Less noise • More sound

Application Note

Acoustical Setups for Mobile Phone Testing

Verifying the audio performance of a mobile phone after assembly is a core step of the entire QC procedure. Depending on the internal design of the phone and its interfaces, an individual setup must be applied.
This document summarizes the most frequently applied test setups. More information on the measurements are filed in NTI's application note „Mobile Phone Testing".

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1. Introduction

An acoustical test stand on a mobile phone production line has to meet the following constraints:

- Enabling measurement of the phone's RX (receive) and TX (transmit) path.
- Sufficient shielding against ambient noise (e.g. anechoic box).
- Proper acoustical coupling between the reference speaker or microphone and the phone under test.
- Establishing an electrical or RF link between the audio test system and the phone under test.

This document summarizes the most frequently used setups that fulfill the aforementioned requirements, depending on the internal design of the phone and its interface(s).
Please note that the 2-channel architecture of RAPID-TEST allows testing the RX & TX path of the phone in one single step: the system simultaneously transmits two independent test signals, whereby it analyzes the RX & TX path individually. However, this does not apply on the last approach (*chapter 2.4*), which should not be used except if no other method is applicable.

2. Test Setups

2.1 RX, TX test through service interface

Required: The phone must be configured so that it provides an internal link from its microphone and earpiece to the service interface.

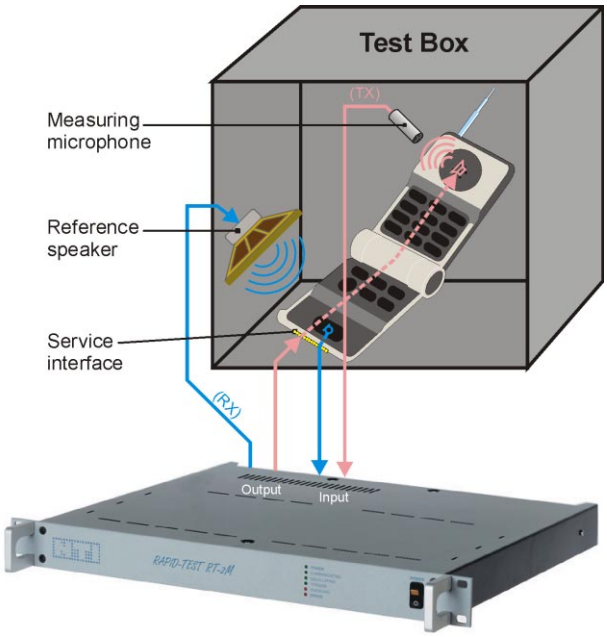

Fig. 1 RX, TX test through service interface

RX path: RT-2M transmits the test signal through the phone's service interface to the earpiece → the measuring microphone picks up the signal and returns it to the RT-2M analyzer.

TX path: Same principle as for RX path, whereby the signal is transmitted through a reference speaker and the phone's microphone to RT-2M.

2.2 RX, TX test through RF link and headset connector

Required: The phone has a headset connector through which the test signal can be transmitted or received to/from a RF link.

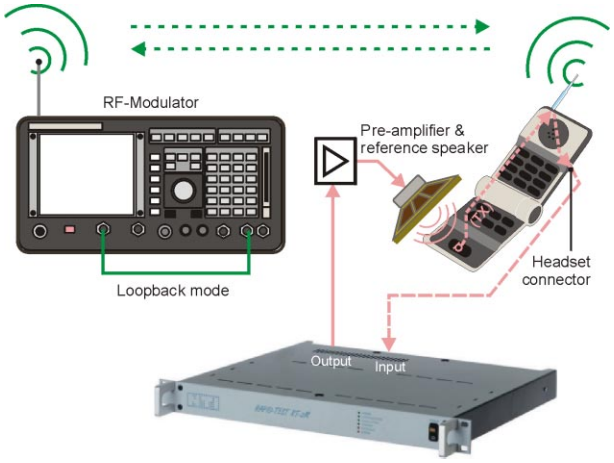

Fig. 2 TX test through RF link and headset connector

TX path: RT-2M transmits the test signal through the amplifier & reference loudspeaker to the phone's microphone → the phone sends out the signal to a RF modulator that is operated in the loopback mode, thus re-sending the received signal to the phone → the phone forwards the signal to the headset connector that is linked to the RT-2M analyzer.

RX path: same principle as for TX path, whereby the test signal is transmitted through the headset connector, the RF modulator and the phone's earpiece to a measuring microphone that is linked to RT-2M.

