Operator's Manual

Multichannel Signal Conditioners

M108
M116

Metra Mess- und Frequenztechnik Radebeul

Meissner Str. 58 - D-01445 Radebeul

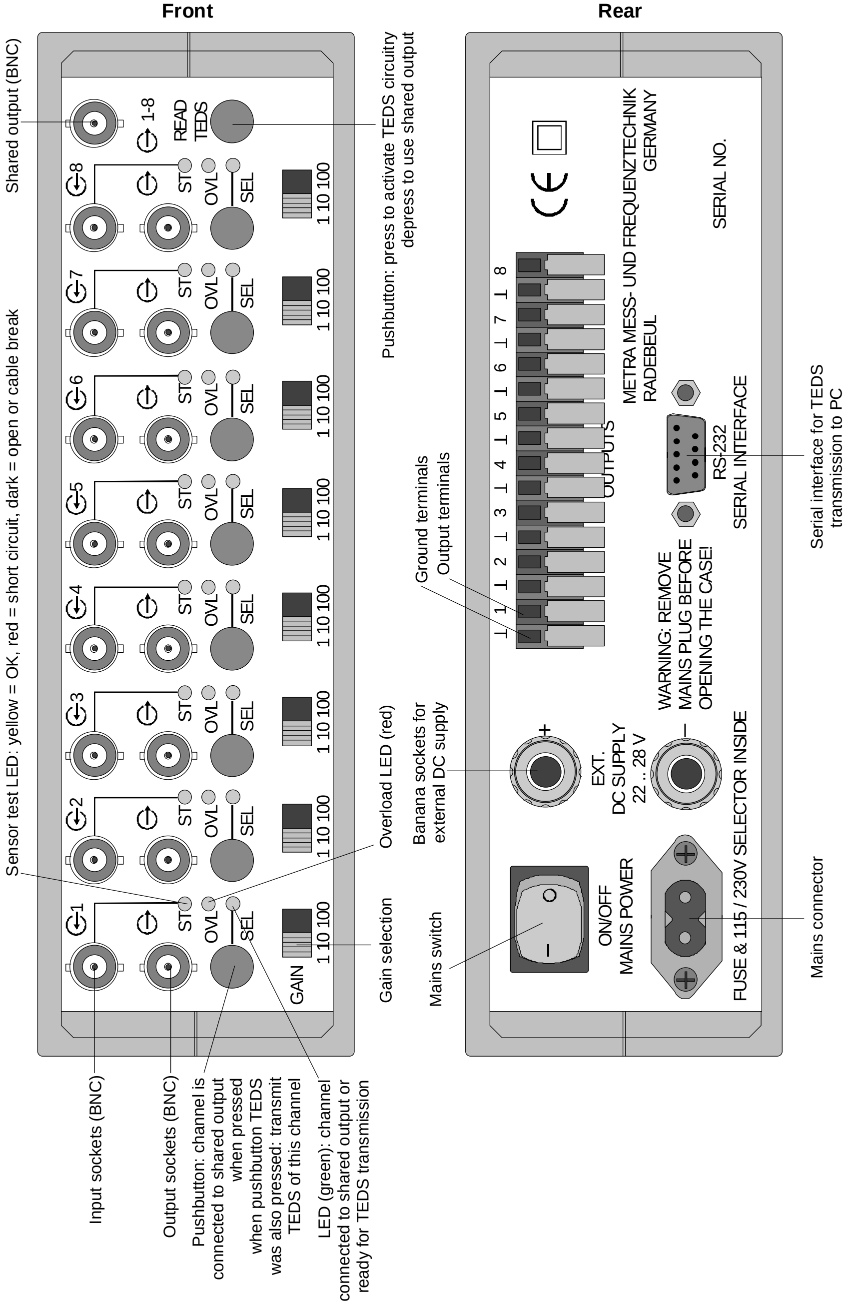
Tel. +49-351 849 21 04 Fax +49-351 849 21 69

