\circ}$ C
Storage Temperature	-40 $^{\circ}$ C to +85 $^{\circ}$ C	-40 $^{\circ}$ C to +85 $^{\circ}$ C	-40 $^{\circ}$ C to +85 $^{\circ}$ C

## GRAS 26AB

### 1/4" LEMO Preamplifier



General purpose preamplifier with an integrated 7-pin LEMO connector. A 1/4" to 1/2" adapter, AF0008, is included, so that it can also be used with GRAS 1/2" microphones. Cable is not included.

## GRAS 26AN

### 1/4" LEMO Insert Voltage Preamplifier



Preamplifier with an integrated 7-pin LEMO connector. Configured to permit use of the insert voltage technique for determining the open-circuit sensitivity of a microphone. A 1/4" to 1/2" adapter, GR0010, is included, so that it can also be used with GRAS 1/2" microphones. Cable is not included.

## GRAS 26AR

### 1/4" LEMO Preamplifier, 4-pin mini-LEMO



Preamplifier with integrated 4-pin LEMO mini connector. It is a robust unit, short enough for use in confined spaces and with option for socket mounting in arrays and similar structures, enabling easy calibration and exchange.  
*To be used with Cable AA0057.*

## GRAS 26AC-1

### 1/4" LEMO Preamplifier with Integrated 5-pin Miniconnector



General purpose preamplifier with integrated 5-pin mini-connector. A 1/4" to 1/2" adapter, GR0010, is included, so that it can also be used with GRAS 1/2" microphones.  
*To be used with Cable AA0091 or AA0092-CL.*

## GRAS 26HG

### 1/4" LEMO Preamplifier, Low Frequency



Similar to 26AC but with 40 GΩ input impedance to enable low level and low frequency measurements. It has a 3 m integrated cable.

## GRAS 26AS

### 1/4" LEMO Preamplifier, Very Short



Preamplifier with an integrated 3 m lightweight cable terminating in a 7-pin LEMO connector. It is a very small unit, short enough for use in e.g. anechoic test boxes and with the KEMAR Manikin and Hearing-protector Test Fixture.

Specifications	26AR	26AB, 26AN // 26AC-1	26HG	26AS
Frequency Range	2.5 Hz - 200 kHz (± 0.2 dB)	2 Hz - 200 kHz (± 0.2 dB)	1 Hz - 200 kHz (± 0.2 dB)	2.5 Hz - 200 kHz (± 0.2 dB)
Input Impedance	20 GΩ, 0.4 pF	20 GΩ, 0.4 pF	40 GΩ, 0.4 pF	20 GΩ, 0.4 pF
Output impedance (typical)	75 Ω	55 Ω	75 Ω	75 Ω
Output Connector	4-pin LEMO male mini	7-pin LEMO male // 5-pin LEMO male	7-pin LEMO male	7-pin LEMO male
Power Supply, Single	28 V, 0.7 mA to 120 V, 2.5 mA	28 V, 0.7 mA to 120 V, 2.5 mA	28 V, 0.7 mA to 120 V, 2.5 mA	28 V, 0.7 mA to 120 V, 2.5 mA
Power Supply, Dual	±14 V, 0.7 mA to ± 60 V, 2.5 mA	±14 V, 0.7 mA to ± 60 V, 2.5 mA	±14 V, 0.7 mA to ± 60 V, 2.5 mA	±14 V, 0.7 mA to ± 60 V, 2.5 mA
Noise: A-weighted	6 (typically 4)	≤ 2.5 μVrms (typically 1.8 μV)	≤ 2.5 μVrms (typically 1.5 μV)	6 (typically 4)
Noise: lin. (20 Hz - 20 kHz)	10 (typically 8)	≤ 6 μVrms (typically 3.5 μV)	≤ 6 μVrms (typically 3.2 μV)	10 (typically 8)
Gain	-0.35 dB (typical)	-0.29 dB (typical)	-0.25 dB (typical)	-0.29 dB (typical)
Operating Temperature	-30 °C to +70 °C	-30 °C to +70 °C	-30 °C to +70 °C	-30 °C to +70 °C
Storage Temperature	-40 °C to +85 °C	-40 °C to +85 °C	-40 °C to +85 °C	-40 °C to +85 °C

## GRAS 26CA

### 1/2" CCP Preamp with BNC Connector



26CA is a CCP preamplifier with integrated BNC connector. For use with 1/2" prepolarized microphones and standard constant-current input devices. Includes built-in TEDS which enables it to be programmed as a complete unit together with a microphone.

*A high-temperature version is available, 26CA-HT.*

## GRAS 26CK

### 1/2" CCP Preamp, Very Short



26CK 1/2" Preamp is a very small preamplifier with Microdot connector. The 26CK has a very low inherent noise level, a large dynamic range, and a frequency response from 2.5 Hz to above 200 kHz.

## GRAS 26CF

### 1/2" CCP Preamp with Gain and Filters



26CF is a CCP preamplifier with integrated BNC connector for use with 1/2" prepolarized microphones and standard constant-current input devices. It has two flush-mounted switches for selecting various combinations of gain and filtering, i.e.:

#### Gain switch settings:

0 dB - for normal microphone signals.

+20 dB - for boosting weak microphone signals.

#### Filter switch settings:

A-Weighting - as required in standard measurements.

Linear - to let the microphone signal pass unfiltered.

High-pass - to cut off unwanted low frequencies.

