Instruction Manual

Charge / IEPE Conditioners

M72 Series

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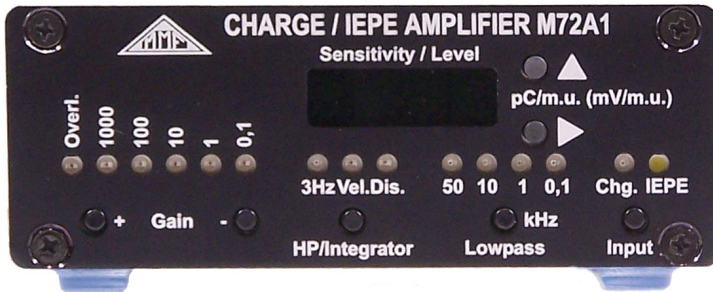   Declaration of Conformity

Figure 1: M72A1 front panel

Figure 2: M72A1 rear panel

The letter "x" in this manual stands for the channel number of the versions M72A1, M72B1, M72A3 and M72B3.

1. Application

The M72 Series Signal Conditioners are intended for connection of piezoelectric acceleration, force or pressure transducers. The input is suitable for sensors with charge output as well as for IEPE compatible transducers and microphones.

The M72 enables optimal adjustment of the sensor signal to existing measuring equipment or PC-based data acquisition systems. The Signal Conditioners provide the following functions:

• Adaptation of the sensor signal and sensor supply

• Amplification

• High- and low-pass filtering (for example anti-aliasing filter)

• Integration of the sensor signal, for instance, to measure velocity or displacement.

The instruments all have a robust aluminum housing making them suitable for work in the laboratory as well as under field conditions.

The following model variants are available:

Type	Channels	Sensitivity Standardization	TEDS[1]	Level Meter
M72A1	1	yes	yes	yes
M72A3	3	yes	yes	yes
M72B1	1	no	no	no
M72B3	3	no	no	no

1   Transducer Electronic Data Sheet

2. Function and Operation

Figure 3 illustrates the most important functional groups of M72 in a block diagram.
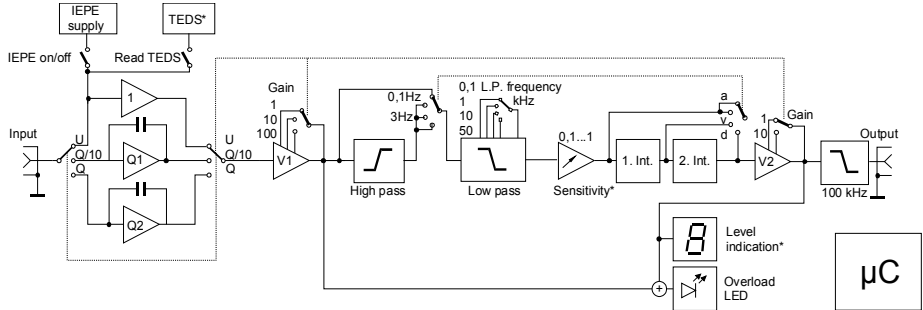

Figure 3: Block diagram (*these elements only with M72Ax and M72S1)

All functions are controlled by a microcontroller.

Depending on the position of the input switch, the input signal passes the impedance converter Q1 or Q2. If IEPE operation has been selected, the signal is transmitted to the amplifier via a buffer stage. During IEPE operation a constant current is fed into the input socket to supply the sensor electronics. With the M72Ax and M72S1 instruments the stored electronic data (TEDS) of selected IEPE sensors can be read out. If an AC voltage supply is to be connected to the input, the constant current supply can be switched off.

The input circuit is followed by the first amplifier stage, low pass and high pass filters. The high pass filter can be switched between 0.1 Hz and 3 Hz. The low pass filter has 4 frequency limits to choose from, including 0.1 / 1 / 10 / 50 kHz.

The sensor sensitivity of M72Ax and M72S1 can be entered to achieve finely tuned amplification. To aid this there is an adjustable damping stage after the filters.

The single and double integrators can be switched on to measure velocity and displacement, respectively.

A second amplification level follows subsequently. Due to the distributed amplification before and after the filter there is an overload reserve which is also applied to signal components outside of the filter or the integrator pass band. Simultaneously a high signal-to-noise ratio is achieved.

Before the output socket there is a driving stage with low pass filters to reduce disturbance. The output is DC coupled.

The overload LED lights up when the output signal is over 90% of the full modulation. It also signalizes the occurrence of overload before and after the filters and integrators.

The M72Ax and M72S1 instruments have a digital display which shows the modulation at the output as a percentage of the maximum value.

All settings are configured via the buttons. Five seconds after the last press of a button the instrument saves the current settings. This means that the last operating status remains even after the instrument has been switched off and on again.

The units with display M72Ax and M72S1 show the hardware version and the software version for one second each, after switching them on.

3. Power Supply and Mass

3.1. Grounding Concept

The inputs and outputs of the signal conditioners are single ended, i.e. asymmetrical. The signal ground is connected to the outer conductor of the input and output sockets.

The instrument housing is internally connected to ground.

The power supply is signal-referenced, i.e. the negative terminal is connected to ground.

