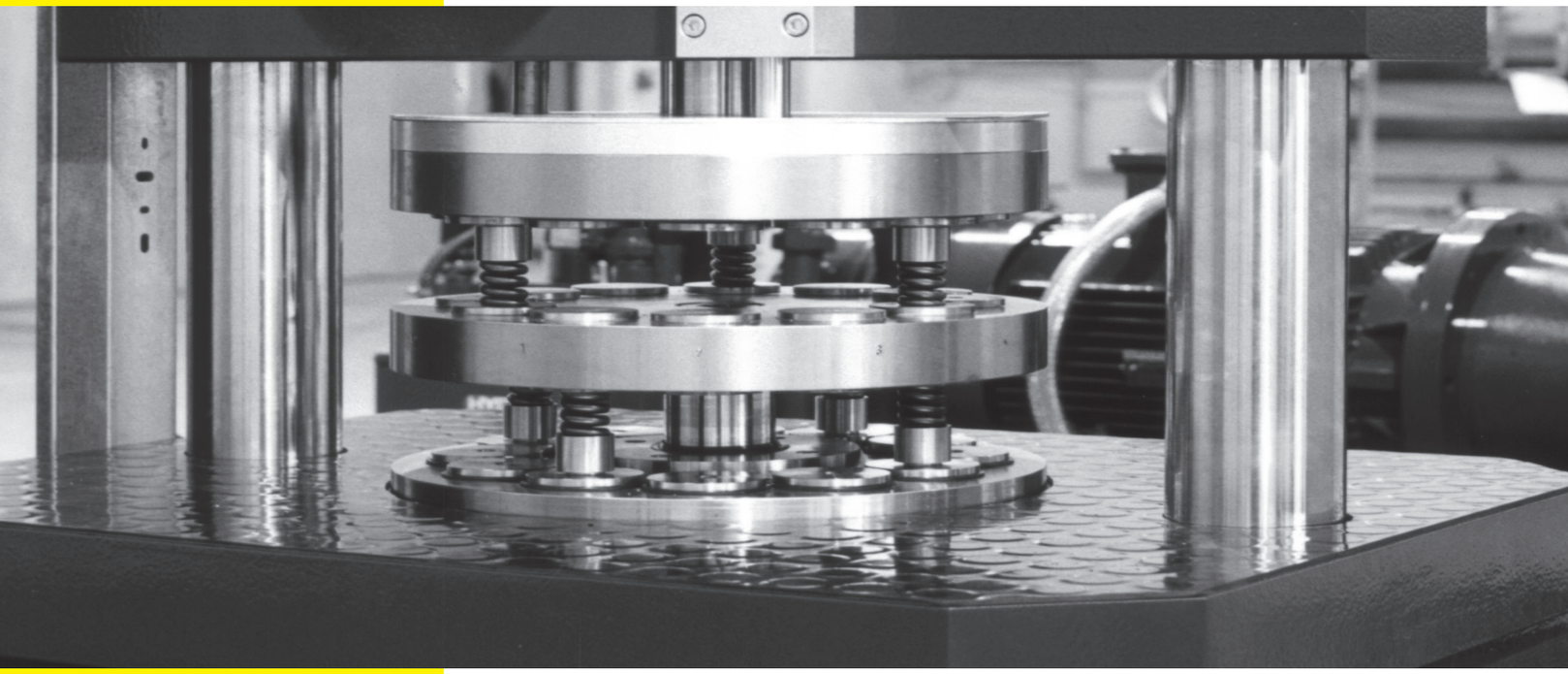
Version 2017

ADwin

Simply more Real-Time



Data Acquisition and Control

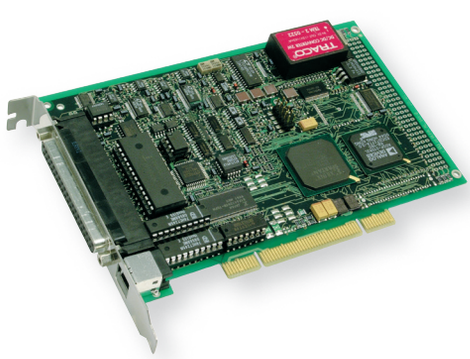
JÄGER
Computergesteuerte
Messtechnik GmbH

ADwin Systems

ADwin systems are used by engineers and scientists for data acquisition, automation, and Real-Time control applications. ***ADwin*** always provides a highly-accurate, precise, and deterministic timing, with a high-speed process execution. ***ADwin*** systems are very robust and form the core of various test stands, machines and scientific experiment controls.

ADwin systems are freely programmable by the user so that the software of the system can be adapted for any kind of a customized solution. This makes ***ADwin*** a universal platform, suitable for many different types of functions, applications, and industries.

ADwin offers more than 25 years of experience in automation and deterministic Real-Time applications. With software solutions since 1987, and with ***ADwin*** hardware systems since 1992, several thousand users and applications worldwide depend on our rugged and reliable systems.



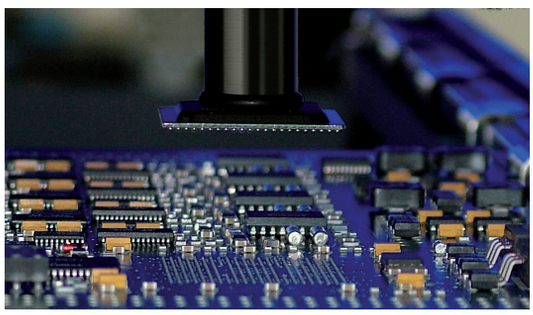
Application Areas

- Test stand control and data acquisition
- Automotive test stands
- Aerospace component test stands
- Dynamic component testing
- Material endurance tests
- Fast machine control applications
- Scientific and industrial research
- Production line automation systems
- HIL / Hardware-in-the-Loop test stands
- Laboratory and mobile systems
- Quality assurance tests

Real-Time Functions

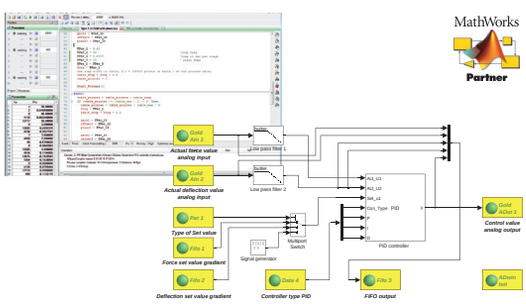
- Intelligent data acquisition
- Fast digital closed-loop controller
- Multi-axis controller, PID and others
- Online analysis of measurement data
- Complex trigger applications
- Online data reduction
- Signal generation, arbitrary and adaptive
- ***ADbasic*** Real-Time code
- Simulink® models in Real-Time

Products, Services, and Solutions



Standard Systems and Products

ADwin offers a large variety of different hardware and software products, developed by experienced engineers and produced in our high-tech production lines. The popular ***ADwin*** system series follows a scalable and flexible concept. All ***ADwin*** systems are programmed with the ***ADbasic*** Real-Time development tool chain. Model-based code from Simulink® may run on the ***ADwin*** systems, which are deterministic and exceptionally fast.

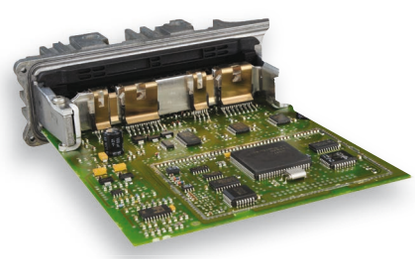


Consultancy, Services, & Workshops

Pre- and post-sales consultancy, and individual application- oriented workshops, are one of the great benefits of using ***ADwin*** systems. Please take advantage of it and feel free to contact our experienced team! We will discuss your project jointly with you to solve your needs. Concerning long-term delivery, all standard ***ADwin*** products are still available for support.

Turnkey Solutions and Projects

The ***ADwin*** project team is continually developing turnkey solutions. Experienced engineers design various kinds of customer-specific solutions specifically for test-stands and machine automation. Our services also include user-interface software design (GUI), if required, and ***ADwin*** hardware development, up to complete machine automation software.



Customized Systems

Beside our standard products, system customization is always a key to solve application needs for OEM applications. If your application requires any kind of new features, the ***ADwin*** engineering team is able to close this gap with our customized hardware or software.

ADwin Real-Time Concept

ADwin systems are characterized by a deterministic execution of intelligent data acquisition and control applications. This is achieved by a local CPU, the Real-Time heart of every ***ADwin*** system. This CPU is responsible for all Real-Time functions and guarantees a fast, precise and deterministic process execution, independent of the PC and its workload.

