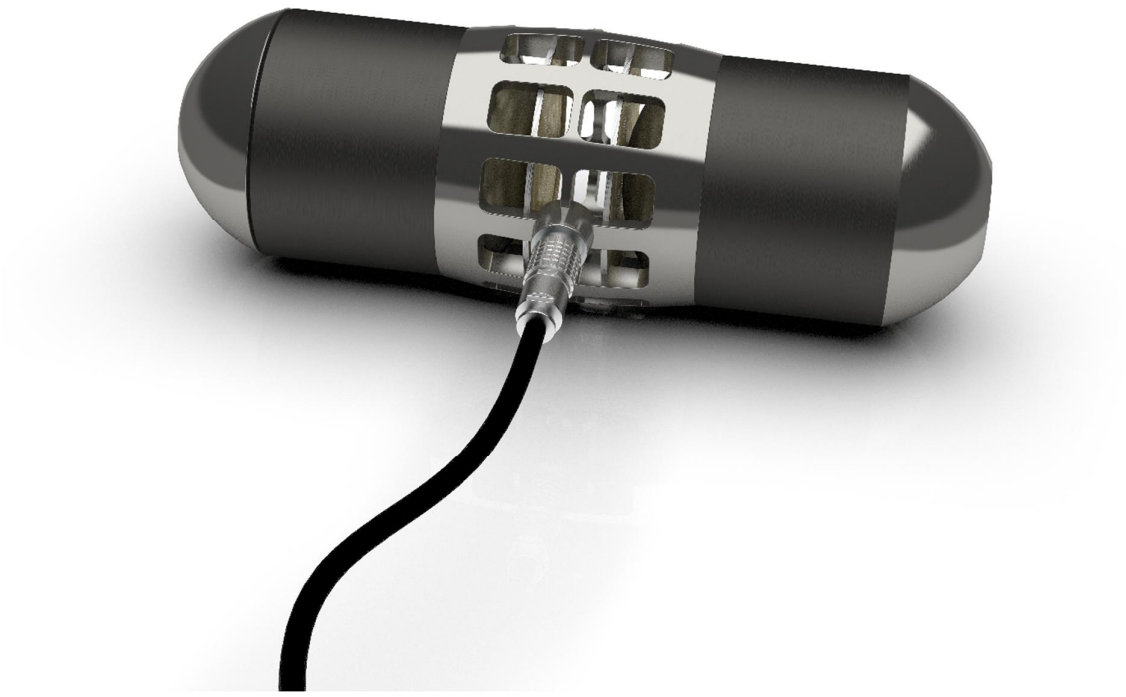
SIEMENS

User Manual

Low Frequency Monopole Source [Q-MED]

Simcenter Qsources Excitation Hardware



Thank you for purchasing the Simcenter™ Qsources Low Frequency Monopole Source.

This product has been manufactured under strict quality control.

Please take a moment to read the manual. It will provide you with the necessary information to operate the Simcenter Qsources Low Frequency Monopole Source in an optimal and safe way. The manual is intended for the sources with serial numbers from 7040C till 7106C.

Contents

Introduction

The Simcenter Qsources Low Frequency Monopole Source is a very compact volume displacement source. This device is especially suitable for lower frequency, reciprocal (vibro-)acoustic transfer function measurements in and around vehicles. It can be applied where monopole noise emission and compact dimensions are important.

The Simcenter Qsources Low Frequency Monopole Source is a unique device due to its internal reference sensor and its large stroke at low frequencies. The internal sensor measures the source sound strength emitted by the source and is the reference for accurate FRF measurements. It is a monopole source with no (or negligible) diffraction effect for frequencies well over 1 000 Hz. Measurements can be done either in a direct or reciprocal way.

Application area

The Simcenter Qsources Low Frequency Monopole Source is a volume displacement source. They are used to perform calibrated (vibro-) acoustic transfer function measurements. The transfer functions can serve several purposes:

- Acoustic modal analysis of enclosed cavities
- Coupled structural-acoustic modal analysis
- Quantification of noise from structural excitation (via reciprocity)
- Quantification of acoustic induced vibration of structures
- Quantification of in-situ airborne isolation or airborne transfer

Cross vehicle (vibro-) acoustic transfer function measurement

The Simcenter Qsources Low Frequency Monopole Source can be used on vehicles to investigate the body isolation between operational sound source locations and the interior target microphones. As the source has similar omni-directional characteristics as a microphone, the measurement can be done either in a direct or reciprocal way.

