MultiChoice
PCI+Express & *USB*
Series

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1 Imprint

Soft & Hardware Entwicklung Goldammer GmbH

Manual: *MultiChoice PCI, PCI/Express +USBI Series*
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2 Introduction

2.1 MultiChoice PCI and USB-Series

The intelligent data acquisition cards of the MultiChoice PCI, PCI/Express and the USB series offer a maximum of flexibility.
Excellent availability, very high processing speeds, and easy configurability by its user's are the outstanding features of the Goldammer cards. Furthermore MultiChoice offers integrated counters and is able to work with pulse width modulation. It is possible to customize the cards to individual needs. The all new card generation not only offers a wide variety of functionality it also offers online mathematics. This is the base for a wide range of different applications:

- Very fast control systems
- Fast control of test systems
- Controlling counter readings, pulse widths/frequencies
- Simultaneous measuring and outputting of signals
- Online mathematics
- Wave form generators

Bus system
The data acquisition cards of the MultiChoice PCI Series are equipped with PCI interfaces. Using this bus interface makes the data rates ten times faster than conventional ISA interfaces. And there are even more advantages:

- No interrupt conflicts
  Using several cards not any longer leads to conflicting interrupts. Several functional groups can share a single interrupt (interrupt sharing). The measuring cards are self configuring.
- No Address Collisions
- Plug´n Play
  Due to the easier handling and several more advantages of the bus system – the computer associates automatically an address range and an interrupt to the card – the less error prone and much simpler installation into existing PC systems is possible.

The USB-versions of these measuring cards are equipped with an USB 2.0-interface. With full downward compatibility this version offers 40 times of the USB1.1 data rate. Additionally to its stand alone capability these portable measurement centers offers hot plug functionality so it is possible to connect it during runtime and have it immediately ready to run.

- No Configuration Conflicts
  The measuring cards are configured after connecting them to the PC system and are ready to run immediately.
- High bandwidths with USB2.0 while fully downward compatible to USB1.1.

MultiChoice cards allow simultaneously measuring and outputting of data with up to three independent sequential control systems. Each sequence has associated its own channel list. So not only a time synchronized measuring is possible but also a time synchronized output of analog and digital data and the output of counter readings. Furthermore the cards offer a lot of different trigger modes which allow starting sequences depending on various signals.

- Up to three simultaneous sequences

- Programmable channel lists
  - Analog inputs
  - Digital inputs
  - Counters
  - Analog outputs
  - Digital outputs
- Single processing: Measuring a single predefined input value is possible
- Block processing: with and without flexible signaling
- Numerous triggers
  - External clock
  - External, digital trigger
  - Edge-/level triggering
  - Gradient triggered start
- Online mathematics: FFT, FIR – Filter (Finite Impulse Response), IIR-Filter (Infinite Impulse Response)
- Output
  - Single output
  - continuous output
  - repetitive output

2.2 Signal Description

The measurement cards offer a wide range of available inputs and outputs. They differ depending on the type of cards in data width, data rate, and functionality.

2.2.1 Analog Inputs:

Analog data acquisition serves to measure analog voltages. It is possible to measure single ended and dual ended. In the first mode the voltage is measured relative to ground of the card. This mode allows measuring voltages only. Dual ended measuring means to measure between two input terminals. The negative terminal should be connected with a resistor to the ground of the card which serves to associate to a referential potential. This mode allows to measure voltages and, aided by a shunt, also currents. Dual ended measuring cuts the number of available inputs in half because each channel has associated two input terminals.
The inputs are available with resolutions of 12 bits (4096 quantifying steps) and 16 bits (65535 quantifying steps)
The most actual models starting with release 1.6 work jumperless. They offer a completely software based configuration. Furthermore there are numerous options associated to the channels. In example it is possible to set the channel gain individually (1x, 2x, 4, 8x) as well to set the inputs to bipolar (+/-) or unipolar (0..+). The channels offer also individually settable oversampling (HS versions, USB and Quattro only) and threshold controlling for triggering.

2.2.2 Simultaneous analog inputs:

The analog acquisition is used to measure analog voltages. The analog signals are recorded simultaneously (simultaneous) on all channels. The analogue inputs are mass-related. For the differential measurement an optional BNC connection module is available, order code G0E-30D0-0. The inputs have a resolution of 16 bits (65536 quantization levels). The input voltage range can be switched between ± 10Volt and ± 5Volt in six groups. Type PCI version G06-1044-1, PCI / Express G0E-1044-1

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2.2.3 Analog Outputs:

The analog outputs deliver a voltage. The voltage is kept as long as a new value is applied. After switching on the measuring card all voltages are set to zero volts. The outputs of all actual cards (release >= 1.6) can be configured by software. There are no more jumpers to set. The DACs can be toggled between unipolar (0..+) and bipolar (+/-) to distribute the resolution to the intended spectrum.
The outputs are available with resolutions of 12 bits (4096 quantifying steps) and 16 bits (65535 quantifying steps).

2.2.4 Digital Inputs/Outputs:

Most of the cards of the PCI and the USB series offer 24 or 32 inputs/outputs. The terminals can be set to input or output by software. For the lightPCI (DA) the configuration is set in groups containing 4 bits each while any light(HS) and USB cards are set individually for each bit. Quattro cards are configured in group containing 8 bits each. Any digital bits can handle voltages up to low voltage TTL level (5V max).

2.2.5 Counters:

The counters count digital pulses (low voltage level) and process them automatically. It is possible to count pulses and measure times and phase differences. All counters are fully software configured. The counters offer the acquisition modes described in the following. The modes may vary depending on the model of the card and the purchased options.

2.2.5.1 Counting Pulses:

Counting pulses up to 24 ('32) bit values (16.777.215) (*4294967295) and a maximum frequency of approx. 10(*100) MHz. It is possible to set an initial value. The counter can be used in up or in down mode. *(USB)

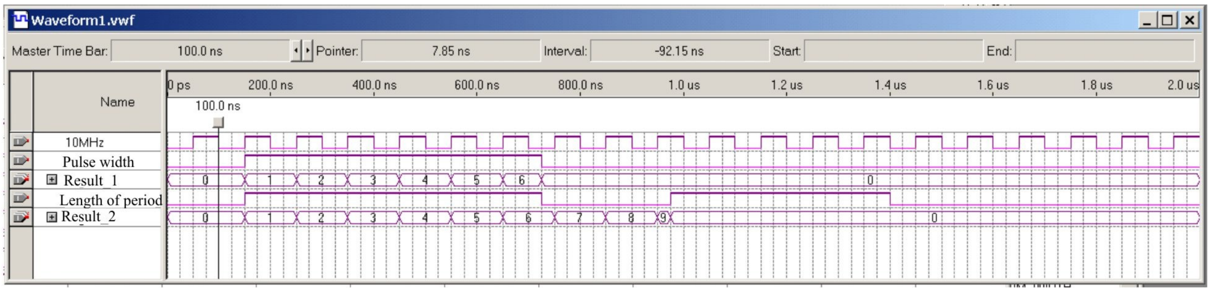
2.2.5.2 Measuring Frequencies:

The method of „measuring frequencies by counting in a time window" depends on the definition of the frequency (number of oscillations or periods per second). After starting the measurement a clock generator keeps open the „time window" for a certain period of time. The time window can be set in 1000, 100, 10 and in 1 millisecond(s). Within the time window the number of pulses of the frequency signal to determine are counted. The number of pulses can be read directly as frequency value shown in Hz and can be used for the display. The highest resolution is available within the one second range because it is counted exactly to 1 Hz. Indeed a new result can be displayed once a second because the time window is one second long.
The display shows the following with an input frequency of 12563 Hz depending on the setting of the reference frequency:

Resolution	Display
1 Hz	12563 Hz
10 Hz	12560 Hz
100 Hz	12600 Hz
1000 Hz	13000 Hz

2.2.5.3 Measuring the Period Length:

To measure the length of a period a time window is compared with the length of the period of the signal to determine and the number of pulses within this window are counted. The counting pulses are generated by a 10(*50) MHz clock oscillator. This is the equivalent of a counter resolution of 100(*20)ns. *(USB)
The measuring of the length of the period is to prefer for high precision or very fast frequency measures because for each period a new reciprocal value of the frequency is available. If an input frequency of 1 kHz is fed into the counter the display shows 10000 which means 10000 * 100 (*20)ns. Other than the frequency measurement the counter reading without a signal, in example if a pulse generator is not turned on any more, is not refreshed because the second reference pulse is missing. The calculation into rotations per second or into a frequency will not lead to a zero value in the display, instead the last value is displayed. This is caused by technical details because a zero frequency means the length of the period had to be infinite – a value that is limited by the properties of the real hardware.



2.2.5.4 Measuring the Pulse Width (Pulse/Pause Ratio):

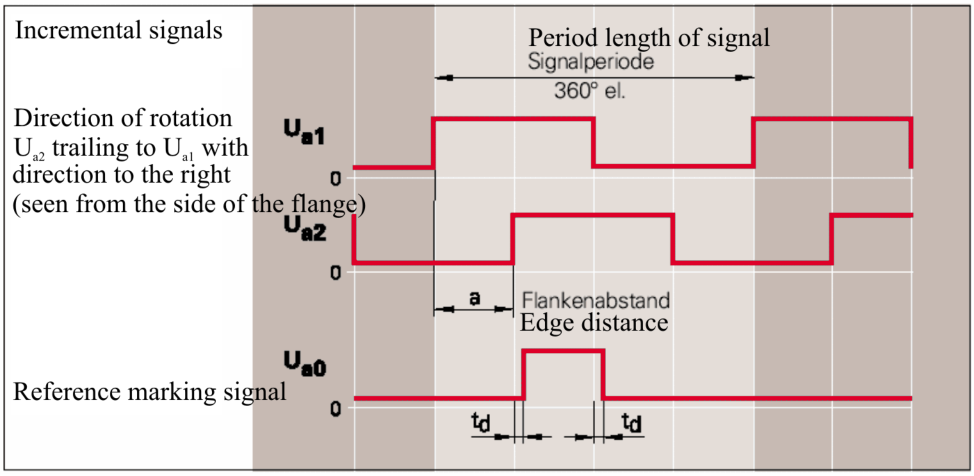
Measuring the pulse width is used to determine pulse width modulated signals. Depending on the selected mode the positive or the negative part of the signal is processed. If two counters are used to measure the pulse width, and one of them is programmed to be triggered by the negative and the other one by the positive edge of the input signal, the summed up result will show the period length. If the input signals are stopped the last measured value becomes available.

	10 Mhz	50 Mhz
32 Bit	429,00000 s	85,00000 s
24 Bit	1,67778 s	0,33550 s
16 Bit	0,00655 s	0,00131 s
8 Bit	0,00003 s	-

2.2.5.5 Incremental Counter:

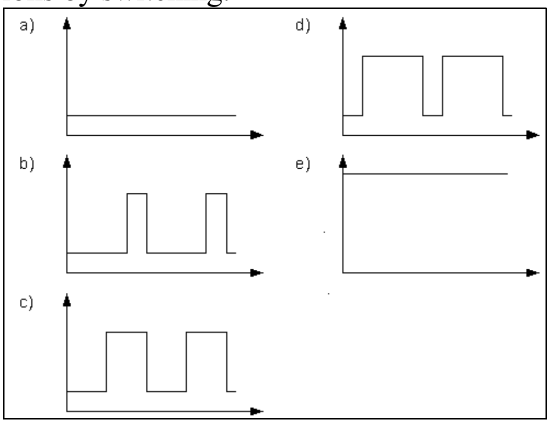
Measuring with an incremental encoder means two signals of the encoder are measured and the direction of counting will be detected by the phase difference and the direction information. The counters can count 24 bits and offer a programmable interpolation (1x, 2x, 4x) which allow to interpolate the signal. The maximum input frequency at the input of the counters is 20 MHz. An edge configurable zero position detection is also available which can be switched off and which makes it possible to reset the counter to zero over an additional digital input. Additionally to the incremental values there are time stamps available. These time stamps are equal to the period length of the last pulse. With a resolution of 100 ns the maximum readable frequency of the counters ranges depends on the type of the card and is between 1 kHz and 100 kHz. Caused by the interpolation a higher resolution of the encoder signals become available. Up to 4x interpolation resulting in 4 times higher resolution is supported.

The time stamp of the incremental encoder shows a zero reading after the maximum time interval within the time stamp was valid. This zero value signals the idle mode of the encoder.



2.2.6 Pulse Width Modulation/Frequency Modulation:

The measure cards offer digital frequency outputs which allow modulating continuously pulse width and frequency. These outputs may be used in example to control proportional valves. To achieve a fully continuous output signal without any distortions during reproduction a new frequency or pulse relation output is set only after the last one is fully completed. In this way it is possible to change pulse width faster than the output frequency without causing any distortions by switching.



Pulse width signal with a) 0%, b) 25%, c) 50%, d) 75% and e) 100%

2.2.7 External Trigger/External Clock

Measurement cards offer a digital input which allows starting of an external measurement and the generation of an external clock for the measurement. External started measurement is run after a change of the logical level (programmable high/low) while externally clocked measurements are edge started (programmable rising/falling) and a burst measurement is provided.
Because of this input measurement can be controlled by external signals.
IF external clock and start shall be used at the same time, the external clock has to be connected to TR while the external start has been moved to PC1.

2.3 Drivers and Applications

The measurement cards and software connections for the PCI and USB series are modularly developed and are based on uniform sources. According to a layered model, only the lower, hardwarespecific layer is different, all methods based on these methods are identical. This process simplifies driver maintenance, guarantees consistency of quality at a high level, and provides uniform dialogs and interfaces for the user. This concept runs through all software packages. Thus even the software development is identical with the programming interface between PCI, PCI / EXPRESS and USB series, by loading the two different basic DLLs is differentiated according to PCI, PCI / Express and USB. On the other hand, the programs developed by the user are completely executable and identical on both series.
See www.goldammer.de

2.4 Extended Customizing

Besides their basic functionality the cards can be customized to the special needs of the users. This is not only possible as far as the software configuration is concerned. It also applies to the hardware configuration.

- Customizing Software
  With a minimum of programming effort it is possible to meet individual needs above the standard functionality like this could be in example for a sine wave analysis in energy generation. To program the signal processor with assembler or C several library functions are available. Programming can be carried out by the user or the manufacturer.
- Customizing Hardware
  It is also possible to fit the individual needs concerning the counters and the digital input or output of the pulse width modulation. The number and the resolution of reference frequencies or event driven control can be customized as well. Any customization of this type can carried out at the manufacturer only.

3 Functional Overview

Type of card	Signal processor 56301 cycle time 12ns 80 MHz	[illegible]	[illegible]	RAM 384 kByte	RAM 1,5 MByte	RAM 24 MByte	[illegible]	[illegible]	ADC 16 Bit 500kHz accumulated sample rate (3)	ADC 16 Bit 1MHz accumulated sample rate (3)	Input voltage ranges ±1.25V,±2.5V,±5V,±10V0-1.25V,0-2.5V,0-5V,0-10	Number of analog inputs 16/8	Number of analog inputs 32/16	Number simultan of analog inputs	DAC 12 Bit 200 kHz output rate (4)	DAC 16 Bit 200 kHz output rate (5)	Number of analog outputs	Number of digital inputs/outputs (6)	Number of counters (7)	[illegible]	[illegible]
G06-1003-0	*			*			*				*	*						24	1	1	1
G06-1013-0	*			*			*				*	*			*		4	24	1	1	1
G06-1024-0		*			*			*			*	*			*		4	24	2	2	1
G06-1034-0		*			*				*		*	*			*		4	24	2	2	1
G06-1034-1		*			*				*		*	*				*	4	24	2	2	1
G06-1034-2		*			*				*	*	*	*				*	4	24	2	2	1
G06-1044-1		*			*				*	*	*	*		16		*	4	24	2	2	1
G0E-1013-0	*			*			*				*		*		*		4	24	1	1	1
G0E-1024-0		*			*			*			*		*		*		4	24	2	2	1
G0E-1034-0		*			*				*		*		*		*		4	24	2	2	1
G0E-1034-2		*			*				*	*	*		*			*	4	24	2	2	1
G0E-1044-2		*			*				*	*	*			24		*	4	24	2	2	1
G09-1005-0		*	*		*	*		*			*		*		*		4/8 (16)	32 (128)	5	6	
G09-1005-1		*	*		*	*			*	*	*		*			*	4/8 (16)	32 (128)	5	6	
G08-1003-0	*														*		8		1		
G08-1013-0	*														*		16		1		
G08-1023-0	*															*	8		1		
G08-1033-0	*															*	16		1		
G07-1023-0	*																		8		
G07-1053-0	*																		12		
G07-1003-0	*																		4		
G07-1033-0	*			*															9		
G07-1013-0	*																		4	4	
G07-1013-2	*			*															8	4	
G07-1014-2	*			*															12	6	
G0A-1024-0			*		*			*			*	*	*		*		4	24	2	2	1
G0A-1024-1			*		*				*		*	*	*			*	4	24	2	2	1
G0A-1033-0			*		*														9		
G0A-1015-0			*		*														8	4	
G0A-1023-0			*		*														8		

See Specifications in chapter 12 (1) …. (7)

4 Measurement standardsoftware

For the support of common measurement programs, the measurement cards with free drivers can be found at www.goldammer.de
The included CDs contain the latest version at the time of delivery, updates can be downloaded and installed free of charge from the Goldammer web server (http://www.goldammer.de) technical Information**:**

4.1 Technical information

The MultiChoice series is designed with of one or more signal processors. The PCI series is equipped with a Motorola DSP56301. While any non HS series cards run with 80 MHz HS cards are operated with 100 MHz. The Quattro offers additionally a second signal processor DSP56311 which runs at 150 MHz. These processors control usually all processes on the cards. In parallel to the signal processors automatic measuring is realized with an FPGA which allows measuring with maximum sample rates directly processed by hardware. A 512Kbyte Flash EEPROM allows stand alone operation without any host. The cards can boot out of the EEPROM, configure themselves, and carry out later on the tasks which were programmed before. The
DSP runs with 384 Kbytes/HS(1.5Mbyte) of fast SRAM which can be used for data or the program. In this memory are stored the measurement sequences and the online processing of measured data. Communication between host and MultiChoice is achieved over the fast PCI bus with transfers aided by bus master DMA respectively with bulk transfer over USB. Bus master DMA and USB 2.0 guarantee continuous data rates.
The architecture of the systems makes high performance data acquisition available with operating systems see www.goldammer.de. Any latencies caused by the operating systems are compensated by the extremely high functionality of the measure cards. With local buffers and high speed bus systems it is possible to decouple the measuring process from the computing power of the main computer. The online processing of the card makes real time measurements available even with non real time operating systems like Windows

4.2 MultiChoice USB G0A-1024-X

4.2.1 Ledstatus

After you have connected the mains plug to the device, the light-emitting diode is green. When the measurement is started, the light-emitting diode changes from green to red and signals a running measurement. After you have finished the measurement, the light-emitting diode switches back to green

5 Hardware/Software Installation

5.1 First Time Installation

Multichoice PCI, PCI/Express:

Before you install the card into the computer, you should set the jumper if necessary for external supply to pin 7 of the SUB-D socket.

Multichoice USB:

With the exception of the jumper SP1, which is used to output 5V supply voltage for the digital port of the OEM version if 5B modules should be operated, there are no jumpers to set.

5.2 Handling of the Measurement Cards

Important:
To avoid erroneous measuring and severe damages to your equipment please follow the following global advices for installing/deinstalling measuring hardware, changing jumper settings or switch positions or connecting/removing plugs.

- Integrated circuits in common and especially CMOS devices input and output circuitry is very sensitive against high voltages. The maximum values can easily be exceeded as in example with static discharging of the human body. Because of this CMOS devices can be destroyed by touching analog inputs, devices or the boards conductive paths.
- Please touch the back panel to discharge any static electricity prior to touch the measuring hardware.
- Avoid any contact to substances which are subject to develop static electricity like plastics, vinyl, styrofoam, woolen or synthetic sweaters and the like.
- Touch measuring cards and other cards on their borders only.
- While switched on, a maximum voltage of ±13.5 Volts (voltage resistant multiplexers: ±40 Volts) should not exceeded under any circumstances. The maximum voltage value for digital inputs and inputs of counters is 5 Volts.
- Switched off the maximum voltage for any kind of input is ±1 volts while voltage resistant multiplexers can withstand up to ±40V. The measurement of inductive loads should be avoided without protective diodes since it can damage the analog inputs.
- Analog outputs and as analog outputs defined bits are not allowed to connect to any voltage. Furthermore it is not allowed to source/sink more current as specified because this can lead to damages to the devices.
- Please note that when the IEPE supply is switched on, no voltages should be applied to the BNC sockets as this will damage the IEPE supply. If you switch on the EIPE supply in the application software, it remains active after the measurement has ended, in order to supply your sensors. Before you connect voltage-carrying signals to the BNC sockets, you must switch off the IEPE supply using application software, as this will damage the IEPE supply.

5.3 Installing *MultiChoice*

<u>MultiChoice PCI:</u>

Prior to install MultiChoice you must ensure the PC is not connected to the wall outlet or switched off at least. For computers with an ATX power supply the switch on the supply itself has to be switched off or the power cable has to be disconnected. It is not sufficient to make a soft-off because the PCI bus is still powered in this cause. If you install a card into a PC which is switched on, not only the card is subject to severe damages. This can also cause damages to other cards or parts of the PC. It is necessary to open the case of your PC if you like to install the card. Please take care of the internal cables which should not stuck to the lid of the case.
Insert the measuring card into a free slot and secure it with a screw sufficient for this purpose right into the whole of the case.

<u>MultiChoice USB:</u>

Connect MultiChoice USB to the provided power supply or an equivalent power source (automotive version). Then connect it to the host computer. This can be done while the PC is switched on or running.

Check again if there are no cables or cards disconnected which were connected before. Close the case of the host computer, connect it to the wall outlet and/or switch the power supply to on.

If your screen does not show anything and/or you can hear beeps in different sequences the reason is normally that a graphics card or another PCI card was not inserted correctly. Please check if any of the cards are inserted and secured correctly.

5.4 Installing Expansions Modules for MultiChoice Quattro G09-1005-X

Each card can be expanded with one module on connector P2 and another one on connector P4. It is not possible to run two modules at the connectors P2 and P4 simultaneously.
To install the expansion modules the measuring card has to be removed from the computer. Please ensure to mount the modules with the provided spacers and screws.

5.4.1 Analog Expansion Module QU/DIFF32 G09-3020-X

Connect the module with connector P7 (Analog Expansion) to the basic board and fix it with the screws on the spacers.
The analog expansion module extends the number of existing analog inputs to 64 if using the single ended inputs and to 32 for dual ended ones. The connection points 0..31 are still available while the connecting points 32..63 can be found on the module.

5.4.2 Analog Expansion Module QU/ANA/128 G09-3014-0

See QU/DIFF32. Expanding MultiChoice QUATTRO with 128 common single ended inputs to 160 total. Maximum sample rate is 100 kHz.

5.4.3 DAC Module G09-3024-0

Connect the expansion module with connector P4 to the basic board and fix it with the screw on the spacers.
The DAC module offers additional eight G09-3024-0 analog outputs with 16 bit data width. They are added to the existent DAC outputs. The output voltage range is ± 10V each and the sampling rate is 100 kHz.

5.4.4 Counter Modules

Connect the expansion module with connector P4 to the basic board and fix it with the screws on the spacers.
The counter modules offer several counting modes and counting inputs. The number of counters and the number of inputs may vary depending on the module.

5.4.5 Pulse Width Output Module G09-3095-5

Connect the expansion module with connector P4 to the basic card and fix it with the screws on the spacers. The PWM output module adds eight additional independent pulse width modulation outputs to those provided with the shipment. The output frequency of the pulse width outputs of the module ranges between 1 Hz and 2,500 kHz.

5.4.6 U/I Module G09-3041-5

Connect the expansion module with connector P2 to the basic card and fix it with the screws on the spacers.
The current output module offers 4 channels with programmable current values. The output voltage is 15V. Current output can be set to 0mA..20mA or to 4mA..20mA. The sample rate is 50 kHz.

5.4.7 DIGI-EXPAND (TTL Expansion Module) G09-3010-0

The module expands the digital inputs/outputs to 128. If eight modules are used 1024 inputs/outputs become available. Connect the module to the socket of the MultiChoice Quattro. Supply the module with 5V and if needed with 12V. The 12 volts are needed if you like to use Adlink optocoupling boards or relay cards. If using Adlink cards the connectors P11..P14 can be used to connect the digital signals. A maximum of eight cards can be connected. If using more than one module the resistor network (termination resistors) must be connected to the last module only.

Counter inputs and PWM outputs are pass through connected to the TTL modules an can be used as usual.
Any of the TTL expansion modules offers eight ports with 16 TTL channels each. The data direction of the ports (16 bit groups) can configured as input or output.
The bus which connects the digital port to the TTL module is able to handle up to seven additional modules. So any user has available up to eight modules which results in 1024 bidirectional TTL bits. As with the PC SCSI bus any of the modules must have an ID associated. The order of the modules does not depend on the module ID’s.
The modules will not be connected directly to the digital port. In between a TTL booster must be used which amplifies the bus signals and reduces the load of the on board digital ports. Please do not use the module without this amplifier.

Connectors on the Module

Any of the TTL modules is equipped with five 50pin four 40pin pin connectors and a screwed contact terminal block.

Name	Type	Use
P5	50pin pin connector	Bus connector: To this connector the 50 pin bus cable is connected. The bus cable connects all modules and the on board digital board of the card.
P10	Terminal strip with six screwed contacts	This serves as connector for the power supply. The TTL modules have to be connected to ground and to +5V. The +12V are not needed..
P1	50pin pin connector	TTL bits 0-31
P11	40pin pin connector	TTL bits 0-31
P2	50pin pin connector	TTL bits 32-63
P12	40pin pin connector	TTL bits 32-63
P3	50pin pin connector	TTL bits 64-95
P13	40pin pin connector	TTL bits 64-95
P4	50pin pin connector	TTL bits 96-127
P14	40pin pin connector	TTL bits 96-127
J1, J2,J3,J4	Jumper	J1, J2, and J3 serve to set the module ID. J4 is actually not connected.

On the 50pin terminals the counter inputs and the PWM outputs of the Quattro card are pass through connected. So counter signals can be aquisited further.

IMPORTANT! Counters can be used over one pin connector only. If the same counter input (in example PWM 0) is connected to more than one module the hardware can be destroyed!

The 40pin pin connectors make only available the TTL bits but no counters and no PWMs.

Associating a Module ID (empty field: no jumper, X: jumper set)

J1	J2	J3	J4	Card	Screwed contact
0	0	0	0	0	0-127
1	0	0	0	1	128-255
0	1	0	0	2	256-383
1	1	0	0	3	384-511
0	0	1	0	4	512-639
1	0	1	0	5	640-767
0	1	1	0	6	768-895
1	1	1	0	7	896-1023

1. While the TTL modules are connected the PC system has to be powered off (power switch to off, power cable disconnected from wall outlet).
2. Open the case of the PC.
3. Take the Quattro card out of the PCI slot. If there is no card installed this step can be omitted.
4. Plug the TTL booster to the on board digital connector of the card (connector P5 on the Quattro card. It is located at the opposite side of the panel.).

5. Insert the Quattro cards with the installed TTL booster into a free PCI slot.
6. Connect the 50pin slot adapter to the plug of the TTL booster.
7. Associate any of the modules an unique ID. Any of the modules must have an ID associated.
8. Connect any of the modules with +5V and ground. The connection can be made in parallel.
9. Connect the plug P5 of any of the TTL modules with a 50pin cable. This cable has the function of a bus cable.
10. The bus cable has to be connected to the plug on the slot adapter of the Quattro card. In some cases it can be necessary to connect further connecting plugs.
11. Connect +5V and ground of the TTL modules to a power supply.

IMPORTANT: Between the power supplies of the TTL modules and the Quattro card has to be an identical voltage potential. If the power supply of the PC is used for the TTL modules no measures have to be taken.
Important: Ensure to connect the supply voltages correctly! Wrong polarity can damage the modules!

12. Close the case of the PC.
13. Connect the PC to the power (connect the power cord and switch the power supply to on).

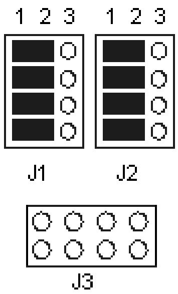
5.5 Configuring the USB-BNC Measurement Card for Single Ended or Dual Ended Mode

The BNC version of the USB measuring card makes it necessary, because of the internal board and the way the inputs are designed, to open the case and to set the jumper if the mode has to be changed from single ended to dual ended mode or vice versa. The card itself is switched by software.

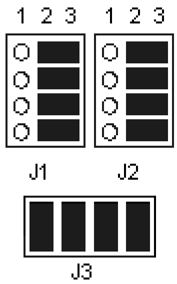
16 channel version

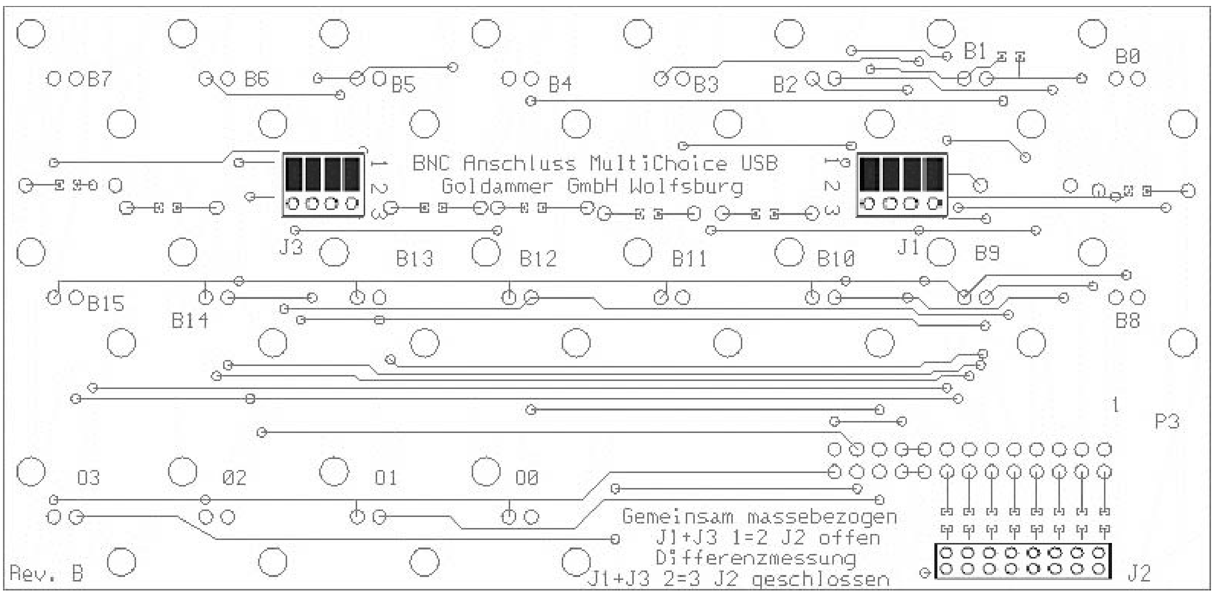
Single ended mode:	J1+ J2 set to single ended,	J3 open
Dual ended mode:	J1+ J2 set to dual ended,	J3 set

16 single ended channels
J1+ J2 set to single ended,
J3 open



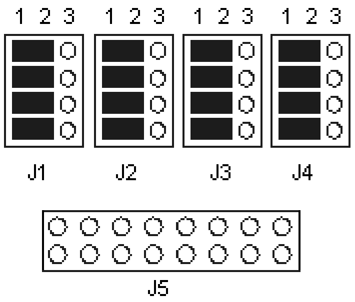
8 dual ended channels:
J1+ J2 set to dual ended, J3 set



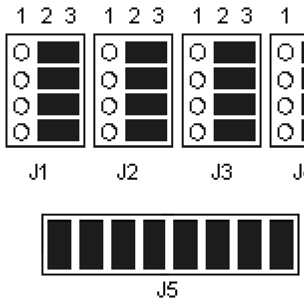


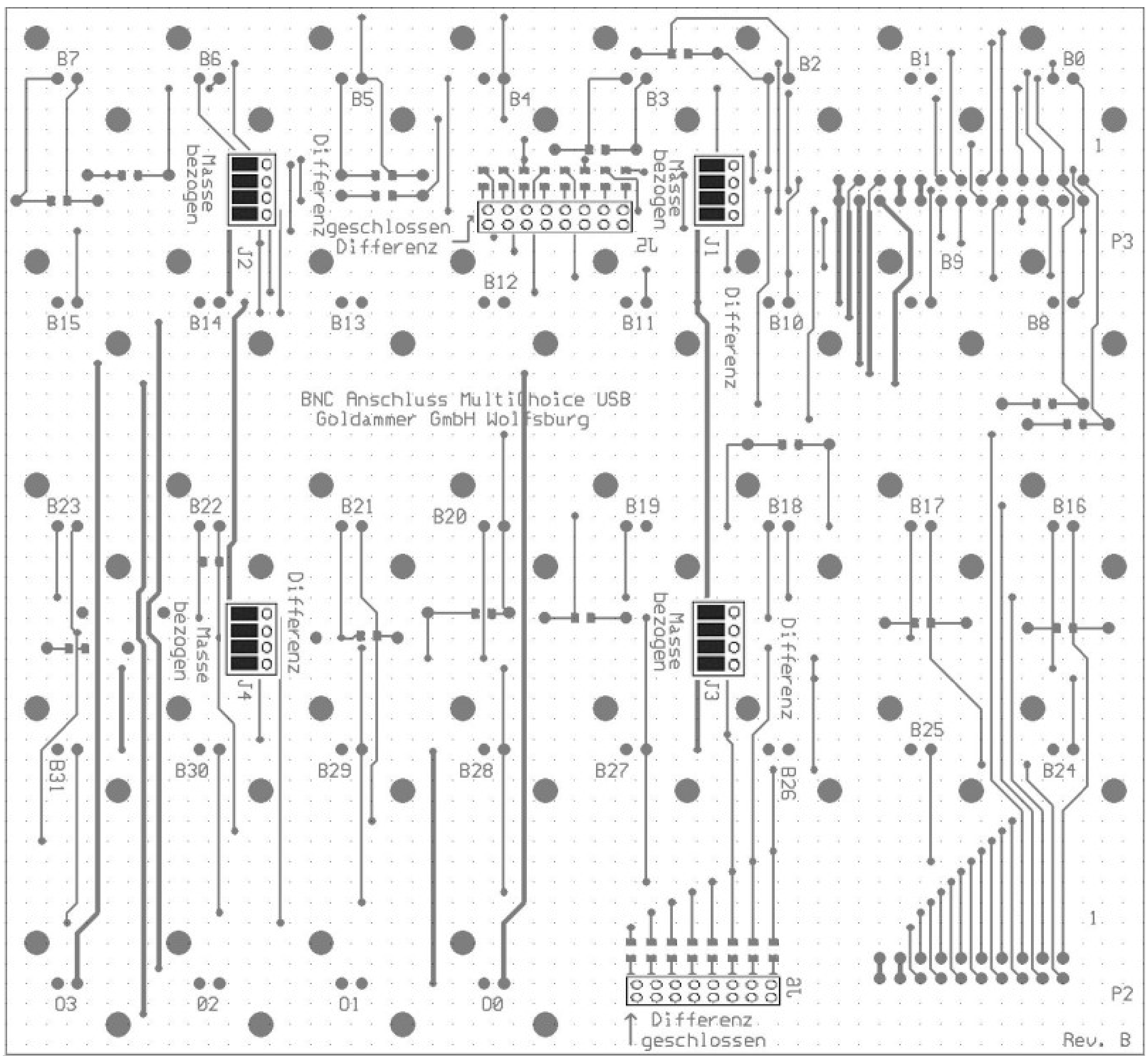
32 channel version		
Single ended mode:	J1+ J2 +J3 + J4 set to single ended,	J5 open
Dual ended mode:	16 channel J1+J2+J3+J4 set to dual ended,	J5 set