3.2. External Power Supply

The M72 Signal Conditioners are powered by an external DC voltage

A mains plug adapter for 115/230 V AC with 12 V output voltage is supplied with the Signal Conditioners M72Ax and M72Bx. The power supply socket according to DIN 45323 is located at the rear of the instruments. Any DC voltage source of 7 V to 28 V DC and around 250 mA (for M72x1) or 750 mA (for M72x3) can be connected to this socket. The positive supply terminal is connected to the center pin (tip). The ON/OFF switch is located at the rear.

Models M72R1 and M72S1 are powered from the rack cases M72R8 or M72S8 via a 9 pin D-Sub connector at the rear side of the modules.

3.3. Sources of Errors

3.3.1. Avoiding Ground Loops

Earthing or ground loops are often the reason for measuring errors in multichannel measuring systems. In most cases you will find a superimposed 50 (60) Hz or 100 (120) Hz voltage on the measuring signal. One reason for this effect may be that the transducers are ground referenced not only via their cable at the signal conditioner, but also at the measuring point through their housing. Vibration transducers are often mounted at grounded machine parts. Within earthing systems transient currents may appear. These transient currents cause a potential drop across the earthing or grounding wires. Via the signal input of the amplifier they may result in a considerable measuring error.

To avoid this, insulated attachment of the transducers is recommended. Metra offers several industrial vibration transducers with an insulated mounting base and different insulating flanges for non-insulated sensors.

A star-shaped grounding network is the ideal solution to avoid ground loops. Star-shaped means that all grounding wires of the sensors and the amplifier outputs are tied to ground at the signal conditioners, without any transverse connections. In many cases this is more difficult to realize for the outputs than for the inputs, because the subsequent measuring equipment may have single-ended inputs. If you have the choice of using differential inputs, which can be found on many data acquisition boards, you should preferably use them.

3.3.2. Low-Frequency Noise

When the M72 is used with high gain and with the lower frequency limit of 0.1 Hz (high pass off) it may be sensitive to temperature transients. Even draft may result in output voltage fluctuation of some hundred millivolts at frequencies around 0.1 Hz. To reach thermal balance a warm-up time of some minutes is recommended before measurement. For measurements outdoors it may be advantageous to isolate the device by foam rubber or similar materials.

Piezoelectric sensors have the so-called pyroelectric effect which may cause similar disturbances. This phenomenon is particularly strong with compression type and bending type (beam) transducers. Here it is also important to maintain stable temperatures.

If lowest frequencies are not of interest the 3 Hz high pass should always be used. With the integrators (see Chapter 8.3) the 3 Hz high pass is always on.

4. Inputs

The Signal Conditioners M72 are designed for both sensors with charge output and sensors with integrated impedance converters to IEPE standards. Both input types use the same BNC input socket. Select the input type by pressing the "Input" button repeatedly. The current status is indicated by a blue LED for charge input or white for IEPE. If neither of the LEDs are lit, the instrument is running as a voltage amplifier without IEPE power supply.

4.1. Charge Input

Capacitive signal sources, usually piezoelectric sensors with charge output, are connected to the charge input. The input stage is a capacitive feedback amplifier, which transforms the sensor charge signal into a voltage. The ratio of output charge (U) to input charge (Q) is determined by the capacitance of the feedback amplifier (C).

$$U = \frac{Q}{C}$$

The M72 Signal Conditioners have two charge converter stages. At the lowest gain range a charge converter with a gain of 0.1 mV/pC is used. For the other gain ranges a charge converter with 1mV/pC is active.

To ensure that the output charge reverts to zero after a specified period of time without a charge signal, discharge resistors are located over the feedback capacities. The resistors are designed in such a way that a lower frequency limit of 0.1 Hz is obtained. This makes manual reset no longer necessary.

The advantage of charge measurement is that cable capacitance and insulation resistance have almost no influence on the measuring results. For sensors with charge output it is strongly recommended to use special low-noise cables. Ordinary cable will cause a considerable measuring error under mechanical stress, as a result of the so-called triboelectric effect. Cables with low insulation resistance, for example caused by humid connectors, reduce the accuracy of measurement at lower frequencies. A desirable insulation resistance is higher than 10 GΩ. Cables longer than 10 m are not recommended at the charge input. Proper shielding is also important.

4.2. IEPE Input

IEPE stands for "Integrated Electronics Piezo Electric". It has been established as the industrial standard for piezoelectric transducers. Other brand names for the same principle are ICP®, Isotron®, Deltatron®, Piezotron® etc. The integrated sensor circuit transforms the charge signal of the piezo-ceramics, with its very high impedance and high EMI sensitivity, into a voltage signal with low impedance. The converted signal can be more easily transmitted. At this signal ordinary low cost coaxial cable with a length of more than one hundred meters can be used.

A peculiarity of IEPE is that power supply and measuring signal use the same line. So, an IEPE transducer needs, like a transducer with charge output, only one single-ended cable. Figure 4 shows the block diagram. To separate the low impedance sensor signal from the power supply, the integrated circuit is supplied with constant current. This constant current must be fed into the measuring line and simultaneously separated from the subsequent amplifier stages.

