

# Kraus Messtechnik GmbH

Gewerbering 9, D-83624 Otterfing, ☎ +49-8024-48737, Fax. +49-8024-5532 - Germany  
Home page <http://www.kmt-gmbh.com> E-mail: [info@kmt-gmbh.com](mailto:info@kmt-gmbh.com)



## MC16/64

### Data acquisition notebook

# OPERATING MANUAL












Version 2006-1



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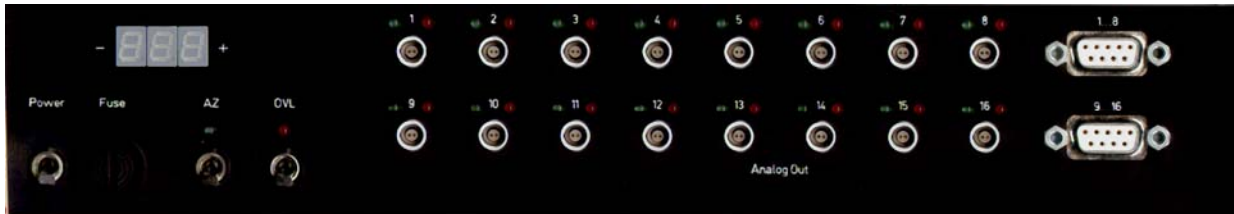
# 1 Installation

- In this manual you find all information about the default configuration settings and configurations of the MC16/64 data acquisition system. In the additional sheet “**User specific system settings**” you find all adaptations for your own system, like channel configuration, special setups, additional or removed functions, periphery devices and software settings. Read this sheet careful before starting your system.
- Plug the 7-pole Tuchel in the female connector labeled with “Power” on the right side of the measure unit and the Banana connectors on the other end of the cable into a DC voltage supply (plus is red, minus is black). The DC voltage input range is specified on the type sign on the bottom of the measure unit (10 - 20V or 20- 30V). Check that the voltage is not too high, because in this case the internal overvoltage protection circuit will destroy the fuse. The power dissipation of the MC16/64 depends on the number and types of channels and the charge state of the notebook battery. Normally a 16-channel unit needs a power of 45 - 60W.
- The notebook will be supplied from the measure unit over the jack connector on the right end side. Establish this connection.
- For better handling during the configuration you can connect a Microsoft PS/2 mouse close to the power jack connector or a serial mouse on COM1 on the back side. Principally it is also possible to work only with the integrated touch pad, but this is a little bit more complicated to handle.
- Plug the security key (dongle) in the printer port on the right rear side of the notebook.
- Plug in the 37-pole SubD connector to the PCMCIA-Card on the right side of the measure unit engraved with “Computer”. Plug the card itself in the middle of the PCMCIA socket (no. 2) with the  logo on the top side, close the lid and connect the other end of the cable through the slit with the card.
- Switch the measure unit on using the power switch on the left front side. The system starts now the internal self test. The green LEDs on the front side must light up one after another as well as the segments of the 3-digit LED display. After them the installed signal conditioning modules will be detected and displayed. You see for example  if in the first 8 channels signal conditioning modules are plugged and  if the current setup number is 4. Has your system more than 16 channels you see before displaying the channel numbers the detected units  (master unit no. 1 → channels 1 - 16),  (slave unit no. 2 → channels 17 - 32),  (slave unit no. 3 → channels 33 - 48) and  (slave unit no. 4 → channels 49 - 64). Note that all units work absolutely independent and will be controlled by an own micro-controller. If in any unit the green LEDs don't light up, the controller of this unit isn't started after power on and the unit will not be detected from the master unit. Additionally the failed processor can influence the other units, so that they start with error displaying. The main reason in this case is a current limitation from the DC power supply. If the self test is finished successfully you hear one beep, otherwise one or more 2-digit error numbers will be displayed, e.g. , simultaneous with three short beeps. An **adding or removing** of signal conditioning modules **without power down is not allowed!** Added parts will not be supported, because they will only be detected after power on. Removed parts lead to error messages.
- Now open the display part and power up the notebook with the slide key on the right side. Be sure that the notebook is connected with the power plug from the measuring unit, otherwise the internal battery will be used and discharged. After starting the Windows-XP operating system it is necessary that the PCMCIA card will be detected. You should hear a beep from the notebook during power on and see a card icon  on the right side in the taskbar.
- For every customer an example configuration for μLab is implemented for his own specific channel set. On the notebook display you find on the right side a short cut labeled as “Demo <name>”. Double click the  icon to open μLab with these demonstration settings.
- Save the configuration as “Test.mlb” using the **SaveAs** command in the **File** menu to avoid an overwriting of the presentation settings.
- Click the start button  on the symbol panel for activating the measurement. A graphical display with the data of all physical channels will appear. Use this example as a base for more complex configurations to have an easy entrance in the μLab software.
- Now connect your sensors channel and compare the displayed data with the actual physical one. The pinning you find in the chapter “Signal conditioning modules”.
- The accuracy of the analog-to-digital conversion is 0.05% and of the signal conditioning normally <0.2% related to the full scale range of ±5V. If you have calibration equipment you can compensate the sensor tolerances in software by defining a channel specific offset and gain value. For this fine tuning make a double click on the channel in the **Job/Datasets** folder in the project tree and select the **Calibration** card.

## 2 Frames

### 2.1 Basic frame

- The basic frame (master unit) includes the first 16 slots (channels 1 – 16) on the rear side for different signal conditioning modules. Every signal conditioning module delivers an output voltage in the  $\pm 5V$  range.
- Following tasks will be handled by the master unit:
  - Signal conditioning module detection.
  - Automatic offset compensation (auto-zeroing).
  - Overload detection (module output voltage is less than  $-5V$  or greater than  $+5V$ ).
  - Overload reset.
  - Power management (switch, overvoltage and reverse-connect protection).
  - Channel-wise sample rate assignment by 16 predefined or user specific setups..
  - Setup changing.
  - Channel-wise sample rate controlled anti-aliasing filtering.
  - Analog-digital conversion.
  - Digital data conversion in the ECIA 100 format.
  - PCM and Clock signal generation for external DAT recorder and telemetry transmission.
  - Controlling of the extension frames (slave units).
  - Controlling of special periphery devices.
  - Permanently internal error monitoring and displaying.
  - Programming of module properties, like sensor excitation, gain, auto-zeroing on/off, (in preparation).
- On the left side of the front panel you find the power switch for the MC16/64. After power on the master and the slave units will be supplied with the DC input voltage from the power connector on the right side. Please check before the correct DC input voltage range (10 – 20V or 20 – 30V) and that you have enough power from the source (appr. 60W). Close to the power switch is the socket for a standard glass fuse. When changing after damaging use only fuses with very fast releasing (FF) and 5A current.



- Beside the fuse, the auto-zeroing key “AZ” is placed. Note, that during this operation the signals from the sensors must have a constant level. After pressing the key, the offset voltages of all sensors, where the auto-zeroing jumper is set to “On” (see chapter “Carrier board”), will be compensated to zero. This takes place in 9 different phases:

Display	Process	Display	Process	Display	Process
000	Pull signal to maximum output	000	Pull signal over zero line (coarse tuning)	000	Pull signal under zero line (fine tuning)
000	Pull signal in measuring range	000	Pull signal under zero line (mid tuning)	000	Pull signal over zero line (fine tuning)
000	Pull signal under zero line (coarse tuning)	000	Pull signal over zero line (mid tuning)	000	noise tuning

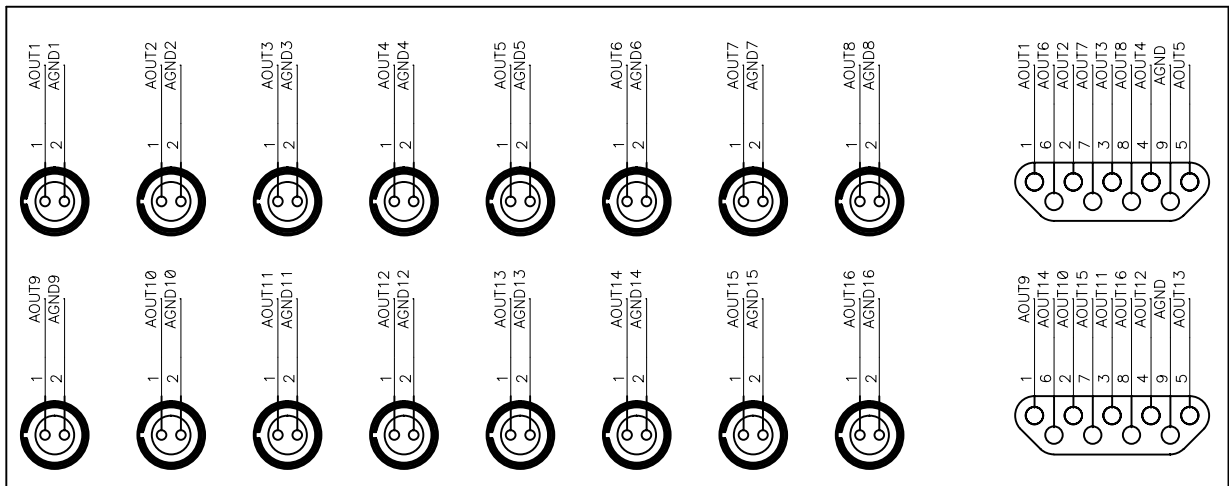
- At the beginning of any phase the green LED’s of the active channels go on, and off when the operation was successfully finished. Only if the current process of all channels is complete, the following process will start. If it is impossible to compensate the offset, an error number will be displayed, e.g. 000, and the number of the failed channel, e.g. 000. Additionally, you hear three short beeps. If the complete auto-zeroing is finished, you hear one beep and the “AZ” LED goes off. The green LED’s of the failed channels are flashing, the others are off. By pressing the overload key (“OVL”) you can clear the flash lights. Possible reasons for an auto-zeroing failure are found in the chapter “Error messages”.

- If the voltage output of a signal conditioning module leaves the  $\pm 5V$  range, the red overload LED of the channel lights up. The LED remains on, if the signal is returned into the measuring range and will only goes off, when you press the overload reset key "OVL". In the case, that the LED of a channel doesn't goes off, the input signal is permanently or temporary with a high frequency in the overload range, so that the LED immediately light up again after clearing.
- Above the switches you find a 3-digit LED display for the current system status. The first sign symbolizes a letter and the other ones a 2-digit number. Following letters have the according meaning:

Letter	Meaning
A	Auto-zeroing phase number
C	Channel number
E	Error number
P	Periphery device number
S	Setup number
U	Unit number

If no function (e.g. auto-zeroing) is active and no error occurred, the display shows the current setup number. With the keys behind the "+" or "-" holes beside the display you can increase or decrease the setup number. To do this **use only the delivered 2mm hexagon key!** Please note, that if you change the setup in the measuring unit, you have also to change the setup number in software (see chapter "Setups" for detailed information).

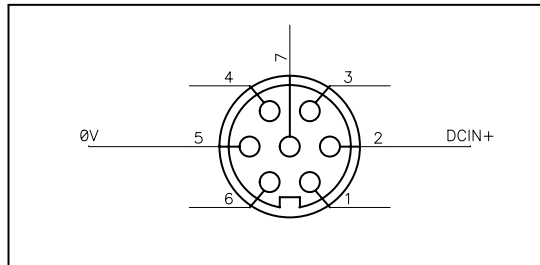
- Last not least you have on the front panel the analog voltage outputs from the signal conditioning modules in a range of  $\pm 5V$ . There are channel-separate 2-pole Lemos connectors and additional a multiple 9-pole SubD connector with the following pinning.



- On the right side of the measure unit you find the "Power" connector (7-pole Tuchel female) for the DC voltage input from the power supply and the "Computer" connector (37-pole SubD female) for the data transfer to the ECIA100 data acquisition card. This digital output is also pin-to-pin compatible with the IF16 desktop card, which can be used on the receiver side in telemetry or DAT applications. Via the "Bus" connector (37-pole SubD male) the data communication with the extension units takes place as well as the power transfer.



