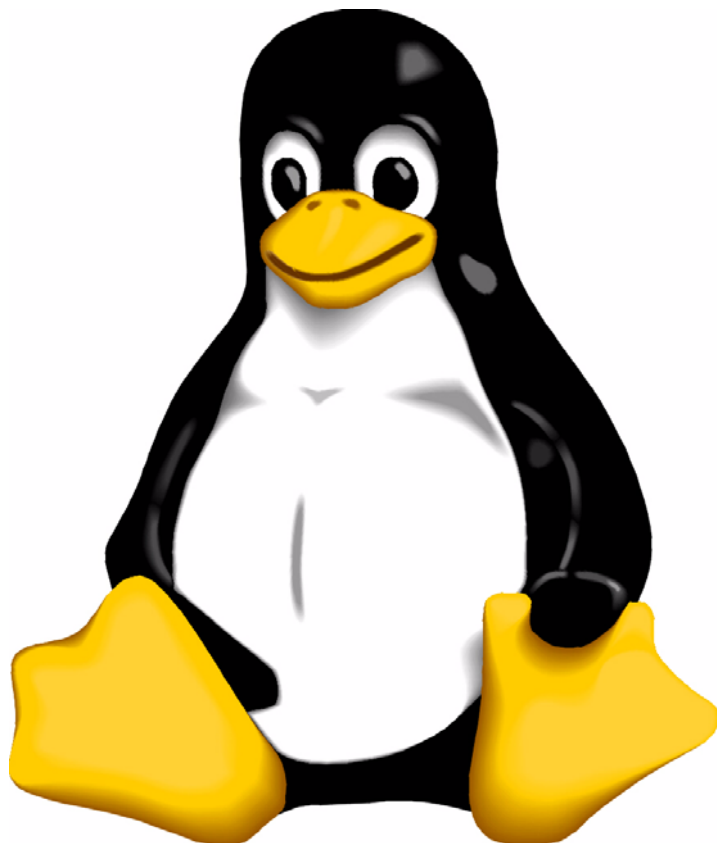


ADwin for Linux/Mac

Manual



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Typographical Conventions



<C:\ADwin\ ...>

Program text

Var_1

"Warning" stands for information, which indicate damages of hardware or software, test setup or injury to persons caused by incorrect handling.

You find a "note" next to

- information, which absolutely have to be considered in order to guarantee an error free operation.
- advice for efficient operation.

"Information" refers to further information in this documentation or to other sources such as manuals, data sheets, literature, etc.

File names and paths are placed in <angle brackets> and characterized in the font *Courier New*.

Program instructions and user inputs are characterized by the font *Courier New*.

ADbasic source code elements such as instructions, variables, comments and other text are characterized by the font *Courier New* and are printed in color (see also the editor of the *ADbasic* development environment).

Bits in data (here: 16 bit) are referred to as follows:

Bit No.	15	14	13	...	01	00
Bit value	2^{15}	2^{14}	2^{13}	...	$2^1=2$	$2^0=1$
Synonym	MSB	-	-	-	-	LSB

1 Information about this Manual

This manual contains information about using the interface library *ADwin* Linux / Mac and the *ADbasic* compiler (Linux only).

Additional information is available in

- the manual "*ADwin* Installation", which describes all interface installations for the *ADwin* systems.
- the manual "*ADbasic*", which contains all instructions for the compiler *ADbasic*. You will also find information about
 - the structure of *ADbasic* programs
 - the optimization of *ADbasic* programs
 - the run-time behaviour of processes

A comfortable user interface as real-time development tool is available for your programming tasks – up to this time only for Windows. You may also use an editor of your choice.

- *ADwin-Pro* systems only: Software manual with the instructions for programming the Pro modules.
- the hardware manual for the *ADwin* system you are using.
- Manuals of *ADwin* drivers for program packages and programming languages.

Knowledge in handling the development environment or programming language is assumed.

Please note:

For *ADwin* systems to function correctly, adhere strictly to the information provided in this documentation and in other mentioned manuals.

Programming, start-up and operation, as well as the modification of program parameters must be performed only by appropriately qualified personnel.

Qualified personnel are persons who, due to their education, experience and training as well as their knowledge of applicable technical standards, guidelines, accident prevention regulations and operating conditions, have been authorized by a quality assurance representative at the site to perform the necessary activities, while recognizing and avoiding any possible dangers.

(Definition of qualified personnel as per VDE 105 and ICE 364).

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Hotline address: see inner side of cover page.



Qualified personnel

Availability of the documents



Legal information

Subject to change.

2 ADwin Linux / Mac

ADwin Linux / Mac is a library. It provides interface functions, so that development environments, such as C, C++ or LabView can communicate with the *ADwin* system.

The library *ADwin* Linux / Mac defines methods, functions and system variables for process control and data transfer from and to the *ADwin* system. The definition includes the name of a function as well as number, data type and order of the parameters to be transferred.

Communication with the *ADwin* system

With the development environment you can control processes in the *ADwin* system, get data from there or send data to the system. The processes are programmed in *ADbasic* (see *ADbasic* manual) and compiled with the compiler which is provided as standard delivery item (see chapter 4).

The library functions communicate with the real-time operating system of the *ADwin* system. Therefore the operating system must be loaded after each power-up (e.g. the file `<adwin9.btl>`). After a successful loading the system will be able to receive and execute processes, receive instructions from the PC and exchange data with it. The processes programmed in *ADbasic*, include the program code for measurement, open-loop or closed-loop control of your application.

The real-time operating system performs the following tasks:

- Management of up to 10 real-time processes with low or high priority (selectable). Processes with low priority can be interrupted by processes with high priority, the latter cannot be interrupted by other processes.
- Providing global variables:
 - 80 integer variables (`PAR_1 ... PAR_80`), already specified
 - 80 float variables (`FPAR_1 ... FPAR_80`), already specified
 - 200 data arrays of arbitrary length (`DATA_1...DATA_200`), user specified

The values of these variables or data arrays can be changed or read from the development environment at any time. Local variables and arrays can be defined.

- Communication between *ADwin* system and PC.

The communication process is running with medium priority on the *ADwin* system and can interrupt low-priority processes for a short time. It interprets and processes all instructions, which are sent from the PC to the *ADwin* system: Control instructions and instructions for data exchange. The following table shows examples for each group.

Control instructions, e.g.	
LOAD_PROCESS	transfers a process to the system
START_PROCESS	starts a process
Instructions for data exchange, e.g.	
GET_PAR	returns the current value of a parameter
SET_PAR	changes the value of a parameter
GETDATA_LONG	returns the values of a DATA array

The communication process never sends data to the PC without being requested to do so. This assures that data is transferred to the PC only if you have requested this data.



