Real time exact to the microsecond in the Windows® environment, with a PLC or stand-alone

# Industrial Control and Data Acquisition Systems: *ADwin*

**KEITHLEY**

A GREATER MEASURE OF CONFIDENCE

# ADwin

## Real-Time Control, Measurement and Automation Systems

- Deterministic and robust operation from a dedicated CPU with a real-time operating system
- Working with a Windows-PC, connected to a PLC or stand-alone
- 32-bit Floating-Point CPU (Analog Devices SHARC-DSP), local DSP-RAM, up to 32 MB DRAM
- Analogue and digital I/Os, parallel synchronized analogue inputs, multiplexed analogue inputs, counters, PWM-I/Os, filters, isolation amplifier, thermocouple and RTD inputs; interfaces for CAN-bus, Profibus, Interbus, RS-232, RS-485, Bootloader for stand alone applications, other fieldbus interfaces on request
- Ethernet or USB interface for PC communication
- Real-time development software; *ADbasic*

**Drivers:** TestPoint, LabVIEW™, LabWINDOWS™, Delphi™, HP-VEE™, InTouch™, DIAdem™, Matlab™, Visual-BASIC™, VBA: Excel™, ACCESS™, Word™, Visual-C™, C/C++, Active-X, others on demand.
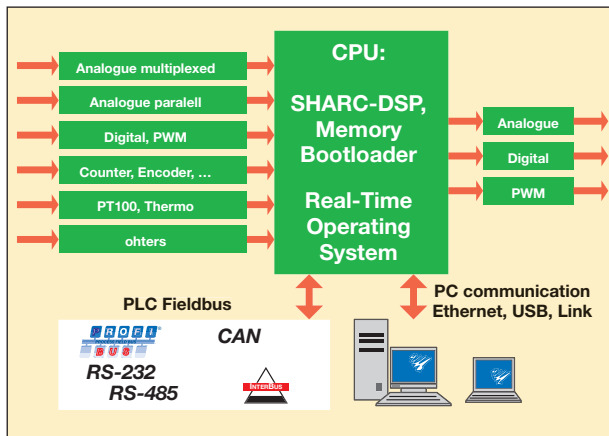


## The *ADwin* Concept

MS Windows™ is not designed for real-time applications. The best solution for for fast real-time applications is to place a dedicated CPU close to the signal source and therefore having it's own resources for the purpose of processing the data. Only this structure gives the ability of exact response times with predictable delays. *ADwin* applications always run in real-time; every sampled value or event can be evaluated in the same step and a control function or online analysis etc. can follow immediately. This is provided by the *ADwin* systems' concept with a local CPU, additional analogue & digital interfaces and different expansions or options. The local CPU is a fast 32-bit Floating-Point DSP with internal memory for executable real-time software code and external SDRAM for data. This DSP in combination with the real-time development tool *ADbasic* provides for fast, deterministic program execution with a guaranteed reaction time of less than 1 μs.

## Communication Interfaces

For operation with a PC, Ethernet or USB interfaces are available. For industrial use with a PLC, there are fieldbus interfaces like Profibus, Interbus, CANbus, etc. and serial interfaces.

## *ADwin* Platforms

There are three different *ADwin* series: *ADwin-Light, ADwin-Gold* and *ADwin-PRO*. The *ADwin-Light* and *ADwin-Gold* systems are designed as price sensitive solutions for applications with a limited number of I/Os. For more channels and flexible configurations the modular, expandable *ADwin-PRO* system is recommended.

## Typical *ADwin* Applications

- Production and R & D test stands
- Production line automation systems
- Data acquisition systems for laboratory or mobile use
- Fast machine control applications
- Automotive test stands for: vibration, diesel/gasoline engines, gearbox, CAN-devices, ABS, brakes, tyres, control units, exhaust systems, bearings, valves …
- Positioning controls with servo motors, stepper motors, piezo drives …
- Component test for: relays, switches, electronic components, ICs, semiconductors, control units …
- Control of scanning processes for: microscopes, surface refinements with electron beams or lasers …
- Stand-alone applications, fast intelligent programmable automation devices, etc.