- With the “PCM Out” connector (BNC) a data transmission via an up to 100m BNC cable can establish using only an additional decoder on the receiver side. The “Clk Out” connector (BNC) together with “PCM Out” is necessary in applications with very rough shock and vibration conditions, where a fault-free data storage to the hard disk of the notebook is not possible. In this case you can connect our high-speed DAT recorder and replay the measured data using the decoder. The “Trigger” connector (9-pole SubD female) is reserved for controlling special periphery devices in user specific applications and on the “Transmitter” output (9-pole SubD male) it is possible to connect a transmitter for send data via telemetry.
- Next schematic picture shows the pinning of the “Power” connector.

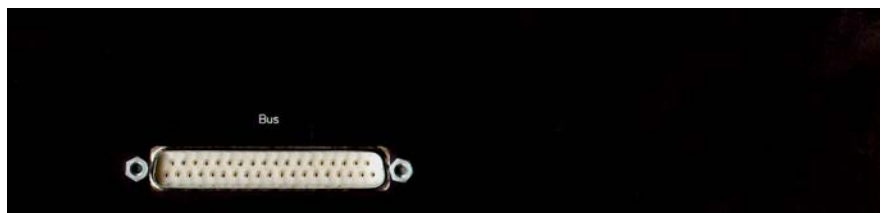



## 2.2 Extension frames





- The basic frame (master unit) can expand with up to 3 extension frames (slave units), so that the total number of channels is 64. The interior of the slave units is equivalent with the master unit, but on the outside you have no display, power switch, controlling keys and periphery connectors.





- The pinning of the multiple 9-pole SubD connector is equivalent to the master unit if you add 16, 32 or 48 to the channel numbers.
- The powering and controlling takes place only via the “Bus” connector. Since do you have no keys, the master unit registers all inputs and sends coded instructions to the slaves. Because of this, it is not possible to work with slave units without a master unit.



- The bus connection between the master and slave units will realized with an pin-to-pin printed circuit board.
- During the self test after power on, the master unit search for connected slave units (Letter ) and displays all founded extensions with the following codes:

Display	Description	Channels
	master unit 1	1 - 16
	slave unit 2	17 - 32
	slave unit 3	33 - 48
	slave unit 4	49 - 64

- After the unit number follows the channel numbers (Letter ) for plugged signal conditioning modules. If no slave unit is connected (16-channel system) the master unit  will not displayed.

## 2.3 Setups

- For an optimal distribution of the total sample rate (max. 80kS/s) to the different channels, the MC16/64 includes 16 predefined setups with channel sample rates you find in the following table. In 16-channel systems in most cases the setup no. 5 is set as default. Setup 8 is only for high speed PC's.

Channel	Setup1	Setup2	Setup3	Setup4	Setup5	Setup6	Setup7	Setup8	Setup9	Setup10	Setup11	Setup12	Setup13	Setup14	Setup15	Setup16
1	80000	40000	20000	10000	5000	2500	1250	40000	20000	10000	5000	2500	10000	5000	2500	39.0625
2	0	40000	20000	10000	5000	2500	1250	1250	20000	10000	5000	2500	10000	5000	2500	39.0625
3	0	0	20000	10000	5000	2500	1250	625	20000	10000	5000	2500	10000	5000	2500	39.0625
4	0	0	20000	10000	5000	2500	1250	625	625	10000	5000	2500	10000	5000	2500	39.0625
5	0	0	0	10000	5000	2500	1250	625	625	10000	5000	2500	10000	5000	2500	39.0625
6	0	0	0	10000	5000	2500	1250	625	625	10000	5000	2500	10000	5000	2500	39.0625
7	0	0	0	10000	5000	2500	1250	625	625	10000	5000	2500	625	5000	2500	39.0625
8	0	0	0	10000	5000	2500	1250	625	625	625	5000	2500	625	5000	2500	39.0625
9	0	0	0	0	5000	2500	1250	625	625	625	5000	2500	625	5000	2500	39.0625
10	0	0	0	0	5000	2500	1250	625	625	625	5000	2500	625	5000	2500	39.0625
11	0	0	0	0	5000	2500	1250	625	625	625	5000	2500	625	5000	2500	39.0625
12	0	0	0	0	5000	2500	1250	625	625	625	5000	2500	625	5000	2500	39.0625
13	0	0	0	0	5000	2500	1250	625	625	625	5000	2500	625	625	2500	39.0625
14	0	0	0	0	5000	2500	1250	625	625	625	5000	2500	625	625	2500	39.0625
15	0	0	0	0	5000	2500	1250	625	625	625	5000	2500	625	625	2500	39.0625
16	0	0	0	0	5000	2500	1250	625	625	625	625	2500	625	625	2500	39.0625
17	0	0	0	0	0	2500	1250	625	625	625	625	2500	625	625	2500	39.0625
18	0	0	0	0	0	2500	1250	625	625	625	625	2500	625	625	2500	39.0625
19	0	0	0	0	0	2500	1250	625	625	625	625	2500	625	625	2500	39.0625
20	0	0	0	0	0	2500	1250	625	625	625	625	2500	625	625	2500	39.0625
21	0	0	0	0	0	2500	1250	625	625	625	625	2500	625	625	2500	39.0625
22	0	0	0	0	0	2500	1250	625	625	625	625	2500	625	625	1250	39.0625
23	0	0	0	0	0	2500	1250	625	625	625	625	2500	625	625	625	39.0625
24	0	0	0	0	0	2500	1250	625	625	0	0	2500	625	625	625	39.0625
25	0	0	0	0	0	2500	1250	625	625	0	0	2500	625	625	625	39.0625
26	0	0	0	0	0	2500	1250	625	625	0	0	2500	625	625	625	39.0625
27	0	0	0	0	0	2500	1250	625	625	0	0	2500	625	625	625	39.0625
28	0	0	0	0	0	2500	1250	625	625	0	0	2500	625	625	625	39.0625
29	0	0	0	0	0	2500	1250	625	625	0	0	2500	625	625	625	39.0625
30	0	0	0	0	0	2500	1250	625	625	0	0	2500	625	625	625	39.0625
31	0	0	0	0	0	2500	1250	625	625	0	0	2500	625	625	625	39.0625
32	0	0	0	0	0	2500	1250	625	625	0	0	625	625	625	625	39.0625
33	0	0	0	0	0	0	1250	625	625	0	0	625	625	625	625	39.0625
34	0	0	0	0	0	0	1250	625	625	0	0	625	625	625	625	39.0625
35	0	0	0	0	0	0	1250	625	625	0	0	625	625	625	625	39.0625
36	0	0	0	0	0	0	1250	625	0	0	0	0	625	625	625	39.0625
37	0	0	0	0	0	0	1250	625	0	0	0	0	625	625	625	39.0625
38	0	0	0	0	0	0	1250	625	0	0	0	0	625	625	625	39.0625
39	0	0	0	0	0	0	1250	625	0	0	0	0	0	625	625	39.0625
40	0	0	0	0	0	0	1250	625	0	0	0	0	0	625	625	39.0625
41	0	0	0	0	0	0	1250	625	0	0	0	0	0	625	625	39.0625
42	0	0	0	0	0	0	1250	625	0	0	0	0	0	625	625	39.0625
43	0	0	0	0	0	0	1250	625	0	0	0	0	0	625	625	39.0625
44	0	0	0	0	0	0	1250	625	0	0	0	0	0	625	625	39.0625
45	0	0	0	0	0	0	1250	625	0	0	0	0	0	625	625	39.0625
46	0	0	0	0	0	0	1250	625	0	0	0	0	0	625	625	39.0625
47	0	0	0	0	0	0	1250	625	0	0	0	0	0	625	625	39.0625
48	0	0	0	0	0	0	1250	625	0	0	0	0	0	625	625	39.0625
49	0	0	0	0	0	0	1250	625	0	0	0	0	0	625	625	39.0625
50	0	0	0	0	0	0	1250	625	0	0	0	0	0	625	625	39.0625
51	0	0	0	0	0	0	1250	625	0	0	0	0	0	625	625	39.0625
52	0	0	0	0	0	0	1250	625	0	0	0	0	0	625	625	39.0625
53	0	0	0	0	0	0	1250	625	0	0	0	0	0	625	625	39.0625
54	0	0	0	0	0	0	1250	625	0	0	0	0	0	625	625	39.0625
55	0	0	0	0	0	0	1250	625	0	0	0	0	0	625	625	39.0625
56	0	0	0	0	0	0	1250	625	0	0	0	0	0	625	625	39.0625
57	0	0	0	0	0	0	1250	625	0	0	0	0	0	625	625	39.0625
58	0	0	0	0	0	0	1250	625	0	0	0	0	0	625	625	39.0625
59	0	0	0	0	0	0	1250	625	0	0	0	0	0	625	625	39.0625
60	0	0	0	0	0	0	1250	625	0	0	0	0	0	625	625	39.0625
61	0	0	0	0	0	0	1250	625	0	0	0	0	0	625	625	39.0625
62	0	0	0	0	0	0	1250	625	0	0	0	0	0	625	625	39.0625
63	0	0	0	0	0	0	1250	625	0	0	0	0	0	625	625	39.0625
64	0	0	0	0	0	0	1250	625	0	0	0	0	0	625	625	39.0625
Total	80000	80000	80000	80000	80000	80000	80000	80000	80000	80000	80000	80000	80000	80000	80000	2500

- To avoid aliasing effects, the MC16/64 includes 8-pole Butterworth filters. The 3dB cut-off frequency will set automatically depending on the chosen channel sample rate. The analog channel band width you can derive by dividing the sample rate by 3.125 (for example: sample rate 10kS/s → bandwidth 3,2kHz).
- For increasing or decreasing the setup number use only the delivered 2mm hexagon key in the “+” or “-” holes beside the display. After power on the last used setup will initialized.
- If you change the setup on the MC16/64 display, you must also change the setup number in the µLab software. To do this follow the queue:

**Job → Properties → Clock source → Device name → ECIA 100@KMT MC16/64@Setup\***

- For special applications, e.g. telemetry transmission, it is possible to define and implement user specific setups with other band width distributions. In this case you find this setup table on the additional sheet “User specific system settings”.

## 2.4 Error messages

- To give a fast support in case of user mistakes and system malfunctions, the MC16/64 celebrates a permanent self monitoring. That means, that every send internal instruction, message or data word will returned on a second line and compared with the send data to be sure that the send instructions was correct received.
- Note, that only during the self test all connected devices, like extension frames, signal conditioning modules and periphery devices will detected and internally saved as the current hardware configuration. For this reason don't add or remove hardware parts without power off! Added parts will not supported, removed parts leads to error messages.
- Every occurred error will displayed as letter **E** and you hear 3 short beeps. A successful action will quit by one beep. After error numbers **888** - **889**, which are related to a specific module, follows the number of the failed channel, e.g. **889**.

