

# Product Data

## Falcon™ Range 1/2" Microphone Preamplifier — Type 2673

### USES:

- Insert voltage calibration of condenser microphones for open-circuit voltage determination
- Calibration of condenser microphones with respect to reciprocity calibration methods
- General sound measurements in connection with Brüel & Kjær condenser microphones

### FEATURES:

- Full electromagnetic compatibility (EMC)
- Detachable cable for easy installation
- Compact LEMO connector for connection to instrument input socket (adaptor for Brüel & Kjær connectors provided)
- Wide dynamic range
- Very low attenuation

1/2" Microphone Preamplifier Type 2673 is very similar in design and performance to another Falcon™ Range product: Type 2669. The main difference is that Type 2673 includes an insert voltage calibration facility.

The Insert Calibration facility is used for reciprocity and insert voltage calibration of condenser microphones in accordance with IEC 1094-1: 1992 and ANSI S1.10.

### Description

This 1/2" Falcon™ Range microphone preamplifier is designed especially to allow calibration of 1/2" and 1" condenser microphones by the insert-voltage technique, either in conjunction with the reciprocity method or with a known sound source. These methods are described in IEC Norm 1094-1 and ANSI S1.10 - 1966 (R 1976). Type 2673 fulfils the requirements of these standards and allows insert voltage calibration to be made. To comply with these standards, the preamplifier is delivered with a Driven Guard configuration. The configuration can be changed to Grounded Guard at Brüel & Kjær service centres. The difference in preamplifier attenuation in these two configurations satisfies the requirements in the standards mentioned above.

Type 2673 consists of a high impedance input stage and an output stage giving a low output impedance for driving long cables and the Driven Guard surrounding the input stage. The thread which accepts the microphone cartridge is isolated from the



preamplifier housing to allow an insert-voltage signal to be applied in series with the microphone for determination of the microphone's open-circuit sensitivity.

### EMC Certification

The preamplifier complies with EMC (electromagnetic compatibility) requirements specified in EN 50082-1 (residential, commercial and light industry) as well as in EN 50082-2 (industrial environment). However, the immunity to external RF fields is

limited because of the wiring principle required for the insert voltage calibration facility. If RF immunity is a critical parameter, we recommend Falcon™ Range 1/2" Microphone Preamplifier Type 2669 for best immunity performance.

### Microphones and Sockets

The preamplifier can be fitted with 1/2" microphones directly and 1", 1/4" and 1/8" microphones using adaptors.

For insert voltage calibration of 1" microphones the adaptor (UA 0786) provided with the preamplifier must be used. This adaptor fulfils the requirements of microphone calibration standard IEC 1094-1.

The preamplifier is delivered with a 3m detachable cable (AO 0419) which fits the new LEMO standard preamplifier input socket. Adaptor UA 1405 is provided for converting the preamplifier to traditional 7-pin Brüel & Kjær sockets.

For insert voltage calibration, the preamplifier may be connected directly to the preamplifier input socket of Frequency Analyzers Types 2010 or 2120 and Measuring Amplifiers Types 2606 and 2607, which also supply the insert voltage. This may originate either from the 1 kHz reference oscillator built into these instruments or from an external signal source such as Sine Generators Types 1049/1051, allowing calibration at other frequencies and signal levels. For other Brüel & Kjær instruments such as Measuring Amplifiers Types 2610 and 2636, which do not provide direct insert voltage calibration, the cable included with UA 1405 can be

used, or adaptor WB 0850 (not included) and an external oscillator.

Type 2673 is also used together with Reciprocity Calibration Apparatus Type 4143 which is designed for the reciprocity calibration of condenser microphones in accordance with IEC 1094, insert-voltage calibration, comparison calibration, and the measurement of the frequency response of condenser microphones using the electrostatic-actuator technique.

**Note:** When used in association with an electric actuator, it is recommended that you connect an external ground wire between the Preamplifier body and the actuator supply, to avoid interference from the actuator current. A clip (DM 0270) is provided for this purpose.

### Accessories

Use adaptor UA 0035 for connecting 1/4" microphones, adaptor UA 0036 for connecting 1/8" microphones the supplied adaptor UA 0786 for 1" microphones. It is possible to use Adaptor DB 0375 for 1" microphones, but the geometry of the guard used in

this adaptor does not comply with the microphone calibration standards.