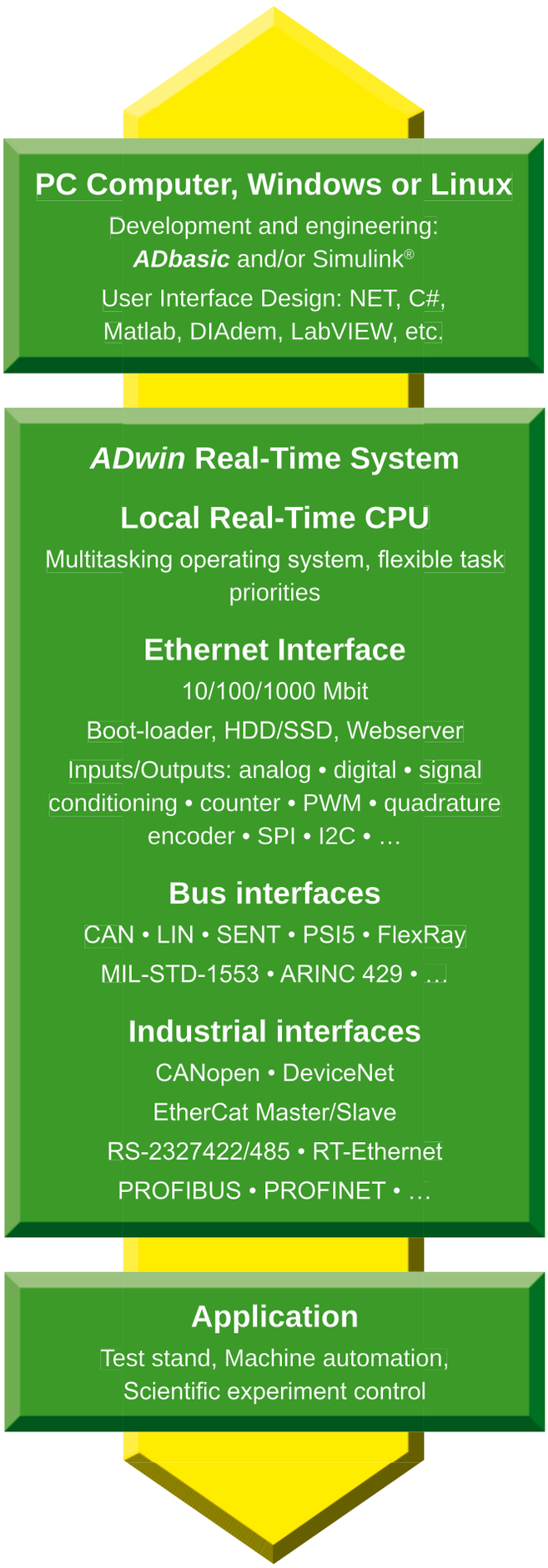
ADwin systems work in close cooperation with the PC, running Windows or Linux on it, or OSx on a Mac, but with clear job sharing:

- The job of the ***ADwin*** system is to execute fast and deterministic processes in Real-Time,
- while the PC performs standard functions such as displaying graphical user interfaces for applications, visualization of data, and database accesses.

ADwin systems add Real-Time capability to a Windows or Linux PC; if the PC crashes, the ***ADwin*** system will continue to run, maintaining the integrity of the application.

ADwin products cover a large variety of I/O types and interfaces, as well as a selection of different Real-Time CPUs. In addition to the CPUs, there is a large local memory for program code and measurement data, analog I/Os, digital I/Os, counters, different kinds of serial interfaces for automotive, avionic and industrial serial busses, and various expansions and options.

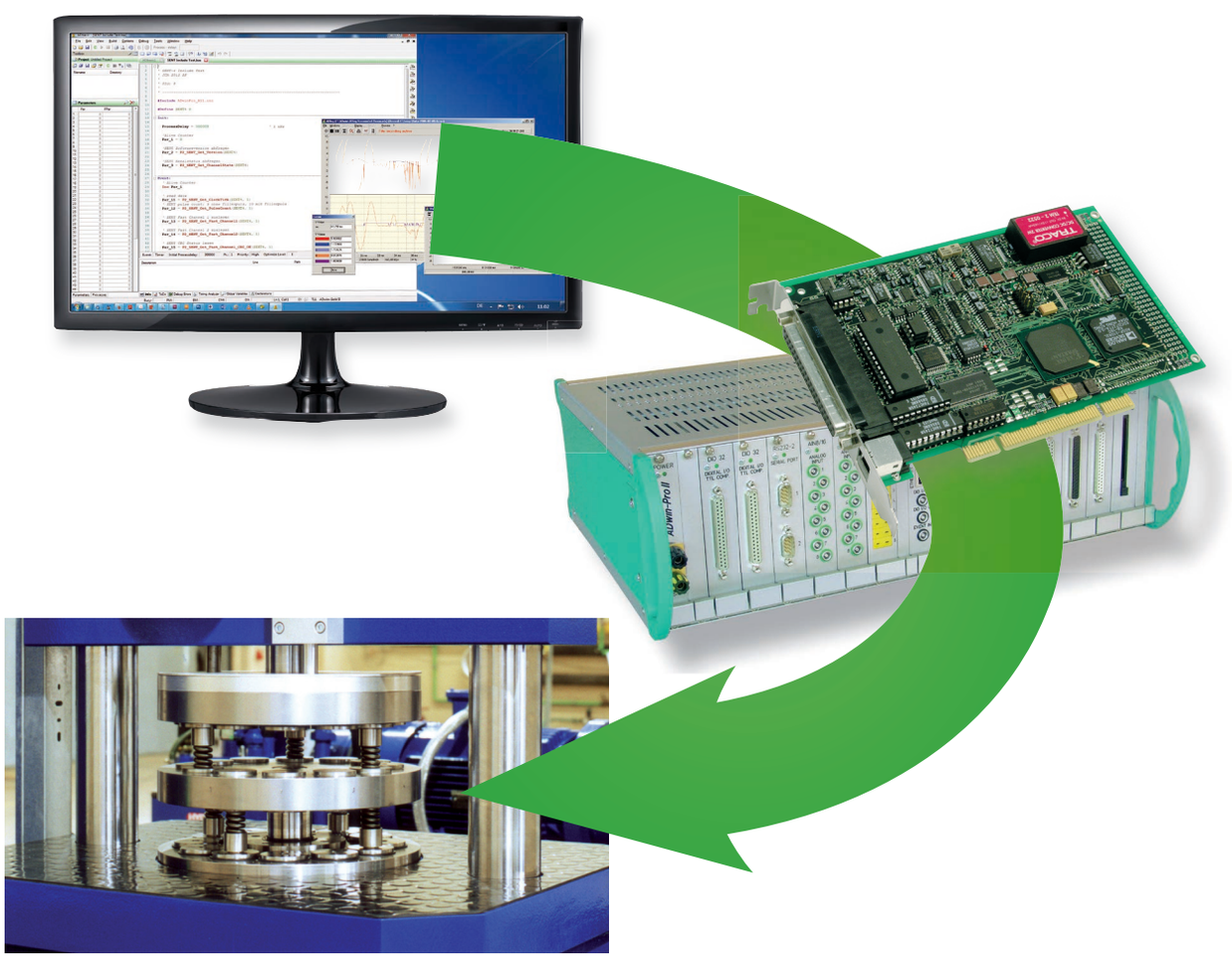
The communication between the ***ADwin*** system and the PC is done via Ethernet. Industrial bus interfaces allow the connection to PLCs, while a bootloader supports complete stand-alone operations of the ***ADwin*** system.



ADwin Real-Time – with Sub-Microsecond Precision!

ADwin applications always run in Real-Time! Every sampled value can be evaluated in the same sampling step, so that a control function or an online analysis can immediately follow. The best solution for fast Real-Time applications is to place a dedicated CPU close to the signals with its own resources for flexible and free programmable processing of measurement data. The ***ADwin*** CPU runs an optimized ***ADwin*** Real-Time multi-tasking operating system–only this combination provides exact, predictable process response times with less than 300 ns. For even more precise timing, some ***ADwin*** systems provide a ***TiCo*** co-processor with response times down to 10 ns.

The ***ADwin*** system can run multiple parallel tasks, each task with its own functionality, cycle time, and individual priority. Depending on the CPU, you can run applications with process cycle times from ‘ms’ down to ‘µs’ range, from kHz up to MHz, perfectly executed on ***ADwin*** with a high timing precision in Real-Time.



ADbasic - Real-Time Software Development Tool Chain

ADbasic is the easy-to-use Real-Time software development tool for deterministic, time-critical processes on ***ADwin*** systems. Whether you need to run intelligent data acquisition with online analysis or complex trigger conditions, to use open- and closed-loop controllers such as multichannel PID and others, or to generate any kind of periodic or non-periodic waveforms, ***ADbasic*** is the key! We provide the development of various Real-Time applications with precise and deterministic operations and timings.

ADbasic is an integrated development environment that runs under Windows with many online debugging features. Its easy-to-learn, standard command syntax has been expanded with a number of functions to access all inputs, outputs and interfaces of an ***ADwin*** system, as well as functions for process control and for communication with the PC.

Along with ***ADbasic***, the ***ADwin*** Real-Time operating system is optimized for the shortest possible response times, down to 300 ns! It manages parallel processes which can be executed on the same CPU in a multi-tasking mode, with different priorities and process cycle times.

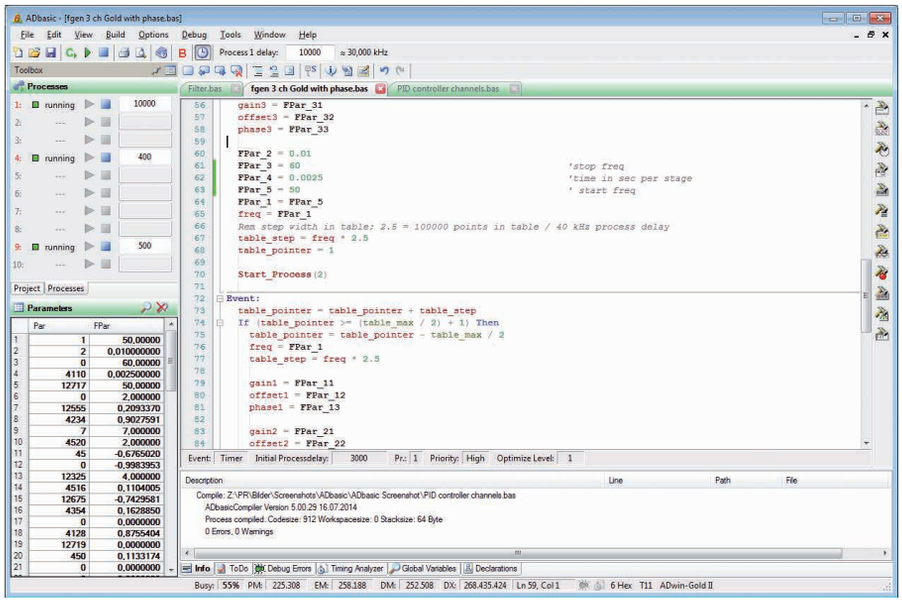
ADbasic is source code compatible to previous versions; the same code can be executed on different ***ADwin*** systems with different CPUs. This means that by using ***ADbasic***, the ***ADwin*** concept gives you a great advantage by using future hardware together with your currently-developed code. This saves on development costs over the long-term.

