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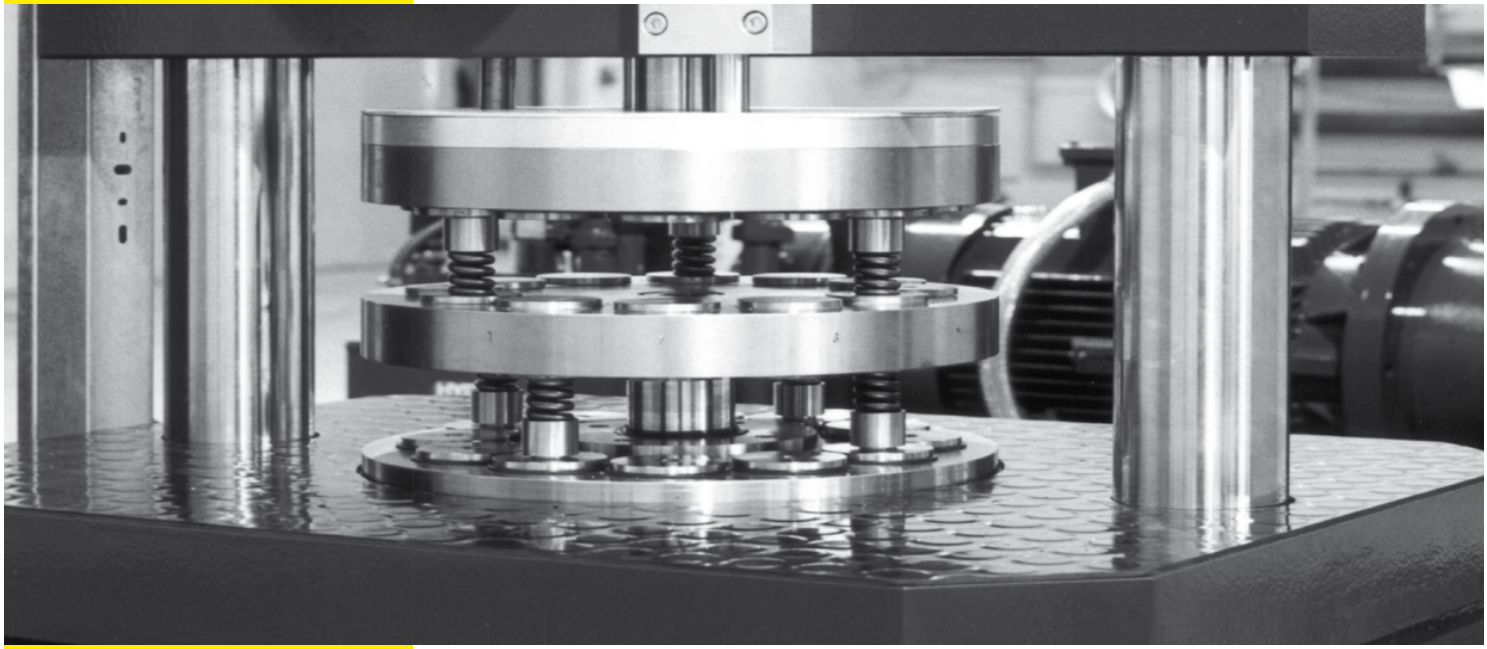
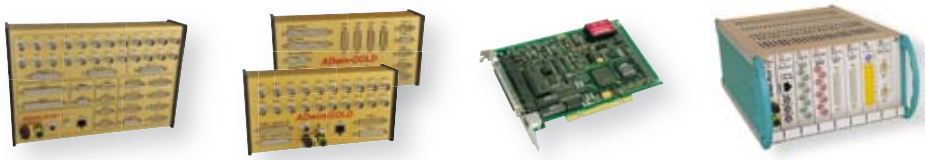
ADwin

Simply more Real-Time



Data Acquisition and Control

JÄGER
Computergesteuerte
Messtechnik GmbH



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ADwin
Real-Time Systems

ADwin systems are used by engineers and scientists around the world for Real-Time applications where **deterministic** timing is required.

ADwin programmable data acquisition and control systems allow many different types of applications to run with precise Real-Time performance. This makes ***ADwin*** a universal platform suitable for many different types of functions, applications and industries.