Real-time operating system

10 processes

Data memory

Communication



3 Installing and Initializing ADwin Linux / Mac

For installation of the library the following is required:

- Linux:
 - Kernel 2.4 for ADwin systems with Link or Ethernet connection.
 - Kernel 2.6 for ADwin systems with Ethernet connection.
- Apple MacIntosh:
 - Mac OS X 10.4 (other versions have not been tested yet).
 - Development environment XCode version 2.4.
 - ADwin system with Ethernet connection.

The installation contains the following steps:

- Software Configuration and Installation
- Configuration of the ADwin System
- Including the Library in C

For parts of the installation "root" privileges are necessary. If root privileges are required, the # sign is indicated at the beginning of an edit line, otherwise the \$ sign.

With some Linux distributions and with Mac OS the root account is disabled for reasons of safety. In this case call the instruction via the program `sudo`, e.g. `sudo make install`.

3.1 Software Configuration and Installation

The `./LINUX` directory with the following tar archives can be found on the ADwin CD-ROM:

- `adwin-lib-x.y.tar.gz`: The archive (version `x.y`) contains:
 - Kernel module, required for ADwin systems with link connector. Applicable for Linux kernel 2.4 only.
 - ADwin Linux / Mac library (shared library).
 - Configuration program `adconfig`.
- `adwin-compiler-x.y.tar.gz`: The *ADbasic* compiler (Linux only).
- `adwin-labview-x.y.tar.gz`: The driver for the LabView development environment (complete installation see manual "LabView Driver").
- `adwin-doc-x.y.tar.gz`: All documentations for software and hardware as pdf format.

Install archives in the same order as indicated above. Start with `adwin-lib-x.y.tar.gz` (see notes below).

To install an archive, proceed as follows:

1. Extract the archive `<filename>.tar.gz`:

```
$ cd ~
$ tar -xvzf <cdrom-path>/<filename>.tar.gz
$ cd <filename>
```
2. Go on with the usual sequence:

```
$ ./configure
$ make
# make install
```

The `configure` options depend on the operating system:

Linux kernel 2.4:

```
$ ./configure
```

Linux kernel 2.6:

```
$ ./configure --disable-link --disable-kernel-module
```



CDROM

Installing the archives

Linux 2.4: Create kernel

Environment variable

Mac OS X 10.4:

```
$ ./configure --disable-link --disable-kernel-module
--disable-dependency-tracking
```

The files are installed in the directory `/opt/adwin/`. We assume this configuration in the following text. To use another installation directory execute the `configure` script using the following option:

```
$ ./configure --prefix=/your-dir-here
```

3. Install the other archives in the same way.

In the end there is a directory structure as shown below (see page 5).

Please note while creating the kernel. (which is part of installation of archive `adwin-lib-x.y.tar.gz`):

- The kernel module is required for *ADwin* systems with link connection only and is applicable for Linux kernel 2.4 only.
- The kernel module is generated and installed in the directory `/lib/modules/`, all other files in the directory `/opt/adwin/`.

- If you haven't compiled a Linux kernel before, `make` may fail due to missing files. In this case, try the following lines:

```
$ cd /usr/src/linux
$ make oldconfig dep
```

Go on with the usual `configure`, `make`, `make install` sequence described above. If you are not successful call our hotline (inner side of cover page).

- The kernel module should be stable with all versions of the kernel 2.4. Kernel versions are available under `ftp.kernel.org` for instance.

If a problem nevertheless occurs, we will be able to help you when you send us the following information:

- A brief description of the problem.
- The kernel version and patches you are using.
- The file `.config` of the kernel.

In earlier versions of the Linux library the installation directory was stored in the environment variable `ADWINDIR`. This is possible further on, but not required.

To set the variable, you may either

- indicate the directory (see `configure`) directly:

```
$ export ADWINDIR=/opt/adwin/
```
- or use a file (automatically generated from `make / make install`):

```
$ export ADWINDIR=`cat /etc/adwin/ADWINDIR`
```

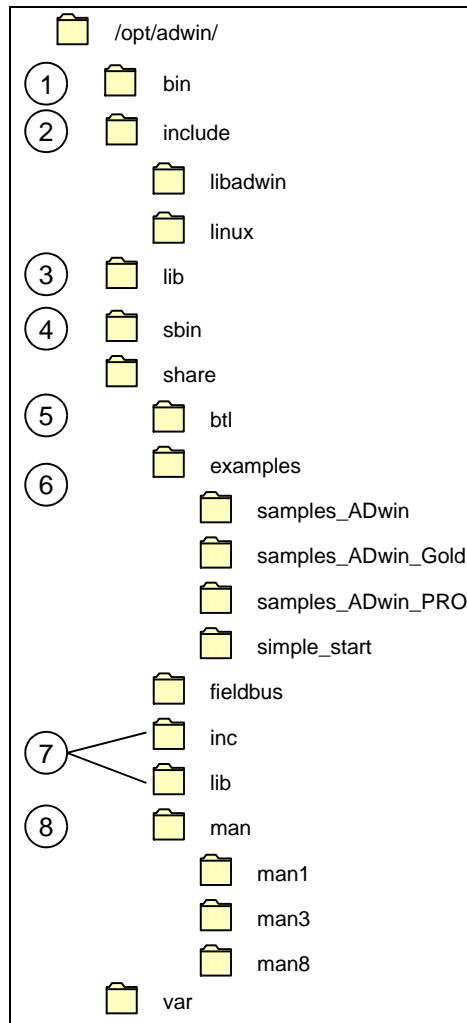
If you use `bash`, the following lines may be useful to add:

```
$ export PATH=$PATH:$ADWINDIR/bin:$ADWINDIR/sbin
$ export MANPATH=$MANPATH:$ADWINDIR/man
```


After installation the structure of directories shown to the right is given.

The most important files and programs are:

1. *ADbasic* compiler¹.
2. Include files for program development.
3. ADwin program library².
4. The program *ADconfig*, which applies a device no. to an *ADwin* system.
5. Operating system files *.btl for *ADwin* processors.
6. *ADbasic* examples, sorted by *ADwin* systems.
7. Include and library files for the *ADbasic* compiler¹.
8. Manuals
 - man1: *ADbasic* compiler¹
 - man3: *ADctl*
 - man8: *ADconfig*



Installed structure of directories

1. not for MacIntosh

2. with MacIntosh under /library/Frameworks/adwin32.framework.