## Typical *ADwin* Functions

- Data acquisition: multiplexed and parallel measurements, timer or event based, threshold-control, complex triggering, online analysis and data reduction, parallel simultaneous measurements, different sample rates per channel, wide range RPM measurements, process identification
- Fast digital controller: PI-, PID-, cascade, adaptive, state space controllers, design and test of different control strategies, i.e. multi-channel PID (from kHz to hundreds kHz)
- Signal synthesis and generation: multi-channel frequency generators, periodic or non-periodic wave forms, random interference signals; frequency, phase, amplitude and offset, online adjustable, values directly output and/or passed as variables for parallel controller processes (e.g. PID controllers)
- Online signal processing, statistical evaluations, digital filtering, LP, BP, HP, FIR, IIR, FFTs, etc.

## Real-Time Software

Running independently of the PC, its operating system, application software and associated overheads; the **ADwin** system supports individually controlled, parallel processes on a single processor. The PC can access **ADwin** at any time to exchange data, start or stop processes or load new processes to the system. **ADwin** systems add real-time capability to a Windows PC! If the Windows PC crashes, the **ADwin** system will continue to run, maintaining integrity of the application.

**ADbasic** is the integrated development environment to create fast real-time measurement and control processes for **ADwin** systems. **ADbasic** is a compiler with standard high-level language commands and special commands (e.g. adc, dac, digin, etc.), for direct access to all inputs and outputs. Additional functions and driver routines allow the automatic transfer of data between the **ADwin** system and the PC. **ADbasic** generates fast binary code that can be downloaded to the **ADwin** systems by all the supported PC software environments.

Early **ADwin** systems used transputers, the current versions use DSPs, future versions will use new processors when appropriate. BUT **ADbasic** remains the software platform for all CPU types. A single compiler option allows use of the same **ADbasic** code across all processors; providing backward and future compatibility.

# ADwin-Light-16
## Compact Industrial Real-Time System with Different Designs

The **ADwin-Light-16** follows the standard **ADwin** concept with a fast local CPU, analogue and digital inputs/outputs on a single system. Based on one common design, there are three different versions: a PCI plug-in board, a Euro-size plug-in board, an external system in a robust metal enclosure, and a CPCI version. It is designed as a reasonably priced solution for applications with a limited number of I/Os.

- 32-bit Floating-Point DSP, 256 kB CPU SRAM, 8 MB SDRAM
- 8 Analogue Multiplexed Inputs, 16-bit 10 µs ADC
- 2 Analogue Outputs, 16-bit 2 µs
- 6+6 Digital Inputs/Outputs, TTL/CMOS
- Software Calibration of analogue I/O
- 2 32-bit Counters
- 1 Trigger Input, TTL/Cmos
- USB Interface
- Fieldbus Interface (planned)
- Up/Down Counter (optional)
- Additional I/O, CAN, … (planned)

Configuration: 32-bit Floating-Point SHARC-DSP, 8 MB memory, 8 analogue multiplexed inputs 16 bit/10 µs, 2 analogue outputs with a settling time 20 V of 2 µs, 6+6 digital I/Os and two 32-bit Pulse Counters. USB interface to the PC, Ethernet is planned. There is an optional up/down counter with quadrature evaluation (replaces standard counters).



