Instruction Manual

Outdoor Microphone System Types 41AM / 41CN

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Outdoor Microphone System
Types 41AM / 41CN

Note: unless individually specified, the term “Outdoor Microphone System” throughout this document refers to both types, i.e. Type 41AM and Type 41CN.

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Important! any dismantling details given in this document are addressed solely to qualified service personnel who must ensure that the unit is first disconnected from its power supply before proceeding.

CONTENTS

1. Introduction and Description

The G.R.A.S. Outdoor Microphone System (Fig. 1.1) is for outdoor use whenever trouble-free noise monitoring is required, e.g. around airports or in communities.

It complies with IEC 651 Type 1 and ANSI S1.4 1983 Type 1 requirements and can be used with any suitable electronic sound or vibration measurement system. It is PTB approved as part of an IEC 651 Type 1 system.

A ½-inch precision condenser microphone and thick-film preamplifier ensure maximum stability and performance. Both microphone and casing are made of stainless steel.

Precise *in-situ* calibration checks at 1000 Hz are enabled any time via a built-in electrostatic actuator and test oscillator.

Fig. 1.1 Outdoor Microphone System

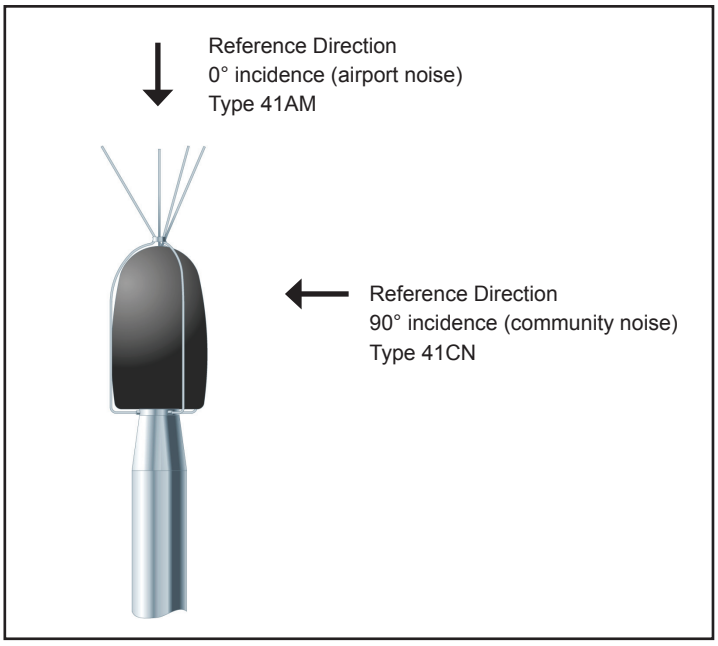


Fig. 1.2 Outdoor Microphone System. Types, reference directions and applications

1.1 Available Types and Applications

There are two types of the Outdoor Microphone System, these are Type 41AM and Type 41CN. Each has its own measurement reference direction and application, i.e.:

- Type 41AM
  Measurement reference direction - vertical (along axis of symmetry)
  Angle of incidence - 0°
  Application - monitoring airport noise
- Type 41CN
  Measurement reference direction - horizontal (perpendicular to axis of symmetry)
  Angle of incidence - 90°
  Application - monitoring community noise

See also Fig. 1.2.

Both types are almost physically identical; differing only in the type of the microphone cartridge and rain-protection cap used. Type 41AM uses Microphone Cartridge Type 41AS and Type 41CN uses Microphone Cartridge Type 40AS.

2. Main Components

The following is a brief description of the main components of the Outdoor Microphone System (see also Fig. 2.1).

All external metal parts are made of stainless steel.

- Windscreen and windscreen holder with anti-bird spikes.
- Electrostatic actuator housing mounted on top of the condenser microphone.
- Condenser microphone and preamplifier mounted on top of the casing. The microphone and electrostatic-actuator assembly are galvanically isolated from the system casing.
- The top of the casing has an inspection window for viewing the state of the dehumidifier when the cover screw is removed.
- The cylindrical casing contains the assembly of electronics and desiccator bags for absorbing moisture.
- The electronics include:

  A switch-mode power supply for generating:

  a) 200 V for microphone polarisation

  b) 120 V for the microphone preamplifier

  And:

  c) an A-weighting network

  d) a circuit jumper for applying a gain of ± 20 dB to the microphone signal
- A pole adaptor with a standard ISO 228/1 G 1½-in thread. Also used for the tripod adaptor (Fig. 2.2).
- The Outdoor Microphone System can be mounted on the tripod adaptor using the pole adaptor. The cable and plug are readily led through the tripod adaptor. The tripod adaptor is not meant for permanent outdoor installations, but for test setups in labs and short-term outdoor surveys.
- The connector is a 6-pole LEMO FFA.2S.306, which locks into a socket at the bottom of the Outdoor Microphone System. It cannot be pulled out by its cable. It can be removed only by pulling outwards on the knurled outer sleeve.

