



## Description

The quality of communication in hands-free scenarios is heavily influenced by the acoustic situation surrounding the talker/listener and the device under test. On these grounds, manufacturers of any hands-free capable device apply complex signal processing to ensure good communication quality.

Quickly changing acoustic conditions – typical for hands-free communication – pose an additional challenge for hands-free systems and devices. For development and optimization, it is therefore vital to be able to influence the acoustic coupling between loudspeaker and microphones during tests, creating a time-variant echo path. For this purpose, HEAD acoustics developed the motorized rotating reflector HRR I.

The reflector can be used in any hands-free situation and any location as an automated, quickly moving and noise-free acoustic reflector. The aim is to identify and subsequently optimize the systems' general communication quality and echo attenuation performance under quickly changing acoustic conditions.

For tests of in-vehicle hands-free communication, HRR I is compliant with the Recommendations ITU-T P.1100/1110/1120 regarding a dynamically changing echo path. As such, it currently is the only described method to guarantee noise-free, accurate and fully repeatable method to change the echo path as specified.

Outside of vehicle hands-free systems, HRR I can be used in any living space, test room and other arbitrary places to specifically and reproducibly influence acoustic coupling. Typical applications for testing with HRR I are echo-performance tests for all types of smart speakers (see exemplary measurement setup on last page) and other smart home devices, conferencing devices and mobile devices with hands-free telephony function (e.g. Bluetooth® loudspeakers).

## Mechanical design & drive system

HRR I consists of a lightweight, acoustically reflective surface mounted to a noiseless electric drive system. The reflector is a lightweight 40 cm × 30 cm (16 inch × 13 inch) panel with a sandwich structure providing high mechanical robustness and excellent acoustic reflectivity up to high frequencies.

The precision stepper motor of HRR I combines high possible rotation speeds with accurate motion. To prevent undesired sound transmission from the power train, the motor is mechanically decoupled from panel and pedestal. Combined with an advanced electronic drive system, HRR I operates noise-free.

The large aluminium baseplate allows steady positioning on flat surfaces. HRR I can also be mounted on tripods via the integrated tripod socket. This allows the reflector to operate vertically as well as horizontally.

## DATA SHEET

### HRR I (Code 6597)

#### HEAD acoustics Rotating Reflector (variable acoustic echo path)

#### Overview

HRR I is a motorized rotating reflector. It allows to dynamically change the acoustic coupling between loudspeaker and microphones in arbitrary hands-free communication scenarios and such the realization of time-variant echo paths. As such, HRR I is compliant with the Recommendations ITU-T P.1100, P.1110 and P.1120 regarding measurements of echo attenuation performance for in-vehicle hands-free systems.

Typical applications for testing with HRR I are echo-performance tests for all types of smart speakers and other smart home devices, conferencing devices and mobile devices with hands-free telephony function.

HRR I operates noise-free and with high precision, creating ideal conditions for uninhibited and fully repeatable tests and measurements.