ADwin offers more than 16 years of experience in automation and deterministic Real-Time applications. With software solutions since 1987, and with ***ADwin*** hardware sytems since 1992, many thousands of users and applications worldwide, relying on these precise and robust systems.

ADwin offers standard hardware and software, developed by experienced engineers, produced in our high-tech production lines. For very specialized applications, customized hardware or software turnkey solutions are also available.

Pre- and post-sales **consultation and engineering** for our customers is one of the great benefits of using ***ADwin*** systems. Please take advantage of this and feel free to contact us, we will discuss your project jointly with you.

Real-Time Functions

- Intelligent data acquisition
- Complex trigger applications
- Online analysis of measurement data
- Open-loop control functions
- Closed-loop control functions
- Signal/Waveform generation

Application Fields

- Production and R&D test stands
- Production line automation systems
- Laboratory and mobile systems
- Fast machine control applications
- Material endurance tests
- Quality assurance tests

Typical Industries

- Automotive and Aerospace
- Semiconductor and component testing
- Machine builders
- Scientific and Industrial Research
- Nano-Science
- Laser and Electron Beam Industries

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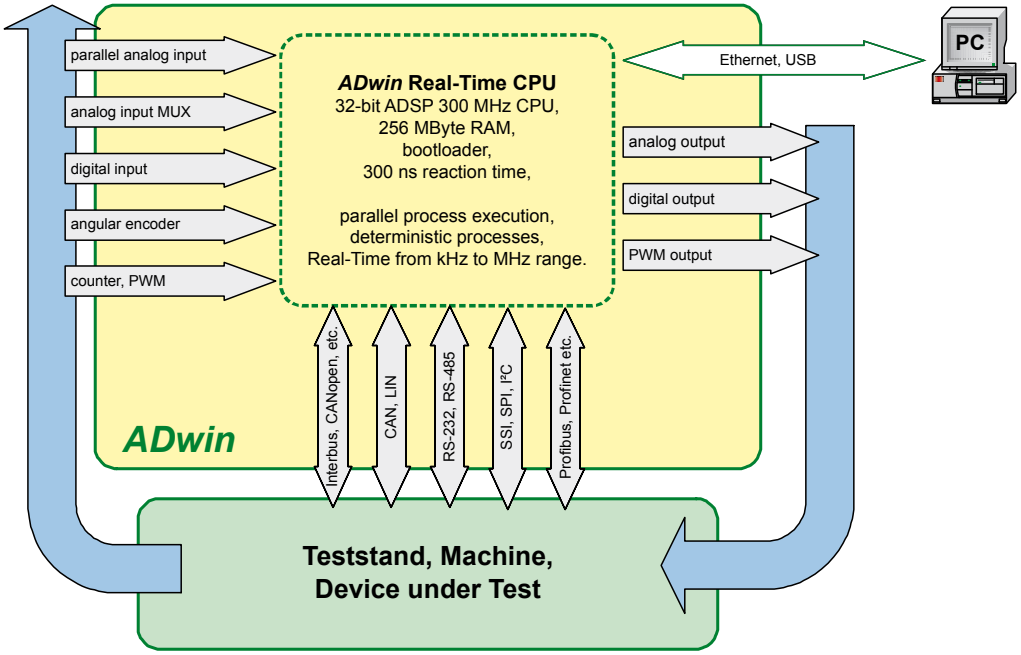
The *ADwin* Real-Time Concept

ADwin systems are characterized by deterministic execution of intelligent data acquisition and control applications. This is achieved by a local CPU (DSP), the Real-Time heart of every ***ADwin*** system. The CPU is responsible for all Real-Time functions and guarantees deterministic process execution, independent of the PC and its workload. ***ADwin*** systems work in close cooperation with the Windows-PC, but there is a clear job sharing: the job of the ***ADwin*** system is to execute fast and deterministic processes in Real-Time, while the Windows PC performs standard functions such as displaying graphical user interfaces for applications, visualization of data, and data base accesses.

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

In addition to the CPU, there is a large local memory for program code and measurement data, analog I/Os, digital I/Os, counters, different interfaces, expansions and options.