3.2 Configuration of the ADwin System

Each ADwin system is accessed under Linux / Mac via a "device no." To configure the device number use the program `adconfig` in the directory `/opt/adwin/sbin/`:

- Add the device no. of the ADwin system under Linux / Mac (there is no default device no. after a fresh installation). The PC uses the log-on data to access the ADwin system.
- If the ADwin system has an Ethernet interface, you must configure the system, too (see page 8).

The configuration data are not stored on the PC, but are transferred to the ADwin system. The data must correspond to the log-on data under Linux / Mac.

In the "ADwin Installation" manual you will find a description about the basics of Ethernet operation.

The `adconfig` program requires root privileges (`su`).

3.2.1 Example: Standard configuration

The following lines explain how to configure the device no. 0x150 for an ADwin system with Ethernet interface:

1. Add the device no. 0x150 (decimal: 336) with a fixed IP address (here: 10.100.100.83) under Linux / Mac:

```
# adconfig add 0x150 TYPE net IP 10.100.100.83
```
2. Display the results of adding the device no.

```
# adconfig
# DeviceNo=0x150 Type=net IP=10.100.100.83 Port=6543 Time-out=1000 PackageCount=5
```
3. Configure the ADwin system with MAC address, IP address and subnet mask:

```
# adconfig config 00:50:C2:0A:22:DD IP 10.100.100.83
MASK 255.255.255.0
```

The device no. 0x150 is now configured and you can start working with the ADwin system.

3.2.2 Configuration in detail

With the `adconfig` program you can execute the following functions:

- Display the list of all device numbers under Linux / Mac:

```
$ adconfig
```
- Add a new device no. under Linux / Mac:

```
# adconfig add <deviceno> [OPTIONS] TYPE link|net
```
- Configure an ADwin system with Ethernet interface

```
# adconfig config <deviceno> [OPTIONS]
```

Use the same data you have used when adding the device number!
- Delete a device no.:

```
# adconfig del <deviceno>
```
- Display the help for the `adconfig` program:

```
$ adconfig --help
```
- Display the version number of the program:

```
$ adconfig --version
```

The parameter `<deviceno>` can be indicated in decimal or hexadecimal notation, e.g. 336 or 0x150.



You will find more details about the functions of the program in the following text or you can display them with `man 8 adconfig`.

Displaying the list of all device numbers

```
$ adconfig
```

A list of all configured device numbers with their parameters is displayed. The device numbers are displayed in hexadecimal notation i.e. 0x150 for decimal 336.

Adding a new link device no. under Linux / Mac

This function is only available with kernel 2.4.

```
# adconfig add <deviceno> [UID <uid|username>]
  [GID <gid|groupname>][MODE <mode>][DESC <" ">]
  <TYPE link BASE <#>>

<deviceno>          The device no. to add
UID <uid|username>   Name of the user (default: root)
GID <gid|groupname> Name of the user group (default: root)
MODE <mode>          Access rights of the user (default: 0666)
DESC <" ">            Description (up to 32 chars, default: "")
TYPE link BASE <#>   ADwin system with link data connection
                    <#>: link base address (e.g. 0x150)
```

You must set the device no. on the *ADwin* board as link address. You will find the description in the installation manual.

Enter only parameters, which have no default settings or whose default settings you want to change.

Add a new Ethernet device no. under Linux / Mac

```
# adconfig add <deviceno> [UID <uid|username>]
  [GID <gid|groupname>][MODE <mode>][DESC <" ">]
  <TYPE IP <addr> [PW <" ">][PORT <#>][TIMEOUT <#>]>

<deviceno>          The device no. to add.
UID <uid|username>   Name of the user (default: root)
GID <gid|groupname> Name of the group (default: root).
MODE <mode>          User access rights (default: 0666)
DESC <" ">            Description (up to 32 chars, default: "")
TYPE net IP <addr>   ADwin system with Ethernet interface.
                    <addr>: IP address in the Ethernet network
PW <" ">              Password (default: "")
PORT <#>              Network port number (default: 6543)
TIMEOUT <#>          Timeout of the network protocol (default:
                    1000ms)
```

Enter only parameters, which have no default settings or whose default settings you want to change.

The access rights set by `UID`, `GID` and `MODE` do merely protect against accidentally faulty access, because they can be bypassed.

The installation of an *ADwin* system in an Ethernet network is described in the installation manual. Here you will also find a more detailed description of the network-specific parameters.

Pay attention that you do not have the same IP address in an Ethernet network twice. Otherwise massive communication problems may occur.

Displaying the device no.

Adding the device no.: Link



Adding the device no.: Ethernet



Adding the Device no: ADwin system and host

Configuring the Ethernet device without DHCP



Example

```
# adconfig add 0x3A TYPE net IP 10.100.100.83
```

Display the results of the configuration:

```
# adconfig
# DeviceNo=0x3A Type=net IP=10.100.100.83 Port=6543
Timeout=1000 PackageCount=5
```

Adding the Device no. - ADwin system and host

In an IP network (e.g. Ethernet) a client PC can communicate with an ADwin system connected to another PC (host PC) even if the system has a link or USB interface, or if it is running in a different network.

It is required that

- the host PC has access to the ADwin system,
- the host PC can be accessed from the client PC via network
- the program ADwinTcpipServer is running on the host PC (currently available for Windows only).

If the requirements are met, the following log-on parameters must be set:

```
# adconfig add <deviceno> ...
TYPE net IP <addr> [PW <" ">] [PORT <#>]
[TIMEOUT <#>] HOSTLINK <#>
```

net IP <addr>	IP address of the host PC
PW <" ">	The parameters must be identical to the settings you made in the host PC program ADwinTcpipServer (see online help of the program).
PORT <#>	
TIMEOUT <#>	
HOSTLINK <#>	Additionally: Device no. of the ADwin system, set with adconfig at the host PC.

Configuring an ADwin system with Ethernet interface (without DHCP)

```
# adconfig config <hwaddr> IP <addr> MASK <addr>
[GATEWAY <addr>] [PORT <#>] [PW <" ">]
```

<hwaddr>	MAC address of the ADwin system in the format 00:50:C2:0A:nn:nn.
IP <addr>	IP address of the ADwin system in the Ethernet network in the format nnn.nnn.nnn.nnn.
MASK <addr>	Subnet mask in the format nnn.nnn.nnn.nnn.
GATEWAY <addr>	IP address for the default gateway (default: 0.0.0.0, i.e. no gateway)
PORT <#>	Network port number (default: 6543)
PW <" ">	New password (default: "", i.e. the existing password will be deleted!)

Enter only parameters, which have no default settings or whose default settings you want to change. Do use the same values you have used with add!

