Manfred Weber
Metra Mess- und Frequenztechnik in Radebeul e.K.
D-01445 Radebeul Meißner Str. 58 Internet: www.MMF.de
Tel. +49-351-836 2191 Fax +49-351-836 2940 Email: Info@MMF.de

Operator´s Manual
Charge Preamplifier
IEPE100

Application

The IEPE100 is a Charge Preamplifier or Remote Charge Converter for piezoelectric transducers with charge output. These can be accelerometers and force or pressure transducers.

The IEPE100 provides an IEPE compatible signal at the output.

Transducers with charge output are preferred in cases where they are superior to an IEPE output. This may be for example, when taking measurements at high temperatures, shock measurements with very high dynamics or in use with specific low size and weight requirements.

The integrated circuit of the Charge Preamplifier transforms the charge signal of the ceramic element, with its very high impedance and high sensitivity against interference, into a voltage signal with low impedance. This signal can be transmitted and processed much more easily than the high impedance charge signal.

The abbreviation IEPE means “Integrated Electronics Piezoelectric”. It has been established as the standard for the output signal of piezoelectric transducers and microphones. Manufacturers' brand names for the same principle also include ICP®, CCLD, Isotron®, Deltatron® and Piezotron®.

Function

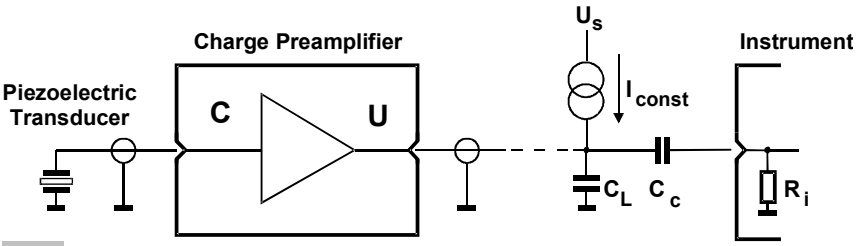

Figure 1: The IEPE principle

Figure 1 shows the construction of a measurement chain with the IEPE100. The signal produced by the ceramic or quartz element of the transducer is transmitted via a special low noise cable to the Charge Preamplifier input. The signal is then amplified and transformed into a low impedance IEPE output signal.

A distinguishing feature of the IEPE principle is that the power supply of the amplifier and its output signal are transmitted via the same cable. A simple shielded signal cable, without the need for any special features is sufficient in this case. Cable lengths of a few hundred meters are permissible.

The IEPE Charge Preamplifier is supplied with constant current, which is fed into the measuring line. When feeding the IEPE Charge Preamplifier with constant current, a positive DC voltage of approximately 13 V arises at the output. The measuring signal may oscillate around this bias voltage with an amplitude of ± 5 V.

In Figure 1 U_S is the supply or compliance voltage of the constant current source fed into the measuring line. C_L is the capacitance of the cable. The capacitor C_k decouples the constant component of the Charge Preamplifier from the subsequent measuring device. In this way a low impedance AC voltage measuring signal is produced, which can then be processed with standard measurement technology, such as analyzers, data loggers or oscilloscopes.
Many measuring instruments have an inbuilt IEPE compatible input with an integrated constant current supply and a coupling capacitor. Metra's power supply unit M28 or the measurement amplifiers M32, M68 and M208 are also suitable for constant power supply and signal output coupling (Figure 2);

Figure 2: Metra's IEPE Measurement Amplifiers

The output voltage of a measuring chain consisting of a piezoelectric accelerometer and a Charge Preamplifier is the product of the acceleration at the measuring point (a), the charge sensitivity of the transducer (B_{qa}) and the gain of the Charge Preamplifier (B_{uq}):

$$U_a = a * B_{ua} * B_{uq}$$

Adjustment of the Amplifier

The IEPE100 includes 3 gains:

Gain 1: 0.1 mV/pC

Gain 2: 1 mV/pC

Gain 3: 10 mV/pC

It is equally well suited for measuring both high amplitude shocks and sensitive vibrations. The amplification level is adjusted by turning the 6 DIP switches located inside the case (Figure 3). First take off the outer casing by removing a screw. In the middle of the circuit board you will see a block containing 6 switches. The switch direction is labeled “ON”.