Name	Display	Description
NOERR	800	no error (will not displayed)
ADRERR	801	error during serial address setting
DACERR0	802	error during serial DAC0 setting
DACERR1	803	error during serial DAC1 setting
DACERR2	804	error during serial DAC2 setting
DACERR3	805	error during serial DAC3 setting
DACERR4	806	error during serial DAC4 setting
DACERR5	807	error during serial DAC5 setting
AZLDERR	808	error during serial auto-zeroing LED setting
EPWBERR	809	error during write to EEPROM - no response from board
EPVBERR	810	verify error after write to EEPROM on board
EPWMERR	811	error during write to EEPROM - no response from module (first reason: module was removed without power down)
EPVMERR	812	verify error after write to EEPROM on module
IOFFERR	813	auto-zeroing of channel not possible (output or overload comparator malfunction or input offset to high → greater than ±250mV)
NOISERR	814	auto-zeroing fine tuning of channel not possible (drift or noise to high, input signal instable, analog input open)
AZERR	815	auto-zeroing of channel failed (error in offset DAC line or input signal instable)
DISPERR	816	error during serial display setting
DNUMERR	817	attempt to display a BCD digit greater than 9 (firmware error)
AZSWERR	818	error on auto-zeroing switch "AZ"
OVSERR	819	error on overload switch "OVL"
SWTPERR	820	error on setup "+" switch
SWTMERR	821	error on setup "-" switch
IFERR	822	error during serial interface data and trigger setting
MONIERR	823	error during serial periphery device setting
MSB1ERR	824	error during serial unit data transfer → time out during communication between MASTER1 and SLAVE2 (channels 17...32)
MSB2ERR	825	error during serial unit data transfer → time out during communication between MASTER1 and SLAVE3 (channels 33...48)
MSB3ERR	826	error during serial unit data transfer → time out during communication between MASTER1 and SLAVE4 (channels 49...64)
MST1ERR	827	error during serial unit data transfer → no response from SLAVE2 (channels 17...32)
MSR1ERR	828	error during serial unit data transfer → SLAVE2 receive false data from MASTER1 (channels 17...32)
MST2ERR	829	error during serial unit data transfer → no response from SLAVE3 (channels 33...48)
MSR2ERR	830	error during serial unit data transfer → SLAVE3 receive false data from MASTER1 (channels 33...48)
MST3ERR	831	error during serial unit data transfer → no response from SLAVE4 (channels 49...64)
MSR3ERR	832	error during serial unit data transfer → SLAVE4 receive false data from MASTER1 (channels 49...64)

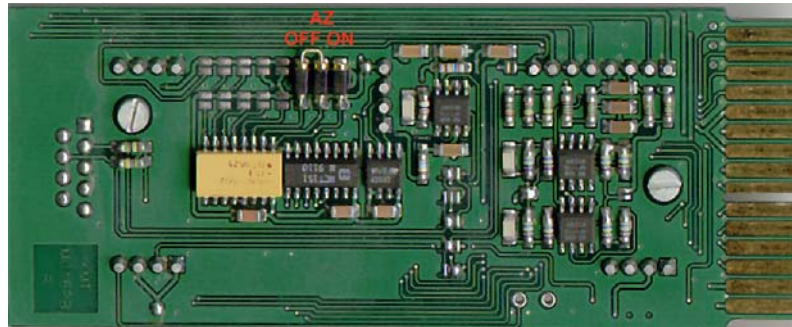
## 3 Signal conditioning modules

### 3.1 General information

- All signal conditioning modules fulfil the task to generate the necessary excitation voltages or currents and to transform the input signal from the sensor into a proportional output voltage in the range of  $\pm 5V$ . This output voltage gets via the module bus to the controller unit, where the anti-aliasing filtering, the 12 bit analog-to-digital conversion and the digital processing take place.
- Every special module is situated on the top of a special carrier board, which is realize the auto-zeroing function. For some special modules, like VOLT and CUR, all functions are implemented on the board itself, so that an additional board is not necessary. Because every carrier board is adapted to the signal conditioning module on the top, it is [not allowed to change carrier boards](#) of different modules.
- An offset voltage of up to  $\pm 250mV$  is guaranteed by the auto-zeroing function. For special modules with high level voltages this range may be increased. Note, that during this operation the signals from the sensors must have a constant level. Is the offset or the signal noise to high, so that the auto-zeroing will not finished successfully, an error and the number of the failed channel will displayed (see previous chapter). For enabling and disabling this function see chapter "Carrier board".
- Analog settings of module properties, like excitation, gain and enabling/disabling the auto-zeroing function, are coded with jumpers. To change these settings follow the procedure:
  1. Power down the measure unit with the key on the front left side. Because the notebook is powered with the internal battery, it is not necessary to finish active programs or power down the notebook.
  2. Unscrew the two socket-head cap screws with the delivered hexagon key and pull out the module from the frame. Change the jumpers using pincers and plug the module back to the socket place.
  3. Fix the module with the two screws and power on the measure unit. All last settings, e.g. offset values from last auto-zeroing, are memorized on the module itself and will reinitialized after power on. Further more the new jumper settings will detect from measure unit.
  4. After changing excitations or gains on modules with high amplifications, e.g. STG, it is recommended to make a new auto-zeroing to compensate the new offset voltage and for optimal using of the measuring range.
- For the next version of the MC16/64 (mid of 1999) an direct programming of module properties from the notebook is possible, so that the last procedure will be a little bit easier and faster.
- The accuracy of the analog-to-digital conversion is 0.05% and of the signal conditioning normally  $<0.2\%$  related to the full scale range of  $\pm 5V$ . If you have calibration equipment you can compensate the sensor tolerances in software by defining a channel specific offset and gain value. For this fine tuning make a double click on the channel in the **JobDatasets** folder in project tree of  $\mu$ Lab and select the **Calibration** card.
- Using some standard setups (8 – 15) the total sample rate will distribute to the different channels, so that the sample rate of one channel can be different from another. Because in this case the software handles all channels with the sample rate of the fastest channel for enabling online calculations, the [setup 8 works only on high speed computer systems](#) (Pentium II  $\geq 400MHz$ ) on the receiver side in telemetry applications.
- For MC16/64 systems, which will used in various applications, sometimes it is possible, that a specific channel have to sampled with different rates. Because in every setup the sample rate of channel 1 is the highest and is equal or falls to the next channel, it can be necessary to change the plug-in place of a module. A second reason for such an action is to use the integrated anti-aliasing low pass filter, which cut-off frequency is automatically coupled to the sample rate (cut-off frequency = sample rate / 3.125), for eliminating parasitic signal frequencies higher than these of the wanted signal. [To change the plug-in place of a module power down the measure unit before.](#) After power on, the measure unit detect the module on the new place and reinitialize it. Please note, that all modules are calibrated on there specific plug-in place. An changing has no influence to the gain, but the offset of modules with high amplifications, e.g. STG modules with gain 1000, can be moved. So it is recommended to compensate the new offset using the auto-zeroing function.

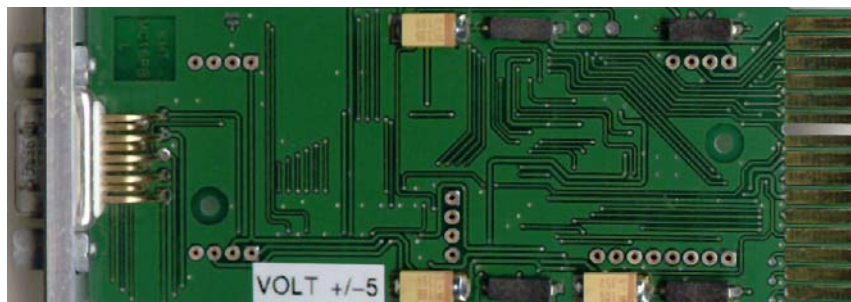
### 3.2 Carrier board

- This board includes a preamplifier with offset adjustment for auto-zeroing, the hardware for the module type detection and a socket for one signal conditioning module.
- By changing the “AZ” jumper against the next picture you can set the auto-zeroing function active for the module. After pressing the “AZ” key on the front panel of the master unit, the voltage signal output of the channel will compensate to zero. If this process successful, the assigned digital auto-zeroing values will be stored in a non-volatile memory on module. During the initialization after power on these values will be read from module and used to regenerate the last zero voltage level. [To change the jumper power down the measure unit](#) with the switch on the front panel and pull the signal conditioning module from the socket on the rear side of the measure unit. The notebook can be on, buffered by the internal battery.

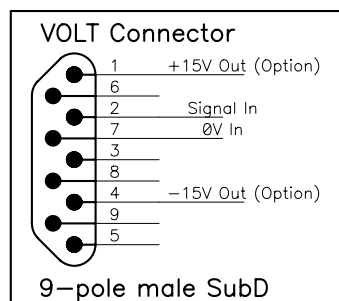


### 3.3 VOLT module

- This module makes fixed single-ended voltage signal inputs in the ranges of  $\pm 2.5V$ ,  $\pm 5V$ ,  $\pm 10V$ ,  $\pm 15V$ ,  $\pm 20V$ ,  $\pm 25V$  or  $\pm 30V$  available as well as a differential input in the  $\pm 5V$  range.
- DC offset voltages of up to  $\pm 250mV$  may be compensated by the auto-zeroing function. For enabling and disabling this function see previous chapter.



- The input impedance depends on the input voltage range, but is in every case greater than  $100k\Omega$ .
- Optional it is possible to generate a non-calibrated output voltage (excitation) for passive sensors of  $\pm 15V$ .
- Next schematic picture shows the pinning of the male connector to the module.



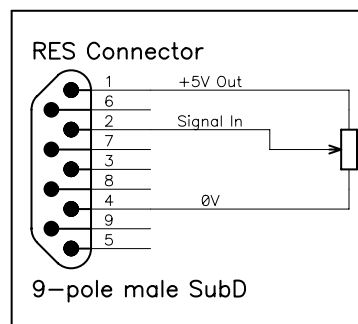
- An additional 8-pole low pass filter can be plugged on board (see chapter “FILTER module”).

### 3.4 CUR module

- This module is suitable for current signal inputs in the range of  $\pm 25\text{mA}$ . From the point of hardware this module is equivalent to the  $\pm 5\text{V}$  differential input voltage module with an additional precision input resistor of  $100\Omega$ .
- DC offset currents of up to  $\pm 1\text{mA}$  may be compensated by the auto-zeroing function. For enabling and disabling this function see chapter "Carrier board".
- Optional it is possible to generate a non-calibrated output voltage for passive sensors of  $\pm 15\text{V}$ .
- The pinning is identical with that of the VOLT module in the previous chapter.
- An additional 8-pole low pass filter can be plugged on board (see chapter "FILTER module").

### 3.5 RES module

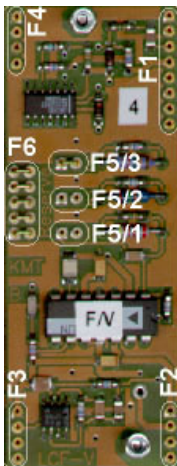
- This module was designed for measuring resistances, distances or rotation angles with sensors based on potentiometers. A fixed excitation voltage of  $+5\text{V}$  will be generated and the input voltage from the sensor in the  $0 - 5\text{V}$  range will be transferred to the output without amplification.
- Next drawing shows the pin assignment of the male connector from the sensor to the module.



- DC offset voltages of up to  $\pm 250\text{mV}$  may be compensated by the auto-zeroing function. For enabling and disabling this function see chapter "Carrier board".

### 3.6 F/V module

- This module converts any input signal frequency into a proportional analog output voltage. With jumpers the frequency ranges  $40\text{Hz} - 500\text{Hz}$ ,  $40\text{Hz} - 2.5\text{kHz}$ ,  $40\text{Hz} - 10\text{kHz}$  are settable (optional  $40\text{Hz} - 20\text{kHz}$ ).
- Next schematic picture shows the pinning of the male connector to the module and the jumper settings.



F/V Connector	Frequency range settings		
1 +15V Out (Option)	40Hz - 500Hz	40Hz - 2.5kHz	40Hz - 10kHz
6	<input checked="" type="checkbox"/> F5/3	<input type="checkbox"/> F5/3	<input type="checkbox"/> F5/3
2 Signal In	<input type="checkbox"/> F5/2	<input checked="" type="checkbox"/> F5/2	<input type="checkbox"/> F5/2
7 0V In	<input type="checkbox"/> F5/1	<input type="checkbox"/> F5/1	<input checked="" type="checkbox"/> F5/1
3	5V = 500Hz	5V = 2.5kHz	5V = 10kHz
8			
4 -15V Out (Option)			
9			
5			
9-pole male SubD			

- The module is plugged with the connectors F1, F2, F3 and F4 in the carrier board. F6 marks reserve jumpers.
- All signal frequencies with amplitudes from  $0.3\text{V}$  to  $10\text{V}$  and sine, square or triangle wave forms will accept (optional from  $2\text{V}$  to  $20\text{V}$ ).
- The module voltage output is in a range of  $0 - 5\text{V}$  and includes a fixed output filter (2-pole Butterworth,  $3\text{dB}$  at  $10\text{Hz}$ ,  $40\text{dB}$  at  $100\text{Hz}$ ).
- Optional it is possible to generate a non-calibrated output voltage for sensors of  $\pm 15\text{V}$ .