Please note that the password is always transferred during configuration. If you want to keep an already existing password, you must therefore indicate the password, otherwise it will be deleted.

Example

```
# adconfig config 00:50:C2:0A:22:DD IP 10.100.100.83
MASK 255.255.255.00
```

Configuring an ADwin system with Ethernet interface for DHCP

It is possible but not recommended that an ADwin system gets its IP address from the DHCP server (see option DHCP).

```
# adconfig config <hwaddr> [GATEWAY <addr>] [PORT <#>] DHCP yes  
[PW <" ">]
```

<hwaddr>	The MAC address of the ADwin system in the format 00:50:C2:0A:nn:nn.
GATEWAY <addr>	IP address for the default gateway (default: 0.0.0.0, i.e. no gateway)
PORT <#>	Network port number (default: 6543)
PW <" ">	New password (default: "", i.e. the existing password will be deleted!)
DHCP <no yes>	Here you determine if a DHCP server is used (default: no); see below.

We recommend that the option DHCP should not be activated!
If this option is active, communication problems may occur frequently.

Enter only parameters, which have no default settings or whose default settings you want to change. Do use the same values you have used with add!

Deleting a device no.

```
# adconfig del <deviceno>
```

The device no. is deleted under Linux / Mac and cannot be accessed any more.

Configuring the Ethernet device with DHCP



Deleting a device no.

3.3 Including the Library in C

To use the functions of the library *ADwin* Linux / Mac in C or C++, go on as follows:

- Include the following lines into your program:
 - Functions for accessing the *ADwin* system:
`#include <libadwin.h>`
 - Error numbers, you may get when accessing the *ADwin* system:
`#include <libadwin/errno.h>`
- Include the following flags into your Makefile for the C compiler, to compile your program with the library *ADwin* Linux / Mac. The flags for Linux and Mac are different.

Linux flags

For Linux, use these flags:

```
$ CFLAGS += -I$(ADWINDIR)/include -L$(ADWINDIR)/lib -ladwin
$ CFLAGS += -Wl,--rpath -Wl,$(ADWINDIR)/lib
```

Note that here the environment variable `ADWINDIR` is used. (For setting the variables see page 4).

If you use threads you have to add:

```
$ CFLAGS += -D_REENTRANT
```

Mac flags

For Mac, use these flags:

```
$ CFLAGS = -I$(ADWINDIR)/include -framework adwin32
```

Porting from Windows

The functions of the *ADwin* Linux / Mac library are compatible to the functions of the interface under Windows (`adwin32.dll`). Therefore program source codes written in a programming language (here: C/C++) under Windows can normally be used under Linux / Mac without making any modifications (of course only with regards to accessing the *ADwin* systems).

Modifications in the program are only necessary where path or file names are used. Here the typical differences between Windows and Linux / Mac become apparent: Syntax and case sensitivity of the path names.

For *ADbasic* source codes porting from (and to) Windows is likewise possible.

4 Compiling ADbasic Source Code

In an *ADbasic* source code you program the functions of a process that is running on the *ADwin* system. You generate an *ADbasic* source code with an editor of your choice. A comfortable Windows user interface as real-time development tool is available.

For Apple Macintosh, the *ADbasic* compiler is not available. Use the Linux or Windows compiler instead.

The *ADbasic* compiler is called under Linux in the command line (shell). It compiles a source code file and generates – depending on the options and parameters – either a binary file or a library file. The function of the binary and library files is described in the *ADbasic* manual.

The license key must be entered with the option `-k` before the compiler can be used. Only then will you be able to generate binary or library files. The license key be found on the cover sheet of the *ADbasic* manual.

One or more command line calls may be combined in a shell script or Makefile, to compile several source codes of a project with only one call.



4.1 Compiler Syntax

There are 5 main options when calling the *ADbasic* compiler:

1. `adbasic -v` Display the compiler version number
2. `adbasic -h` Call the help
3. `adbasic -k <license>` Enter license key (see cover sheet of the *ADbasic* manual).
A write authorization is necessary for `/opt/adwin/var/license/`.
4. `adbasic [OPTIONS] <filename>` Compile an *ADbasic* source code and generate a binary file.
5. `adbasic -l [OPTIONS] <filename>` Compile an *ADbasic* source code and generate a library file.

The [OPTIONS] for compiling source code are described below.

Syntax

```
[path/]adbasic [-p <ptype>] [-s <system>]
  [-n <#>] [-e <event>] [-g <cycle>]
  [-r <prio>] [-o <level>][ -l ] [-L <path/>] [-I <path>]
  [-a [path/]<fout>] [path/]infile.bas
```

Switches

- [path/] Directory where you find the program `adbasic`, at standard installation: `/opt/adwin/bin/`
- `-p<ptype>` Processor type for which the file is to be compiled:
- `-p2` Processor T2
 - `-p4` Processor T4
 - `-p5` Processor T5
 - `-p8` Processor T8
 - `-p9` Processor T9; default
 - `-p10` Processor T10
 - `-p11` Processor T11

```
-s<system> ADwin system for which the file is to be compiled:
            -sc    Boards (ISA bus)
            -sl    Light-16
            -sg    Gold; default
            -sp    Pro

-n<#>      Sets the process number (1...10) of the file to be com-
            piled; default = 1.

-e<event>   Select the event source for the process:
            -et    Timer; default
            -ee    External

-g<cycle>   Sets the 'Initial Processdelay'; default = 1000.

-r<prio>     Sets the priority of the process to:
            -rh    High; default
            -rl    Low
            -rln   Low, Level n (1...255); default: n=1.
                    Level 255 has the highest priority.

-o<level>   Sets the optimize level. Optimization may shorten pro-
            cessing time, but may exceptionally cause run-time
            errors.
            -o0    Optimization off; default
            -o1    little optimization
            -o2    strong optimization

-l          Compile source code and generate a library file with the
            extension ".lix".
            If the option is not set a binary file with the extension
            ".tXY" is generated.
            X = 2, 4, 5, 8, 9, a (corresponds to processor type -p) .
            Y = 1...9, 0 (corresponds to process number -n: 1...10) .

-L<path>    Sets the search path for library files;
            default /opt/adwin/share/lib/

-I<path>    Sets the search path for include files;
            default /opt/adwin/share/inc/

-a<fout>    Optional: Name of the binary or library file to be gener-
            ated, without file extension.

infile.bas  File name of the source code to be compiled. Path is
            optional.
```

Notes

Optional switches are set in square brackets. The order of the options is arbitrary. In command lines the writing is case sensitive.

If the option `-a` is not used the generated binary or library file is saved in the directory where the source code is located.