32 single ended channels:
J1+J2+J3+ J4 set to single ended,
J5 open



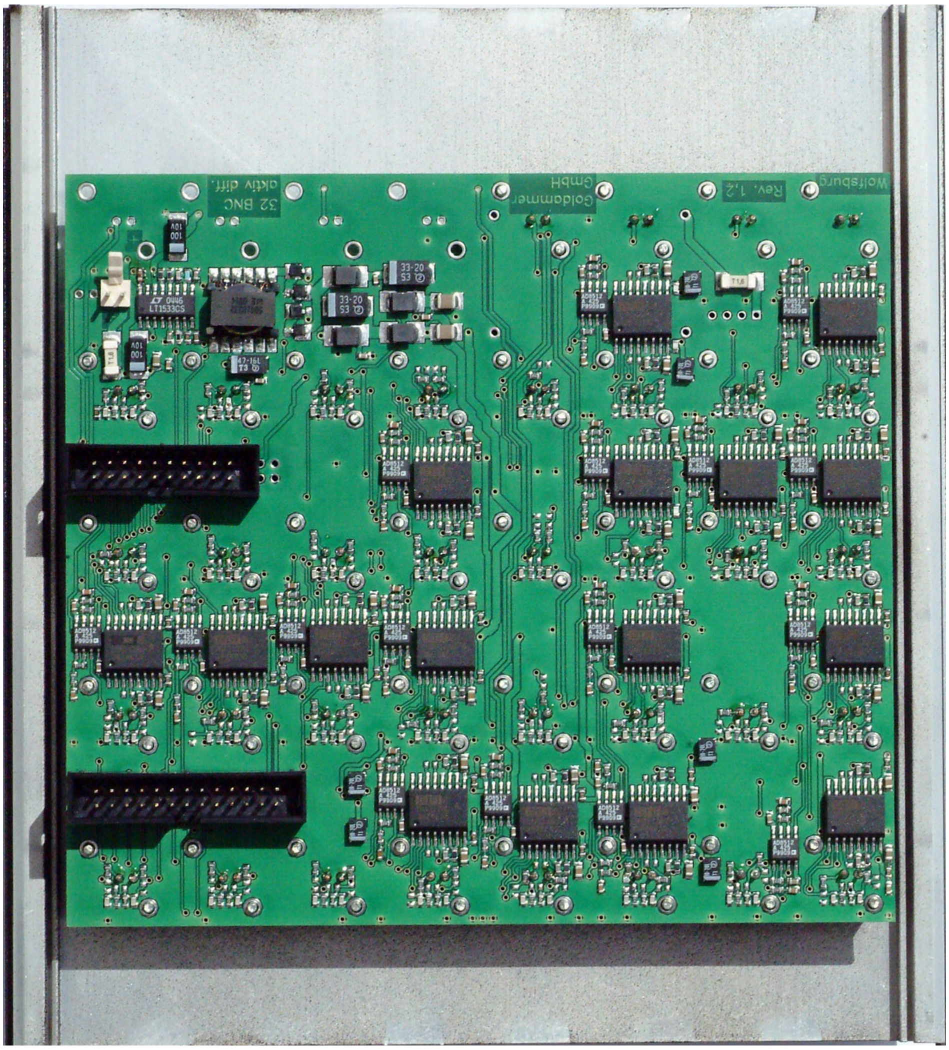
16 dual ended channels:
J1+ J2 +J3 + J4 set to dual ended J5
set





5.6 16 or 32 Active Differential Inputs G0A-30D0-(0-5)

Any channel is equipped with an INA2128 instrumentation amplifier. The inputs are connected to ground over a 2.47 MΩ resistor. The frequency limitation of the inputs is set to 80 kHz.
An optional installable resistor provides additional gain settings.



Active inputs allow longer signal lines without an increase of distortions. Even very long lines can be used to connect sensors. Instead of pseudo differential measurements true differential measuring is possible.
Because of the instrumentation amplifiers for each of the channels no more capacitive changes can occur like this was often found with very weak sensors.

5.7 Configuring the Output Voltage PC_DA-16 PCI G08-1013-0

DAC 0-3

J1	10 Volt	±10 Volt
3+5 u. 4+6	x	
1+3 u. 2+5		x

DAC 8-11

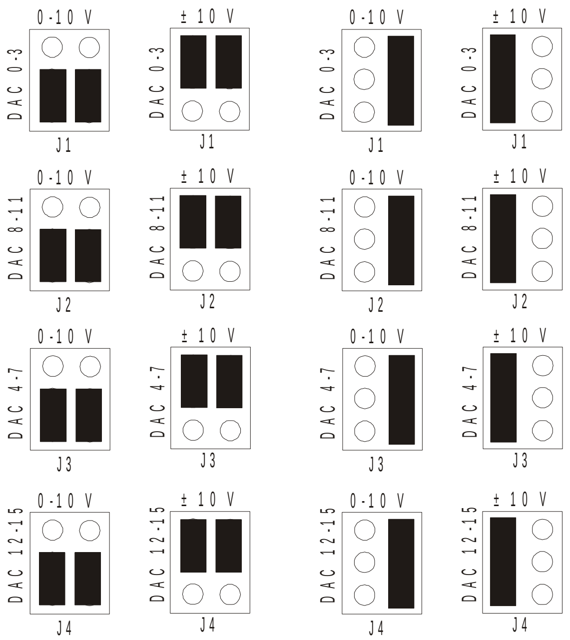
J2	10 Volt	±10 Volt
3+5 u. 4+6	x	
1+3 u. 2+5		x

DAC 4-7

J3	10 Volt	±10 Volt
3+5 u. 4+6	x	
1+3 u. 2+5		x

DAC 12-15

J4	10 Volt	±10 Volt
3+5 u. 4+6	x	
1+3 u. 2+5		x



J5	Configuration	Mode
P1 Pin24	1-2	GND
P1 Pin24	2-3	+5 Volt

5.8 Installing the System Drivers

To run with 32/64 bit Windows drivers are necessary which support the access to the measuring card.
Because of the Windows release history for the PCI series there are two different system drivers available. Because of the USB bus structure for the USB version there is only one driver necessary.
On YouTube you can find a video showing the installation of the system driver.

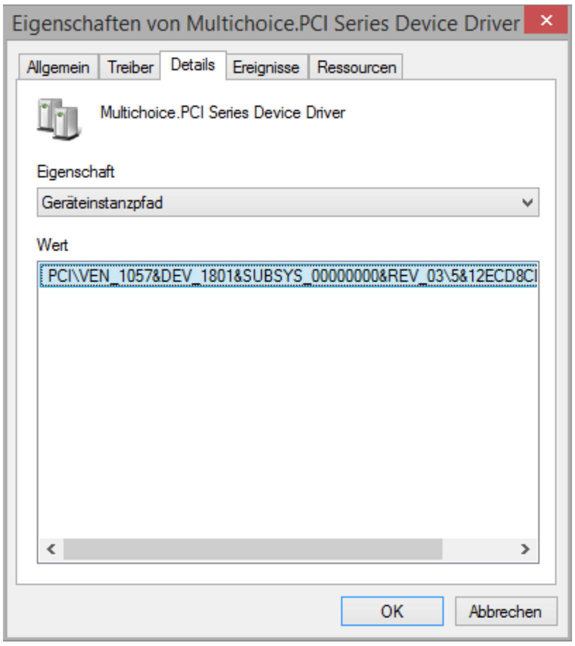
5.8.1 PCI version:

The WDM driver is based on the current driver concept of Microsoft Windows, which was introduced with Windows ME / 2000. There is a basic compatibility with Windows 98SE, but for Windows 98, we recommend using the HWAccess version. After installation and initial start-up of the operating system, the device manager finds a new device and the assistant for the hardware installation is started. Have it searched for the system driver on the supplied CD.

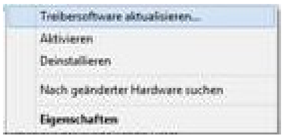
If a manual installation is necessary from an administrative point of view, install it for each Device class available WDMSetup (wdmsetup.exe) from the CD. The measurement card is now displayed under Multifunctional Adapter Multichoice PCI.

!!! Error !!!
If the device is not listed under the multifunction adapter as described above and no unknown device is displayed in the device manager, the driver might have been incorrectly installed by another driver.

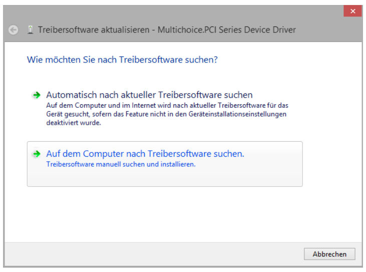
In this case, check whether a device with the characteristic shown in the figure is located in other device classes (sound card or multi-media devices).

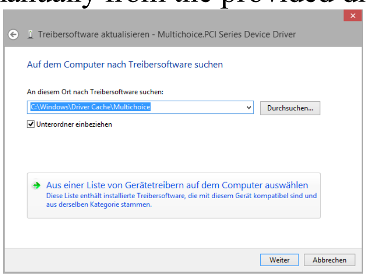


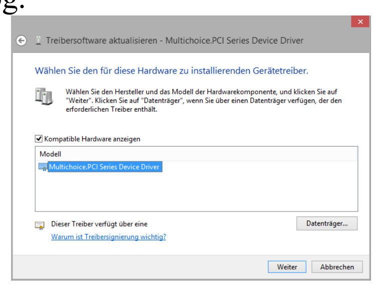
In this case, use Update Driver Software for the device in question.



Select the correct device driver manually from the provided dialog.







HWAccess:
The HWAccess driver offers direct access to the hardware under all versions of Windows, even under Windows NT 4.0. This driver is an older version which does neither support bus master DMA nor Plug-n-Play. The PnP operating system in the BIOS has to be switched off because otherwise the card would not be recognized correctly. For Windows 95/98/ME HWACCESS.VXD is available which emulates direct access, where necessary, which keeps the access under both kinds of operating systems transparent.
Windows 2000/XP lists the driver in Device Manager-> Non PnP Devices. For this type of device View->Deactivated Devices has to be activated.
This driver is installed and registered by the drivers of the measuring program. Therefore the administrator rights are necessary for the first time start. The installation of a system driver is not necessary when the installation request is shown.

5.8.2 USB version

After plug in the USB device the assistant for installing new devices appears. Insert the provided CD into the CDROM drive and let the assistant search for the respective driver. After the driver was found Windows XP shows the message that the driver is not digitally signed. Please click on the button Install Driver and use this driver.
After the installation the driver is available system wide. It is not necessary to restart the system.
The measuring card is shown now under Multifunktionsadapter → Multichoice PCI.
Please repeat the last steps for each of the cards.

Important!
After changing the USB port the measuring card is recognized as a new device and is newly installed. Windows XP stores the last version of the driver for each port. If you are going to actualize the driver you have to achieve this for all existent ports.

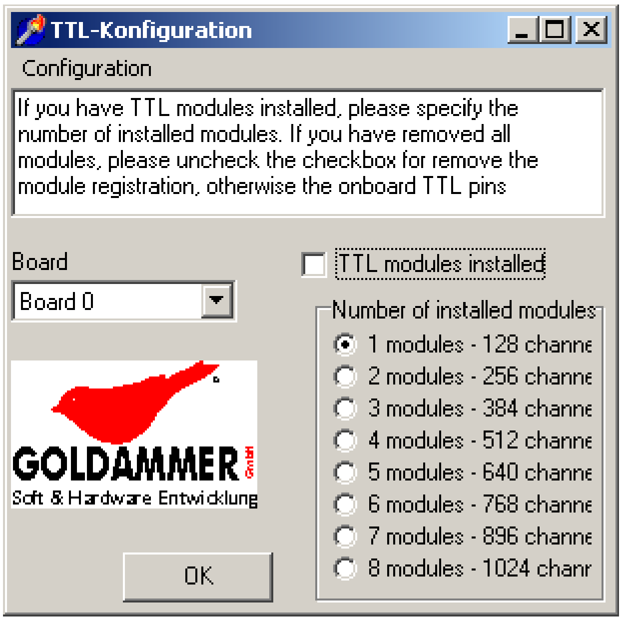
5.8.3 Registering the TTL Expansion Modules for G09-1005

The PC driver is not able to detect if a TTL module is connected. It is necessary to make an entry into the Windows registry to ensure the TTL modules are recognized correctly. For any of the Goldammer cards in the PC it is possible to set information if a card has TTL modules available and if they are connected.
On the Goldammer CD the program **InstallTTL.EXE** can be found in the directory "**MultiChoice PCI-Serie\Tools\Install TTL**". This program makes the respective entries into the registry or removes them. The program is described in chapter 5.8.3.1.

Installing the Software:

1. Switch on your PC and start the operating system.
2. If necessary install the standard driver for your measuring program (in example the driver for DIAdem or DasyLab).
3. Look for the number of the Quattro card which has TTL modules installed. This can be carried out with the program TestMC4 in the directory "**Multichoice PCI-Serie\Testprogramm\TestMC4"**.
4. Start the program **InstallTTL.EXE** in the respective directory.
5. Type in the number of the connected modules for any of the cards with TTL modules. To do this the checkbox „TTL modules installed“ has to be marked. If you remove the mark the registry entry for the associated card is also removed.
6. After the TTL modules are registered the program can be quit.

5.8.3.1 Tool Program „InstallTTL.EXE“



The option list "Board" can be used to select the respective board number. This program does not access the card and does not scan the PCI bus. Therefore it is not possible to detect if any card is installed. The option field „Number of installed modules" allows to set the number of TTL modules installed on the selected card. With the checkbox "TTL modules installed" the entry for the selected card can be activated.
The configured values are stored in the registry when leaving the program. If the program is run again the new made entries are loaded and can be verified and/or changed.

For hints according to the installation of the measuring program please read chapter „Software Installation".

6 Connecting the Signals to Measure

6.1 Miscellaneous Information

The kind of feeding of the signals to measure depends on the type of the card and the type of the device. Generally it has to be taken into consideration that the signals shouldn't be fed to a switched off device. Measurement cards with voltage resistant multiplexers (FMUX) a voltage of up to ±40V can be applied regardless of the state switched on or off.
The digital signals are not permitted to be applied if the device is switched off especially not if voltage resistant multiplexers are installed.
After switching on the signals of all analog outputs are reset to zero. The digital pins are configured as inputs with no voltage applied. The PWM output is inactive. During the starting process a short voltage pulse at the analog outputs can occur, if the standard voltage range is set. Connected systems have to be configured in a way that this pulse may not cause any negative effects.

In the single ended mode the analog inputs are measured relative to the cards ground. The common single ended inputs are usable for voltage measurements only. Any of these inputs relate to the same reference ground against which the voltage is measured. Any of the inputs are independent. Please ensure that the ground terminal of the cards are connected together and are connected with the ground terminal of the measuring signal ground. All of the analog inputs are available.
In the dual ended mode the difference between two terminals is measured. The inputs can be used for voltage and current measurement. If current is measured the shunt resistor R and the voltmeter V are a measuring unit (equivalent to an ammeter). The shunt resistor has to have a certain exactly known resistance. If the dual ended inputs are connected it has to be taken into consideration that the voltage measurement is achieved parallel to the circuitry while the current measurement is a sequential one. If a dual ended input has to be connected both terminals of the input have to be connected.
It is mandatory to connect the ground of the card (board) to the ground of the signal source and a resistor must be in the negative terminal against ground to ensure a reference potential. The negative terminal of the dual ended inputs has to be connected with a resistor of 5kΩ to ground if the lightPCI is used while for Quattro cards 10 kΩ are sufficient.
For this purpose two of the inputs of neighboring multiplexers are put together to an input (in example 0-8, 1-9, 2-10, …, 16-24, 17-25, …).

6.1.1 Multichoice PCI G06-10XX-X

Feeding of the analog and the digital input signals is done over a 50pin SUB-D50 socket.

Multichoice lightPCI PCI/Express ans Quattro:
The changeover is made entirely by software commands. The changeover takes place as soon as the driver is selected according to the measuring mode and the measurement is started. The cards are equipped with an electronic calibration. The number of available inputs is halved by switching from mass-to-difference.

6.1.2 Multichoice USB G0A-1024-X

Feeding of the signals is achieved depending on the type of case and card over different sockets.
The BNC sockets are connected to an encoder or a signal source on one side and the other one is connected to the channel in question. The digital inputs are connected with the screwable terminals on the back panel. For dual ended measurements the jumpers on the board under the BNC sockets have to be configured respectively. After this is carried out the dual ended inputs are available at the channels 0 .. 7, where the BNC signal carries the positive and the negative part.

The screwable Phoenix type terminal version is connected respectively. To use the dual ended mode please connect the negative route (K8-K15) with a 5 kΩ resistor to the cards ground. Connecting the digital signals is similar to the BNC version. The OEM version is equipped with three pin connectors (P2, P5, P6). Aided by flat ribbon cables the signals are fed. In this way customer specific kinds of connections can be realized easily.
The OEM version always offers both analog connectors even when there are only 16 channels available and the second connector P5 is without function. The kind of connections of the OEM version can be easily taken of P1b like PA0=P1B pin 01.

7 Pin Positions of the Measuring Cards

7.1 MultiChoice light PCI P1 D-Sub50 (G06-10xx-x)

D-Sub Pin	Signal name	Function
38	K0 +K0	Analog input 0
37	K1 +K1	Analog input 1
36	K2 +K2	Analog input 2
20	K3 +K3	Analog input 3
6	K4 +K4	Analog input 4
22	K5 +K5	Analog input 5
21	K6 +K6	Analog input 6
39	K7 +K7	Analog input 7
4	K8 -K0	Analog input 8
18	K9 -K1 Ue. Diff.	Analog input 9
3	K10 -K2	Analog input 10
2	K11 -K3	Analog input 11
5	K12 -K4	Analog input 12
19	K13 -K5	Analog input 13
34	K14 -K6	Analog input 14
35	K15 -K7	Analog input 15
1	GND	Ground
7	GND/+5V	Digital ground/+5V J4
23	DA0	*Analog output 1*
40	DA1	*Analog output 2*
17	DA2	*Analog output 3*
33	DA3	*Analog output 4*
8	TR.	External trigger
24	Tin	Counter input 0
41	PA 4	Digital input/output 4
25	PA 5	Digital input/output 5
9	PA 6	Digital input/output 6
42	PA 7	Digital input/output 7
45	PA 0	Digital input/output 0
12	PA 1	Digital input/output 1
28	PA 2	Digital input/output 2
44	PA 3	Digital input/output 3
10	PB 4	Digital input/output 12 incremental 1 zero detection
26	PB 5	Digital input/output 13/incremental 1 PH90
27	PB 6	Digital input/output 14/incremental 1 PH0
11	PB 7	Digital input/output 15 /SSI DATA
48	PB 0	Digital input/output 8
32	PB 1	Digital input/output 9
16	PB 2	Digital input/output 10
43	PB 3	Digital input/output 11
14	PC 0	Digital input/output 16 /SSI CLK
47	PC 1	Digital input/output 17
31	PC 2	Digital input/output 18
15	PC 3	Digital input/output 19/incremental 0 zero detection
30	PC 4	Digital input/output 20/incremental 0 PH90
46	PC 5	Digital input/output 21/incremental 0 PH0
13	PC 6	Digital input/output 22/ counter input 1
29	PC 7	Digital input/output 23/*PWM output*
49	GND	Ground
50	GND	Ground

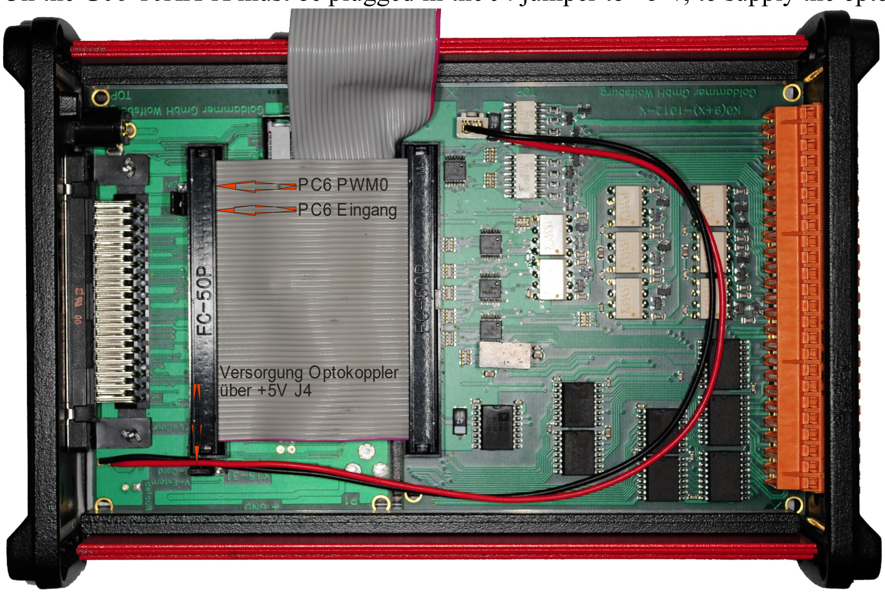
7.1.1 EIPL-3000-0 **Connection unit** Weidmüllerterminal 48-pin

Digital input/output 0	PA 0	Pin 01		Pin 48	PB 0	Digital input/output 8
Digital input/output 1	PA 1	Pin 02		Pin 47	PB 1	Digital input/output 9
Digital input/output 2	PA 2	Pin 03		Pin 46	PB 2	Digital input/output 10
Digital input/output 3	PA 3	Pin 04		Pin 45	PB 3	Digital input/output 11
Digital input/output 4	PA 4	Pin 05		Pin 44	PB 4	Digital input/output 12 Inkrement1/Nullstellen
Digital input/output 5	PA 5	Pin 06		Pin 43	PB 5	Digital input/output 13 incremental 1 PH90
Digital input/output 6	PA 6	Pin 07		Pin 42	PB 6	Digital input/output 14 incremental 1 PH0
Digital input/output 7	PA 7	Pin 08		Pin 41	PB 7	Digital input/output 15
		Pin 09		Pin 40		
Ground	DGND	Pin 10		Pin 39	DGND	Ground
Ground /+5V J4	GND/+5V	Pin 11		Pin 38	GND/+5V	Ground /+5V J4
Counter 0	Z0	Pin 12		Pin 37	Trig.	Trigger
		Pin 13		Pin 36		
		Pin 14		Pin 35	PC 1	Digital input/output 17
		Pin 15		Pin 34	PC 2	Digital input/output 18
		Pin 16		Pin 33	PC 3	Digital input/output 19 /incremental 0 zero detection
		Pin 17		Pin 32	PC 4	Digital input/output 20 incremental 0 PH90
Digital input/output 16	PC 0	Pin 18		Pin 31	PC 5	Digital input/output 21 incremental 0 PH0
		Pin 19		Pin 30	PC 6	Digital input/output 22
		Pin 20		Pin 29	PC 7	Digital input/output 23
		Pin 21		Pin 28		
		Pin 22		Pin 27		
		Pin 23		Pin 26		
Ground	DGND	Pin 24		Pin 25	DGND	Ground

7.1.2 EIPL-3000-0 **Connection unit** Weidmüllerterminal 48-pin with EIPL-30GI-0

Digital output 0	PA 0	Pin 01		Pin 48	PB 0	Digital output 8
Digital output 1	PA 1	Pin 02		Pin 47	PB 1	Digital output 9
Digital output 2	PA 2	Pin 03		Pin 46	PB 2	Digital output 10
Digital output 3	PA 3	Pin 04		Pin 45	PB 3	Digital output 11
Digital output 4	PA 4	Pin 05		Pin 44		
Digital output 5	PA 5	Pin 06		Pin 43		
Digital output 6	PA 6	Pin 07		Pin 42		
Digital output 7	PA 7	Pin 08		Pin 41		
		Pin 09		Pin 40		
Digital output Port A Grund	PAGND	Pin 10		Pin 39	PBGND	Digital output Port B Ground
Supply digital-output max. 35Volt. Port A	PAPWR	Pin 11		Pin 38	PBPWR	Supply digital-output max. 35Volt. Port B + PWM0-1
Counter 0	Z0	Pin 12		Pin 37	Trig.	Trigger
Digital input 0 incremental 1 zero	PB 4	Pin 13		Pin 36		
Digital input 1 incremental 1 PH90	PB 5	Pin 14		Pin 35	PC 1	Digital input 5
Digital input 2 incremental 1 PH0	PB 6	Pin 15		Pin 34	PC 2	Digital input 6
Digital input 3 SSI DATA	PB 7	Pin 16		Pin 33	PC 3	Digital input 7 /incremental 0 zero detection
		Pin 17		Pin 32	PC 4	Digital input 8 incremental 0 PH90
Digital intput 4	PC 0	Pin 18		Pin 31	PC 5	Digital input 9 incremental 0 PH0
		Pin 19		Pin 30	PC 6	Digital input 10 Counter 1
		Pin 20		Pin 29	PC 7	Digital input 11
		Pin 21		Pin 28		
		Pin 22		Pin 27		
		Pin 23		Pin 26		
Ground digital input	DGND	Pin 24		Pin 25	DGND	Ground digital input

On the G06-10XX-X must be plugged in the J4 jumper to +5 V, to supply the optocoupler.



7.1 MultiChoice light PCI/Express analog P1 SCSI III 68 (G0E-10xx-x)

D-Sub Pin	Signal name	Function
65	K0 +K0	Analog input 0
31	K1 +K1	Analog input 1
64	K2 +K2	Analog input 2
30	K3 +K3	Analog input 3
63	K4 +K4	Analog input 4
29	K5 +K5	Analog input 5
62	K6 +K6	Analog input 6
28	K7 +K7	Analog input 7
61	K8 +K8	Analog input 8
27	K9 +K9.	Analog input 9
60	K10 +K10	Analog input 10
26	K11 +K11	Analog input 11
59	K12 +K12	Analog input 12
25	K13 +K13	Analog input 13
58	K14 +K14	Analog input 14
24	K15 +K15	Analog input 15
57	K16 -K0 Ue.Diff	Analog input 16
23	K17 -K1	Analog input 17
56	K18 -K2	Analog input 18
22	K19 -K3	Analog input 19
55	K20 -K4	Analog input 20
21	K21 -K5	Analog input 21
54	K22 -K6	Analog input 22
20	K23 -K7	Analog input 23
53	K24 -K8	Analog input 24
19	K25 -K9	Analog input 25
52	K26 -K10	Analog input 26
18	K27 -K11	Analog input 27
51	K28 -K12	Analog input 28
17	K29 -K13	Analog input 29
50	K30 -K14	Analog input 30
16	K31 -K15	Analog input 31
49	GND/+3,3V	Digital ground/+3,3V J4
67	DA0	Analog output 0
33	DA1	Analog output 1
66	DA2	Analog output 2
32	DA3	Analog output 3
68	GND	Ground
34	GND	Ground
15	GND	Ground

7.2 MultiChoice light PCI/Express digital P1 SCSI III 68 (G0E-10xx-x)

D-Sub Pin	Signal name	Function
48	TR.	External trigger
14	Tin	Counter input 0
47	PA 0	Digital input/output 0
13	PA 1	Digital input/output 1
46	PA 2	Digital input/output 2
12	PA 3	Digital input/output 3
45	PA 4	Digital input/output 4
11	PA 5	Digital input/output 5
44	PA 6	Digital input/output 6
10	PA 7	Digital input/output 7
43	PB 0	Digital input/output 8
9	PB 1	Digital input/output 9
42	PB 2	Digital input/output 10
8	PB 3	Digital input/output 11
41	PB 4	Digital input/output 12 Incremental /zero detection(1)
7	PB 5	Digital input/output 13 Incremental /PH90(1)
40	PB 6	Digital input/output 14 Incremental /PH0(1)
6	PB 7	Digital input/output 15 /SSI DATA
38	PC 0	Digital input/output 16 /SSI CLK
4	PC 1	Digital input/output 17
37	PC 2	Digital input/output 18
3	PC 3	Digital input/output 19/ Incremental1/zero position(0)
36	PC 4	Digital input/output 20 Incremental /PH90(0)
2	PC 5	Digital input/output 21 Incremental /PH0(0)
35	PC 6	Digital input/output 22/ counter input 1
1	PC 7	Digital input/output 23/*PWM output*
39	GND	Ground
5	GND	Ground

7.3 MultiChoice USB Phoenix Version (G0A-1024-4+5)

Analog inputs/outputs of P7 Phoenix socket K0-15

D-Sub Pin	Signal name	Function
GND	GND	Ground
K0	K0 +K0	Analog input 0
K1	K1 +K1	Analog input 1
K2	K2 +K2	Analog input 2
K3	K3 +K3	Analog input 3
K4	K4 +K4	Analog input 4
K5	K5 +K5	Analog input 5
K6	K6 +K6	Analog input 6
K7	K7 +K7	Analog input 7
K8	K8 -K0	Analog input 8
K9	K9 -K1 Ue. Diff.	Analog input 9
K10	K10 -K2	Analog input 10
K11	K11 -K3	Analog input 11
K12	K12 -K4	Analog input 12
K13	K13 -K5	Analog input 13
K14	K14 -K6	Analog input 14
K15	K15 -K7	Analog input 15
GND	GND	Ground
GND	GND	Ground
DA0	DA0	Analog output 0
DA1	DA1	Analog output 1
DA2	DA2	Analog output 2
DA3	DA3	Analog output 3
GND	GND	Ground

7.4 Analog inputs/outputs P6 K0-15 (G0A-1024-6-9

Analog input 0	K0	+K0	Pin 01		Pin 02	K8	-K0	Analog input 8
Analog input 1	K1	+K1	Pin 03		Pin 04	K9	-K1	Analog input 9
Analog input 2	K2	+K2	Pin 05		Pin 06	K10	-K2	Analog input 10
Analog input 3	K3	+K3	Pin 07		Pin 08	K11	-K3	Analog input 11
Analog input 4	K4	+K4	Pin 09		Pin 10	K12	-K4	Analog input 12
Analog input 5	K5	+K5	Pin 11		Pin 12	K13	-K5	Analog input 13
Analog input 6	K6	+K6	Pin 13		Pin 14	K14	-K6	Analog input 14
Analog input 7	K7	+K7	Pin 15		Pin 16	K15	-K7	Analog input 15
Ground	GND		Pin 17		Pin 18	GND		Ground
Ground	GND		Pin 19		Pin 20	GND		Ground
Analog output 0	DA0		Pin 21		Pin 22	DA1		*Analog output 1*
Analog output 2	DA3		Pin 23		Pin 24	DA3		*Analog output 3*
Ground	GND		Pin 25		Pin 26	GND		Ground

7.5 Analog inputs/outputs P5 K16-31 (G0A-1024-6-9)

Analog input 16	K16	+K8	Pin 01		Pin 02	K17	-K8	Analog input 17
Analog input 18	K18	+K9	Pin 03		Pin 04	K19	-K9	Analog input 19
Analog input 20	K20	+K10	Pin 05		Pin 06	K21	-K10	Analog input 21
Analog input 22	K22	+K11	Pin 07		Pin 08	K23	-K11	Analog input 23
Analog input 24	K24	+K12	Pin 09		Pin 10	K25	-K12	Analog input 25
Analog input 26	K26	+K13	Pin 11		Pin 12	K27	-K13	Analog input 27
Analog input 28	K28	+K14	Pin 13		Pin 14	K29	-K14	Analog input 29
Analog input 30	K30	+K15	Pin 15		Pin 16	K31	-K15	Analog input 31
Ground	GND		Pin 17		Pin 18	GND		Ground
Ground	GND		Pin 19		Pin 20	GND		Ground

7.6 P1 MultiChoice USB Digital Inputs/Outputs (G0A-1024-0-5)

Phoenix and BNC version

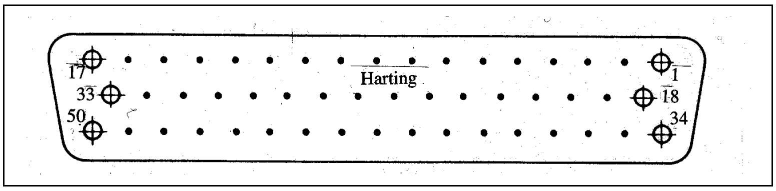
Signal name	Function	Signal name	Function
GND	Ground	GND	Ground
PA 0	Digital input/output 0	PB 0	Digital input/output 8
PA 1	Digital input/output 1	PB 1	Digital input/output 9
PA 2	Digital input/output 2	PB 2	Digital input/output 10
PA 3	Digital input/output 3	PB 3	Digital input/output 11
PA 4	Digital input/output 4	PB 4	Digital input/output 12 Incremental(1)/zero position
PA 5	Digital input/output 5	PB 5	Digital input/output 13 Incremental(1)/PH90
PA 6	Digital input/output 6	PB 6	Digital input/output 14 Incremental(1)/PH0
PA 7	Digital input/output 7	PB 7	Digital input/output 15 SSI DATA
GND	Ground	GND	Ground
GND	Ground	GND	Ground
PC 4	Digital input/output 20 Incremental(0)/PH90	PC 0	Digital input/output 16 SSI CLK
PC 5	Digital input/output 21 Incremental(0)/PH0	PC 1	Digital input/output 17 Counter Sync
PC 6	Digital input/output 22 Timer 1	PC 2	Digital input/output 18 Synchronization Master / Slave
PC 7	Digital input/output 23 PWM 0	PC 3	Digital input/output 19 Incremental(0)/zero position
Tri.	Trigger	TIN0	Timer 0
GND	Ground	GND	Ground

