BRÜEL & KJÆR® Calibration Systems

Basic Microphone Calibration System

210054

This secondary-level calibration system is for calibration of the most common microphones. The system calibrates microphones according to standardized methods: the comparison method as described in IEC 61094-5 and the electrostatic actuator method as described in IEC 61094-6.

The system is built with advanced software which has automatic test execution and easy pass/fail identification. All measurement results are stored in a database making it easy to recall/display the calibration history of individual microphones.

Uses and Features

Uses

- Measurement microphone calibration in private and governmental service centres
- Calibration of microphones (IEC 61094-4, -1 and others) with or without preamplifiers
- Calibration of microphones with or without the protection grid

Features

- Sensitivity calibration by comparison with reference microphone (IEC 61094-5)
- Sensitivity update of TEDS (transducer electronic datasheet)
- Calibration of open-circuit and loaded sensitivity (that is, sensitivity with preamplifier)
- Frequency response calibration by comparison (IEC 61094-5), 20 Hz to 20 kHz with option of 0.1 Hz lower limiting frequency
- Frequency response calibration by electrostatic actuator (IEC 61094-6), 10 Hz to 200 kHz
- Pressure, free-field and diffuse-field frequency responses by applying corrections
- Fast, automated measurement execution
- Procedures, microphone types and measurement results stored in Microsoft® Access® database
- Certificate template generation and printing using Microsoft Word
- Data export for analysis to Microsoft Excel®
- Detailed operator instructions

Introduction

This general-purpose microphone calibration system can be used to calibrate measurement and laboratory standard microphones, including those that fulfil standards IEC 61094-4 (working standard microphones) and IEC 61094-1 (laboratory standard microphones).

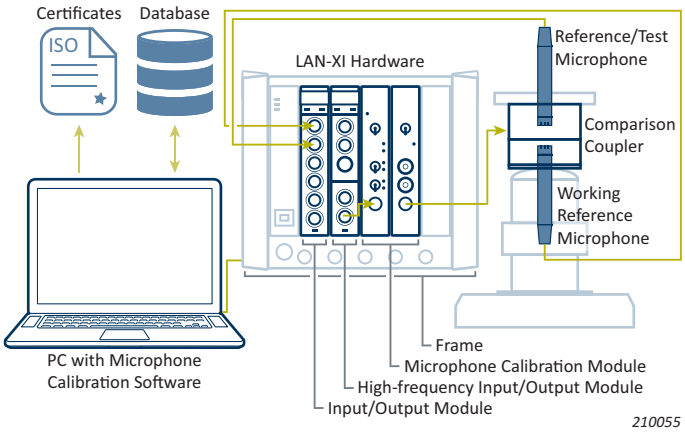
The system can calibrate microphones with ⅛-, ¼-, ½- and 1-inch diameters, surface microphones, and array microphones. Non-standard microphones may also be calibrated by use of special adaptors and other accessories.

Methods

Comparison – IEC 61094-5

The system can be used to determine the pressure sensitivity or to determine the frequency response of the microphone using the comparison method described in IEC 61094-5. Comparison calibration uses an active coupler with a built-in sound source and a reference microphone.

Fig. 1 *Setup for comparison calibration according to IEC 61094-5, the hardware shown is Type 9721-A and UA-9721-A-B01*



Pressure Sensitivity

The two microphones are exposed to the same sound pressure in the coupler.

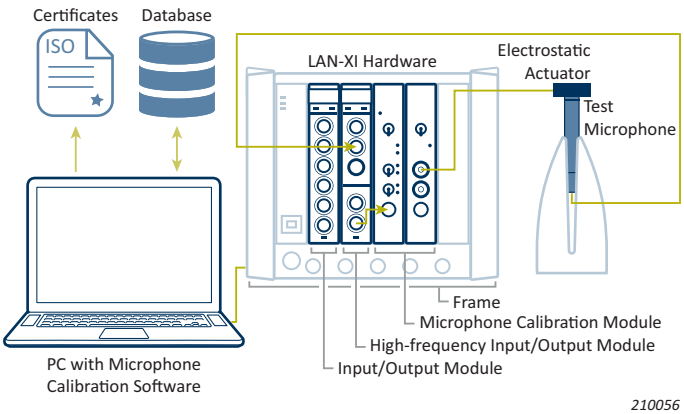
Frequency Response

Using the comparison method, the standard frequency range is from 20 Hz to 20 kHz with an option for extension to 0.1 Hz. Microphones can be calibrated with and without a protection grid.