**ADwin-L16-EXT**



**ADwin-L16-EUR**



**ADwin-L16-PCI**

## ADwin-Light-16 Series Ordering Information
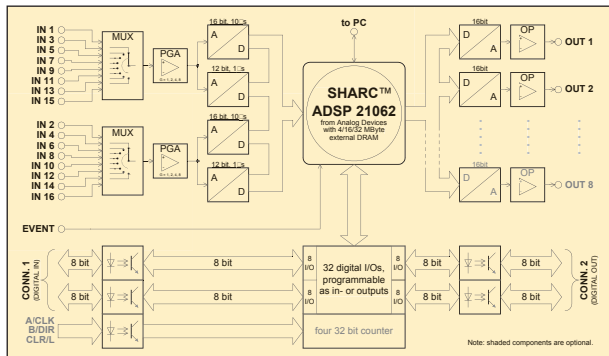
| | |
|---|---|
| **ADwin-L16-PCI** | PCI plug-in board |
| **ADwin-L16-CPCI** | Compact PCI plug-in board |
| **ADwin-L16-EURO** | EURO-size plug-in board, needs 5 VDC from DIN-connector 96pin, USB cable |
| **ADwin-L16-EXT** | In a robust metal enclosure, needs 10-18 VDC power supply, USB & power cable |
| **Options (manufacturing options only, no upgrade possible)** | |
| **ADwin-L16-CO1** | 1 channel up/down counter, quadrature evaluation, replaces standard counters |
| **ADwin-G-MEM-512K** | memory option of 512 kB local CPU memory (replaces the standard 256 kB) |
| **ADwin-L16-pow** | Power supply device (12 VDC) for **ADwin-L16-EXT** |

# ADwin-Gold

## Compact Robust Industrial Real-Time System

The **ADwin-Gold** system follows the standard **ADwin** concept with a fast local CPU, memory, analogue & digital inputs/outputs on a single system. It is designed in a robust metal enclosure and has to be connected to a PC or a notebook computer via Ethernet, USB or Link.

**ADwin-Gold** has 16 analogue inputs. There are two input blocks, with 8 analogue inputs each, connected to a multiplexer. The multiplexer outputs are connected with two different 1 µs ADCs: a 12-bit ADC to execute very fast measurements and a 16-bit ADC (10 µs) for highly accurate measurements. The ADCs can be started in synchronous or asynchronous mode.

The standard version of the **ADwin-Gold** system is equipped with two analogue outputs with 16-bit Resolution, optionally up to eight are possible. The low-level settling time (<2 V) is 3 µs; the full range settling time (20 V) is 10 µs. A synchronous update of the DAC outputs is possible.

The system has 32 user-defined, TTL-compatible digital I/Os, configurable in groups of eight as input or output, and a trigger input (EVENT). The trigger input is used for external control of program sequences. The option **ADwin-Gold-opt** isolates the digital I/Os. The counter option **ADwin-Gold-Co1** provides four 32-bit Counters for period width measurement, pulse measurement, or up/down counters with clock/direction or quadrature evaluation. The bootloader option **ADwin-Gold-Boot** allows standalone operations (only in combination with Ethernet interface).



- 32-bit Floating-Point DSP, 256 kB CPU RAM, 4 MB DRAM
- 16 analogue inputs
  2 × 16-bit 10 µs ADC and
  2 × 12-bit 1 µs ADC
- 2 analogue outputs: 2 × 16 bits DAC 16-bit, 10(3)µs
- 32 digital inputs/outputs, TTL/CMOS

- 1 trigger/event input, TTL/CMOS
- Link interface to PC
- Compact Metal Enclosure

### Optional configurations
- USB interface to PC
- Ethernet interface to PC
- 4 × 32-bit Counters, event, period, up/down with encoder interface, PWM input
- Isolated digital I/O
- Up to 8 analogue Outputs
- 16-MB or 32-MB memory
- Bootloader

## ADwin-Gold Ordering Information

| **ADwin-Gold** Standard System | |
|---|---|
| **ADwin-Gold** | **ADwin-Gold** with PC-ISA link adapter with 2-m link cable/power supply cable included |
| **ADwin-Gold-USB-Set** | **ADwin-Gold** with USB interface adapter, 1.8-m USB cable, power supply cable for desktop PC included |
| **ADwin-Gold-ENET-Set** | **ADwin-Gold** with Ethernet 10/100 Mbit interface adapter (TCP/IP protocol), 1.8-m Ethernet cross-over cable, power supply cable for desktop PC included |
| Options (manufacturing options only, no upgrade possible) | |
| **ADwin-G-MEM/16** | Memory expansion from 4 MB to 16 MB |
| **ADwin-G-MEM/32** | Memory expansion from 4 MB to 32 MB |
| **ADwin-G-MEM-512K** | Memory option, 512 kB local DSP memory, replaces the standard 256 kB |
| **ADwin-Gold-DA** | Additional analogue outputs, 6 channel, 16-bit |
| **ADwin-Gold-Co1** | Counter option, four 32-bit Counters, software selectable for: period width measurement, pulse width measurements, up/down counters with clock/direction or quadrature evaluation |
| **ADwin-Gold-Opt** | Isolation of the digital inputs/outputs and counters (if counter option) |
| **ADwin-Gold-DA/Opt** | Combination of **ADwin-Gold-opt** and **ADwin-Gold-DA** |
| **ADwin-Gold-Boot** | Bootloader for standalone operations (only in combination with Ethernet interface) |
| **ADpcmcia** | Link adapter board for connecting a notebook computer, 2-m cable included |
| **ADwin-Gold-pow** | Power supply device (12 VDC) for **ADwin-Gold** |