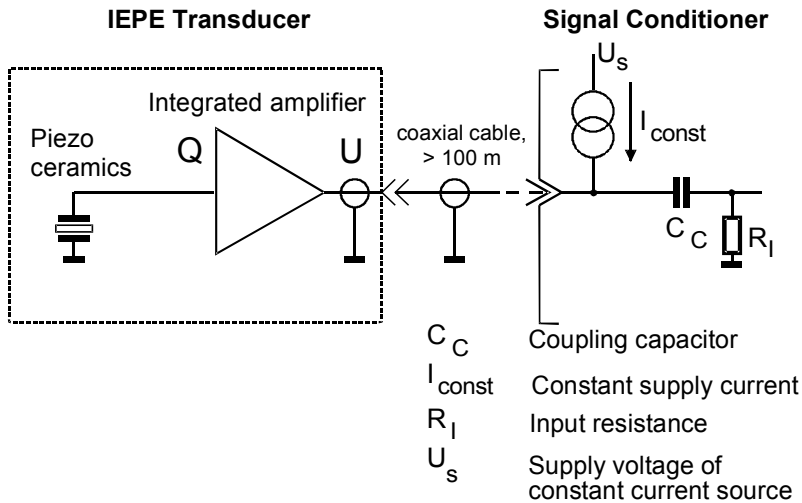The flow of constant current into the sensor it is indicated by the permanently lit white LED "IEPE".

Figure 4: IEPE Principle

By supplying the sensor with constant current a positive DC voltage arises over its terminals. This bias voltage depends on manufacturer and specimen and is usually between 5 and 15 V. The sensor signal is superposed on this bias voltage. The output voltage of the transducer never changes to negative values. Its minimum value is the saturation voltage of the integrated impedance converter (0.5 V to 1 V). The supply voltage of the constant current source determines the maximum value of the output voltage. For the M72 this voltage amounts to 24 V and guarantees an optimum dynamic range for all available sensors. Figure 5 shows these relations.

The M72 uses the bias voltage for an IEPE functional check. Sensor errors are indicated as follows:

- quick flashing (ca. 4 Hz) of white LED: IEPE bias voltage < 1 V
  → short circuit in the sensor cable or sensor

- slow flashing (ca. 1 Hz) of white LED: IEPE bias voltage > 20 V
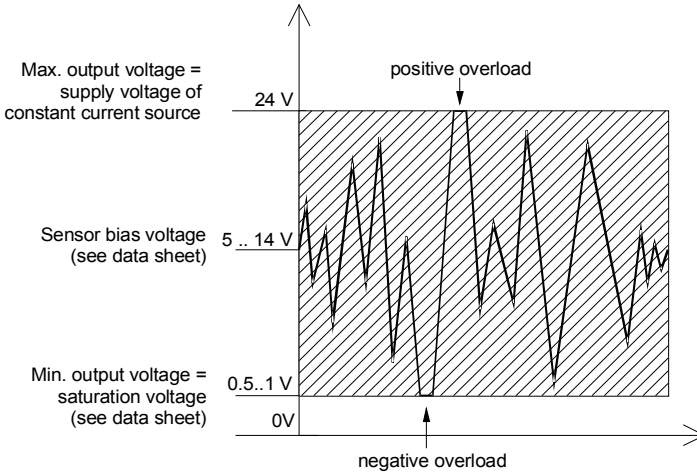 → open input or disconnected cable

Figure 5: IEPE Sensor Modulation Limits

4.2.1. Switching Off the IEPE Power Supply

In some cases it may be necessary to switch off the IEPE constant current supply in order to use the IEPE input as a regular AC input. In this case, press the "Input" button repeatedly until the blue and white LEDs switches off.

The input resistance of the amplifier is approximately 10 MΩ.

5. Amplifier

The M72 Series instruments have the following gain ranges:

Charge mode: 0.1 / 1 / 10 / 100 / 1000 mV/pC

IEPE mode: 1 / 10 / 100 / 1000 times or 0, 20, 40 and 60 dB.

The gain can be selected using buttons "Gain +" and "Gain -".

After switching the input the lowest amplification is automatically configured.

After connecting a sensor and sometimes after changing the measuring range, the amplifier needs a certain settling time because of short term overload. In this case it may take up to 30 seconds until the output voltage is free from DC components.

The amplifier output is buffered and DC coupled. Potential offset currents, which may subsequently be fed into the amplifier output by equipment such as a PC data acquisition board, do not cause a DC offset at the output.

6. Transducer Sensitivity (M72Ax / M72S1)

The output voltage of the M72Ax and M72S1 instruments can be scaled to result in a decimal ratio between the output voltage and the mechanical measurement quantities, for example 100 mV/ms^{-2} or 1 V/Pa. By this means a measuring chain will always yield the same output voltage per mechanical unit, independently of the sensor type.

To ensure these results the transducer sensitivity, also called the transfer factor, is required. In the case of accelerometers with charge output this is the charge transfer factor B_{qa}, and for IEPE accelerometers it is the voltage transfer factor B_{ua}. The charge transfer factor is stated on the calibration certificate or the sensor data sheet.

The transducer sensitivity can be entered in two ways:

1. Manually: to enter the sensitivity manually press ▲ or ► to switch from the modulation display to the sensitivity display. By pressing the button ► again the decimal point moves position. Press ▲ to increase the digits left of the decimal point by one. Enter all four sensitivity decimals consecutively. After this, position the decimal point to the right by pushing the button ►.

2. Automatically: when connecting a transducer with an electronic data sheet (TEDS) to IEEE 1451.4 (Templates 25, 27 or 28), the sensitivity is read automatically and appears briefly on the display.

The most recently entered sensitivity can be viewed at any time by a short press of ▲ or ►. It is also saved when the instrument is switched off.