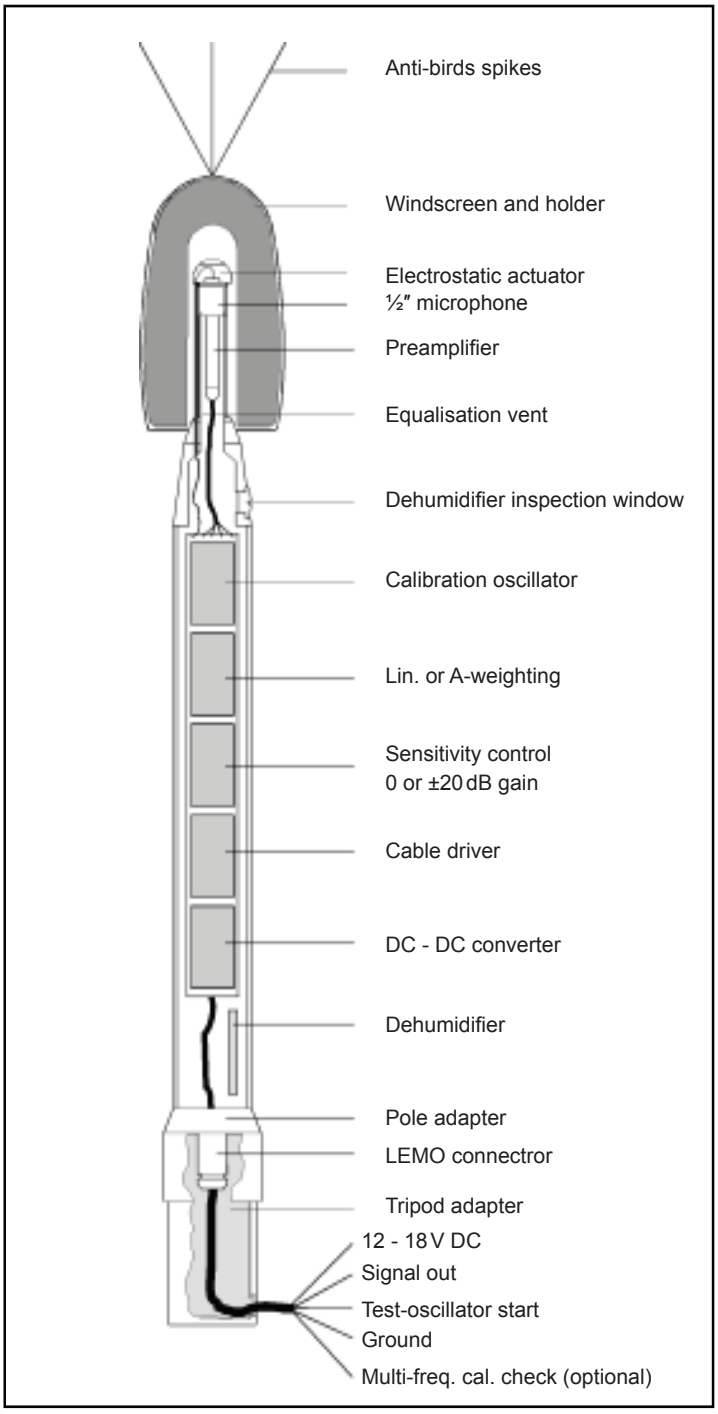


Fig. 2.1 Main components of the Outdoor Microphone System

Fig. 2.2 Left to right; tripod and pole adapters

2.1 Windscreen

This comprises a windscreen and a windscreen holder (see Fig. 2.3).

The windscreen itself is made of polyurethane foam. It reduces wind-noise to a minimum and gives maximum rain protection. It also allows for 0 ° (Type 41AM) and 90 ° (Type 41CN) reference directions of incidence.

The windscreen holder has four anti-bird spikes to prevent birds from perching on top of the windscreen. The centre spike prevents smaller birds from perching between the other three spikes.

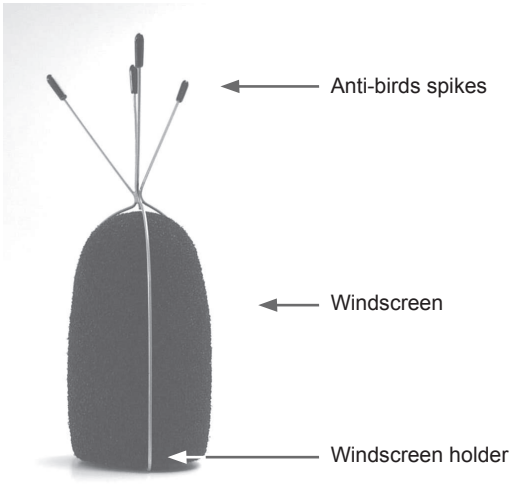


Fig. 2.3 Windscreen of the Outdoor Microphone System

2.2 Microphone Assembly

On delivery, the microphone assembly is protected by a transport tube, see Fig. 2.4. A small hole of 0.5 mm diameter at the top end of the transport tube ensures pressure equalization during transport. The transport tube is also used when testing for self-noise. In this case, the hole must be sealed using a piece of tape. Remember to remove the tape after use.

When screwing the windscreen onto the microphone, apply some silicone grease (supplied) to the thread - see Fig. 2.4). The silicone grease is waterproof and protects against rust.

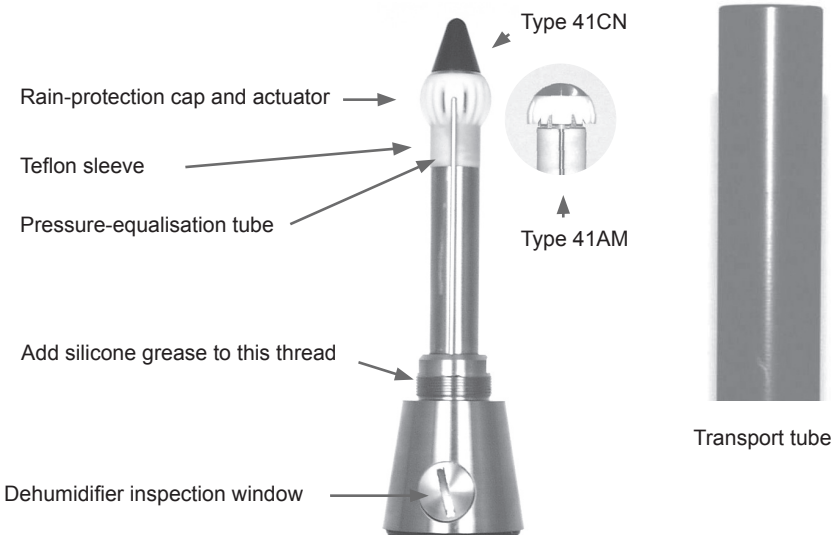


Fig. 2.4 Showing microphone assembly - note the difference between the two rain-protection caps

2.2.1 Pressure Equalisation

The pressure equalisation system, which ensures that the air-pressure within the cartridge of the condenser microphone is kept equal to the ambient atmospheric pressure, allows sufficiently rapid pressure equalisation while keeping to a minimum the exchange of air between the interior and exterior. This also extends the working life of the dehumidifier.