The communication between the ***ADwin*** system and the PC is done via Ethernet or USB. Fieldbus interfaces allow the connection to PLCs, while a bootloader supports complete stand-alone operation 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 and a control function, or an online analysis can follow immediately. The best solution for fast Real-Time applications is to place a dedicated CPU close to the signals with its own resources for processing the data.

The ***ADwin*** CPU runs an optimized Real-Time multi-tasking operating system; only this combination provides exact, predictable process response times as short as 300 ns. Applications with process cycle times from 'ms' down to 'µs' range, from kHz up to a MHz, can run perfectly on ***ADwin*** in Real-Time.

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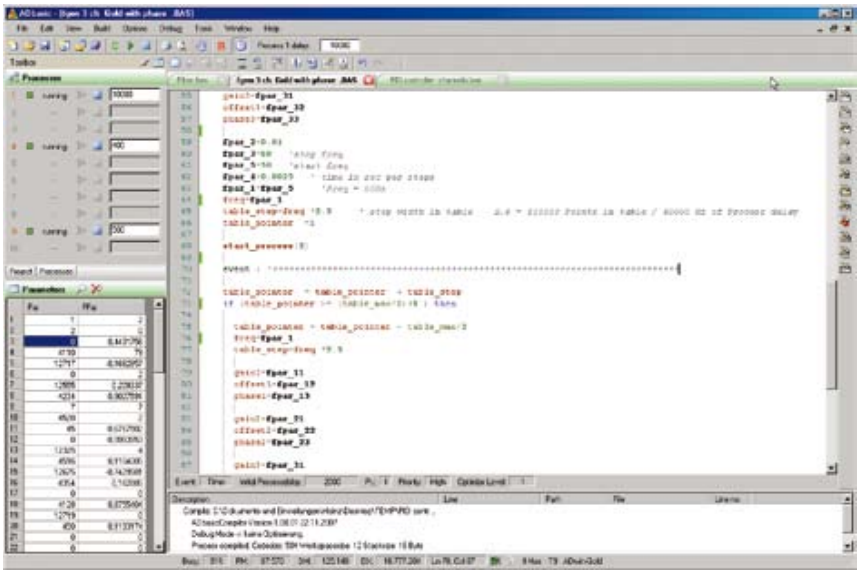
ADwin Software *ADbasic*

Real-Time Software Development Tool – *ADbasic*

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, use open and closed-loop controllers, or generate any kind of periodic or non-periodic waveforms, ***ADbasic*** is always the key for 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 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 simultaneously 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 in the long term perspective, by using future hardware together with your currently developed code. This saves your today's development costs in a long term perspective.

```
DIM a,b as FLOAT
DIM X1,X2 as INTEGER
DIM X3,X4 as INTEGER

INIT:
 a=12
 b=0,34

EVENT:
 X1=adc(1)
 X2=adc(2)
 X3=adc(3)
 X4=adc(4)

 Y=X1/a+ X2*b
 dac(1,Y)

 Z=func(X3,X4)
 dac(2,Z)
```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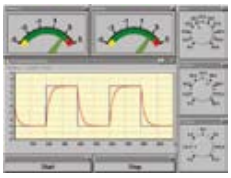
ADwin Software Drivers, *ADtools*, *ADlog*

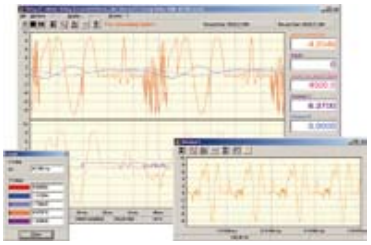
Graphical User Interface and Debugging Tools – *ADtools*

ADtools is a collection of indicators and controls to exchange parameters with the ***ADwin*** system and for the visualization of measurement data. These tools are ideal for the ***ADbasic*** software development and for quick lab-applications. They offer direct access to all ***ADwin*** resources, as well as data storage to files and direct data transfer to Excel.



Free Datalogging Package – *ADlog*

ADlog is a data logging program for ***ADwin*** systems. Analog, digital, counter, and CAN signals can be acquired, visualized and stored in different file formats, such as ASCII, CSV, binary and DIAdem.