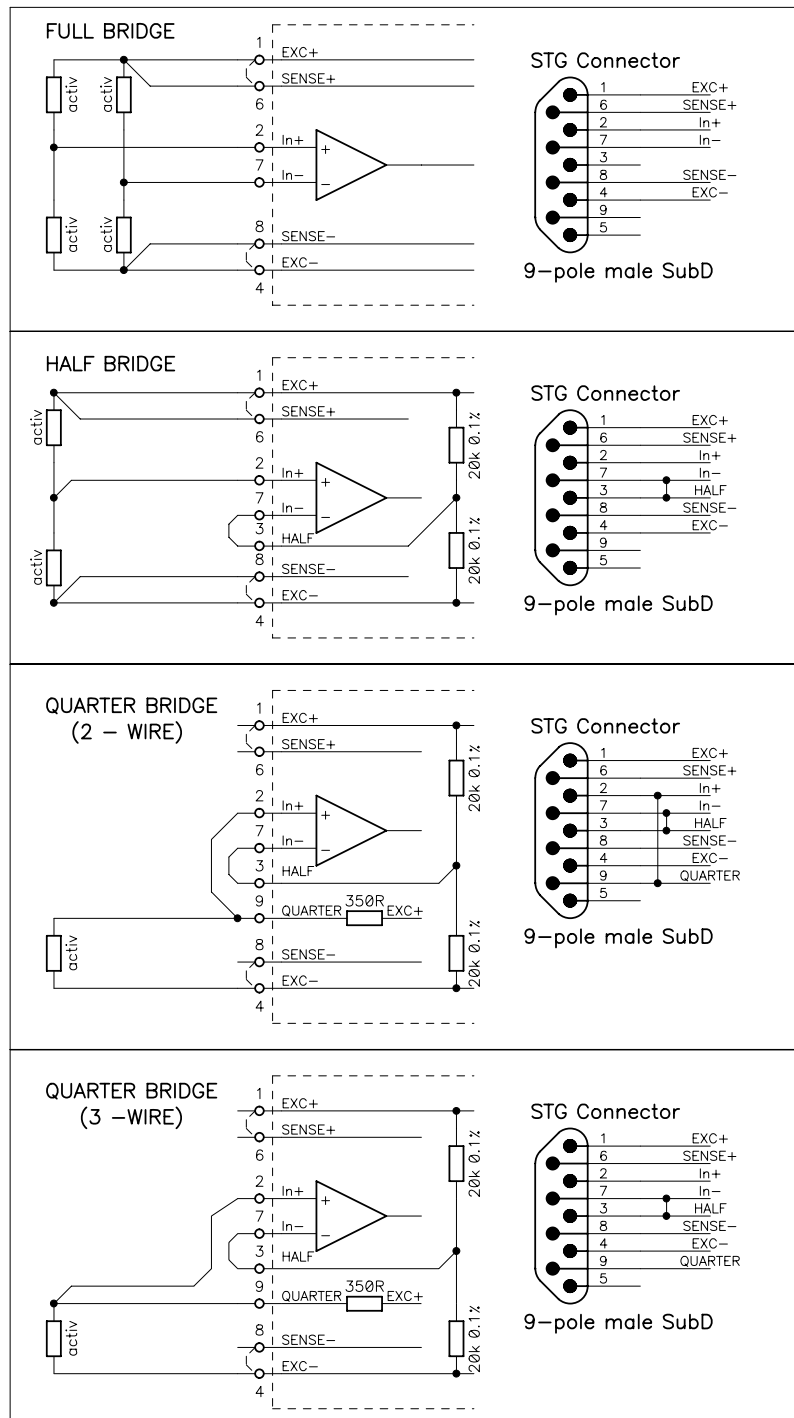
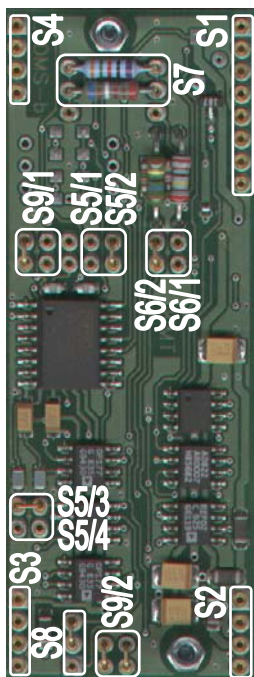
### 3.7 STG Module (Versions 2 and 3)

- The STG module measures oscillations, vibrations, forces, pressures, accelerations, material stresses and mechanical stretches based on strain gauges. 2- and 3-wire quarter bridges, half and full bridges from 120Ω to 1kΩ may be connected.
- Next picture shows the positions of connectors, jumpers and the quarter bridge completion resistors and in the drawing you find the pin assignment of the male connector to the module for the four different bridges.

STG module version 2

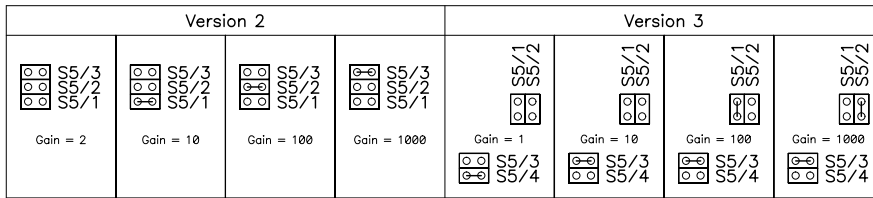


STG module version 3

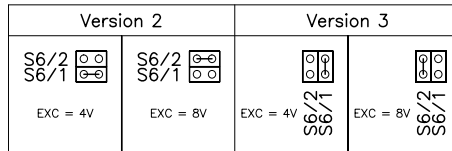


- The module is plugged with the connectors S1, S2, S3 and S4 in the carrier board. S9/1 and S9/2 marks reserve jumpers.
- DC offset voltages of up to ±250mV on the input may be compensated by the auto-zeroing function. For enabling and disabling this function see chapter “Carrier board”.

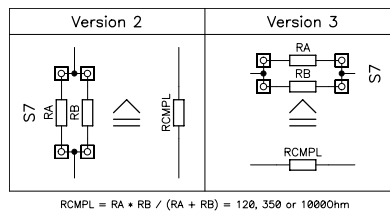
- The difference input signal from the bridge will amplified by one of four possible gains.



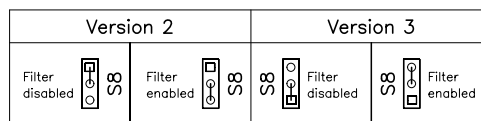
- Two bridge supply voltages (excitations) are available.



- The onboard quarter bridge completion is set by default to 350Ω with 2 plugged resistors. For applications with other bridge resistances, e.g. 120Ω, these 2 parallel resistors can be changed.



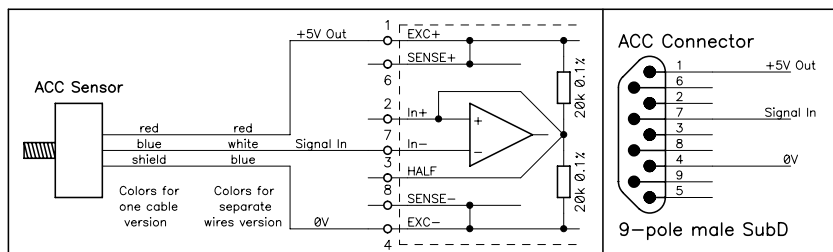
- The output of the amplifier pass through a fixed 2-pole Butterworth low pass filter with 3dB at 5kHz and 40dB attenuation per decade (optional others). With the jumper S8 it is possible to disable this filter with the exception, that [for version 2](#) the set gain is divided by -2. That means if you select a gain of 1000, you have on the unfiltered output an inverted signal with a gain of 500. Because of the signal inversion the [auto-zeroing function will not supported](#) and leads to error messages. For version 3 the gain of the filtered and unfiltered output is equal, so that there are no restrictions.



- An additional 8-pole low pass filter can plugged on board (see chapter “FILTER module”).

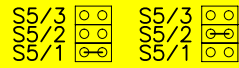
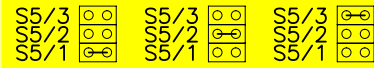
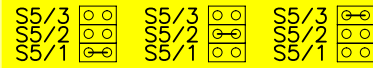
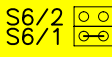
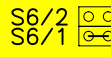
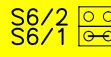
### 3.8 ACC sensor and module

- The capacitive acceleration sensor ACC measures accelerations and vibrations as well as inclination of objects and are conceived for measurements on vehicles, machines, buildings and plants. They also guarantee for fast diagnosis of errors and are extraordinarily appropriated for stress control at strained components. Very remarkable properties are the shock resistance up to 10000g, the high long-term stability, the hermetically sealed housing (IP65), the true DC response and the very low temperature drift.
- Next drawing shows the pin assignment of the male connector from the sensor to the module.



- By rectangular mounting of 3 sensors on a cube the acceleration vector in a 3-dimensional area can be determined. Further more the velocity and covered distance of the test object can be derived by μLab online integration.

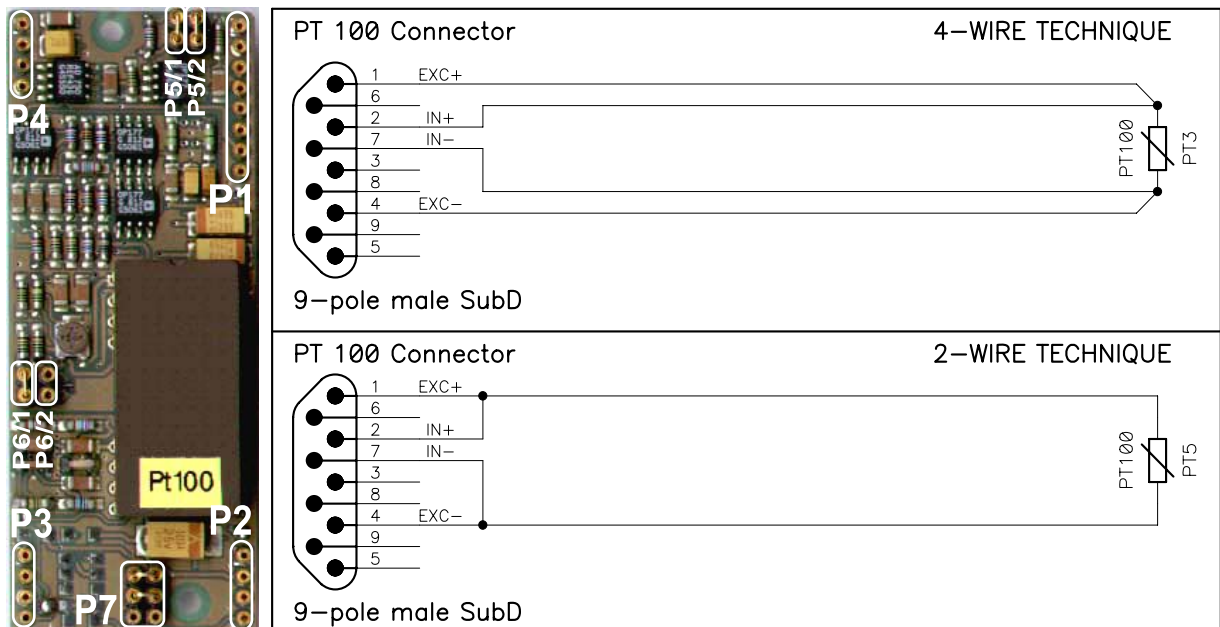
- The sensor integrated circuit converts the capacitive response from the gas-dynamical damped spring-mass-system in a non-calibrated small analog voltage. The sensor assigned module amplifies this signal in a calibrated output voltage in the  $\pm 5V$  range and enables the possibility of jumper programmable measuring ranges.
- From point of hardware the signal conditioning module is equivalent to the STG module (see previous chapter) with the exception of only one excitation voltage and gain calibration assigned to the specific sensor. Therefore pay attention to the fact, that the serial number of the sensor is equal to that labeled on module. Three different acceleration sensor models are available.