## GRAS 26CI

### 1/2" CCP Preamp with BNC Connector, Low Frequency



26CI is optimized for low frequency use with prepolarized condenser microphones. It uses a CCP power supply (ICP ©), e.g. 12AL. It has a very low inherent noise level, a large dynamic range and a frequency response from 1 Hz to above 200 kHz.

Specifications	26CA	26CA-HT	26CF	26CK	26CI
Frequency Range	2.5 Hz - 200 kHz (± 0.2 dB)	2.5 Hz - 200 kHz (± 0.2 dB)	2.5 Hz - 200 kHz (± 0.2 dB)	2.5 Hz - 200 kHz (± 0.2 dB)	1 Hz - 200 kHz (± 0.2 dB)
Input Impedance	20 GΩ, 0.4 pF	20 GΩ, 0.4 pF	20 GΩ, 0.4 pF	20 GΩ, 0.4 pF	40 GΩ, 0.4 pF
Output Impedance	50 Ω	50 Ω	50 Ω	50 Ω	50 Ω
Output Connector	BNC	BNC	BNC	Microdot	BNC
Power Supply	2 mA to 20 mA (typ. 4 mA)	2 mA to 20 mA (typ. 4 mA)	4 mA to 20 mA (typ. 4 mA)	2 mA to 20 mA (typ. 4 mA)	2 mA to 20 mA (typ. 4 mA)
Noise A-weighted	≤ 2.5 μVrms (typ. 2.0 μV)	≤ 2.5 μVrms	Typ. 10 μVrms (built-in A-weighting)	≤ 2.5 μVrms	≤ 2.5 μVrms
Noise Linear	≤ 6 μVrms (typ. 3.5 μV)	≤ 6 μVrms	Typically 8 μVrms	≤ 6 μVrms	≤ 6 μVrms
Gain (Typically)	-0.3 dB	-0.3 dB	-0.35 dB	-0.35 dB	-0.35 dB
Operating Temp.	-30 °C to +85 °C	-30 °C to +120 °C	-30 °C to +85 °C	-30 °C to +85 °C	-30 °C to +85 °C
Storage Temp.	-40 °C to +85 °C	-40 °C to +85 °C	-40 °C to +85 °C	-40 °C to +85 °C	-40 °C to +85 °C

## GRAS 26CB

### 1/4" CCP Preamplifier



26CB is a CCP preamplifier with integrated Microdot connector for use with 1/4" prepolarized microphones. It includes built-in TEDS which enables it to be programmed as a complete unit together with a microphone.  
*A high-temperature version is available, 26CB-HT*

## GRAS 26CG

### 1/4" CCP Preamplifier



26CG is a CCP preamplifier with integrated Microdot connector for use with 1/4" prepolarized microphones. It includes built-in TEDS which enables it to be programmed as a complete unit together with a microphone.

## GRAS 26CC

### 1/4" CCP Preamplifier



26CC is a CCP preamplifier with integrated SMB connector. For use with 1/4" prepolarized microphones. For direct use on GRAS Array Modules PR0001 and PR0002 connected to constant-current input devices. Includes built-in TEDS which enables it to be programmed as a complete unit together with a microphone.

## GRAS 26CS

### 1/4" CCP Preamplifier, Very Short



26CS has a Microdot connector for constant-current input devices. It is a very small unit, short enough for use in e.g. anechoic test boxes and with the KEMAR Manikin and 45CA Hearing-protector Test Fixture.

Specifications	26CB	26CB-HT	26CC	26CG	26CS
Frequency Range	2.5 Hz - 200 kHz (± 0.2 dB)	2.5 Hz - 200 kHz (± 0.2 dB)	2.5 Hz - 200 kHz (± 0.2 dB)	1 Hz - 200 kHz	2 Hz - 200 kHz
Input Impedance	20 GΩ, 0.4 pF	20 GΩ, 0.4 pF	20 GΩ, 0.4 pF	40 GΩ, 0.4 pF	20 GΩ, 0.4 pF
Output Impedance	< 50 Ω	< 50 Ω	< 50 Ω	< 55 Ω	< 50 Ω
Output Connector	Microdot	Microdot	SMB	Microdot	Microdot
Power Supply	2 mA to 20 mA (typ. 4 mA)	2 mA to 20 mA (typ. 4 mA)	2 mA to 20 mA (typ. 4 mA)	2 mA to 20 mA (typ. 4 mA)	2 mA to 20 mA (typ. 4 mA)
Noise A-weighted	≤ 2.5 μVrms (typ. 1.8 μV)	≤ 2.5 μVrms (typ. 1.8 μV)	≤ 2.5 μVrms (typ. 2.0 μV)	≤ 2.5 μVrms (typ. 1.5 μV)	≤ 2.5 μVrms
Noise linear	≤ 6 μVrms (typ. 3.5 μV)	≤ 6 μVrms (typ. 3.5 μV)	≤ 6 μVrms (typ. 3.5 μV)	≤ 6 μVrms (typ. 3.5 μV)	≤ 6 μV
Gain (Typically)	-0.35 dB	-0.25 dB	-0.35 dB	-0.35 dB	-0.45 dB
Operating Temp.	-30 °C to +85 °C	-30 °C to +120 °C	-30 °C to +85 °C	-30 °C to +85 °C	-30 °C to +85 °C
Storage Temp.	-40 °C to +85 °C	-40 °C to +85 °C	-40 °C to +85 °C	-40 °C to +85 °C	-40 °C to +85 °C