By entering the sensor sensitivity (B) the selected gain (G) of the M72 is multiplied by a correction factor (K). The total resulting gain (G_{tot}) is:

$$G_{tot} = B \cdot K \cdot G$$

The correction factor (K) is calculated from the entered transducer sensitivity. In this calculation the decimal point is moved to give a numerical value of between 1 and 10. Then the reciprocal value is calculated. For this reason, the correction factor can only take values in the range of 0.100 to 1.000.

Consequently, the entered position of the decimal point for the sensitivity has no effect on the gain. The decimal point only provides the entry position and displays the transducer sensitivity. Even leading zeros have no influence. In this way, for example, the input of "2.570" results in the same gain as "025.7". It is nevertheless important to enter all known decimals.

Of most relevance to the user is the ratio between the output voltage and the measured mechanical quantity. For example:

The sensitivity of an accelerometer is B_{qa} = 18.25 pC/ms^{-2}. The selected gain is V = 100 mV/pC. The calculated correction factor is

$$K = \frac{1}{1,825} = 0{,}5479$$

Thus resulting in the total gain of:

$$G_{tot} = 18.25\,pC/ms^{-2} \cdot 0.5479 \cdot 100\,mV/pC = 1000\,mV/ms^{-2}$$

Upon switching the input type the sensor sensitivity is reset to 1.000.

7. Level Indicators

The red LED "Overload" warns of signal clipping by high magnitudes. The indicator switches on at around 9 V peak voltage. At 9 V the output signal is still without distortion, however, it is close to the limit.

The overload detector monitors the signal level at both the output and before the filters and integrators (see Figure 3). This ensures that high signal components occurring beyond the filter pass band are indicated, even though they do not appear at the output.

In addition, the M72Ax and M72S1 instruments display the modulation level via the digital sensitivity display if neither ▲ nor ► have been pressed for more than 5 seconds. The modulation is displayed as a percentage of the peak value (0 – 99 %). The display is updated every 5 seconds. For display values of over 80 % the gain should be decreased and for under 6 % it should be increased to yield an undistorted low-noise signal.

8. Filters and Integrators

8.1. Low Pass Filter

To eliminate disturbing noise or to comply with the Shannon theorem, it can be advantageous to use a low pass filter.

$$signal\ frequency < \frac{sampling\ frequency}{2}$$

Furthermore, for higher accuracy in the time domain the following is recommend:

$$signal\ frequency < \frac{sampling\ frequency}{10}$$

The M72 Series instruments have four internal low pass filters. To select the filter press the "low pass" button consecutively. The selected -3 dB frequency limits are indicated by four green LEDs in kilohertz.

The corresponding 10 % - limits are shown in the following table:

3 dB Frequency	10 % Frequency
100 Hz	80 Hz
1 kHz	800 Hz
10 kHz	8 kHz
50 kHz	45 kHz

The M72 has fourth-order Butterworth filters. The slope of the low pass filters is over 75 dB per decade. The frequency response is shown in 6.

8.2. High Pass Filter

The M72 Signal Conditioners have a high pass filter with a lower limiting frequency of 3 Hz (-3dB). This eliminates low frequency noise which may otherwise occur with piezoelectric compression accelerometers under the influence of temperature transients (see Chapter 3.3.2). The second-order Butterworth filter has a slope of 40 dB / decade. The 3 Hz high pass is switched on and off by pressing the "HP/Integrator" button. When the high pass is switched on the green LED "3 Hz" lights up. When the integrators are in use the high pass is always active.

If the high pass filter is switched off the minimal lower limit frequency of the amplifier, 0.1 Hz (-3 dB) is available.

The frequency response is shown in Figure 6.

8.3. Integrators

The M72 Signal Conditioners can measure non-integrated, single and double-integration sensor signals. Integration is particularly useful for vibration measurement with accelerometers on rotating machinery. Single integration of vibration acceleration generates velocity, whereas double integration generates displacement.

The "HP/Integrator" button activates the integrators. Single integration is indicated by the orange lit LED "Vel." (velocity) and double integration by the orange lit LED "Disp." (displacement). If there are no integrators in use then both lights remain switched off.

When the integrators are switched on the 3 Hz high pass filter is always activated.

The crossing point of the of the frequency response graph with and without integrators is 15.92 Hz (see Figure 6)

The following calculations show how the M72 output voltage u_{out} relates to the three vibration quantities, whereby the M72 configured voltage gain G_u in mV/mV and the accelerometers sensitivity B_{ua} (see data sheet) is:

Vibration acceleration a (without integration):

$$a = \frac{u_{out}}{G_u \cdot B_{ua}}$$

(a in m/s²; u_{out} in mV; G_u in mV/mV; B_{ua} in mV/ms^{-2})

Vibration velocity v (single integration):

$$v = \frac{u_{out}}{G_u \cdot B_{ua}} \cdot 10$$

(v in mm/s; u_{out} in mV; G_u in mV/mV; B_{ua} in mV/ms^{-2})

Vibration displacement d (double integration):

$$d = \frac{u_{out}}{G_u \cdot B_{ua}} \cdot 100$$

(d in μm; u_{out} in mV; G_u in mV/mV; B_{ua} in mV/ms^{-2})

The above equations apply to IEPE compatible accelerometers. Accelerometers with charge output are calculated in the same way with charge amplification G_q in mV/pC and the charge transfer factor B_{qa} of the transducers in pC/ms^{-2}.