Model	B1	B2	B3
Sensor range	3g	10g	50g
Jumper programmable ranges on module (see STG)	$\pm 3g$ $\pm 1g$ 	$\pm 10g$ $\pm 5g$ $\pm 1g$ 	$\pm 50g$ $\pm 20g$ $\pm 5g$ 
Sensor supply voltage	EXC = 5V (fixed) 	EXC = 5V (fixed) 	EXC = 5V (fixed) 
Band width	0-160 Hz	0-350 Hz	0-550 Hz
Resolution	$10^{-3}g$	$10^{-2}g$	$10^{-1}g$

- DC offset voltages, e.g. based on the earth gravitation, may easy be compensated to 0V output using the auto-zeroing function. For enabling and disabling this function see chapter “Carrier board”.
- An additional 8-pole low pass filter can plugged on board (see chapter “FILTER module”).

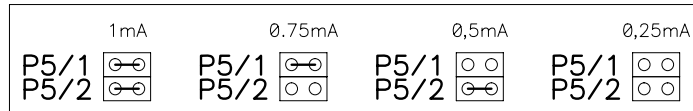
### 3.9 Pt100 module

- This module is suitable for temperature measuring from  $-100^{\circ}C$  to  $700^{\circ}C$  with standard RTD elements, like Pt100 or Pt1000 sensors as well as general resistance measurement of resistors from  $50\Omega$  to  $2k\Omega$ .
- Next picture shows the positions of connectors and jumpers and in the drawing you find the pin assignment of the male connector to the module. For long cables to the sensor the 4-wire technique is recommended. Here the voltage drop along the excitation lines has no influence to the measuring result, due to the using of separate measuring lines with a high input resistance ( $> 10M\Omega$ ).

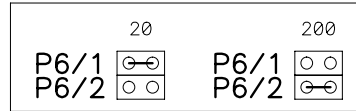


- The module is plugged with the connectors P1, P2, P3 and P4 in the carrier board. P7 marks reserve jumpers.
- All modules are calibrated in work for the specified sensor and the auto-zeroing function is disabled. For enabling this function to recalibrate the sensor see chapter “Carrier board”. General all input offset voltages generated from the  $100\Omega$  ( $1000\Omega$ ) resistance of the sensors on  $0^{\circ}C$  may be compensated. If the offset is to high, it is necessary to reduce the excitation current.

- For the excitation of a Pt100 sensor a jumper programmable precision DC current of 1mA (default), 0.75mA, 0.5mA or 0.25mA will generated on module. Using a Pt1000 sensor these excitations are set to 100 $\mu$ A, 75 $\mu$ A, 50 $\mu$ A and 25 $\mu$ A, so that the input signals in both cases are the same (100mV at 0 $^{\circ}$ C).



- The gain is set to 20 as default to guarantee a measurement range from -100 to 700 $^{\circ}$ C for Pt100/Pt1000 sensors. For special applications it is also possible to increase this gain to 200, what results in a higher dynamic, but only a  $\pm 65^{\circ}$ C temperature measuring range.

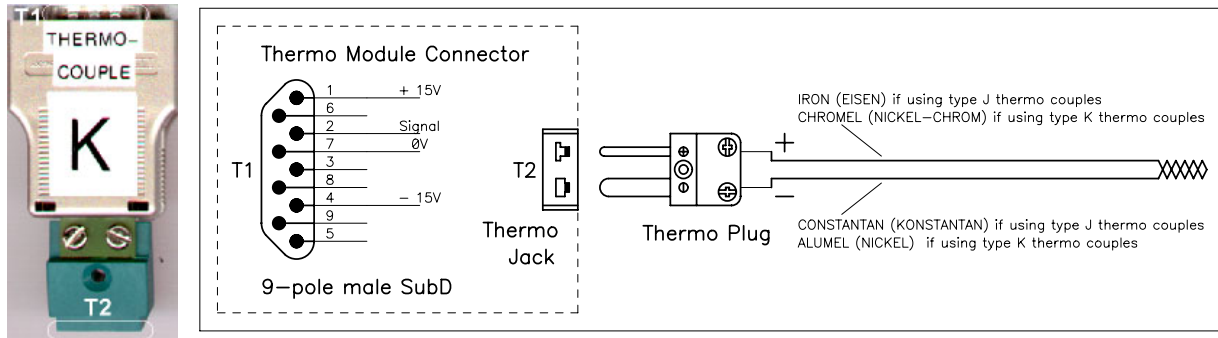


- Optional is a galvanic isolation of the input signals and the excitation current possible.
- The signal output of the module pass through a fixed 4-pole Butterworth low pass filter with 3dB at 4Hz and 80dB attenuation per decade.
- With the default settings of an excitation current of 1mA for a Pt100 sensor (100 $\mu$ A for a Pt1000) and a gain of 20, the following output voltages are to be expected. The non-linear characteristic can be linearized by an optional action module in the  $\mu$ Lab software.

Temperature ( $^{\circ}$ C)	PT100 out (mV)	Zero compensated module input (mV)	Module output (mV)	Temperature ( $^{\circ}$ C)	PT100 out (mV)	Zero compensated module input (mV)	Module output (mV)
-100	60,40	-39,60	-792	310	215,13	115,13	2303
-90	64,41	-35,59	-712	320	218,66	118,66	2373
-80	68,42	-31,58	-632	330	222,17	122,17	2443
-70	72,41	-27,59	-552	340	225,66	125,66	2513
-60	76,38	-23,62	-472	350	229,15	129,15	2583
-50	80,35	-19,65	-393	360	232,62	132,62	2652
-40	84,30	-15,70	-314	370	236,09	136,09	2722
-30	88,25	-11,75	-235	380	239,54	139,54	2791
-20	92,18	-7,82	-156	390	242,97	142,97	2859
-10	96,09	-3,91	-78	400	246,40	146,40	2928
0	100,00	0,00	0	410	249,81	149,81	2996
10	103,89	3,89	78	420	253,22	153,22	3064
20	107,78	7,78	156	430	256,61	156,61	3132
30	111,65	11,65	233	440	259,98	159,98	3200
40	115,50	15,50	310	450	263,35	163,35	3267
50	119,35	19,35	387	460	266,70	166,70	3334
60	123,18	23,18	464	470	270,05	170,05	3401
70	127,01	27,01	540	480	273,38	173,38	3468
80	130,82	30,82	616	490	276,69	176,69	3534
90	134,61	34,61	692	500	280,00	180,00	3600
100	138,40	38,40	768	510	283,29	183,29	3666
110	142,17	42,17	843	520	286,58	186,58	3732
120	145,94	45,94	919	530	289,85	189,85	3797
130	149,69	49,69	994	540	293,10	193,10	3862
140	153,42	53,42	1068	550	296,35	196,35	3927
150	157,15	57,15	1143	560	299,58	199,58	3992
160	160,86	60,86	1217	570	302,81	202,81	4056
170	164,57	64,57	1291	580	306,02	206,02	4120
180	168,26	68,26	1365	590	309,21	209,21	4184
190	171,93	71,93	1439	600	312,40	212,40	4248
200	175,60	75,60	1512	610	315,57	215,57	4311
210	179,25	79,25	1585	620	318,74	218,74	4375
220	182,90	82,90	1658	630	321,89	221,89	4438
230	186,53	86,53	1731	640	325,02	225,02	4500
240	190,14	90,14	1803	650	328,15	228,15	4563
250	193,75	93,75	1875	660	331,26	231,26	4625
260	197,34	97,34	1947	670	334,37	234,37	4687
270	200,93	100,93	2019	680	337,46	237,46	4749
280	204,50	104,50	2090	690	340,53	240,53	4811
290	208,05	108,05	2161	700	343,60	243,60	4872
300	211,60	111,60	2232	710	346,65	246,65	4933

### 3.10 THERMO module

- This module is suitable for temperature measuring from -100°C to +480°C with direct connecting of type K and J (optional T) thermo couples using standard plugs. An integrated circuit inside the module plug housing realizes the cold junction compensation and amplifies the input voltage from the sensor in a range of 10mV/°C. The THERMO module will be connected outside from the MC16/64 to a VOLT module with ±15V excitation or an ISO module (see next chapter), if galvanic isolation is necessary for temperature measuring on parts with voltage potential (e.g. car chassis).
- Next drawing shows the pin assignments of the male SubD connector and the thermo plug.

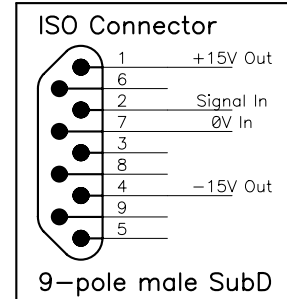
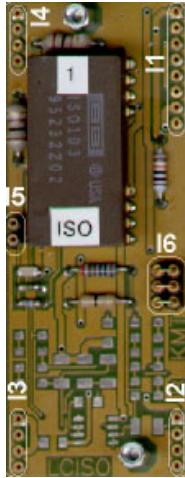


- All modules are calibrated in work for the specified sensor and the auto-zeroing function is disabled. For enabling this function to recalibrate the sensor see chapter "Carrier board". Note, that it is necessary to have either a thermo calibrator to simulate a 0°C input or an ice-point reference. **If you only short-circuiting the input you measure the environmental temperature, not 0°C!**
- Following output voltages for the thermo couples type K and J are to be expected. The non-linear characteristic can be linearized by an optional action module in the µLab software.

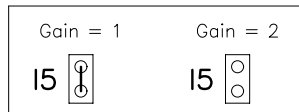
Temperature (°C)	Sensor K output (mV)	Module K output (mV)	Sensor J output (mV)	Module J output (mV)
- 100,0	- 3,553	- 876	- 4,632	- 893
- 80,0	- 2,920	- 719	- 3,785	- 729
- 60,0	- 2,243	- 552	- 2,892	- 556
- 40,0	- 1,527	- 375	- 1,960	- 376
- 20,0	- 0,777	- 189	- 0,995	- 189
- 10,0	- 0,392	- 94	- 0,501	- 94
0,0	0	2,7	0,0	3,1
10,0	0,397	101	0,507	101
20,0	0,798	200	1,019	200
25,0	1,000	250	1,277	250
30,0	1,203	300	1,536	300
40,0	1,611	401	2,058	401
50,0	2,022	503	2,585	503
60,0	2,436	605	3,115	606
80,0	3,266	810	4,186	813
100,0	4,095	1015	5,268	1022
120,0	4,919	1219	6,359	1233
140,0	5,733	1420	7,457	1445
160,0	6,539	1620	8,560	1659
180,0	7,338	1817	9,667	1873
200,0	8,137	2015	10,777	2087
220,0	8,938	2213	11,887	2302
240,0	9,745	2413	12,998	2517
260,0	10,560	2614	14,108	2732
280,0	11,381	2817	15,217	2946
300,0	12,207	3022	16,325	3160
320,0	13,039	3327	17,432	3374
340,0	13,874	3434	18,537	3588
360,0	14,712	3641	19,640	3801
380,0	15,552	3849	20,743	4015
400,0	16,395	4057	21,846	4228
420,0	17,241	4266	22,949	4441
440,0	18,088	4476	24,054	4655
460,0	18,938	4686	25,161	4869
480,0	19,788	4896	26,272	5084

### 3.11 ISO module

- This module is suitable for measuring voltages with galvanic isolation. Additionally, an also isolated non-calibrated  $\pm 15V$  supply voltage will be generated as excitation for sensors or circuits, e.g. the THERMO module. Next picture and drawing show the jumper positions and pin assignments of the male SubD connector to the module.