In the latest version ***ADbasic*** 6 for T12-based CPUs in ***ADwin***-Pro-II and ***ADwin***-X, the ***ADbasic*** also allows users to include and execute C-code libraries and to use generated C-code from Simulink® or other C-code generation tools.

ADbasic RT Development Tool – Key Features:

- Single Compiler for all ***ADwin*** systems
- Easy-to-develop, parallel-executed processes
- Compatible between different ***ADwin*** CPU types
- Standard programming code functions:
  - for..next, if…then…else, +, -, ;*/ , sin, cos, log, …
- Advanced functions for I/O module access:
  - x=adc(1), dac(1,y), z=digin<u>w</u> ord(), digout<u>w</u> ord(i)
- Data exchange of variables and arrays with the PC
- Debugging features, timing analyzer, variables access
- Versions for Windows XP, 7, 8, 10, and future versions
- Command line version for Linux
- ***ADbasic*** update free of charge, compiled code royalty-free

Real-Time Development Tool




```
Dim a, b As Float              'Declaration of Variables
Dim X1, X2 As Long
Dim X3, X4 As Long
Dim Y, Z As Long

Init:                          'Initialization
 a = 12.
 b = 0.34

Event:                         'Event Loop, precise down to 300ns
 X1 = ADCF(1)
 X2 = ADCF(2)                  'Reading 4 analog inputs
 X3 = ADCF(3)
 X4 = ADCF(4)

 Y = a*X1^2 + b*X2 + X3        'Calculation of free programmable
 Z = Func(X3, X4)              'routines

 DAC(1, Y)                     'Writing to analog outputs
 DAC(2, Z)
```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Simulink® Support

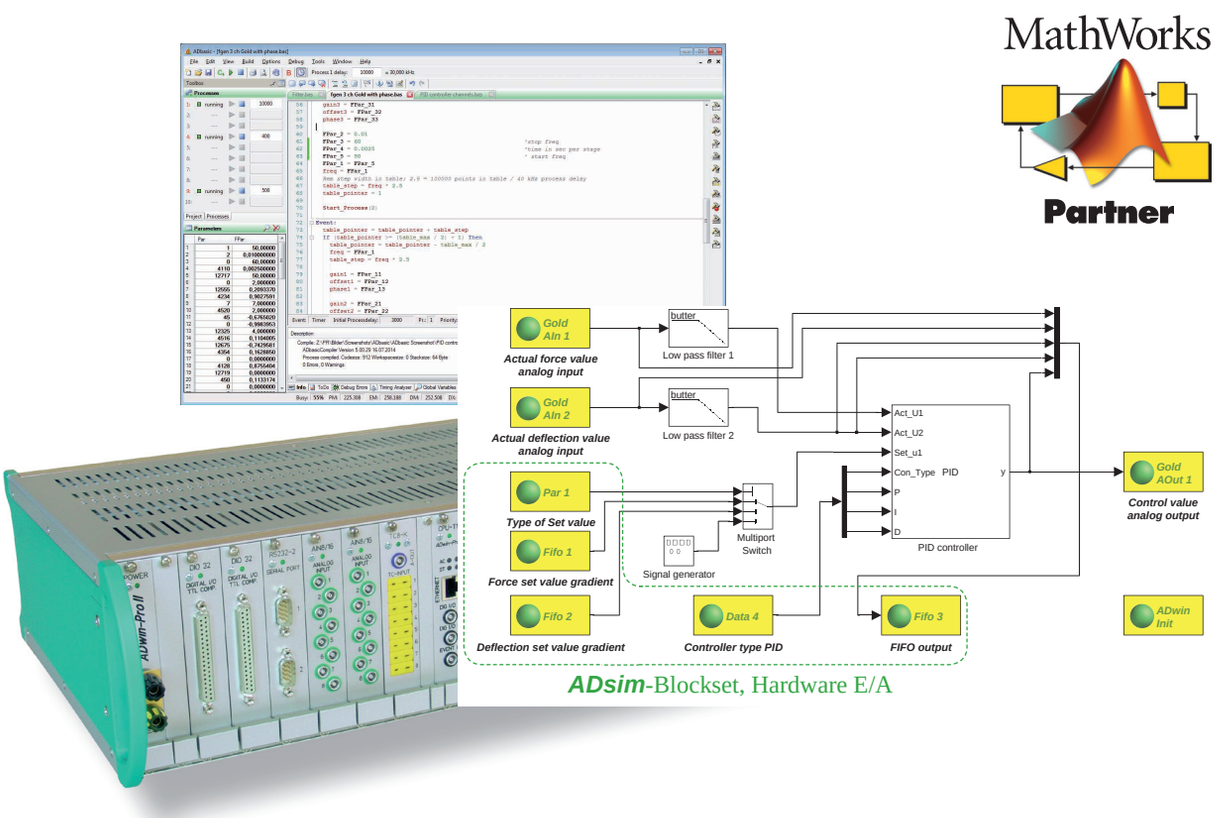
Simulink Models in Real-Time on *ADwin* Systems

Complex models, such as for HIL applications, digital filtering, and digital control may be described in Simulink or other simulation tools. Generated C-code from such tools may run on ***ADwin*** systems at high speed while absolutely deterministic in Real-Time. Users are able to take advantage of the complete ***ADwin*** Real-Time concept and structure. For example, it is possible to run model code in a single task or to multitask with individual task priorities and task cycle times. Beside generated C-code, ***ADbasic*** can also run on the same ***ADwin*** hardware (T12/T12.x) in parallel, performing additional jobs if required. All ***ADwin*** drivers for communication to Windows, Linux, or OSx may be used for an exchange of model data with a PC for visualization and as user interface.

It only takes just a few mouse clicks and a few seconds to go from viewing a model in Simulink to running the model on an ***ADwin*** system in Real-Time! Just contact our sales support in order to learn how your Simulink models can run on ***ADwin*** systems.

Below, you will find benchmark examples of Simulink models running on ***ADwin***, also relating to the ***ADwin*** system and CPU usage.

- 16 PID controller + IIR-LP filter running at 25 kHz with 19 % CPU usage
- 24 FIR300 filters, running at 6 kHz
- Very large and complex models running at 25 kHz
- Large models with hundreds of blocks running at 200 kHz
- Very dedicated models may run up to 1 MHz



ADwin Drivers

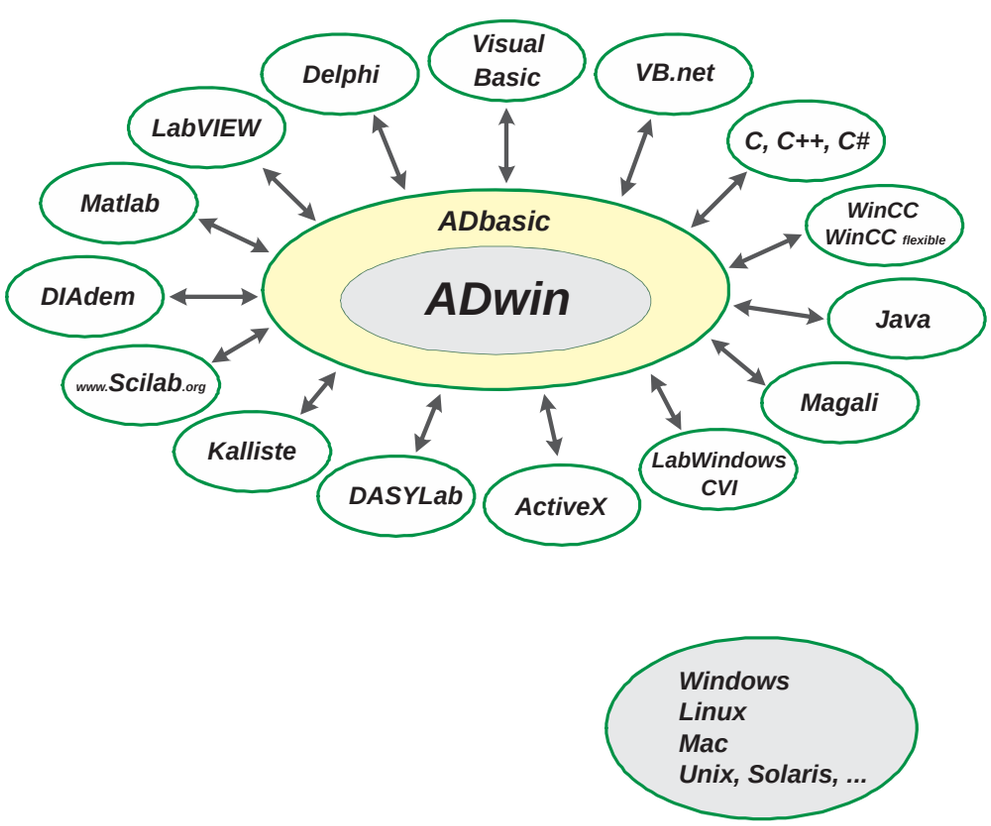
Drivers are available for a wide range of PC programs under the Windows and Linux operating systems, as well as for OSx on Mac computers. The software drivers provide functions for communication between PC and the ***ADwin*** system. ***ADbasic*** processes may exchange data along with system status. Simulink models running on ***ADwin***, as an exported C-code to ***ADbasic***, can take advantage of the same kind of driver set.