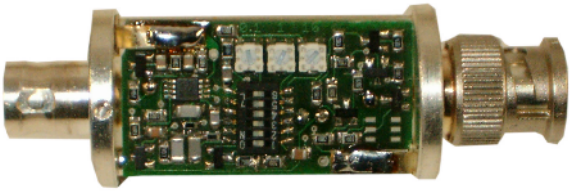

Figure 3: An open case showing the DIP switches for selecting the gain level

The gain settings are as follows:

Switch No.	1	2	3	4	5	6
0.1 mV/pC	ON	OFF	OFF	ON	OFF	OFF
1 mV/pC	OFF	ON	OFF	OFF	ON	OFF
10 mV/pC	OFF	OFF	ON	OFF	OFF	ON

Alternative settings result in an irregular operating function.

The amplification setting can be marked on the label of the case with a smear-resistant marker pen.

Note: The three potentiometers are for gain adjustment and may only be altered when carrying out a calibration.

Connection

Input and output are single ended. Both ground terminals are connected to the case.

The piezoelectric transducer is connected to the Charge Preamplifier via a BNC socket. Due to the high sensitivity of the charge input to interference a special low noise cable needs to be used. Suitable low noise cables available at Metra are:

Type	**Transducer socket**	**Maximum temperature**	**Cable diameter**	**Cable length**
009-UNF-BNC-1.5	UNF10-32 (Microdot)	120 °C	2.1 mm	1.5 m
010-UNF-BNC-5	UNF10-32 (Microdot)	120 °C	2.7 mm	5 m
010-UNF-BNC-10	UNF10-32 (Microdot)	120 °C	2.7 mm	10 m
009-SUB-BNC-1.5	Subminiature M3	120 °C	2.1 mm	1.5 m
010-TNC-BNC-1.5	TNC	120 °C	2.7 mm	1.5 m

With other cables the shielding effect against electromagnetic fields is often insufficient. With mechanical strain, such as bending strain, an interference signal as the result of a so-called triboelectrical effect, may falsify the measuring value. With special low-noise cable material this effect has been minimized by coating the dielectric with a conductive plastic layer.

Important:

- The transducer cable should always be kept to a minimum length. A length of more than 10 m is not recommended.
- Any contamination of the input socket must be avoided.

The cable between the Charge Preamplifier and the measuring instrument, however, may have a length of more than some 100 m. It is connected to the Charge Preamplifier with a BNC plug. If the cable already has a plug, then a BNC coupler can be used. Standard coaxial cable is sufficient for this purpose. Please pay attention to the low inner capacitance of the cable. The inner capacitance of the cables offered by Metra is around 100 pF per meter. Cables with greater capacitance reduce the dynamic range at higher frequencies. By increasing the constant current, the dynamic range is again widened. In this way, for example, with a cable capacitance of 20 nF (approx. 200 m length), the full dynamic range of ±6 V at 20 kHz is only reachable with constant current of 20 mA.

Technical Data

Input	Charge input, BNC socket
Output	IEPE compatible output, BNC plug
Gain	0.1 / 1 / 10 mV/pC ± 2 %, DIP setting options
DIP switch life	> 2000 switching operations
Output voltage*	> ± 5V
Measuring range*	± 500 pC / ± 5000 pC / ± 50 000 pC
IEPE power supply	Constant current 4 to 20 mA, compliance voltage > 20 V
Adjustment of amplification with constant current	± 0.8 % from 4 to 20 mA
Frequency range*	0.5 Hz to 23 kHz (- 5 %) 0.2 Hz to 33 kHz (-10 %) 0.1 Hz to 65 kHz (-3 dB)
Output impedance	< 100 Ω
Noise voltage at the output*	< 50 µV; RMS 0.1 Hz to 50 kHz
Output bias voltage	11 to 16 V, dependent on constant current and temperature
Over voltage protection at the input	50 V impulse
Operating temperature range	-40 to 80 °C
Temperature coefficient of the gain	-0.02 %/K

*measured with 1 nF transducer capacitance and 1 nF cable capacitance at 4 mA constant current.

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.

CE

Declaration of Conformity

Product: Charge Preamplifier

Type: IEPE100

Hereby is certified that the above mentioned products comply with the demands pursuant to the following standards

EN 61326-1: 2006

The producer responsible for this declaration is

Metra Mess- und Frequenztechnik
in Radebeul e.K.

Meißner Str. 58, D-01445 Radebeul

Declared by

Michael Weber

Radebeul, 3rd April 2012