#### Key Features

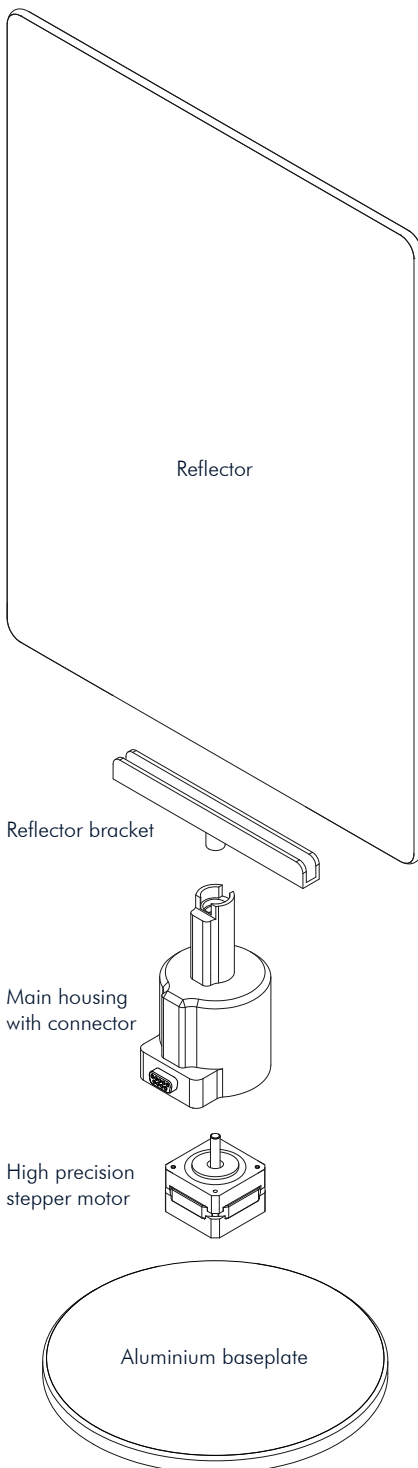
- Rotating reflector for dynamically changing acoustic coupling between receiver and microphones
- Precise & fully repeatable time-variation of the echo path
- Can be applied in living spaces, test rooms, vehicles etc.
- Noise-free motion with high precision
- Easy installation and operation
- Fully automated operation with appropriate test suites (e.g. ITU-T P.1100/1110, HQS-SmartHome)
- Time-accurate triggering via pulses stored with audio signal

#### Applications

- Dynamically changing the echo path for acoustic tests/measurements of hands-free devices with
  - Full automation
  - Very high accuracy
  - Full repeatability
- Dynamically changing the echo path in measurements according to ITU-T P.1100/1110/1120

## Main components of HRR I

HRR I comprises several components – the main parts are displayed below. The lightweight reflector panel is held by a bracket that connects to the stepper motor through the main housing. The large aluminium baseplate ensures stability when placed freely on flat surfaces. The connector for the RS-485 cable sits at the bottom edge of the main housing to keep the cable close to the below surface and reduce tension on the plug.



HRR I is powered via a USB 3.0 output supplying 1.0 A or more<sup>1</sup>.

The reference position for the panel is determined through a Hall effect sensor, ensuring full reproducibility of all measurements.

For receiving commands, HRR I connects to one of the general-purpose in-/outputs (GPIO 1/2) of *labCORE*<sup>2</sup>. Trigger pulses are stored with the audio file to achieve accurately timed and fully repeatable measurements. HEAD acoustics test suites that can make use of the rotating reflector (e.g. P.1100/1110, HQS-Smart-Home) will include corresponding trigger signals for HRR I. Manual editing of audio files (\*.hdf) to add triggers for HRR I is possible with the ACQUA Signal Editor (ACOPT 01).

HRR I communicates with *labCORE* over the industry-proven RS-485 serial connection. From *labCORE*, the supplied breakout cable CUD IV adapts USB Type-A (power supply) and BNC (trigger input) to a D-Sub 9 socket. From there, the supplied cable CAB II.10 or other (e.g. shorter/longer) full-featured RS-485 cables can be used.

## General requirements

### Software

- **ACQUA (Code 6810)**, Full-license or Compact (version 3.4 or later) including corresponding system components (see ACQUA data sheet)

### Hardware

- **labCORE (Code 7700)**, Modular multi-channel hardware platform

### Options

#### Software

- **ACOPT 01 (Code 6811)**, ACQUA Signal generator and editor (for customized operation of HRR I)