Electrostatic Actuator – IEC 61094-6

The system can be used to determine the electrostatic actuator response of a microphone as described in IEC 61094-6. The electrostatic actuator method simulates a constant sound pressure on the diaphragm of the microphone.

Fig. 2 *Setup for calibration using an electrostatic actuator, the hardware shown is Type 9721-A and UA-9721-A-B01*



Frequency Response

With the electrostatic actuator method, the standard range is from 10 Hz to 50 kHz with an option for extension to 200 kHz. With this method, the protection grid must be removed during calibration.

Corrections

Pressure Sensitivity

The measured sensitivity is valid at the environmental conditions when measurements are performed. Correction is made for influence of environmental pressure and temperature on the reference microphone.

The system will also calculate the sensitivity at reference conditions (101.325 kPa and 23 °C), if pressure and temperature coefficients are available for the type of microphone being calibrated. The system has the facility for automated measurement of ambient pressure, temperature and relative humidity. If activated, the system will read dedicated files with the relevant ambient data and apply the values for making the necessary corrections.

Frequency Response

Frequency responses are measured as both magnitude and phase. The magnitude measurements are normalized at 251 Hz. Corrections are added to the measured frequency responses to reflect the type and application of microphone: pressure, free-field or diffuse-field.

Uncertainty

The system is delivered with a system manual with guidance on how to calculate uncertainties on the microphone measurements. The following tables give typical values for different types of microphones.

Table 1 *Typical uncertainties (k = 2) of sensitivity measurements at 251 Hz for microphones of different diameters in dB*

1 in	½ in	¼ in	⅛ in
0.08	0.09	0.15	0.45

Table 2 *Typical uncertainties (k = 2) of comparison calibration frequency response (IEC 61094-5) in dB*

		0.1 Hz	1 Hz	10 Hz	20 Hz	100 Hz	250 Hz	1 kHz	2.5 kHz	5 kHz	10 kHz	16 kHz	20 kHz
½ in	Without grid	0.16	0.12	0.08	0.08	0.04	Ref.	0.04	0.04	0.04	0.04	0.19	0.31
	With grid	0.16	0.12	0.10	0.10	0.07	Ref.	0.11	0.13	0.16	0.24	0.87	0.98
¼ in	Without grid	0.16	0.13	0.13	0.13	0.13	Ref.	0.12	0.13	0.15	0.18	0.22	0.44
	With grid	0.16	0.15	0.15	0.15	0.15	Ref.	0.21	0.23	0.26	0.38	0.74	1.09

Table 3 *Typical uncertainties (k = 2) of electrostatic actuator frequency response (IEC 61094-6) in dB*

10 Hz	100 Hz	250 Hz	2.5 kHz	5 kHz	10 kHz	20 kHz	40 kHz	80 kHz	100 kHz	200 kHz
0.15	0.10	Ref.	0.10	0.10	0.15	0.25	0.30	0.35	0.40	0.80

After Calibration

Updating TEDS Data

After finishing a measurement, the system can update TEDS in combined microphone and preamplifier units. TEDS is updated with the actual sensitivity for the calibrated unit. TEDS data is intended for automatic identification and setup of measurement channels, when the combined unit is used in a multi-channel measurement system.

Certificate Generation

The system can automatically create and prepare certificates for printing. Templates with logos, saved test setups, test results and graphs are easily defined from Microsoft Word. Test results can also be exported to Microsoft Excel for detailed analysis of, for example, calibration history for individual microphones.

Extending the Basic System

Extensions for the system are available. For example, you can extend the upper and lower frequency ranges for calibration, add support for additional microphone sizes and types, or enable phase match calibration.

Phase Match Calibration

Add UA-9721-A-G01 and WT-9651-N to the basic system to calibrate phase match of intensity microphone pairs used in sound intensity measurement systems. Phase match, amplitude match and pressure-residual intensity are measured on the calibrated microphone pairs.

Phase match calibration is also available as a stand-alone system, the principles and design of which are described in a separate product data: BP 2632.