Pressure equalisation takes place via the 1.5 mm diameter stainless-steel tube visible on the side of the upper cylindrical section (see Fig. 2.4). This tube is also a conduit for the signal wire connecting the calibration oscillator with the electrostatic actuator.

2.2.2 Electrostatic Actuator

The position of the actuator relative to the microphone is maintained by a calibration ring positioned under the Teflon sleeve. The calibration ring ensures the correct spacing between the actuator and the diaphragm of the microphone.

For inspection purposes, access to the signal wire in the pressure-equalisation tube is gained after removing the rain-protection cap (see section 2.2.4) which is held in place by a left-hand thread mushroom-head screw. In the case of the Type 41CN, the small black plastic cone mounted on top of the screw has to be removed first.

2.2.3 Microphone

If the electrostatic actuator, Teflon sleeve and calibration ring are removed, the microphone can be unscrewed (see section 2.2.4). The microphone is mounted on a galvanically isolated assembly, together with a thick-film, high-impedance input preamplifier which is miniature, ceramic-based, and robust.

2.2.4 Dismantling the Microphone Assembly

Dismantling the microphone assembly is rarely necessary and should be done by a qualified technician recognised by G.R.A.S. Sound & Vibration.

First disconnect the power from the Outdoor Microphone System before proceeding. The actuator voltage is 300 V.

The circled numbers refer to which part of the special tool AM0038 (Fig. 2.5) to use

1. Unscrew the windscreen ①.
2. Remove the black cone from the top of the rain-protection cap (Type 41CN only).
3. Unscrew the mushroom-head screw holding the Teflon rain-protection cap in place. Use ② for the Type 41AM and ③ for the Type 41CN.
   Note: Left-hand thread - unscrew clockwise.
4. Remove the Teflon rain-protection cap.
5. Disconnect the signal wire (with gold plated pin) from the top of the actuator housing so that it sticks directly out of the pressure-equalisation tube.
6. Use the special key RA0087 (Fig. 2.5) to unscrew the actuator housing (right-hand thread) and remove the spacer and insulator rings placed around the microphone capsule. Be very careful not to damage the diaphragm of the microphone capsule.
7. The microphone capsule can now be unscrewed to gain access to the preamplifier. It is recommended to mount a protection grid (not included) on the microphone capsule before unscrewing it.

Re-assembling is in the reverse order of the above. Don't forget the spacer and insulator rings otherwise the microphone diaphragm can be seriously damaged.

After re-assemby, re-calibrate the electrostatic actuator as described in section 4.1.1.

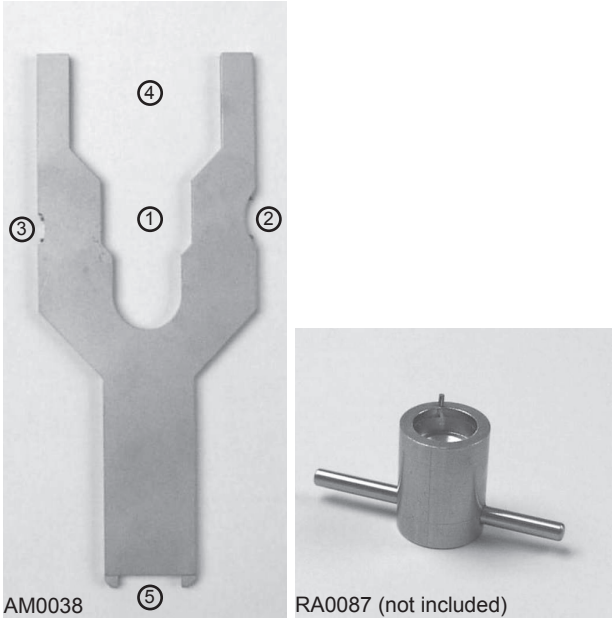


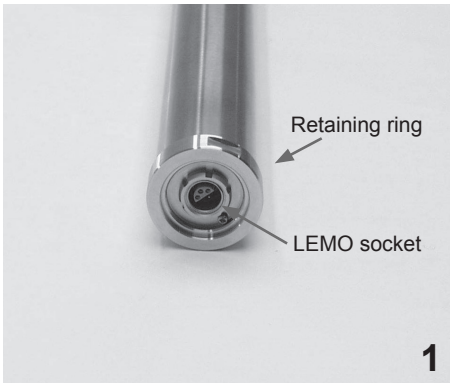
Fig. 2.5 Special tools for dismantling the Outdoor Microphone System; left to right:
Multi-spanner
Key for dismantling actuator housing

3. Access to Electronics Assembly

For access to the electronics assembly, do the following. The circled numbers refer to which part of the tool AM0038 (Fig. 2.5) to use:

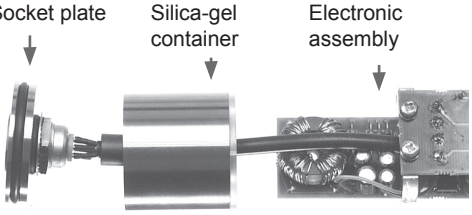
1. Unscrew the large retaining ring at the base of the casing ④.

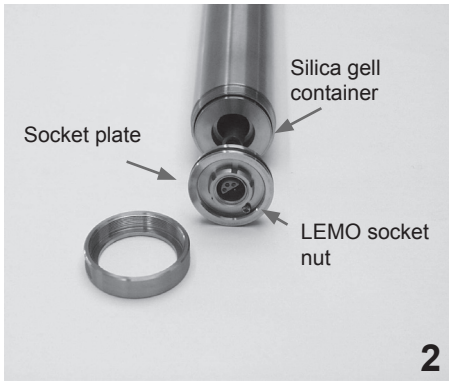
   Make sure that only the retaining ring turns.



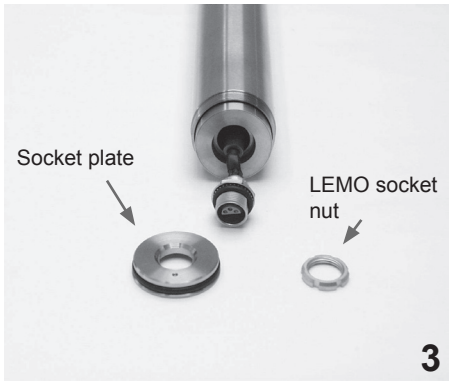
2. Pull out the socket plate.