Example:

With an accelerometer which has a sensitivity of B_{qa}= 5 pC/ms^{-2}, the velocity should be measured. The M72 operates with a charge amplification of G_q= 100 mV/pC. At the output a voltage of u_{out}= 300 mV$_{RMS}$ arises. How great is the measured velocity v?

Solution:

$$v = \frac{300}{100 \cdot 5} \cdot 10 = 6 \, mm/s_{eff}$$

The sensitivity settings (see Chapter 6) of the M72Ax and M72S1 instruments are also applied to the integrators.

At frequencies above 15.92 Hz the integrators generate smaller signal amplitudes due to their damping behavior. As a result of this the modulation declines, as does the signal-to noise ratio. As a guide value single integration should only be applied to frequencies up to 1000 Hz, and double integration up to 200 Hz.

For frequencies below 15.92 Hz, added gain occurs. In the case of double integrators this can be up to 12 times and cause the amplifier output to overload.

Overload may occur if there are larger signal components at high frequencies. Despite the fact that the output voltage is not overloaded as a result of integrator damping, the integrator input can nevertheless overload.

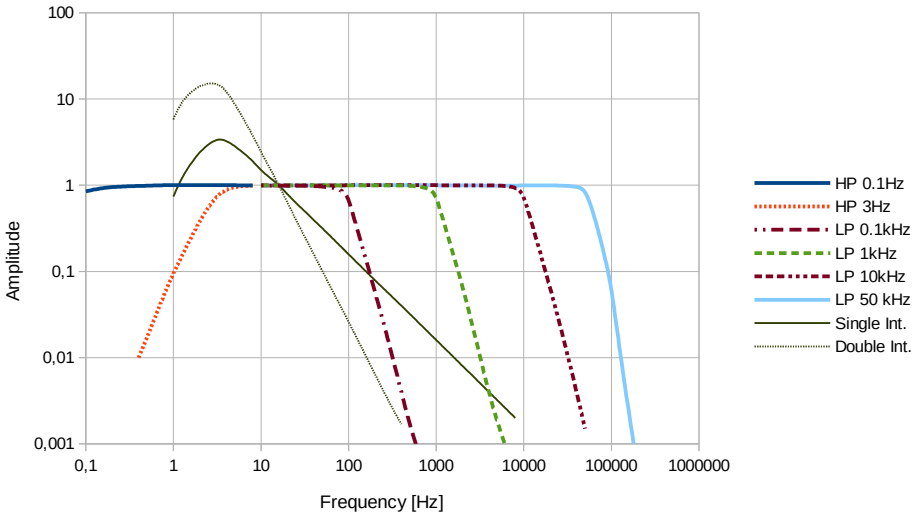The integrator frequency response curves are shown in Figure 6.)

Figure 6: Frequency Response of the Filters and Integrators

9. Keypad Lock

To protect the instrument from unwanted or unauthorized operation, the keypad lock can be activated. To activate the keypad lock, hold down the "Input" button for 5 seconds when switching on the power supply voltage. Now, the instrument will no longer respond to the press of a button. The keypad lock is deactivated by switching the instrument on and off again.

For M72R1 and M72S1 the keypad lock can also be activated via the USB interface (see Chapter 11).

10. Function Check and Calibration

We recommend calibrating your instrument at two year intervals.

Inside the housing there are no calibration points. All configuration is carried out via an internal serial interface.

Metra provides a factory calibration service in conformity with the reference standards of the German National Metrology Institute PTB (Physikalisch-Technischen Bundesanstalt).

Alternatively, our instruments may be calibrated in other calibration laboratories which carry out the necessary checks and settings.

Upon request Metra will provide a USB adapter cable and instructions for the calibration procedure.

11. Control via USB (M72R1 / M72S1)

11.1. Rack M72R8 and M72S8

The 19" rack enclosure can house up to eight M72R1 or M72S1 modules. The power supply is fed through the 9 pin D-Sub socket at the back of the amplifier modules (Figure 9). This socket also provides a serial RS-232 interface for communication with the rack enclosure. All functions of the amplifier modules are controlled via the USB port at the rear of the rack enclosure.

Figure 7: Rack enclosure M72S8 with tower feet (front and rear view, with 8 modules M72S1)

Figure 8: Rack enclosure M72R8 (front and rear view, without modules)

The power supply socket is also located at the rear side of the rack enclosures. It is a circular DC power connector for the supplied mains plug adapter or another DC source with 8 to 28 V and 2 A.
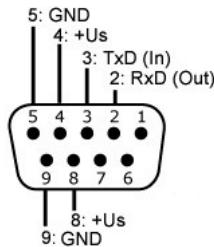

Figure 9: Contact assignment at the M72R1 and M72S1 (view at socket)
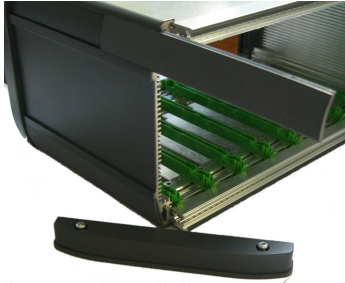
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For vertical use of the rack enclosures M72R8 and M72S8 an optional pair of tower feet is available (Figure 7).

For later attachment of the tower feet remove the left two plastic caps from the front side of the rack enclosure and unscrew the aluminum cover (Figure 10). Slide out the two plastic strips and slide in the two tower feet instead.