For connecting an electrical input directly into the preamplifier, use Input Adaptor JJ 2617 together with cable AO 0038 and 1-32 UNF to BNC Plug Adaptor JP 0145.

The LEMO to 7-pin Brüel & Kjær adaptor UA 1405 provided enables the use of all the cables in Table 1.

## Characteristics

The small and large signal frequency response of the preamplifier depend on the capacitance of the microphone connected to its input and the capacitive load (for example, extension cables) connected to the output.

### Small Signal Frequency Response

The curves in Fig. 1 show the low-frequency response of the preamplifier for 50 pF and 20 pF microphone capacitances. Note that they do not show or take into account the lower cut-off frequencies of the microphones. The effects of various capac-

### The Insert Voltage Calibration Technique

The Insert voltage technique is primarily used in calibration laboratories for determining the open-circuit sensitivity of a condenser microphone. The open-circuit sensitivity is defined as the voltage appearing at the output terminals when the microphone is working into an infinitely large electrical impedance.

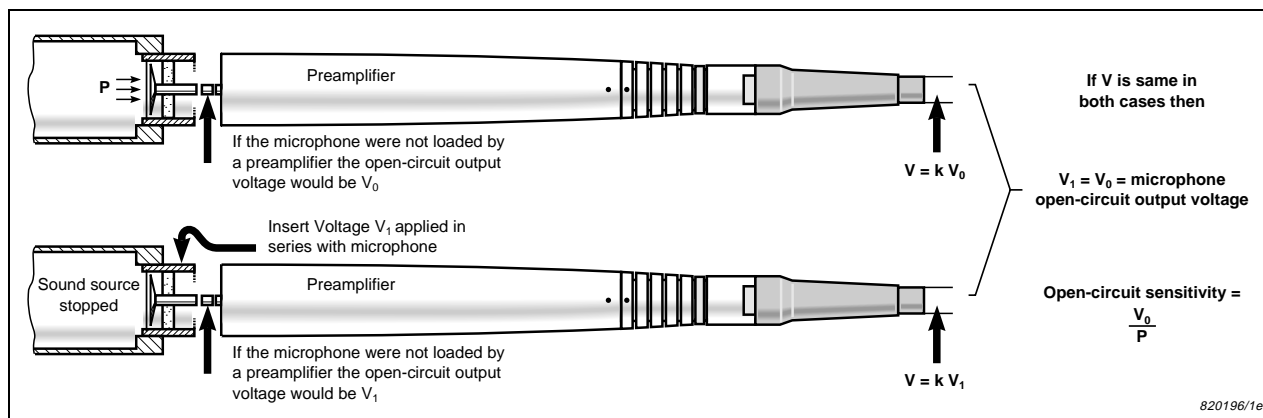
The insert voltage technique may also be used to provide a convenient field-check of the electrical sensitivity of a complete sound measurement system including preamplifier and cables. However, in this case the method does

not account for the mechanical parameters which determine the acoustic properties of the microphone cartridge itself.

The principle of open-circuit sensitivity determination using the insert voltage technique is shown below. A well-defined sound pressure level of known frequency is first applied to the microphone. This causes the microphone to generate an internal voltage  $V_0$  (the open-circuit output voltage of the microphone) which, when loaded by the preamplifier, produces an output voltage  $V$  at the preamplifier output. The sound source is then switched off and a calibration voltage  $V_1$  (the insert voltage) of the same frequency is applied in series with the microphone. The level

of the insert voltage is then adjusted until the output voltage of the preamplifier is the same as that when the reference sound source was applied ( $V$ ). The open-circuit sensitivity of the microphone cartridge is then given by the magnitude of the insert voltage divided by the reference sound pressure.

1/2" Microphone Preamplifier Type 2673 has been especially designed for performing open-circuit sensitivity calibration of condenser microphones using the insert voltage technique. This technique is described in IEC 1094-1 (1992), 486 (1974) and ANSI S 1.10-1966 (R 1976).



itive output loads (cable length) on the high-frequency response are also shown. The curves in Fig. 1 apply for signal levels within the large signal limits in Table 2.