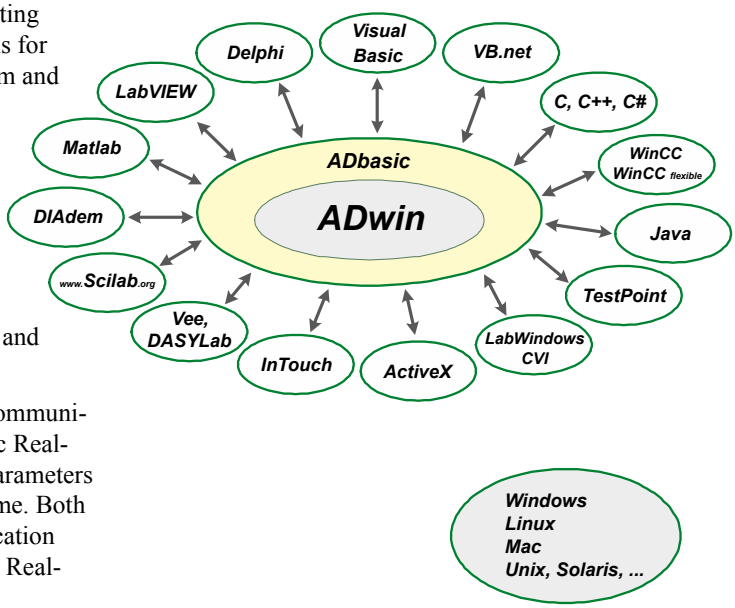
ADtools and ***ADlog*** are supplied free of charge together with an ***ADwin*** system.

ADwin Drivers

Drivers are available for a wide range of PC programs under the Windows, MacIntosh or Linux operating systems. The software drivers provide functions for communication between PC, the ***ADwin*** system and ***ADbasic*** processes:

- bi-directional data exchange of variables,
- arrays and data structures,
- FIFO data exchange,
- system booting and process downloads,
- starting and stopping processes,
- monitoring and control of system variables and resources.

One of the key benefits in the ***ADwin***-to-PC communication is the possibility to run fast deterministic Real-Time processes AND communicate data and parameters between PC and ***ADwin*** system at the same time. Both have no influence on each other: the communication does not disturb the deterministic timing of the Real-Time processes and vice versa.



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Compact Real-Time Systems

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

ADwin-Gold II and ***ADwin-Gold*** are built in a robust metal enclosure and include 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*** 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 **

- 32-bit floating-point Real-Time DSP, 300 MHz
- 768 kB CPU RAM, 256 MB DRAM
- 16 diff. analog inputs, MUX, 2 × 18-bit 2 µs ADC
- 2, 4 or 8 analog outputs, 16-bit DAC
- 32 digital I/O, 1 Trigger input, TTL/CMOS
- 4 Counter, 32-bit; event, period, duty cycle, up/down, encoder interface, PWM, frequency
- Interfaces 4 × SSI, 2 × RS-232/485
- 2 × LS-Bus for HSM module access
- 2 × CAN, Automotive, CANopen, Profibus, others
- Ethernet interface to PC, Bootloader
- Compact metal enclosure, DIN rail mounting kit

* Product features: standard and options

*ADwin-Gold **

- 32-bit floating-point Real-Time DSP, 40 MHz
- 256 kB CPU RAM, 16 MB or 64 MB DRAM
- 16 differential analog inputs via MUX and 2 × 16-bit 5 µs ADC and 2 × 14-bit 0.5 µs ADC
- 2 or 8 analog outputs, 16 bit DAC 16-bit
- 32 digital I/Os, 1 Trigger input, TTL/CMOS
- Counter, 4 × 32-bit, event, period, duty cycle, up / down, encoder interface, PWM input
- 4 × SSI, 2 × RS-232/485
- 2 × CAN bus, Automotive CAN, CANopen
- Ethernet or USB interface to PC, Bootloader
- Compact metal enclosure, DIN rail mounting kit