Figure 10: Disassembly of the front cover to attach tower feet

11.2. USB Interface

The M72R1 and M72S1 modules are configured within the rack enclosures M72R8 or M72S8 via a USB interface.

The first time you connect the rack casing to a PC you will be asked to install the device driver. The driver data file "MMF_VCP.zip" is located on the internet site

http://www.mmf.de/software_download.htm#m72.

Unzip and save both of the enclosed files to a directory on your computer. This directory will need to be entered when windows asks you for the device driver. The provided driver is signed and can run in Windows XP, Vista, 7, 8 and 10.

The computer will install a virtual COM port which runs in CDC mode. The advantage of the virtual COM port is that the modules can be controlled via ASCII commands in an uncompli-cated manner. Several rack enclosures can be connected to a PC at once, however, each rack en-closure requires its own USB port.

The addressing is carried our via a switch at the back of the rack enclosures. The configuration is hexadecimal from 0 to F.

11.3. Interface Commands

All commands are structured as follows: `#RMx..x`

The commands always begin with a hash symbol followed by the address (R) of the rack enclosure (0 to F). Next the address of the module (M) appears at its location in the rack enclosure. The address of the left module is 0 and the right module 7. Next, the actual commands appear (x). A command is saved when the `<CR>` symbol is sent. Permitted commands with valid parameters are acknowledged by `/a`. If a command is incorrect the answer is `/n`.

The M72 also answers with `/n` if a timeout occurs, i.e. if no `<CR>` is received within 100 ms after the last character (from version 001.006).

The following commands are supported:

#RMBnnnnnnnnnnnnnnnnnnnn: write device name
    n: name (exactly 20 capital letters, spaces or numbers)
    command acknowledgment: `/a<CR>`
    error at invalid parameters: `/n<CR>`
    Send example:
    `#B1BMEASURING POINT NO 1`

#RMD: set default parameters
    command acknowledgment: `/a<CR>`

#RME: save all settings to non-volatile memory (from version 001.005)
    command acknowledgment: `/a<CR>`

#RMGg: set gain
    g: gain   0: 0.1 (only with Q); 1: 1; 2: 10; 3: 100; 4: 1000
    command acknowledgment: `/a<CR>`
    error at invalid parameters: `/n<CR>`
    Send example:
    `#11G1` (Gain = 1)

#RMHh: high pass / integrator on/off
    h: 0: high pass off; 1: high pass on; 2: single integrator; 3: double integrator
    command acknowledgment: `/a<CR>`
    error at invalid parameters: `/n<CR>`
    Send example:
    `#10H0` (high pass off)

#RMIi: select input
    i: 0: charge input; 1: IEPE input; 2: voltage input (without IEPE supply)
    command acknowledgment: `/a<CR>`
    error at invalid parameters: `/n<CR>`
    Send example:
    `#21I1` (IEPE input)

#RMKk: keypad lock on/off
    k: 0: keypad lock off; 1: keypad lock on
    command acknowledgment: `/a<CR>`
    error at invalid parameters: `/n<CR>`
    Send example:
    `#K1` (keypad lock on)

#RMLl: select low pass
l: 0: 0.1 kHz; 1: 1 kHz; 2: 10 kHz; 3: 50 kHz
command acknowledgment: /a<CR>
error at invalid parameters: /n<CR>
Send example: #B5L3   (50 kHz)

#RMO: overload condition (from version 001.005)
Answer:
0   no overload since last #O command
/a

1   at least one overload occurred since last #O command
/a

#RMSsssss: enter transducer sensitivity
s: sensor sensitivity, 4 digits with the decimal point after 1st to 4th position
command acknowledgment: /a<CR>
error at invalid parameters: /n<CR>
Send example: #00S101.2

#RMX: read settings
Answer:

aaaaa hhh.vvv	a: device type (,,M72R1" or M72S1");
nnnnnnnnnnnnnnnnnnnn	h: hardware version (3 numbers);
IiGgHhLlSsssss	v: software version (3 numbers)
	n: device name (20 characters)
	i: input (1 number)
	g: gain (1 number)
	h: high pass / integrator (1 number)
	l: low pass (1 number)
	s: sensitivity (4 numbers and decimal point)

Answer example: M72S1 001.002
                  CHARGE AMPLIFIER
                  I1G1H1L3S1.000
                  /a

#RMY: Read calibration values
Answer:

ccccc	c: 12 calibration values, 5 digits each
...	(7 x charge; 4 x voltage, 1 x zero corr.)
ccccc	

Answer example: 10001
                  10010
                  09981
                  09878
                  09999
                  10021
                  09580
                  10120
                  10002
                  10045
                  09876
                  00002
                  /a

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11.4. Setup Tool for M72R8 / M72S8 Rack Cases

The PC software tool is intended to set the M72R1 and M72S1 Charge / IEPE Signal Conditioners in M72R8 or M72S8 rack cases via USB. All settings of the signal conditioners can be controlled from the PC. The settings can be saved to and restored from files.

The program is compatible with Windows XP, Vista, 7, 8 and 10.

Please download the zip compressed file *m72x8.zip* from our web page

http://mmf.de/software_download.htm#m72

and unzip it on your PC. In the extracted folder start *setup.exe* and follow the instructions. You may change the installation folders but in most cases the default folders can be used. In addition to the program the LabView runtime environment from National Instruments will be installed (if not done yet) which may take some time.