Email: Info@MMF.de Internet: www.MMF.de

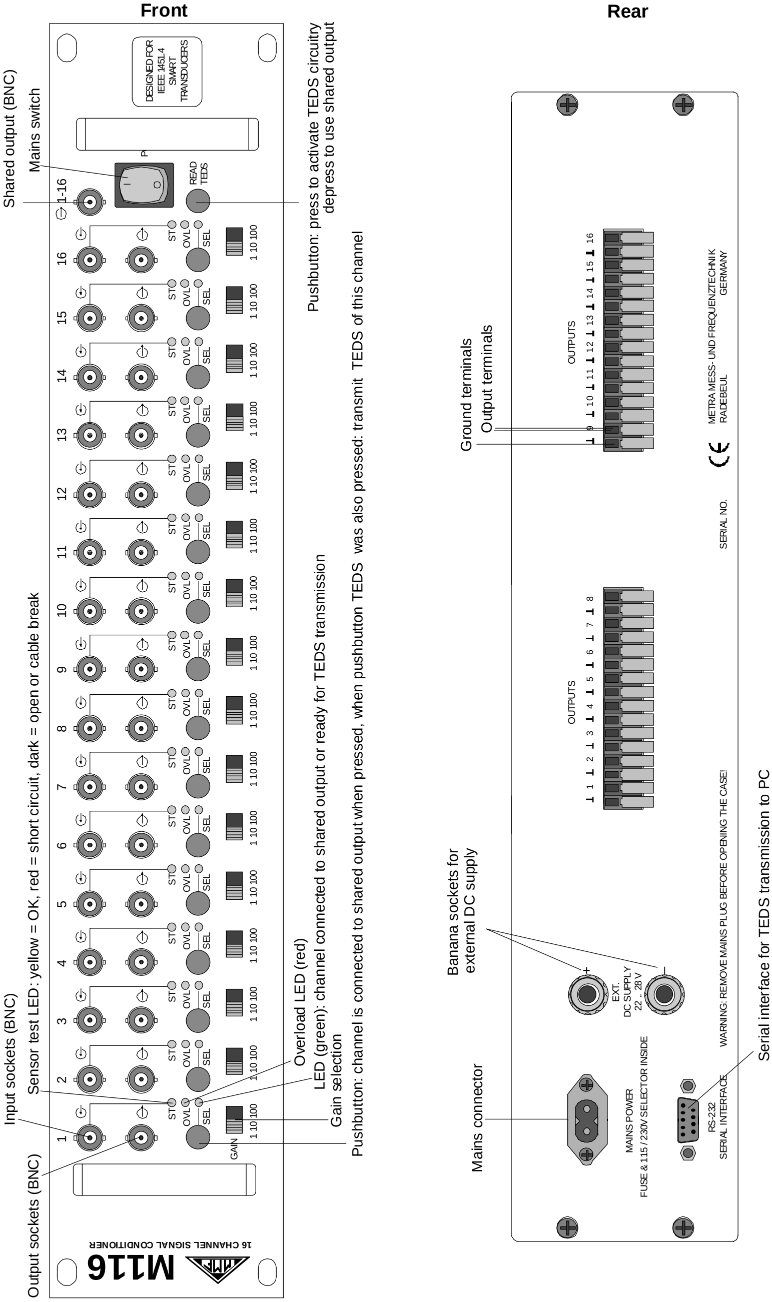
Contents

Jul. 02 #152

The 8-Channel Signal Conditioner M108 at a Glance:



The 16-Channel Signal Conditioner M116 at a Glance:



1. Application

The Multichannel Signal Conditioners M 108 and M116 are intended for measurement of acceleration, force or pressure by means of piezoelectric transducers working at the established technology of ICP®-Standard. This ICP®-principle is rugged and less susceptible to any kind of interference. Therefore, the instruments may be used under rough industrial surroundings as well as in laboratory.

Model **M108** has **8**, Model **M116 16** measuring channels. Multichannel measuring tasks can be solved with them in a space saving manner with a minimum of cable connections.