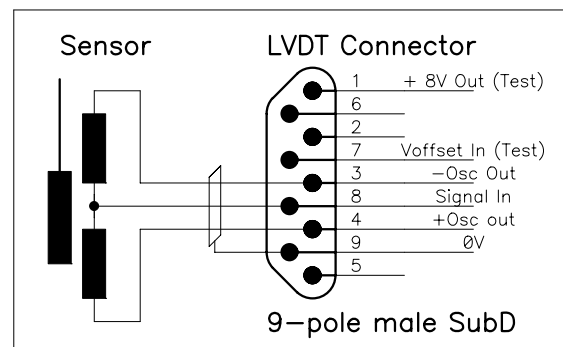
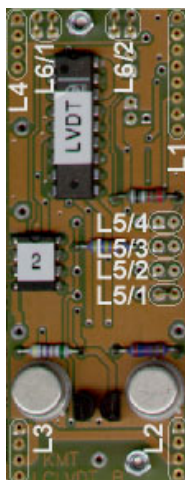
- The module is plugged with the connectors I1, I2, I3 and I4 in the carrier board. I6 marks reserve jumpers.
- Signals with band widths of up to 20kHz may be transmitted in a voltage output range of  $\pm 5V$ . For temperature measurements, e.g. with the THERMO module, an optional fixed 4-pole Butterworth low pass filter with 3dB at 4Hz and 80dB attenuation per decade is available.
- Two gains for input ranges of  $\pm 5V$  (gain = 1) and  $\pm 2,5V$  (gain = 2) are programmable with jumper I5.



- DC offset voltages of up to  $\pm 250mV$  may be compensated by the auto-zeroing function. For enabling and disabling this function see chapter "Carrier board".
- An additional 8-pole low pass filter can be plugged on board (see chapter "FILTER module").

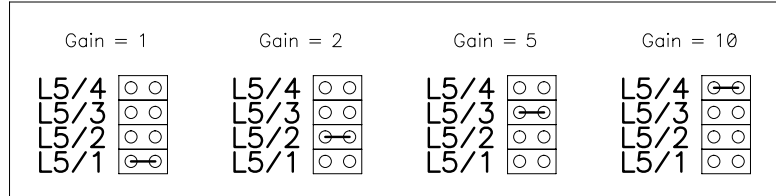
### 3.12 LDVT module

- This module is designed for measuring small distances using LVDT sensors. Next picture and drawing show the jumper positions and pin assignments of the male SubD connector to the module.



- The module is plugged with the connectors L1, L2, L3 and L4 in the carrier board. L6/1 and L6/2 marks reserve jumpers.

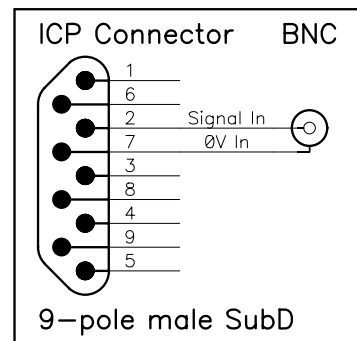
- Signals with band widths of up to 20kHz may be transmitted in a voltage output range of  $\pm 5V$ . The sensor will be supplied by a 5kHz sinusoidal carrier frequency with an amplitude of 5V.
- The module is aligned for a  $\pm 10mm$  HBM sensor, but for adaptations to other sensor types a recalibration will be recommended. This takes place by determining the most suitable gain for the best dynamic performance in hardware, eliminating the offset of the reference point using the auto-zeroing function (see chapter "Carrier board") and defining an assigned gain in software for the fine tuning in accordance to the physical distance. Next drawing shows the jumper positions for the gain setting on the module. The gains 1, 2, 5 and 10 correspond to distances of  $\pm 10mm$ ,  $\pm 5mm$ ,  $\pm 2mm$  and  $\pm 1mm$  for the reference sensor.



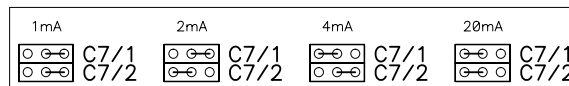
- An additional 8-pole low pass filter can be plugged on board (see chapter "FILTER module").

### 3.13 ICP module

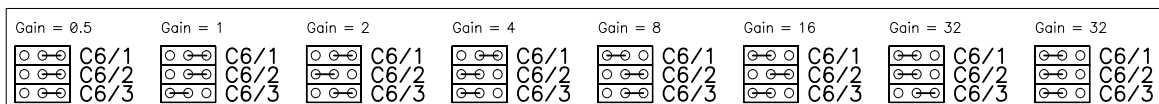
- This module is suitable for acceleration and acoustics measurement with all ICP<sup>®</sup> and compatible sensors and microphones.
- Next picture and drawing show the positions of connectors and jumpers and the pin assignment of the additional adapter from BNC to the 9-pole SubD module connector.



- The module is plugged with the connectors C1, C2, C3, C4 and C5 in the carrier board.
- Following excitation currents are programmable with jumpers C7/1 and C7/2, optional also other 4 different currents between 1 and 20mA.



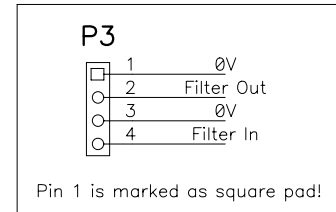
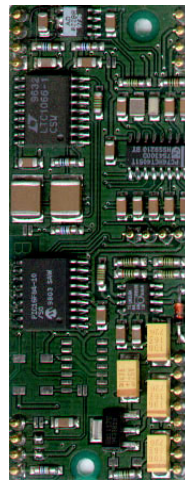
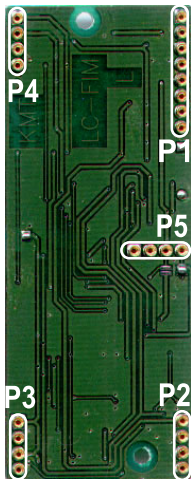
- 7 different gains are programmable with jumpers C6/1, C6/2 and C6/3, optional also others.



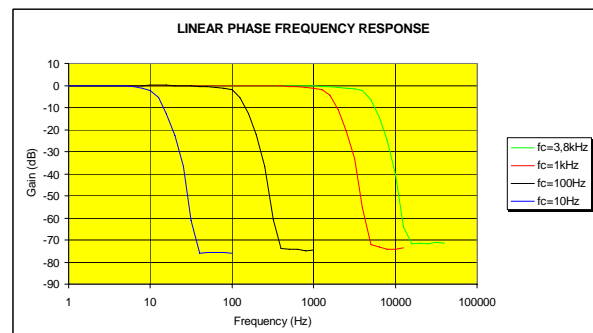
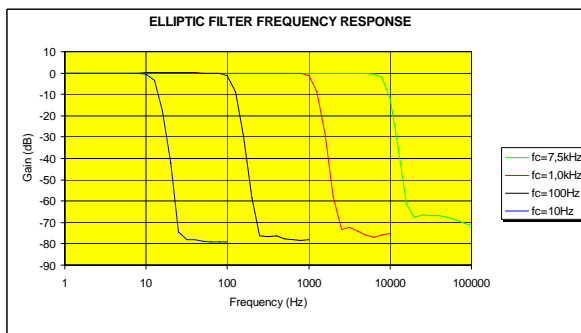
- An optional direct programming of excitation currents and gains from the notebook is in preparation.
- The output voltage range is  $\pm 5V$  and the signal band width starts from 5Hz and goes up to 16kHz. Because DC signals will not be supported an offset adjustment is not necessary and so the auto-zeroing function is disabled.
- An additional 8-pole low pass filter can be plugged on board (see chapter "FILTER module").

### 3.14 FILTER board

- This 8<sup>th</sup> order elliptic or linear phase low pass filter intermediate board is available for well-defined signal band width limitation for almost all modules (VOLT, CUR, RES, STG, ACC, ISO, LVDT and ICP).
- Next pictures and drawing show the positions of connectors and the pin assignment of P3.



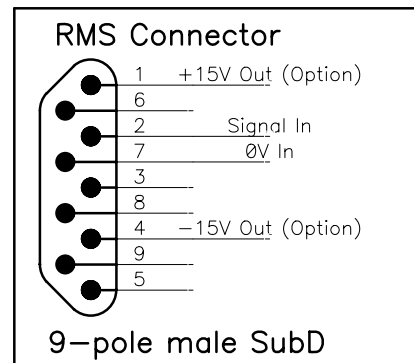
- This board is plugged with the connectors P1, P2, P3, P4 and P5 in the carrier board and above the assigned signal-conditioning module.
- The maximum input and output voltage range is  $\pm 5V$  and the resolution is 14bit.
- For an elliptic frequency response one of more than 2000 cut-off frequencies between 10Hz and 7,68kHz is available. To determine the possible frequencies divide 23,04kHz by 3, 4, 5, ... , 2304. For a linear frequency response one of more than 1000 cut-off frequencies between 10Hz and 3,84kHz is available. To determine the possible frequencies divide 11,52kHz by 3, 4, 5, ... , 1152.
- Characteristic and cut-off frequency of every filter board should specified by order, but reprogramming is every time possible in company. An optional direct programming of filter properties from the notebook is in preparation.
- The signal outputs of all signal conditioning modules are situated by default above pin 2 of P3. For applications with integrated filters this connection is cut and paste to pin 4, because the filter output is connected to pin 2. This have two important consequences for the user when filter boards will added or removed.
  1. If modules will equipped with filters later, then cut the output signal of module from pin 2 and connect it to pin 4!
  2. If a filter board will removed from a module then connect pin 2 with pin 4.
- Following graphics show the actual frequency responses for different cut-off frequencies with elliptic and linear phase characteristic.



- If more than one filter board is plugged in a unit the filter clocks have to synchronize to avoid the creation of heterodyne frequencies, which can influence the measuring signal quality. The filter clock is generated only on one filter board labeled as "Master". All other boards are labeled as "Slave" and get this clock via the internal system bus. This has the consequence, that if the master module is removed the "Slave" boards doesn't work, because no filter clock is on the bus. **Therefore it is important, that for the right function of all filters at least the master board is plugged.**

### 3.15 RMS module

- This module is suitable for measuring small signal RMS voltages.
- Next picture and drawing show the positions of connectors and the pin assignment.




- The module is plugged with the connectors R1, R2, R3 and R4 in the carrier board.
- Optional it is possible to generate a non-calibrated output voltage (excitation) for sensors of  $\pm 15V$ .
- Input RMS voltages from 0 to  $200mV_{RMS}$  are supported with a DC voltage output range from 0 to +5V.
- The signal band width starts from 50Hz and goes up to 20kHz. The max. reading error is 0.5% for frequencies less than 1KHz and 1% the other ones.
- Because DC signals have no influence to the output value, an offset adjustment is not necessary and therefore the auto-zeroing function is disabled.