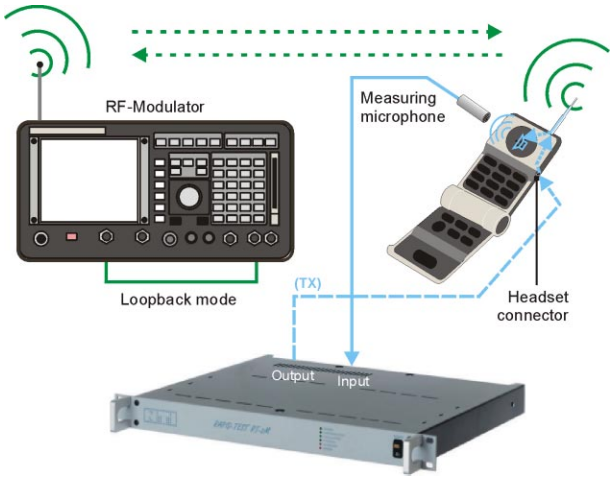

Fig. 3 RX test through headset connector and RF link

2.3 RX, TX test through RF modulator with audio signal breakout

Required: The phone has no electrical connector that can be linked to the test instrument, but the RF modulator comprises an „audio breakout", i.e. a connector that allows feeding the received and decoded audio signal directly to an external test instrument.

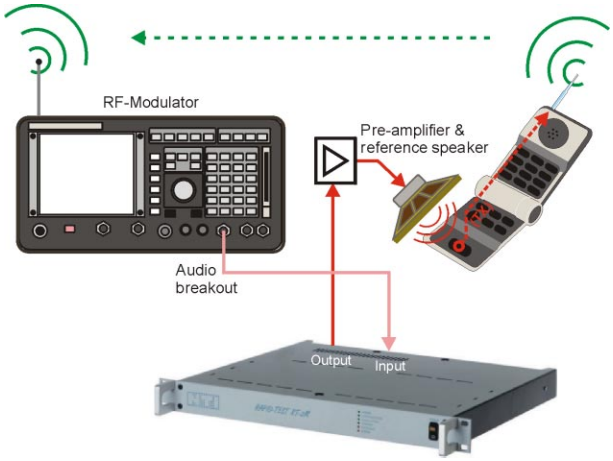

Fig. 4 TX test through RF modulator audio breakout

TX path: RT-2M transmits the test signal through the amplifier & reference loudspeaker to the phone's microphone → the phone sends out the signal to a RF modulator that feeds the audio signal back to the RT-2M analyzer.

RX path: same principle as for TX path, whereby the test signal is transmitted through the RF modulator and the phone's earpiece to a measuring microphone that is linked to RT-2M.

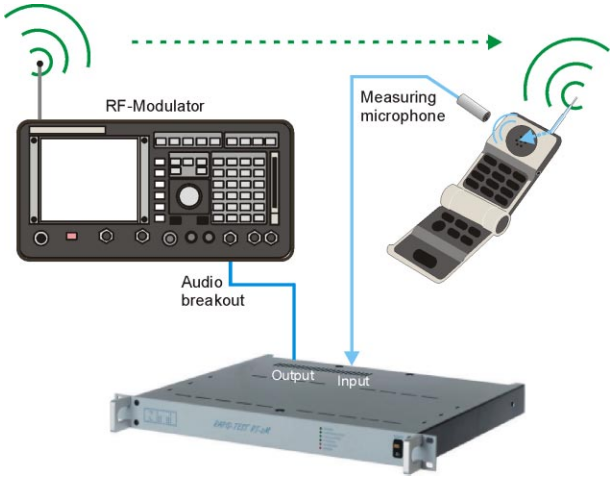

Fig. 5 RX test through RF modulator audio breakout

2.4 Simultaneous RX & TX test through RF link

Required: Same restrictions as described under *chapter 2.3*, whereby the RF modulator does not provide an „audio breakout". Please note that this setup is the least desireable since it includes the acoustical and electrical RX & TX path, thus making it impossible to exactly localize a fault.

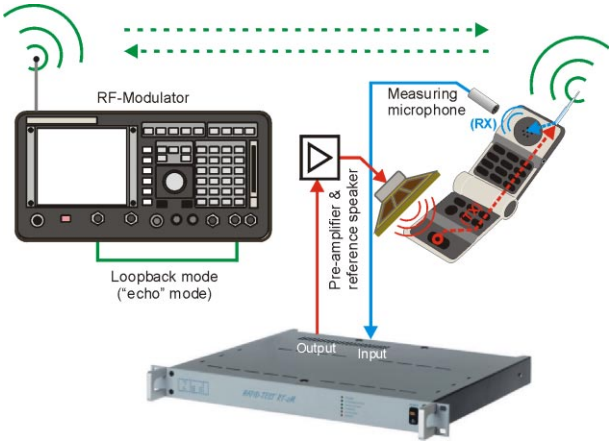

Fig. 6 Combined TX & RX test with RF modulator

TX & RX path: RT-2M transmits the test signal through the amplifier & reference loudspeaker to the phone's microphone → the phone sends out the signal to a RF modulator that is operated in the loopback mode (preferably with a time delay), thus re-sending the signal to the phone → the phone forwards the received signal at its earpiece, where it is picked up by a measuring microphone linked to the RT-2M analyzer.

NOTE Apply this setup only if none of the others is feasible.

3. Anechoic Test Box

Most production environments are rather noisy, thus compromising the audio test. To minimize this negative impact, it is necessary to protect the audio test stand against ambient noise.
The best way is to enclose the acoustical test stand in a solid box (typically made of wood) that damps external sound. Such boxes are typically made of wood and covered inside with sound absorbing material (e.g. foam or felt).