*ADwin-light-16 **

- 32-bit floating-point Real-Time DSP, 40 MHz
- 256 kB CPU RAM, 16 MB RAM
- 8 differential. analog inputs, MUX, 16-bit 2 µs ADC
- 2 analog outputs, 16 bit DAC
- 6+6 digital I/O, 1 trigger input, TTL/CMOS
- 32 digital inputs/outputs, TTL/CMOS
- 1 or 2 counter; event, period, duty cycle, up/down, encoder interface, PWM, frequency
- 1 × CAN bus, Automotive CAN, CANopen
- 1 × LS-Bus for HSM module access
- Ethernet or USB interface to PC, Bootloader
- Customized OEM versions available

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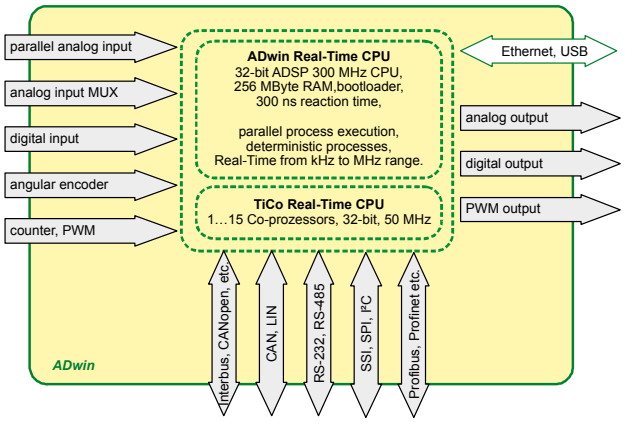
TiCo
Real-Time Co-Processor

TiCo processor

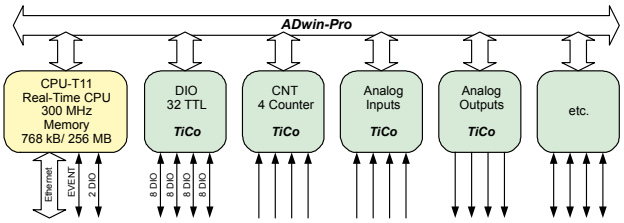
There is a new enhanced Real-Time CPU for ***ADwin*** systems, the embedded ***TiCo*** processor (Timing Controller). This processor is used as a co-processor in the system and it has access to the specific module inputs/outputs, while the ***ADwin*** main CPU has access to the ***TiCo*** variables, data and processes. The ***TiCo*** can handle several programs in parallel in a multitasking mode.



The ***TiCo*** processor opens a new door for deterministic applications with a timing precision of nanoseconds. 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.

The ***TiCo*** program development environment is ***TiCoBasic***, it has the same look and feel, and it is as easy as the existing ***ADbasic*** language.



Typical *TiCo* applications

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

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

TiCo processor specifications

- 32-bit integer CPU, 50 MHz clock
- Co-processor on ***ADwin*** systems
- Highly optimized CPU instruction set for application code accurate to nanosecond level
- ***TiCoBasic*** development tool
- Bootloader

TiCo Availability

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

- ***ADwin-Pro II***
- ***ADwin-Gold II***

and is used in addition to the standard ***ADwin*** CPU. Up to 15 ***TiCo*** processors in tandem with the main ***ADwin*** CPU, make ***ADwin-Pro II*** an extremely powerful Real-Time system.

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ADwin-Pro II

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 the ***ADwin-Pro II*** offers a flexible, adaptable solution for various applications. It supports signal counts from a single channel up to several hundred channels. A wide range of I/O modules, chassis, processors and memory options allows a customization of the system for universal use, especially in industrial applications.

The system communicates via Ethernet to a Windows PC, via a Fieldbus interface with a PLC, or is running stand-alone with a bootloader option.

Fast deterministic CPUs

The heart of every ***ADwin***-Pro system is a fast dedicated Real-Time CPU, responsible for all deterministic functions in the system. The applications run completely independent from the PC and its operating system. The CPU software timing is completely predictable, which enables precise control of all processes. Run multiple processes (tasks) in parallel with high speeds from kHz to hundreds of kHz, even up to MHz – in Real-Time.