Compliance with Standards

	The **CE** marking is the manufacturer's declaration that the product meets the requirements of the applicable EU directives. For this product, it is the Radio Equipment Directive 2014/53/EU **RCM** mark indicates compliance with applicable ACMA technical standards – that is, for telecommunications, radio communications, EMC and EME **China RoHS** – all items shipped to China must be marked as compliant or non-compliant with the Chinese restriction of hazardous substances **WEEE** mark indicates compliance with the EU WEEE Directive **FCC** mark is a certification mark employed on electronic products manufactured or sold in the United States which certify that the electromagnetic interference from the device is under limits approved by the Federal Communications Commission
Electrical Safety	**EN/IEC 61010-1, ANSI/UL 61010-1 and CSA C22.2 No. 1010.1** and other country deviations (CB certificate): Safety requirements for electrical equipment for measurement, control and laboratory use, part 1: General requirements
EMC Emission and Immunity	**EN/IEC 61326:** Electrical equipment for measurement, control and laboratory use – EMC requirements **EN/IEC 61000-6-2:** Generic standards – Immunity for industrial environments **EN/IEC 61000-6-4:** Generic emission standard for industrial environments, class A **CISPR 32:** Radio disturbance characteristics of multimedia equipment. Class A Limits **47 CFR FCC Part 15 subpart B**, Class A device
Temperature	**IEC 60068-2-1 and IEC 60068-2-2:** Environmental Testing. Cold and Dry Heat
Humidity	**IEC 60068-2-78:** Damp Heat: 93% RH (non-condensing at 40 °C (104 °F)). Recovery time 2 to 4 hours.
Mechanical (non-operating)	Non-operating: **IEC 60068-2-6:** Vibration: 0.15 mm, 20 m/s^2, 10 – 500 Hz **IEC 60068-2-29:** Bump: 1000 bumps at 250 m/s^2 **IEC 60068-2-27:** Shock: 1000 m/s^2
Enclosure	IEC 60529: Protection provided by enclosures: **Type 3660-C:** IP 20; **Types 3050, 3160, 3161:** IP 31; **WB-3655:** IP 31
RoHS	All system components are RoHS compliant

Note: The above is only guaranteed using accessories listed in this document.

EFFECT OF RADIATED AND CONDUCTED RF EXPOSURE
Radiated RF: 80 – 1000 MHz, 80% AM 1 kHz, 10 V/m
Conducted RF: 0.15 – 80 MHz, 80% AM 1 kHz, 10 V
Caution:
- The preamplifiers of the system are sensitive to radiated RF fields in the range 80 MHz – 850 MHz.
- Demodulation in the preamplifiers can disturb the calibration function when in the vicinity of a RF field.
- It is not recommended to operate the system near a RF field.

Specifications – Basic Microphone Calibration System

Calibrate measurement microphones in private and governmental service centres according to:
- IEC 61094-5:
  – Sensitivity calibration by comparison with reference microphone
  – Frequency response calibration by comparison
- IEC 61094-6: Frequency response calibration by electrostatic actuator

Calibrate:
- Microphones (IEC 61094-4, IEC 61094-1 and others)
- Microphones with or without preamplifiers
- Microphones with or without protection grid
- Open-circuit and loaded sensitivity (that is, sensitivity with preamplifier)

SOFTWARE
The system is built on PULSE™ LabShop, a Windows®-based application platform. Software licences are delivered on and node-locked to a PC.

FREQUENCY RANGE
- Comparison: 20 Hz to 20 kHz with option of 0.1 Hz lower limiting frequency
- Electrostatic actuator: 10 Hz to 50 kHz with option of 200 kHz upper limiting frequency

FREQUENCY RESPONSE CORRECTIONS
- Pressure
- Free-field
- Diffuse-field

MICROSOFT OFFICE
Certificate templates are edited and printed from Microsoft Word
Procedures, microphone type data, and measurement results are stored in a Microsoft Access database
Measurement results can be exported into Microsoft Excel for further analysis

TEDS EDITOR
Update the sensitivity of TEDS equipped microphones

Please note: Calibration systems, along with any optional extensions, are only delivered as complete, ready-to-use systems with Microsoft Office Professional and calibration software installed on the PC. Therefore, an order for a calibration system must include all the components of a complete system: hardware, software and software support. Extended warranty, on-site training and installation services are optional.