# ADwin-Pro
## Industrial Modular 19-inch System

**ADwin-PRO** is a modular, expandable, intelligent real-time system for fast data acquisition and control applications in industrial environments. The modular design of the **ADwin-PRO** offers flexible adapted solutions for all kind of applications, with signal counts from single channels up to several hundred. A wide range of I/O modules, chassis, microprocessors and memory options allows customization of the system for universal use, especially in industrial applications. The system runs via USB or Ethernet in conjunction with a Windows PC, via a Fieldbus interface with a PLC, or as a standalone unit with a boot loader.

- Modular, flexible design, VARIOUS chassis
- Operation with a Windows PC, a PLC or standalone
- 32-bit Floating-Point DSP, 256 kB CPU SRAM, 4 MB SDRAM
- Memory options
- Analogue input and output modules
- Analogue inputs with parallel ADC
- Digital input and output modules
- Counter, Encoder and PWM modules
- Filters, fixed or programmable types
- Amplifiers for thermocouple and RTD
- Isolation amplifier
- CAN bus, Profibus and Interbus interfaces, others on request
- RS-232, RS-485 interface
- Boot loader for standalone applications
- Ethernet interface to PC
- USB interface to PC

**USB** B

**ETHERNET**



**ADwin-PRO** full 19" chassis



**ADwin-PRO-Light**



**ADwin-PRO-mini**

# *ADwin-Pro*

## Industrial 19-inch system

### *ADwin-Pro* Ordering Information – Base Modules

| *ADwin-Pro* Standard Chassis | |
|---|---|
| The 115/230 VAC power supply is a series regulator type. | |
| *ADwin-Pro* | 16 slots, 19", 3 U, 115/230 VAC at 50/60 Hz, 70 W |
| *ADwin-Pro-BM* | Like *ADwin-Pro* but 15 slots, module access from the rear side |
| *ADwin-Pro-light* | 7 slots, 9", 3 U, 115/230 VAC at 50/60 Hz, 40 W |
| **ADwin-Pro Optional Chassis** | |
| *ADwin-Pro-DC* | 16 slots, 19" W, 3 U, 10-35 VDC, 75 W |
| *ADwin-Pro-mini* | 5 slots, requires regulated 5.1 VDC |
| *ADwin-Pro-mini-2* | 5 slots, requires 10-18 VDC 40 W |
| *ADwin-Pro-mini-3* | 5 slots, requires 20-35 VDC 40 W |
| **ADwin-Pro CPUs** | |
| All memory options and the boot loader are manufacturing options only, no update possible. | |
| *Pro-CPU-T9-ENET* | Processor module, CPU: SHARC-DSP ADSP21062 (40 MHz/256 kB local RAM), 4 MB DRAM, Ethernet interface 10/100 Mbits, trigger input, 2 slots |
| *Pro-BOOT-E* | Boot loader for standalone operations, for *Pro-CPU-T9-ENET* only |
| *Pro-CPU-T9-USB* | Processor module, CPU: SHARC-DSP ADSP21062 (40 MHz/256 kB local RAM), 4 MB DRAM, USB interface, trigger input |
| *Pro-CPU-T9* | Processor module, CPU: SHARC-DSP ADSP21062 (40 MHz/256 kB local RAM), 4 MB DRAM, link interface, trigger input |
| *ADlink* | PC link adapter board, 1 channel, ISA version, 2-m cable included |