Go to the start menu of your PC and click under *Programs* / *Metra Radebeul* on *VS1x*. The program window opens as shown in Figure 11.
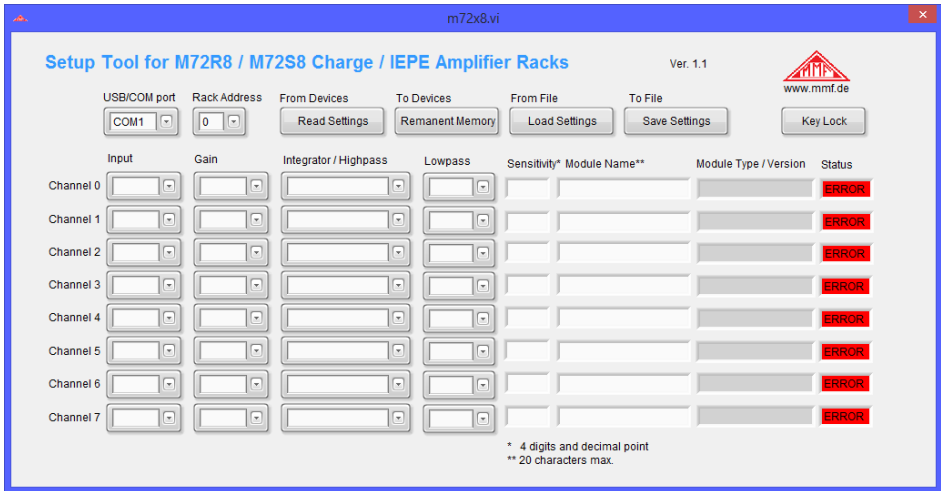

Figure 11: Blank Program window

The rack case M72R8 or M72S8 should now be connected to the PC and the device driver installed as described in section 11.2. When the driver is properly installed each rack case will be automatically assigned to a virtual COM port. The COM port number can be seen in Windows under Control Panel / System / Device Manager. Several rack cases can be operated on one PC by using different USB ports or a USB hub. Each one will be assigned to an individual COM port.

Select the virtual COM port of the rack case in the pull-down menu *USB/COM port* of the setup program.

Enter the *Rack Address* (0 to F) as adjusted by the DIP switch on the rear panel of the rack case. Now a connection to the rack case and its modules can be established. Click *Read Settings* to transfer the current settings of the 8 modules in the addressed rack case. The modules from the left to the right are numbered in the software as *Channel 0* to *Channel 7*.
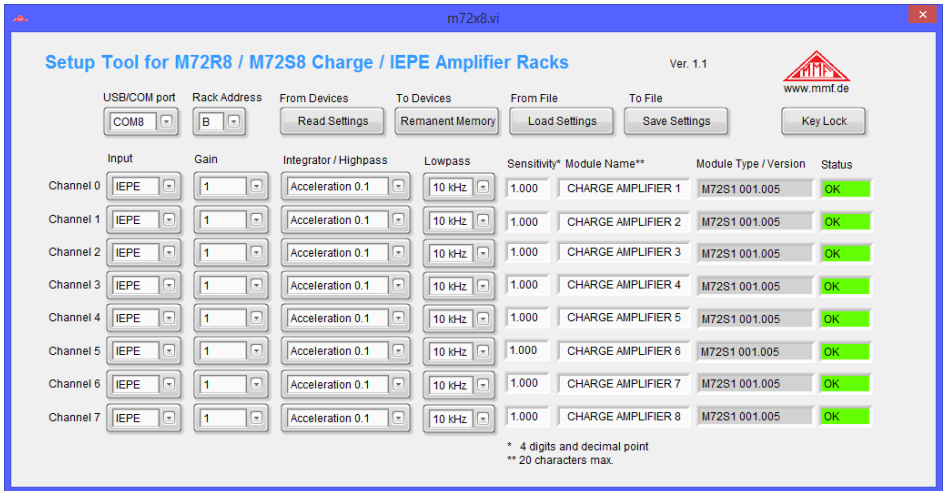
Figure 12: Program window with loaded settings

Figure 12 shows the program window with the settings for eight modules. The eight channels of the addressed rack case are listed in rows. In the column *Input* you can select the input type. The types Charge, IEPE and Voltage are available. Under *Gain* the amplification is set for each module. The gain can be 0.1 (only for charge), 1, 10, 100 and 1000. Under *Integrator / Highpass* you can select acceleration from 0.1 or 3 Hz, velocity or displacement. Four *Lowpass* filters of 0.1, 1, 10 and 50 kHz are selectable. Transducer *Sensitivity* is entered as 4 digit number with decimal point. The decimal point is mandatory. It must not be before the first digit. Valid examples are "0.123", "1.234", "12.34", "123.4" or "1234.". *Module name* is a 20 character text for the identification of the channel. Only letters and numbers are allowed. Letters are converted into upper case. Module names with less than 20 characters are filled with spaces on the left side.

The settings are transferred to the M72 immediately after entering. Valid entries are confirmed in the *Status* column by *OK*. Invalid entries are indicated as *ERROR*.

Please note that settings transferred via the digital interface are not stored in the non-volatile memory of the M72 modules. This means that the M72 modules will be reset to the previous condition which was set via the front panel if the power supply is interrupted. If you want to keep your settings after switching off the device please click the button "Remanent Memory". This will store all settings in the non-volatile memory of the M72 modules.