A typical instrumentation includes 24 to 60 channel SCADAS frontend, one or two sources and 20-30 microphones. Typical software includes Simcenter Test.lab Spectral Acquisition.

Acoustic modal analysis passenger car cavities

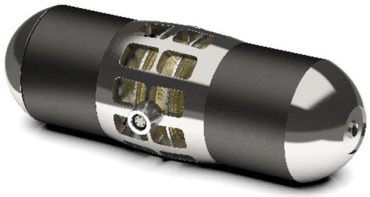
The Simcenter Qsources Low Frequency Monopole Source is able to excite the acoustic cavity of a passenger car up to 1 kHz. This makes it an ideal excitation device to derive the complex acoustic modes inside a car. To excite all modes inside the cavity the minimum number of excitation locations typically exceeds 6. Its small size practically prevents any influence of the sound field. It can also be positioned in many space constraint areas like the pedal area or under the seat. A set of sources can also be used as in a Multiple-Input, Multiple-Output configuration(MIMO) where sources are actuated in parallel with uncorrelated signals.

A typical instrumentation comprises of one or more Simcenter Qsources Low Frequency Monopole Sources, 60-100 microphones and a Simcenter SCADAS frontend. Typical software includes Simcenter Test.lab Spectral Acquisition. To emphasize the low frequency output, pink noise can be applied. Monitor the body temperature of the source when using the source at its limits. Adjust the amplification level such that the electronic protection of the source is not active.

Component identification

The package consists of following separate parts:

Flight case



Low Frequency Monopole Source

Signal and power cable with LEMO connectors

Main power cable with integrated, electronic protection device

Eye bolt for vertical mounting

¼”-20 UNC to M6 adaptor for mounting.

Manual + sensitivity sheet

Flash memory USB drive

Part	Quantity
Flight case	1
Low Frequency Monopole Source	1
Main power cable with integrated, electronic protection device	1
Signal and power cable with LEMO® connectors	1
User manual + sensitivity sheet	1
Flash memory USB drive	1
¼" to M6 Adaptor for mounting	1
Eyebolt for vertical mounting	1

Safety instructions

Please follow the instructions below in order to produce correct results and prevent unnecessary damage. It will also allow the user to maintain right to warranty. Please find a one-page summary comprising of all essential operating do's and don'ts at the end of this manual, designed to be printed out and kept close to the product.

- Never connect the power leads to a DC power source or to a 115 V or 230 V mains outlet. This will destroy the source and its cabling. Connection to a 115 V or 230 V mains outlet also poses a severe risk for electric shock, burns and fire.
- It is advised to limit the signals going into the device within the frequency range from 10 – 3 000 Hz.
- The reference sensor should be used in voltage AC mode, not IEPE.
- Never connect the source to a power amplifier without the protection circuit.
- Do not:
  - Drop the source on a hard surface.
  - Open the housing.
  - Submerge the volume source in water or other fluid.
  - Use the source in an environment warmer than 40°C or colder than 0°C.
  - Transport the source in an environment warmer than 70°C or colder than -10°C.
  - Short the power cable once they are connected to a power amplifier.

Damage as a result of not following the above instructions will result in a loss of the right to warranty.

Operating Instructions

Positioning the source

The source can be used in and around vehicles. Make sure the area around the proximity of the source is free of metal dust/debris as the powerful magnets may attract this. Infiltration of debris may result in loss of performance.

There are several options to position the source at the desired location.

Use a M6 rod fixed at one of the two inner M6 threads.

Use the M6 eyebolt which serves as a hookup point for elastic ropes, bungees, zip-tie

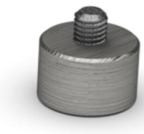
Use the blue foam in the flightcase cover for acoustically transparent support

Use the thread adaptor to interface with photographic mounting material

The source can be supported with bungees for dynamic structural decoupling. It can also be put on foam that has an open cell structure. The structure of the foam incorporated in the cover of the flightcase ensures low frequent noise emission is not affected.