Communication between the ***ADwin*** system and the PC is done via Ethernet (10/100/1000Mbit). One ***ADwin*** system can be addressed by several PCs, while a single PC can handle several connected ***ADwin*** systems. If required, Ethernet communication can be password-protected.

One of the key benefits in the ***ADwin***-to-PC communication is the possibility to run fast absolute deterministic Real-Time processes, and also to communicate data and parameters between the PC and the ***ADwin*** system at the same time. Neither has influence on the other: the communication does not disturb the deterministic timing of the Real-Time processes and vice versa.

The following function-set allows for comfortable usage in all PC environments :

- Bi-directional data exchange of variables, arrays and data structures
- FIFO data exchange
- System booting and process downloads
- Starting and stopping of processes
- Monitoring and control of system variables and resources

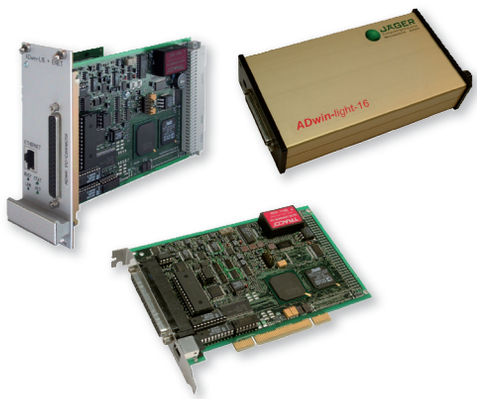


ADwin-L16 and *ADwin-Gold II*

ADwin-Gold II and ***ADwin-light-16*** are powerful Real-Time systems in very compact packages at a reasonable price.

ADwin-Gold II is built in a robust metal enclosure and includes a fast, local Real-Time CPU and memory, analog and digital inputs and outputs, as well as an Ethernet or USB interface for the communication with a PC.

Options include additional functions such as counters, encoder interfaces, serial and CAN bus interfaces, and SSI interfaces. The systems can be used in laboratories, on a DIN-rail in industrial machines, or in mobile and in-vehicle applications.



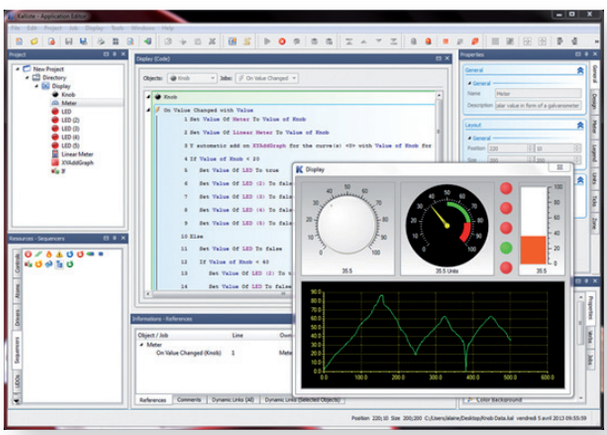
ADwin-light-16 offers similar functionality to the ***ADwin-Gold II*** system, but with a reduced number of channels. Based on one common design, there are three different versions: a PCI plug-in board, a Euro-size plug-in board, and an external system in a robust metal enclosure.

Because of their compact design, all three systems are ideal for OEM applications.

	ADwin-Gold-II	***ADwin-L16***
Real-Time CPU	32 bit, FP, 300 MHz, 768 kB SRAM, 256 MB DRAM	32bit, FP, 40 MHz 256 kB SRAM, 16 MB DRAM
PC Interface	Ethernet	Ethernet
Analog inputs, channels, resolution, conversion time	16 ch (= 8ch via MUX × 2) 2×18 bit/2 µs ADC, diff.	8 ch via MUX 1×18 bit/2 µs ADC, diff.
Max sampling frequency 1 channel 2 channels 8 channels 16 channels	 500 kHz 500 kHz 100 kHz 50 kHz	 500 kHz 75 kHz 20 kHz –
Analog outputs / resolution / settling time	2ch, 4ch, or 8ch 16 bit, 3 µs (FSR/10)	2ch, 16bit, 3 µs (FSR/10)
Digital I/O, Counter (CNT), Encoder, PWM	4×8, TTL, EVENT, 4×CNT, PWM (in/out), encoder, 4×SSI	6+6 TTL, +32 TTL, EVENT, 1× or 2×CNT/PWM/Encoder, 1×SSI, 1×SPI
Other features	2×CAN bus, 2×LS Bus, 2×RS-232/485, Profibus, ProfiNET, EtherCat, DeviceNet, CANopen, Bootloader, DIN rail	CAN bus, LS Bus, Bootloader, DIN rail
System features incl expansions and options, for details please contact our sales support and request your personal quotation.		

With Kallisté you create your own development environments, getting direct access to data, variables and processes of the ***ADwin*** system. Just a few clicks, and the surface is ready to start.

Thanks to intuitive graphic handling, Kallisté supports both the experienced programmer as well as the unpracticed beginner right from the start of the project in order to develop a complete user interface. The clearly arranged design allows for fast success accompanied by a short training period without programming skills.



Using Drag & Drop, the user simply drags selected elements like a knob, a diagram, or a switch to the future user interface. Since access to the ***ADwin*** hardware is built-in innately, you can have ***ADwin*** data and variables immediately connect to visualizing objects. Each Kallisté object is to be parametrized with a simple mouse click, individually and easy to handle.

The numerous operating features of Kallisté allow for visualization of single values, thresholds, and measuring processes. For more complex presentations, Kallisté supports the refining of data, for example using mathematical methods.

Visualized data can be stored to files, printed, copied to the clipboard in a selectable graphics format or directly exported to Excel.

Kallisté is delivered as single user version free of charge along with the ***ADwin*** system on the ***ADwin*** CDROM. On the other hand, there is a version subject to a fee, which enables you to create licence-free user interfaces as an independently executable program (run-time version).

Kallisté offers a lot of objects displaying and processing data:

- x-y-chart in 2D/3D, waterfall chart, spreadsheet
- Numeric and graphic display of values: Button, slider, potentiometer, …
- Numeric and graphic input box
- Data input / output via file, Excel, Word
- Logical and mathematical functions
- Case processing, block processing
- Print data, save data, copy data to clipboard

Kallisté supports access to the ***ADwin*** hardware ex works:

- Boot hardware
- Load, start, stop processes
- Control system resources
- Read and write variables and data sets

Kallisté is a product of the ADAS company, which belongs to the French Nexeya group.

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ADwin-Pro II

The *ADwin-Pro II* System

ADwin-Pro II is a modular, scalable, expandable, intelligent Real-Time system for fast data acquisition and control applications in industrial and scientific environments.

The modular design of ***ADwin-Pro II*** offers a flexible, adaptable solution for various applications. It supports signal counts from single channels up to hundreds of channels.

A wide range of different analog and digital I/O module types, many kinds of interfaces, various enclosures, processors, and memory options, allow a customization of the system for a universal use, especially in industrial applications.

The system communicates via fast Ethernet to a PC with Windows or Linux, to a MAC with OSx, to UNIX workstations, via a fieldbus interface with a PLC, or it is running as a stand-alone unit with a bootloader option.

The ***ADwin-Pro II*** enclosures are available in three different form factors and sizes. The systems are offered alternatively with AC (115 V / 230 V) or DC (10 V – 35 V) power supplies.

The systems are delivered as desktop unit, while the large 19” enclosure ***ADwin-Pro II*** also has a kit for rack mounting included.

ADwin-Pro II comes in three different versions:

- ***ADwin-Pro II***, 16 slots, AC / DC
- ***ADwin-Pro II-light***, 7 slots, AC / DC
- ***ADwin-Pro II-mini***, 5 slots, DC

ADwin-Pro II-light,
7 module slots

ADwin-Pro II-mini,
5 module slots

Fast deterministic Real-Time CPUs

The heart of every ***ADwin-Pro II*** system is a fast dedicated Real-Time CPU, responsible for all deterministic functions. The applications run completely independent of the PC and its operating system. The CPU software timing is completely predictable, which enables a precise control of all processes. Run multiple processes in preemptive multitasking and in parallel with individual speeds and process priorities. The CPU executes ***ADbasic*** compiled code, and also supports Simulink© models and generated C-code.

Processes from kHz range up to MHz range run on the same system in Real-Time.

Pro-CPU-T12-ENET

Fast and complex processes require a fast RT-CPU: XILINX ZYNQ with Dual-Core ARM Cortex-A9, 64 Bit Floating-Point (double precision), 1 GHz CPU clock, 1 Gigabyte memory for program code and measurement data, a Gigabit Ethernet interface (10/100/1000Mbit) for a high-speed data transfer from/to the PC, and a trigger input.

Pro -CPU-T11-ENET

The Real-Time execution is based on a 32-bit floating-point DSP and an optimized operating system. The Pro CPU-T11 processor module contains a 300 MHz ADSP processor from Analog Devices, with 768KB CPU memory for program code, and 256 MByte memory for measurement data, an Ethernet interface (10/100/1000Mbit/s) for PC communication and a trigger input.

Processor module Pro-CPU-T12

Bootloader

The Bootloader option ***Pro-Boot*** for Ethernet-based Pro-CPUs loads the software to the ***ADwin***-Pro CPU without a PC and starts the software processes automatically. After a system start, it is always possible to connect a PC afterwards and get any kind of data from the system, also from the optional built-in hard drive / SSD.

Hard-disks

In order to store measurement data values directly in the ***ADwin*** system, there are a variety of disk versions available. The disk may be used as a redundant data storage sink while a PC is connected, but also as a data storage sink while the ***ADwin*** system is running stand-alone, started by a bootloader. If a PC is connected to the ***ADwin*** system, the disk is presented as a regular network drive in the PC operating system.