The program also indicates type and version of the plugged in modules.

Click *Key Lock* to disable the front panel keys of all modules. The button becomes yellow when the keys are locked. The key lock can be released by clicking the button again or by switching the power supply off and on.

To save the entered settings to a file click *Save Settings*. Select a folder and enter a file name. The program will automatically append the extension ".xml".

You can reload the saved settings by clicking *Load Settings*. Select the ".xml" file and click OK. The loaded settings will be transferred to the M72 modules immediately.

The program is based on LabView 2014. Metra provides the source code on demand.

12. Technical Data

Measuring Inputs	Charge, AC voltage and IEPE BNC socket, single-ended
IEPE Sensor Supply	3.5 to 4.5 mA constant current, compliance voltage >24 V, switchable, IEPE function check with LED
TEDS Support*	IEPE 1451.4, Template No. 25 for accelerometers and force trans- ducers, with and without transfer function, Templates 27 and 28 for measuring microphones, only reads the sensitivity.
Gain	0.1 / 1 / 10 / 100 / 1000 mV/pC (charge) 1- / 10- / 100- / 1000 fold; 0 / 20 / 40 / 60 dB (voltage / IEPE)
Sensitivity Configuration*	16 bit digital-analog converter, 0.100 … 1.000 fold, 4 digit, 7 segment LED display
Accuracy	$\pm$ 0.5 % of measuring value at modulation > 10 % of the full-scale value, at the center of the frequency band
Low Pass Filter (-3dB)	0.1 / 1 / 10 / 50 kHz, 4-pole, Butterworth, damping 75 dB/decade
High Pass Filter (-3 dB)	3 Hz, 2 pole, Butterworth, 40 dB/decade, selectable
Frequency Range with Integrators	Single integration: 3 to 1000 Hz Double integration: 3 to 200 Hz Crossing point of the integrator frequency response graph with the non-integrated frequency response graph: 15.92 Hz
Output	$\pm$ 10 V$_S$, DC coupled, Offset error < 10 mV, R_a = 50 Ω, BNC socket, single ended
Output Noise with Charge Input	Measured at the output with band width 1 Hz to 100 kHz: < 6 mV$_{RMS}$ (filter 0.1 Hz to 50 kHz, gain 1000 mV/pC) < 3 mV$_{RMS}$ (filter 0.1 Hz to 10 kHz, gain 1000 mV/pC) Referred to input: < 6 fC$_{RMS}$ (filter 0.1 Hz to 50 kHz, gain 1000 mV/pC) < 3 fC$_{RMS}$ (filter 0.1 Hz to 10 kHz, gain 1000 mV/pC)

Output Noise with IEPE Input	Measured at the output with band width 1 Hz to 100 kHz: < 7 mV$_{RMS}$ (filter 0.1 Hz to 50 kHz, gain 60 dB) < 3 mV$_{RMS}$ (filter 0.1 Hz to 10 kHz, gain 60 dB) Referred to input: < 7 µV$_{RMS}$ (filter 0.1 Hz to 50 kHz, gain 60 dB) < 3 µV$_{RMS}$ (filter 0.1 Hz to 10 kHz, gain 60 dB)
Overload Indicator	LED, > 90 % of full modulation
Modulation Display*	0 to 99 %, 7 segment LED display
Power Supply	7 to 28 VDC, 250 .. 60 mA (per channel) plug connection DIN 45323
Mains Plug Adapter	Input range 100 .. 240 VAC, 50 / 60 Hz with 2 pole plug, available types: EU (standard) or AU, UK, US Output: 12 VDC / 0.5 A (M72x1) or 12 VDC / 1.6 A (M72x3)
Warm-up Time	15 minutes
Operating Temperature	-10 to 55 °C, 95 % relative humidity, no condensation
Dimensions (B x H x T)	105 x 43 x 95 mm³ (M72A1) 105 x 37 x 95 mm³ (M72B1) 105 x 104 x 95 mm³ (M72A3) 105 x 78 x 95 mm³ (M72B3) 8TE x 3HE x 170 mm (M72S1) 6TE x 3HE x 170 mm (M7RS1)

* Only for instruments M72Ax and M72S1

Limited Warranty

Metra warrants for a period of

24 months

that its products will be free from defects in material or workmanship

and shall conform to the specifications current at the time of shipment.

The warranty period starts with the date of invoice.

The customer must provide the dated bill of sale as evidence.

The warranty period ends after 24 months.

Repairs do not extend the warranty period.

This limited warranty covers only defects which arise as a result
of normal use according to the instruction manual.

Metra's responsibility under this warranty does not apply to any
improper or inadequate maintenance or modification
and operation outside the product's specifications.

Shipment to Metra will be paid by the customer.
The repaired or replaced product will be sent back at Metra's expense.

Declaration of Conformity

According to EMC Directive 2014/30/EC

Product: Charge/IEPE Conditioners

Type: M72A1/M72B1/M72B1/M72B3/M72R1/M72S1/M72R8/M72S8

It is hereby certified that the above listed products comply
with the demands pursuant to the following standards:

DIN EN 61326-1: 2013
DIN EN 61010-1: 2011
DIN 45669-1: 2010

The producer is responsible for this declaration

Metra Mess- und Frequenztechnik in Radebeul e.K.
Meißner Str. 58, D-01445 Radebeul

declared by

Michael Weber
Radebeul, April 22, 2016