7.1 OEM version connector P1B P1 MultiChoice (G0A-1024-6-9)

Digital input/output 0	PA 0	Pin 01		Pin 02	PB 0	Digital input/output 8
Digital input/output 1	PA 1	Pin 03		Pin 04	PB 1	Digital input/output 9
Digital input/output 2	PA 2	Pin 05		Pin 06	PB 2	Digital input/output 10
Digital input/output 3	PA 3	Pin 07		Pin 08	PB 3	Digital input/output 11
Digital input/output 4	PA 4	Pin 09		Pin 10	PB 4	Digital input/output 12 Incremental1/zero position
Digital input/output 5	PA 5	Pin 11		Pin 12	PB 5	Digital input/output 13 Incremental1/PH90
Digital input/output 6	PA 6	Pin 13		Pin 14	PB 6	Digital input/output 14 Incremental1/PH0
Digital input/output 7	PA 7	Pin 15		Pin 16	PB 7	Digital input/output 15 SSI DATA
Ground	GND	Pin 17		Pin 18	GND	Ground
5V Adlink Wiring pin 19 is connected to pin 39. There is no connection to the power supply of the card.	5V	Pin 19		Pin 20	12V	12V
Digital input/output 20 Incremental/PH90	PC 4	Pin 21		Pin 22	PC 0	Digital input/output 16 SSI CLK
Digital input/output 21 Incremental/PH0	PC 5	Pin 23		Pin 24	PC 1	Digital input/output 17 Counter Sync
Digital input/output 22 Timer 1	PC 6	Pin 25		Pin 26	PC 2	Digital input/output 18 Synchronization Master / Slave
Digital input/output 23 PWM 0	PC 7	Pin 27		Pin 28	PC 3	Digital input/output 19 Incremental/Zero position
Trigger	Tri.	Pin 29		Pin 30		
Timer 0	TIN0	Pin 31		Pin 32	LED 2	LED 2
LED 0 red	LED 0	Pin 33		Pin 34	EP 1	Digital expansion 1
LED 1 green	LED 1	Pin 35		Pin 36	EP 0	Digital expansion 0
Ground	GND	Pin 37		Pin 38	Ground	GND
5V see Pin 19	5V	Pin 39		Pin 40	12V	12V

7.2 PCI CountPeri4 (G07-1003-0)

D-Sub Pin	Signal name	Function
19	Z0	Counter input 0
36	Z1	Counter input 1
37	Z2	Counter input 2
35	Z3	Counter input 3
7	GND/+5V	Digital ground/+5V J4
49	GND	Digital ground
50	GND	Digital ground

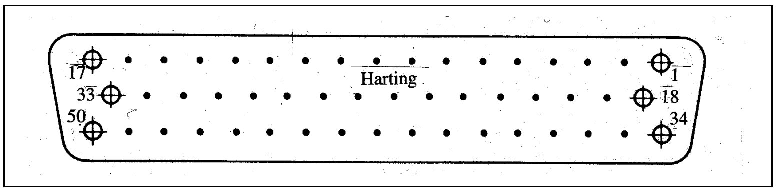


7.3 USB CountPeri4 (G0A-1003-0)

Pin name	Signal name	Function
PC 0	Z0	Counter input 0
PC 1	Z1	Counter input 1
PC 2	Z2	Counter input 2
PC 3	Z3	Counter input 3
GND	GND	Digital ground
GND	GND	Digital ground
Tri.	Trigger	Synchronization Slave

7.4 PCI CountInkr4 (G07-1013-0-1)

D-Sub Pin	Signal name	Function
19	PHI0(0)	Counter input 0 pulse
36	PHI90(0)	Counter input 0 direction
35	PHI0(1)	Counter input 1 pulse
37	PHI90(1)	Counter input 1 direction
18	PHI0(2)	Counter input 2 pulse
34	PHI90(2)	Counter input 2 direction
24	PHI0(3)	Counter input 3 pulse
8	PHI90(3)	Counter input 3 direction
41	REF (0)	Reference pin 0
25	REF (1)	Reference pin 1
9	REF (2)	Reference pin 2
42	REF (3)	Reference pin 3
7	GND/+5V	Digital ground/+5V J4
49	GND	Digital ground
50	GND	Digital ground

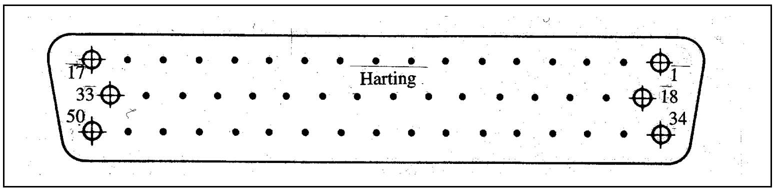


7.5 USB CountInkr4 (G0A-1015-0-1)

PC 0	PHI0(0)	Counter input 0 pulse
PC 1	PHI90(0)	Counter input 0 direction
PC 2	PHI0(1)	Counter input 1 pulse
PC 3	PHI90(1)	Counter input 1 direction
PC 4	PHI0(2)	Counter input 2 pulse
PC 5	PHI90(2)	Counter input 2 direction
PC 6	PHI0(3)	Counter input 3 pulse
PC 7	PHI90(3)	Counter input 3 direction
PB 0	REF (0)	Reference pin 0
PB 1	REF (1)	Reference pin 1
PB 2	REF (2)	Reference pin 2
PB 3	REF (3)	Reference pin 3
Tri.	Trigger	Synchronization Slave
GND	GND	Digital ground
GND	GND	Digital ground

7.6 PCI CountInkr6 (G07-1013-2)

D-Sub Pin	Signal name	Function
19	PHI0(0)	Counter input 0 pulse
36	PHI90(0)	Counter input 0 direction
35	PHI0(1)	Counter input 1 pulse
37	PHI90(1)	Counter input 1 direction
18	PHI0(2)	Counter input 2 pulse
34	PHI90(2)	Counter input 2 direction
24	PHI0(3)	Counter input 3 pulse
8	PHI90(3)	Counter input 3 direction
44	PHI0(4)	Counter input 4 pulse
15	PHI90(4)	Counter input 4 direction
10	PHI0(5)	Counter input 5 pulse
11	PHI90(5)	Counter input 5 direction
41	REF (0)	Reference pin 0
25	REF (1)	Reference pin 1
9	REF (2)	Reference pin 2
42	REF (3)	Reference pin 3
43	REF (4)	Reference pin 4
14	REF (5)	Reference pin 5
7	GND/+5V	Digital ground /+5V J4
49	GND	Digital ground
50	GND	Digital ground

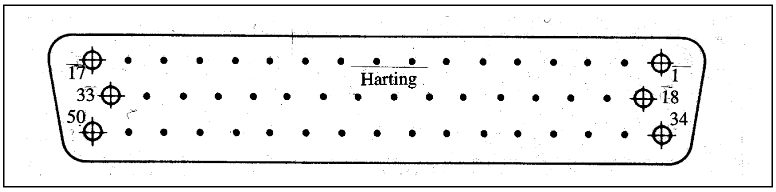


7.7 USB CountInkr6 (G0A-1015-2)

Pin name	Signal name	Function
PC 0	PHI0(0)	Counter input 0 pulse
PC 1	PHI90(0)	Counter input 0 direction
PC 2	PHI0(1)	Counter input 1 pulse
PC 3	PHI90(1)	Counter input 1 direction
PC 4	PHI0(2)	Counter input 2 pulse
PC 5	PHI90(2)	Counter input 2 direction
PC 6	PHI0(3)	Counter input 3 pulse
PC 7	PHI90(3)	Counter input 3 direction
PA 0	PHI0(4)	Counter input 4 pulse
PA 1	PHI90(4)	Counter input 4 direction
PA 2	PHI0(5)	Counter input 5 pulse
PA 3	PHI90(5)	Counter input 5 direction
PB 0	REF (0)	Reference pin 0
PB 1	REF (1)	Reference pin 1
PB 2	REF (2)	Reference pin 2
PB 3	REF (3)	Reference pin 3
PB 4	REF (4)	Reference pin 4
PB 5	REF (5)	Reference pin 5
Tri.	Trigger	Synchronization slave
GND	GND	Digital ground

7.8 MU Count8 (G07-1023-0)

Pin number	Signal name	Function
19	Z0	Counter input 0
36	Z1	Counter input 1
37	Z2	Counter input 2
35	Z3	Counter input 3
18	Z4	Counter input 4
34	Z5	Counter input 5
24	Z6	Counter input 6
8	Z7/Externe Trigger	Counter input 7 external triggers
41	PA 4	Digital input/output 4
25	PA 5	Digital input/output 5
9	PA 6	Digital input/output 6
42	PA 7	Digital input/output 7/ 100Hz
45	PA 0	Digital input/output 0
12	PA 1	Digital input/output 1
14	PA 2	Digital input/output 2
44	PA 3	Digital input/output 3
10	PB 4	Digital input/output 12
47	PB 5	Digital input/output 13
31	PB 6	Digital input/output 14
11	PB 7	Digital input/output 15
15	PB 0	Digital input/output 8
32	PB 1	Digital input/output 9
16	PB 2	Digital input/output 10
43	PB 3	Digital input/output 11
49	GND	Digital ground
50	GND	Digital ground
7	GND/+5V	Digital ground/+5V J4



7.9 USB Count8 (G0A-1023-0)

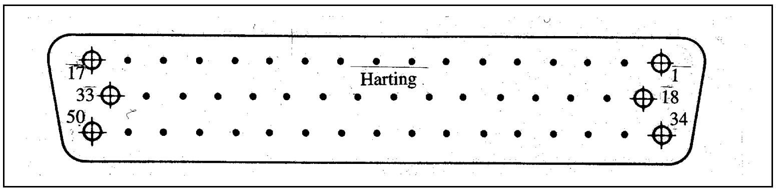
Pin name	Signal name	Function
PC 0	Z0	Counter input 0
PC 1	Z1	Counter input 1
PC 2	Z2	Counter input 2
PC 3	Z3	Counter input 3
PC 4	Z4	Counter input 4
PC 5	Z5	Counter input 5
PC 6	Z6	Counter input 6
PC 7	Z7	Counter input 7
PA 0	PA 0	Digital input/output 0
PA 1	PA 1	Digital input/output 1
PA 2	PA 2	Digital input/output 2
PA 3	PA 3	Digital input/output 3
PA 4	PA 4	Digital input/output 4
PA 5	PA 5	Digital input/output 5
PA 6	PA 6	Digital input/output 6
PA 7	PA 7	Digital input/output 7
PB 0	PB 0	Digital input/output 8
PB 1	PB 1	Digital input/output 9
PB 2	PB 2	Digital input/output 10
PB 3	PB 3	Digital input/output 11
PB 4	PB 4	Digital input/output 12
PB 5	PB 5	Digital input/output 13
PB 6	PB 6	Digital input/output 14
PB 7	PB 7	Digital input/output 15
Tri.	Trigger	Synchronisation slave
GND	GND	Digital ground

7.10 CountPwm8 (G07-1033-0)

D-Sub Pin	Signal name	Function
45	Z0	PWM output 0
12	Z1	PWM output 1
14	Z2	PWM output 2
44	Z3	PWM output 3
41	Z4	PWM output 4
25	Z5	PWM output 5
9	Z6	PWM output 6
42	Z7	PWM output 7
8	Z7/External Trigger	Counter input 7 external triggers
7	GND/+5V	Digital ground/+5V J4
49	GND	Digital ground
50	GND	Digital ground

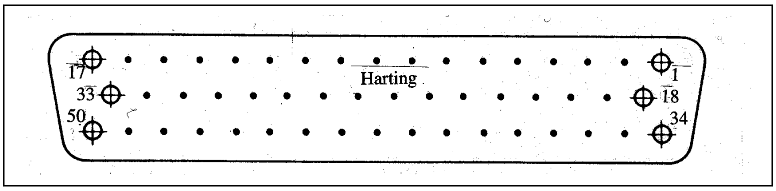
7.11 USB CountPwm8 (G0A-1033-0)

Pin name	Signal name	Function
PC 0	Z0	PWM output 0
PC 1	Z1	PWM output 1
PC 2	Z2	PWM output 2
PC 3	Z3	PWM output 3
PC 4	Z4	PWM output 4
PC 5	Z5	PWM output 5
PC 6	Z6	PWM output 6
PC 7	Z7	PWM output 7
TIN0	TIN0	Timer input
GND	GND	Digital ground



7.12 PCI Count8 Up/Down (G07-1043-0)

D-Sub Pin	Signal name	Function
19	Z0 up	Counter input 0
36	Z0 down	Counter input 0
37	Z1 up	Counter input 1
35	Z1 down	Counter input 1
18	Z2 up	Counter input 2
34	Z2 down	Counter input 2
24	Z3 up	Counter input 3
8	Z3/ down External Trigger	Counter input 3 external trigger
41	PA 4	Digital input/output 4
25	PA 5	Digital input/output 5
9	PA 6	Digital input/output 6
42	PA 7	Digital input/output 7/ 100Hz
45	PA 0	Digital input/output 0
12	PA 1	Digital input/output 1
14	PA 2	Digital input/output 2
44	PA 3	Digital input/output 3
15	Z 4 up	Counter input 4
32	Z 4 down	Counter input 4
16	Z 5 up	Counter input 5
43	Z 5 down	Counter input 5
10	Z 6 up	Counter input 6
47	Z 6 down	Counter input 6
31	Z 7 up	Counter input 7
11	Z 7 down	Counter input 7
49	GND	Digital ground
50	GND	Digital ground
7	GND/+5V	Digital ground/+5V J4

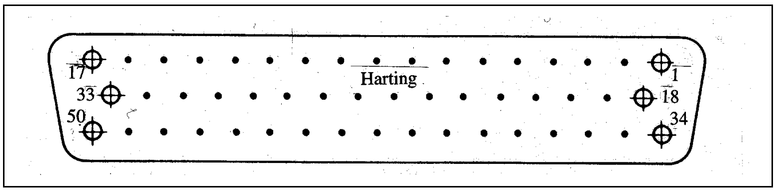


7.13 USB Count8 Up/Down (G0A-1043-0)

D-Sub Pin	Signal name	Function
PC 0	Z0 up	Counter input 0
PC 1	Z0 down	Counter input 0
PC 2	Z1 up	Counter input 1
PC 3	Z1 down	Counter input 1
PC 4	Z2 up	Counter input 2
PC 5	Z2 down	Counter input 2
PC 6	Z3 up	Counter input 3
PC 7	Z3/ down	Counter input 3
PA 0	PA 0	Digital input/output 0
PA 1	PA 1	Digital input/output 1
PA 2	PA 2	Digital input/output 2
PA 3	PA 3	Digital input/output 3
PA 4	PA 4	Digital input/output 4
PA 5	PA 5	Digital input/output 5
PA 6	PA 6	Digital input/output 6
PA 7	PA 7	Digital input/output 7
PB 0	Z 4 up	Counter input 4
PB 1	Z 4 down	Counter input 4
PB 2	Z 5 up	Counter input 5
PB 3	Z 5 down	Counter input 5
PB 4	Z 6 up	Counter input 6
PB 5	Z 6 down	Counter input 6
PB 6	Z 7 up	Counter input 7
PB 7	Z 7 down	Counter input 7
49	GND	Digital ground
Tri.	Trigger	Synchronization slave
50	GND	Digital ground

7.14 PCI Count16 (G07-1053-0)

D-Sub Pin	Signal name	Function
19	Z0	Counter input 0
36	Z1	Counter input 1
37	Z2	Counter input 2
35	Z3	Counter input 3
18	Z4	Counter input 4
34	Z5	Counter input 5
24	Z6	Counter input 6
8	Z7/Externe Trigger	Counter input 7 external trigger
15	Z8	Counter input 8
32	Z9	Counter input 9
16	Z10	Counter input 10
43	Z11	Counter input 11
41	PA 4	Digital input/output 4
25	PA 5	Digital input/output 5
9	PA 6	Digital input/output 6
42	PA 7	Digital input/output 7
45	PA 0	Digital input/output 0
12	PA 1	Digital input/output 1
14	PA 2	Digital input/output 2
44	PA 3	Digital input/output 3
49	GND	Digital ground
50	GND	Digital ground
7	GND/+5V	Digital ground/+5V J4



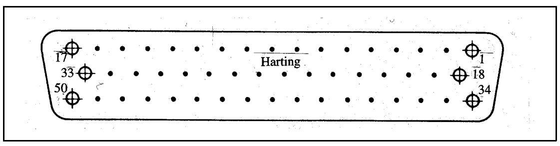
7.15 PC_DA-16 PCI (12 and 16 Bit Version) (G08-10xx-0)

Analog output socket P1 D-SUB25

D-Sub Pin	Signal name	Function
1	A0	Analog output 0
14	A1	Analog output 1
2	A2	Analog output 2
15	A3	Analog output 3
3	A4	Analog output 4
16	A5	Analog output 5
4	A6	Analog output 6
17	A7	Analog output 7
5	A8	Analog output 8
18	A9	Analog output 9
6	A10	Analog output 10
19	A11	Analog output 11
7	A12	Analog output 12
20	A13	Analog output 13
8	A14	Analog output 14
21	A15	Analog output 15
9	AGND	Analog ground
22	AGND	Analog ground
10	AGND	Analog ground
23	AGND	Analog ground
11	AGND	Analog ground
24	AGND/+5V	Analog ground / +5Volt (J5)
12	AGND	Analog ground
25	GND	Digital ground
13	Z0	Counter input

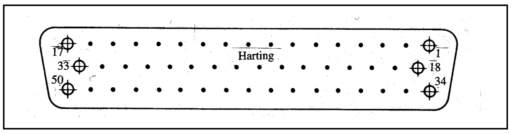
7.16 MultiChoice IV Single Ended Analog Signals (G09-1005-0+1)Fehler! Textmarke nicht definiert.

D-Sub Pin	Signal name	Function
38	K0	Analog input 0
37	K1	Analog input 1
36	K2	Analog input 2
20	K3	Analog input 3
6	K4	Analog input 4
22	K5	Analog input 5
21	K6	Analog input 6
39	K7	Analog input 7
4	K8	Analog input 8
18	K9	Analog input 9
3	K10	Analog input 10
2	K11	Analog input 11
5	K12	Analog input 12
19	K13	Analog input 13
34	K14	Analog input 14
35	K15	Analog input 15
42	K16	Analog input 16
10	K17	Analog input 17
27	K18	Analog input 18
43	K19	Analog input 19
11	K20	Analog input 20
28	K21	Analog input 21
44	K22	Analog input 22
12	K23	Analog input 23
29	K24	Analog input 24
45	K25	Analog input 25
13	K26	Analog input 26
30	K27	Analog input 27
46	K28	Analog input 28
14	K29	Analog input 29
31	K30	Analog input 30
47	K31	Analog input 31
23	Vout0	Analog output 0
40	Vout1	Analog output 1
17	Vout2	Analog output 2
33	Vout3	Analog output 3
25	Vout4	Analog output 4
41	Vout5	Analog output 5
9	Vout6	Analog output 6
26	Vout7	Analog output 7
7	GND_VCC	
1	AGND	Analog ground
24	AGND	Analog ground
15	AGND	Analog ground
32	AGND	Analog ground
48	AGND	Analog ground
16	AGND	Analog ground
50	AGND	Analog ground
8	AGND	Analog ground
49	AGND	Analog ground



7.17 MultiChoice IV Dual Ended Analog Signals (G09-1005-0+1)

D-Sub Pin	Signal name	Function
38	+K0	Analog input 0
37	+K1	Analog input 1
36	+K2	Analog input 2
20	+K3	Analog input 3
6	+K4	Analog input 4
22	+K5	Analog input 5
21	+K6	Analog input 6
39	+K7	Analog input 7
42	+K8	Analog input 8
10	+K9	Analog input 9
27	+K10	Analog input 10
43	+K11	Analog input 11
11	+K12	Analog input 12
28	+K13	Analog input 13
44	+K14	Analog input 14
12	+K15	Analog input 15
4	-K0	Analog input 0
18	-K1	Analog input 1
3	-K2	Analog input 2
2	-K3	Analog input 3
5	-K4	Analog input 4
19	-K5	Analog input 5
34	-K6	Analog input 6
35	-K7	Analog input 7
29	-K8	Analog input 8
45	-K9	Analog input 9
13	-K10	Analog input 10
30	-K11	Analog input 11
46	-K12	Analog input 12
14	-K13	Analog input 13
31	-K14	Analog input 14
47	-K15	Analog input 15
23	Vout0	Analog output 0
40	Vout1	Analog output 1
17	Vout2	Analog output 2
33	Vout3	Analog output 3
25	Vout4	Analog output 4
41	Vout5	Analog output 5
9	Vout6	Analog output 6
26	Vout7	Analog output 7
7	GND_VCC	
1	AGND	Analog ground
24	AGND	Analog ground
15	AGND	Analog ground
32	AGND	Analog ground
48	AGND	Analog ground
16	AGND	Analog ground
50	AGND	Analog ground
8	AGND	Analog ground
49	AGND	Analog ground



7.18 Pin Positions 5B Adapter MultiChoice light, Quattro USB-OEM

P3 light

Digital input/output 0	PA0	Pin 01		Pin 01	PA1	Digital input/output 1
Digital input/output 2	PA2	Pin 03		Pin 03	PA3	Digital input/output 3
Digital input/output 4	PA4	Pin 05		Pin 05	PA5	Digital input/output 5
Digital input/output 6	PA6	Pin 07		Pin 07	PA7	Digital input/output 7
Digital input/output 8	PB0	Pin 09		Pin 09	PB1	Digital input/output 9
Digital input/output 10	PB2	Pin 11		Pin 12	PB3	Digital input/output 11
Digital input/output 12	PB4	Pin 13		Pin 14	PB5	Digital input/output 13
Digital input/output 14	PB6	Pin 15		Pin 16	PB7	Digital input/output 15
Digital input/output 16	PC0	Pin 17		Pin 18	PC1	Digital input/output 17
Digital input/output 18	PC2	Pin 19		Pin 20	PC3	Digital input/output 19
Digital input/output 20	PC4	Pin 21		Pin 22	PC5	Digital input/output 21
Digital input/output 22	PC6	Pin 23		Pin 24	PC7	Digital input/output 23
Ground	GND	Pin 25		Pin 26	GND	Ground
Ground	GND	Pin 27		Pin 28	GND	Ground
Analog output 0	VOUT0	Pin 29		Pin 30	VOUT1	Analog output 1
Analog output 2	VOUT2	Pin 31		Pin 32	VOUT3	Analog output 3
External trigger	TR.	Pin 37		Pin 38	Tin	Counter input 0
Ground	GND	Pin 39		Pin 40	GND	Ground

P1 channel 0-15

P3 Quattro

Ground	GND	Pin 25		Pin 26	GND	Ground
Ground	GND	Pin 27		Pin 28	GND	Ground
Analog output 0	VOUT0	Pin 29		Pin 30	VOUT1	Analog output 1
Analog output 2	VOUT2	Pin 31		Pin 32	VOUT3	Analog output 3
Analog output 4	VOUT4	Pin 33		Pin 34	VOUT5	Analog output 5
Analog output 6	VOUT6	Pin 35		Pin 36	VOUT7	Analog output 7
Ground	GND	Pin 39		Pin 40	GND	Ground

P1 channel 0-15   P2 channel 16-31

P5 USB-OEM

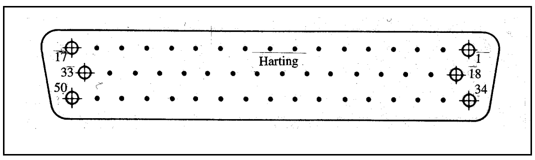
Analog output 0	VOUT0	Pin 01		Pin 01	GND	Ground
Analog output 1	VOUT1	Pin 03		Pin 03	GND	Ground
Analog output 2	VOUT2	Pin 05		Pin 05	GND	Ground
Analog output 3	VOUT3	Pin 07		Pin 07	GND	Ground
		Pin 09		Pin 09	GND	Ground

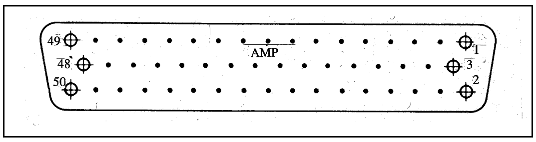
P1 channel 0-15   P2 channel 16-31

7.19 Pin positions P5 MultiChoice IV Connecting the Digital Signals to pin terminal 50 (G09-1005-0+1)

Digital input/output 0	PA0	Pin 01		Pin 02	PA1	Digital input/output 1
Digital input/output 2	PA2	Pin 03		Pin 04	PA3	Digital input/output 3
Digital input/output 4	PA4	Pin 05		Pin 06	PA5	Digital input/output 5
Digital input/output 6	PA6	Pin 07		Pin 08	PA7	Digital input/output 7
Digital input/output 8	PB8	Pin 09		Pin 10	PB9	Digital input/output 9
Digital input/output 10	PB10	Pin 11		Pin 12	PB11	Digital input/output 11
Digital input/output 12	PB12	Pin 13		Pin 14	PB13	Digital input/output 13
Digital input/output 14	PB14	Pin 15		Pin 16	PB15	Digital input/output 15
Digital input/output 16	PC16	Pin 17		Pin 18	PC17	Digital input/output 17
Digital input/output 18	PC18	Pin 19		Pin 20	PC19	Digital input/output 19
Digital input/output 20	PC20	Pin 21		Pin 22	PC21	Digital input/output 21
Digital input/output 22	PC22	Pin 23		Pin 24	PC23	Digital input/output 23
Digital input/output 24	PD24	Pin 25		Pin 26	PD25	Digital input/output 25
Digital input/output 26	PD26	Pin 27		Pin 28	PD27	Digital input/output 27
Digital input/output 28	PD28	Pin 29		Pin 30	PD29	Digital input/output 29
Digital input/output 30	PD30	Pin 31		Pin 32	PD31	Digital input/output 31
Counter input 0	Z0	Pin 33		Pin 34	Z1	Counter input 1
Counter input 2	Z2	Pin 35		Pin 36	Z3	Counter input 3
Counter input 4	Z4	Pin 37		Pin 38	Z5	Counter input 5
Counter input 6	Z6	Pin 39		Pin 40	Z7	Counter input 7
Expansion module *2	EXT_2	Pin 41		Pin 42		Expansion module *0
Expansion module *4		Pin 43		Pin 44		Expansion module *1
Pulse width output 0	PWM0	Pin 45		Pin 46		Expansion module *3
External trigger	Tri.	Pin 47		Pin 48	PWM1	Pulse width output1
Digital Ground	GND	Pin 49		Pin 50	GND	Digital Ground

The digital signals are routed over a flat ribbon cable to a SUB-D50 socket mounted to a slot panel. You can find the positions of the pins on the following page. Please take into consideration that the SUB-D50 socket is an AMP product which pin markings are made in a different order. The pin positions are identical to the measuring card. The APM sockets (see also picture on page 32) numbering scheme is identical to the scheme of pin connectors. That means pin 1 on the pin connector is associated to pin 1 on the SUB-D50 socket, pin 2 of the pin connector relates to pin 2 of the SUB-D50 socket an so on. The numbering scheme of the terminal pins of Harting sockets (see picture on page 32) is different compared to pin connectors. That means pin **1** of the pin connector is associated to pin **1** of the SUB-D50 socket while pin **2** of the pin connector is connected to pin **4** of the SUB-D50 socket (see picture on the following page). Please follow this hint to ensure correct feeding of the signals.
If you connect the Harting socket with a cable to a screwable Phoenix type terminal block you can use the preconfigured pin positions to feed the signals directly. Please note that the numbering scheme of the Harting socket differs from the description of the pins itself.





7.20 MultiChoice IV Connecting the Digital Signals to SUB-D50 (G09-1005-0+1)

SUB-D50 DFLK 50 Phoenix **Harting**	SUB-D50 Adapter **AMP**		
1	1	PA 0	Digital input/output 0
34	2	PA 1	Digital input/output 1
18	3	PA 2	Digital input/output 2
2	4	PA 3	Digital input/output 3
35	5	PA 4	Digital input/output 4
19	6	PA 5	Digital input/output 5
3	7	PA 6	Digital input/output 6
36	8	PA 7	Digital input/output 7
20	9	PB 0	Digital input/output 8
4	10	PB 1	Digital input/output 9
37	11	PB 2	Digital input/output 10
21	12	PB 3	Digital input/output 11
5	13	PB 4	Digital input/output 12
38	14	PB 5	Digital input/output 13
22	15	PB 6	Digital input/output 14
6	16	PB 7	Digital input/output 15
39	17	PC 0	Digital input/output 16
23	18	PC 1	Digital input/output 17
7	19	PC 2	Digital input/output 18
40	20	PC 3	Digital input/output 19
24	21	PC 4	Digital input/output 20
8	22	PC 5	Digital input/output 21
41	23	PC 6	Digital input/output 22
25	24	PC 7	Digital input/output 23
9	25	PD 0	Digital input/output 24
42	26	PD 1	Digital input/output 25
26	27	PD 2	Digital input/output 26
10	28	PD 3	Digital input/output 27
43	29	PD 4	Digital input/output 28
27	30	PD 5	Digital input/output 29
11	31	PD 6	Digital input/output 30
44	32	PD 7	Digital input/output 31
28	33	Z0	Counter input 0
12	34	Z1	Counter input 1
45	35	Z2	Counter input 2
29	36	Z3	Counter input 3
13	37	Z4	Counter input 4
46	38	Z5	Counter input 5
30	39	Z6	Counter input 6
14	40	Z7	Counter input 7
47	41		Expansion module *0
31	42		Expansion module *1
15	43		Expansion module *2
48	44		Expansion module *3
16	45	PWM0	Pulse width output 0
32	46		Expansion module *4
49	47	Tri.	External trigger
33	48	PWM1	Pulse width output 1
17	49	GND	Ground
50	50	GND	Ground

7.20.1 EIPQ-3000-1 **Connection unit** Weidmüllerterminal 48-pin **(G09-1005-0+1)**

Digital input/output 0	PA 0	Pin 01		Pin 48	PB 0	Digital input/output 8
Digital input/output 1	PA 1	Pin 02		Pin 47	PB 1	Digital input/output 9
Digital input/output 2	PA 2	Pin 03		Pin 46	PB 2	Digital input/output 10
Digital input/output 3	PA 3	Pin 04		Pin 45	PB 3	Digital input/output 11
Digital input/output 4	PA 4	Pin 05		Pin 44	PB 4	Digital input/output 12
Digital input/output 5	PA 5	Pin 06		Pin 43	PB 5	Digital input/output 13
Digital input/output 6	PA 6	Pin 07		Pin 42	PB 6	Digital input/output 14
Digital input/output 7	PA 7	Pin 08		Pin 41	PB 7	Digital input/output 15
Pulsweitenausgang 0	PWM0	Pin 09		Pin 40	PWM1	Pulsweitenausgang 0
Digital Masse	PAGND	Pin 10		Pin 39	PBGND	Digital Masse
Ground / +5Volt (J1)	GND/VCC	Pin 11		Pin 38	GND/VCC	Ground / +5Volt (J1)
Zähler Eingang 0	Z0	Pin 12		Pin 37	Tri.	Externer Trigger
Zähler Eingang 2	Z2	Pin 13		Pin 36	Z3	Zähler Eingang 3
Zähler Eingang 5	Z4	Pin 14		Pin 35	Z5	Zähler Eingang 5
Digital input/output 0	PC 0	Pin 15		Pin 34	PD 0	Digital input/output 8
Digital input/output 1	PC 1	Pin 16		Pin 33	PD 1	Digital input/output 9
Digital input/output 2	PC 2	Pin 17		Pin 32	PD 2	Digital input/output 10
Digital input/output 3	PC 3	Pin 18		Pin 31	PD 3	Digital input/output 11
Digital input/output 4	PC 4	Pin 19		Pin 30	PD 4	Digital input/output 12
Digital input/output 5	PC 5	Pin 20		Pin 29	PD 5	Digital input/output 13
Digital input/output 6	PC 6	Pin 21		Pin 28	PD 6	Digital input/output 14
Digital input/output 7	PC 7	Pin 22		Pin 27	PD 7	Digital input/output 15
		Pin 23		Pin 26		
Ground digital input	DGND	Pin 24		Pin 25	DGND	Ground digital input

7.20.2 EIPQ-3000-1 **Connection unit** Weidmüllerterminal 48-pin with EIPQ-30GI-1

Digital output 0	PA 0	Pin 01		Pin 48	PB 0	Digital output 8
Digital output 1	PA 1	Pin 02		Pin 47	PB 1	Digital output 9
Digital output 2	PA 2	Pin 03		Pin 46	PB 2	Digital output 10
Digital output 3	PA 3	Pin 04		Pin 45	PB 3	Digital output 11
Digital output 4	PA 4	Pin 05		Pin 44	PB 4	Digital output 12
Digital output 5	PA 5	Pin 06		Pin 43	PB 5	Digital output 13
Digital output 6	PA 6	Pin 07		Pin 42	PB 6	Digital output 14
Digital output 7	PA 7	Pin 08		Pin 41	PB 7	Digital output 15
Pulsweitenausgang 0	PWM0	Pin 09		Pin 40	PWM1	Pulsweitenausgang 0
Digital output Port A ground	PAGND	Pin 10		Pin 39	PBGND	Digital output Port B ground
Supply digital-output max. 35Volt. Port A	PAPWR	Pin 11		Pin 38	PBPWR	Supply digital-output max. 35Volt. Port B + PWM0-1
Counter 0	Z0	Pin 12		Pin 37	Tri.	Externer Trigger
Counter 2	Z2	Pin 13		Pin 36	Z3	Counter 3
Counter 5	Z4	Pin 14		Pin 35	Z5	Counter 5
Digital input 0	PC 0	Pin 15		Pin 34	PD 0	Digital input 8
Digital input 1	PC 1	Pin 16		Pin 33	PD 1	Digital input 9
Digital input 2	PC 2	Pin 17		Pin 32	PD 2	Digital input 10
Digital input 3	PC 3	Pin 18		Pin 31	PD 3	Digital input 11
Digital input 4	PC 4	Pin 19		Pin 30	PD 4	Digital input 12
Digital input 5	PC 5	Pin 20		Pin 29	PD 5	Digital input 13
Digital input 6	PC 6	Pin 21		Pin 28	PD 6	Digital input 14
Digital input 7	PC 7	Pin 22		Pin 27	PD 7	Digital input 15
		Pin 23		Pin 26		
Ground digital input	DGND	Pin 24		Pin 25	DGND	Ground digital input

On the G09-1005-X must be plugged in the J1 jumper to +5 V, to supply the optocoupler.