There are two thread inserts available on the outer faces of the device. The thread type is metric M6. These can be used for fixing the source in any orientation.

Picture: The eyebolt can be mounted in one of the threadholes



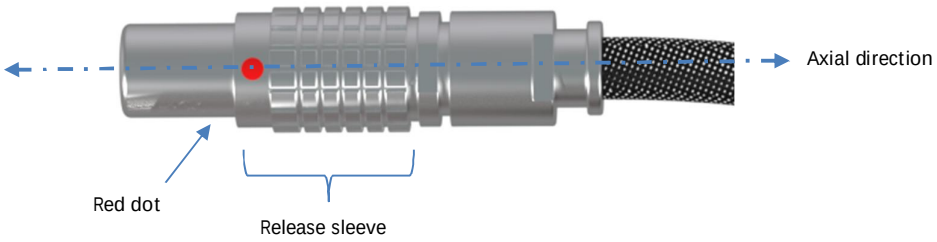
Picture: ¼"-20 UNC to M6 adaptor for mounting.

The thread adaptor can be used to mount the source onto a typical microphone stand thread (¼"-20 UNC to M6 adaptor). Fasten hand tight only. An optional tripod is optional, material code: AL0006, available through your local Siemens PLM Software office.

Connecting the source

Powering

The source has simply one LEMO multi-pin receptacle transmitting both electric power into the source as well as outputting the sound source strength equivalent voltage. The LEMO connection is Push-Pull self-latching. Align the red dots on both ends of the connection and push the connector in axially. Disengage the connector by pulling the outer release sleeve.



Picture: LEMO connector

The other end of the cable connects to the electronic protection device in the main power cable.

The source must be powered by an instrumentation amplifier like the Simcenter Qsources Measurement Power Amplifier.

The main power cable of this device has two black banana plugs, which should be connected to the power amplifier. Turn the amplifier on when the output level is zero.

The following picture gives an overview of the connections of the electronic protection device.

Picture: Electronic protection device

Typical measurement settings

The source can be driven with any band-limited signal between 10 and 1 000 Hz.

For accurate frequency response measurements on linear structures burst random and continuous random signals can be used.

Following table shows typical settings for Simcenter Test.Lab Spectral Acquisition:

Specification	Value
Bandwidth	1280 Hz
Frequency resolution	0.5 Hz
Number of averages	100
FRF estimator	H_1
Burst or continuous random	Apply appropriate windowing
Frequency definition	Absolute 50 – 1 280Hz
Type of signal	Random pink noise
Simcenter SCADAS DAC Output voltage	5 V
Amplifier setting	+26 dB

These settings can be used to drive the source for minutes. This warms up the source and will provide repeatable results. In order to reduce the cold effect on the reference sensor output, it is advised to use this signal for 5 minutes.

Electronic protection

The Monopole source must be powered by an instrumentation amplifier like the Simcenter Qsources Measurement Power Amplifier (product code: Q-AMP230V or Q-AMP115V). A high-quality audio or PA amplifier can also be used. An undistorted RMS power output of at least 50 Watt to 8 Ohms impedance is required.

An electronic protection device is integrated in the main power cable. The including electronic protection device is intended for this particular source only and will protect it against overload. A normal procedure to achieve maximum level of output is to increase the amplifier output slowly until the electronic protection device acts. As soon as the signal level becomes hazardous to the source, the internal protection circuit will start to limit the signal. When the electronics starts to interfere, the red LED light will be activated.

1. In the first stage, the protection circuit will first limit the voltage peaks. Depending on the signal nature, this can sometimes be heard as an increased distortion of the sound. In this mode the source can still be used over long periods for measurements.
2. In the second stage, when the signal level is increased further, the protection circuit will suddenly increase the impedance of the system that will cause a decrease in the output noise level by 10 dB or more. This can be heard as a drop in noise level.

Warning: When the second stage is active, the signal level should be decreased manually.

The second stage can act rapidly when excessive level is applied or it can act after a few minutes when the system risks overheating. Also, if the second stage is active, the source should not be used for measurements, because a large amount of electrical energy is now dissipated and both the source and the used amplifier will heat-up considerably without significant sound or noise.