Model M108 is designed for desktop use, whereas the M116 is intended for rackmounting into 19”-rack systems.

The great number of measuring channels and the availability of the output signals through connecting terminals make the instruments ideally suitable for PC based data acquisition. A great advantage for this purpose are the variable anti-aliasing lowpass filters.

The Multichannel Signal Conditioners have a new circuit for identification of the used sensor, provided that they are so-called “Smart Transducers” corresponding to IEEE 1451.4.

By means of this circuit the Models M108 and M116 get, in connection with an up-to-date PC-based data acquisition system, a “Plug & Play” function, that means uncomplicated connection and replacement of transducers.

The instruments can be powered from mains or from 24 V DC.

2. Function and Operation

2.1. General Introduction

Figure 1 shows the block diagram of one measuring channel with the most important functional groups.

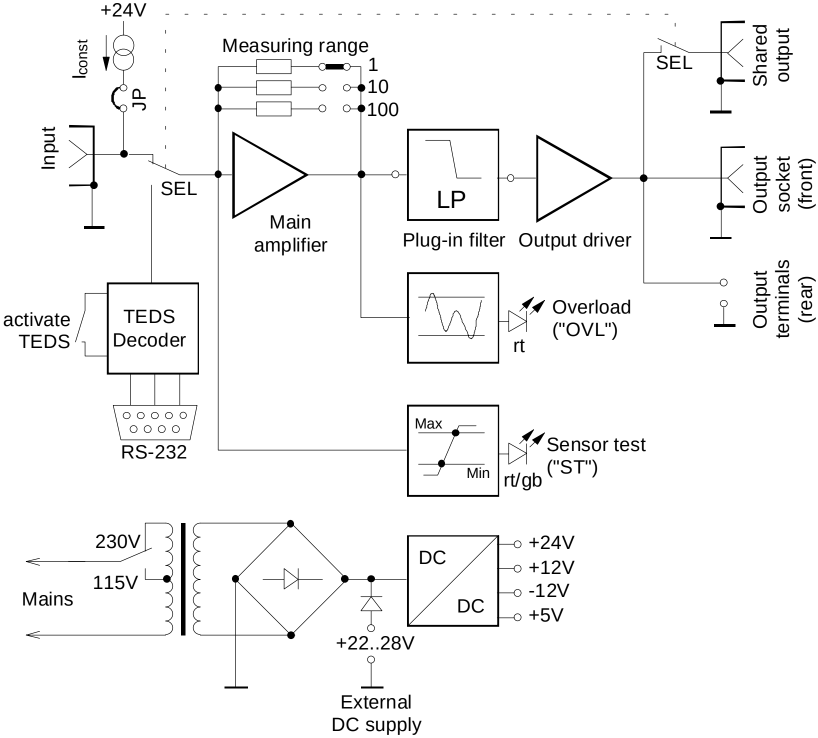


Figure 1: Block diagram

2.2. Power Supply

The Models M108 and M116 have two possibilities to be powered:

- From mains through a power connector according to IEC 630 at the rear of the instruments. The instruments are protective insulated and, therefore, need a two-pole power connection, only. The supply voltage can be chosen between 115 V or 230 V by an internal switch (see below).
- From 24 V DC, for instance a car battery or a local industrial network, through two banana sockets at the rear of the instruments (red for plus and blue for minus). The instruments are protected against faulty polarization.

The ON/OFF switch (at the rear of Model M108 and at the front panel of Model M116) works at mains operation, only.

☞ Before switching ON the instrument for the first time, ensure that the voltage at the rating plate on the plate agrees with the supply voltage! Ignoring this may cause the damage of the instrument!

Setting the power supply voltage

The Multichannel Signal Conditioners M108 and M116 can be operated from mains with a voltage of 115 V or 230 V. The mains voltage can be changed by a switch inside the instruments. This will be performed as follows:

- Pull out the mains plug.
- Open the instrument case (see chapter 2.5).
- Set the switch to the required voltage (Figure 2).
- Close the instrument case.