7.21 MultiChoice G09-1005-X Connecting the Digital Signals to DIGI-EXPAND P1-P4

Pin connector 50			
1	PA 0	Digital input/output 0	P1 = terminal number 0-31
2	PA 1	Digital input/output 1	P2 = terminal number 32-63
3	PA 2	Digital input/output 2	P3 = terminal number 64-95
4	PA 3	Digital input/output 3	P4 = terminal number 96-127
5	PA 4	Digital input/output 4	
6	PA 5	Digital input/output 5	
7	PA 6	Digital input/output 6	
8	PA 7	Digital input/output 7	
9	PB 0	Digital input/output 8	
10	PB 1	Digital input/output 9	
11	PB 2	Digital input/output 10	
12	PB 3	Digital input/output 11	
13	PB 4	Digital input/output 12	
14	PB 5	Digital input/output 13	
15	PB 6	Digital input/output 14	
16	PB 7	Digital input/output 15	
17	PC 0	Digital input/output 16	
18	PC 1	Digital input/output 17	
19	PC 2	Digital input/output 18	
20	PC 3	Digital input/output 19	
21	PC 4	Digital input/output 20	
22	PC 5	Digital input/output 21	
23	PC 6	Digital input/output 22	
24	PC 7	Digital input/output 23	
25	PD 0	Digital input/output 24	
26	PD 1	Digital input/output 25	
27	PD 2	Digital input/output 26	
28	PD 3	Digital input/output 27	
29	PD 4	Digital input/output 28	
30	PD 5	Digital input/output 29	
31	PD 6	Digital input/output 30	
32	PD 7	Digital input/output 31	
33	Z0	Counter input 0	
34	Z1	Counter input 1	
35	Z2	Counter input 2	
36	Z3	Counter input 3	
37	Z4	Counter input 4	
38	Z5	Counter input 5	
39	Z6	Counter input 6	
40	Z7	Counter input 7	
41			
42			
43			
44			
45	PWM0	Pulse width output 0	
46			
47	Tri.	External trigger	
48	PWM1	Pulse width output 1	
49	GND	Ground	
50	GND	Ground	

7.22 MultiChoice G09-1005-X Connecting the Digital Signals to DIGI-EXPAND P11-P14

Pin connector 40			
1	PA 0	Digital input/output 0	P11 = terminal number 0-31
2	PA 1	Digital input/output 1	P12 = terminal number 32-63
3	PA 2	Digital input/output 2	P13 = terminal number 64-95
4	PA 3	Digital input/output 3	P14 = terminal number 96-127
5	PA 4	Digital input/output 4	
6	PA 5	Digital input/output 5	
7	PA 6	Digital input/output 6	
8	PA 7	Digital input/output 7	
9	PB 0	Digital input/output 8	
10	PB 1	Digital input/output 9	
11	PB 2	Digital input/output 10	
12	PB 3	Digital input/output 11	
13	PB 4	Digital input/output 12	
14	PB 5	Digital input/output 13	
15	PB 6	Digital input/output 14	
16	PB 7	Digital input/output 15	
17	GND	Ground	
18	GND	Ground	
19	+5V	+5 Volt	
20	+12V	+12 Volt	
21	PC 0	Digital input/output 16	
22	PC 1	Digital input/output 17	
23	PC 2	Digital input/output 18	
24	PC 3	Digital input/output 19	
25	PC 4	Digital input/output 20	
26	PC 5	Digital input/output 21	
27	PC 6	Digital input/output 22	
28	PC 7	Digital input/output 23	
29	PD 0	Digital input/output 24	
30	PD 1	Digital input/output 25	
31	PD 2	Digital input/output 26	
32	PD 3	Digital input/output 27	
33	PD 4	Digital input/output 28	
34	PD 5	Digital input/output 29	
35	PD 6	Digital input/output 30	
36	PD 7	Digital input/output 31	
37	GND	Ground	
38	GND	Ground	
39	+5V	+5 Volt	
40	+12V	+12 Volt	

7.23 MultiChoice Quattro Pin Positions Expansion Module

7.23.1 Module: QU/Inkre/6/32 (G09-3095-5)

Incremental encoder P1 D-SUB25

D-Sub Pin	Signal name	Function
1	PHI0(0)	Counter input 0 pulse
14	PHI90(0)	Counter input 0 direction
2	PHI0(1)	Counter input 1 pulse
15	PHI90(1)	Counter input 1 direction
3	PHI0(2)	Counter input 2 pulse
16	PHI90(2)	Counter input 2 direction
4	PHI0(3)	Counter input 3 pulse
17	PHI90(3)	Counter input 3 direction
5	REF (0)	Reference pin 0
18	REF (1)	Reference pin 1
6	REF (2)	Reference pin 2
7	PHI0(4)	Counter input 4 pulse
20	PHI90(4)	Counter input 4 direction
8	PHI0(5)	Counter input 5 pulse
21	PHI90(5)	Counter input 5 direction
9	REF (4)	Reference pin 4
22	REF (5)	Reference pin 5
12	GND	Digital ground
25	GND	Digital ground
13	GND	Digital ground

7.23.2 Module: QU/UI12/10/4 (G09-3041-5)

Current output module P5 D-SUB50

D-Sub Pin		Signal name	Function
47	41	I0	Current output 0
31	42	I1	Current output 1
15	43	I2	Current output 2
48	44	I3	Current output 3
17	49	GND	Ground
50	50	GND	Ground

7.23.3 Module: QU/DA16/10/4-8 (G09-3024-5)

16 Bit Analog Output Socket P1 D-SUB25

D-Sub Pin	Signal name	Function
1	A0	Analog output 0
14	A1	Analog output 1
2	AGND	Analog ground
15	AGND	Analog ground
3	A2	Analog output 2
16	A3	Analog output 3
4	AGND	Analog ground
17	AGND	Analog ground
5	A4	Analog output 4
18	A5	Analog output 5
6	AGND	Analog ground
19	AGND	Analog ground
7	A6	Analog output 6
20	A7	Analog output 7
8	AGND	Analog ground
21	AGND	Analog ground

Module: QU/8/UP (G09-3094-5)

UP & Down Counter P1 D-Sub25

D-Sub Pin	Signal name	Function
1	Z0 up	Counter input 0
14	Z0 down	Counter input 0
2	Z1 up	Counter input 1
15	Z1 down	Counter input 1
3	Z2 up	Counter input 2
16	Z2 down	Counter input 2
4	Z3 up	Counter input 3
17	Z3/ down	Counter input 3
5	Z 4 up	Counter input 4
18	Z 4 down	Counter input 4
6	Z 5 up	Counter input 5
7	Z 5 down	Counter input 5
20	Z 6 up	Counter input 6
8	Z 6 down	Counter input 6
21	Z 7 up	Counter input 7
9	Z 7 down	Counter input 7
12	GND	Digital ground
25	GND	Digital ground
13	GND	Digital ground

7.23.4 Module: QU/PWM (G09-3095-5)

PWM Output P1 D-Sub25

D-Sub Pin	Signal name	Function
1	Z0	PWM output 0
14	Z1	PWM output 1
2	Z2	PWM output 2
15	Z3	PWM output 3
3	Z4	PWM output 4
16	Z5	PWM output 5
4	Z6	PWM output 6
17	Z7	PWM output 7
12	GND	Digital ground
25	GND	Digital ground
13	GND	Digital ground

7.23.5 Module: QU/Rel8 (G09-3097-0)

Relay Terminals P1 D-Sub25

D-Sub Pin	Signal name	Function
1	S 0	Normally open0
14	Ö 0	Normally closed 0
2	F 0	Common contact 0
15	S 1	Normally open 1
3	Ö 1	Normally closed 1
16	F 1	Common contact 1
4	S 2	Normally open 2
17	Ö 2	Normally closed 2
5	F 2	Common contact 2
18	S 3	Normally open3
6	Ö 3	Normally closed 3
19	F 3	Common contact 3
7	S 4	Normally open 4
20	Ö 4	Normally closed 4
8	F 4	Common contact 4
21	S 5	Normally open 5
9	Ö 5	Normally closed 5
22	F 5	Common contact 5
10	S 6	Normally open 6
23	Ö 6	Normally closed 6
11	F 6	Common contact 6
24	S 7	Normally open 7
12	Ö 7	Normally closed 7
25	F 7	Common contact 7
13		

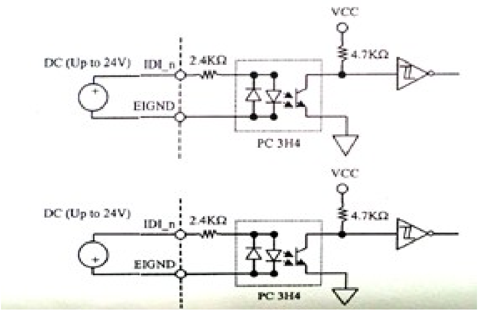
7.23.6 Module : QU/Opto/16/16

Digital input P1 D-Sub25

D-Sub Pin	Signal name	Function
1	E 0	Input 0
14	E 1	Input 1
2	E 2	Input 2
15	E 3	Input 3
3	EGND0	Input ground 0-3
16	EGND0	Input ground 0-3
4	E 4	Input 4
17	E 5	Input 5
5	E 6	Input 6
18	E 7	Input 7
6	EGND1	Input ground 4-7
19	EGND1	Input ground 4-7
7	E 8	Input 8
20	E 9	Input 9
8	E 10	Input 10
21	E 11	Input 11
9	EGND2	Input ground 8-11
22	EGND2	Input ground 8-11
10	E 12	Input 12
23	E 13	Input 13
11	E 14	Input 14
24	E 15	Input 15
12	EGND3	Input ground 12-15
25	EGND3	Input ground 12-15
13		

The module offers 16 optocoupled inputs.

Inputs are grouped together with 4 inputs each and they are connected to the same ground. This input signals are galvanically separated of the ground of the card. The circuit diagram shows the circuitry on which the inputs are based.

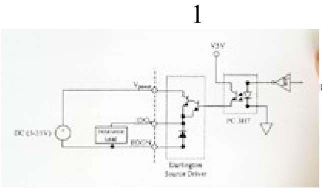


7.23.7 QU/ Opto/16/16 Digital Output P2 D-Sub25

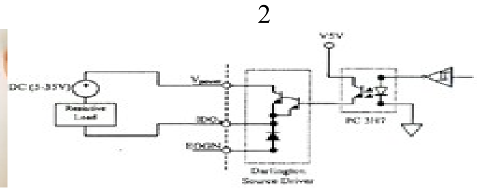
D-Sub Pin	Signal name	Function
1	D0 0	Output 0
14	D0 1	Output 1
2	DO2	Output 2
15	DO3	Output 3
3	DO4	Output 4
16	DO5	Output 5
4	DO6	Output 6
17	DO7	Output 7
5	EOGND	Output ground
18	EOGND	Output ground
6	EOGND	Output ground
19	EOGND	Output ground
7	DO8	Output 8
20	DO9	Output 9
8	DO 10	Output 10
21	DO11	Output 11
9	DO12	Output 12
22	DO13	Output 13
10	DO14	Output 14
23	DO15	Output 15
11	EOGND	Output ground
24	EOGND	Output ground
12*	EOGND	Output ground
25	EOGND	Output ground
13	VPower	Power supply output

The module offers 16 optocoupled outputs. The output signals are available at a Darlington transistor. Any of the outputs are connected to a common ground and a common voltage supply. The power supply is connected to pin 13. EOGND is used as referential ground for inductive loads while resistive loads are connected to DO_n. Example 1 shows how to connect inductive loads while example 2 explains how to connect resistive loads.

1



2



7.23.7.1 Synchronization of several Cards

The MultiChoice PCI series allows to synchronize several cards (new models starting with release 1.6 only).
In this case one of the measuring cards is specified in the driver as master. Any other of the remaining cards are synchronized as slaves. The connection of the cards in question is achieved with a 10 wire cable to plug P2.
IMPORTANT: Only one of the cards in the daisy chain can be specified as a master otherwise the ALTERA circuit can be damaged. Slave and stand alone devices are not affected.

The master device provides the clock frequency which is used of the slave devices to measure. The channel associated sample rate is passed through and if a clock pulse arrives a burst measurement is carried out.
This kind of synchronization is possible only for automatic measurements. It cannot be used for single trigger actions (in example DIAdem software does not offer synchronization features).

The cards will be synchronized as in the following:
MultiChoice lightPCI, MultiChoice Quattro: For this cards the ADC acquisition is synchronized in the meaning that the ADC sample rate is switched off while the acquisition is started by a pulse coming over the synchronization cable.
MultiChoice Countxxx: For this cards the CT acquisition is synchronized. That means the CT sample rate is switched off and the acquisition starts with a pulse fed over the synchronization cable.
MultiChoice CountInkrx/HS: The automatic counter acquisitions are synchronized (see MultiChoice Countxxx). This mechanism is available for HS versions equipped with external memory only.

Other kinds of measurement synchronizations are not implemented yet.

USB cards are synchronized over the digital input PC2. Please ensure to connect the digital ground of the systems together.

8 Installation of Software

8.1 Installation of the Drivers of the DIAdem Versions 6 – 11.x

8.1.1 Driver Properties and Performance

Types of Measurements:

- Standard measurement with hardware and software clock
- Disk measurement
- High speed measurement
- Edge triggered window measurement (each of the measurements) external triggering with hardware clock for high speed and disk measurements
- wave form generator (function generator)
- Analog and digital PWM (pulse width measurement)
- Measuring digital, counter, and analog signals at the same
- Wave form generator: output of sine wave, triangle, square, pulse, saw tooth, white noise, and files.
- Online scaling of measured data
- Online filter: IIR und FIR
- Online FFT (fast fourier transformation)
- Oversampling
- Online PID control
- Online digital control

8.1.2 Installation

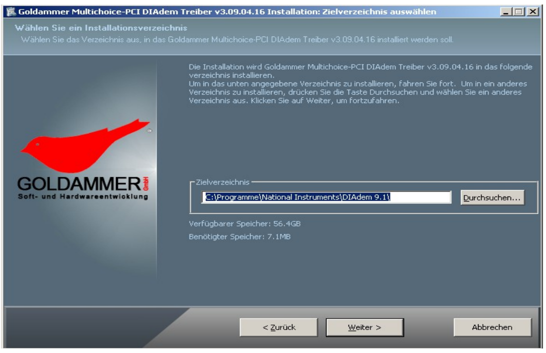
The driver for the MultiChoice series can be used for any DIAdem version starting with release 8.0. It supports all cards of the MultiChoice series and has to be installed once only even when using more than one card in parallel. The drivers for USB and PCI versions are different because of the different bus structures. Therefore both of the drivers have to be installed if both will be run in parallel.

Insert the provided driver CD into your CDROM or DVD drive. Thereafter a selection program starts automatically if autorun is activated. If the program does not run automatically it has to be run with My Computer.

After the starting screen has appeared click on the Install button to install or click on Cancel to terminate the program.

Important!

Within the menu CD Autorun the drivers for all of the actual Goldammer cards can be installed. The drivers for the MultiChoice Light cards are intended for the ISA bus card Multichoice Light but cannot used for cards of the series Multichoice lightPCI or Multichoice USB.



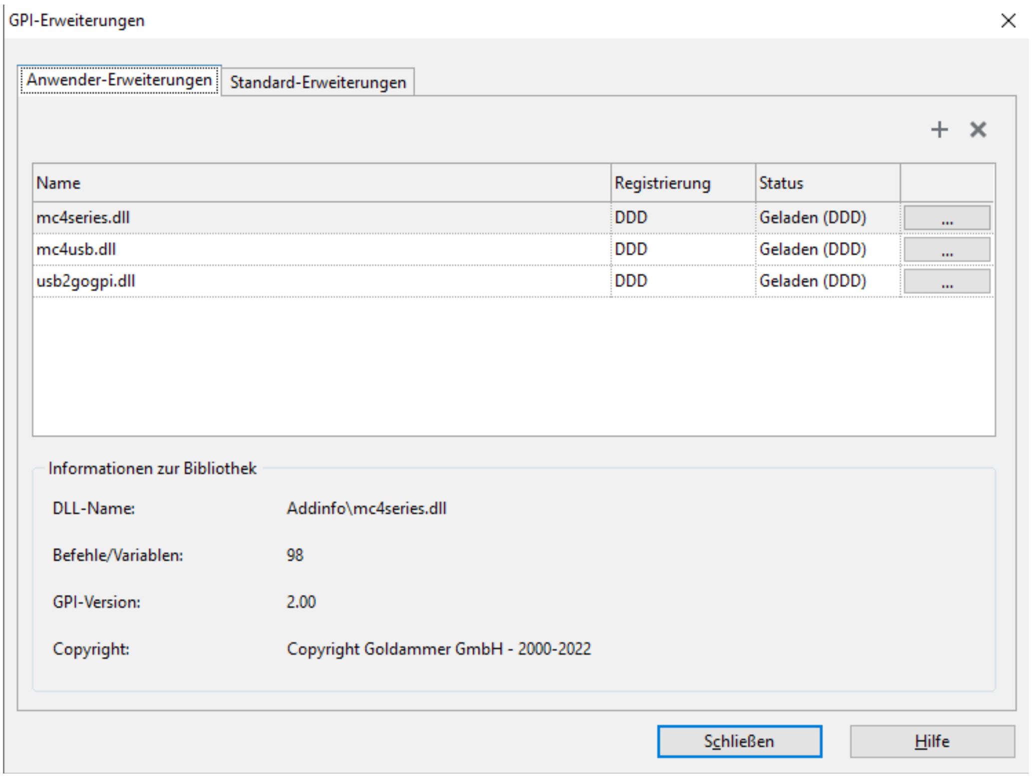
To install the measurement device driver, please use the new Driver Installer Assistant.

8.1.3 Registering the driver in DIAdem

To be able to use the installed device driver in DIAdem, it must first be
be registered. To do this, start your Diadem application.

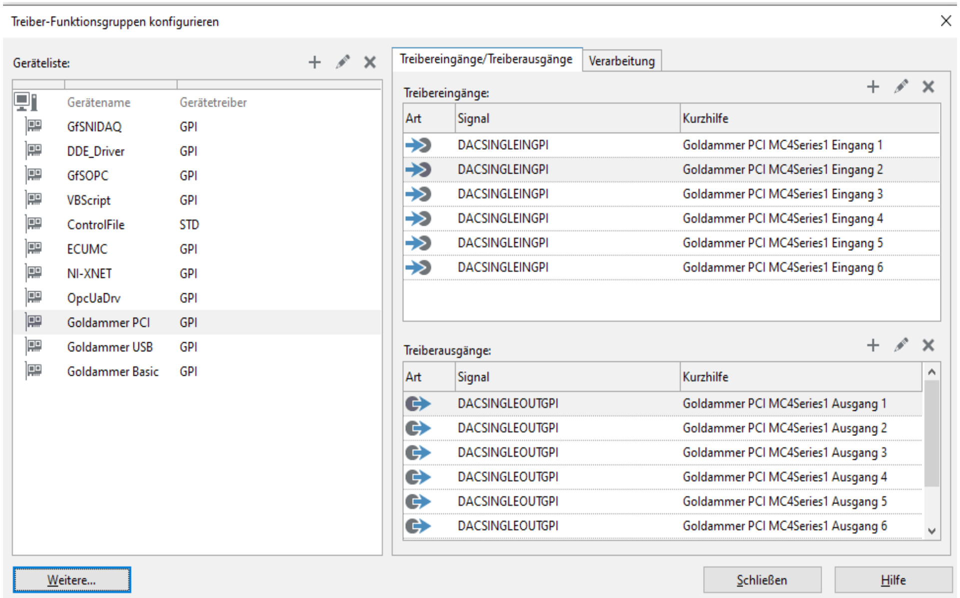
In the next step select under the DIAdem DAC View
select the menu item GPI Extensions.
Options → Extensions → GPI Extensions

Press the Add button and select the previously installed device driver.
from the list. The corresponding file can be found in the Diadem home directory of the selected Diadem version
to be found.
(Ex.: C:\Programs\National Instruments\Diadem 20.xx)



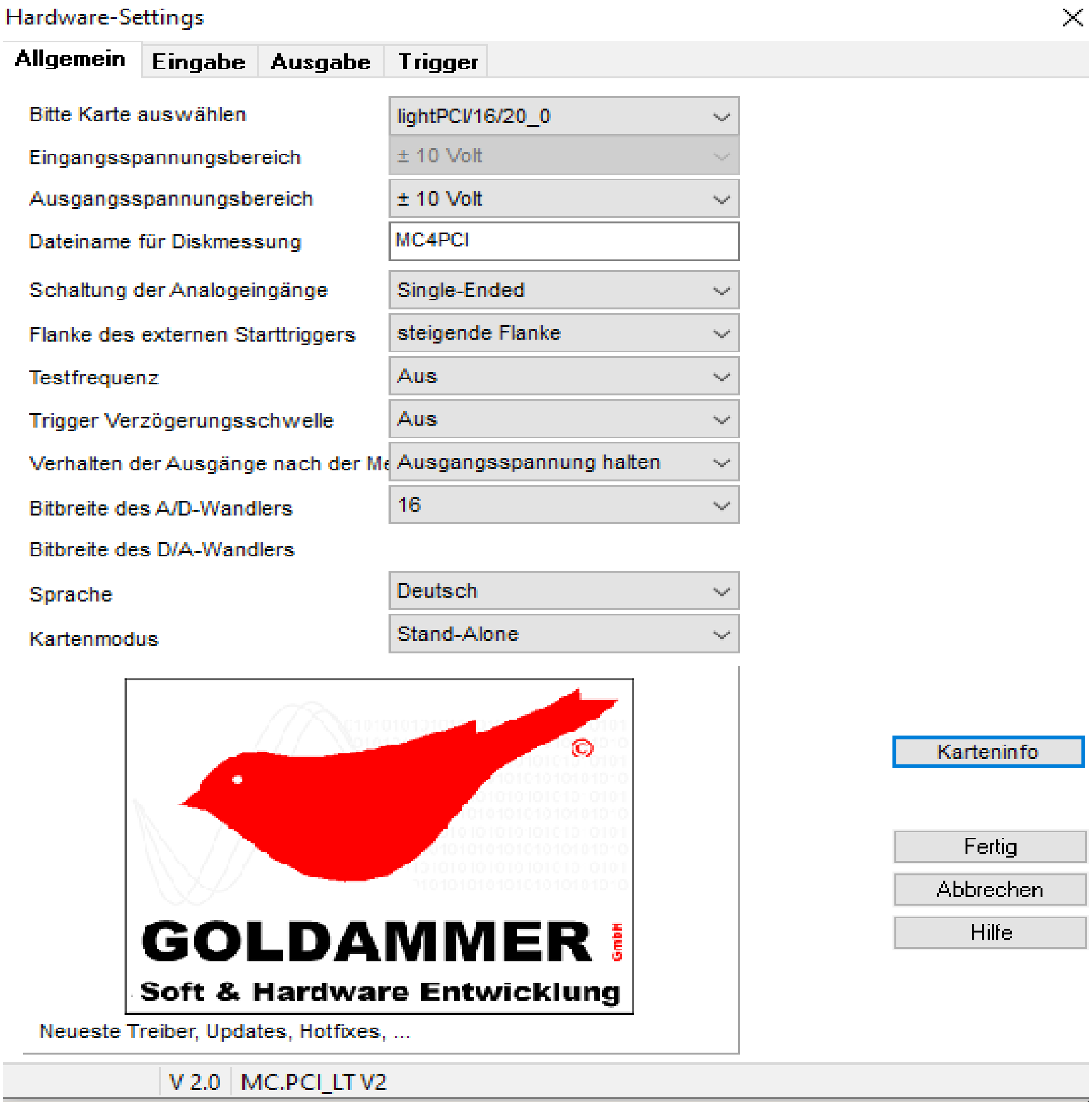
GPI-driver:
MultichoicePCI - mc4series.dll
MultichoiceUSB - mc4usb.dll
MultichoiceUSBBasic - usb2gogpi.dll

Then select DIAdem DAC followed by the menu option „Settings → „Einzelwertverarbeitung (Single Value)“ → „Treiber konfigurieren (Configure Driver)“
The existent measuring cards can be configured there.
Please select „Goldammer PCI“ as manufacturer followed by the entry „MC4Series1“. Use for USB versions “Goldammer USB” and „MC4USB1“. With registering the driver all important configurations have been made. Now you are able to run up to four cards of the MultiChoice PCI respectively USB series of your choice in parallel.



Switching between the cards is carried out in the dialog box of the measurering blocks where each of the blocks can be associated to one of the available cards.

Under „Input Driver“ you will find the settings of the respective card



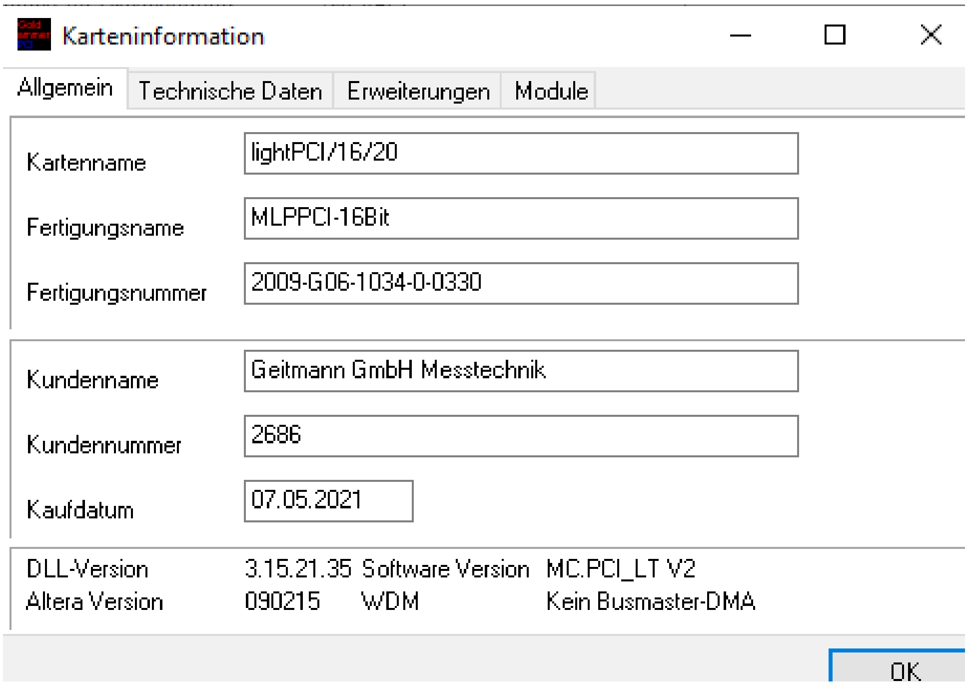
If you open an input block followed by the option devices you will get an overview of the device specific features which can be configured. You can set which card has to be used for measurement if there are more than one and you can configure some more details.
Filename for disk measurement to disk is the name of the .DAT file which contains the measured data after ending the measurement. If the file already exists if starting a new measure cycle, a message appears which warns and overwrites it.
With Setting of analog input you can switch between dual ended and single ended inputs.
The edge of the External starttrigger describes the signal that has to be fed over the trigger input terminal by an externally triggered measurement to start the process. You can select a rising (low to high) or a falling (high to low) edge.
Furthermore it is possible to generate a Test frequency on the card. You can select Off, Internal or External.
If internal is selected the test signal is fed directly to the first counter. Externally the signal is available at the TTL port PC7. The frequency of the test signal depends on the type of the card. It is 50 Hz for the MultiChoice lightPCI for any other card 100 Hz.

The trigger reaction delay defines the sensitivity of the trigger input. In there are significant EMG distortions in the surrounding which may cause erroneous triggering you can specify the time interval in which a trigger signal has to be applied continuously to be recognized as a valid trigger signal.

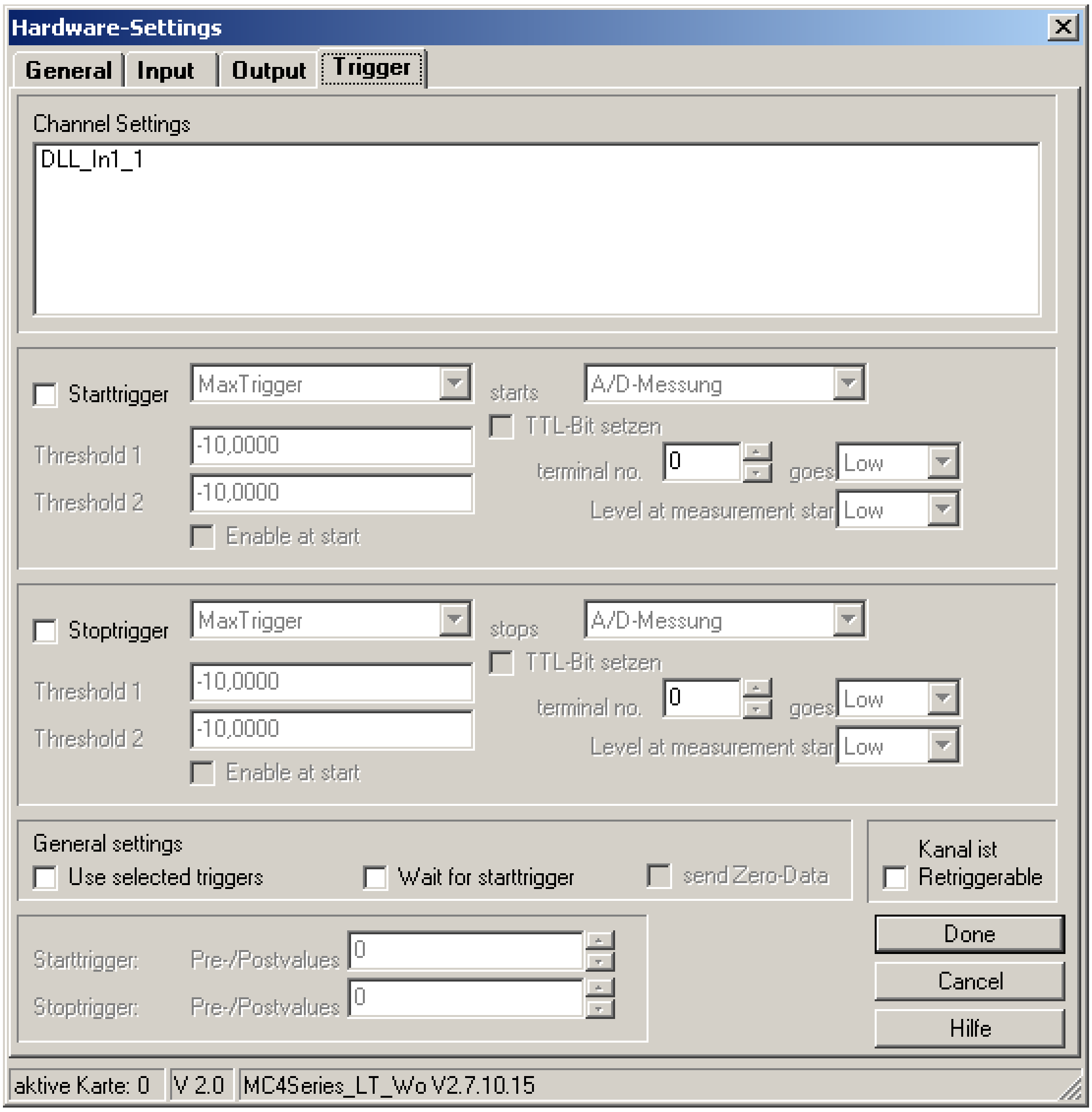
Furthermore there is the possibility to change the language of the hardware related dialogs. This affects the card specific dialogs only. The language selection of DIAdem is not affected.

To get a better overview at the bottom of the dialog a small information bar shows the actual active card and the release number of the program running on the digital signal processor. Because you are able to switch without limitation between cards you are better informed about the card you are measuring actually.

The available settings may change if another card is selected. Because not all types of MultiChoice offer the same settings for a counter card without analog inputs the configuration options single ended and dual ended are disabled.



Hardware Settings now has a new register card named Trigger.



These triggers are start and stop conditions which are controlled by the card. The lightPCI series allow to configure each of them individually and to active and deactivate them.
The triggers are available with the measuring modes high speed, hardware clock, and disk measurement.

The triggers are transmitted to the DSP as conditions which were checked after starting a measurement. Because the trigger mechanism is controlled by the DSP the delay between the occurrence of a trigger event and the start or stop of a measurement goes to zero.

Additionally it is possible to set any TTL output to high or low if a trigger event occurs. To set an output to low it has to be set to high before. Otherwise it is impossible to recognize the change. Furthermore the starting condition for the measurement can be set.

Important: If the option „TTL Bit setzen“ is used the quadruple block of the TTL outputs (PA0..3, PA4..7) is switched to output and therefore cannot be used as input.