   If necessary, insert the LEMO connector in the LEMO socket and pull out the socket plate. This will reveal the silica-gel container.





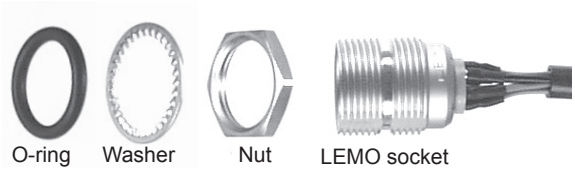
3. Unscrew the LEMO socket nut and remove the socket plate ⑤.

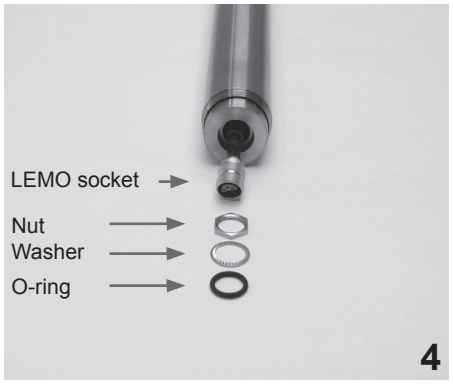


Note: steps 4 and 5 are necessary only if the silica-gel container is to be removed. Otherwise, go to step 6 if only access to the electronics is required.

4. Remove the rubber O-ring, locking washer and nut from the LEMO socket.

   This will allow the silica-gel container to pass over the LEMO socket.



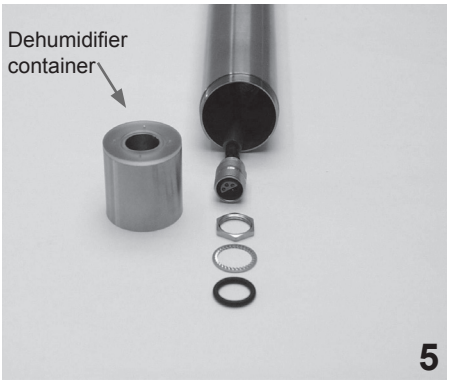


5. Remove the silica-gel container.

   At this point, the silica-gel crystals can be removed from the container, dried off and used again (see section 5.2).

6. Unscrew the stainless-steel casing to give access to the electronics assembly.

   If necessary, remove the screw from the dehumidifier inspection window and screw the tommy bar (AM0063) in its place if the casing is difficult to unscrew.



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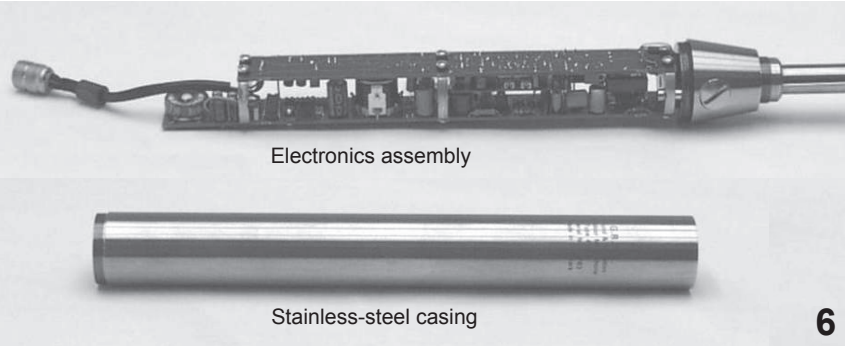

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4. Calibration

4.1 Electrostatic Actuator

The Outdoor Microphone System is equipped with a built-in electrostatic actuator to enable rapid calibration checks *in-situ*. The electrostatic actuator is factory adjusted to simulate a sound level of 90 dB at a frequency of 1000 Hz on the diaphragm of the microphone (94 dB is also available on order). The electrostatic actuator is switched on by connecting pin 1 to pin 6 on the LEMO socket (see Fig. 5.2). This will cause a calibration signal of 500 Hz AC to be applied to the actuator.

Warning! do not touch the actuator while the calibration signal is applied. The voltage applied to the actuator is approximately 300 V RMS. **Extreme care** should be taken when handling the circuit boards while the power is on. High voltages are present!

The 500 Hz signal creates an oscillating electrostatic field which causes the diaphragm of the microphone to oscillate at twice the applied frequency thus generating a reference signal of 1000 Hz. The result is a simulated sound pressure on the diaphragm of the microphone which is directly proportional to the applied voltage and inversely proportional to the spacing between the actuator surface and the microphone diaphragm.

It can be shown that this method of calibration relates directly to simple absolute physical parameters.

The stability of this method ensures that the microphone calibration is consistent; therefore no other calibration check is necessary. Electrostatic actuator calibration should be carried out at regular intervals.

4.1.1 Adjustment

With the electrostatic actuator switched on, adjust P201 (see Fig. 8.3) to give a signal output level of 31.6 mV.

An electrostatic-actuator calibration is referred to a Pistonphone calibration as described in section 4.2.1 and assumes that the Outdoor Microphone System has a sensitivity of 50 mV/Pa. In turn, this means that an output level of 31.6 mV will correspond with 90 dB as simulated by the electrostatic actuator.

A-Weighting

At this stage, the A-weighting network can also be checked as follows:

1. Move the “Jumper for response” (see Fig. 8.3) from **Lin** to **A-w**.
2. With the electrostatic actuator switched on, adjust P101 (see Fig. 8.3) to give a signal output level which corresponds with 90 dB, i.e. 31.6 mV.
3. Move the “Jumper for response” back to the position **Lin**.
   Position **Com** is not used.

4.1.2 Calibration Control Box AC0001

A useful accessory available from G.R.A.S. is the Calibration Control Box AC0001 (see Fig. 4.1). This has a lead which plugs directly into the output socket of the Outdoor Microphone System. The AC0001 has sockets for signal output, remote-control calibration and external power (12 – 18 V DC, e.g. from a G.R.A.S. Mains/line Adapter AB0002/AB0003*). It also has an on/off switch for local calibration control.