The following options mutually exclusive:

Option	excludes
-sg, -sl	-p2, -p4, -p5, -p8
-sp	-p2
-l	-n, -e, -g, -r, -d, -o

If an error occurs during compilation, the compiler stops and does not generate any binary or library files.

4.2 Examples

```
$ /opt/adwin/bin/adbasic -l /home/user/test.bas
```

The source code file `test.bas` is compiled and generates the library file `test.li9` in the directory `/home/user/`.

Since no other options than `-l` are indicated, the default settings are used:

- Processor: T9
- System: Gold
- Process number: 1
- Event: Timer
- Initial Processdelay: 1000
- Priority: High
- Include-path: `/opt/adwin/share/inc/`
- Library path: `/opt/adwin/share/lib/`

If you include the directory where the compiler `adbasic` is located, into your search path (see "Installation" page 3), you can write the line above in a shorter way:

```
$ adbasic -l /home/user/test.bas
```

In the following examples we assume that the `adbasic` path is part of your search path.

```
$ adbasic -l /string.bas -sp
```

The command line call compiles the source code file `string.bas` to a library file for a Pro system with a T9 processor.

The same call, but for a T10 processor, is as follows:

```
adbasic -l /test.bas -p10 -sl
```

```
$ adbasic /home/user/test.bas  
/opt/adwin/share/example/bas_dmo6f -p9 -sg
```

Compiles the demo file `bas_dmo6f.bas` into a binary file for an *ADwin-Gold* system with T9 processor.

```
$ adbasic /opt/adwin/share/example/bas_dmo6 -p8 -sc
```

Compiles the demo file `bas_dmo6.bas` into a binary file for an *ADwin* board with a T8 processor.

```
$ adbasic /home/user/my_file.bas -p4 -sc -ayour_file
```

Compiles the file `my_file.bas` for an *ADwin* board with a T4 processor. The generated binary file has the name `your_file.t41` and can be found in the current directory.

```
$ adbasic /home/user/my_file.bas -a/somewhere/your_file
```

The name of the binary file is `your_file.t91` and is located in the directory `/somewhere`.



5 Methods and Functions of ADwin Linux / Mac

The syntax of ADwin Linux / Mac methods and functions depends on the development environment.

This is the reason why we have used a general syntax in the description below. Use the relevant syntax for your development environment.

The syntax of the instructions is illustrated below:

```
datatype instr (datatype Var1, datatype Var2, ...)
```

Meaning

datatype	With an instruction: Data type of the return value. With a parameter: Data type of the parameter. Data types are: void, long, float, double, char. Note that here the data type long is equal to signed int 32bit.
instr	In some development environments (C, C++) instruction names are case sensitive.
<i>Var1, Var2</i>	Variables and return values are described under "Parameters", behind the instruction syntax.



Instructions for accessing analog and digital inputs and outputs (and other hardware functionalities) are not included in the ADwin Linux / Mac library. Such applications are programmed in ADbasic.

5.1 System Control and System Information

Initialization of the ADwin system and information about the operating status.

Set_DeviceNo

The function Set_DeviceNo sets the device number of the ADwin system for all following instructions.

```
void Set_DeviceNo(long DeviceNo)
```

Parameters

<i>DeviceNo</i>	Device number of the system. Typical device numbers are 336 (= 0x150 hexadecimal), 400 (= 0x190 hexadecimal).
-----------------	---

Notes



The PC distinguishes and accesses the ADwin systems using this device number. Systems with link adapter are already delivered with the default setting: 0x150h.

The function Set_DeviceNo does not communicate with the ADwin system and therefore does not affect error handling.

Example

```
Set_DeviceNo(3)
```

The device number 0x3 is set. All further instructions refer to this device (until a new device number is set with Set_DeviceNo).

`Boot` initializes the *ADwin* system and loads the operating system file.

```
void Boot (char pFilename())
```

Parameters

Filename pointer to the file name of the operating system file

Notes

The initialization deletes all processes on the system and sets all global variables to the value 0.

The operating system which is to be loaded depends on the processor. The following table shows the file names for the different processors.

Processor	Short name	Operating system file
T225	T2	ADwin2.btl
T400	T4	ADwin4.btl
T450	T5	ADwin5.btl
T805	T8	ADwin8.btl
ADSP 21062	T9	ADwin9.btl
ADSP 21162	T10	ADwin10.btl
ADSP TS101S	T11	ADwin11.btl

The PC will only be able to communicate with the *ADwin* system after the operating system has been loaded. Reload the operating system after each power-up of the *ADwin* system.

Loading the operating system successfully with `Boot` takes about 1 second.

`Test_Version` checks, if the correct operating system for the processor has been loaded and if the processor can be accessed.

```
long Test_Version()
```

Parameters

return value 0 : OK
 1 : wrong driver version, processor continues working
 2 : wrong driver version, processor stops
 3 : no response from the *ADwin* system

Booting



...

Test_Version

Processor_Type

`Processor_Type` returns the processor type of the system.

```
long Processor_Type( )
```

Parameters

return value processor code number of the system

Notes

The function returns the used processor type for testing purposes, according to the table below.

return value	processor type
0	Error
2	T2
4	T4
5	T5

return value	processor type
8	T8
9	T9
1010	T10
1011	T11

Workload

`Workload` returns the processor workload.

```
long Workload (long Priority)
```

Parameters

Priority 0 (zero): current total workload of the processor
 ≠0 : not supported at the moment

return value processor workload (in percent)

Free_Mem

`Free_Mem` determines and returns the free memory for different memory types.

```
long Free_Mem (long Mem_Spec)
```

Parameters

Mem_Spec type of memory
 0: all types of memory; processors T2, T4, T5, T8 only
 1: local program memory (PM_LOCAL); up from T9
 2: local extra memory (EM_LOCAL); up from T11
 3: local data memory (DM_LOCAL); up from T9
 4: external DRAM memory (DRAM_EXTERN); up from T9

return value currently free memory (in bytes)

Note

The different memory areas are described in more detail in the *ADbasic* manual.

5.2 Process Control

Instructions for controlling processes on the *ADwin* system.

`Load_Process` loads the binary file of a process into the *ADwin* system.

```
void Load_Process (char pFilename())
```

Parameters

Filename pointer to the file name of the binary file

Notes

You generate a binary file under Linux by calling the compiler `adbasic` (without the option `-l`, see chapter 4.1).

Switching a system on and off deletes loaded processes. You must therefore load the necessary processes again after power-up.