## 4 Notebook and software




### 4.1 Notebook

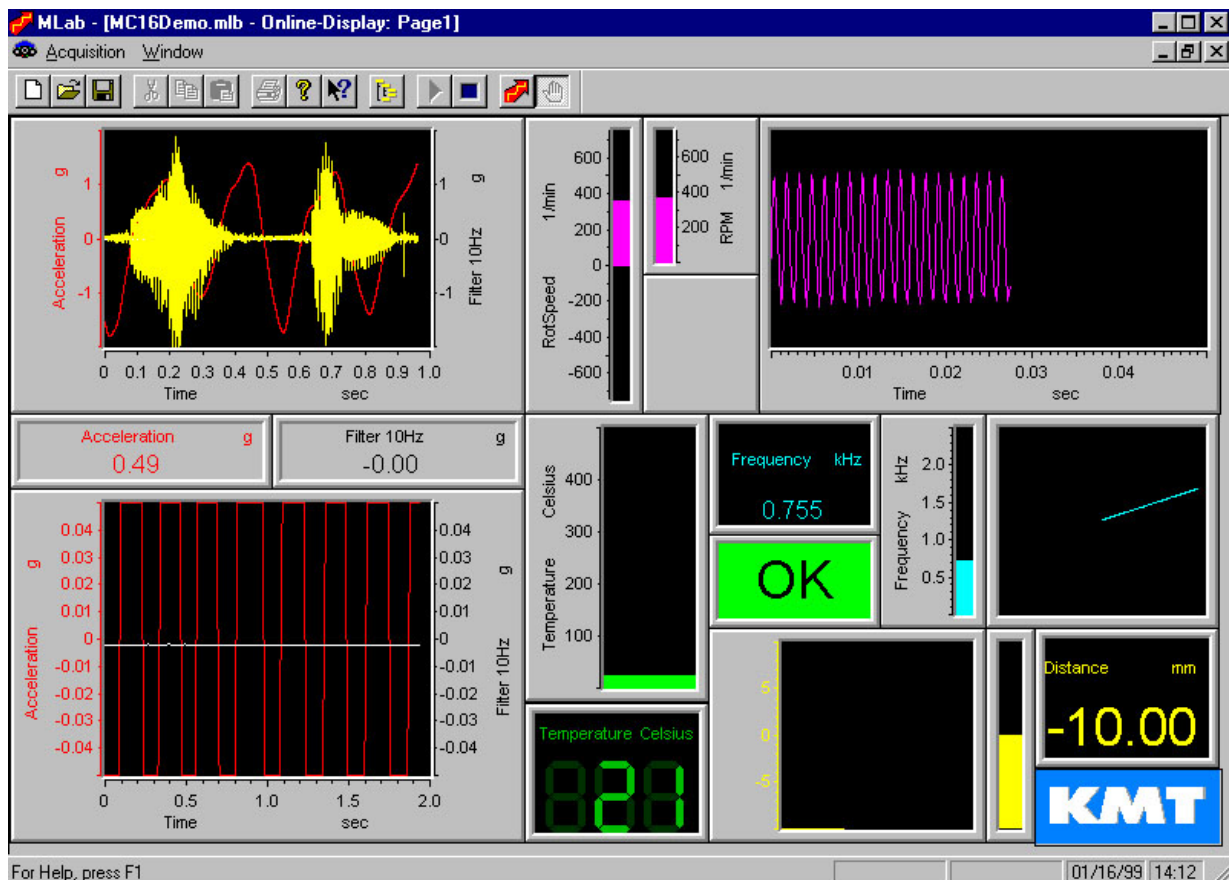
- All information you need about the notebook **Panasonic CF29** you find in the assigned user manual.
- To separate the notebook from the measure unit use a 2.5mm hexagon key and unscrew the 4 screws of the bottom plate of the notebook. Be sure that the PCMCIA card connector and the power jack is removed before. Transportation of and work with the notebook is recommended together with the bottom plate for guarantee always an easy and fast mounting with the measure unit.

### 4.2 Hardware configuration with $\mu$ Setup





- On the default installation you find on the display a short cut  to  $\mu$ Setup. This program is a part of  $\mu$ Lab and will only used for defining the external hardware, like data acquisition cards, PCM boards, PCM devices etc. Because in most cases the acquisition hardware is predefined in your installation and will never changed in your application (default is ECIA100 as PCM board and MC16/64 as PCM device), normally you don't need this program. The necessary hardware configuration file "\*.mhc" for  $\mu$ Lab is named by default as "Mc16.mhc" or "Mc16-64.mhc".

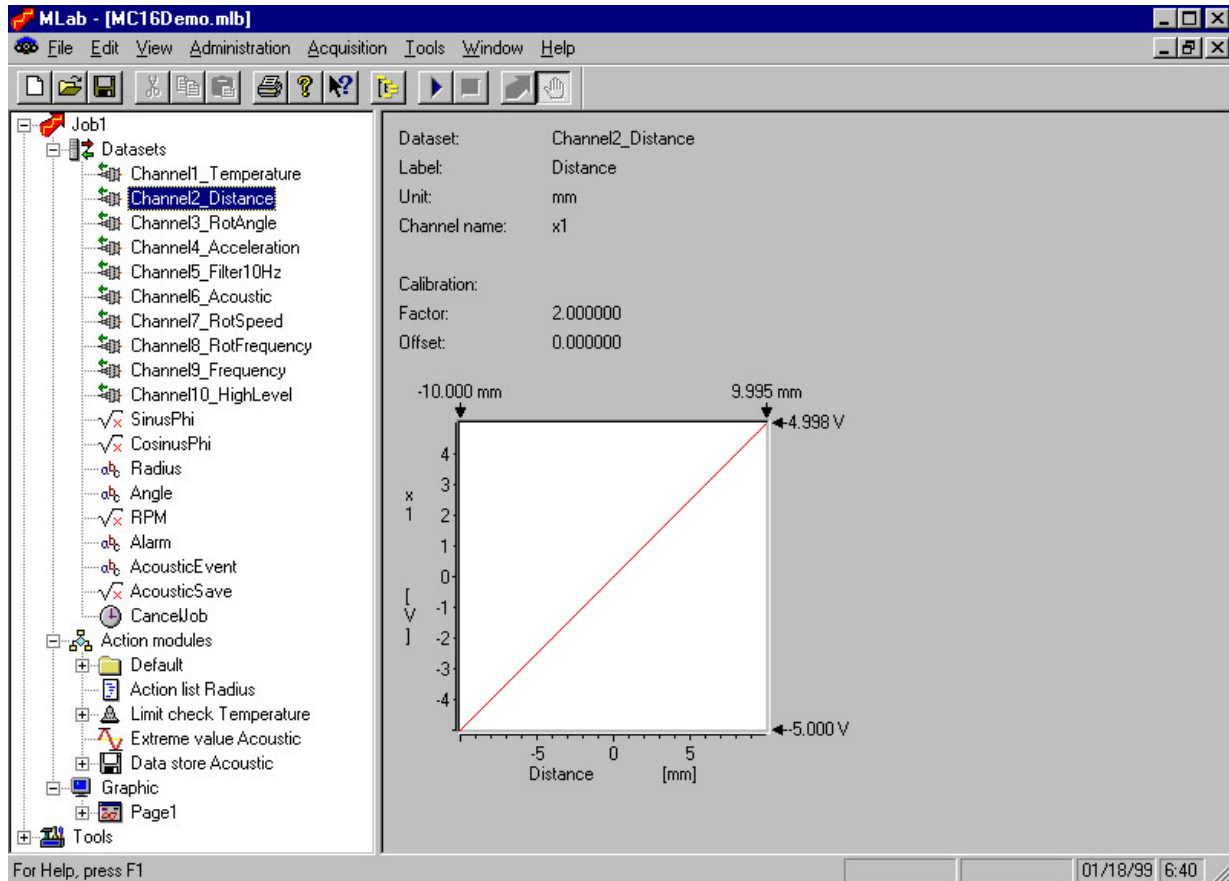
### 4.3 Data acquisition with $\mu$ Lab

- Start  $\mu$ Lab by double clicking the  icon on the display. Click on the icon  to load the desired configuration file "\*.mlb". A shorter way is to create a short cut to this file and copy it to the desktop. Now you can start after power up by double clicking the  icon on the display.




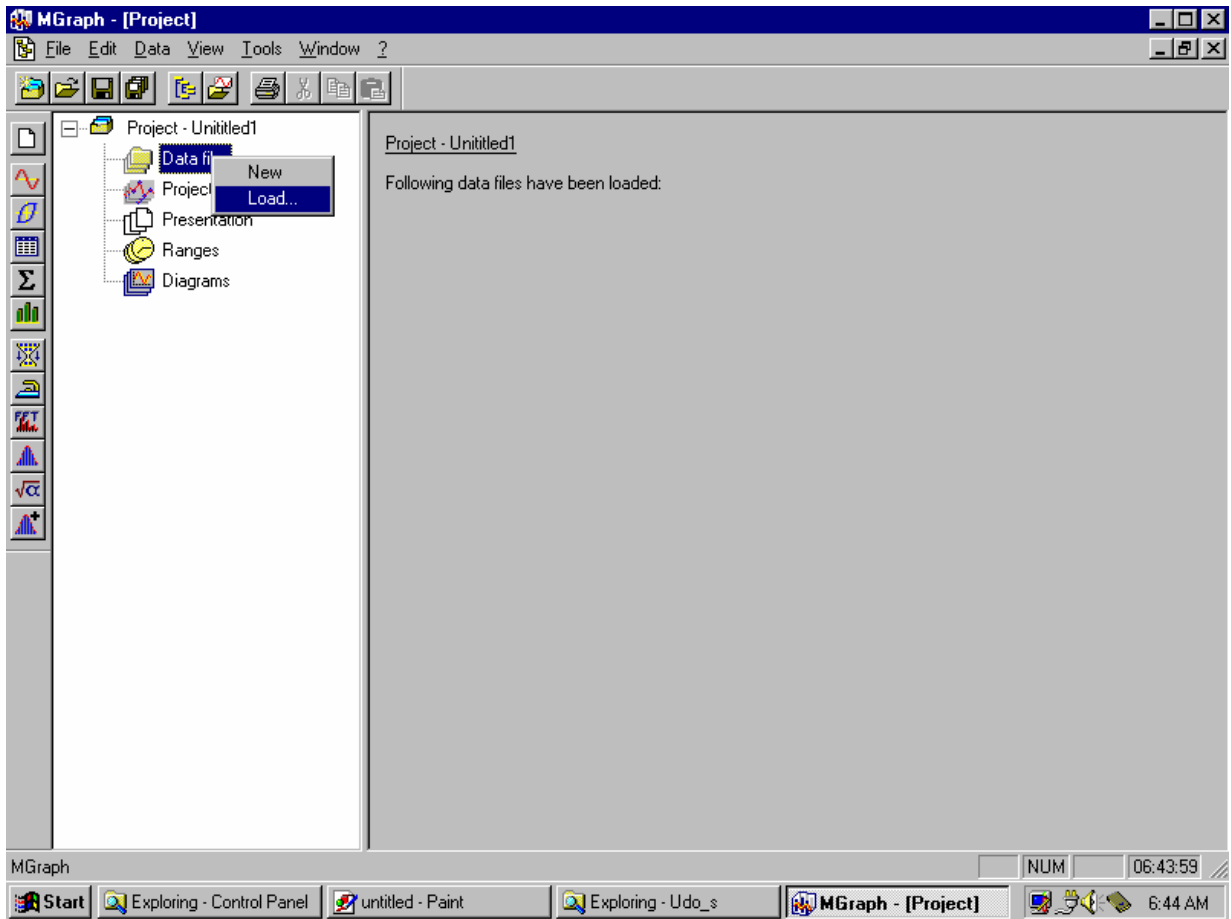
- If you use the installed demo configuration, save at first the configuration with another file name using the **SaveAs** command in the **File** menu to avoid overwriting the presentation settings.

- Click the  button on the symbol panel for starting the measurement and the graphical online display will appear.
- To store the measured data of the active channels for analyzing in  $\mu$ Graph later, press the  button, to stop the data storage the  button.
- For stopping the measurement and return to the project window click the  button on the symbol panel.
- In the project window you see on the left side the project tree, where you find all objects which are implemented in your current configuration. Every folder marked with a + sign on the left contains invisible subfolders. To show these click on the + sign in the tree.
- On the right side in the project window you find the main properties of the chosen object in project tree. By double clicking this object you open a window, where you can change all properties. By clicking the right mouse button you can select possible actions with the object.
- For detailed information see the  $\mu$ Lab user manual!