After the signal level from the amplifier is decreased manually to zero, the protection circuit will reset and once again allow normal use.

If high noise levels are needed for measurements, it is advised to experiment with signal types and frequency range of the applied signal. Even if this causes repeated interruption of the source by the protection circuit, such experiments will not damage the source. This is true as long as the used power amplifier does not malfunction (relevant when using a non- Simcenter Qsources amplifier). The Simcenter Qsources Measurement Power Amplifier is internally protected against overload, shortcut, signal loops, etc. This procedure will normally allow ample noise levels for normal applications.
50 Hz or 60 Hz content in the signal can also cause this problem.

When driving the source in cold conditions, a rattle noise can be heard which will decrease in time. This high frequency rattle does not influence the FRF measurement<1000Hz.

Internal source strength sensor

The sensor output voltage is proportional to the source volume displacement in the frequency range between 10 and 1 000 Hz. The sensor provides a stable signal, but the voltage level is in millivolts only. The sensor works in voltage mode, not IEPE, nor charge, nor Wheatstone bridge. There is no supply needed.

The actual sensitivity value of each signal is given on the "sensitivity sheet", included separately in the delivery. The acoustic center is in the middle on the centerline of the device.

The reference signal can be directly connected to the Simcenter SCADAS frontend. The channel mode of the sensor is Voltage AC, not IEPE. The unit of a common acoustic FRF is $\frac{Pa}{m^3/s^2}$. You cannot measure this directly with this excitation device. The sensitivity value provided on the sensitivity sheet is in ${}^{mV}/_{m^3}$. If an acoustic FRF is measured for example, the unit will be ${}^{Pa}/_{m^3}$. Double integration of the FRF will result in $\frac{Pa}{m^3/s^2}$.

Stocking the source

The device is to be stored and transported using the original flight case. Make sure the flight case is free of debris. Be careful with small metal debris as it is attracted by the powerful magnets and may infiltrate the source. Use a plastic bag for storage. Keep the original packing material which should be used for shipment.

Technical specifications

Specification	Feature *
Dimensions (ex. connector)	Ø70 x 206 mm
Mass	1.75 kg
Effective frequency range	10 – 1 000 Hz
Constant sensitivity freq. range	10 – 1 000 Hz, ±2 dB
Omnidirectionality freq. range	10 – 2 000 Hz, ±2 dB
Output signal condition requirement	Voltage AC
Signal output connector socket type	Female BNC
Amplifier interface connection type	4mm banana plug

* Performances and dimensions of the device, as stated above, are an indication only. The actual values of the delivered product can deviate from the given specification. However, in most of such cases the specifications will exceed the given ones above, because of improvements in the used materials and design.

Error diagnosis and maintenance

The input channel for the internal reference sensor is to be set on Voltage AC. An acoustic semi-free field FRF can be measured to check the microphones and source used for the test campaign. With all microphones bundled together at the same distance from the source, phase and amplitude should be the same in the lower frequency range. When the distance in a semi-free field (e.g. in a semi-anechoic room) is 0.5 meters, the amplitude should be between 0.3 and 0.4. A (vibro-) acoustic reciprocal measurement can also help in understanding unexpected results.

The output of the source can reduce suddenly during the measurements. This is due to the electronic protection that interferes. Stop the measurement, let it cool down for a few minutes, reduce the output and restart the measurement. Put the electronic protection in such orientation so that the LED is visible during the measurement.

The sensitivity of the sources as provided by Simcenter Qsources does not vary over time (within reason). This can however be impaired by mechanical damage or electrical overload in excess of the given specification.

When driving the source in cold conditions, a rattle noise can be heard which will decrease in time. This high frequency rattle does not influence the FRF measurement.

If wished by the user, a sensitivity measurement service is offered by Simcenter Qsources for re measurement of the source performance and sensitivity (product code: Q-SR-SENS). It is advised to let the source work for some time to warm up (e.g. 5 minutes at maximum level).

Legal notice

All Simcenter Qsources products and product specifications are subject to change without notice to improve reliability, design or otherwise. The operating instructions in this manual represent the technical status at the time of printing.