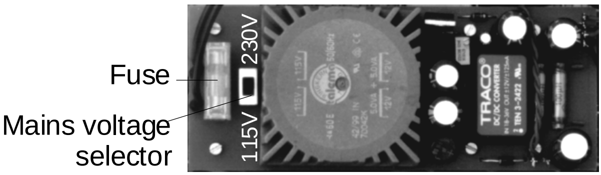


Figure 2: Power Supply PCB

Replacing the fuse The fuse holder is located on the power supply PCB inside the instrument case (see Figure 2). To replace the fuse, take off the plastic lid of the fuse holder first.

☞ Make sure that the fuse to be replaced corresponds to the value on the rating plate.

Conception of grounding All inputs and outputs are single-ended, that means asymmetric. The ground of the inputs and the outputs, the minus pole of the DC supply and the ground of the RS 232 interface (with push button "READ TEDS" pressed) are connected with one another.

The case has no contact to the ground of the instrument.

2.3. Inputs

The Multichannel Signal Conditioners M108 and M116 are intended for connecting transducers with integrated impedance converter to ICP® standard. For this purpose a constant current source (4 mA at 24 V) is part of the instruments.

What means ICP® The abbreviation ICP means "Integrated Circuit Piezoelectric". It has been established between many other names as industrial standard for piezoelectric transducers. The integrated circuit of the sensor transforms the charge signal of the piezo-ceramics, with its very high impedance and sensitivity against interference, into a voltage signal with low impedance. Such a signal can be handled and transmitted much easier than the other. The length of ordinary low cost measuring cable at this input may be extended to more than hundred meters.

It is the distinguishing feature of the integrated circuits for impedance transformation, that power supply and measuring signal use the same line. So, an ICP® compatible transducer needs, like a transducer with charge output, only one single-ended line.

Figure 3 shows the principle circuit diagram. To separate the low impedance sensor signal from the power supply, the integrated circuit is supplied with constant current. This constant current has to be sent into the measuring line and simultaneously separated from following measuring devices. This task will be executed by the Multichannel Signal Conditioners M108 and M116.

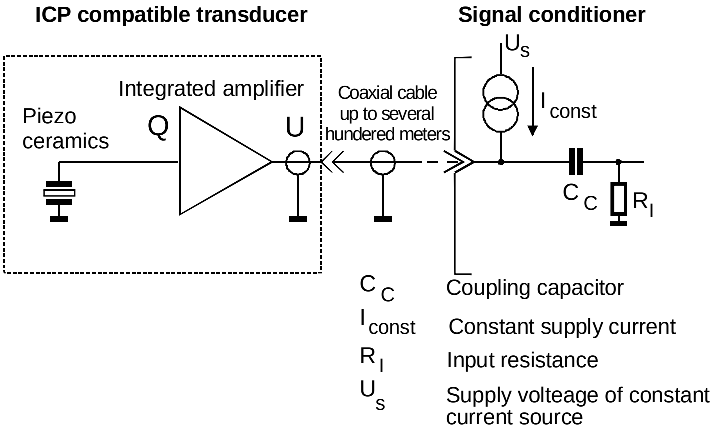


Figure 3: Principle of ICP®

Sensor Monitoring

By supplying the sensor with constant current a positive DC voltage arises. This DC voltage depends on the producer and the specimen and reaches the amount of 5 V to 14 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 maximum value of the output voltage is limited by the supply voltage of the constant current source. For the Models M108 and M116 this voltage amounts to 24 V and guarantees an optimum dynamic range for all market-dominating sensors.

By the help of the DC voltage across the transducer, Model M108 and M116 control the connected pick-up. For this purpose each channel has a separate LED “ST” (that means sensor test). They show three different conditions (see Figure 4):

LED dark: The voltage at the input is higher than 20 V.
Conclusion: The input is left open or the measuring cable has broken.

LED yellow: The input voltage reaches from 1 to 20 V.
Conclusion: The sensor is working well.

LED red: The input voltage is less than 1 V.
Conclusion: The input is short-circuited (defective cable or sensor).