`Start_Process` starts a process.

```
void Start_Process (long ProcessNo)
```

Parameters

ProcessNo number of the process (1...10)

`Stop_Process` stops a process.

```
void Stop_Process (long ProcessNo)
```

Parameters

ProcessNo number of the process (1...12, 15)

Note

It may happen that a process cannot be stopped immediately after the instruction has been executed, but somewhat later. The status of the process is queried using `Process_Status`.

Load_Process



Start_Process

Stop_Process

Clear_Process

`Clear_Process` deletes a process from memory.

```
void Clear_Process (long ProcessNo)
```

Parameters

ProcessNo number of the process (1...12, 15)

Notes

Loaded processes allocate memory in the system. You can delete processes from memory with `Clear_Process`, in order to get more memory space for other processes.

A process, which is to be deleted, must not be running. Stop a running process first with `Stop_Process`, (and determine with `Process_Status` that the process has stopped), before you delete it from memory with `Clear_Process`.

After power-up the internal processes 11, 12 and 15 are running on the *ADwin* system. If you want to delete them do so in the following order: 15, 12, 11.

Process 15 flashes the LED in the Gold and Pro systems. After deleting it, the LED does not blink any more.

**Process_Status**

`Process_Status` returns the status of a process.

```
long Process_Status (ProcessNo)
```

Parameters

ProcessNo number of the process (1...12, 15)

return value status of the process

1 : process is running.

0 : process is not running, that is, it is not loaded, it has not been started or stopped.

-1: process is being stopped, that is, it has received a `Stop_Process`, but still waits for the last event.

Set_Processdelay sets the parameter *Processdelay* for a process

```
void Set_Processdelay (long ProcessNo,
                        long Processdelay)
```

Parameters

ProcessNo number of the process (1...10)

Process-delay value to be set for the parameter *Processdelay*.

Notes

The parameter *Processdelay* controls the time interval between two events of a time-controlled process (see *ADbasic* manual).

The time interval is indicated in units of time, which depend on the processor type and the priority of a process.

Processor type	Process priority	
	high	low
T2, T4, T5, T8	1 µs	64 µs
ADSP 21062 (T9)	0.025 µs (=25ns)	100 µs
ADSP 21162 (T10)	0.025 µs (=25ns)	50 µs

Example (C)

```
Set_Processdelay(1,2000);
// the Processdelay of process is set to 2000.
```

This time-controlled process is called every 50 µs (=2000 · 25ns) in a high priority process and when using an T9 processor.

Set_Processdelay

Get_Processdelay returns the parameter *Processdelay* of a process.

```
long Get_Processdelay (long ProcessNo)
```

Parameters

ProcessNo number of the process (1...10)

return value currently set value for *Processdelay*;
in case of error: 255

Notes

The parameter *Processdelay* controls the time interval between two events of a time-controlled process (see *Set_Processdelay* and *ADbasic* manual).

Example (C)

```
long erg;
erg = Get_Processdelay(1);
// query Processdelay of ADbasic process 1
```

Get_Processdelay

5.3 Transfer of Global Variables

Instructions for data transfer between PC and ADwin system with the standard global variables PAR_1 ... PAR_80 and FPAR_1 ... FPAR_80.

5.3.1 Global long variables (PAR_1 ... PAR_80)

Set_Par

Set_Par sets a global long variable to the specified value.

```
void Set_Par (long Index, long Value)
```

Parameters

<i>Index</i>	number of the global long variable (1 ... 80)
<i>Value</i>	value to be set for the long variable

Get_Par

Get_Par returns the value of a global long variable.

```
long Get_Par (long Index)
```

Parameters

<i>Index</i>	number of the global long variable (1 ... 80).
return value	current value of a variable

Get_Par_Block

Get_Par_Block transfers the indicated amount of global long variables into an array.

```
void Get_Par_Block (long Array(), long StartIndex,  
long Count)
```

Parameters

<i>Array</i>	pointer to an array (Array length \geq Count)
<i>StartIndex</i>	number of the first variable to be transferred (1...80)
<i>Count</i>	number of variables to be transferred (max. 80)

Get_Par_All

Get_Par_All transfers all global long variables into an array.

```
void Get_Par_All (long Array())
```

Parameters

<i>Array</i>	pointer to an array (array length \geq 80)
--------------	--

5.3.2 Global float variables (FPar_1...FPar_80)

Set_FPar sets a global float variable to a specified value.

```
void Set_FPar (long Index, long Value)
```

Parameters

<i>Index</i>	number of the global float variable (1...80)
<i>Value</i>	value to be set for a float variable

Get_FPar returns the value of a global float variable.

```
float Get_FPar (long Index)
```

Parameters

<i>Index</i>	number of the global float variable (1...80)
return value	current status of the variables

Get_FPar_Block transfers the indicated amount of global float variables into an array.

```
void Get_FPar_Block (float Array(), long StartIndex, long Count)
```

Parameters

<i>Array</i>	pointer to an array (array length \geq Count)
<i>StartIndex</i>	number of the first variable to be transferred (1...80)
<i>Count</i>	number of variables to be transferred (max. 80)

Get_FPar_All transfers all global float variables into an array.

```
void Get_FPar_All (float Array())
```

Parameters

<i>Array</i>	pointer to an array (array length \geq 80)
--------------	--

Set_FPar

Get_FPar

Get_FPar_Block

Get_FPar_All

Get_FPar_Block_Double

Get_FPar_Block_Double transfers the indicated amount of global float variables into a double array.

```
void Get_FPar_Block_Double (double Array(),  
                             long StartIndex, long Count)
```

Parameters

<i>Array</i>	pointer to an array (array length \geq <i>Count</i>)
<i>StartIndex</i>	number of the first variable to be transferred (1...80)
<i>Count</i>	number of variables to be transferred (max. 80)

Notes

This method has been developed for applications, which process floating point data sets only with double precision.

Please consider that *ADwin* systems use single precision data. To avoid misunderstandings, you should display the array *Array()* only with single precision.

**Get_FPar_All_Double**

Get_FPar_All_Double transfers all global float variables into a double array.

```
void Get_FPar_All_Double (double Array())
```

Parameters

<i>Array</i>	pointer to an array (array length \geq 80)
--------------	--

Notes

This method has been developed for applications, which process floating point data sets only with double precision.

Please consider that *ADwin* systems use single precision data. To avoid misunderstandings, you should display the array *Array()* only with single precision.



5.4 Transfer of Data Arrays

Instructions for data transfer between PC and *ADwin* system with global DATA arrays (DATA_1...DATA_200), which may be declared as FIFO arrays.

You must declare each array in *ADbasic* with the instruction DIM before usage (see "*ADbasic*" manual).