| *ADpcmcia* | PCMCIA link adapter, 1 channel, 2-m cable included |
| *Pro-MEM-T9-512K* | Processor memory extension: 512 kB local RAM |
| *Pro-MEM-T9-16M* | Memory expansion from 4 MB to 16 MB |
| *Pro-MEM-T9-32M* | Memory expansion from 4 MB to 32 MB |
| **Multiplexed analogue input modules** | |
| Software calibration; connectors: shielded LEMO sockets CAMAC European standard; | |
| D-type version optionally available, add "-D" to the module number. E.g. *Pro-AIn-8/12-RB-D* | |
| *Pro-AIn-8/12-RB* | 8 channels, 12 bits, 1 µs conversion time, gain 1/2/4/8, ±10 V, 0-10 V; 3 µs MUX settling time, differential inputs |
| *Pro-AIn-32/12-RB* | 16 diff/32 se channels, 12 bits, 1 µs conversion time, gain 1/2/4/8, ±10 V, 0-10 V; 3 µs MUX settling time, diff/single-ended inputs |
| *Pro-AIn-8/16-RB* | 8 channels, 16 bits, 10 µs conversion time, gain 1/2/4/8, ±10 V; 3 µs MUX settling time, differential inputs |
| **Parallel analogue input modules** | |
| Synchronized conversions or individual conversions; connectors: shielded LEMO sockets CAMAC European standard; | |
| D-type version optionally available, add "-D" to the module number. E.g. *Pro-AIn-F-8/16-D* | |
| *Pro-AIn-F-4/16* | 4 channels, 16 bits, 10 µs conversion time, gain 1, voltage range ±10 V, differential inputs |
| *Pro-AIn-F-8/16* | 8 channels, 16 bits, 10 µs conversion time, gain 1, voltage range ±10 V, differential inputs |
| *Pro-AIn-F-4/12* | 4 channels, 12 bits, 1 µs conversion time, gain 1, voltage range ±10 V, differential inputs |
| *Pro-AIn-F-8/12* | 8 channels, 12 bits, 1 µs conversion time, gain 1, voltage range ±10 V, differential inputs |
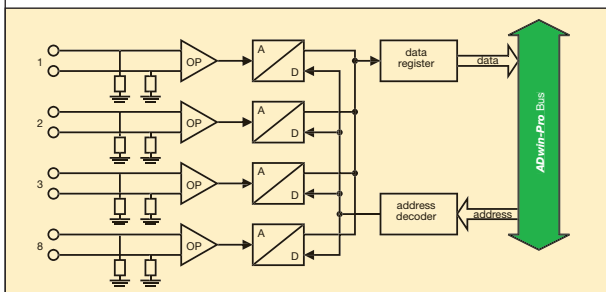


Block diagram of the analog input modules *Pro-AIn-F-8/16* and *Pro-AIn-F-8/12*

# ADwin-Pro Ordering Information – Expansion Modules

## Thermocouple amplifiers modules

One thermocouple amplifier per channel, the amplifier outputs are connected via a multiplexer to a LEMO socket, software commands select the multiplexer channel, the output must be connected to an additional analogue input module, type K or J, ±1° C accuracy, 10-ms settling time, on-chip cold junction reference, standard connectors: Omega sockets; D-type version optionally available, add "-D" to the module number. E.g. **Pro-TC-4-K-D**

| | |
|---|---|
| **Pro-TC-4-K** | 4 channels, Omega sockets |
| **Pro-TC-8-K** | 8 channels, Omega sockets |
| **Pro-TC-16-K** | 16 channels, special D-type socket |
| **Pro-TC-4-J** | 4 channels, Omega sockets |
| **Pro-TC-8-J** | 8 channels, Omega sockets |
| **Pro-TC-16-J** | 16 channels, special D-type socket |
| **Pro-TC-con-J** | D-type connector for 4-/8-/16-channel type J **Pro-TC** modules with D-type connector |
| **Pro-TC-con-K** | D-type connector for 4-/8-/16-channel type K **Pro-TC** modules with D-type connector |