3.1 Construction hints

- Wooden box: heavy and stable (e.g. 22 mm MDF). All edges srewed and glued in order to make them 'soundproof'.
- Inner surface: as much of the inner surfaces as possible shall be covered by absorbing foam (or an equivalent material).
- Entry and exit: to avoid disturbing noise to enter, use a tunnel as narrow as possible, covered inside with absorbing foam. The tunnel on either side should be as long as possible, but at least half of the longest wavelength of the test signal used (typically 0.6 m). The tunnel may reach into the box.
- Window (optional): if you need a 'window' to look into the box, use acryl or plastic, screw it to a sort of 'window frame' and fix it as tight as possible to the box with some sort of rubber sealing in between.

NOTE Since the window has a reflecting surface, it must not be placed in a vertical angle to any other side of the box nor to the reference speaker.

- Box mounting: the box as well as the bottom shelf must not be fixed/screwed to the conveyer directly. Instead, they should lie/ stand on a flexible rubber sealing. This is to make the box soundproof and - even more important - to avoid structure born noise from the conveyor to be radiated into the box from the wooden surfaces.

3.2 Example

Fig. 7 shows a schematic example of such an anechoic test box.

- Decouple the measuring microphone from structure born noise by mounting it with shock absorbing fixtures.
- Place the reference speaker as close to the phone's microphone as possible.

NOTE ***In many applications, the conveyor belt does not go directly through the test box, but is located directly aside or below. In such cases, an operator or robot must transfer the phone under test into the box.***

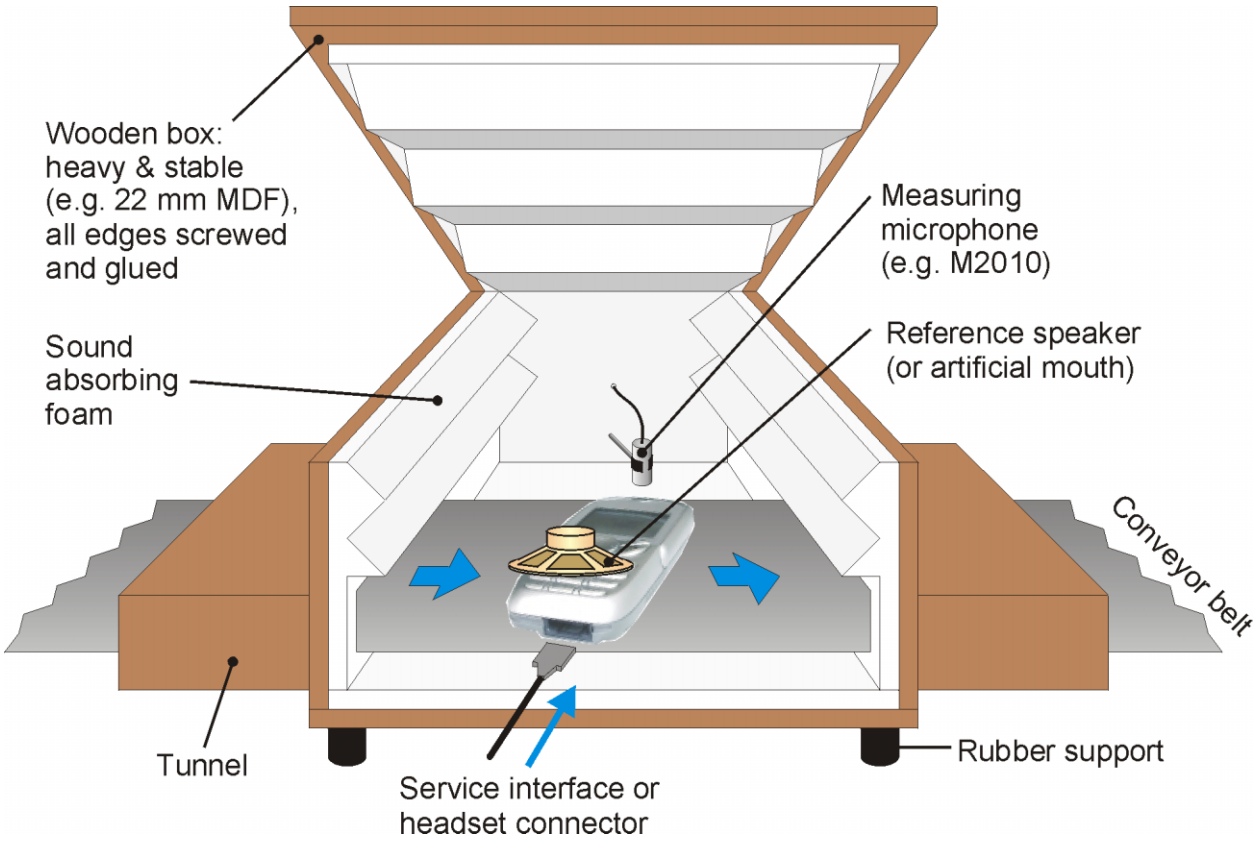

Fig. 7 Schematic example of an anechoic test box