Watchdog Operation

User Manual

Revision History

Rev	Data	Changes	DRN	CHK	APP
0.0	8 Jul 08	Initial release.	AW		
0.2	1 Jun 09	Preliminary release.	AW		

Document Number:

Whilst every care has been taken in the preparation of this document, inaccuracies due to typographical or other errors may be present. No warranty of accuracy or reliability is given in relation to any advice or information contained in this document and no responsibility for any loss or damage whatsoever arising in any way for any representation, act or omission whether express or implied (including responsibility to any person by reason of negligence) is accepted by Motium Pty Ltd (Motium) or any officer, agent or employee of Motium.

Motium reserves the right to alter the specifications of this product at any time, without prior notice.

Table of Content

1. Watchdog operation

This chapter describes the operation of the Watchdog timer.

1.1. Watchdog terminology definitions

The following is the definitions for the terminology used within this document.

Watchdog A Watchdog is a combination of system means that support automatic recovery from an error condition such as deadlocks and system hang-ups.

Watchdog Timeout A Watchdog Timeout defines the time period after which the Watchdog generates a Watchdog Event if there is no longer a response from the system.

Watchdog Event If there is no system response within a defined time period, then the Watchdog generates a Watchdog Event. Usually this is a hardware signal such as a non-maskable interrupt or a reset signal.

Watchdog Trigger This is the system response that forces the Watchdog to reload its timeout counter, i.e. triggering the Watchdog prevents a Watchdog Event.

BIOS Power On Self Test (POST)
This is the amount of time needed for system initialization between power-up and the start of the loading of the operating system.

Runtime The phase of normal system operation starting with the loading of the operating system, i.e. after the POST has finished.

CMOS Setup Utility This is the system configuration tool built into the BIOS. It controls the CMOS RAM used to save the system configuration.

1.2. Runtime Watchdog

The Runtime Watchdog is available during normal system operation and is used to recover from malfunctioning operating systems, application software or system expansions like add-in hardware or peripheral devices. It supports up to three stages. For every stage a separate timeout value and event type can be specified. The granularity of the timeout values is one millisecond and the watchdog timer may have a maximum deviation of 2%.

1.2.1. Runtime Watchdog Modes

The Watchdog Mode defines what happens when the Watchdog generates the event of the last defined stage. When there are several stages defined, then the Watchdog switches to the next stage after generating an event. The selected Watchdog Mode defines how the Watchdog behaves after it has generated the last defined event. Below is a list of the possible modes.

Single Event Mode In the Single Event Mode, the Watchdog switches off after generating the event of the last defined stage.

Repeated Event Mode When in the Repeated Event Mode, and after generating the event of the last defined stage, the Watchdog stays in the last stage and restarts the timeout counter.

Single Trigger Mode The Single Trigger Mode is a variant of the Single Event Mode. It also switches off after generating the event of the last defined stage. Additionally, it switches off when it gets triggered the first time.