Pro-CPU-T11-ENET

Real-Time execution is based on a 32-bit floating-point DSP and optimized operating system. The Pro-CPU-T11 processor module contains a 300 MHz ADSP processor, 768KB CPU RAM, 256 MB DRAM, Ethernet interface (10/100Mbit/s) for PC communication and a trigger input.

Pro-Boot

Boot-loader option for Ethernet Pro-CPUs; loads the software to the ***ADwin***-Pro CPU without a PC and starts the software processes automatically.

Analog Input Modules

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

- multiplexed analog inputs
- parallel synchronous analog inputs, with one ADC per channel
- on-board RAM buffer for high-speed measurements
- embedded ***TiCo*** Real-Time co-processor
- signal conditioning, extended voltage ranges, filters

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. Different 4 and 8 channel modules are available, with a resolution/speed of 14 bits at 50 MHz or 18 bits at 500 kHz.

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.

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Parallel Analog Output Modules

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 wave form 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.

The ***ADwin-Pro II*** system offers 4 or 8 channels analog output modules with 16 bit resolution. The output range is ±10V 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.

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.

Digital I/O Modules, Comparators

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 -2 V…8 V, other ranges are possible on request.

Signal Conditioning and Filter Modules

ADwin offers signal conditioning modules for RTD/PT100, thermocouple, and low voltage ranges. Or with standard 8B modules, strain gage, current, resistance and high or low voltages inputs.

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
- SPI, I²C
- LS-Bus
- Profibus, Interbus, CANopen, Profinet, etc.

TiCo processor on *ADwin-Pro II* modules

The ***TiCo*** embedded Real-Time processor is used on ***ADwin-Pro II*** modules as a co-processor in the system. This processor has access to the inputs/outputs of the specific module it resides on, while the ***ADwin*** main CPU has access to the ***TiCo*** variables, data and processes.

Use the ***TiCo*** to improve ***ADwin-Pro II*** modules to an intelligent Real-Time front end.

Cables and Adapters

A variety of cable sets and adapters are available to connect the ***ADwin-Pro II*** modules to sensors and other hardware.

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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.

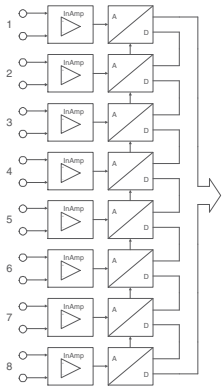
In the simplest applications, data is acquired for a period of time and stored.

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 contains information are acquired and stored, the rest can be discarded.

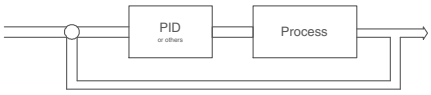
Data reduction – Data acquisition with online analysis or intelligent, trigger conditions provide significant data reduction. Also it is possible to change sampling speed online, based on the signal information content. Even with high sampling rates in the range of kHz up to MHz, it is possible to acquire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

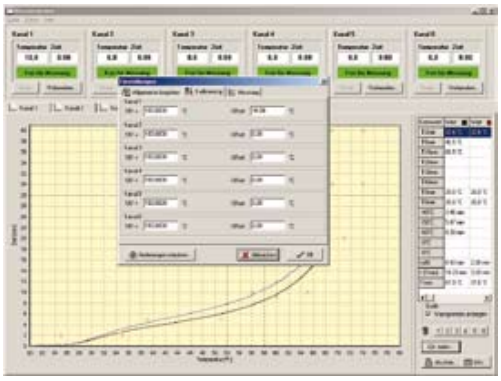
Example: ***ADwin-Gold*** can run 8 × PID at 40 kHz, or 2 × PID at 200 kHz; ***ADwin-Gold II*** with up to 8 × 200 kHz and the fastest ***ADwin-Pro*** system allow 20 × PID at 100 kHz. The maximum speed for a PID controller is 1 MHz.



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.



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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.