Basic Microphone Calibration System

HARDWARE

Type 9721-A Hardware for Basic Microphone Calibration System

Includes the following:

- High-end notebook (PC)
- LAN-XI Module Type 3160-A-042, input/output data acquisition hardware
- LAN-XI Microphone Calibration Module WB-3655
- Comparison Coupler WA-0817
- Electrostatic Actuator UA-0033
- Laboratory Standard Microphone Type 4180, reference microphone
- ½-inch Condenser Microphone Type 4192-T, working reference microphone

Type 9721-A supports ½-inch microphones and includes the hardware (with relevant calibrations) necessary to perform coupler calibrations in the 20 Hz to 20 kHz frequency range and electrostatic actuator calibrations in the 10 Hz to 50 kHz frequency range. Type 9721-A includes manuals (for the system and its hardware), accessories and cables to build and check the system.

SOFTWARE

Type 7797-N	PULSE Basic Electroacoustics
WT-9649-N	Microphone Coupler Calibration for PULSE

SOFTWARE SUPPORT AGREEMENTS

M1S-7797-N	1-year agreement for Type 7797
M1S-9649-N	1-year agreement for WT-9649

Related Products and Services

EXTENDED RANGE OPTIONS

UA-9721-A-B01	Extended high-frequency range (up to 200 kHz) for electrostatic actuator method, includes LAN-XI 5-module Frame Type 3660-C-100 and LAN-XI High-frequency Input/Output Module Type 3161-A-011, 204.8 kHz
UA-9721-A-C01	Extended low-frequency range (down to 0.1 Hz) for comparison method, includes a low-frequency comparison coupler and low-frequency reference microphones

EXTRA REFERENCE MICROPHONE OPTION

UA-9721-A-A01	Laboratory Standard Microphone Cartridge Type 4180, with primary calibration

MICROPHONE SUPPORT OPTIONS

UA-9721-A-D01	Support for calibration of ⅛-inch microphones
UA-9721-A-E01	Support for calibration of ¼-inch microphones
UA-9721-A-L01	Support for calibration of 1-inch microphones
UA-9721-A-F01	Support for calibration of Probe Microphone Type 4182
UA-9721-A-H01	Support for calibration of surface microphones
UA-9721-A-J01	Support for calibration of array microphones
UA-9721-A-K01	Support for calibration of Multi-field Microphone Type 4961

PHASE MATCH CALIBRATION OPTIONS

UA-9721-A-G01	Support for phase match calibration of ½-inch microphone pairs, requires WT-9651-N
WT-9651-N	Phase Match Microphone Calibration Software for PULSE, ordered with UA-9721-A-G01
UA-9721-B-A01	Adaptors, for calibration of ¼-inch microphone pairs
UA-9721-B-B01	Actuator Measurement Kit, for phase-matched microphones

SOFTWARE SUPPORT AGREEMENT

M1S-9651-N	1-year agreement for WT-9651

EXTENDED WARRANTY

9721-A-EW1	Extended warranty for Type 9721-A, 1-year extension

CALIBRATION SERVICES

ET-2030	Primary calibration at BKSV-DPLA, for Type 4180
ANA-LNXI-CAF	LAN-XI Module Accredited Calibration
ANA-LNXI-TCF	LAN-XI Module Conformance Test
WB-3655-TCF	LAN-XI Microphone Calibration Module Conformance Test
5008-TCF	Polarization Voltage Buffer Conformance Test
WA-0817-TCF	Calibration Coupler Conformance Test
MIC-PAMP-CAF	Microphone Preamplifier Accredited Calibration, for regular check/calibration of Types 2669, 2670 and 2673
MIC-PAMP-TCF	Microphone Preamplifier Conformance Test, for regular check/calibration of Types 2669, 2670 and 2673
WA-0371-TCF	Input Adaptor Conformance Test, for regular check of adaptors for microphone preamplifiers (UA-1434, WA-0371, WA-0406 and UA-0160)
WA-1544-TCF	Phase Coupler Conformance Test, for regular check of phase match couplers (WA-1544 (½ in) and WA-1545 (¼ in))

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