### Delivery items

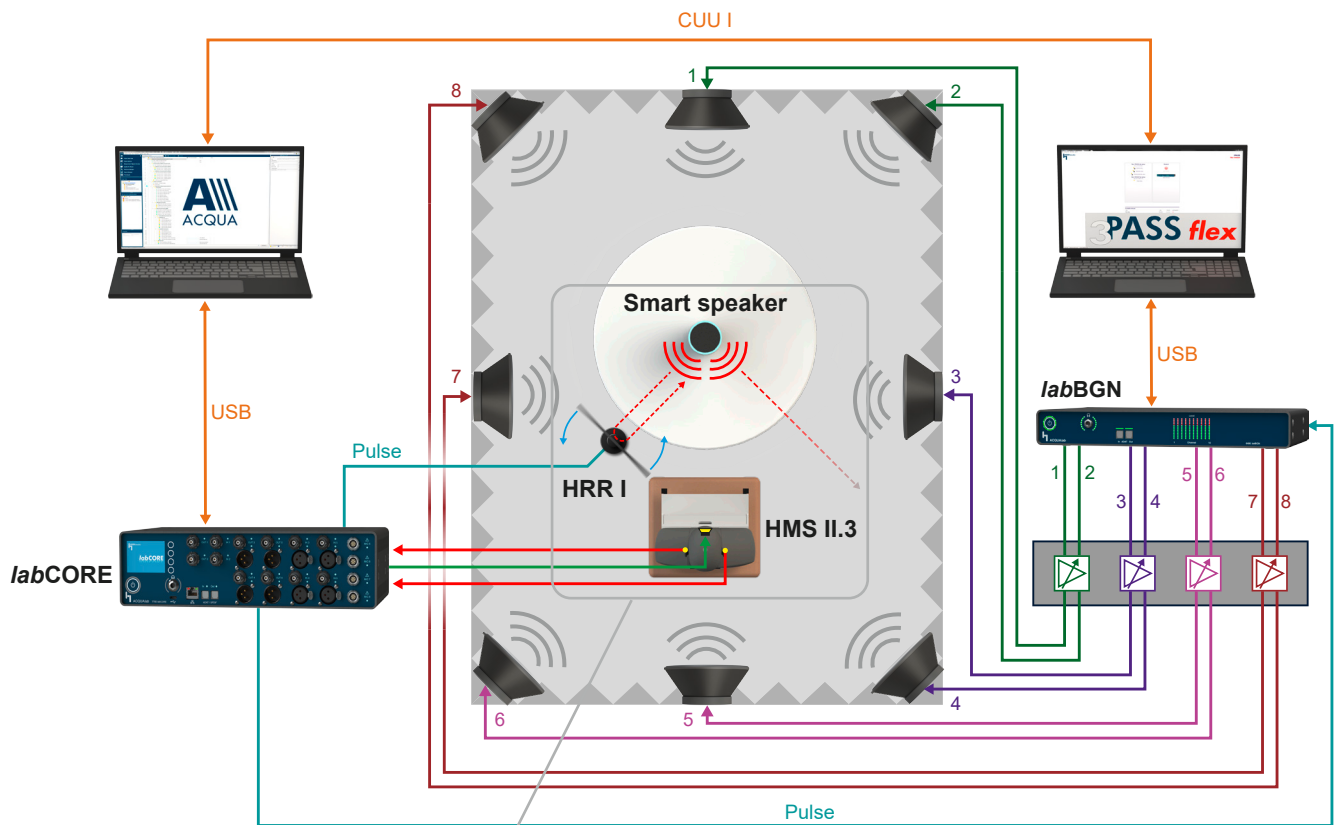
- **HRR I (Code 6597)**, HEAD acoustics Rotating Reflector (Variable Acoustic Echo Path)
- **CUD IV (Code 6113)**, Adapter USB + BNC <> D-SUB 9-pin RS 485 for Control HRR I (Connection to ACQUA PC)
- **CAB II.10 (Code 6093-10)**, Cable D-SUB 9-pin, 10 m
- **Manual**