The hard disk is a manufacturing option for the ***ADwin*** CPU and is available as SSD or as magnetic hard disk, fixed built-in or as removable version.

Analog Input Modules

The ***ADwin-Pro II*** system provides many different solutions for analog measurements. There are modules with:

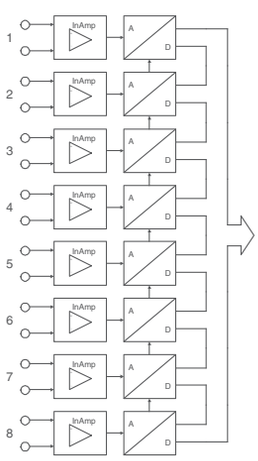
- parallel synchronous analog inputs, one ADC per channel
- multiplexed analog inputs
- 18 bits@500 kHz / 16 bits@4 MHz / 14 bits@50 MHz
- on-board RAM buffer for high-speed measurements
- embedded ***TiCo***: Real-Time co-processor (optional)
- signal conditioning, extended voltage ranges, filters
- Lemo, BNC or D-type connectors
- customized versions

Variety of analog input and analog output modules

Parallel Analog Input Modules

The parallel analog measurement modules acquire all channels simultaneously, without any phase shift between the measurement channels. This measurement technique is achieved by using one ADC per channel. Parallel sampling is a great advantage if measurement signals must be correlated to each other and if, based on these signals, controls loops or an online signal analysis are executed. For instance for the determination of phase shift between signals. If the application requires more channels, additional modules can be used simultaneously, up to 120 channels in a single system.

Different 4 and 8 channel modules are available, with a resolution/speed of 14bits@50 MHz, 16bits@4 MHz, or 18bits@500 kHz. Depending on the module, they offer additional onboard memory, statistical evaluation, filters, minimum/maximum evaluation, and threshold controls.



Multiplexed Analog Input Modules

The measurement modules with multiplexer (MUX) offer a higher number of channels on a single module. The analog inputs are connected via a multiplexer and depending on the module with a programmable amplifier to one ADC. The module has an 18bit/500 kHz ADC, the sampling frequency is related to the number of channels and the MUX settling time. The module is alternatively available with an onboard ***TiCo*** as co-processor for pre-analysis of measurement data.

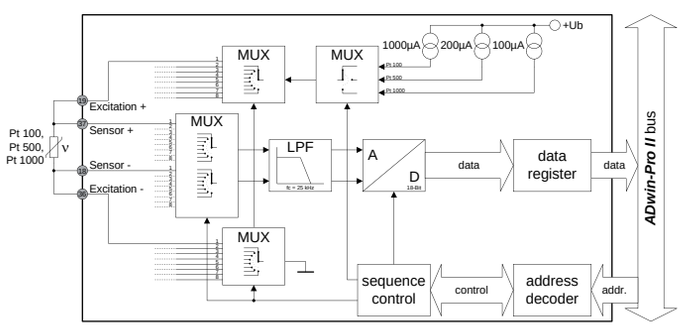
Parallel or Multiplexed Acquisition?

The most significant error occurring during a multiplexed measurement is the phase error between channels. If it matters for your application or not depends e. g. on the dynamic of the measurement signals. In case of any question, please contact our pre-sales support free of charge.

Analog Input Modules

RDT Temperature Input Modules

The RTD module Pro II-RTD-8 offers an 8 channel measurement of temperature sensors such as type Pt100, Pt500, Pt1000, or Ni100. The module supports measurements with 2-, 3-, or 4-wire technique. The maximum possible measurement range is -200°C…+700°C, depending on the temperature sensor. The inputs are connected via a multiplexer (MUX) to an ADC. The sensor supply current is switched via a MUX, resulting in a reduced self-heating effect of the sensor during measurement. It is possible to perform high speed measurements up to kHz range. Alternatively, the RT-CPU may perform measurements synchronized to 50/60 Hz with oversampling and online averaging, in order to reject 50/60 Hz coupling effects. Measuring methods and sensor type are set via software, or performed by the RT-CPU. There are modules with a 37-pin D-Sub connector or with 4-pin Lemo connectors.

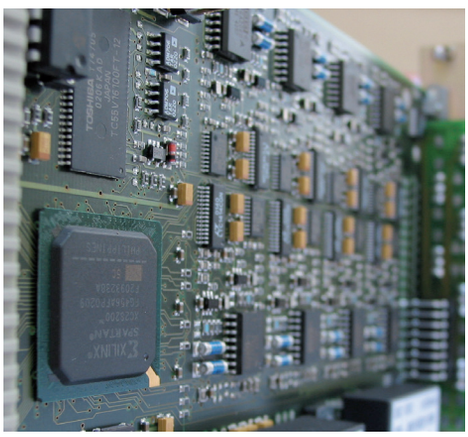


Block diagram of module RTD-8

Thermocouple Input Modules

The module Pro II-TC-8 ISO has 8 inputs for thermocouples and can be operated with thermocouples of the types B, E, J, K, N, R, S, or T. For others types please contact the factory.

Each channel is equipped with a separate ADC. The module provides an on-board cold junction compensation for all temperature inputs. For each channel the temperature or the thermoelectric voltage can be read. The inputs have a 5 Hz low-pass Butterworth filter, also manufacturing options allow modules without filters.



Filters, Signal Conditioning, and 30 V Modules

In addition to all standard modules, there are variants of the analog input modules with higher voltage ranges, and/or on-board low-pass hardware filters, or signal conditioning such as strain-gauge on the module.

Advanced and flexible filters may be realized in addition to that in Real-Time as in software, allowing flexible filters like low-pass, high-pass, band-pass, band-stop, and others as IIR, FIR, or other filters types.

Parallel Analog Output Modules

The analog output modules are used for various kind of applications and offer different speed and built-in options:

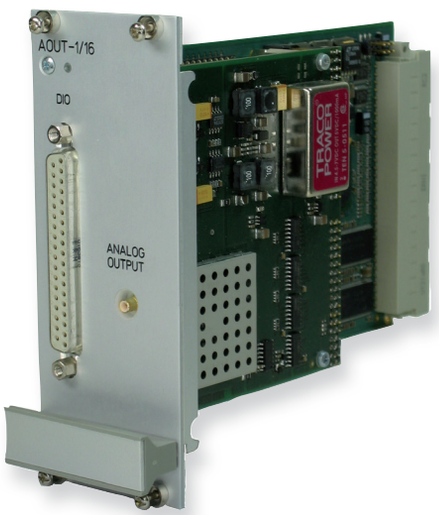
- ATE tests
- Digital controller outputs
- Test device stimulation
- Function Generation
- Arbitrary Waveforms
- 16 bit/2 µs conversion time
- 16 bit/20 ns conversion time / DIO
- ***TiCo*** co-processor module, optional

Generating waveforms is largely used for many test and automation applications to reproduce any kind of specific signals. ***ADwin*** offers (non-) periodical waveforms, numerical waveform generation, arbitrary waveform generation, adaptive signal generation with feedback measurement, internal timer or external triggered signals, single or multiple channels.

The signals can be used at analog or digital outputs, or used internally as set-points for controller functions.

Analog output modules for ***ADwin-Pro II***:

- 4 or 8 channels analog output modules with 16 bit resolution. The output range is ±10 V and the settling time is 10 µs (20 V) or 3 µs (1 V). It is possible to have up to 120 channels in a single system. Optionally, these modules come with a ***TiCo*** co-processor in order to generate any kind of a waveform on the module.
- 1 channel 50 MHz analog output module with 20 ns settling time. The output range is ±1 V, ±2 V, and may drive 50 Ohm inputs. The module comes with additional digital I/O, a large memory of 256 Mbyte, and ***TiCo*** co-processor.

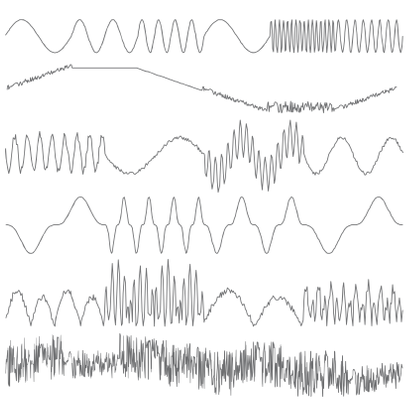


Module AOut-1/16

MIO Module – Multi-I/O

For special applications there is a multi I/O module available. Beside the ***TiCo*** co-processor and memory it offers, depending on the version, analog I/O, digital I/O, counter, SSI, EtherCAT slave interface, optically isolated I/O, etc.

This module is a good choice for dedicated stand-alone jobs within a large ***ADwin*** solution, in parallel to the main ***ADwin*** Pro-CPU-T11, Pro-CPU-T12.



Signal patterns created with AOut module

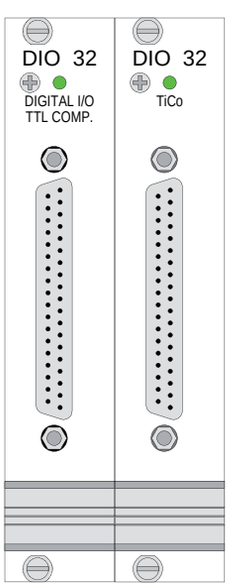
Digital I/O Modules

There are different digital input/output modules for the ***ADwin-Pro II*** with TTL/CMOS level, optically isolated 5 V, 12 V or 24 V input modules, isolated transistor output modules, and relay output modules. A comparator input module is also available with software selectable thresholds in the range of -1 V…30 V, other ranges are possible on request.

Pattern-Generation-Unit - PGU

The ***TiCo***-based DIO cards are supplied with a Pattern-Generation-Unit (PGU). This function allows to generate pulse sequences at digital outputs. Into a FIFO buffer the output patterns are loaded in combination of the relative time between patterns. The resolution is 10 ns (5 ns), with a shortest length of 20 ns (10 ns), depending on the fact, which ***TiCo*** module ***TiCo*** or ***TiCo***-2 is used.