* AB0002 for 230 V AC; AB0003 for 120 V AC

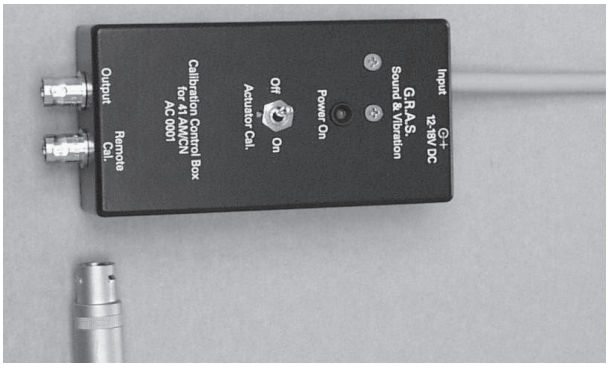

Fig. 4.1 Calibration Control Box AC0001

4.2 Pistonphone

If actuator calibration results give rise to suspicion by showing abnormal variations, i.e. in excess of 0.4 dB (temperature coefficient accounted for), after a warm-up period of at least one hour, a Pistonphone calibration is advisable.

A calibration using a Pistonphone (or Sound Calibrator) requires first removing the windscreen from the Outdoor Microphone System and mounting a special adapter in its place: no other parts need be removed.

- Use Adapter RA0009[1] for Type 41AM
- Use Adapter RA0041[1] for Type 41CN
  Note: remove the black plastic cone from the rain-protection cap only if a Sound Calibrator is to be used.

The RA0009/RA0041 consists of a support tube with a close-fitting collar which holds together the two halves of a split coupler. The two halves of the split coupler are engraved with a common number to show that they are correctly matched. The correction values supplied with each RA0009/RA0041 must be applied to the nominal value for the Pistonphone or Sound Calibrator used (+ means add, – means subtract).

When using a Pistonphone, apply any barometric correction in the normal way. The Pistonphone/Calibrator must be fitted with a coupler for 1-inch microphones.

Once the windscreen has been removed, mount the adapter as follows (refer to Fig. 4.2):

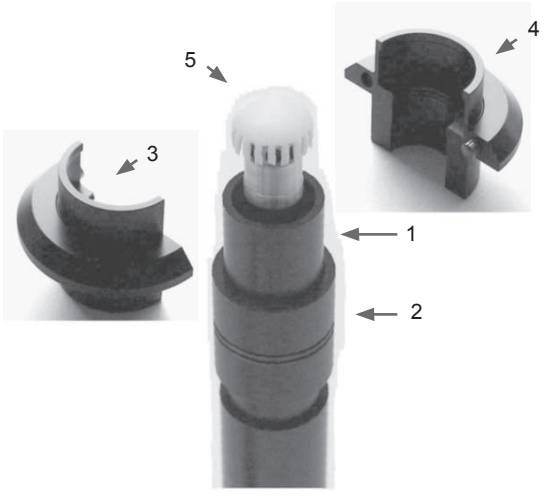

Fig. 4.2 Mounting the Adapter RA0009/RA0041

[1] The Adapter RA0009/RA0041 is not included with the Outdoor Microphone System Type 41AM/41CN but is available on separate order.

4.2.1 Setup and adjustment

1. Screw the support tube (1), with its collar (2) on, onto the thread used by the windscreen. If the adapter has not been used recently, the collar might stick a little and should be made free before proceeding.
2. Assemble the two halves of the split coupler (3 and 4) around the microphone assembly (5). It is very important for the calibration that the two halves fit correctly around the microphone assembly making sure to accommodate for the thin pressure-equalisation tube.
3. Push the collar up onto the lower part of the split coupler to keep the two halves tightly together. While doing this, press the two halves of the split coupler against the support cylinder.
4. Mount the Pistonphone/Calibrator on top of the split coupler and switch on. It is important for the calibration that the two halves of the split coupler are pressed against the support cylinder to avoid faulty results. **Do not turn or twist the Pistonphone/Calibrator while mounting it or removing it because this could damage the thin pressure-equalisation tube**.
5. With a pistonphone mounted and switched on, adjust P102 (see Fig. 8.3) to give a signal output level of:
   - 5 V for a nominal pistonphone signal of 134 dB.
   - 1.6 V for a nominal pistonphone signal of 124 dB.
   - 500 mV for a nominal pistonphone signal of 114 dB.

   This will ensure that the sensitivity of the Outdoor Microphone System will be 50 mV/Pa.

A Pistonphone calibration will help in tracing any dubious results with the electrostatic-actuator to one or more of the following:

- Actuator
- Actuator voltage supply
- Microphone preamplifier
- Microphone cartridge

Actuator calibration should be carried out at regular intervals. Calibration using a Pistonphone/Calibrator should be carried out primarily for diagnostic purposes.

4.3 Factory Calibration

The Outdoor Microphone System is a self-contained unit. The microphone polarisation voltage is supplied internally by the system's electronics which also supplies the 120 V needed to power the preamplifier as well as the voltages needed for the built-in actuator. This enables the system to be calibrated to the nominal sensitivity of 50 mV/Pa as given on the calibration chart.

If a basic verification is desired *in-situ*, this should be carried out using the Pistonphone method of calibration as described in section 4.2. The frequency-response of the Outdoor Microphone System is given on the calibration chart. It can be shown that any change in frequency response of the microphone used in Outdoor Microphone System is highly unlikely without an attendant change in sensitivity and, hence, in the calibration level. There is no advantage in performing annual checks on the Outdoor Microphone System as long as the built-in calibration performs correctly. Small deviations during warm up and cooling down periods will occur owing to changes in the static pressure within the microphone unit.

Variations of approximately 0.4 dB will level off within half an hour, depending on the magnitude of the variations. This is normal and should be taken as a sign of correct system performance. If required, a timely calibration result can be used to correct the measurement of a short-term event such as an aircraft flyover.