## Technical Data

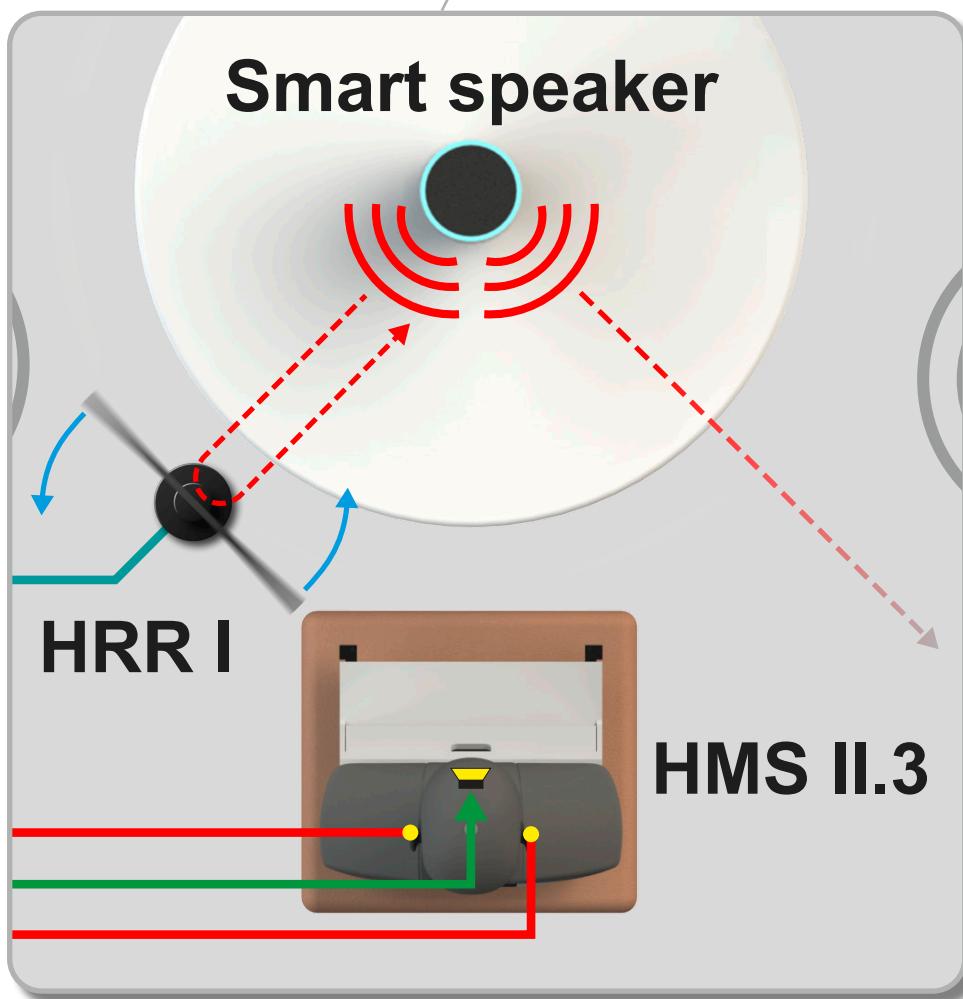
General	
Input	Pulse input, BNC
Rotation angle	360°
Standard revolutions per minute	15 rpm (for P.1100)
Motor torque	Max. 8 Ncm
Angular resolution	0.01°
Angular repeatability	0.1°
Environmental conditions	
Operating temperature range	0° C – 45° C; 32° F – 113° F
Storage temperature range	-20° C – 70° C; -4° F – 158° F
Air humidity	20 % – 80 % (non-condensing environment)
Other	
Power consumption	Typ.2.5 W via USB 3.0
Reflector dimensions (W x H x D)	300 x 400 x 6 mm
Total dimensions (W x H x D)	300 x 525 x 180 mm
Overall weight	Approx. 1.3 kg

1) Please make sure that the selected output is a qualified USB 3.0 output fully compliant with USB specifications. Otherwise, please use a powered USB 3.0 hub fully compliant with USB specifications.

2) Alternatively, HRR I can be triggered by any device with a BNC output capable of generating appropriate pulse signals.



Exemplary measurement setup in a test room including HRR I. In the presence of background noise, HMS II.3 has a conversation with a smart speaker.



While the smart speaker responds to its conversational partner, HRR I varies the echo path and thus allows to examine its echo attenuation performance.