5.4.1 Simple data arrays

Data_Length returns the length of an array (i.e. number of elements), declared under *ADbasic*.

```
long Data_Length (long DataNo)
```

Parameters

<i>DataNo</i>	number of the array (1...200)
return value	declared data length (=number of elements)

SetData_Long transfers long data from the PC into a DATA array of the *ADwin* system.

```
void SetData_Long (long DataNo, long Data(),  
                    long Startindex, long Count)
```

Parameters

<i>DataNo</i>	array number (1...200)
<i>Data()</i>	pointer to an array
<i>StartIndex</i>	number of the first variable to be transferred
<i>Count</i>	number of variables to be transferred

GetData_Long transfers long data from a DATA array of an *ADwin* system into an array.

```
void GetData_Long (long DataNo, long Data(),  
                    long Startindex, long Count)
```

Parameters

<i>DataNo</i>	array number (1...200)
<i>Data()</i>	pointer to an array (array length \geq Count)
<i>StartIndex</i>	number of the first variable to be transferred
<i>Count</i>	number of variables to be transferred



Data_Length

SetData_Long

GetData_Long

SetData_Float

SetData_Float transfers float data from the PC into a DATA array of the ADwin system.

```
void SetData_Float (long DataNo, float Data(),
                    long Startindex, long Count)
```

Parameters

<i>DataNo</i>	array number (1...200)
<i>Data()</i>	pointer to an array
<i>StartIndex</i>	number of the first variable to be transferred
<i>Count</i>	number of variables to be transferred

GetData_Float

GetData_Float transfers float data from a DATA array of the ADwin system into an array.

```
void GetData_Float (long DataNo, float Data(),
                    long Startindex, long Count)
```

Parameters

<i>DataNo</i>	array number (1...200)
<i>Data()</i>	pointer to an array (array length \geq Count)
<i>StartIndex</i>	number of the first variable to be transferred
<i>Count</i>	number of variables to be transferred

SetData_Double

SetData_Double transfers double data from the PC with single precision to a DATA array of the ADwin system.

```
void SetData_Double (long DataNo, double Data(),
                     long Startindex, long Count)
```

Parameters

<i>DataNo</i>	array number (1...200)
<i>Data()</i>	pointer to an array
<i>StartIndex</i>	number of the first variable to be transferred
<i>Count</i>	number of variables to be transferred

Notes

This method has been developed for applications, which process floating point data sets only with double precision.

Please consider that ADwin systems use single precision data. To avoid misunderstandings, you should display the array *Data()* only with single precision.



GetData_Double transfers float data from a DATA array of the ADwin system into a double array.

```
void GetData_Double (long DataNo, double Data(),
                    long Startindex, long Count)
```

Parameters

<i>DataNo</i>	array number (1...200)
<i>Data()</i>	pointer to an array (array length \geq <i>Count</i>)
<i>StartIndex</i>	number of the first variable to be transferred
<i>Count</i>	number of variables to be transferred

Notes

This method has been developed for applications, which process floating point data sets only with double precision.

Please consider that ADwin systems use single precision data. To avoid misunderstandings, you should display the array *Data()* only with single precision.

Data2File saves long or float data from a DATA array of the ADwin system in a file (on the hard disk).

```
void Data2File (char pFilename(), long DataNo,
               long Startindex, long Count, long Mode)
```

Parameters

<i>Filename</i>	pointer to the file name
<i>DataNo</i>	number of the DATA array (1...200)
<i>Startindex</i>	number of the first variable to be transferred
<i>Count</i>	number of elements to be transferred
<i>Mode</i>	0 : file will be overwritten (if file exists) 1 : data are appended to an already existing file

Notes

This DATA array must not be defined as FIFO. The data is saved in binary code.

Example (C)

```
Data2File("Test.dat", 1, 1, 1000, 0);
// Saves the elements 1...1000 from the ADbasic-
// array DATA_1 in the file Test.dat
```

GetData_Double

Data2File



...

5.4.2 FIFO Arrays

Instructions for data transfer between the PC and the ADwin system with global DATA arrays (DATA_1...DATA_200), which are declared as FIFOs.

Before using it you have to declare each FIFO array under *ADbasic* (see *ADbasic* manual): `DIM DATA_x[n] AS TYPE as FIFO`

When working with FIFO arrays you should not write more elements into the FIFO than you have declared. You should definitely not read out more elements than you have written into the FIFO. To avoid malfunction check the FIFO status first:

- Check with the function `Fifo_Full`, if a FIFO array contains at least as many elements as you wish to read out with `GetFifo_X`.
- Check with the function `Fifo_Empty`, if a FIFO array contains at least as many free elements as you wish to write into the FIFO with `SetFifo_X`.

Fifo_Empty

`Fifo_Empty` returns the number of free elements of a FIFO array.

```
long Fifo_Empty (long FifoNo)
```

Parameters

<i>FifoNo</i>	number of the FIFO array (1...200)
return value	number of free elements in the FIFO array

Fifo_Full

`Fifo_Full` returns the number of used elements in a FIFO array.

```
long Fifo_Full (long FifoNo)
```

Parameters

<i>FifoNo</i>	number of the FIFO array (1...200)
return value	number of used elements in the FIFO array

Fifo_Clear

`Fifo_Clear` initializes the write and read pointers of a FIFO array.

```
void Fifo_Clear (long FifoNo)
```

Parameters

<i>FifoNo</i>	number of the FIFO array (1...200)
---------------	------------------------------------

Notes

While declaring a FIFO array (in *ADbasic*) the FIFO pointers are not automatically initialized. Therefore call `Fifo_Clear` just at the beginning of your program, either in *ADbasic* or with this function.

Initializing the FIFO pointers during the program is useful, when all written elements are to be cancelled (for instance because of an error).