Multi-frequency calibration check (see section 5.3) is an available option if required. It provides a check on the frequency response and gain of the electronic circuits. It does not increase system reliability.

5. Maintenance

5.1 Windscreen

The windscreen should be cleaned as and when necessary depending on the severity of local conditions. Recommended exchange frequency is one year.

First remove the foam inner sleeve and thereafter unscrew the windscreen assembly and lift it over the top of the microphone assembly. Pull the foam windscreen out of its holder and wash it in clean water. Squeeze it, place it back in the holder then remount it over the microphone assembly.

5.2 Dehumidifiers

There are two dehumidifiers in the form of silica-gel containers in the Outdoor Microphone System. The one at the top can be viewed through the inspection window after removing the screw (see Fig. 2.4). The one at the bottom is referred to in section 3, step 5 and is shown in Fig. 5.1. Both contain silica-gel crystals. In the dry state the colour of these crystals are:

- Top dehumidifier: blue*
  (changing to pink while absorbing moisture)
- Bottom dehumidifier: orange
  (changing to white when absorbing moisture)

The top dehumidifier is an indicator of the state of the silica-gel crystals in the bottom dehumidifier. If the top dehimidifier starts absorbing moisture, then its time to change/dry-off the silica-gel crystals in the bottom dehumidifier. The effect of this will also dry off the silica-gel crystals in the top dehumidifier.

There are two ways of drying off the silica-gel crystals in the bottom dehumidifier.

1. Unscrew the Plexiglas lid and put the dehumidifier and crystals in a standard oven (pre-heated to 100 °C – 120 °C) for approximately one hour.
2. Pour the silica-gel crystals onto a piece of paper and place in a microwave oven at medium power for approximately 10 minutes.

After drying off, the colour of the crystals should have changed to dark orange. If not, repeat the process. Next, pour the crystals back into the dehumidifier and refit the lid.

A new dehumidifier (GU0037) can be ordered, as well as 15 grams of replacement silica-gel crystals (MI0013).

It is recommended that the colour of the crystals is checked at least once a year in dry climates and twice a year in humid climates; more often in extremely humid areas or when large temperature fluctuations occur.

Fig. 5.1 Silica-gel container (GU0037) used at the bottom of the Outdoor Microphone System

* For environmental considerations, to be phased out and orange crystals used instead

5.3 Multi-frequency Calibration Check (Optional)

This makes use of an option which calls for an internal modification of the Outdoor Microphone System.

This option allows an AC signal of approximately 1 V RMS to be applied to pin 4 shown in Fig. 5.2. This signal is led to the calibration circuit for amplification and then applied to the system's electrostatic actuator built into the rain-protection cap (see Fig. 2.4). As with the system's own calibration oscillator, frequency doubling will take take place.

This option is useful for checking the stability of the system's frequency response. It is not a measure of its free-field frequency response.

5.3.1 Output Connections

The output connections via the LEMO socket at the base of the Outdoor Microphone System are shown in Fig. 5.2.

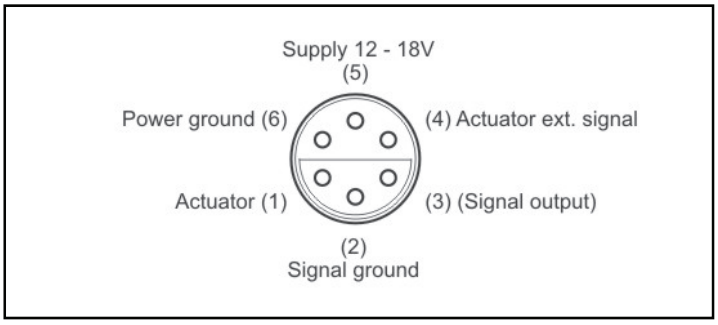

Fig. 5.2 LEMO socket output connections (external view)

6. Service and Repair

Service and repair should be carried out only by qualified service personnel. The Outdoor Microphone System should not be dismantled with power on because of the presence of high voltages in its circuits.

7. Specifications

Valid for Types 41AM/41CN at 1013 mbar, 23 °C and 50 % RH unless stated otherwise

Nominal sensitivity:

50 mV/Pa

Frequency response:

IEC 651 Type 1 and ANSI S1.4-1983 Type 1

For the applicable reference direction as shown in Fig. 1.2, re. 1000 Hz:

20 Hz - 80 Hz:	± 1 dB
80 Hz - 4 kHz:	± 0.7 dB
4 kHz - 8 kHz:	± 1 dB
8 kHz - 12.5 kHz:	± 1.5 dB
12.5 kHz - 16 kHz:	+ 1.5 dB, – 5 dB

Dynamic range (upper limit):

>156 dB SPL (at – 20 dB setting) re. 20 µPa

Total system-noise level:

A-weighted:	< 20 dB re. 20 µPa
Lin. 22.5 Hz - 22.5 kHz:	< 23 dB re. 20 µPa

Output impedance:

<50 Ω

Output current:

>25 mA

Power supply:

12 - 18 V DC

Power consumption:

120 mA at 15 V

180 mA at 15 V calibrator “on”

Operating-temperature range:

– 40 °C to + 50 °C

Calibration level of electrostatic actuator:

90 dB re. 20 µPa at 1000 Hz:	± 0.2 dB at 23 °C
Actuator temp. coefficient:	– 0.021 dB/ °C

Dimensions:

Casing (ext. dia.):	40 mm (1.57 in)
Length:	520 mm (20.5 in)
Pole-adapter thread:	50 mm (1.97 in) x G 1½ in (ISO 228/1)

Weight:

1.3 kg (2.8 lbs)

Accessories included:

Windscreen complete:	AM0052
Spanner:	AM0038
Transport protection cap:	AM0037
Tripod adapter:	AM0033
Pole adapter:	AM0029
LEMO plug FFA.2S.306:	AE0001
Silicone grease (7-ml tube)	MI0016

Accessories available:

Pistonphone adapter:	RA0009 (Type 41AM)	RA0041 (Type 41CN)
Foam windscreens (5 items):	AM0009	
Calibration Control Box:	AC0001	
Extension cables:		
3m:	AA0003	
10m:	AA0002	
20m:	AA0001	
30m:	AA0017	
50m:	AA0004	
100m:	AA0015	
200m:	AA0016	

Manufactured to conform with:

CE marking directive:
93/68/EEC

WEEE directive:
2002/96/EC

RoHS directive:
2002/95/EC

G.R.A.S. Sound & Vibration continually strives to improve the quality of our products for our customers; therefore, the specifications and accessories are subject to change.