## Analogue output modules

Parallel synchronized conversions or individual conversions, 1st-order low-pass filters (fc = 890 kHz) to cut off glitches; Software calibration, connectors: shielded LEMO sockets CAMAC European standard; D-type version optionally available, add "-D" to the module number. E.g. **Pro-AOut-8/16-D**

| | |
|---|---|
| **Pro-AOut-4/16** | 4 channels, 16 bits, 3 µs settling time, voltage range ±10 V, ±5 V, 0-10 V |
| **Pro-AOut-8/16** | 8 channels, 16 bits, 3 µs settling time, voltage range ±10 V, ±5 V, 0-10 V |

## Counters, PWM modules

It is possible to read each counter individually or to latch + read all counter-synchronized. Standard connectors: 37-pin D-type; TTL logic input; optionally optically-isolated inputs for 5/12/24 V (5-30 VDC for PWM outputs): add "-i" to the module number. E.g.

| | |
|---|---|
| **Pro-CNT-16/16-i;** | **Pro-TC-4-K**, 4 channels, Omega sockets |
| **Pro-CNT-16/16** | 16-channel, 16-bit Pulse Counters |
| **Pro-CNT-8/32** | 8-channel, 32-bit Pulse Counters |
| **Pro-CNT-VR4** | 4-channel, 32-bit Up/Down Counters; clock/direction or encoder interface with quadrature evaluation |
| **Pro-CNT-PW4** | 4 channels; acquisition of positive and negative pulse widths, duty cycle, period time and frequency of a TTL signal; fixed 5-MHz measurement clock |
| **Pro-CNT-VR2/PW2** | Compatible to 2 channels of **Pro-CNT-VR4** and 2 channels of **Pro-CNT-PW4**, 4 channels total, ideal for measuring signals over a wide range of frequencies |
| **Pro-PWM-4** | 4 channels (outputs); generates pulse-width-modulated signals (PWM). PWM resolution: 16-bit, TTL logic output |

## RTD amplifiers modules

One RDT amplifier per channel, the amplifier outputs are connected via a multiplexer to a LEMO socket, software commands select the multiplexer channel, the output must be connected to an additional analogue input module; 2-/3- or 4-wire measurements; standard connectors: shielded 4-pin LEMO sockets CAMAC European standard; D-type version optionally available, add "-D" to the module number. E.g. **Pro-PT100-8-D**

| | |
|---|---|
| **Pro-PT100-4** | 4 channels, 1 slot |
| **Pro-PT100-8** | 8 channels, 2 slots |

## Serial modules[1]

Serial interface modules are equipped with a 64-Byte receive FIFO and a 64-Byte transmit FIFO. Programmable features: Number of data bits, number of stop bits, baud rate, handshake and parity.

| | |
|---|---|
| **Pro-RS232-2** | 2-channel RS232 interface module, 1 slot |
| **Pro-RS232-4** | 4-channel RS232 interface module, 2 slots |
| **Pro-RS485-2** | 2-channel RS485 interface module, 1 slot |
| **Pro-RS485-4** | 4-channel RS485 interface module, 2 slots |

## CAN modules[1]

The CAN interface provides 14 full-CAN mailboxes and 1 BASIC-CAN mailbox, according to CAN specification 2.0 Part A and Part B. The module provides standard CAN and extended CAN. The signals comply with the ISO 11898 standard.

| | |
|---|---|
| **Pro-CAN-1** | 1 CAN bus interface |
| **Pro-CAN-2** | 2 CAN bus interfaces |

## Profibus-DP slave module[1]

Functions: Cyclic data exchange, freeze, unfreeze, sync, unsync, clear. Bit rates from 9600 bit/s to 12 Mbit/s are supported. The interface transmits and receives up to 200 Bytes of data during each bus cycle. Other Fieldbus interfaces on request.

| | |
|---|---|
| **Pro-PROFI-DP-SL** | Interface for operating an **adwin-Pro** system as a Profibus slave |

## Interbus slave module[1]

Functions: Cyclic and acyclic data exchange. Bit rate of 500 kbit/s is supported. The interface transmits and receives up to 20 Bytes of cyclic data and up to 200 Bytes of acyclic data.

| | |
|---|---|
| **Pro-Inter-SL** | Interface for operating an **adwin-Pro** system as an Interbus slave |