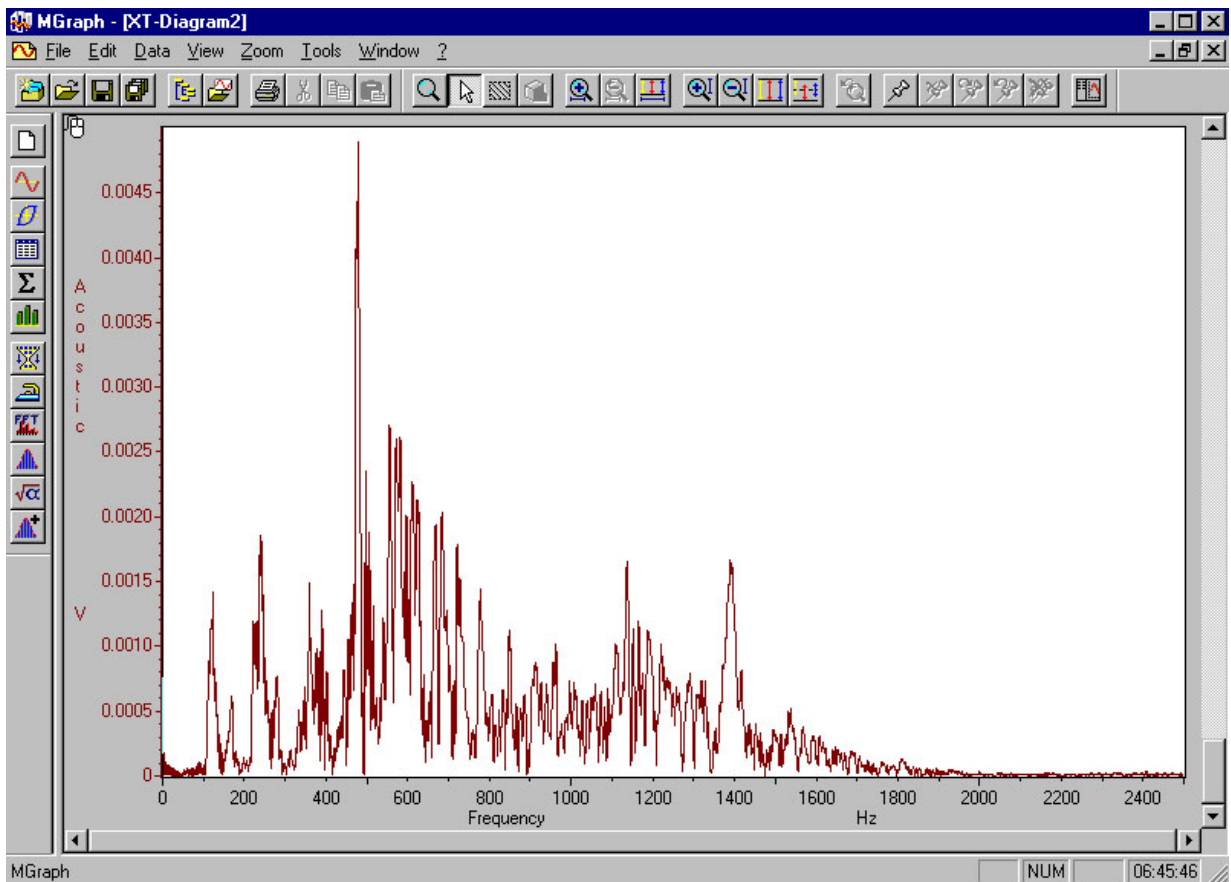


## 4.4 Data analysis with $\mu$ Graph

- Start  $\mu$ Graph by double clicking the  icon on the display.
- For displaying stored data from  $\mu$ Lab, select **Data files** in project tree, press the right mouse button, select **Load** and press the left mouse button. Select the desired file "\*.rms" and press the **Open** button. Answer the question after this action with **No**. Under the folder **Data files** you find now a subfolder with the name of the chosen data file.
- Open it by clicking on the + sign and you see the stored channel data with additional information about ranges. By selecting the interested channels you have on the right side of the project window a quick look to the data. By double clicking on a channel you open a xt-diagram window, where you can free zoom, scale and mark data.
- All marked data you can Drag&Drop with the left mouse button direct to an icon to make the desired operation, like open a data table or statistic window, frequency or bin-Analysis, printing, etc. This feature exist also in the quick look window and other parts.



- Further information you find in the  $\mu$ Graph user manual.



# 5 Appendix

## 5.1 Specifications

System:	
No. of channels:	16 in the base unit, expandable to 32, 48, 64
Auto zero:	automatically over the full measuring range
Sampling:	simultaneous
Total sample rate:	80, 40, 20, 10, 5, 2.5kSamples/s
Channel sample rate:	total sample rate divided by 2, 4, 8, 16, ... down to 156,25 Samples per second (added sample rates of all channels is equal to the total sample rate) 16 predefined setups are available (different for 16, 32, 48 and 64 channel version)
Resolution:	12Bit, 72dB dynamic range
Software:	μ-Lab and μ-Graph
Notebook	Rugged notebook "Panasonic CF-29 Toughbook" (more details see website from Panasonic) Pentium M 738 1.4GHz, 512MB, 60GB HDD Processor: Intel Pentium M 738 1.4 GHz Cache Memory: 2MB - L2 Cache RAM: 512MB / MAX 1536MB Hard Drive: 60GB Display: 1024 x 768 (XGA), TFT Active Matrix Color LCD with Touchscreen Graphics Controller: Intel® 855GME graphic controller Audio Output: Sound Card - Telecom: 56 Fax / modem - 56Kbs Networking: Internal 10/100 / Intel® Pro Wireless 2915ABG WLAN Input Device: Keyboard, Touchpad - Battery: Lithium Ion Operating System: Microsoft Windows XP Professional
Interfaces:	PCM (Miller) output with clock, transmitter output including power supply, single and multiple analog signal output (±5V), 37 pin connector to IF16-Card (PCMCIA or Desktop) for data transmission
Power supply:	10-18V DC (optional 18-30V)
Dimensions:	16 channel base unit: 320 x 260 x 130mm 16 channel extension 320 x 260 x 60mm



Example of a 48 Channel version



Plug-in signal conditions modules

## 5.2 Signal conditioning modules

To measure:	Module	Description	Characteristics
Force, pressure, strain, torsion, material stress	<b>STG</b>	Strain gauge	<ul style="list-style-type: none"> <li>• Full, half, quarter bridges in 2- and 3-wire technique (120Ω, 350Ω, 1kΩ)</li> <li>• Settable gain (2, 10, 100, 1000)</li> <li>• Settable bridge supply (4V, 8V)</li> <li>• Auto-zeroing, optional FILTER board</li> <li>• 5kHz fixed filter (2pol. Butterworth)</li> </ul>
Distance	<b>LVDT</b>	Inductive distance sensor	<ul style="list-style-type: none"> <li>• Settable gain (1, 2, 5, 10)</li> <li>• Sensor supply 5kHz, ±5V</li> <li>• Auto-zeroing, optional FILTER board</li> </ul>
Resistance, rotation angle, distance	<b>RES</b>	All sensors based on potentiometers	<ul style="list-style-type: none"> <li>• Excitation 5V</li> <li>• Auto-zeroing</li> </ul>
Frequency, distance, RPM, velocity by pulse frequency	<b>F/V</b>	Frequency to voltage converter	<ul style="list-style-type: none"> <li>• Settable maximum frequency (500Hz, 2.5kHz, 10kHz)</li> <li>• Minimum frequency 40Hz</li> <li>• Signal amplitude 0.3-10V</li> <li>• Square, sine and triangle wave forms</li> <li>• 10Hz output filter (2pol. Butterworth)</li> <li>• Optional sensor excitation ±15V</li> </ul>
Acceleration, oscillation, vibration, acoustics  Velocity, distance by numerical online integration of acceleration	<b>STG</b>	Sensors based on STG	<ul style="list-style-type: none"> <li>• see STG module</li> </ul>
	<b>ACC</b>	Capacitive accelerometer	<ul style="list-style-type: none"> <li>• Sensor ranges ±3g, ±10g, ±50g</li> <li>• Measuring ranges ±1g, ±3g, ±5g, ±10g, ±20g, ±50g</li> <li>• Sensor shock resistance up to 10.000g</li> <li>• Frequency ranges 0-160Hz (±3g), 0-350Hz(±10g), 0-550Hz (±50g)</li> <li>• Auto-zeroing, optional FILTER board</li> </ul>
	<b>ICP</b>	Piezoelectric accelerometer and microphones	<ul style="list-style-type: none"> <li>• Excitation current 1mA, 2mA, 4mA, 20mA (optional others)</li> <li>• Excitation voltage 30V (optional 24V)</li> <li>• Gains 0.5, 1, 2, 4, 8, 16, 32 (optional others)</li> <li>• Signal bandwidth 5-16000Hz</li> <li>• Optional FILTER board</li> </ul>
Temperature	<b>THERMO</b>	Thermocouples Type J, K (T)	<ul style="list-style-type: none"> <li>• Measuring range from -100°C up to +480°C</li> <li>• Gain 10mV/°C</li> <li>• Internal cold junction compensation</li> <li>• Optional galvanic isolation with integrated ISO module</li> <li>• Optional software online linearization with data table</li> </ul>
	<b>Pt100</b>	Thermo resistors Pt100 / Pt1000	<ul style="list-style-type: none"> <li>• Measuring range from -100°C up to +700°C</li> <li>• Gain 7.7mV/°C</li> <li>• Excitations 0.25, 0.5, 0.75, 1mA (Pt100) or 25, 50, 75, 100μA (Pt1000)</li> <li>• Optional galvanic isolation with integrated ISO module</li> <li>• Optional software online linearization with data table</li> </ul>
Galvanic isolated voltage	<b>ISO</b>	Isolation amplifier	<ul style="list-style-type: none"> <li>• Isolated sensor excitation ±15V</li> <li>• Input range ±10V</li> <li>• Auto-zeroing, optional FILTER board</li> <li>• 4Hz fixed filter with THERMO module (4pol. Butterworth)</li> </ul>
Current	<b>CUR</b>	Current to voltage converter	<ul style="list-style-type: none"> <li>• Input current ±25mA</li> <li>• Input impedance 100Ω</li> <li>• Auto-zeroing, optional FILTER board</li> <li>• Optional sensor excitation ±15V</li> </ul>
Voltage	<b>VOLT</b>	Voltage input	<ul style="list-style-type: none"> <li>• Fixed input range ±2.5V, ±5V, ±10V, ±15V, ±20V, ±25V or ±30V</li> <li>• Input resistance &gt;100kΩ (depends on range)</li> <li>• Auto-zeroing, optional FILTER board</li> <li>• Optional bridge excitation ±15V</li> </ul>
	<b>RMS</b>	RMS to DC voltage converter	<ul style="list-style-type: none"> <li>• Fixed input range 200mV<sub>RMS</sub></li> <li>• Optional bridge excitation ±15V</li> </ul>

To measure:	Module	Description	Characteristics
Force, pressure, strain, torsion, material stress	STG	Strain gauge	<ul style="list-style-type: none"> <li>Full, half, quarter bridges in 2- and 3-wire technique (120Ω, 350Ω, 1kΩ)</li> <li>Settable gain (2, 10, 100, 1000)</li> <li>Settable bridge supply (4V, 8V)</li> <li>Auto-zeroing, optional FILTER board</li> <li>5kHz fixed filter (2pol. Butterworth)</li> </ul>
Distance	LVDT	Inductive distance sensor	<ul style="list-style-type: none"> <li>Settable gain (1, 2, 5, 10)</li> <li>Sensor supply 5kHz, ±5V</li> <li>Auto-zeroing, optional FILTER board</li> </ul>
	FILTER	Optional filter board for almost all modules	<ul style="list-style-type: none"> <li>8<sup>th</sup> order elliptical or linear phase frequency response</li> <li>more than 2000 cut-off frequencies from 10Hz to 7.68kHz available (reciprocal scaling)</li> </ul>

**Blockdiagram:**