8. Circuit and Component Diagrams

Fig. 8.1 shows the circuit diagram for signal conditioning.

Fig. 8.2 shows the circuit diagram for the power supply.

Fig. 8.3 shows component placement and the location of user-serviceable jumpers and adjustment potentiometers.

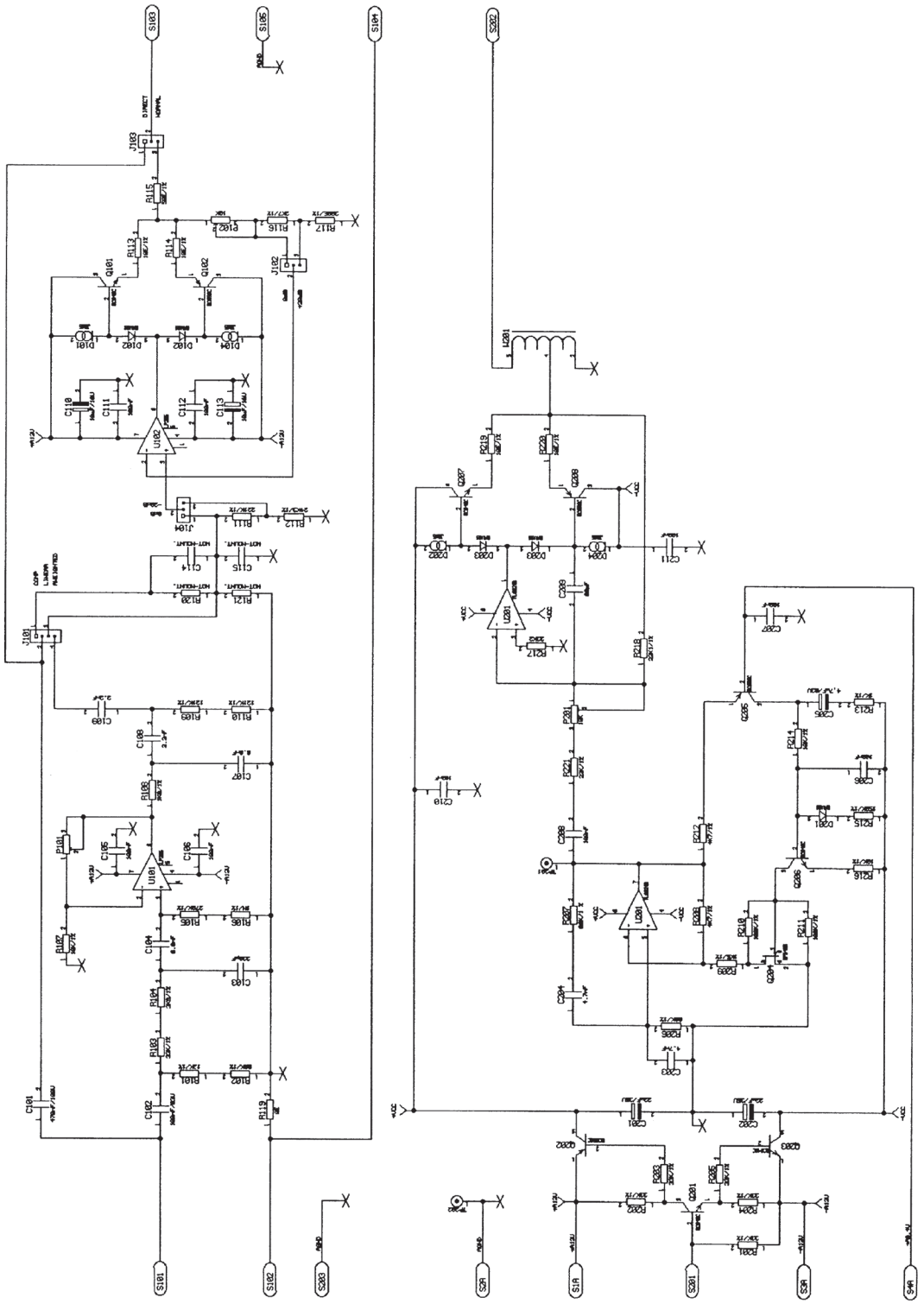