The ***ADwin*** CPU or the on-board ***TiCo*** CPU can fill the FIFO buffer in parallel to the pattern generation, so continuous pattern sequences may be generated.



EDU - Edge-Detection-Unit

The digital I/O cards are supplied with an Edge-Detection-Unit (EDU) in order to detect dynamic changes at the digital inputs. A selected number (max. 32) of input channels are scanned with a timing resolution of 10 ns (5 ns[1]). At the moment there is any change at the selected inputs, all channels of the module are stored in a FIFO table, together with a timestamp. The ***ADwin*** CPU or the on-board ***TiCo*** CPU can empty the FIFO buffer in parallel to the acquisition of edges at the inputs. As long as the FIFO is read, a continuous edge detection can run for hours and days, without any loss of data.

This EDU is ideal to detect any kind of digital pulses or pulse-trains, to use as an interface input card, in physical experiments, etc.

No.	Pattern	Time [10 ns]	$d_t=t_n-t_{n-1}$ [10 ns]
1	110 …	2	-
2	100 …	4	2
3	001 …	6	2
4	011 …	10	4
5	001 …	14	4
6	111 …	18	4
7	101 …	19	1
8	001 …	20	1
9	101 …	22	2
10	001 …	28	6
…	…	…	…

Digital-Filter-Unit – DFU

TiCo based digital I/O modules provide also a digital low-pass filter in order to **eliminate short spikes** on the digital lines. Internally, the filter works like a time based integrator. The filter can be enabled or completely disabled. All functions and filter parameter settings are software selectable.

1 5 ns are valid for module DIO-32-TiCo-2

Counter and PWM Modules

ADwin's high-speed digital counter and PWM modules offer flexible solutions for a wide range of counting and measurement applications. These modules allow the user to read quadrature encoders, measure signal periods or the length of pulses, acquire SSI signals, evaluate or generate PWM signals, measure frequency and revolution speed, detect revolution speed variations, and more.

The ***ADwin-Pro II*** counter modules provide 4×32-bit independent multifunction counters, with software selectable counter modes. For high channel count, there is a 16 channel counter module for event counting. The counters have TTL / CMOS inputs or isolated 5 V, 12 V or 24 V inputs. There is also a PWM module, which provides 4 PWM outputs.

Bus Interface Modules

The following modules are available to connect the ***ADwin*** system to a PLC, or any automotive bus, or to connect any other external system via a standard interface:

- CAN for automotive
  CAN database software tool
- RS-232/485/422
- LIN, SENT, PSI5
- SPI, I²C
- LS-Bus
- Profibus, Profinet
- EtherCAT-Slave, EtherCAT-Master
- Interbus
- CANopen, DeviceNet, etc.

Comparator Modules

There is a digital input module with a comparator functionality available. The input range for the signals is -1 V…30 V, and the switching thresholds are software selectable. For other ranges, please contact the sales support.

The number of inputs is 8 or 16, depending on the hysteresis type. For a large user-defined software selectable hysteresis, 8 inputs may be used. If just a 100 mV hysteresis is required, 16 inputs may be used. All inputs are single-ended ground coupled. For threshold settings, the inputs are grouped in blocks of 2 or 4.

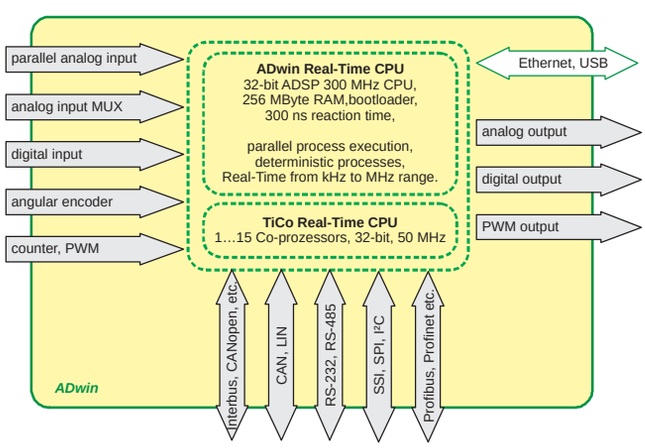
The module has the DFU (Digital-Filter-Unit). Also the module is equipped with the digital EDU (Edge-Detection-Unit).

TiCo Processor

There is a highly sophisticated deterministicly embedded Real-Time CPU, the ***TiCo***, for ***ADwin*** systems.

TiCo means **Ti**ming **Co**ntroller. This CPU offers a very precise code execution with a perfect timing precision. The Jitter is just **one** clock cycle of the CPU that means 10 ns or 20 ns, depending on the ***TiCo*** version.

This processor is used as a co-processor in the system or on a module and it has access to the specific module inputs/ outputs, while the ***ADwin*** main CPU has access to the ***TiCo*** variables, data and processes. The ***TiCo*** can handle several programs in parallel in



a multitasking mode.

The user can quickly create Real-Time code for this processor, and load it in the ***TiCo*** CPU with one click. ***TiCo*** programs run fast like FPGA based systems (VHDL or graphically programmed), but the ***TiCo*** development time is much shorter and easy to learn. The ***TiCo*** programming development environment is ***TiCoBasic***. It has the same look and feel, and is as easy as the ***ADbasic*** language.

TiCo Applications

Typical ***TiCo*** applications

- Pre-processing of data
- Online analysis of measurement values
- Intelligent, programmable trigger conditions
- On-board controller functions
- Flexible digital filters
- Noise reduction using moving average filter
- Revolution variation measurement
- SPI protocol generation, interface simulation
- CAN bus analysis, logging, bus stimulation
- LIN bus communication handling

For OEM applications, there are also customized modules and stand-alone modules with ***TiCo*** processor available, please contact the factory for consultation.

TiCo Availability

The ***TiCo*** processor is available in

- ***ADwin-Gold II***
- ***ADwin Pro II*** on :
  - Digital I/O modules
  - Analog input module (MUX)
  - Analog output module
  - Multi-I/O module
  - Counter modules
  - Serial, CAN, LIN, SPI modules

The ***TiCo*** processor is used in addition to the standard ***ADwin*** CPU. There is no limitation in the number of ***TiCo*** modules in one ***ADwin-Pro II***, that makes ***ADwin-Pro II*** an extremely powerful Real-Time system.

Functions

Intelligent Data Acquisition, Online Analysis, Complex Triggering

ADwin systems allow the measurement of multiplexed or synchronized parallel analog channels, digital channels, counters, CAN interfaces, and other signal types.

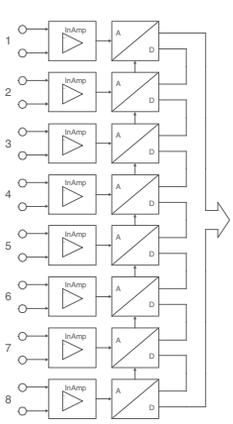
In the simplest applications, data is acquired for a period of time and stored.

But ***ADwin***'s great advantage is its Real-Time capabilities, which allows all measured data to be evaluated online by the local CPU, immediately after collecting each sample in the same sampling step.

Online analysis – Any user programmable function can be performed, such as statistical operations, true RMS, min/max, mean, integral, derivative, correlation, digital filters, FFT, signal analysis, etc.

Intelligent or complex triggers – The ***ADwin*** system allows logical and mathematical operations to be executed immediately at every sampling step. In the same step it is also possible to decide if any trigger condition has been met or not. As a consequence, only the measurement data or analyzed data that contain information are acquired and stored, the rest can be discarded.

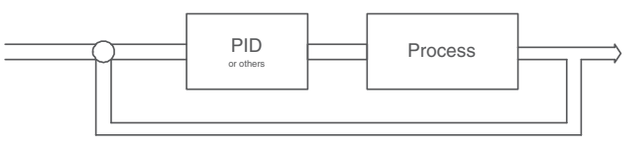
Data reduction – Data acquisition with online analysis or intelligent, trigger conditions provide significant data reduction. Also it is possible to change sampling speed online, based on the signal information content. Even with high sampling rates in the range of kHz up to MHz, it is possible to acquire data over a period of hours, days and weeks.



Fast Open- / Closed-Loop-Control

On all ***ADwin*** systems you can run fast digital **closed-loop controllers** such as **PID**, PI, cascade controllers, deadbeat controllers, adaptive controllers, and others. ***ADwin*** systems are ideal for multichannel and high-speed controllers.

Example: ***ADwin-Gold*** can run 8 × PID at 40 kHz, or 2 × PID at 200 kHz; ***ADwin-Gold II*** with up to 8 × 200 kHz and the fastest ***ADwin-Pro II*** system allows 30 × PID at 300 kHz. The maximum speed for a PID controller is 1 MHz.



Even if most applications don't require these high controller speeds, it also shows that ***ADwin*** still has a lot of performance reserve for other jobs on the same system.

It is possible to run different controller types on a single system with different control cycle times if necessary. Beside all control functions, other jobs such as data acquisition, signal generation or data exchange with a connected PC or PLC can run on the same ***ADwin*** system in parallel.

ADwin offers also powerful **open-loop controller** solutions. Just read any type of input signal, calculate using a user programmable online formula, or use a lookup table, and write new values to analog or digital outputs. This can be perfomed with some MHz speed if needed.