☞ If some of the LEDs “ST” start to glow although the corresponding inputs are left open, this may result from too low supply voltage. This may occur when the unit is powered by external DC supply with a voltage below 22 V DC.

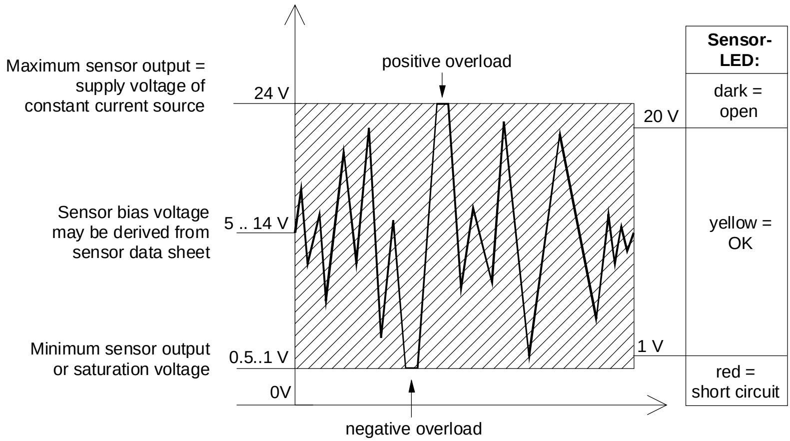


Figure 4: Sensor output span and sensor test LED

How to avoid ground loops

Ground loops are often the reason for measuring errors within multichannel measuring systems. In most cases you will find a superposed 50-Hz-voltage to the measuring signal. One reason for this effect may be, that the transducers are connected to ground not only through their cable at the Multichannel Signal Conditioners M108 or M116, but also in addition at the measuring point through their case. So, for instance, vibration transducers are often fixed at grounded housings of machines. Within earthing systems transient currents will appear. These transient currents cause a potential drop across the earthing or grounding wires, which superposes the measuring signal in an interfering manner, although they are not very high.
To avoid this, an insulated fixing of the transducers is recommended, as far as it can be technically realized.

Metra offers, for instance, some industrial vibration transducers with isolated mounting base.
In general, a star-shaped grounding network is the ideal solution for low interference during measurement. Star-shaped means, that all grounding wires from inputs and outputs are connected with each other at the Multichannel Signal conditioners M108 or M116, without any transverse connections. In most cases it is more difficult to realize this for the outputs than for the inputs, because the following measuring equipment may have asymmetric, i.e. single-ended, inputs. If you have the choice to use differential inputs, like you will often find at PC data acquisition boards, you should prefer them.

2.4. Amplifiers

Main Amplifier

The input is followed by the main amplifier (see Figure 1). This amplifier has a selectable gain factor by means of a slide switch, in steps of 1, 10, and 100. The amplifier stages of the different channels work independently.

☞ Due to temporary overload, it may occur after connecting a sensor or, in some cases, after changing the gain range, that it takes up to 30 s for the amplifier to settle. After this settling time the output signal will appear.

Overload Indicators

At the front panel of the instruments there is one LED “OVL” for each channel, which indicates an overload at the output of the amplifier. It starts glowing at a peak value of the output voltage of 9 V. The measuring signal is just undistorted up to a peak value of 10 V. Reaching this value the gain factor should be reduced. When the LED “OVL” is glowing at changes of the gain factor, at switching on the instrument or when connecting the transducer it is a normal phenomenon. After some seconds (as a result of the low lower limiting frequencies) the transient process of the amplifier has finished, the LED “OVL” stops glowing and the amplifier works normally.

2.5. Filters

Lowpass Filters To eliminate disturbing noise or to comply with the sampling theorem: Signal frequency has to be less than half the sampling frequency, it is often of favorable effect, if the measuring signal passes a lowpass filter.