Siemens Industry Software NV has taken reasonable care to ensure the information is complete and correct but does not warrant the liability for any errors or spelling mistakes. However, the information in this publication is reviewed regularly and any necessary corrections are included in subsequent editions.

Warranty and liability

For detailed information on warranty and liability, see the STS Simcenter Hardware “Product Specific Terms”.

Shipment preparation

In order to ship your product in a safe and robust way, we like to give you some additional packing hints.

- In case of shipment for service: pack one product per HR TAC identification number.
- Please make sure the package is complete to enable a full service.
- Remove any add-ons, tape, glue or custom-made auxiliaries.
- Please pack the flightcase in the original cardboard box or equivalent.
- Pack the products in a way that reduces the chance of shocks or scratching.

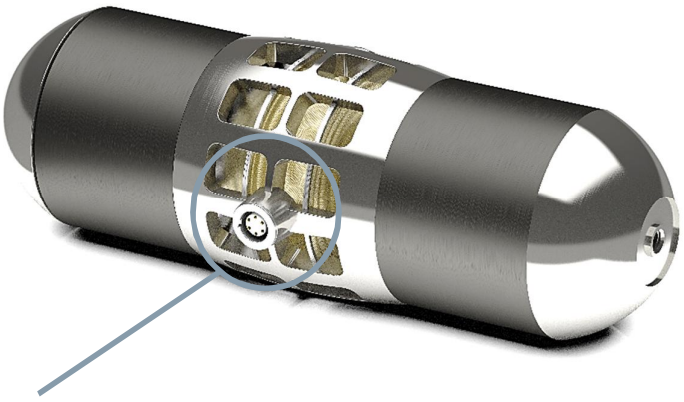
Operating Essentials Q-MED
Simcenter Qsources Low Frequency Monopole Source

Handle with care

- Store products in original flight case when not used.
- Never leave products unattended while in operation.
- Do not apply an excitation signal to the sensor output connection.
- Do not operate when safety LEDs are lighting up.
- Source should not be in safety mode for more than 30s.
- Sensor cables must not lay alongside cables carrying power or large switching currents.
- Never use without electronic protection device.
- Strong magnets inside. Never place product near (metal) debris or dust.
- Do not apply tension to signal cables/connectors.
- Do not move test body when product is installed.
- Never use workshop tools to remove product.
- Never open the housing.
- Avoid ground loops.

Read manual

Avoid hot/cold environments



No single sine signals.
No impulsive signals
e.g. square waves.
No signals below 10Hz.
Operate source max 5min continuously.

Avoid contact with any fluids

* In case of deviating measurement conditions, please reach out to your local Siemens contact for more information.

Simcenter Qsources Portfolio

Simcenter Engineering uses its experience in NVH technology to continuously develop new acoustic and structural exciters under the brand name Simcenter Qsources.

Products

Miniature Shaker

- Frequency range: 50 – 5 000 Hz
- Integrated force and acceleration transducer

Integral Shaker

- Frequency range: 20 – 2 000 Hz
- Integrated force and acceleration transducer

Thumper Shaker

- Excitation possible from 5 Hz
- Excitation possible in any orientation
- Self-supporting and self-aligning

High Frequency shaker

- Frequency range: 500 – 10 000 Hz
- Low mass loading
- Integrated force sensor

Mid High Frequency Source

- Frequency range: 150 – 10 000 Hz
- Real-time volume acceleration reference signal

Low Mid Frequency Source

- Frequency range: 10 – 1 000 Hz
- Real-time volume acceleration reference signal
- Human torso diffraction effect

Low Freq. Monopole Source

- Dual driver technology
- Monopole until 1 000 Hz, no diffraction effect
- Internal source strength sensor

Measurement Power Amplifier

- Accurate amplification
- Frequency range: 10 – 40 000 Hz
- High pass filter

Detailed information can be found on https://www.plm.automation.siemens.com/global/en/products/simulation-test/exciters.html

Global Technical Access Center

Installation assistance

For additional installation assistance, or to report any problems, contact the Global Technical Access Center (GTAC).

Website:

https://www.plm.automation.siemens.com/global/en/support/

Phone:

United States and Canada: 800-955-0000 or 714-952-5444

Outside the United States and Canada: Contact your local support office.

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