### Large Signal Frequency Response

The capacitive load of extension cables on the output of the preamplifier influences its frequency response and available output voltage. If the specified maximum output current of the preamplifier is exceeded, the signal will be distorted. The curves in Fig. 2 show the upper distortion limits (3%) as a function of preamplifier output voltage, frequency and capacitive loading (cable length). The curves are shown for total supply voltages of 120 VDC and 28 VDC ( $\pm 60$  VDC and  $\pm 14$  VDC dual supply voltages respectively).

### Noise

Fig. 3 shows typical noise frequency spectra when loading the preamplifier with 20 pF and 50 pF microphone capacities. The low noise of the preamplifier ensures that the noise floor for a microphone/preamplifier assembly is determined mainly by the associated microphone over most of the frequency range. The preamplifier can work at temperatures up to 150°C, but reduced specifications for noise and output capability will apply.

More information on preamplifiers and other Falcon™ Range products is given in the Microphone Handbook BA 5105.

## Extension Cables

All the extension cables with LEMO connectors (see Table 1) are fully EMC certified. The preamplifier can be used with traditional cables with Brüel & Kjær connectors, but EMC compatibility is not guaranteed. The cables in Table 1 have a working temperature range from -20 to +80 °C. They are very robust, have low capacitance and extremely good shielding so that several of them can be connected in series without loss of signal quality.

Extension Cable	AO 0414/15 /16	AO 0027	AO 0028/29
Connectors	LEMO	Brüel & Kjær	
Length	3/10/30 m	3 m	10/30 m
Diameter	4 mm	6 mm	9 mm
Capacitance	290/960 /2900 pF	300 pF	570/ 1700 pF

Table1 Extension cables

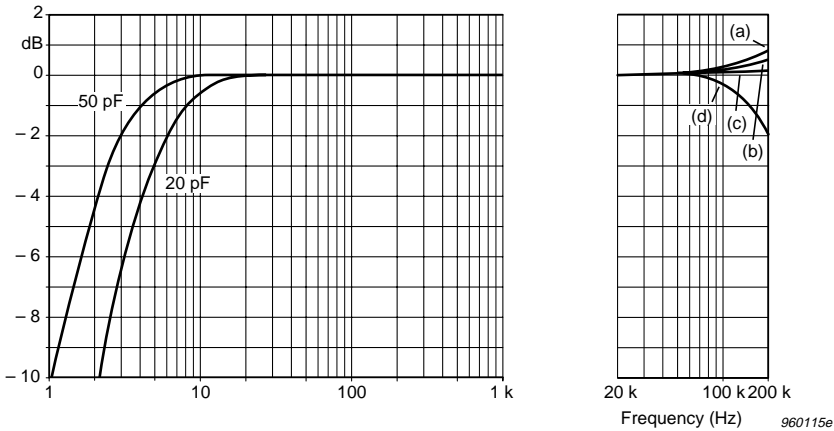


Fig.1 Small signal frequency response of the preamplifier at low frequencies for 50 pF and 20 pF microphone capacitances and at high frequencies for various capacitive loads which are (a) 10 nF (b) 3 nF (c) with the 3 m cable supplied (d) 30 nF

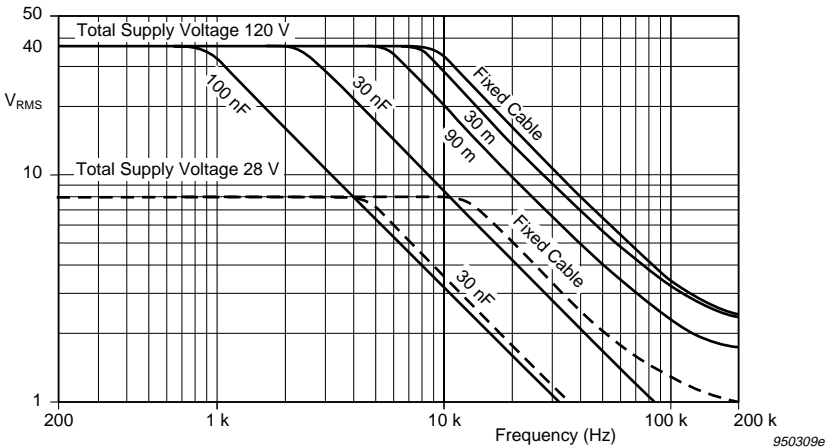


Fig.2 Upper distortion limit (3%) as a function of preamplifier output voltage and frequency for various capacitive loads. The full-drawn curves are valid for a preamplifier powered with 120 VDC ( $\pm 60$  VDC) and the dotted curves are for 28 VDC ( $\pm 14$  VDC)