Model M108 and M116 offer the possibility to add optionally available plug-in filters with lowpass function. The following plug-in filters are available as accessories:

Ordering name	Limiting frequency (-3 dB attenuation)	Limiting frequency -10 % accuracy
FB-0,1	100 Hz	70 Hz
FB-0,3	300 Hz	210 Hz
FB-1	1 kHz	700 Hz
FB-3	3 kHz	2,1 kHz
FB-10	10 kHz / 9,3 kHz(1)	7 kHz / 6,5 kHz(1)
FB-30	30 kHz / 21 kHz(1)	21 kHz / 13 kHz(1)

(1) with gain factor x100

The filter curve has Butterworth characteristics, i.e. it is flat in the passband without overshooting. The attenuation rises with –40 dB/decade.

The frequency response of the amplifier with the different Filter Plug-in Units is shown in Figure 5 and Figure 6.

The lower limiting frequency of the amplifier is independent of the used plug-in filter and reaches 0.08 Hz (-3 dB) or 0.15 Hz (-10 %).

Please note that in the frequency response of Figure 6 the characteristics of the plug-in filters FB-10 and FB-30, when used with gain factor "x100", something differ from that with gain factors "x10" and "x1". The reason for this difference is the limited bandwith of the main amplifier in the range "x100". Therefore, Figure 6 shows separate curves depending on the gain factor.

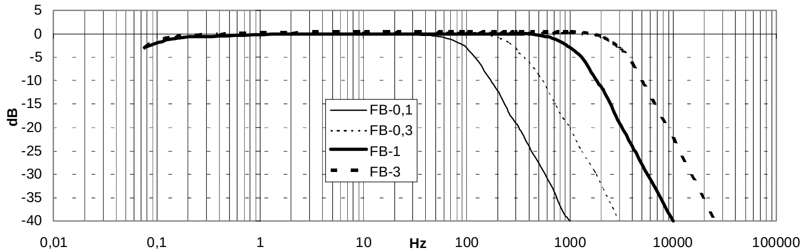


Figure 5: Frequency response of plug-in filters FB-0,1 / 0,3 / 1 / 3

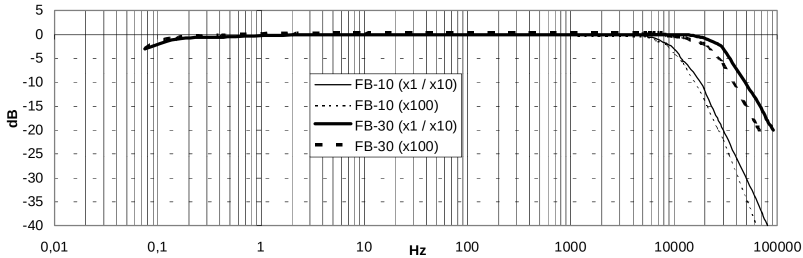


Figure 6: Frequency response of plug-in filters FB-10 and FB-30

How to insert plug-in filters

To insert a plug-in filter into the instrument you have to pull out the mains plug and to open the instrument case.

Opening the case

Model M108 gets opened by snapping off the four plastic covers of the bolt heads on the upper part of the case by means of a screwdriver. Now you have to unfasten the four screws below them and after that you can remove the upper part of the case (pay attention, not to tilt it).

Model M116 can be opened by unfastening the 4 screws at both sides of the upper part of the case and then remove it.

Now you can see the printed circuit boards. Near to the center of the main board there is situated a row of sockets for the plug-in filters. They are classified from left to right as belonging to the channels 1 to 8 or 1 to 16.

If no plug-in filter is inserted, a wire bridge (jumper) has to be slipped into the concerning socket, for leading the measuring signal to the output. This wire bridge has to be extracted before inserting a plug-in filter. Figure 7 shows the position of the wire bridge

and how to insert the filters.
When slipping a plug-in filter into the socket, the bevelled edge of its case has to show to the notch of the socket. Otherwise the signal path will be interrupted.