Fig. 8.1 Circuit diagram for signal conditioning

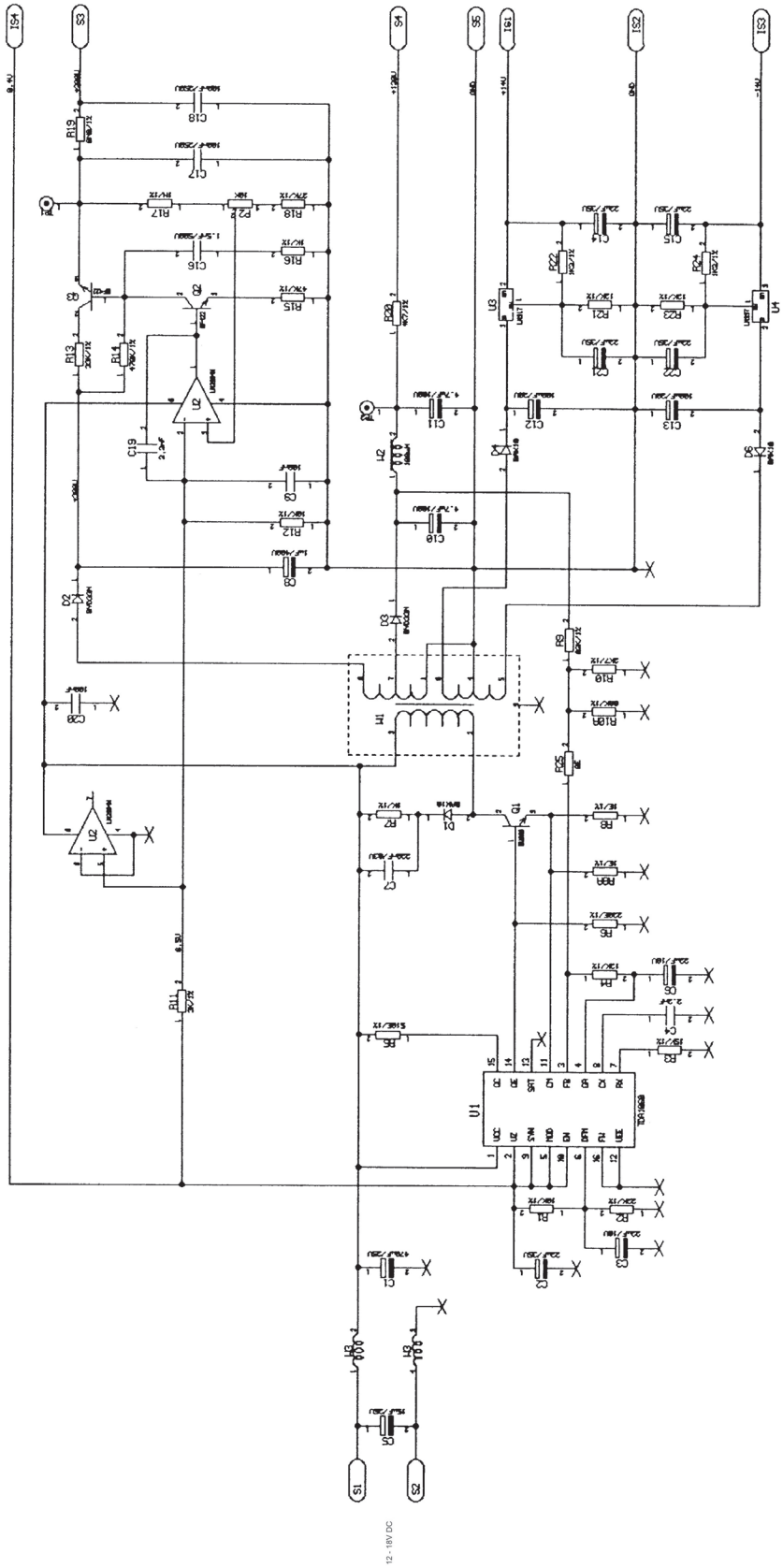

Fig. 8.2 Circuit diagram for power supply

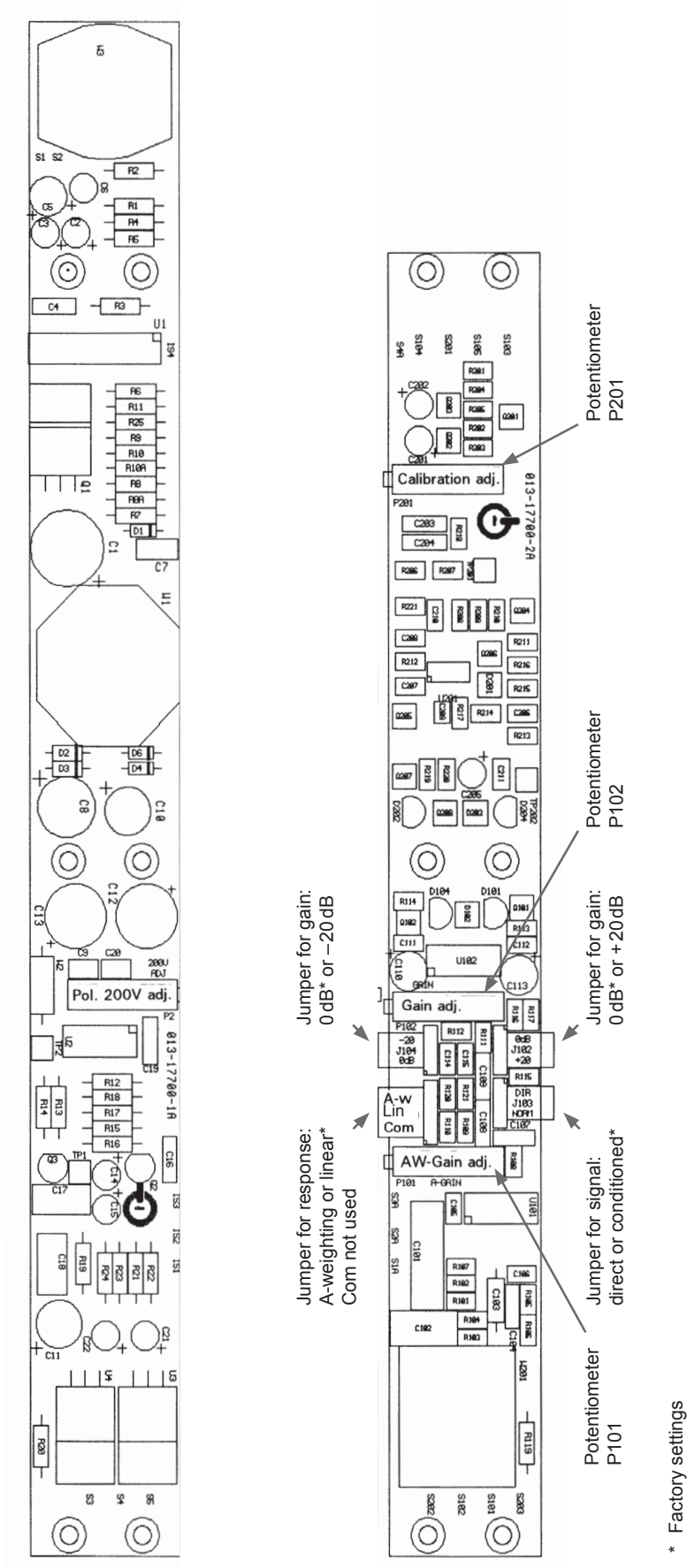

Fig. 8.3 Showing component placement and the location of user-serviceable jumpers and adjustment potentiometers