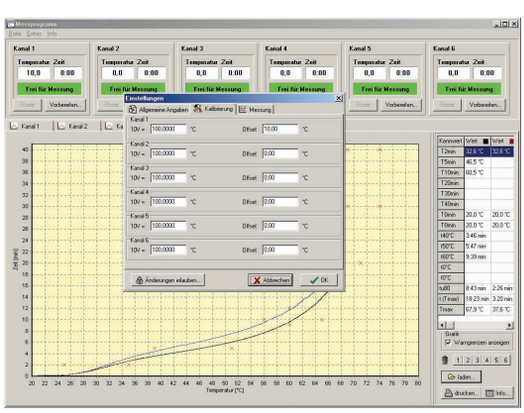
Intelligent Signal Generation

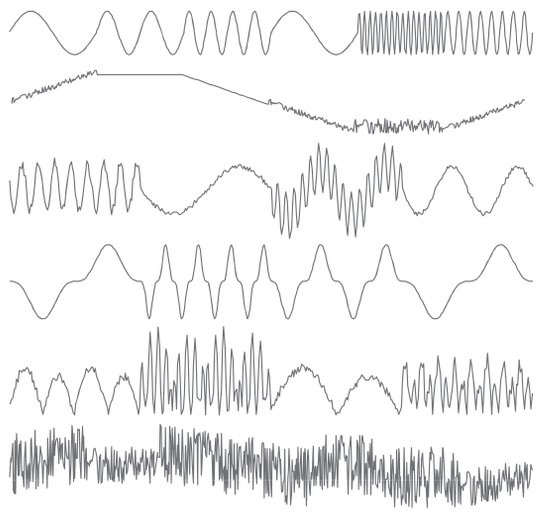
Periodic or non-periodic waveforms are easily created, due to the ***ADwin*** system's Real-Time capabilities. Any kind of waveform with analog or digital signals, single-channel or multiple channels, can be calculated online by the ***ADwin*** system's CPU. Frequency, phase shift, amplitude, offset, and many other signal properties can be corrected in real time during any output step. Add noise, peaks, random signals, or use multi-frequency signals.

For high speed applications, multi-channel arbitrary waveform generators with large memory buffers are available. You can also combine different waveforms and overlay them to construct multi-frequency signals.

Generated signals can be time-controlled, phase-controlled, based on encoder inputs, GPS-controlled, or external trigger-controlled, so incredibly flexible signal applications are possible.

Adaptive waveforms generation is another great advantage. While the ***ADwin*** system produces new waveforms and writing them to analog/digital outputs, input channels can be acquired and analyzed. Based on the analysis results, output waveforms can be adapted online.





The analog output modules have a parallel design; all channels can be updated simultaneously, without any phase shift between the channels.

- Multi-channel signal generator for analog and/or digital signals
- Periodical or non-periodical signals
- Adaptive signal generation, based on RT feedback measurements
- Sinusoid, triangular, trapezoid, rectangular, random, noise, peaks
- Arbitrary signal generation, multi-frequency signals
- Superimposition of different signal shapes
- Block modes
- Online adjustable signal properties
- Analog, digital outputs, or internal usage as set-points for controllers
- Electron and laser beam control, deflection, dynamic focus
- Atomic traps, magneto optical traps (MOT)
- N-channel (x, y, z, ..) figure generation, online adjustable figure type, position, size, rotation

Applications

Automotive Components Tests

ADwin satisfies a wide range of applications in the Automotive Industry. From single R&D test applications, endurance test stands, production line automation and test applications, up to end-of-line tests, ***ADwin*** provides fast and deterministic control, for automation and monitoring jobs.

Fast dynamic test stands for mechanical vibration

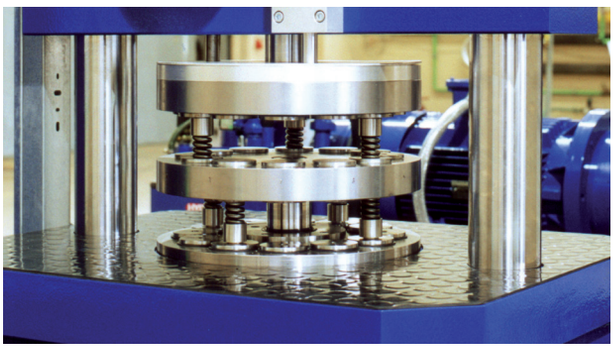
- Shock absorbers, dampers
- Motor bearings
- Exhaust pipes
- Chassis components
- Wheel suspension
- Elastomer components
- Material endurance tests, etc.

Test stands for electronic components

- CAN devices, LIN devices
- ECUs – Electronic Control Units: ABS, airbags, ESP, TCS, engine
- Sensor tests
- Small electrical motors (e. g. wipers)
- X-by-Wire

Functional test stands for car components

- Engine (diesel/gasoline)
- Brake pedals, brake-assist systems, brake boosters and master, disc brakes, drum brakes
- Gearbox, power-train, brakes
- Injection pump, injection valves
- Magnetic valves
- Power windows
- Steering components, power-steering
- Clutch
- Automatic transmission
- Fuel cells
- Small electrical motors (e.g. wipers)
- Lamps, fuse box



Control of Vibration Tests

Vibration test stands are widely used in automotive and aviation industry for endurance tests in production lines and R&D. The equipment undergoes tests with predefined position, force, speed, or acceleration profiles.

ADwin controls hydraulically, pneumatically, or electrically (shaker) operated test stands in Real-Time.

These test stands are single- or multi-axial, and stimulate the Device Under Test with defined test profiles. Various sensors record the response, and a test analysis can be performed online in the ***ADwin*** system itself.

A single ***ADwin*** system implements the following functions:

- PID-control of the hydraulic cylinder
- Numeric function generator, or predefined data
- Evaluation of response, amplitude, phase shift
- Boundary value monitoring, including warnings
- General test stand control, pressure, temperature

Typical applications include: sweep tests, endurance tests, resonance endurance tests with post-regulation of the excitation frequency (resonance frequencies shift due to the temperature of the parts), artificial aging of modules, etc.

Examples of typically tested components include:

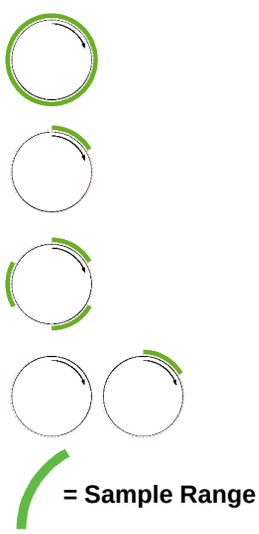
- Automotive and Power train components
- Railroad and Aerospace components
- Various prototypes

Frequency / Rotation Speed Acquisition, Evaluation of Signal Variation

For measurement of frequency, rotation speed and PWM, all ***ADwin*** systems offer powerful, high speed counter solutions. Multiple counters per system are available, with 32-bit resolution. The counter modes are software selectable for event counting, for measurement of periods, PWM, and frequencies, or as an encoder interface. The reference clock in the system is 40 MHz or 100 MHz, depending on the system.

Due to the ***ADwin*** counter register structure, it is possible to acquire frequencies from Millihertz to Megahertz range with a high resolution. This is achieved by using several different counter modes and registers in parallel for a single measurement signal. This allows the user to start a test at 0 Hz going up to high MHz range, without any resolution gap.

A dynamic **variation of frequency and revolution signals** can be analyzed online by ***ADwin***'s Real-Time capability. This allows an online evaluation of the variation with Millihertz or Hertz resolution, even at high frequencies. For safety-critical application, the ***ADwin*** system can generate an alarm signal in Real-Time, so dangerous frequency/revolution can not build up and the equipment can be shut down.

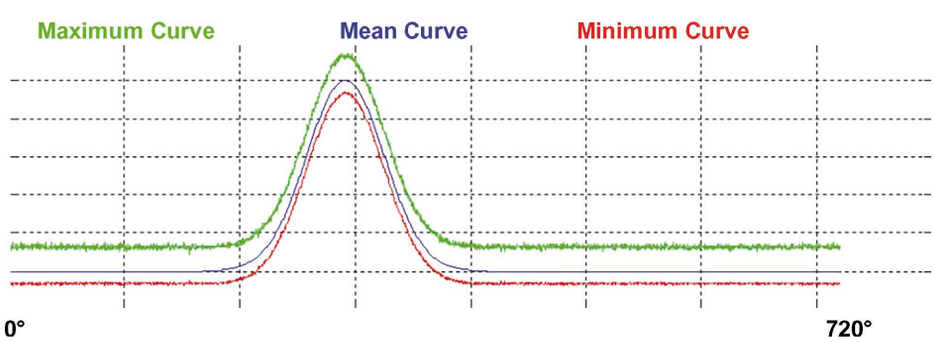


a) Data acquisition range 360°

b) Data acquisition range 60° of 360°

c) Data acquisition range 3×60° of 360°

d) Data acquisition range 60° of 720° = every 2nd revolution

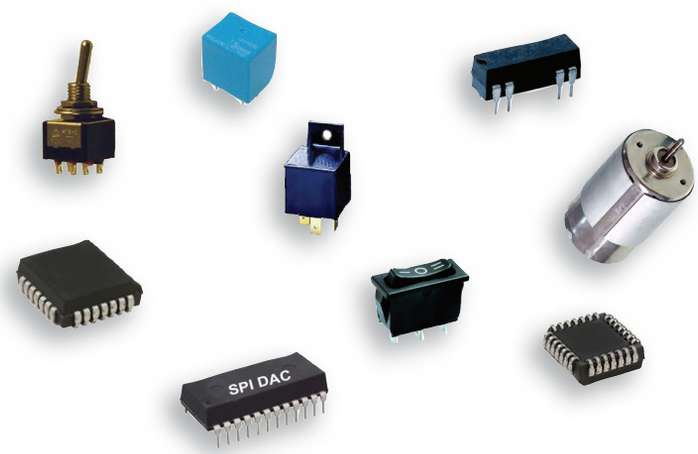


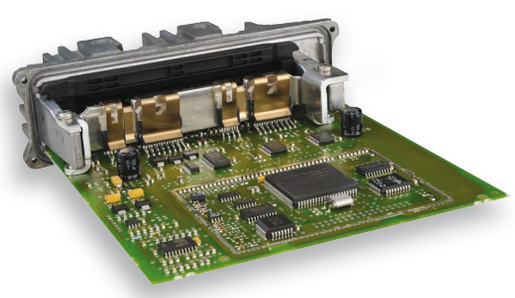
Applications

Component Tests in R&D

Dynamic tests of various electrical, mechanical or semiconductor components are performed by ***ADwin*** systems. The ***ADwin*** outputs stimulate the Device Under Test, the inputs measure the response, and the ***ADwin*** CPU analyzes the response online. With the ***ADwin*** Real-Time capabilities for online evaluation, these tests can run for weeks or months with high sampling rates and without filling stacks of hard-disks with redundant data.