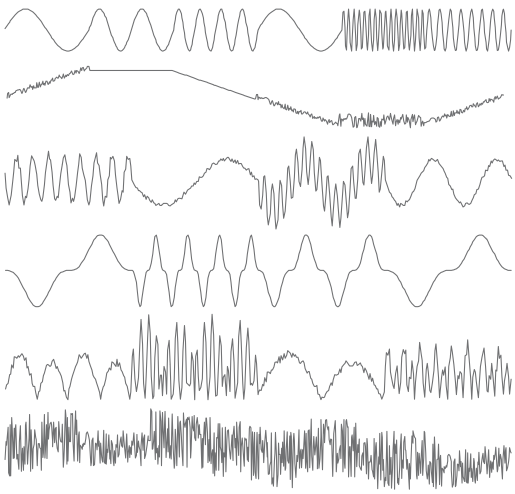
For high speed applications, multi-channel arbitrary waveform generators with large memory buffers are available. You can also combine different waveforms and overlay them to construct multi-frequency signals.

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 it 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



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.

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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 electrical (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 components
- Power train components
- Various prototypes
- Aerospace components
- Materials
- Steel, plastics, rocks
- Pipes and tubes
- Railroad components

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Applications

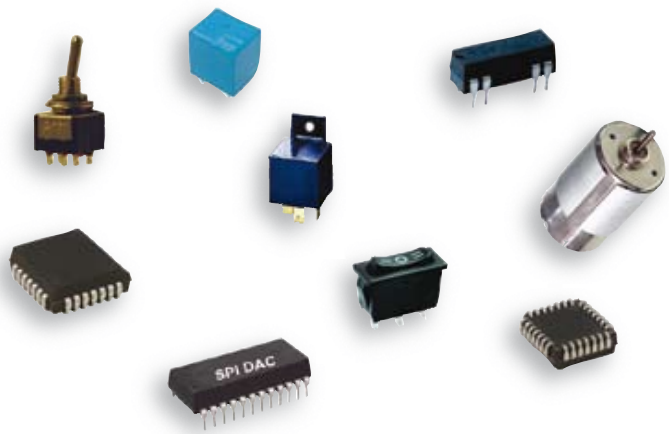
Component Tests in R&D / Production

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-discs 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.

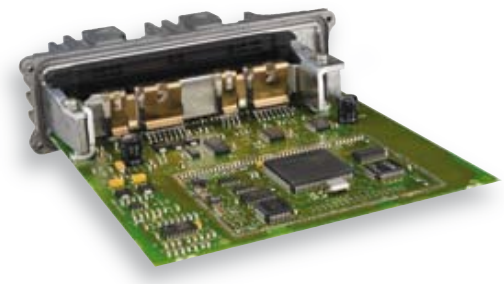
Examples of typically tested components

- Sensors
- CAN, LIN, FlexRay, SPI Devices
- ECU's
- Relays, switches
- Connectors, contacts
- Semiconductors,
- Circuit boards
- Small electrical motors
- 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.

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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 extreme 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 signal 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

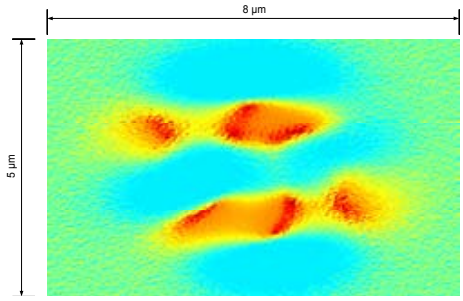
- Laser Microscope, Laser Focal Microscope
- Tunneling Microscope
- Electron Beam Microscope
- Atomic Force Microscope (AFM)
- Focused Ion Beam Microscope (FIB)

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

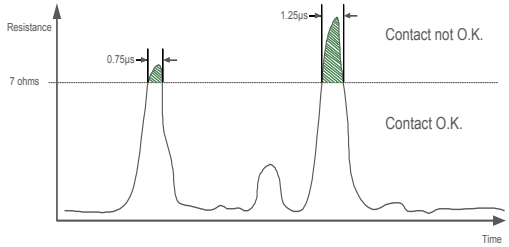


Dynamic Contact Test – Detection of µ-Interruptions

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.



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Applications

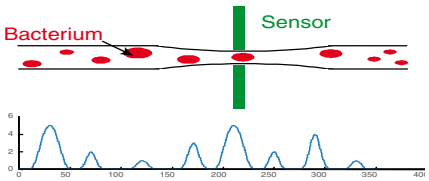
Statistical Data Online Analysis

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.

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.

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.

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