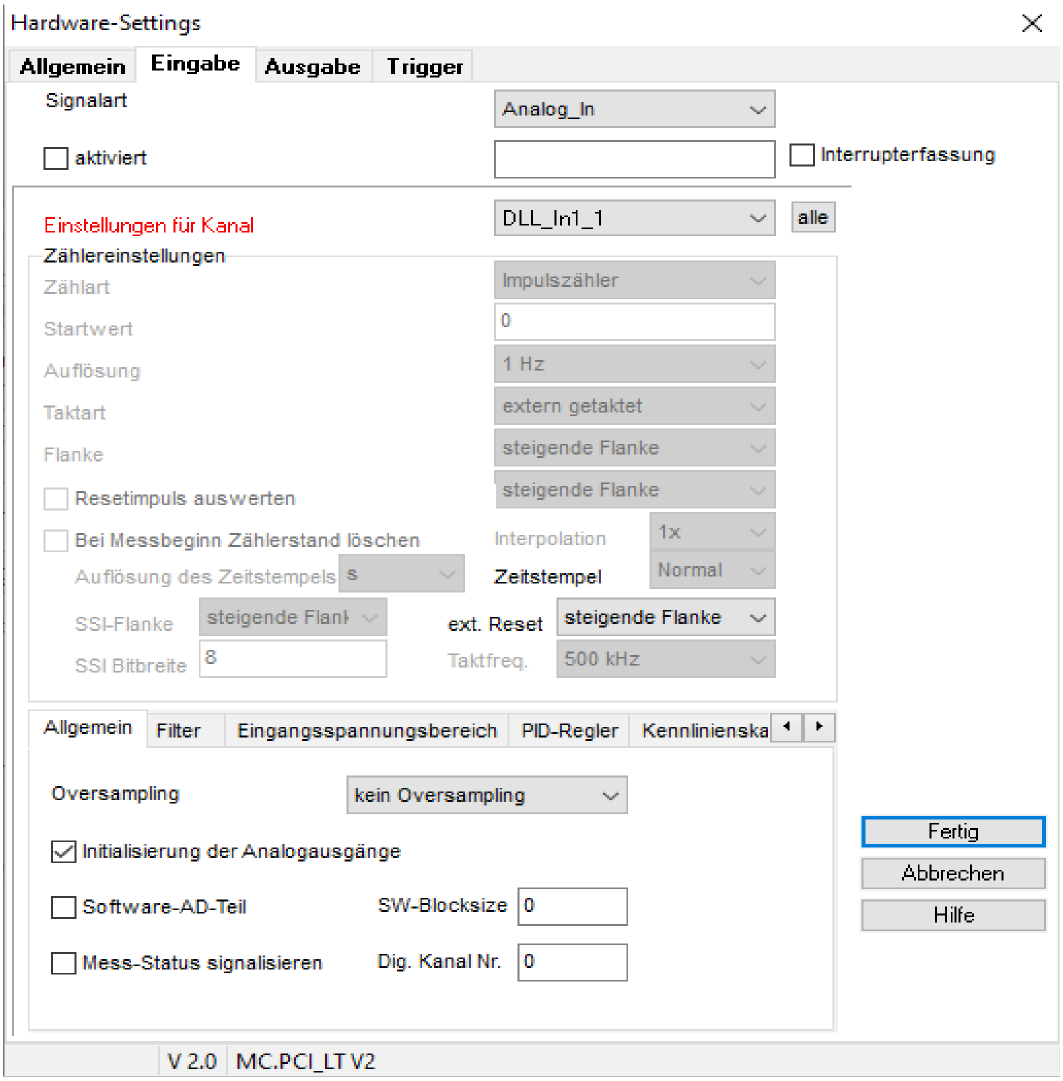
The channels defined in the input block are shown in the upper part. If you select one of these channels in the right area the channel specific settings are shown. The general settings are global in the meaning they are applied to all channels.

The option „Use selected triggers“ allows to activate/deactivate all of the triggers without loosing the set trigger conditions. This makes it possible to measure the signal without triggering to determine signal borders or other options without the necessity to change the circuit diagram.

The MultiChoice PCI cards store the measured values in a circular organized buffer and check in the background if the trigger conditions are valid. If a trigger condition becomes true the full size of the circular buffer can be used to store the pretrigger values. Post trigger signals are acquisited like the measured values. There is no limit caused by the card.

If there are questions left click on the button Hilfe (Help). The online help function is run and you will find an explanation according to the settings in question.

This window appears if an input block is opened:



This window allows setting the type of measurement for the input signal and the detail configuration of the measurement. The possible settings are shown as default values and can be selected.

8.1.3.1 Oversampling

The upper paragraph is used to configure the PCI Cards.
The cards of the MultiChoice series make it possible to set for each of the channels an oversampling which is used to reduce the distortion of the measured signal. There is 2x, 4x, 8x, and 16x oversampling available. By request other oversampling rates can be implemented.
The cards of the MultiChoice series allow setting different oversampling for each of the channels.
The oversampling runs autonomously on the processor of the measurement card. It does not depend on the load of the processor. So DIAdem gets passed the averaged values only. Access to the original oversampling values is not possible.
Because the cards are limited to a maximum upper sample rate the “shown” sample rate is reduced with rising oversampling. If you use 10 channels with 1 kHz and 8x oversampling the effective averaged sample rate results in 80 kHz. This has to be taken in consideration to avoid buffer overruns which results in losses of measured data. Oversampling can be used in the modes hardware clock, high speed, and disk measurement.

The possible shown settings vary depending on the input signal and the kind of installed hard- and software expansions.

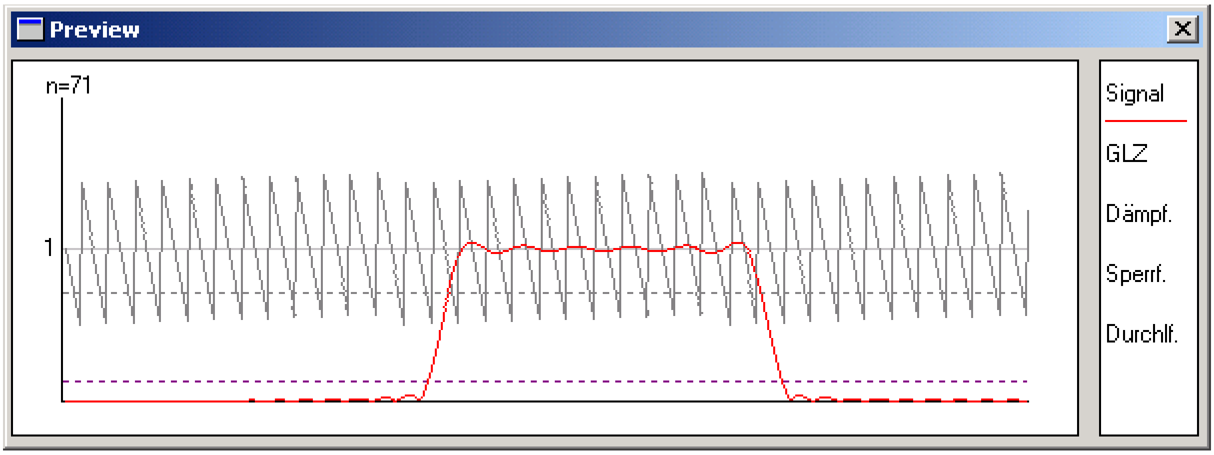
The later mentioned online functionality is only available with MultiChoice Quattro and with the HS models of MultiChoice PCI.

8.1.3.2 Online Scaling

The lower paragraph is used to set the options for the online scaling. The online scaling projects a previously defined file which can be edited in example with MS-Excel to the measured values. Data which are passed over to DIAdem are changed in correspondence to the table. This allows to feed DIAdem with physical dimensions or units and to calculate pressure, force or vice versa out of voltages in the range ±10V. These tables also allow to set value ranges to zero for areas in which no measurement should be done.
Important: The online scaling in available only with 12 bit HS cards.

8.1.3.3 Online Filter

Because of the extremely fast signal processor which is used for all cards of the PCI series it is possible to do many mathematical calculations with the DSP and to influence the measured signal.
Furthermore many filter mechanisms are implemented yet or are under development. For example this are high band, low band, band pass and many other filters which can be used in real time applications without rising the load of the processor. By request customized filters can be implemented. For details and actual information please contact the manufacturer or refer to the website http://www.goldammer.de.
With the dynamic calculation of coefficients it is possible to adopt to nearly any characteristic of the filter. The following picture shows an example for a possible filter curve. For more information according this item please read chapter 9.



8.1.3.4 Filter Coprocessor

The second processor of Multichoice Quattro is equipped with an integrated filter coprocessor (EFCOP) including an own buffer which reduces the processor load and guaranties optimal performance. The coprocessor is able to handle nearly any kind of filter like FIR and IIR filters. The main processor only serves to carry out the transmission of data from and to the coprocessor.

8.1.3.5 Online PID Controller

The mathematic power of the signal processor permits also a real time PID control without intervention of the PC system.
A PID control is implemented in the single value driver. For this purpose an ADC input block and a DAC output block are connected together. The set value ist set statically in the user interface. After starting the measurement the ADC input measures continuously the actual value using the set frequency and passes it to the PID program on the DSP. This program calculates the manipulated variable and outputs it over the DAC output.
A second variable PID control is implemented in the packet driver. The packet driver allows to set the number of inputs and outputs in any of the blocks in the circuit diagram as desired. Such a kind of PID block contains two inputs (set value and manipulated variable) and an output (manipulated variable) which carries out the upper functions.

8.1.3.6 Online FFT

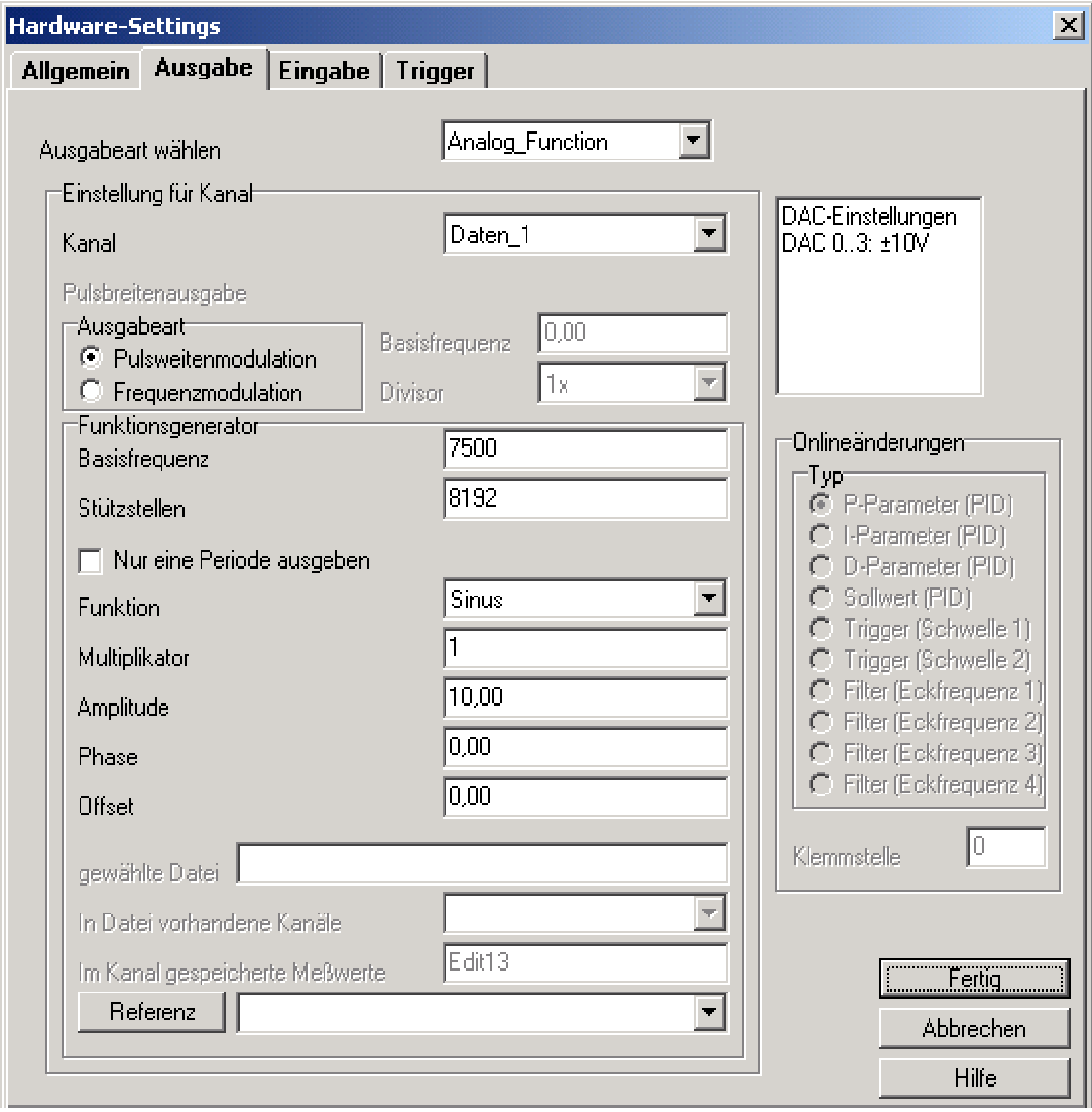
Online FFT serves as a fast Fourier transformation which runs in real time on the DSP. Data passed to DIAdem with a selected FFT contain already the calculated frequency spectrum according to the set parameters.

8.1.3.7 Miscellaneous Online Functions

By request we can realize special mathematical functions in form of a DSP program which is executed in real time on the signal processor. Because this programs run without changing the load of the processor of the PC system they are the ideal choice for time critical or very fast measure and control applications.

Please contact the manufacturer if you need customized drivers.

This window is shown after opening an output block:



In this window similar to the input signals kind and description of the output signal can be set. With the selected output mode the available configuration fields are enabled so you can make the detail settings for any kind of measurement.

Furthermore in the right section a small subwindow is shown which serves to display the output range of the analog outputs in question.

- The available settings depend on the kind of the selected output method and on the installed hardware and software expansions.

Filename
Type in the name of the file in which the measured values shall be stored during a measurement to disk. Please select the name very carefully. ALREADY EXISTING FILES ARE SUBJECT TO BE OVERWRITTEN.

Analog Output Channel 0-3
This serves to set the voltage range for the output channels. Please select among two options:

0-10	Volt
±10	Volt

All four outputs are set to the desired range. Default is 0V-10V. Switching over the voltage ranges is achieved by software.

DAC cards are kept together in groups of four in example 0..3, 4..7, 8.. 11, … All of these quadruple groups can be defined nearly synchronously which means four DAC outputs are defined together.

Pulse width modulation MultiChoice light
The pulse width signal is output over pin PC7. The upper four bits of port C are set to output. Further a 50 Hz test signal can be output over PC7. It is used to test the counters. Please connect pin 29 (PC7) and pin 24 of the counter input.

Pulse width modulation MultiChoice IV
The pulse width signal is output over pin 47 PWM0 and pin 48 PWM1

8.1.3.8 Trigger

Window/Edge triggering (for any kinds of measurements) See Trigger Conditions
External triggering (High Speed and Disk Measurement)
The trigger event is valid if bit D0 of the digital input A changes from low (0) to high (1). The external trigger signal is connected to pin 45 of socket P1. The triggering edge is set either to positive or to negative.

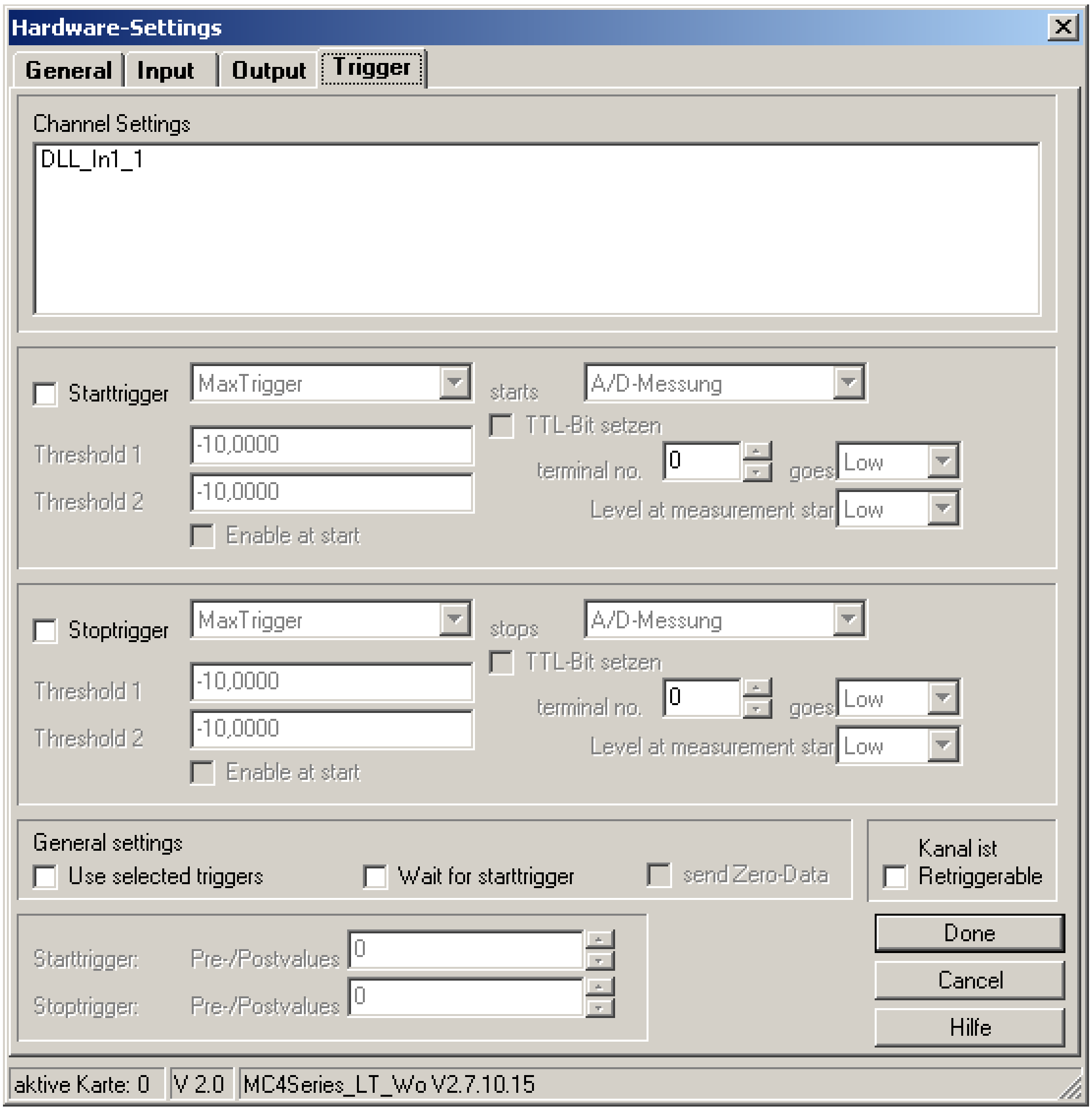
8.1.3.9 Trigger Conditions

MultiChoice lightPCI cards support start and stop trigger which are processed with the digital signal processor of the card. Therefore it is possible to implement it in all kinds of measurements with the exception of a single value processing software clock.
These triggers work independent of the speed of your PC system so maximum performance is available without rising the load of the PC processor.

The register card Trigger contains all settings necessary for this purpose.
In the left part all channels are listed which are set in DIAdem. This channels are associated to the channel and terminal relations of the input block

8.1.3.10 Start and Stop Trigger

The settings for the trigger conditions associated to a channel can be made here. Start and stop triggers are individually set for each of the channels. It is possible to define up to two different start and stop trigger for each channel which are combined with a boolean AND respectively OR operation.
If two triggers are connected with an OR operation the resulting condition is valid if one of both is valid. The result of AND operation connected triggers is valid only if both conditions are valid at the same time.
Start and stop triggers can be activated/deactivated individually (start trigger activated) respectively (stop trigger activated).



Additionally global rules may be applied.
These rules include the setting of any digital output on the card. This output is set in the menu „TTL-Bit setzen". To use both edges (High→Low and Low→ High) it is possible to set the condition at start measurement for example a high level.

If the TTL bits for start and stop trigger are connected to the same output the starting condition for the stop trigger is deactivated and the start trigger is adapted. If the TTL outputs are set different it is possible to set different start conditions of the TTL ports as well.

Start and Stop Trigger
Combinations of start and stop signaling are possible with the TTL ports. In example:
Both signalings to bit 0
Starting condition Low
Start trigger: Rising edge
Stop trigger: Falling edge
For settings like these bit 0 of the TTL output A is set to low as long as the starting trigger condition becomes true. It the stop condition of the trigger becomes valid the output is set to low again.
This can be used to realize test systems or emergency stop systems.

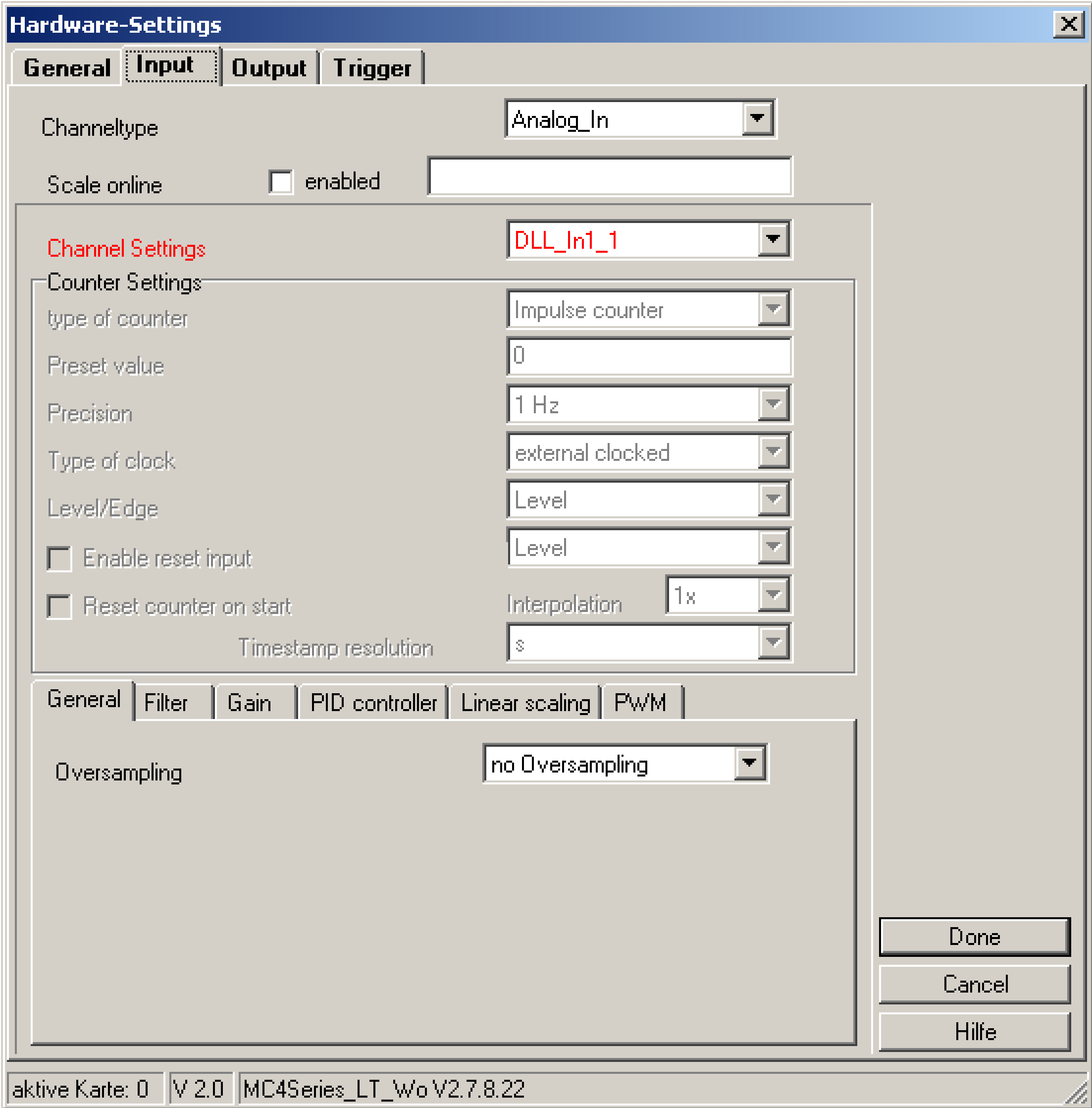
Pretrigger
For the whole measurement pre- and posttrigger values can be defined.
The pretrigger values of the start trigger are the number of measured data sets which were measured immediately before the trigger event. This makes it possible to get data measured before the actual trigger event.

Posttrigger
The posttrigger values for the stop trigger are the equivalent of the measured data sets which were measured after the stop trigger event. This allows to react on a certain stop trigger and to measure the signals after this event has occurred.

The pretrigger values for the stop triggers and the post trigger values for the start triggers define the number of values which were dropped after an respective event. Momentarily they are not implemented.
If you select a new channel in the left part of the window the settings of this channel are displayed. The global settings are shown on the lower side. They are applied to any channel and can only be changed for all channels in common. These global settings include the settings for TTL bits, the start conditions of the digital outputs, and the pre- and post trigger values.

8.1.3.1 External Clock of the ADC conversion

The minimum period length of the external clock (pin P1, pin P8) has to be similar to CMOS TTL circuits 15 ns.
It can be programmed if the conversion is started by a rising or a falling edge. For each trigger pulse the whole number of activated channels are measured.



8.1.3.2 Counters

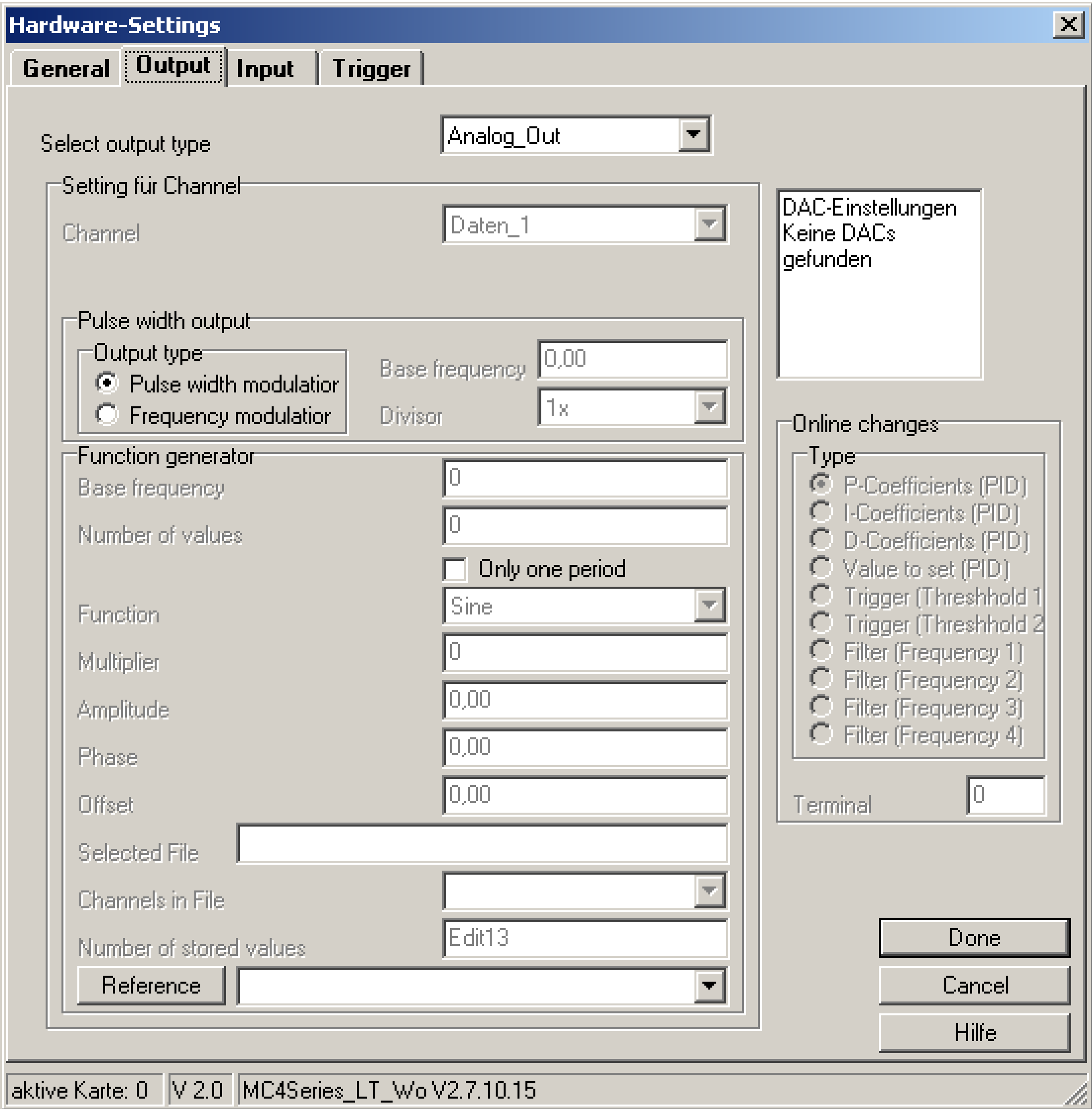
For counting frequencies all four modes of the timer are supported. Furthermore it can be set if and when the timer has to be reset. With a value written to an output the counter can be preset by the user.
It has to be taken into consideration that contact points are associated dynamically depending on the type of counter. If signals are connected to counter contact points Count0, Count1, and so on (refer to terminal assignment), in diadem the channels 0, 1, are associated to them.
Incremental counters need two contact points: one for the counting pulse itself and the other one for the time stamp. Diadem scheme blocks process them as two channels. If counter values, incremental, and SSI sensor signals are acquisited at the same time the following order of channels is used: Firstly the counter channels, secondly incremental counter channels and

lastly the SSI sensor channels are associated. If e.g. a single incremental sensor is measured the incremental counter is associated to channel 0 while the time stamp is channel 1.

8.1.3.3 Frequency

This mode allows to measure frequencies, period lengths and pulse widths. The desired unit can be set by the user (kHz, Hz, Sec, ms etc.). If the respective reference frequency (1/10/100/1000 Hz to 10(*100)MHz) is set measurements in the range from 1 Hz up to the maximum counter frequency of 10 (*100)MHz can be measured. The counter is connected via pin 24 of the socket.

8.1.3.4 Wave Form Generator



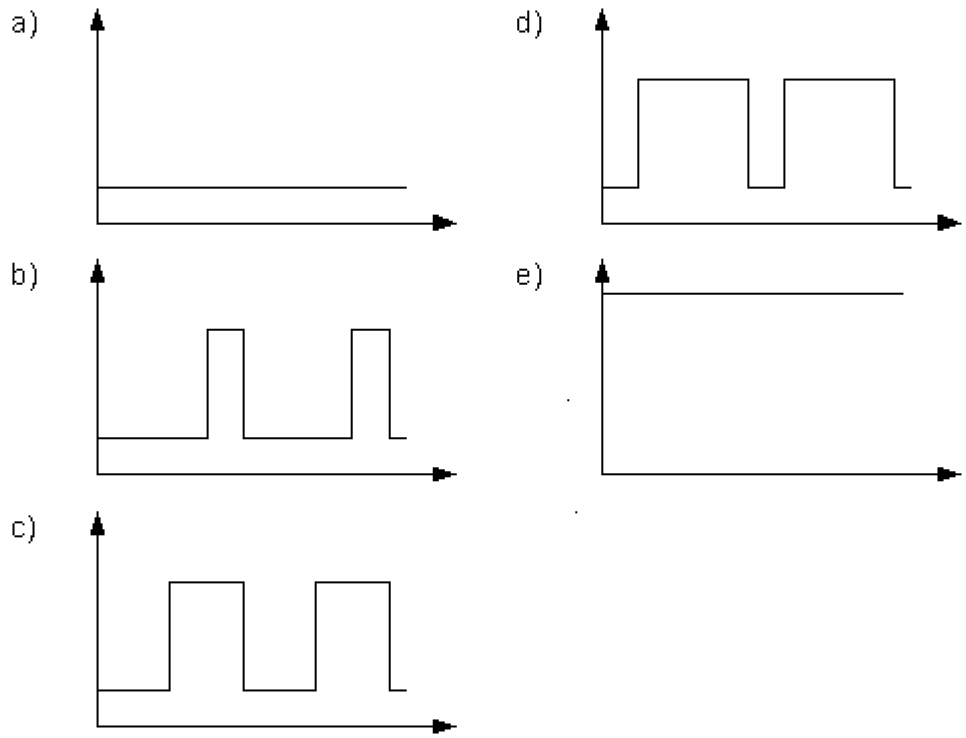
As an option MultiChoice cards offer a wave form generator. Aided by this generator it is possible to output several kinds of signals over different outputs.

By default sine wave, triangle, square, pulse, saw tooth, and white noise are available as wave forms. In the near future an analog pulse width output will become available for the wave form generator.
Furthermore it is possible to reproduce signals periodically measured with a *mc4pci* card or any other card which allows to generation nearly any desired wave form.

This kind of reproduction of wave forms works independent of a measuring process in the background. Therefore it is possible to measure analog and digital signals and to make counter readings. Even outputting of analog and digital controlled voltages to free terminals is possible during the reproduction of wave forms.

8.1.3.5 Pulse Width Modulation (PWM)

PWM modulates the pulse width of a square wave signal with constant period width. The pulse width is set as percentage of the period length related to a 50%/50% related pulse width. If a value of -100 is set the PWM output is low all the time. A value of zero (0) leads to a symmetric high/low relation while a value of 100 keeps the output to high level all the time.



Pulse width signal with a) 0%, b) 25%, c) 50%, d) 75%, and e) 100%

8.1.3.6 Frequency Modulation (FM)

With frequency modulation the period length of a square wave signal is modulated. The pulse/pause relation is kept constant. The little most period length is equivalent to the maximum frequency and vice versa.

8.1.3.7 Structure of the Online Scaling Files

Online scaling files are pure text files (ASCII) which are divided into 32 columns and 4097 rows including numbers (32 bit floating point numbers. The columns are separated with tabs (#9), while the lines are terminated with carriage return/line feed (#13#10). The example file “demo.txt“ is provided.

Important: The first line of the files only serves for purposes of numbering, it does **not** influence the scaling functionality.
Furthermore the online scaling is available for **12 bit converters only**.

The most easy way to edit/create this files is an Excel sheet with a table including the numbering in the first line followed by the scaling values.
Please use text format “Text (OS/2 or MS-DOS) (*.txt)” if the file is saved. The validity of the file content can be checked with the provided program testtxt.exe. This program loads the .txt file into a table where you can check your settings.

Important: The value at position 0/1 is equivalent to the voltage value which is output to channel 0 -10V in the given example while a value of 0/4096 leads to an output voltage of +10V over channel 0.
A maximum of 32 channels can be scaled at once. The order of the channels is similar to the order of the screwed terminals. In DIAdem the channels can be measured in any order and the linearization is achieved in a fixed relationship to the screwed terminal.