SetFifo_Long transfers long data from the PC to a FIFO array of the ADwin system.

```
void SetFifo_Long (long FifoNo, long Data(),
                  long Count)
```

Parameters

<i>FifoNo</i>	number of the FIFO array (1...200)
<i>Data()</i>	pointer to an array
<i>Count</i>	amount of elements to be transferred

GetFifo_Long transfers long FIFO data from the ADwin system to the PC.

```
void GetFifo_Long (long FifoNo, long Data(),
                  long Count)
```

Parameters

<i>FifoNo</i>	number of the FIFO array (1...200)
<i>Data()</i>	pointer to an array (array length \geq <i>Count</i>)
<i>Count</i>	amount of elements to be transferred

SetFifo_Float transfers float data from the PC into a FIFO array of the ADwin system.

```
void SetFifo_Float (long FifoNo, float Data(),
                   long Count)
```

Parameters

<i>FifoNo</i>	number of the FIFO array (1...200)
<i>Data()</i>	pointer to an array
<i>Count</i>	amount of the elements to be transferred

GetFifo_Float transfers float FIFO data from the ADwin system to the PC.

```
void GetFifo_Float (long FifoNo, float Data(),
                   long Count)
```

Parameters

<i>FifoNo</i>	number of the FIFO array (1...200)
<i>Data()</i>	pointer to an array (array length \geq <i>Count</i>)
<i>Count</i>	amount of elements to be transferred

SetFifo_Long

GetFifo_Long

SetFifo_Float

GetFifo_Float

SetFifo_Double

SetFifo_Double transfers double data from the PC with single precision to a FIFO array of the ADwin system.

```
void SetFifo_Double (long FifoNo, double Data(),
                    long Count)
```

Parameters

<i>FifoNo</i>	number of the FIFO array (1...200)
<i>Data()</i>	pointer to an array
<i>Count</i>	amount of the elements to be transferred

Notes

This method has been developed for applications, which process floating point data sets only with double precision.

Please consider that ADwin systems use single precision data. To avoid misunderstandings, you should display the array *Data()* only with single precision.

**GetFifo_Double**

GetFifo_Double transfers float FIFO data from the ADwin system into a double array.

```
void GetFifo_Double (long FifoNo, double Data(),
                    long Count)
```

Parameters

<i>FifoNo</i>	number of the FIFO array (1...200)
<i>Data()</i>	pointer to the array (array length \geq Count)
<i>Count</i>	amount of elements to be transferred

Notes

This method has been developed for applications, which process floating point data sets only with double precision (double precision arrays).

Please consider that the data have single precision. Therefore you should display data from the array *Data()* only with single precision, in order to avoid misunderstandings regarding the precision.



5.4.3 Data arrays with string data

Instructions for the data transfer between PC and *ADwin* system with global DATA arrays (DATA_1...DATA_200), which contain string data. The DATA array must be declared with DIM ... AS STRING in *ADbasic*.

SetData_String transfers a string into a DATA array.

```
void SetData_String (long DataNo, char pData())
```

Parameters

<i>DataNo</i>	number of the DATA array (1...200)
<i>Data</i>	pointer to the string to be transferred

Notes

Each transferred string is automatically NULL-terminated(i.e. ASCII code 0 is appended).

Please consider the different usage of the development environments with this end identifier, when it is part of the string.

For instance, *ADbasic* and C transfer the string "Hello\0 world" only up to the end identifier, i.e. "Hello". Delphi (Kylix) however, transfers the complete string.

Example (C)

```
SetData_String (2, "this is a text" );  
// the string "this is a text" is written into the array  
// DATA_2 and the end identifier is added.
```

SetData_String



GetData_String

GetData_String transfers a string from a DATA array to a buffer.

```
long GetData_String (long DataNo, char pData(),
                     long MaxCount)
```

Parameters

<i>DataNo</i>	number of the DATA array (1...200)
<i>pData</i>	pointer to the array, into which the string is to be written (array length $\geq \text{MaxCount}+1$)
<i>MaxCount</i>	maximum amount of characters to be transferred
return value	amount of the read characters (without end identifier)

Notes

After writing the string into the array *pData* an additional end identifier is added as last string (ASCII number 0), so that the string contains *MaxCount*+1 elements.

If the string which is to be transferred has an end identifier, then the transfer stops exactly there. The number of the characters read up to this point without end identifier is the return value.

If *MaxCount* is greater than the number of string chars defined in **ADbasic**, you will receive the error "Data too small" via `Get_Last_Error()`.

If you set *MaxCount* to a high value, the function will have an appropriately long execution time, even if the transferred string is short. For time-critical applications with large strings, it may be faster to proceed as follows:

- You determine the actual number of chars in the string using `String_Length()`.
- You read the string with `Getdata_String()` and pass the actual number of chars as *MaxCount*.

Example (C)

```
char ArrayString[100];
GetData_String (2, ArrayString, 100);
// get a string with 100 elements from DATA_2
```

If the DATA array in the ADwin system has an end identifier for instance at position 9, then 8 characters are read.

String_Length

String_Length returns the length of a data string in a DATA array.

```
long String_Length(long DataNo)
```

Parameters

<i>DataNo</i>	number of the DATA array (1...200)
return value	length of the string

Notes

String_Length counts the characters in a DATA array until the first end identifier occurs (ASCII number 0). The end identifier is not counted as a character.

Example (C)

```
erg = String_Length (2);  
// determines the length of the string in DATA_2.
```

Get_Last_Error**5.5 Error Handling**

`Get_Last_Error` returns the error number, which refers to the last instruction (of the program) sent to the *ADwin* system.

```
long Get_Last_Error()
```

Parameters

return value $\neq 0$: number of error, which occurred last (see Annex A.1).
 0 : no error occurred

Notes

The returned error number always refers to

- the last instruction which was sent to the *ADwin* system (most but not all instructions are members of this group)
- the program, which sent that instruction

After the function is called, the error number is reset to 0 (zero).

Example (C)

```
long Error;
Error = Get_Last_Error();
```

Get_Last_Error_Text

`Get_Last_Error_Text` returns an error text related to an error number.

```
char Get_Last_Error_Text (long Errno)
```

Parameters

Errno error number
 return value pointer to the error text

Notes

This function can be called in combination with the function `Get_Last_Error`.

Beispiel (C)

```
long Error = Get_Last_Error();
printf("Get_Last_Error:%d\n", Error);
printf("Last_Error_Text:%s\n",
  Get_Last_Error_Text(Error));
```

Annex

A.1 Error messages

No.	Error message
0	No Error.
1	Timeout error on writing to the ADwin-system.
2	Timeout error on reading from the ADwin-system.
3	Timeout error on fast writing to the ADwin-system.
4	Timeout error on fast reading from the ADwin-system.
10	The device No. is not allowed.
11	The device No. is not known.
15	Function for this device not allowed.
20	Incompatible versions of ADwin operating system, driver and/or ADbasic binary-file.
100	The Data is too small.
101	The Fifo is too small or not enough values.
102	The Fifo has not enough values.
200	File not found.
201	A temporary file could not be created.
202	The file is not an ADBasic binary-file.
203	The file is not valid.
204	The file is not a BTL.
1000	Network error (RPC).
1001	Network error (Bind).
1002	Network error (String bind).
1003	Wrong password (RPC).
2000	Network error (Tcplp).
2001	Network timeout.
2002	Wrong password.
3001	Device is unknown.

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