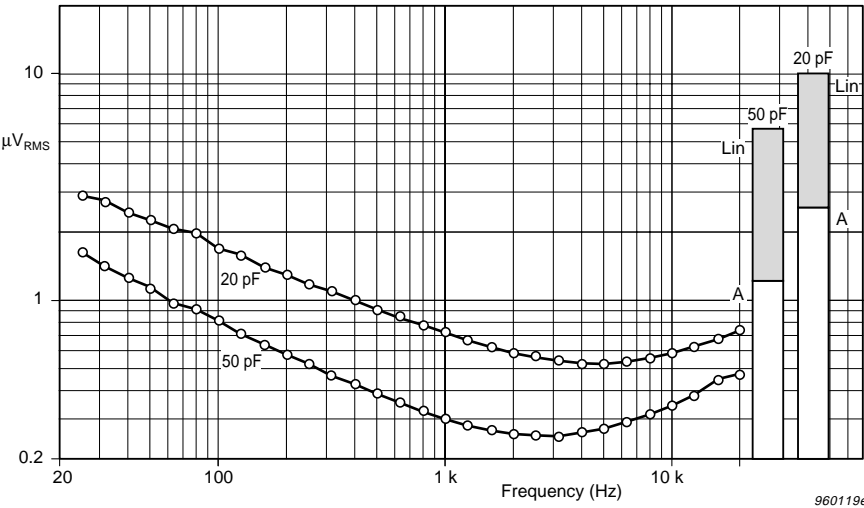


Fig.3 Typical noise frequency spectra in  $\mu$ V measured with 20 pF and 50 pF microphone capacities. The spectra are measured in  $1/3$ -octave bands with levels at centre frequencies indicated by circles. The bar graphs represent broad-band (22.4 Hz to 300 kHz) and A-weighted noise levels for both microphone capacities

# Specifications 2673

## FREQUENCY RESPONSE (re 1 kHz):

30 Hz to 200 kHz,  $\pm 0.5$  dB. See Fig. 1

**ATTENUATION:** 0.05 dB (max.)

## PHASE LINEARITY:

$\leq \pm 2^\circ$  from 250 Hz to 50 kHz

**INPUT IMPEDANCE:**  $1\text{ G}\Omega \parallel 0.05\text{ pF}$

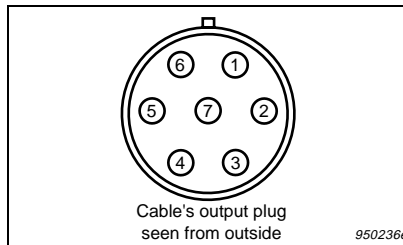
**OUTPUT IMPEDANCE:**  $25\text{ }\Omega$

## CONNECTOR TYPE:

LEMO type FGJ.OB.307 at preamplifier

LEMO type FGG.1B.307 for instrument input socket

## PIN CONNECTIONS:



Pin	LEMO
1	Calibration input
2	Signal ground
3	Pol. voltage
4	Signal output
5	Not connected
6	Power supply positive
7	Power supply negative/ground
Casing	Connected to instrument chassis

**MAX. OUTPUT CURRENT:** 20 mA (peak)

**Note:** The max. output current can be limited by the power supply

## MAX. OUTPUT VOLTAGE:

Maximum output voltage  $V_{p-p}$  is equal to total supply voltage minus 10 V

**OUTPUT SLEW RATE:**  $2\text{ V}/\mu\text{s}$

## DISTORTION (THD):

Less than  $-80$  dB at 25 V out, 1 kHz

## NOISE:

$11.0\text{ }\mu\text{V}$  Lin. 20 Hz – 300 kHz

$20.0\text{ }\mu\text{V}$  Lin. 20 Hz – 300 kHz (max. \*)

$1.8\text{ }\mu\text{V}$  A weighted

$2.7\text{ }\mu\text{V}$  A weighted (max. \*)

**POWER SUPPLY, DUAL:**  $\pm 14\text{ V}$  to  $\pm 60\text{ V}$

**POWER SUPPLY, SINGLE:** 28 V to 120 V

## OUTPUT DC OFFSET:

$\approx 1\text{ V}$  for a dual supply, or

$\approx 1/2$  the voltage of a single supply

## CURRENT CONSUMPTION:

3 mA plus output current

## CALIBRATION INSERT VOLTAGE:

Max. 10 V RMS, input impedance: 1 nF

\* See EMC Note 2

## DIMENSIONS AND WEIGHT:

Diameter: 12.7 mm (0.5")