## Digital input/output modules

Standard connectors: 37-pin D-type

| | |
|---|---|
| **Pro-DIO-32** | 32 TTL I/Os, software-selectable as input or output channels |
| **Pro-OPT-16** | 16 digital inputs with optocouplers, 5/12/24 V voltage range, |
| **Pro-REL-16** | 16 relay outputs, 500 mA max per channel, max. 30 V AC/DC, normally-open contact |
| **Pro-TRA-16** | 16 isolated transistor outputs, max. 100 mA per channel, 5-30 VDC, open emitter |

## 5B/MB carrier board

This **ADwin-PRO** module takes up to eight 5B/MB modules, there are inputs to connect signals to the 5B/MB modules, and outputs to connect the 5B/MB modules to analogue input modules, all input/output connectors can be selected as Lemo or D-type.

| | |
|---|---|
| **Pro-MB8-DD** | D-type connectors for inputs/outputs, 3 slots |
| **Pro-MB8-LL** | Lemo connectors for inputs/outputs, 3 slots |
| **Pro-MB8-LD** | Lemo connectors for inputs, D-type connectors for outputs, 3 slots |
| **Pro-MB8-DL** | D-type connectors for inputs, Lemo connectors for outputs, 3 slots |

[1] With these serial or Fieldbus modules, use of the 512 k option for the **Pro-CPU-T9** is highly recommended

# *ADtools*

## Easy to Use Visualisation Tools for *ADwin*
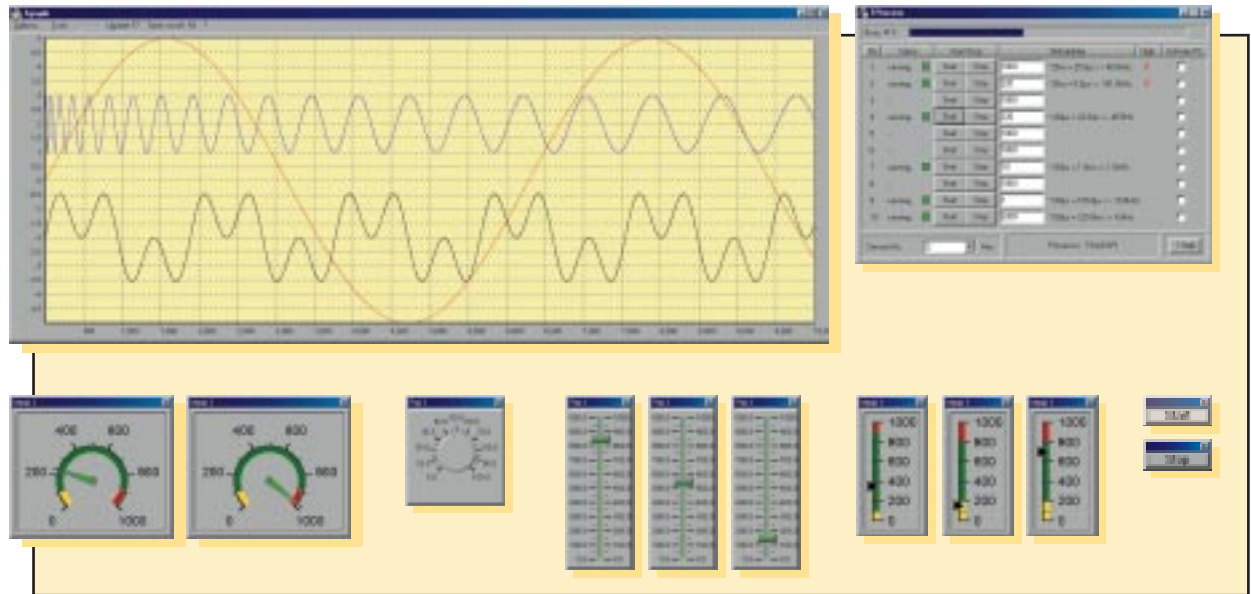


Easy to use graphical development tools for visualisation and control. *ADtools* are free of charge, supplied with all *ADwin* Systems

Printed in Germany

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