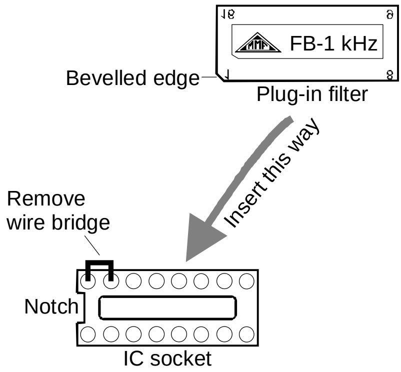


Figure 7: Inserting plug-in filters

☞ Be careful, when extracting the plug-in filters, not to deform their pins. By alternate pressure to the longer side of the filter case it can be extracted slowly from the socket.

2.6. Outputs

Outputs Model M108 and M116 have three different outputs:

- Each channel has a BNC output socket at the front panel of the instrument.
- In addition the output voltage is accessible via rear terminals. These terminals have direct contact to the sockets on the front panel. Each output terminal (blue colored) has an appropriate ground terminal (gray colored). The terminals are srewless. They are opened for slipping in the stripped wire by powerful pressure to the lever, belonging to them, by means of a screwdriver or something like that. The terminals are designed for wires with cross sections of 0.08 mm² to 2.5 mm². These terminals can be used, for instance, to connect a PC data acquisition board to the instruments via a multiwire cable. This way you can avoid the lavish soldering of plugs to the cable.

- A shared output with BNC-connector is located at the right of the front panel. This output can be switched to each of the 8 or 16 channels, respectively. For this purpose each channel has the push button “SEL”. The LED, near to the pushbutton “SEL”, of the channel that has been switched to the shared output, glows green. The shared output, for instance, can be used for connection of an oscilloscope. This way you get a good view over the quality of the measured signals of all channels, without changing the cable connection.

☞ The shared output can only be used with the pushbutton “READ TEDS” not pressed!

The maximum signal voltage at each of the outputs amounts to ± 10 V (peak value).

The measuring outputs are buffered and DC coupled. Therefore possible offset currents to the outputs of Model M108 or M116, caused by the following equipment (for instance a PC board), don’t have considerable influence to the DC voltage accuracy.

2.7. Operation with Smart Transducers (IEEE 1451.4)

Subject of IEEE 1451

The standard IEEE 1451, discussed in recent time, complies with the increasing importance of digital data acquisition systems. IEEE 1451 mainly defines the protocol and network structure for sensors with fully digital output. The part IEEE 1451.4, however, deals with "Mixed Mode Sensors", which have a conventional analog output, but contain in addition a memory for an “Electronic Data Sheet”. This data storage is named "TEDS" (Transducer Electronic Data Sheet). The memory of 256 bits contains all important technical data, which are of interest for the user:

Electronic data sheet

- Model and version
- Serial number
- Manufacturer
- Type of transducer; physical quantity
- Sensitivity
- Last calibration date

In addition to this data, programmed by the manufacturer, the user for itself can store information for identification of the measuring point.

The Transducer Electronic Data Sheet opens up a lot of new possibilities to the user:

- When measuring at many measuring points it will make it easier to identify the different sensors as belonging to a particular input. It is not necessary to mark and track the cable, which takes up a great deal of time.
- The measuring system reads the calibration data automatically. Till now it was necessary to have a data base with the technical specification of the different transducers, like serial number, measured quantity, sensitivity etc.
- You can change a transducer with a minimum of time and work ("Plug & Play"), because of the sensor self-identification.
- The data sheet of a transducer is a document which disappears very often. The so called TEDS sensor contains all necessary technical specification. Therefore, you are able to execute the measurement, even if the data sheet is just not at hand.

Sensor hardware

The standard IEEE 1451.4 is based on the common ICP®-principle. TEDS sensors, therefore, can be used instead of common ICP® transducers. The communication with the 256 bit non-volatile memory of the transducer, Type DS2430A, is based on the 1-Wire®-protocol of Dallas Semiconductor. Details of programming and test programs you will find under www.iButton.com.