8.1.4 Auto Sequences in DIAdem

The DIAdem driver for the MultiChoice PCI series supports auto sequences to change single parameters of the measurements interactively or aided by automatic processes. More details to auto sequences you may find in the DIAdem online help.

Any of the parameters supported by the PCI driver are listed in the following. It has to be taken into consideration that any of the variables need at least one parameter which specifies the card in question. The numbering scheme starts with 1 while the order is identical to the order in the dialog box of DIAdem.
Channel specific parameters need at least a second parameter which is used to select the desired channel. The numbering scheme starts also with 1.
In example:
Switching over from single ended measuring mode to dual ended mode for the third card is done with:

MeasMode(3) := 1;

The number in brackets specifies the card in question and the new value is set to 1.

Activating 4x oversampling for the second card in the third channel:
Oversampling(2,3) := 2;
The first parameter selects the card (2) while the second one chooses the desired channel (3). The new value is set to two.

Important
The numbering scheme for the cards and the channels always start with 1 while parameters always start with zero (0). The number to set is identical to the one in the input boxes of the dialog field. Oversampling offers five entries in the dialog. They are associated as shown in the following:

Dialog entry:	Parameter to set
No Oversampling	0
2x Oversampling	1
4x Oversampling	2
8x Oversampling	3
16x Oversampling	4

Because the available entries are subject to be changed by new releases or revision changes please read the latest information on this subject in the online help of the driver.

8.1.4.1 Parameters of DIAdem:

Global Variables	1. Parameter: Card
InputRange	set the input voltage range of the card
MeasMode	switches from single ended to dual ended mode
ExtTrigger	set the triggering edge of the external trigger
HoldVolt	specifies if after ending the measurement all voltages are set to zero or if the last value is hold
Input variables	1. Parameter: Card 2. Parameter: Channel

Oversampling	sets a new value for oversampling for the selected card and the selected channel
OnlineCalc	set online signal processing to a new value
Countermode	set a new counting mode for counters and HSCounters
CounterEdge	determines the edge of the specified counter input
CounterPreset	sets a new preset value for the selected counter channel (pulse measurements only)
CounterRslt	sets the resolution of the selected counter channel (frequency measurements only)
OnlineScale	specifies if the selected card has to use online scaling
OnlineScaleFile	determines the file out of which the data for online scaling have to be loaded

Output Variables 1. Parameter: Card
2. Parameter: Channel

Wave Form Generator:

FuncGen_Function	sets a new output function for the specified channel
FuncGen_Ampl	sets a new amplitude for the specified channel
FunkGen_Offset	sets a new offset for the specified channel
FunkGen_Phase	sets a new phase for the desired channel
FunkGen_Multipl	sets a new multiplier for the selected channel
FunkGen_BaseFreq	sets the base frequency for output of the wave form generator for the selected card
FuncGen_NoV	sets the number of sampling points for the selected card

Pulse Width Output

PWM_Out_BaseFreq sets a new base frequency for pulse width output

Global Trigger Variables 1. Parameter: Card

EnableTrigger	This variable allows to activate/deactivate any set triggers at once. This allows in example to examine the measured signal before the actual measurement without reconfiguring of the circuit diagram. Possible values: 0 deactivated, 1 activated.
Trig1PrePost	sets the pre-/post trigger values for the start trigger. Because of the internal buffer structure values between -2048 and 2048 can be used.
Trig2PrePost	sets the pre-/post trigger values for the stop trigger. Because of the internal buffer structure values between -2048 and 2048 (samples) can be used.
Retrigger	If a measurement has to be retriggerable start and stop triggers have to be set. The stop trigger enables the start trigger if its condition becomes true. So if the next trigger event allows to measure further data. If this function is not activated no data is measured after a true stop trigger condition. Possible values are: 0= not retriggerable, 1= retriggerable.

Start Trigger Variables	1. Parameter: Card 2. Parameter: Channel
EnableTrig1	This variable is used to activate/deactivate the start trigger. Possible values: 0 deactivated, 1 activated.
SetTrig1Type	sets the trigger type. Possible values depend on the driver version. The numbering scheme of the trigger type is identical to the user interface and starts with zero (0) (number – 1)
SetTrig1Value1	configures the threshold of the start trigger. The valid range is -10.0 up to 10.0. It is interpreted as a voltage range.
SetTrig1Value2	configures the threshold of the second start trigger. The valid range is -10.0 up to 10.0. It is interpreted as a voltage range. The second threshold is used only if a respective trigger type is used (in example a window trigger).
Trig1FromStart	This specifies if the trigger is activated at the beginning of the measurement or if it has to be activated later. If the trigger is not activated at start the stop trigger is activated earliest if the condition of the start trigger becomes true. Possible values are 0=deactivated, 1=activated.
SetTrig1Meas	specifies if a measurement has to be run. The value is the equivalent of the entry in the dialog box.
SetTrig1Bit	With this variable the signaling of the trigger can be controlled over digital inputs. If this value is set to zero the signaling is deactivated. With a value of 1 it is activated.
Trig1BitChannel	This variable specifies the digital output over which the selected channel is signaled. The maximum number depends on the card used (lightPCI: 0..23, MU Quattro: 0..31).
Trig1BitLevel	To achieve signaling a defined condition is necessary. Set the output condition which has to be used (0=low 1=high)
Trig1BitStartLvl	To ensure a correct signaling it can be necessary to define a start condition which is set at the beginning of the measurement. Overwriting of the digital outputs during the measurement is possible at any time (0=low 1=high).
Stop Trigger Variables	1. Parameter: Card 2. Parameter: Channel
EnableTrig2	With this variable the start trigger is activated/deactivated. Possible values are 0=deactivated, 1=activated.
SetTrig2Type	Here the type of trigger is specified. The possible values depend on the respective version of the driver. The numbering scheme of the trigger type is similar to the one in the user interface and it starts with 0 (number – 1).
SetTrig2Value1	This specifies the threshold of the start trigger. The valid range is spread from -10.0 up to 10.0. It is interpreted as a voltage.
SetTrig2Value2	Here the second threshold of the start trigger is specified. The valid range is spread from -10.0 up to 10.0. It is interpreted as a voltage. The second threshold value is used only with respective types of trigger (in example a window trigger)
Trig2FromStart	This specifies if the trigger is activated at the beginning of the measurement or if it has to be activated later. If the trigger is not activated at start the stop trigger is activated earliest if the condition of

	the start trigger becomes true. Possible values are 0=deactivated, 1=activated.
SetTrig2Meas	specifies if a measurement has to be run. The value is the equivalent of the entry in the dialog box.
SetTrig2Bit	With this variable the signaling of the trigger can be controlled over digital inputs. If this value is set to zero the signaling is deactivated. With a value of 1 it is activated.
Trig2BitChannel	This variable specifies the digital output over which the selected channel is signaled. The maximum number depends on the card used (lightPCI: 0..23, MU Quattro: 0..31).
Trig2BitLevel	To achieve signaling a defined condition is necessary. Set the output condition which has to be used (0=low 1=high)
Trig2BitStartLvl	To ensure a correct signaling it can be necessary to define a start condition which is set at the beginning of the measurement. Overwriting of the digital outputs during the measurement is possible at any time (0=low 1=high).

SetAnalogOut	writes a certain value to a DAC channel SetAnalogOut(Card, Channel, Volt) Parameters: Card: Number of the desired card starting with 0 (LONG) Channel: Number of the desired channel starting with 0 (LONG) Volt: desired voltage (DOUBLE)
SetDigitalOut	sets a digital output to the desired level SetDigitalOut(Card, Channel, Level) Parameters: Card: Number of the desired card starting with 0 (LONG) Channel: Number of the desired channel starting with 0 (LONG) Level: level to output, 0=LOW, 1=HIGH (LONG)
SetPWMOut	Starts PWM outputwith predefined values SetPWMOut(Card, Channel, BaseFreq, Ratio) Card: Number of the desired card starting with 0 (LONG) Channel: Number of the desired channel starting with 0 (LONG) BaseFreq: frequency to output (LONG) Ratio: Value between -100 .. +100 which defines the relation between pulse and pause
CalibrateDA	Starts calibrating of the DAC converters CalibrateDA(Card, DAchannel, ADchannel) Card: Number of the desired channel starting with 0 (LONG) DAchannel: DAC channel to calibrate ADchannel: ADC channel to calibrate

8.2 DasyLab

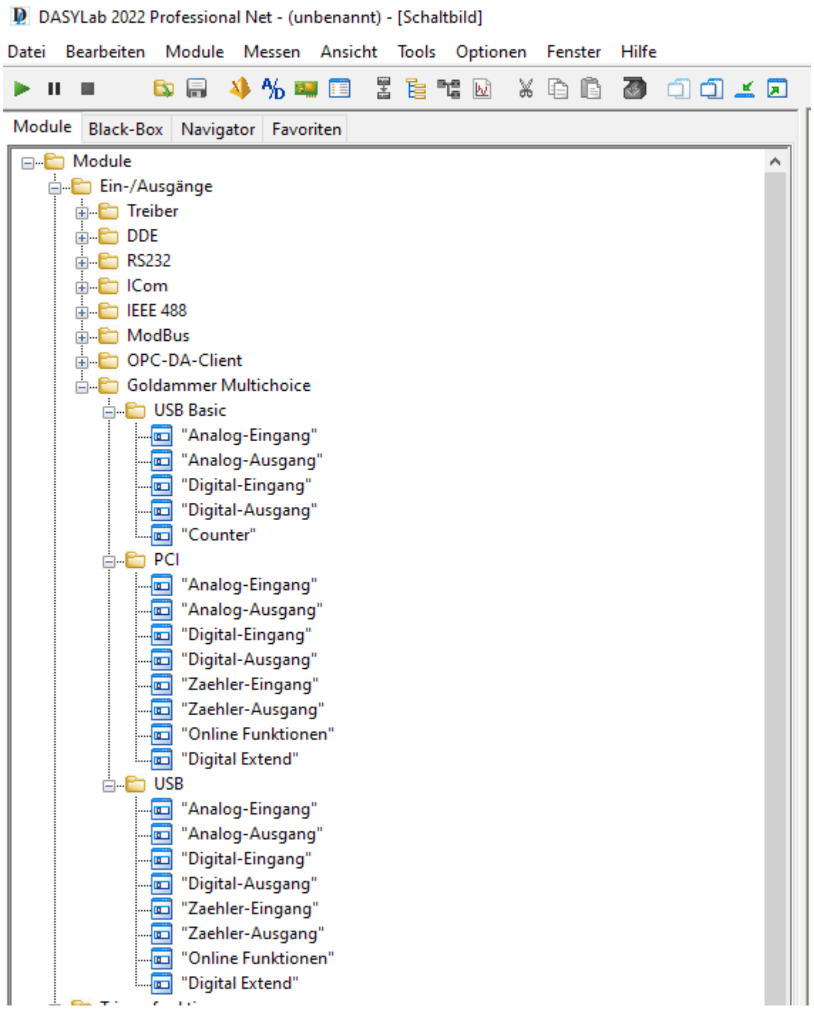
8.2.1 Installation

Installation of the driver for DasyLab is carried out with the provided installation program „SETUP.EXE“. For this installation procedure all necessary files have to be copied into the directory of DasyLab.

It is important to have administrator rights for the first time start under Windows NT/2000 and Windows XP because the driver has to be registered in Windows. If you have no administrator rights please consult your system administrator.

The driver is no acquisition driver but it is integrated as an additional interface. Therefore proprietary block definitions are provided which have to be used instead of the existent ADC and DAC blocks. The advantage of this additional driver is that you can measure with up to four measurement cards at the same time. Furthermore an additional measuring hardware can be integrated and used also at the same time.

The additional DLL generates a menu called „MC4-Boards“ respectively „USB-Boards” within the DasyLab menu. In this menu you can select the desired blocks. Alternatively you can reconfigure the module bar with the desired icons. To avoid conflicts or mix ups with other acquisition systems any of the blocks are marked with a T in front of their names. So the analog acquisition can be found under TanalogIn.



Now you can use the driver in the known way. During the first time start of a driver block all cards existing in the system are loaded automatically.

To keep the circuit diagrams configurable offline, nearly any options can be activated in the user interface. Error messages appear only at starting time if an invalid screwed terminal or a non existent option is tried to be used.

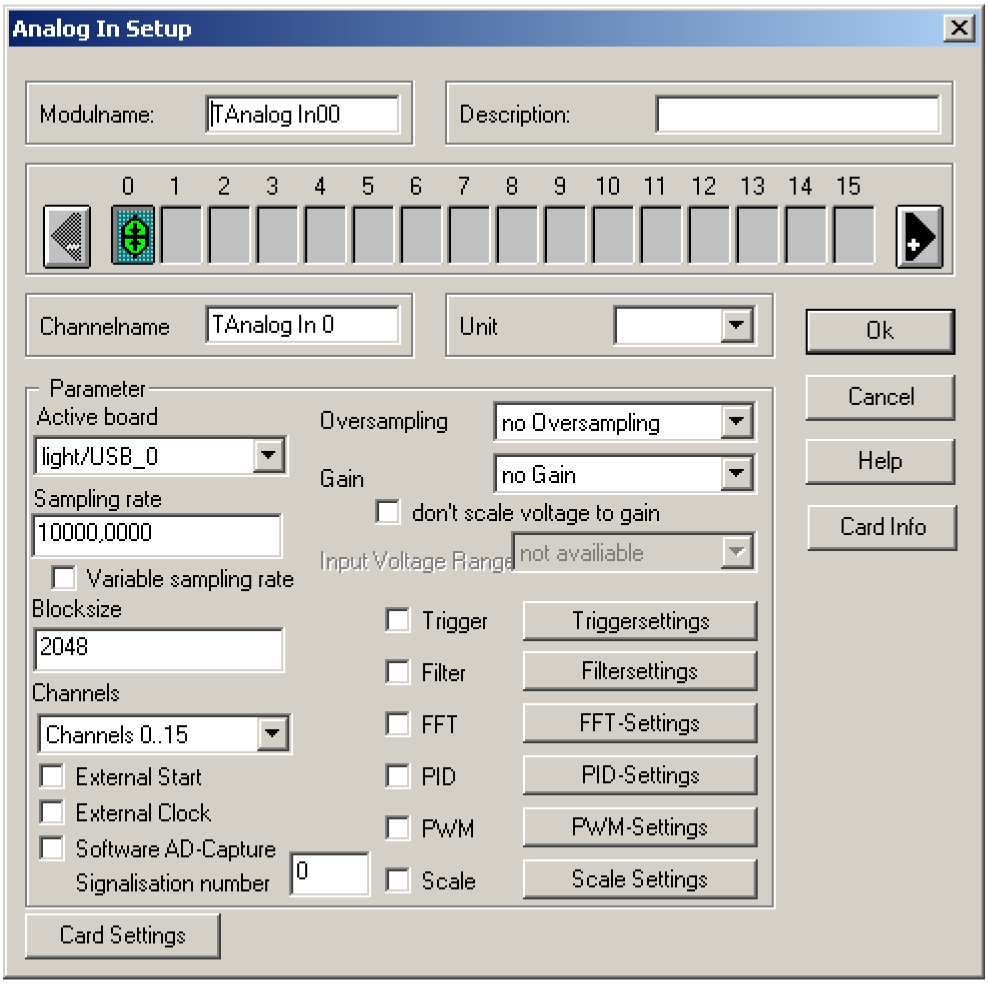
Depending on the type of block after double clicking a signal specific dialog box is opened which allows to specify the settings for the measurement card.

In example for analog measuring the sample rates, block size and online functions like oversampling, trigger, filter, or FFT calculation can be activated or configured.
The switching between the cards is done within the block and it is valid only within the block.

Because of limitations of DasyLab, where each block can consist of a maximum of 16 channels, for some signals like digital inputs or outputs or analog inputs the channel range of the block can be selected to cover more than 16 channels. A channel setting of 16..32 projects the set channels and parameters to the appropriate higher channels. The sample rates are taken from the block which was called first, because different sample rates per type of signal on one card are not possible.

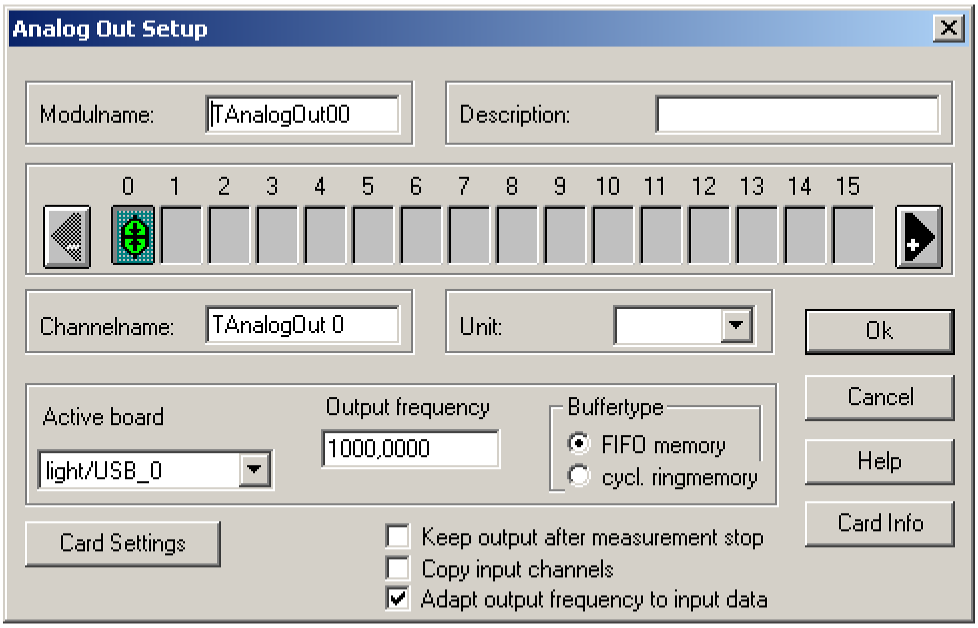
8.2.2 Dialog Window

Analog Acquisition :

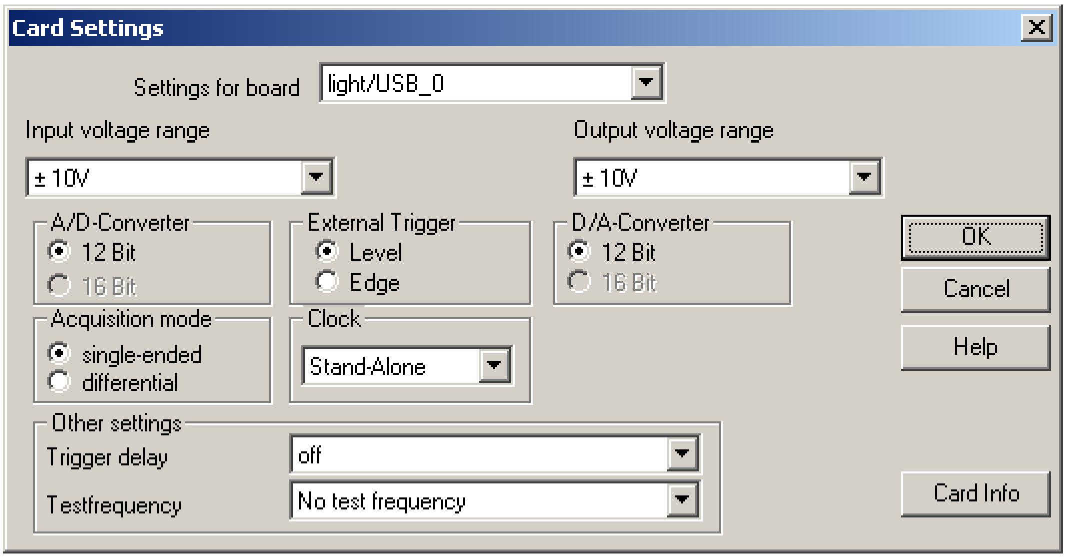


In some cases the synchronization is done with the parameters predefined for the default interface. If analog output is controlled of a generator it is necessary to set the output rate to a value identical to the global one of which the generator receives its time information. Otherwise no continuous output is possible.

With analog output it is possible to synchronize the block size with the fed frequency of the prior block. To do this, activate the option in the block „Adapt output frequency to input data“.

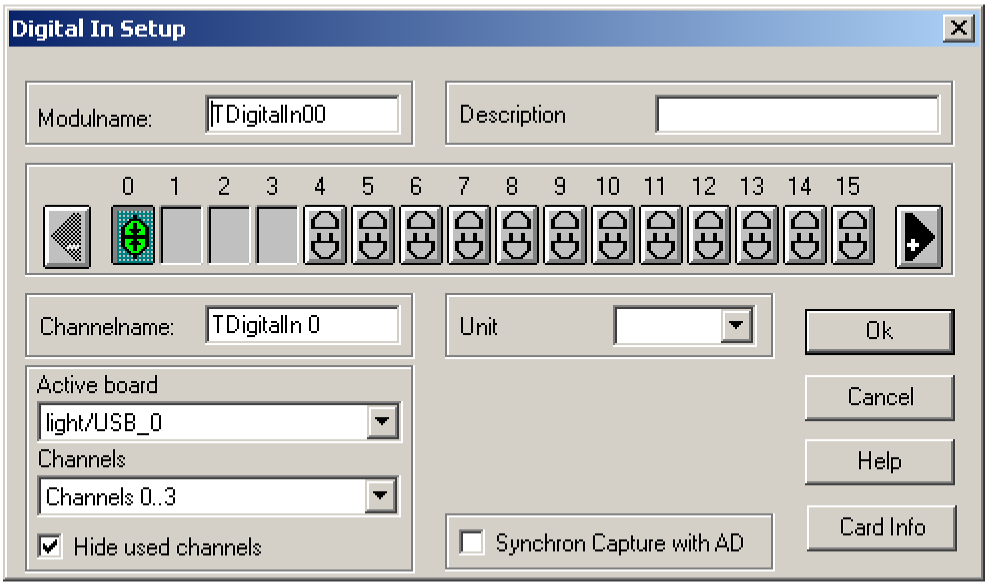


The most important global settings of the measuring card can be configured for the respective blocks by clicking on „Card Settings“. Please note that only the data relevant to the respective output will be applied. For AnalogIn blocks the output voltage range is not changed.



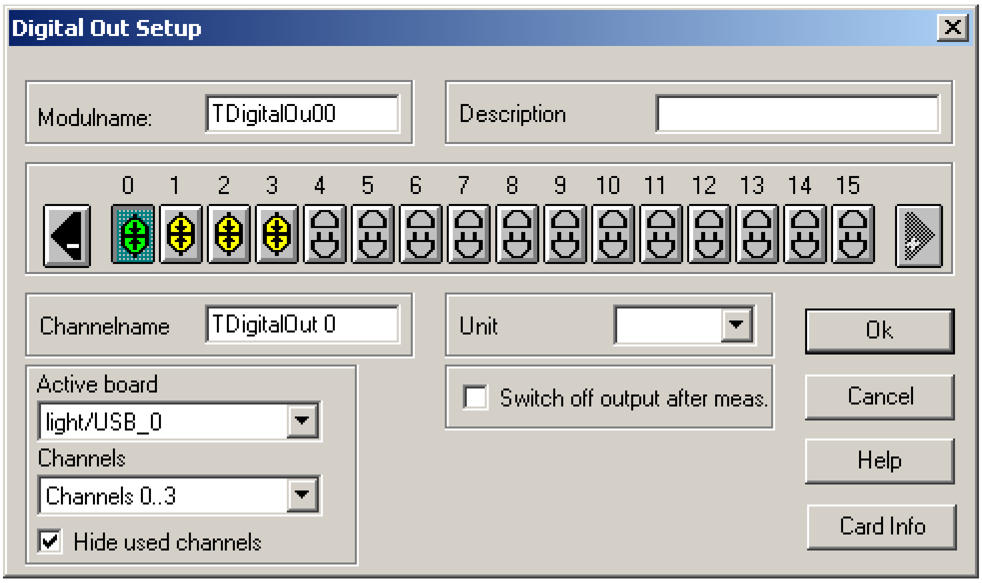
Synchronous Digital Acquisition

DasyLab drivers support the synchronous digital acquisition for multi function cards. This means that digital channels are put into the list of analog channels and are treated identically. Therefore they are run with the same clock so it is possible to have an exact time oriented association between analog and digitally measured values. Furthermore exact and quite fast sample rates are possible.



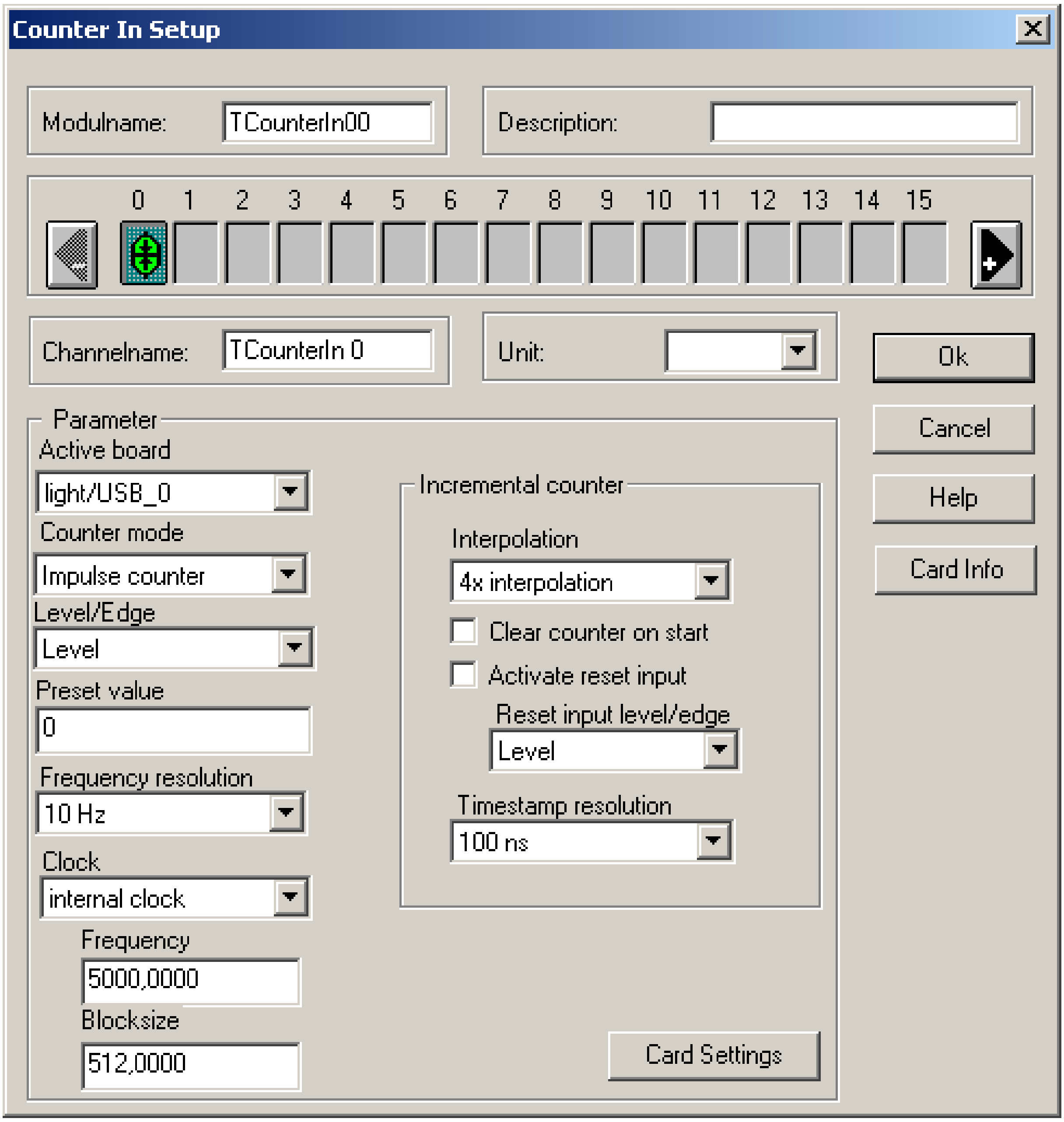
Pulse Width and Frequency Modulation

The pulse width and the frequency modulation both use input values in the range of –100 to 100. For PWM a negative value of -100 is the equivalent of a permanent low level while a value of 100 leads to a permanent high level. The value zero defines a 50% to 50% relation between high and low level. For frequency modulation the pulse width relation is set in the range 0% to 100% and directly used as output frequency of the input of the block.



Measuring with Counters
Measurements made with counters can be synchronously or asynchronously. Depending on the type of the measuring card it is switched between the types of measurement.
The measuring cards which offer an automatic acquisition use a channel list and internal timers while other cards without external storage (CountInkr/4, CountPeri4) work with asynchronous measuring clocked by the PC.

The parameters are distinguished depending on the type of the card.
The set measuring edge, clock type, block size, and frequency are valid for the whole counter while any other settings are specific to the individual counter. Preset values are used only for a single pulse counter while the frequency resolution is taken over for frequency measuring, and incremental encoders with reset, interpolation and so on are configured. Counters for measuring period length and pulse width cannot be configured.



It has to be taken into consideration that contact points are associated dynamically depending on the type of counter. If signals are connected to counter contact points Count0, Count1, and so on (refer to terminal assignment), in Dasylab the channels 0, 1, are associated to them. Incremental counters need two contact points: one for the counting pulse itself and the other one for the time stamp. Dasylab scheme blocks process them as two channels. If counter values, incremental and SSI sensor signals are acquisited at the same time the following order of channels is used: Firstly the Counter channels, secondly incremental counter channels and lastly the SSI sensor channels are associated. If e.g. a single incremental sensor is measured the incremental counter is associated to channel 0 while the time stamp is channel 1.

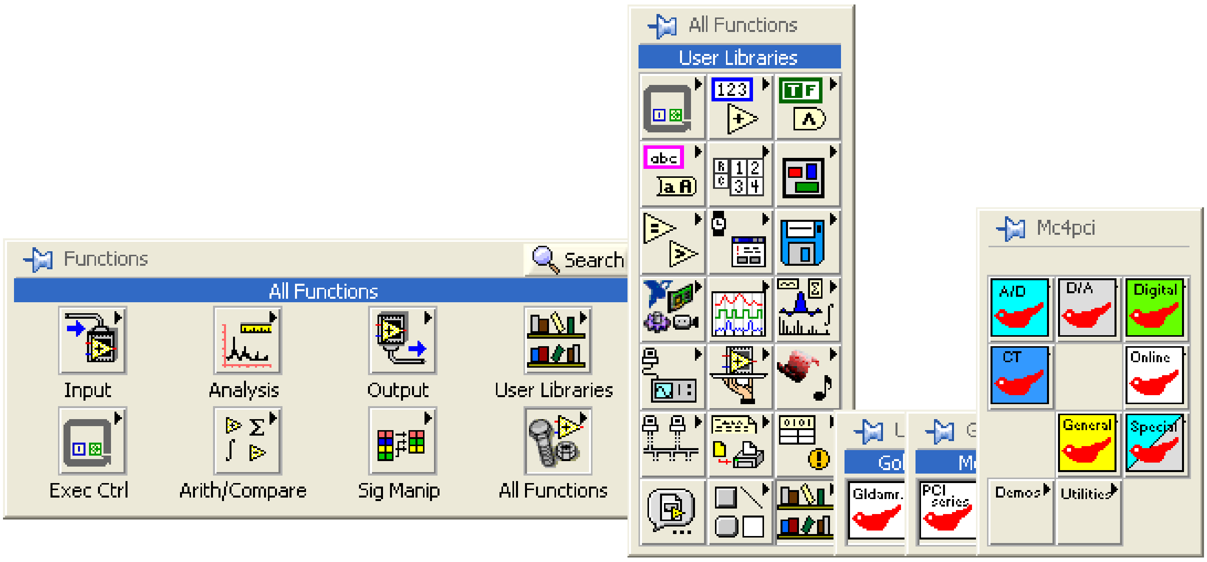
9 Multichoice Series and LabView

For the MultiChoice series LabView virtual instruments (VI's) are available which allow easy integration of measuring cards in measurement systems run with LabView. Only 32 bit operating systems are supported.

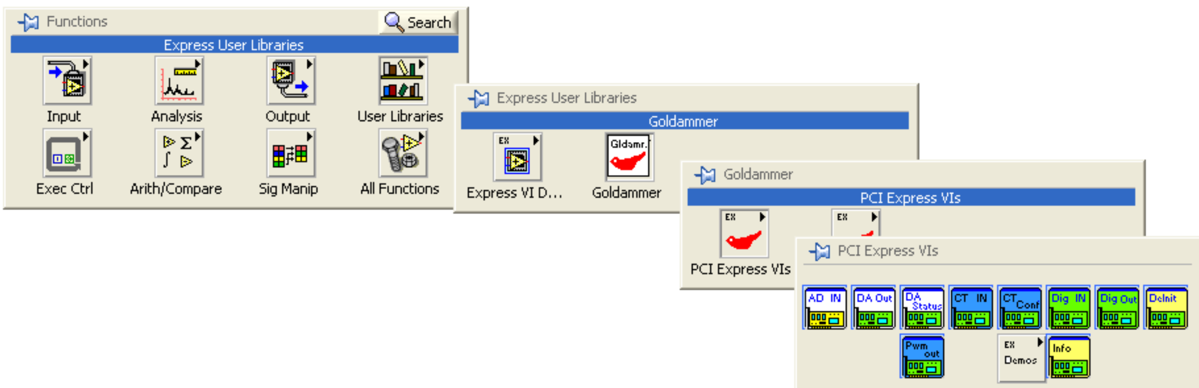
9.1.1 Installation

SETUP.EXE is provided to install the LabView driver. During the installation any necessary files are copied to the LabView directory. Because there is no standardized driver for LabView drivers – programming is performed graphically by the users instead - are installed as an additional function in the menu Functions->User Libraries.
Beside standardized virtual instruments (VIs) Express VIs are installed also similar to version 6.X of LabView.