Example – Relays & Switch Test: The wear and switching behavior of relays and switches is recorded for millions of switching cycles, with several test cycles per second. The ***ADwin*** system initializes each switch, measures the analog response with some MHz, calculates the switching behavior for each cycle, and logs the resulting switching parameters with µ-second resolution in a file.





Examples of typically tested components

- Sensors, actuators, and ECUs
- CAN, LIN, SENT, PSI5, FlexRay, SPI Devices
- Relays, switches, connectors, contacts
- Semiconductors, circuit boards
- Hydraulic pumps, valves, and cylinders
- Magnetic valves, injection valves
- Pipes and tubes

Sensor, Actuator, ECU Tests, CAN, LIN, FlexRay, SPI

ADwin offers various solutions for functional tests of ECUs (Airbag, ABS, ESP, …), as well as for CAN devices, LIN devices, sensors, actuators, and other automotive electronic components.

By using ***ADwin***, the hardware and software of the ECU can be completely tested, with signal timings accurate down to the sub-microsecond range. The ***ADwin*** system tests the ECU by generating specific test signals, and stimulates the ECU via multiple analog and/or digital output channels, or messages on the CAN bus. These test signals simulate ‘real world’ data, such as vehicle speed, engine temperature, acceleration, etc. In parallel to the stimulation, ***ADwin*** simultaneously monitors the outputs of the ECU and CAN/LIN messages, and analyzes in Real-Time whether the ECU response corresponds to the specifications.

Similar procedures can be used to test a wide variety of automotive sensors, actuators or components.

Simulation of SPI devices

There are two types of applications around SPI devices:

- Simulation of SPI devices; sensors, ADCs, DACs
- Test of SPI devices

Simulation of SPI devices is widely used in applications where the SPI device is not yet mounted into a target system, for example an ECU, while the target system must already be tested for hardware or software stability. The job of the ***ADwin*** system is to simulate the functionality of the SPI device, by using the same device-specific SPI protocol and offering the same type of data or data structure like the SPI device itself.

Testing of SPI devices – While ***ADwin*** maintains SPI communication, it also acquires the device's analog response, or stimulates the device in order to get a SPI feedback. ***ADwin*** tests the SPI device for all its specifications, analog, digital, SPI protocol, shocks, temperature, etc.

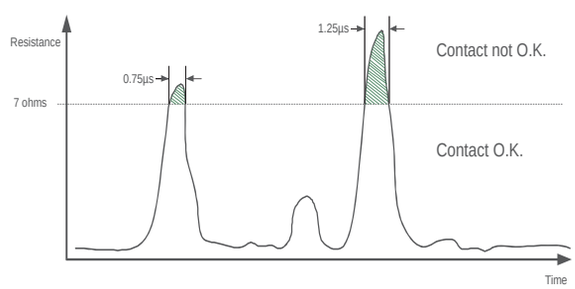
Intelligent CAN Multiplexer and Matrix

An ***ADwin*** system may serve 1…30 separate CAN bus hardware channels, with connections to sensors, actuators and ECU control devices. Incoming messages from any CAN channel may be evaluated in the Real-Time system immediately after arrival of the message. It is important to understand, that the ***ADwin*** system's Real-Time performance is much higher than the CAN bus performance. After arrival of CAN messages, any kind of mathematical and logical software may be performed in Real-Time, and results may be sent as new messages to software selected CAN channels. Beside this job, ***ADwin*** also may handle rest-bus simulations such as life-cycle counter messages or others. Also ***ADwin*** may work as intelligent gateway to different bus types.

Dynamic Contact Test – Detection of µ-Interruptions

ADwin has powerful counter and comparator functions for analog or digital signals. One unique application is the detection of µ-second interruptions at contacts on:

- Connectors
- Smart cards, SIM cards
- Relays, switches, keyboards (phone)
- Circuit boards, cables



ADwin detects µ-interruptions by sampling the contact voltage, current or resistance at sampling speeds of 50 MHz, performing a comparison function, calculating the length, amplitude, size of an interruption, and storing the result in a statistical distribution for every sampling step. The test can run continuously for days or weeks, while at the same time allowing the user to access the statistical information of all µ-interruptions, as well as the raw data, without stopping the test or missing any interruption.

Applications

Control of Scanning Microscopes

A 2-dimensional image is taken by a XY-scan of the sample surface. The microscope measures the height profile of the sample surface with a beam (Laser, electron, ion), or an extremeLY sharp needle, or by use of the tunneling effect. A 3-dimensional image, is taken by a XYZ-scan of the sample representing the surface profile of the sample, e. g. biological cell samples. XY are position variables, while Z is the measured height.

ADwin performs this XY/XYZ scan by writing position signals and focus signals via analog outputs to amplifiers for piezoelectric nano positioners. ***ADwin*** also reads back the response, or performs a closed loop control (raster tunneling, atomic force). This scan can be at a fixed velocity with a constant update of XY position at a µs rate. Or, the scan can be at a variable rate, where the system waits at every position until a minimum feedback level or error level is reached which allows this technique to increase the image quality.

ADwin systems are used for various types of scanning microscopes, such as

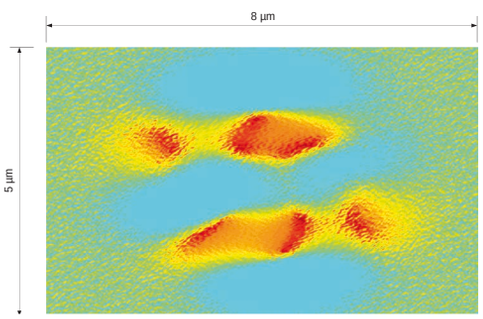
- Laser Microscope, Laser Focal Microscope
- Tunneling Microscope
- Electron Beam Microscope
- Atomic Force Microscope (AFM)
- Focused Ion Beam Microscope (FIB)

Electron Beam, Laser Application

Applications with electron beam or Laser control are a perfect fit with ***ADwin***'s control capabilities. ***ADwin*** performs multi-channel beam deflection, control of beam position, intensity, focus, etc. Typical scan rates are 0.5 … 20 µs per step, with a constant timing or a variable process-controlled adaptive timing.

Typical ***ADwin*** jobs:

- Microscope applications
- Magneto-optical traps
- Deflection, intelligent adaptive deflection
- Laser marking
- Various research applications
- Welding, temper material
- Surface refinement



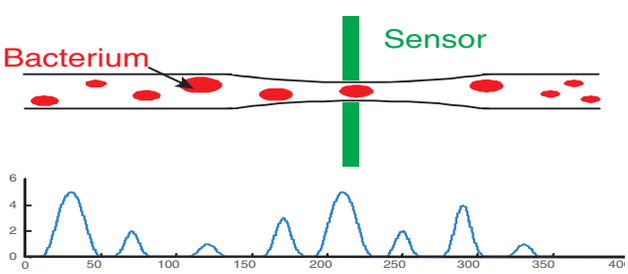
Statistical Data Online Analysis

Spectroscopy, evaluation of a signal distribution, particle sizes analysis are just some applications in the field of online data analysis.

ADwin can read analog and digital signals and perform an online analysis in the same sampling step.

Example – particle sizes online analysis and statistic

In a fluid there are very small particles. These particles can be measured while the fluid streams through a small pipe. A sensor in this pipe gives feedback of the diameter of a current particle, while the particle passes by the sensor typically within 0.5…10 ms. ***ADwin*** measures the sensor signal up to a 1 MHz, evaluates the length of the particle, calculates the size of the particle, and stores the result in a statistical distribution. This test can run for days and weeks continuously, even at 1 MHz sampling rate.



Data-Reduction, Up-Sampling, Down-Sampling

For tests of new prototypes in a test stand, real-world data from mobile data acquisitions is often required. Such data acquisition is performed over hours and days, so an intelligent **data reduction** algorithm is required.

One of many algorithms is to store min/max signal values together with a timestamp.

Back in the test stand this min/max/timestamp data is reconstructed, by using a half cosine curve interpolation to connect consecutive min/max points.

ADwin performs both, data acquisition in the field with data reduction, and reproduction of the field data in the test stand, plus test stand control if needed.

Up-sampling – In some test stand applications the device under test is stimulated with raw field data, while the test stand has a higher dynamic bandwidth compared with the raw data that was measured at a lower acquisition rate. To prevent this test against sample induced vibration and to smooth movements, the raw data can be up-sampled online by the ***ADwin*** system to interpolate points.

Magneto Optical Traps - MOT

A magneto-optical trap (MOT) is used to cool down atoms to temperatures near absolute zero. The MOT traps these atoms to a certain position by using magnetic fields and circularly polarized laser light.

ADwin's job is to control the laser and the magnetic fields by its analog outputs and digital outputs.

A typical configuration consists out of 16 to 32 analog outputs plus a larger number of digital outputs that control other devices like amplifiers, or DDS units.

Table of Contents

You find the current ***ADwin*** brochure on www.***ADwin***.us

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