TEDS function of the M108 and M116

The Models M108 and M116 have a read/write circuit for the 1-Wire® protocol, which can be switched by a pushbutton to the transducer of the selected channel. This circuit works like the adapter DS9097U of Dallas Semiconductor. The instruments have an RS-232 serial interface with 9-pole socket at the rear.

Do you want to use the TEDS data, you have to activate at first the TEDS decoder by pressing the push button “READ TEDS”. After that you select the channel to be tested by pressing the pushbutton “SEL”. The LED of this channel glows green. The transducer of this channel is now disconnected from the input and connected with the RS-232 interface. By means of a suitable PC software you can now transfer the TEDS data from or to the transducer.

State of standardization in June 2000

Some of the standards, belonging to IEEE 1451, has been already published. Part IEEE 1451.4, however, is still under development and has reached now the last stage of draft. Because of the definite demands for the hardware the Multichannel Signal Conditioners M108 and M116 are fitted with corresponding electronic circuits. Therefore, they have all the premises to use the advantages of the new standard. As soon as the standardization will have come to its conclusion, Metra as well as a number of other manufacturers will offer compatible transducers and corresponding software. We are at your‘s disposal for all technical questions in this field.

3. Technical Data

Inputs	M108: 8 voltage inputs with ICP® compatible sensor supply M116: 8 voltage inputs with ICP® compatible sensor supply
Sensor supply	3.8 .. 5.6 mA constant current, compliance voltage 24 V, to be switched off by internal jumpers LED sensor status indicators (open / OK / short circuit)
Amplifier gain	1 (± 1 %) 10 (± 1 %) 100 (± 1 %) selectable by slide switches
Cross talk attenuation	> 60 dB (1 kHz, gain=100)
Output noise voltage	< 2 mV_{rms} (full bandwidth)

Frequency response of amplifier without plug-in filter

Gain	Frequency range	Accuracy
x 1	0.15 Hz .. > 100 kHz	-10 %
x 1	0.08 Hz .. > 100 kHz	- 3 dB
x 10	0.15 Hz .. > 100 kHz	-10 %
x 10	0.08 Hz .. > 100 kHz	- 3 dB
x 100	0.15 Hz .. > 12 kHz	-10 %
x 100	0.08 Hz .. > 25 kHz	- 3 dB

Available plug-in filters

Model	Cut-off frequency (-3 dB)	Cut-off frequency (-10 %)
FB-0,1	100 Hz	70 Hz
FB-0,3	300 Hz	210 Hz
FB-1	1 kHz	700 Hz
FB-3	3 kHz	2.1 kHz
FB-10	10 kHz / 9.3 kHz[1]	7 kHz / 6.5 kHz[1]
FB-30	30 kHz / 21 kHz[1]	21 kHz / 12 kHz[1]

[1] at gain factor x100

Outputs

- each channel 1 BNC socket at front
- rear terminal blocks (wire ☐ 0.08 to 2.5 mm²)
- shared output at front (BNC socket)

	Impedance: < 100 Ω Peak output voltage: ± 10 V
Overload indication	each channel 1 LED, threshold voltage: approx. 9 V at output
Power supply	• 22 .. 28 V DC < 0.3 A (M108), < 0.6 A (M116) • mains 115V /230 V, < 10 W
Operating temperature range	-10 .. 55 °C / 14 .. 131 °F, no condensation
Dimensions (B x H x T)	M108: 225 x 85 x 220 mm^3 M116: 19 ” (483 mm) x 2 height units (88 mm) x 262 mm

Limited Warranty

Metra warrants during 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.
Customer has to 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
from 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 has to be paid by the customer.
The repaired or replaced product will be sent back
at Metra’s expense.

Declaration of Conformity

Product: Multichannel Signal Conditioner

Models: M108, M116

Hereby is certified that

the above mentioned product

complies with the demands

of the following standards:

- EN 50081-1
- EN 50082-1
- EN 61000-3

Responsible for this declaration is the producer

Metra Mess- und Frequenztechnik

Meißner Str. 58

D-01445 Radebeul

Declared by
Manfred Weber
Radebeul, 12th of May, 2000