Simple VIs can be found in the following menu:



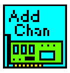
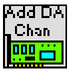
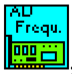
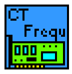
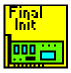
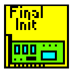
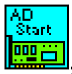
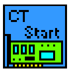
„Express VIs“ are provided like shown in the following:

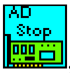


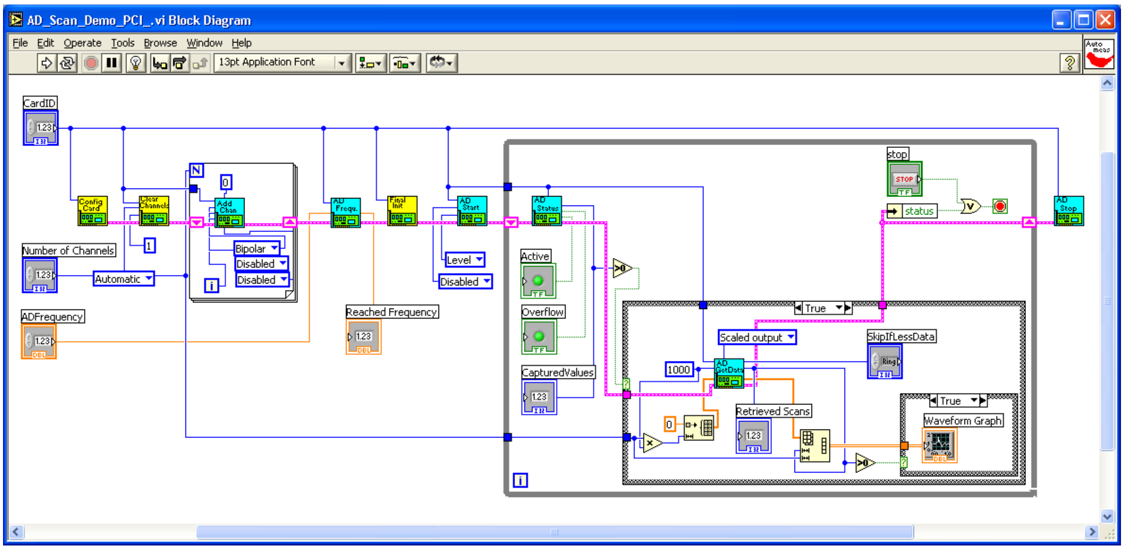
9.1.2 Simple VI's

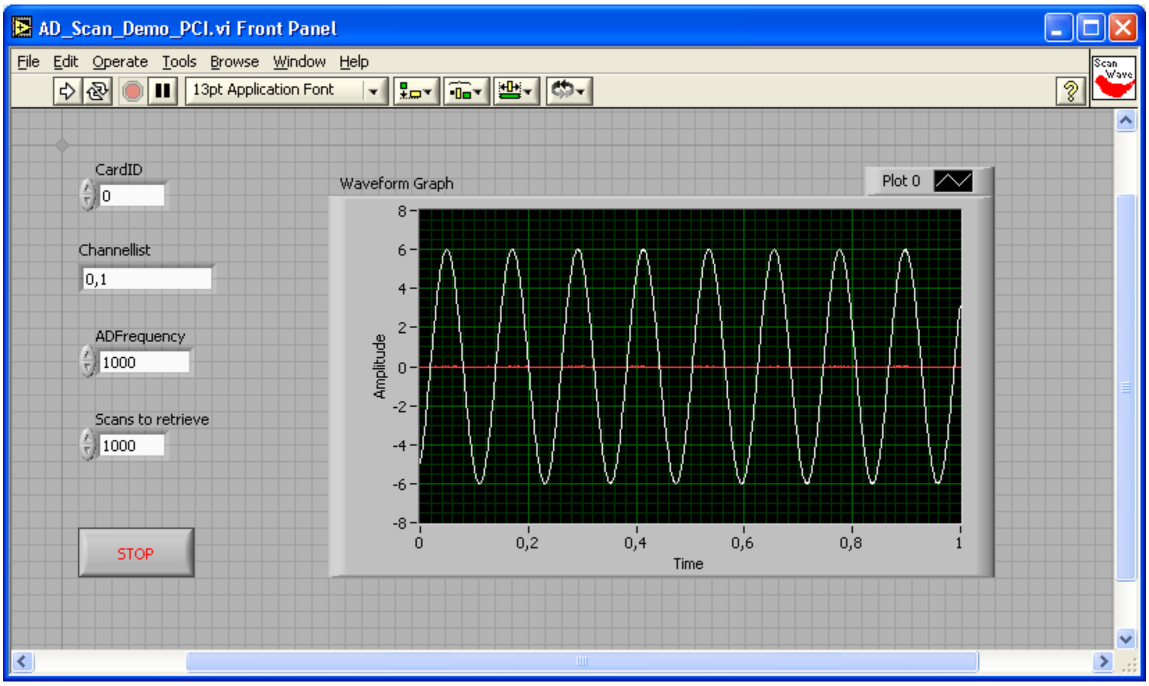
If working with simple VIs simple functions can be used without limits with MultiChoice cards. It is important to keep a certain order of calls to the VIs.

In the beginning the measurement card is configured by calling  then, calling  resets the channels list.

Later calls of  respectively  and  certain channels can be configured for analog acquisition/output and counting. Afterwards calling ,  and  sets the sample rate and the output frequency. Calling of  transmits the settings to the card. After calling  no more changes of the channel list are allowed. With the calling sequence ,  and  the measurement configured before can be started. After the measurement was started, measured values are read from the buffer of the card within a loop.

The calling sequence ,  and  stops the measurement.
Digital output, acquisition, PWM output, and manual analog acquisition can be performed at any time by calling the respective VIs. Please refer to the LabView driver manual for more details about VIs.



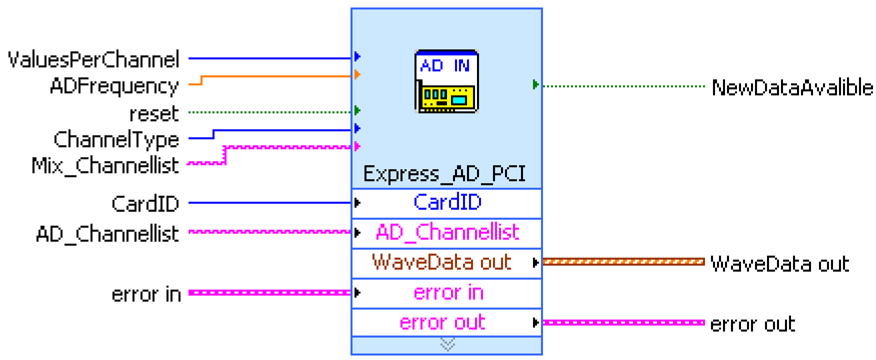


This example shows a simple scheme based on simple VIs.

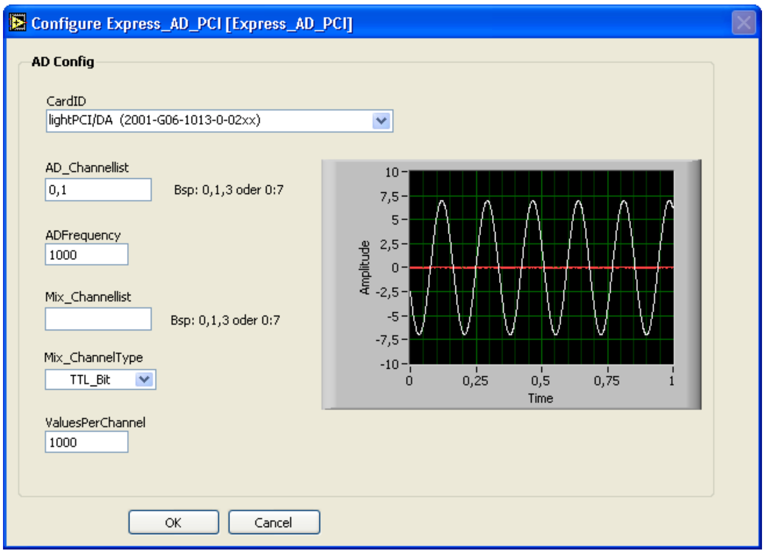
9.1.3 Express VI's

There is no need for a traditional configuration when „Express VIs" are used. They are called within the body of a loop. Within the first two passes of the loop channel lists are set and the measurement is started. During the further loops measured values are read from the buffer of the card (respectively the output values are written to the buffer).

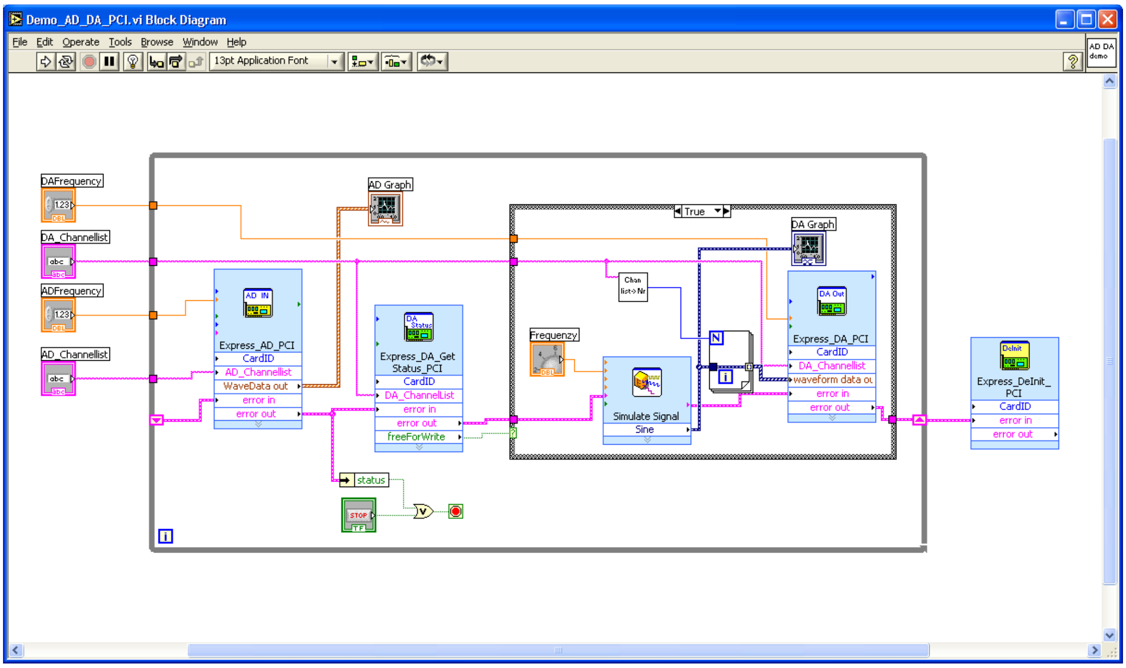
All started measurements are stopped by calling 
.
Detailed descriptions of Express VIs can be found in the driver manual of LabView.
One more advantage of Express VIs compared to simple ones is a configuration which can be performed within an input mask.

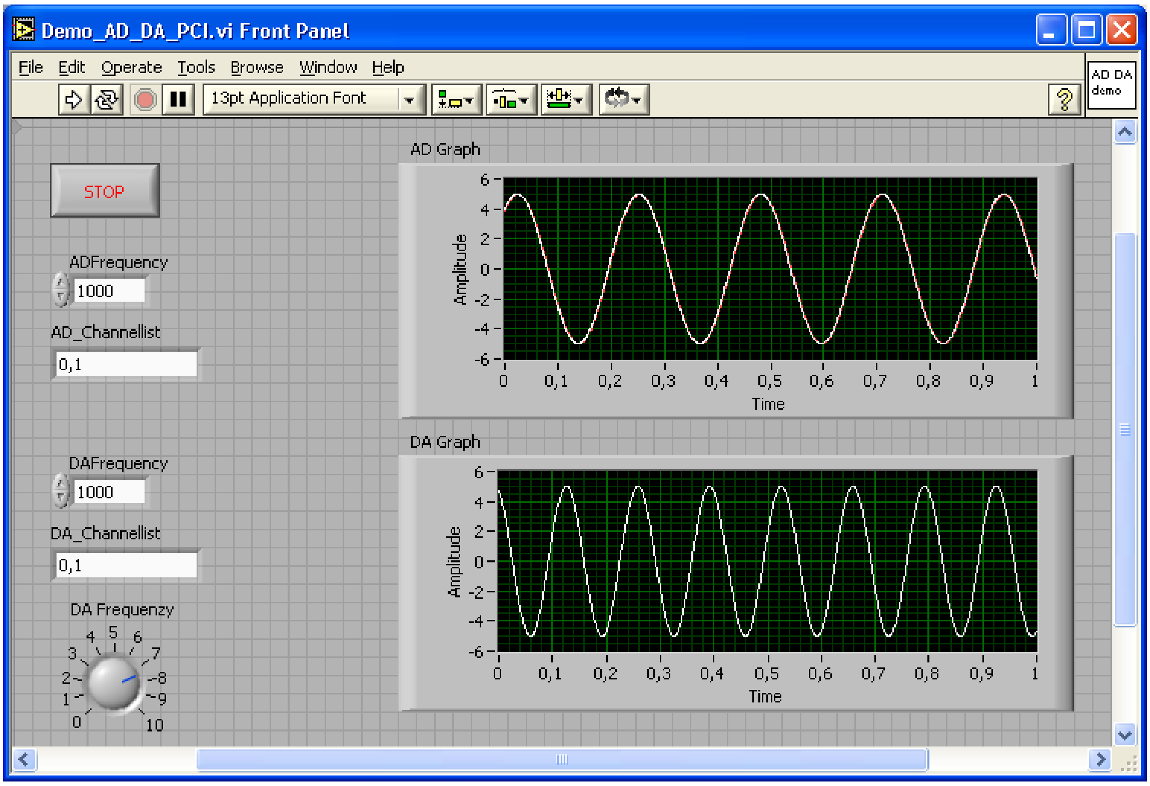


Any possible settings can be made easily in the configuration mask of the scheme. The configuration mask is called by clicking on the scheme with the right mouse button.

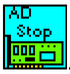


The integrated signal window shows the signal fed to the card. Express VIs are a fast and easy way for acquisition and output of a certain signal.





This example shows a simple scheme using Express VIs.

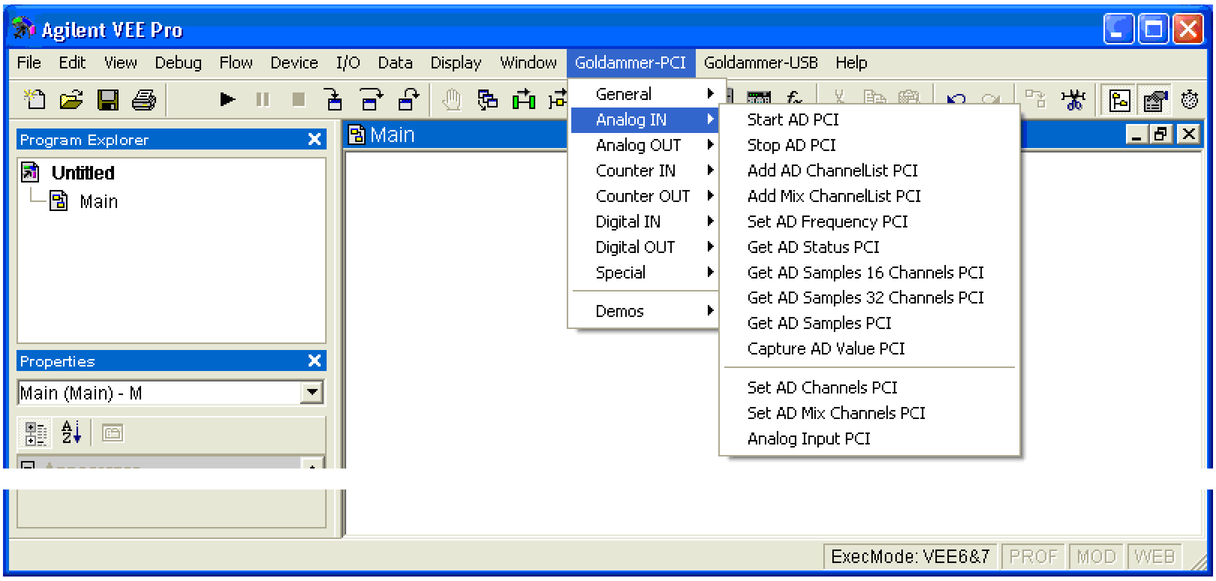
Calling , respectively ,  and  at the end of a measurement is mandatory because this calls stop the measurement performed by the hardware of the card. If these calls are not made (e.g. measurement is stopped with stop button of the LabView menu) the card performs further measurements internally. This may lead to problems if the next measurement shall be started.

10 Multichoice Series and Agilent VEE

10.1.1 Installation

Installation of the VEE driver is performed with SETUP.EXE. Any needed files are copied to the Agilent VEE directory during installation.

The driver is not installed as an acquisition driver but as an additional interface. The driver is offered to the user as a collection of schemes of which any acquisition and output application can be designed.

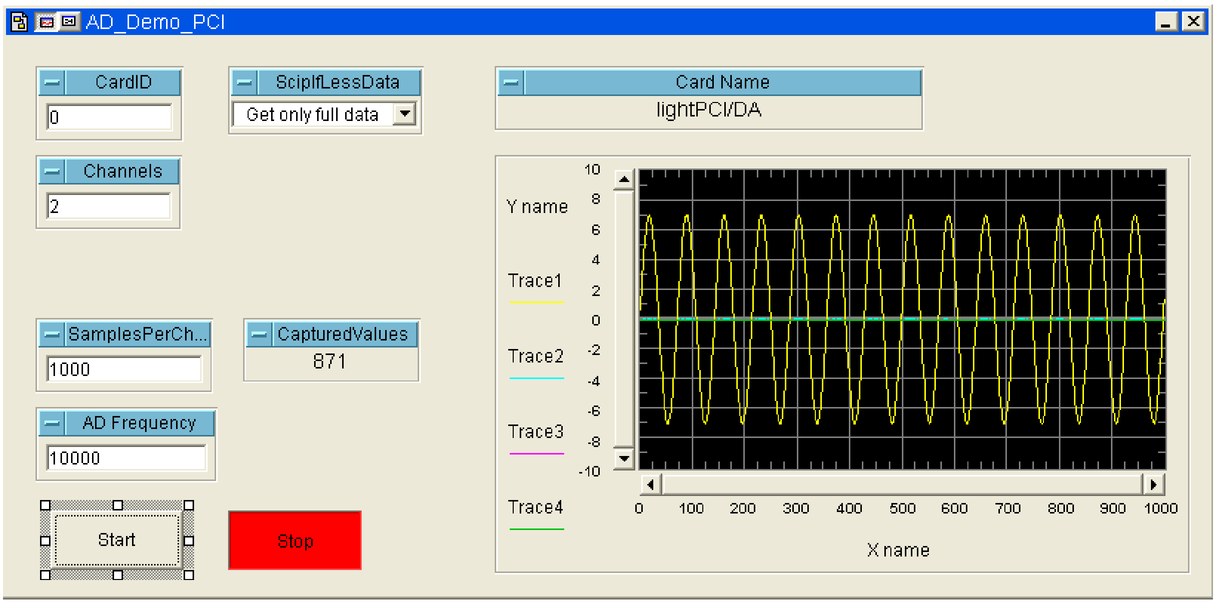


After installation of the driver additional menus “Goldammer-PCI” and/or “Goldammer-USB” are generated in the Agilent VEE menu.

10.1.2 Measurements with VEE Pro

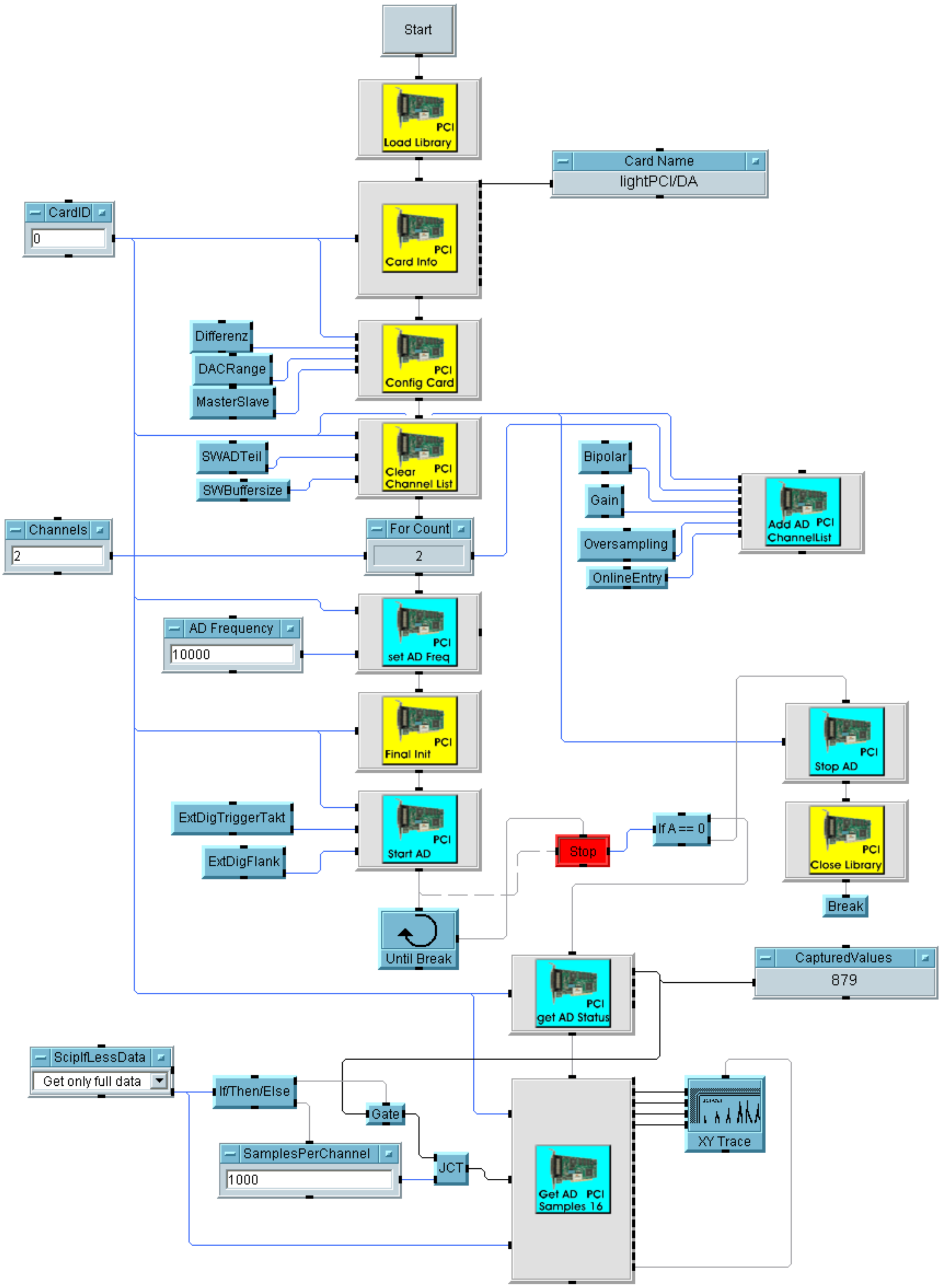
Right after starting the application „LoadLibrary“ function is called which in turn loads any functions from the DLL needed for the measurement.
Next “ConfigCard“ is called. The measurement card is configured ready for measurement.
Calling „ClearChannelList“ resets the channel list on the card.
„AddADChannelList and „AddDAChannelList“, or AddCTChannelList“ adds channels to the channel list on the card.
„SetADFrequency“, respectively „SetDAFrequency“, or „SetCTFrequency“ are used to set sample rate and output frequency for the measurement.
Calling „FinalInit“ ends the configuration of the measurement. Until now no more changes of the configuration for the measurement are allowed.
Calling „StartAD“, respectively „StartDA“, or „StartCT“ starts the hardware controlled measurement of the card. Acquisited data are buffered in the internal memory of the card until they are read with the function “GetADSamples“.
„GetADSamples“ is called within a loop until measurement is stopped.
During the shutdown of the measurement „StopAD“, respectively „StopDA“, and „StopCT“ are carried out. These calls stop the measurement hardware of the card. If „StopAD“, respectively „StopDA“, and „StopCT“ are not called (e.g. by stopping the measurement with

the stop button of the menu) the measurement hardware performs further measurements. This may lead to problems if the next measurement is started.
„CloseLibrary“ unloads the DLL.



Digital output and acquisition, PWM output and manual acquisition and output can be performed without prior configuration. Respective calls can be made at any time.

Please refer to the Agilent-VEE driver manual for further details.


Start
PCI
Load Library
Card Name
lightPCI/DA
CardID
0
PCI
Card Info
Differenz
DACRange
MasterSlave
PCI
Config Card
SWADTeil
SWBuffersize
Clear PCI
Channel List
Bipolar
Gain
Oversampling
OnlineEntry
Add AD PCI
ChannelList
Channels
2
For Count
2
AD Frequency
10000
PCI
set AD Freq
PCI
Final Init
PCI
Stop AD
ExtDigTriggerTakt
ExtDigFlank
PCI
Start AD
Stop
If A == 0
PCI
Close Library
Break
Until Break
CapturedValues
879
PCI
get AD Status
SciplfLessData
Get only full data
If/Then/Else
Gate
SamplesPerChannel
1000
JCT
Get AD PCI
Samples 16
XY Trace

11 Digital Filters

11.1 The Real Time Concept of Goldammer Measurement Cards

The intelligent measuring cards of the MC4 series of Goldammer reduce the load of the PC during acquisition and reproduction of signals. This also includes a real time processing of signals. This real time processing is integrated into our drivers and therefore it is easy to activate and configure it. Each channel is processed individually.
Measured signals can be filtered in real time on the card. The filtering can be necessary to separate the measured signal from distorting noise. To achieve this the measured signals were fed into a filter algorithm. The determination of the coefficients is realized with a program library which is integrated in our drivers which support the most common products like DIAdem, DasyLab, and LabView. Therefore additional programs are not necessary. Users only have to specify the conditions for the filter characteristics. Any other activities are carried out by our drivers.

11.2 Sampling Theorem or Rules for the Sampling of Time Signals

For the sampling and processing of sampled signals with digital systems some prerequisites apply. These are:

1. The bandwidth of the signals has to be limited. Above a certain border frequency any frequencies have to be zero.
2. The sampling frequency has to be in minimum twice as fast as the highest border frequency of the measured signal.

These rules are named the sampling theorem of SHANNON. If it is not met and the sampling frequency is not twice the border frequency of a signal partial frequencies appear which are not really part of the original signal. The effect is called aliasing. It is made out of the mirroring of frequencies above the border frequency into a frequency band under the border frequency. The border frequency is called Nyquist frequency.

11.3 How Digital Filters Work

Sampled signals are normally mixed of a useful signal (which contains information) and noise. The noise can consist of signals of other frequencies or it is white noise which is overlaid.
In most of the cases the amplitude of the noise is very small compared to the signal itself so it has not to be taken into consideration. If this is not the case it is possible that the noise covers the useful signal and the information included in the useful signal cannot retrieved.
If the noise can removed from the sampled signal the information of the useful signal are available. For this purpose very often active filters are used. This filters use the fact that mostly the noise is of higher frequency than the useful signal. They filter the useful signal out of the sampled signal and suppress any other frequencies.
The filtering of a signal needs under certain circumstances lots of computing power. To reduce the load of the PC arising out of filtering sampled signals, Goldammer cards filter the signal on the card itself and pass the already filtered signal to the PC.
In the last part of the chapter performance measurements are shown. They show the possible number of coefficients of FIR filters in dependence to the number of channels and the accumulated sample rate.

11.4 Types of Filters

There are four standard types of selective filters:

Low Pass

High frequencies are suppressed, low frequencies remain unchanged.

Low Pass

low frequencies are suppressed, high frequencies remain unchanged.

Band Pass

Frequencies within a certain range remain unchanged, any others are suppressed.

Band Stop

Frequencies within a certain range are suppressed while any others remain unchanged.
There are also multi band filters which apply several passes with stop and pass through characteristics which are not discussed here.

What type of filter has to be used and how stop and pass ranges have to be distributed over a frequency response is specified with coefficients and therefore they are independent of the used calculation algorithm. The coefficients have to be determined for any of the filter algorithms in a specific way. They cannot be applied to other algorithms. Filter algorithms are called filter structures also.
The most common structures for filters are recursive (IIR) and non recursive (FIR) filters. Both types are supported by Goldammer measuring cards.

11.5 The Tolerance Scheme

The tolerance scheme is a basic part of the filter design. In this scheme all information are inserted which are needed to design a filter. The necessary parameters are:

Border frequencies	define the width of the transmission range beginning with pass through into the stop range. Depending on the type of filter it can be a different number. For each edge of the filter a pair of border frequencies has to be defined. Therefore: Low and high passes need 2 border frequencies while band passes and band stops have to work with four.
Block absorption	Minimum absorption value for frequencies in the range to suppress
Pass absorption	Maximum value for absorption of frequencies in the pass through range

Sometimes allowed ripple is given. Ripple can be calculated to absorption values and vice versa.

The width of the transmission range and the specified absorption define the order of the filter. The smaller the transmission range and the bigger the Block absorption the higher the order of the filter and the bigger the calculation processes necessary for the filter.
The tolerance scheme can be presented in several different ways. In most of the cases the absorptions are shown.
 shows a tolerance scheme for which the absorptions are shown. In the allowed ripple is displayed. To settle the requirements of the tolerance scheme the frequency response of the filter is not allowed to cross the hatched areas. In this case the tolerance scheme could not be applied any longer. To reduce the order of the filter sometimes it can be necessary to decide if minor violations of the upper rule should not be tolerated.

Tolerance scheme of a low pass with the following specifications:

Sample frequency:	1000 Hz
Lower border frequency:	100 Hz
Upper border frequency:	200 Hz
Allowed ripple in the pass through range:	d_d
Allowed ripple in the absorption range:	d_s

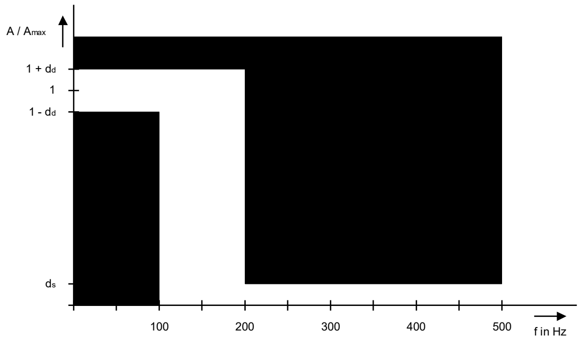


Figure 11.1: Tolerance scheme with frequencies and allowed ripple

Instead of the ripple the following picture shows a tolerance scheme including absorption values. In this case important also: The hatched areas are not allowed to be crossed by the frequency response of the filter.

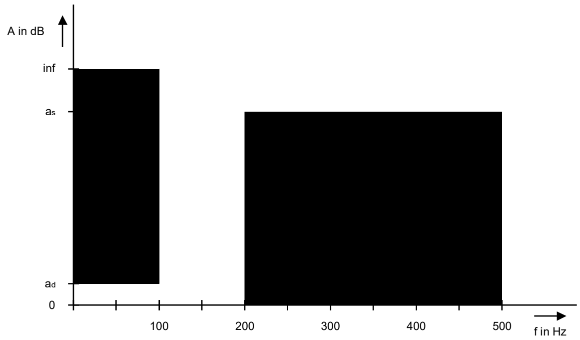


Figure 11.2: Tolerance scheme with frequencies and allowed absorption

11.6 Recursive Filters (IIR Filter)

Recursive filters are a type of filter for which the output signal of the filter is fed back into the input of the filter. The name is English and has the meaning „infinite impulse response". By feeding back the order of the filter can be reduced. Of course the normally nonlinear phase is a disadvantage.
The design of IIR filters can be reduced to the design of a traditional analog filter. Therefore it is possible to determine the order of the filter which is necessary to fulfill the requirements of the tolerance scheme. The design of a high pass filter can be reduced also to the design of a low pass filter. Therefore only a low pass filter has to be determined. Other types of filters (low pass, high pass, band pass, band stop) have to be calculated by so called frequency transformations based on the prototype of a low pass filter. There is no need to set limits for the coefficients. This is a great advantage compared to FIR filters.
The group delay of the filter determines the length of the delay of the frequency ranges between input and output. IIR filters mostly have variable group delays, in the meaning there is a change of the phase of the frequency range at the output. Therefore the signal at the output is altered. This is the case also if the filter has not changed the amplitude of frequency ranges.

11.6.1 Butterworth

Linear frequency response in the pass through and stop ranges, therefore no complete use of the tolerance scheme. The filter order is relatively high. There is no significant change of the group delays over the frequency response.

11.6.2 Chebycheff 1

Linear frequency response in the stop range only and ripple in the pass through range. The tolerance scheme is better used in the pass trough range. Therefore the order of the filter is less than the one of Butterworth filters. The group delays are changed slightly over the frequency response.

11.6.3 Chebycheff 2

Linear frequency response in the pass through range only and ripple in the stop range. The tolerance scheme is used to its full content in the stop. Any other characteristics like Chebycheff1.

11.6.4 Cauer

Ripple in stop and in pass through range, therefore full use of the tolerance scheme. The order of the filter is less than Chebycheff1/2. The group delays are changed significantly over the frequency response.

11.6.5 Bessel

The tolerance scheme is used very badly so the order of the filter is a lot higher than for any other types of filters. The group delays are nearly constant over the whole frequency response.

11.7 Non recursive Filters (FIR-Filter)

Non recursive filters are filters where the output signal is not fed back to the input. Their name is English and means "finite impulse response". These types of filters are stable under any conditions. With this type of filter it is possible to realize linear phase and therefore constant group delays. This advantage over the IIR filters is compensated by a higher order of the filter. The design of FIR filters cannot be reduced to a analog design. And it is not possible to determine the order of the filter which is necessary to settle the requirements of the tolerance scheme. This leads to trial and fail processing with recursive steps for the whole design. For any single process step the order of the filter is risen and tested if it fulfills the tolerance scheme. If this is the case the recursion is terminated. There are no known transformations by which a low pass can be converted to any other type like a high pass. Any design has to be processed anew.

11.7.1 Design Process

The **Goldammer card** driver supports several different design processes to carry out the calculations for FIR filters. Any of the calculation processes can determine

low passes, high passes, band passes, and band stops.

Because the order of a FIR filter cannot be calculated with a basic type of calculation an additional function is implemented which determines the order which is able to fulfill the necessities of the tolerance scheme. This may take some time because there is a recursion used until the usable order is determined.

11.7.2 Window Method

With the window method a pulse response is calculated. Functions are used which allow to calculate the coefficients directly. But in this way a linear phase can be realized only.