Length: 110 mm (4.3")

Weight: 40 g (1.41 oz) (without cable)

**Note:** All values are typical at  $25^\circ\text{C}$  ( $77^\circ\text{F}$ ), unless measurement uncertainty or tolerance field is specified. All uncertainty values are specified at  $2\sigma$  (i.e. expanded uncertainty using a coverage factor of 2).

The values are measured with the preamplifier in Driven Guard mode, and are valid for 20 pF mic. capacitance and a 3 metre cable unless otherwise specified.

## COMPLIANCE WITH STANDARDS:

<b>CE</b>	CE-mark indicates compliance with: EMC Directive and Low Voltage Directive.
<b>Safety</b>	EN 61010-1 and IEC 1010-1: Safety requirements for electrical equipment for measurement, control and laboratory use.
<b>EMC Immunity</b>	EN 50082-1: Generic immunity standard. Part 1: Residential, commercial and light industry. EN 50082-2: Generic immunity standard. Part 2: Industrial environment. <b>Note 1:</b> The above is guaranteed only with extension cables AO 0414, AO 0415 and AO 0416. <b>Note 2:</b> Susceptibility to radiated RF (response measured on output when exposed to levels specified in EN 50082-2): $< 200\text{ mV}$ .
<b>Temperature</b>	IEC 68-2-1 & IEC 68-2-2: Environmental Testing. Cold and Dry Heat. Operating Temperature: $-20$ to $+60^\circ\text{C}$ ( $-4$ to $+140^\circ\text{F}$ ), ( $150^\circ\text{C}$ ( $302^\circ\text{F}$ ) with increase in noise) Storage Temperature: $-25$ to $+70^\circ\text{C}$ ( $-13$ to $+158^\circ\text{F}$ )
<b>Humidity</b>	IEC 68-2-3: 95% RH (non-condensing at $40^\circ\text{C}$ ( $104^\circ\text{F}$ ))
<b>Enclosure</b>	IEC 529: Protection Provided by Enclosure: IP 20
<b>Mechanical</b>	IEC 68-2-6: Vibration: $0.3\text{ mm}$ , $20\text{ m/s}^2$ , 10–500 Hz IEC 68-2-27: Shock: $1000\text{ m/s}^2$ IEC 68-2-29: Bump: 4000 bumps at $400\text{ m/s}^2$
<b>Reliability</b>	MI-HDBK 217F, GB (Part-Stress): MTBF $> 40000$ hours (max. 2.5% errors/1000 h)

# Ordering Information

## Type 2673 $1/2$ " Microphone Preamplifier

Includes the following accessories:

AO 0419: Microphone Cable 3 m (9.8 ft.)

UA 0786:  $1$ " Microphone Adaptor with standard Guard

UA 1405: CIC Adaptor LEMO to 7-pin Brüel & Kjær (insert voltage)

DM 0270: Clip for Actuator Measurement

DP 0901:  $1/2$ " Cylindrical Adaptor

## Optional Accessories

JJ 2617: Input Adaptor (51 pF). Is screwed directly onto a preamplifier for connection to 10–32 UNF cables

AO 0038: 10–32 UNF cable

JP 0145: 10–32 UNF to BNC Plug Adaptor

UA 0196: Flexible Extension Rod

UA 0035:  $1/2$ "  $\varnothing$  to  $1/4$ " Adaptor

UA 0036:  $1/2$ " to  $1/8$ " Adaptor

UA 1317:  $1/2$ " Microphone Holder

UA 1284: Microphone Stand

BA 5105: Microphone Handbook

WB 0850: Insert Junction Adaptor for insert voltage calibration

## Extension Cables

### LEMO to LEMO:

AO 0414: 3 m (9.8 ft.)

AO 0415: 10 m (32.8 ft.)

AO 0416: 30 m (98.4 ft.)

AR 0014: Flat Cable, 0.5 m (1.64 ft)

Brüel & Kjær reserves the right to change specifications and accessories without notice

**Brüel & Kjær** 

WORLD HEADQUARTERS: