

DATA SHEET

MFE VI (Code 6460)

Telecom Measurement Front End

Portable two-channel front end with software-controlled level adjustment



DESCRIPTION

MFE VI is a universal two-channel front end for measuring digital and analog (tele)communication components and networks. The battery power supply and the compact, lightweight design enable the use of MFE VI as a portable system for data acquisition and signal conditioning.

Due to the integrated digital echo path filter, it is particularly suited for the measurement of echo cancellers. The programmable digital signal processor (DSP) also allows the use of user-defined filters and, in combination with the BEQ option, the equalization of artificial head signals, all in real time.

Via Pulse in- and outputs (TTL levels) the measured devices can be controlled.

The USB port allows Plug&Play operation with any standard Windows® PC or notebook. MFE VI is controlled by an intuitive user interface via the communication analysis software ACQUA.

When measuring especially low or high input levels, the level of the analog inputs can be adjusted by software control in 10 dB steps from -40 to +20 dB.

Overview

The portable, cost-effective front end MFE VI forms the connecting link between data acquisition via the artificial head HMS II.3/II.4 and digital speech quality analysis with ACQUA. Connected to a notebook or PC via the Plug&Play USB port, it is configured and controlled by ACQUA.

Via MFE VI, ACQUA performs automated measurements according to international, HEAD acoustics or user-defined standards. MFE VI thus serves for problem solving, quality control, benchmarking and product optimization in many areas where the voice quality of communication devices and networks plays an important role.

In addition, MFE VI can be extended to a digital binaural equalizer (by software option).

MAIN FEATURES

DSP onboard

- Signal processing/filtering/equalization in real time
- Digital filters, e.g. for echo path simulation or as user-defined filters

Mobile use

- Battery power, min. 2 h operating time
- Compact design (hand luggage)
- USB port: no PCI slots required
- Can be used with notebook

User-friendly

- Plug&Play operation
- Control via intuitive Windows® software environment (ACQUA)

Universal

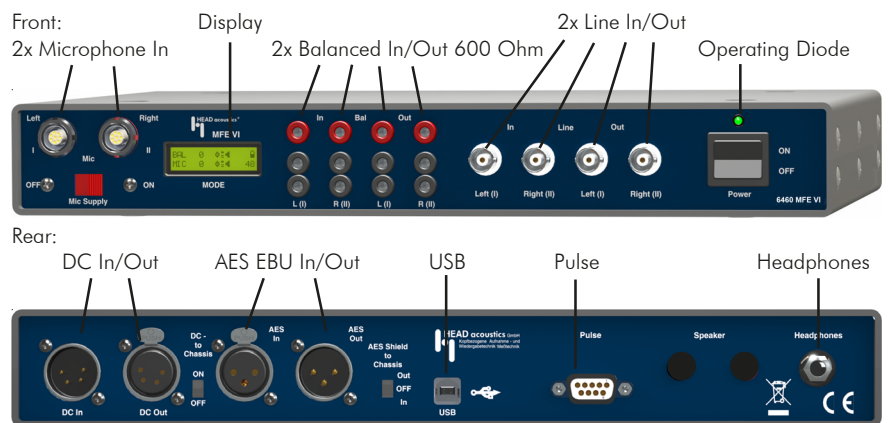
- Synchronizable in- and outputs, full duplex capabilities
- **IN:** 2x Balanced, 2x Line, 2x MIC, 2x Pulse, AES/EBU, USB 2.0
- **OUT:** 2x Balanced, 2x Line, 2x Pulse, Headphones, AES/EBU, USB 2.0
- Binaural equalizer (software option)
- High dynamic range, 24 bit technology
- On-line switching of external and internal supply, "smart charge" electronics

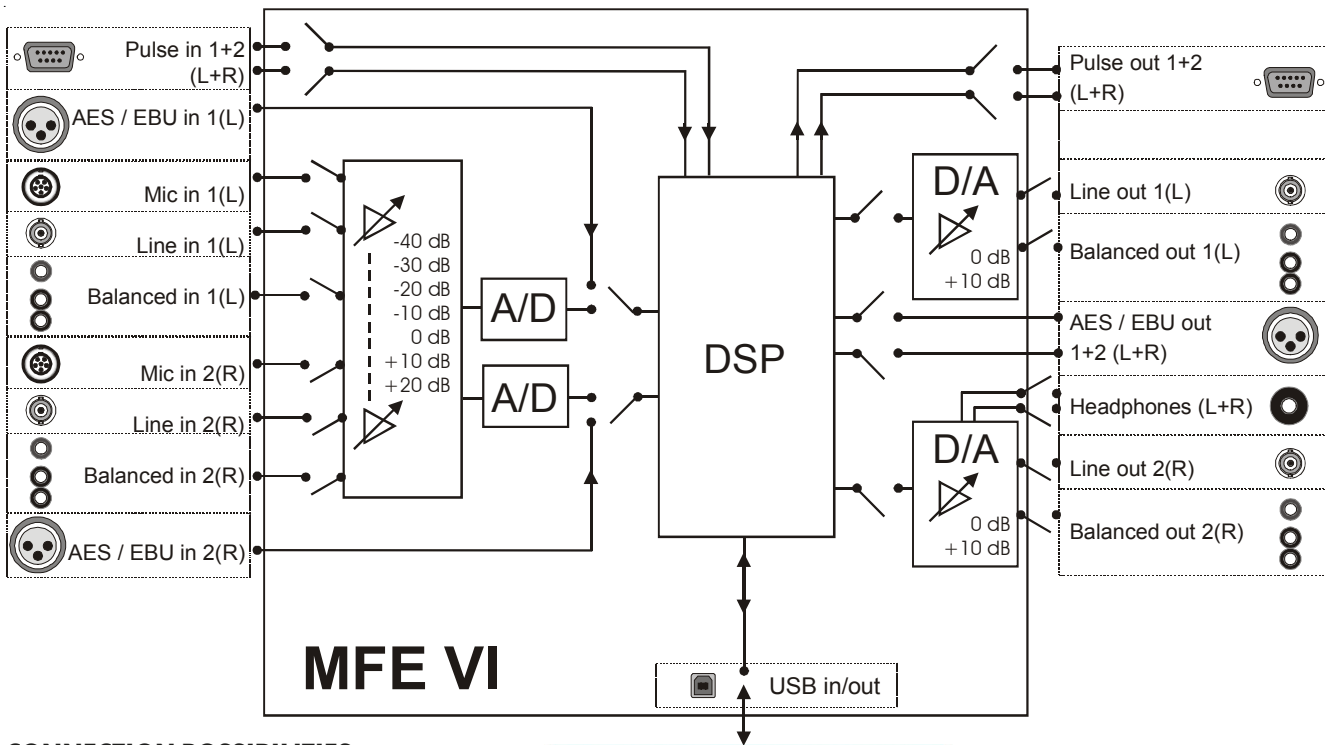
APPLICATIONS

- Electrical / electroacoustical binaural measurements of analog / digital (tele)communication devices / networks
- Particularly suited for measurement and control of echo cancellers (in real time)
- Use of non-linear echo paths, e.g. for simulation of loudspeaker distortions or housing vibrations
- Binaural equalizer (software option)
- Mobile data acquisition and analysis
- Direct impedance measurements

DEPLOYMENT AREAS

- Research and development: signal processing development, design validation, design ranking
- Manufacturing: production control with regard to voice quality, ensuring system performance and compliance to standards
- Providers and carriers: speech quality monitoring, troubleshooting
- Independent test labs: objective comparison of products from different manufacturers, custom-ordered speech quality tests
- Sales and marketing: demonstrating excellent quality of products tested and optimized with ACQUA and MFE VI





CONNECTION POSSIBILITIES

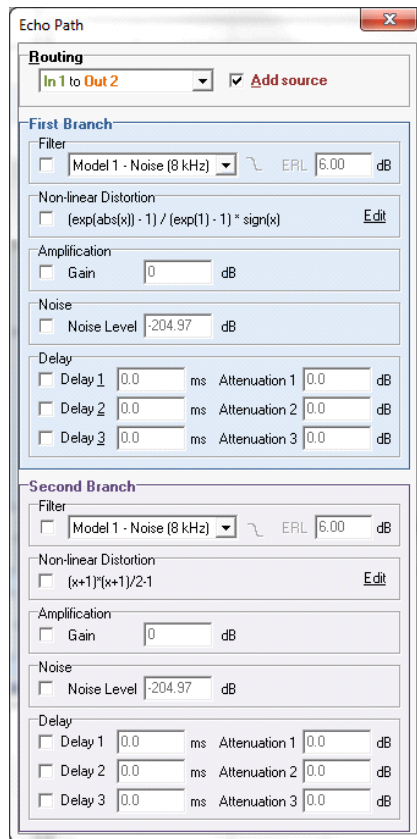
MFE VI has been developed for a wide range of applications and therefore offers numerous connection possibilities. The block diagram above gives a comprehensive overview.



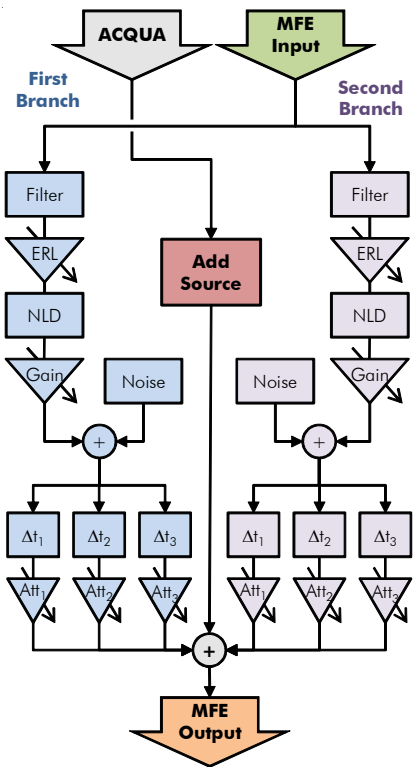
DIGITAL ECHO PATH

Due to the integrated digital echo path the frontend MFE VI is particularly suited for real-time measurement of echo cancellers. The pictures to the right show the function of the digital echo path which may consist of up to two branches:

- In addition to the assignment of the in- and output of the echo path, a source signal can be added.
- Eight different filters according to ITU-T Recommendation G.168 can be selected, each with two amplitude factors, i.e. 16 filters in total. An Echo Return Loss (ERL) value is automatically assigned to each filter which can be modified by the user. The default ERL values are also derived from ITU-T G.168. Moreover, a user-defined filter can be used (for sampling rates of 8, 16, 48 kHz).
- Non-linear distortions (NLD) can be used in the echo path, e.g. for simulation of loudspeaker distortions or housing vibrations.
- Gain and noise level can be set.
- Up to three parallel delay lines with a maximum delay of 900 ms can be defined. For each delay line an attenuation value can be determined.



Echo path settings in ACQUA

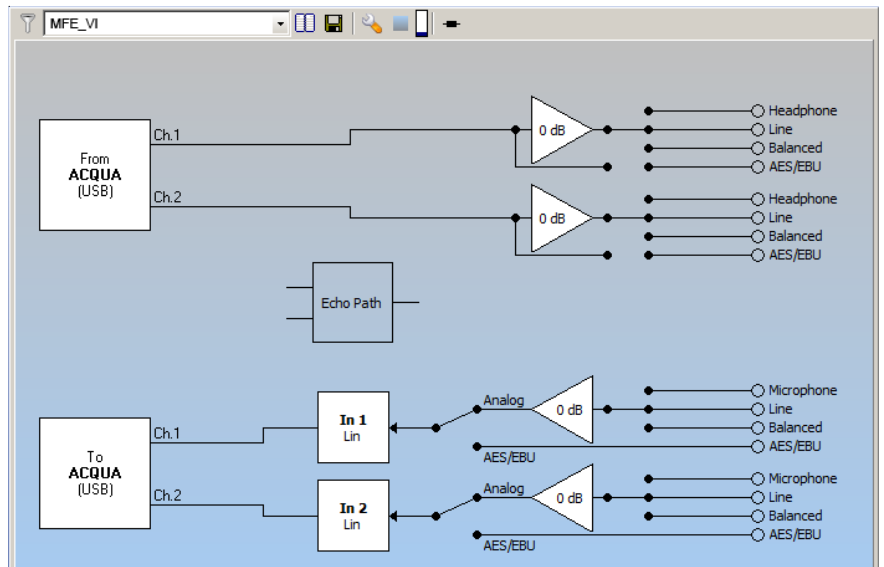


Echo path block diagram

SOFTWARE OPTION BEQ

By an optional software upgrade, MFE VI can be extended to a binaural equalizer. For this purpose, individual equalization filters for use with the corresponding artificial head are determined by HEAD acoustics and stored in the front end. These filters are then available in ACQUA for the following equalization types:

- **User:** user-defined equalization
- **Lin:** Linear (no equalization)
- **FF** - Free field equalization
In this case artificial head microphone signals for frontal sound incidence in a reflection-free environment are equalized so that a linear frequency-independent transfer response is obtained.
- **ID** - Independent of Direction
The outer ear transfer function can be sub-divided into two components. One is dependent on direction, the other is independent of direction. The directionally dependent one is affected by the diffraction and reflection resulting from external human geometry including the chest region, shoulder, head, edge of outer ear, cavum conchae opening. The independent-of-direction components result from resonances in the cavum conchae hollow and the ear canal entrance. ID equalization linearizes only those components of the transfer function produced by the independent of direction components. This independent of direction component of the outer ear function cannot be



determined by measuring techniques. It is the result of a purely mathematical calculation.

- **DF** - Diffuse field equalization
In this case the artificial head recording microphone is brought into a diffuse sound field and in turn equalized so that a linear frequency-independent transfer function can be measured.

In the ACQUA software module for control of MFE VI the desired type of equalization is selected via a context menu, which opens by right-clicking one of the input blocks.

The calibration values of the artificial head microphones are automatically read out from MFE VI by ACQUA and are transfer-

red for both channels into the list of calibration values in the window "Calibration Values". This window is evoked via the corresponding command in the ACQUA settings menu.

In the rows "Acoustic" and "Electric" of the window "Calibration Assignment" (also evoked via the ACQUA settings menu), the microphones which are used for reference measurements and measurements are subsequently selected. The measurement descriptors which use one of these calibrations (SMD parameter "Calibration & unit") automatically use the values of the microphones selected in the Calibration Assignment.

Technical data – MFE VI	
Overview Interfaces	
Input:	For all terminated inputs: THD+N \geq 95 dB (1 kHz) and nominal level (-6 dBFS), channel separation > 60 dB, amplification for each channel adjustable in 10 dB steps from -40 to +20 dB (nominal sensitivity 0 dBV), frequency range 20 Hz – 20 kHz \pm 0.3 dB, selectable filters: highpass 1 st order 180 Hz (\pm 10%) passive, highpass 3 rd order 22 Hz active
MIC In:	2 x at front, nominal sensitivity in normal mode 114 dB _{SPL} : 12.5 mVeff/Pa (calibratable), microphone voltage feed 120 V and 200 V
Balanced In:	2 x at front, symmetrical, 600 Ohm input impedance, nominal sensitivity 1 Veff at 0 dB gain, maximum input signal voltage approx. 9 Veff
Line In:	2 x at front, BNC, asymmetrical, nominal sensitivity 1 Veff at 0 dB gain, input impedance 50 kOhm, maximum input signal voltage approx. 9 Veff
Pulse In:	2 x at rear via D-Sub socket, limit frequency approx. 20 kHz, input sensitivity TTL level
AES EBU In:	1 x at rear, XLR, digital audio input
USB In/Out:	1 x at rear, universal serial bus 2.0 for control and data exchange with ACQUA
Output:	For all outputs: THD + N \geq 90 dB (1 kHz), frequency range 20 Hz – 20 kHz \pm 0.3 dB
Balanced Out:	2 x at front, symmetrical, 600 Ohm output impedance, nominal level 1 Veff for all sensitivities, max. level approx. 6V
Line Out:	2 x at front, BNC, nominal level 1 Veff for all sensitivities, output impedance approx. 10 Ohm, max. level approx. 6V; direct impedance measurement (approx. 4 – 350 Ohm) possible at Line Out 1
AES EBU Out:	1 x at rear, XLR, digital audio output
Headphones:	1x rear panel, 6.3 mm cinch socket, headphone type: dynamic, nominal level approx. -12dBV/ 250mV (at +10 dB output adjustment correspondingly higher), not calibratable, maximum current: approx. 30mA, headphones with low impedance (<50Ohm) can lead to distortions during high levels
Pulse Out:	2 x at rear via D-Sub socket, TTL level
Channel separation:	Typically > 90 dB (without equalization)
Digital unit	
Signal processor:	Motorola DSP56311 (120 Mips), 24 bit data processing
A/D converter:	24 bit resolution
Sampling rate:	Internal synchronization 32 kHz, 44.1 kHz, 48 kHz; alternatively: external synchronization via AES/EBU with 32 kHz, 44.1 kHz, 48 kHz
Filter:	Digital echo path filter
Digital equalizations (requires BEQ option):	Linear (Lin), Independent-of-direction (ID), Free-field (FF), Diffuse-field (DF), User-specific (USER)
Power supply	
On-line switching between external and internal supply, "smart charge" electronics	
External power unit - PSH I	
Input voltage:	100-240 V AC ~ 47-63 Hz
Max. input current:	0.65 A at 90 V AC
Output voltage:	15 V DC
Output current:	4 A
DC output:	XLR 4-pin
External DC power supply:	15 V DC nominal voltage (9-18 V, e.g. car circuit or external power unit PSH I.1)
Internal DC power supply:	NiMH rechargeable battery, 12 V, 2 Ah
Charging procedure:	Fast charge (max. 3 h), conservation charge
Operating time with battery:	Minimum 2 h
Current, power consumption:	Charging and operating (during power amplifier mode): 4 A / 60 W
Operation:	
Remote control:	Via ACQUA software (Version 2.5.100 or later)
System check:	Automatic hardware check of digital and analog units as well as A/D converter at system boot
Display:	2 x 16-digit LCD with LED background lighting for display of active in-/outputs and sensitivities on both channels
Environmental conditions	
Operating temperature range:	0°C - 45°C, 32°F - 113°F (in power amplifier mode: 0°C - 35°C, 32°F - 95°F)
Storage temperature range:	-20°C - 70°C, -4°F - 94°F
Air Humidity:	35 – 70 % (non-condensatory environment)
Housing	
Overall dimensions (WxHxD):	327 mm x 44 mm x 230 mm
Weight:	ca. 2.5 kg

STANDARD DELIVERY ITEMS

- **MFE VI (Code 6460):**
Two-channel analog/digital frontend (incl. USB cable, 1.5m)
- **PSH I.1 (Code 1364):**
External power supply, 100-240 V AC -> 15 V DC
- **PCC I.9x (Code 997x):**
Mains cable to local specification
- **Pulse Breakout Cable:**
D-Sub 9-pin \leftrightarrow 4 x BNC
- **User Manual**

ACCESSORIES

- **ACQUA (Code 6810)*:**
Advanced Communication Quality Analysis System
- **ACQUA Compact Systems (Code 68xx)***
- **HMS II.3-33/HMS II.3-34 (Code 1230.1/1230.2):**
Head and torso simulator including ear simulator and artificial mouth
- **HMS II.4-33/HMS II.4-34 (Code 1240.1/1240.2):**
Head and torso simulator including ear simulator
- **CTD II (Code 6078):**
Cable Telecom plug \leftrightarrow D-Sub 9-pin (for GSM/3G)
alternatively:
CTD III (Code 6081):
Cable Telecom plug \leftrightarrow D-Sub 9-pin (for CDMA)

OPTIONS

- **Software Option MFEVI-BEQ (Code 6461):** extends MFE VI to Binaural Equalizer

*ACQUA Version 2.5.100 or later required!

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