The calculated pulse response is limited for its length. If it is cut off it is called a square window limitation. This leads to oscillations at the edges of the filter. These oscillations drop down with the distance to the edges. Rising of the order of the filter does not reduce the amplitudes of the oscillations. Using another window function which does not cut off the pulse response but develops the coefficients at the borders to zero, reduces the oscillations significantly. But this leads to less steeper edges also. In picture 11.7.5 the function graphs of some window functions are shown.

The following pictures show frequency responses of filters with different orders. As you can see rising of the order does not lead to make the oscillations disappear but they are concentrated in a smaller range around the edge. The Hanning window reduces the oscillations significantly but the steepness of the edge is reduced.

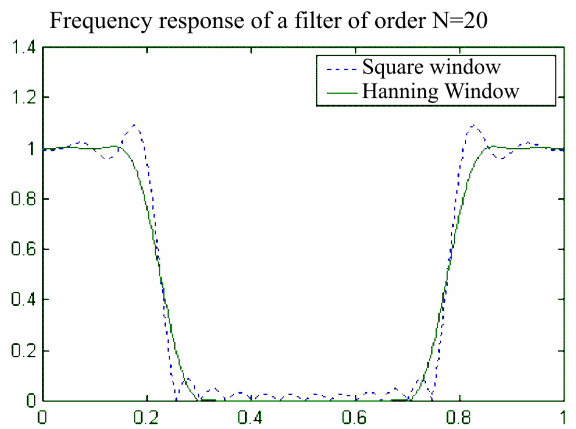


Figure 11.3: Frequency response of a filter of 20th order designed with the window method. It can be seen easily the ripple caused by using a square window. The Hanning window reduces the ripple but reduces the steepness of the edge also.

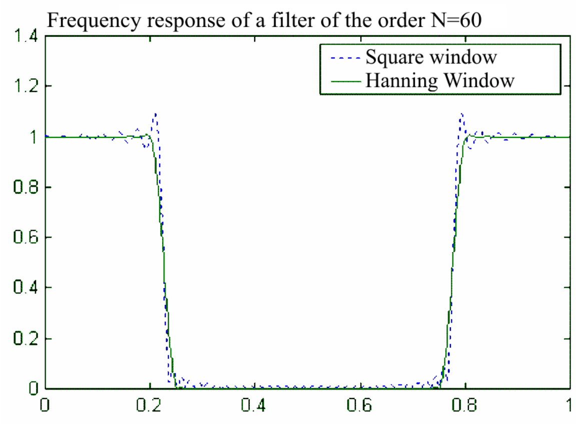


Figure 11.4: Frequency response of a filter of 60th order designed with the window method. The steepness of the edge rises but the ripple is not reduced.

11.7.3 Frequency Sampling

Frequency sampling generates out of frequency and phase response a pulse response if aided by the inverse FFT. The advantage is that any frequency and pulse responses can be realized. The computing load is mostly determined by the FFT processing. The order of the filter is not significant.

The coefficients calculated here are just an approximation of the real pulse response. The precision can be risen by the rising number of the FFT points. But the time necessary for the calculations increases significantly.

The problem of oscillations at the edges of the filter is existent to. By using window functions the oscillations amplitude can be reduced but the steepness of the edges is reduced.

11.7.4 Remez Method

The Remez method generates filter coefficients which are known as „equi-ripple-filters". Another name is „optimized FIR filter". Filters designed according to this method are optimized in the meaning that the requirements of the tolerance scheme are fulfilled perfectly for the pass through and the band stop ranges. Because of this in the pass through and in the band stop ranges a ripple is generated (similar to the Tschebycheff3 IIR filter). Furthermore these filters need often lower orders of their order compared to the filter designs discussed above what is sufficient to fulfill the tolerance scheme.
The major disadvantage is the relatively high need for calculation time. Though this design offers very high flexibility.

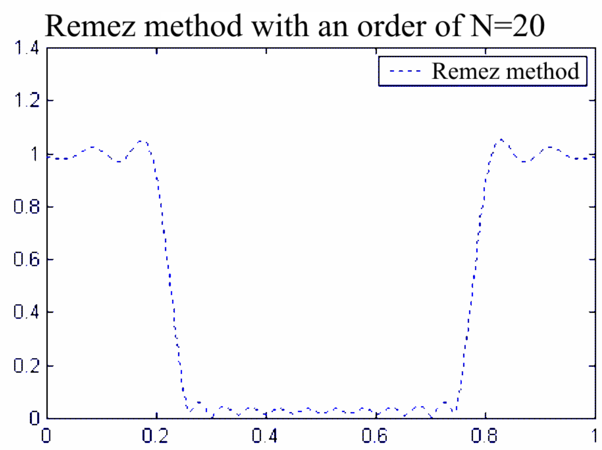


Figure 11.5: Frequency response of a filter with a 20th order designed according to the Remez method.

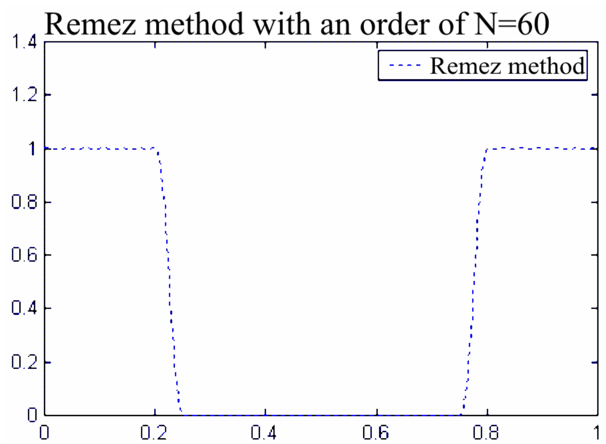


Figure 11.6: Frequency response of a filter with a 60th order designed according to the Remez method.

For the Remez method there is no need for a window function because with rising orders the ripple decreases.

11.7.5 Window Function

This design method generates a window function only and passes it to the calling routine. The number of coefficients of the window function is the passed order plus one. There are more than 200 window functions known. Most of the commonly used are offered by the Goldammer driver.

The following picture shows several window functions.

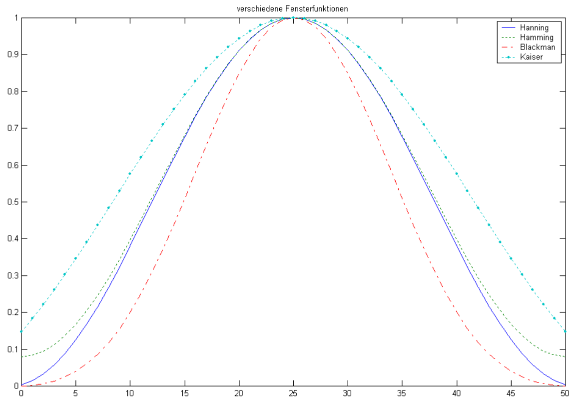


Figure 11.7: Graphs of some window functions

11.8 Comparing IIR and FIR Filters

An immediate comparison between IIR and FIR filters is not possible. The user has to decide himself depending on the task and the specific conditions which type of filter can be used. To decide, advantages and disadvantages have to be weighted.

The following table is intended to make the decision easier:

FIR Filter		**IIR Filter**	
Advantages	**Disadvantages**	**Advantages**	**Disadvantages**
Stable operation			Stable operation not under any conditions, necessity to check stability
constant (linear) group delay			variable (nonlinear) group delay
Output signal is not altered			Output signal is altered
	Finite pulse response therefore oscillations at discontinuities	Infinite pulse response therefore no oscillations at discontinuities	
	Higher order necessary for fulfilling the tolerance scheme as compared to IIR	Lower order to fulfill tolerance scheme as compared to FIR	
	Big group delays and big calculation efforts	Less group delays and less calculation efforts	

Table 11.1: Comparing advantages and disadvantages of FIR and IIR filters

11.9 Settings for Digital Filters in DIAdem

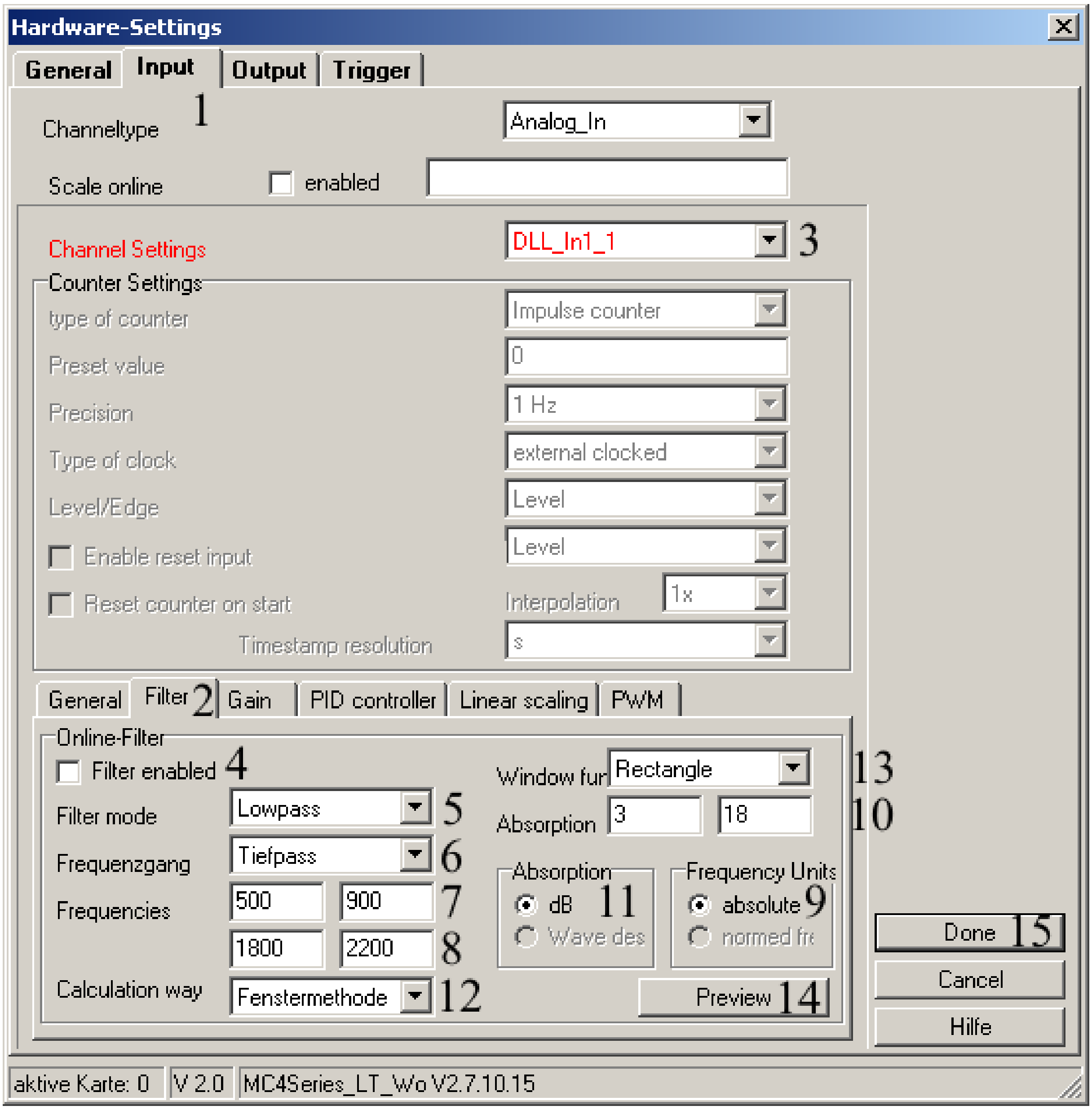


Figure 11.8: Filter dialog box in DIAdem

To activate and configure filters you have to click on „Device..“. The dialog box which then appears contains the possible settings seen in the upper part.

1. At this tap the inputs are configured.
2. Here are the settings for the filters of a channel located which is selected under (3). The settings on this page can be configured individually for each of the channels.
3. This is used to select the channel to be configured. After configuring the channel the next can be selected immediately.
4. Here you can specify for the channel selected under (3) if the sampled values of this channel have to undergo a filtering process.
5. Selection of the filter structure (recursive IIR or nonrecursive FIR filter). The structure selected here has influence to the meaning and the entries of other input fields.

6. Specifying of the filter type. Possible settings: Low pass, high pass, band pass, band stop
7. Border frequencies of the 1st edge of the filter. To the left the lower, to the right the upper border frequency of the edge.
   The entries are necessary for high and low passes. For this types the second edge is ignored.
8. Border frequencies of the second filter edge. To the left the lower, to the right the upper border frequency of the edge.
   These entries are necessary for band pass and band stop only.
9. Frequencies can be input in absolute (in Hz) or in standardized form. Standardized frequencies offer the advantage that the sampling rate has not to be taken into consideration. Absolute frequency values can be converted to standardized ones if the sampling rate is known. The sample frequency is taken over of the block clock while configuring “absolute” frequencies.
10. The values for absorption in the pass through and the stop range can be input here. To the left you will find the pass through absorption, to the right the block absorption. The value of the Block absorption have to be bigger than the one for the pass trough absorption.
11. Absorptions can be specified as allowed ripple (wave) also. The conversion is achieved internally. Here it has to be specified if the input value has to be interpreted as absorption or as ripple .
12. Here the type of acquisition is specified. At this place it has to be distinguished which filter structure was selected under (5). Advantages, disadvantages and special features are discussed above.
    FIR-Filter window method, frequency sampling, Remez method, window function
    IIR-Filter Butterworth, Chebyshev 1, Chebyshev 2, Cauer
13. This field serves to select the window function which has to be used to validate the coefficients to minimize the ripple at the edges of the filter. This option in available for FIR filters only.
14. Clicking on this field opens a window in which frequency response and group delays of the filter are displayed. So the user can see the properties of the defined filter at a glance.
15. If any parameters are set for any of the channels the configuration window can be closed here.

11.9.1 Settings for Digital Filters and DasyLab

With DasyLab digital filters are supported with the Expansion Toolkit only.

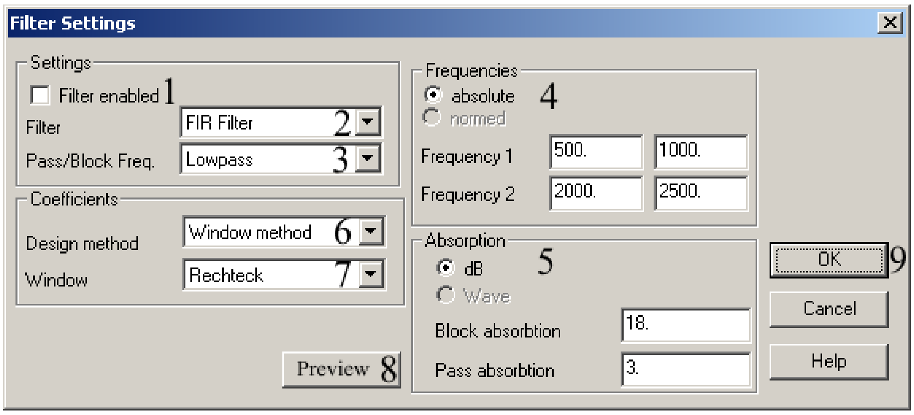


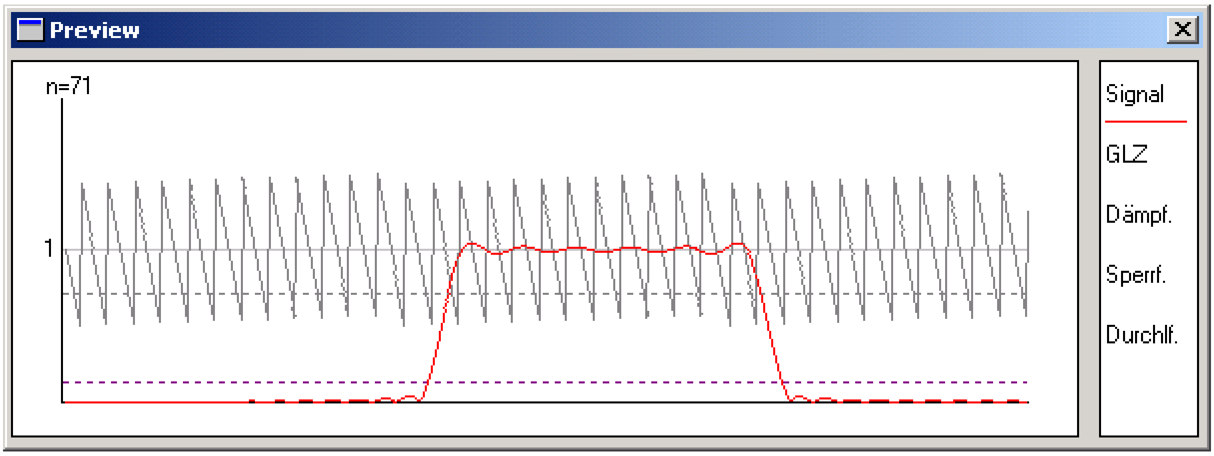
Figure 11.9: Input mask for filters with DasyLab

This dialog box is opened by clicking on the field „Filter Settings“ within the configuration dialog of the selected block.

1. Here you can specify for the selected channel if the sampled values of this channel have to be filtered.
2. Selection of filter structures (recursive IIR or non recursive FIR filter). The structure selected here has influence to the meaning and the entries of other input fields.
3. Specifying of the filter type. Possible settings: Low pass, high pass, band pass, band stop.
4. Frequencies can be input in absolute (in Hz) or in standardized form. Standardized frequencies offer the advantage that the sampling rate has not to be taken into consideration. Absolute frequency values can be converted to standardized ones if the sampling rate is known. The sample frequency is taken over of the block clock while configuring “absolute” frequencies. Here the border frequencies for the 1st and the 2nd edge of the filter are input.
   To the left the lower, to the right the upper border frequency of the edge is specified. The entries are necessary for high and low passes only. For this types the second edge is ignored. For band passes and band stops it is necessary to specify the values of the 2nd edge also.
5. Absorptions can be specified as allowed ripple (wave) also. The conversion is achieved internally. Here it has to be specified if the input value has to be interpreted as absorption or as ripple. The values for absorption in the pass through and the stop range can be input here. The value of the block absorption has to be bigger than the one for the pass through absorption.
6. Specify here the used designing process. It has to be distinguished here what kind of filter structure was selected under (5). Advantages, disadvantages and special features are discussed above.
   FIR-Filter window method, frequency sampling, Remez method, window function
   IIR-Filter Butterworth, Chebyshev 1, Chebyshev 2, Cauer
7. This field serves to select the window function which has to be used to validate the coefficients to minimize the ripple at the edges of the filter.
   This option is available for FIR filters only.

8. Clicking on this field opens a window in which frequency response and group delays of the filter are displayed. So the user can see the properties of the defined filter at a glance.
9. If any parameters are set for any of the channels the configuration window can be closed here.

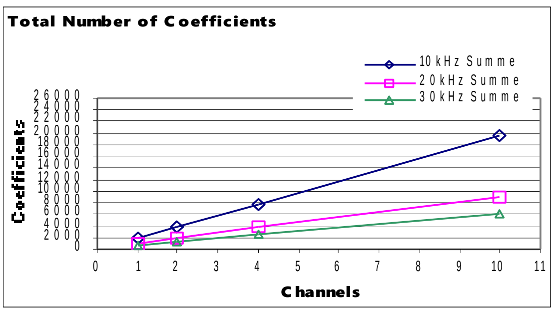
The drivers of the commonly used measuring programs offer previews for the signals so the filter coefficients can be displayed graphically:



11.9.2 Performance Data of FIR Filters

Number of coefficients at constant averaged sample rate

No. channels	Sample Freq.	Averaged Sample Rt	Border freq. Freq1	Border freq. Freq2	Width in %	Absorptions Ad	Absorptions As	Order per ch.	Coefficients per ch.	Coefficients Total	Ratio no./channel 30 / 10	Ratio no./channel 30 / 20	20 / 10
1	30000	30000	4000	4049	0,16	3	22	600	601	601	0,3157	0,6583	
2	15000	30000	2000	2049	0,33	3	37	620	621	1242	0,3176	0,6509	
4	7500	30000	2000	2020	0,27	3	31	603	604	2416	0,3146	0,6474	
10	3000	30000	500	510	0,33	3	37	608	609	6090	0,3117	0,6692	
1	10000	10000	1000	1011	0,11	3	38	1903	1904	1904	3,1681		2,0854
2	5000	10000	500	505	0,10	3	36	1954	1955	3910	3,1481		2,0493
4	2500	10000	250	253	0,12	3	41	1919	1920	7680	3,1788		2,0579
10	1000	10000	125	126	0,10	3	36	1953	1954	19540	3,2085		2,1473
1	20000	20000	2000	2022	0,11	3	38	912	913	913		1,5191	0,4795
2	10000	20000	1000	1011	0,11	3	23	953	954	1908		1,5362	0,4880
4	5000	20000	500	506	0,12	3	24	932	933	3732		1,5447	0,4859
10	2000	20000	200	202	0,10	3	21	909	910	9100		1,4943	0,4657



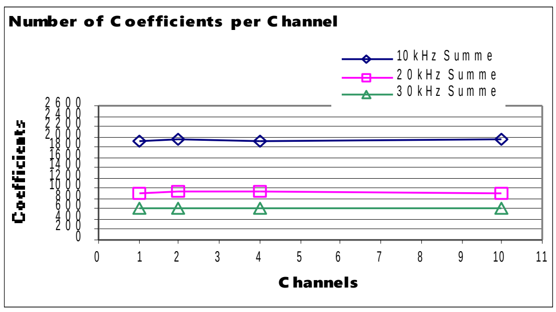
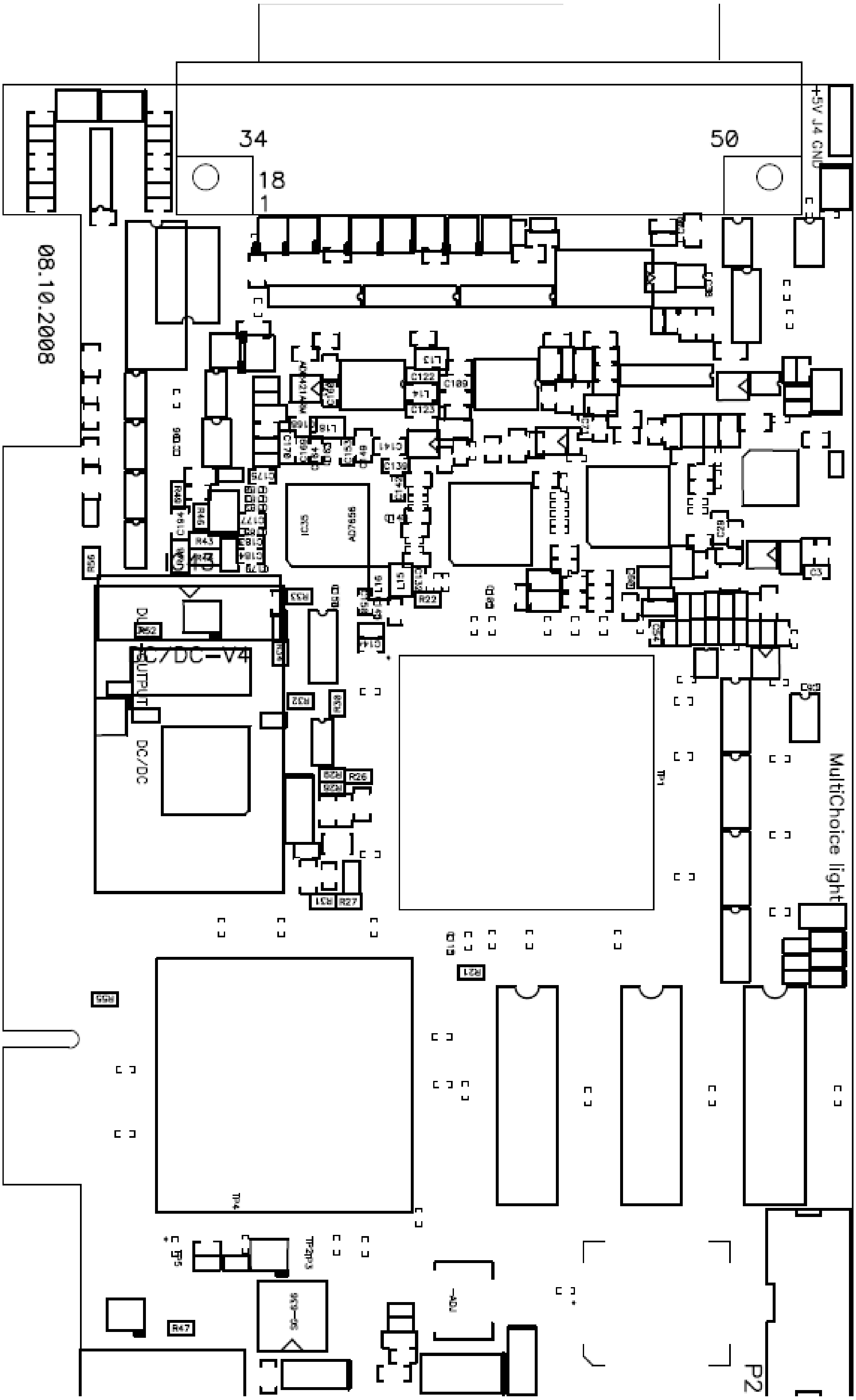
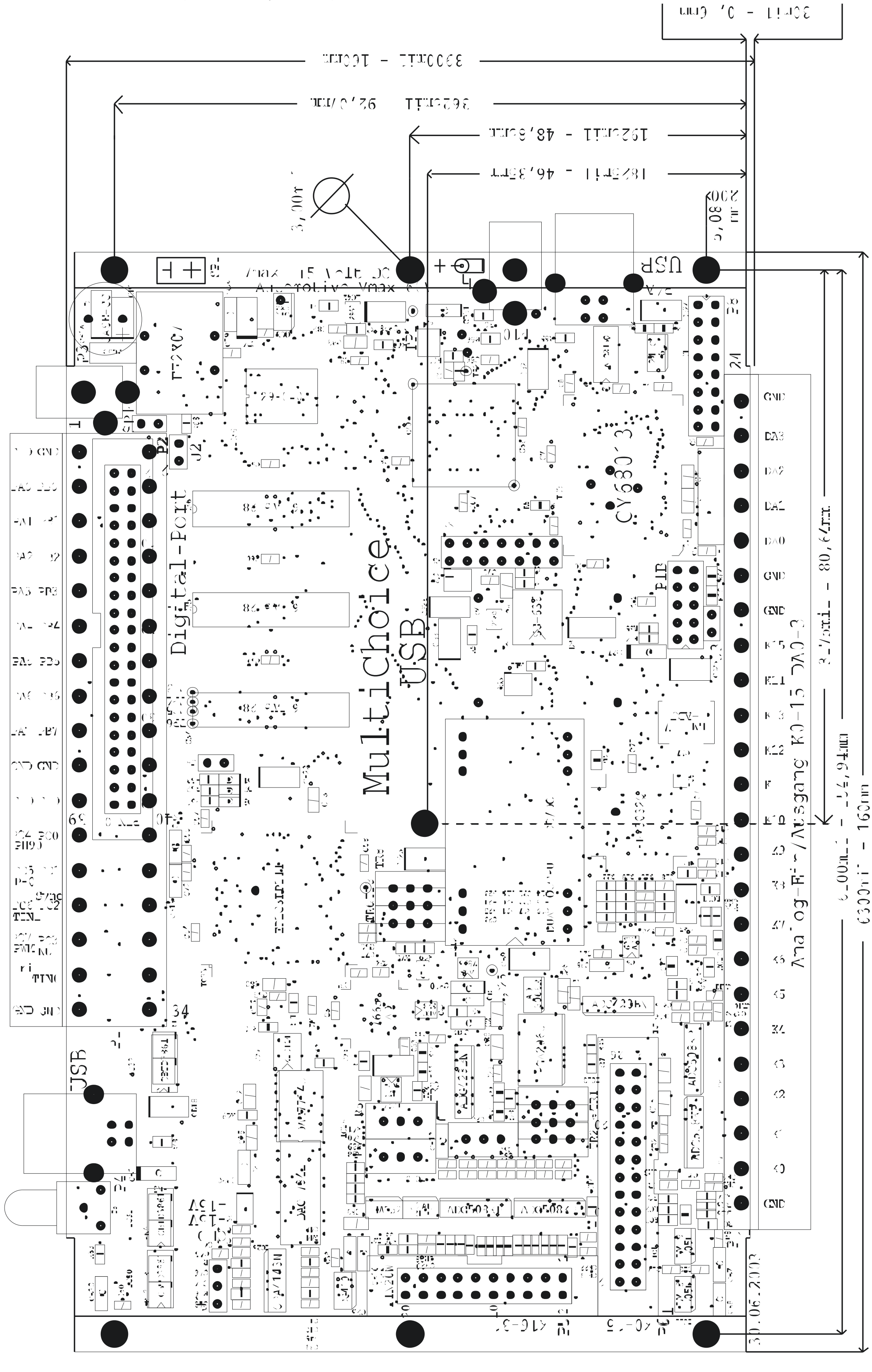


Table 11.2: Comparing the possible number of coefficients with the accumulated sampling rat

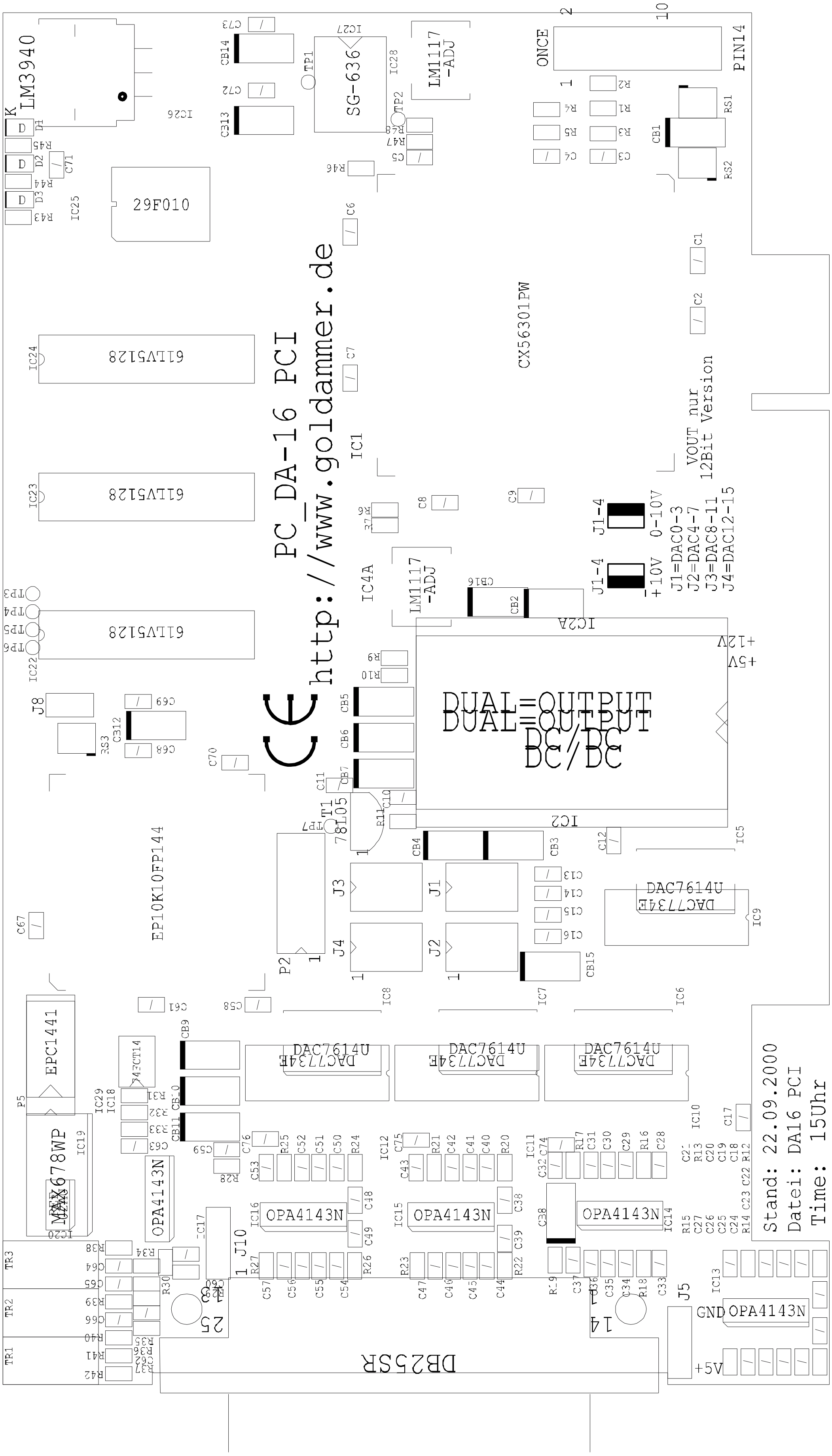
11.10 PCI- G00-10xx



11.11 Silk Screen (Assembly Print): MultiChoice G0A-1024-X



11.12 Silk Screen (Assembly Print): *PC_DA-16 PCI*



12 CE Conformance and FCC Rules

CE

This device was tested and found to comply in practical operation with the protection requirements of council directives (89/336/EWG) relating to safety and electromagnetic compatibility according to the standards EN 55022, and EN61000-3.

FCC

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules.

CE and FCC

These limits are designed to provide reasonable protection against interference in a residential area. This device generates and uses radio frequency energy and if not installed and used in accordance with the instructions, it may cause interference to radio or TV reception. If this unit does cause interference with TV or radio reception, you can try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and the radio or TV receiver.
- Plug the equipment into a different wall outlet so that it is not on the same circuit as the radio or TV receiver.
- Consult the dealer or an experienced radio/TV technician for help.
- To ensure that the use of this product does not contribute to interference, and to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules, it is necessary to use shielded I/O cables.

Important
The Federals Communications Commision points out expressively that changes or modifications to this equipment not expressly approved by the authority for compliance could void the user’s authority to operate this equipment.

13 Disclaimer (Technical Changes)

Important
Any changes made to the software or the hardware of the device which are not approved with the written consent of „Soft & Hardware Entwicklung Goldammer GmbH“ will not only void the warranty. This can also void the user’s authority to operate the device. Soft & Hardware Entwicklung Goldammer GmbH is not liable by any means according to consequences which may arise of such changes.