1.2.2. Watchdog Timing Diagram

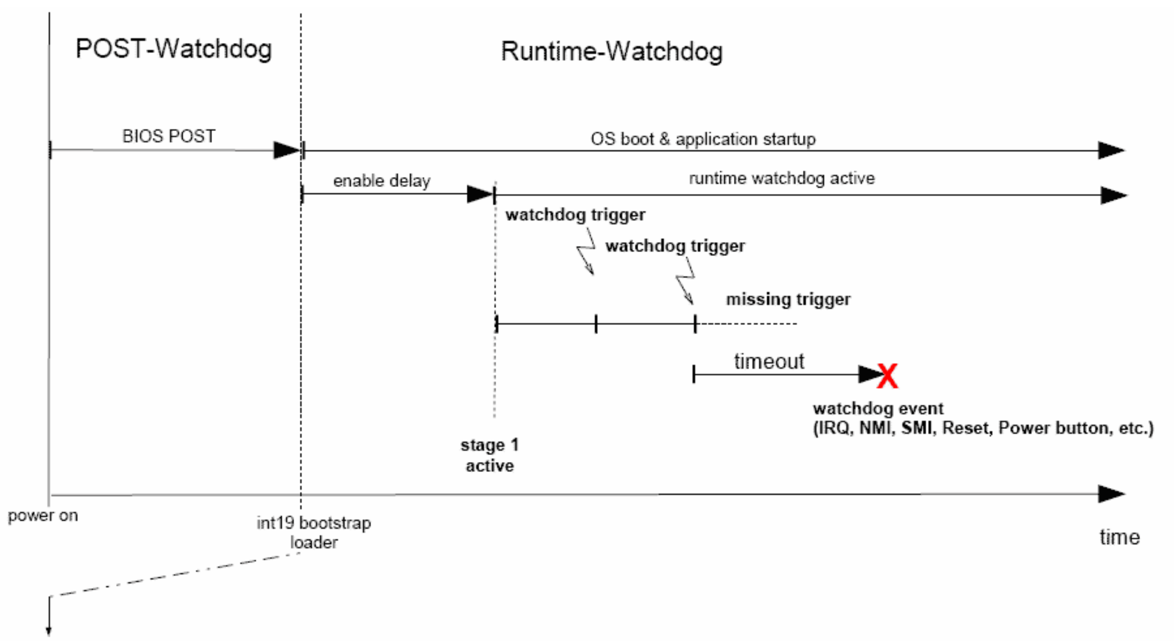


Figure 1. Single-stage / Single-event mode

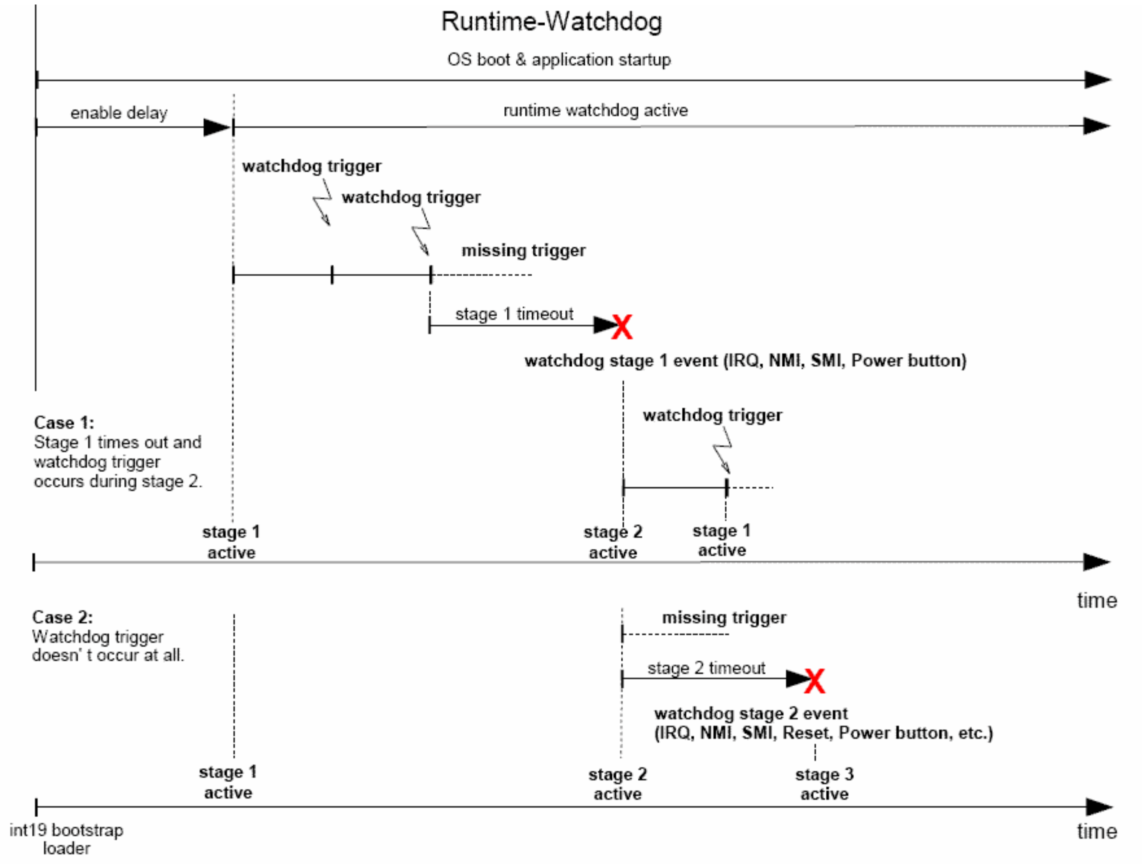


Figure 2. Multi-stage / Single-event mode

1.2.3. Watchdog Events

The following is a description of possible Watchdog Events:

NMI / IRQ	This Watchdog Event generates an interrupt. Depending on the system implementation this may be a non-maskable interrupt (NMI) or a normal interrupt request (IRQ).
ACPI	This Watchdog Event generates a system management interrupt. Depending on the system management implementation (ACPI/APM) this may be an SCI or an SMI. See the *Notes and Cautions* for more information about the ACPI Event.
Reset	This Watchdog Event generates a reset signal. Depending on the system implementation this may reset the whole system, part of it, or just the CPU. In any case after generating the reset signal the Runtime Watchdog gets switched off and no further Watchdog stages will be processed.
Power Button	This Watchdog Event generates a power button signal. Depending on the system implementation this can invoke a system shutdown, switch off the system or power up the system.

1.3. POST Watchdog

The POST Watchdog is available during the system initialization process and is used to recover from a malfunction of system expansions like add-in hardware or peripheral devices. If enabled the POST Watchdog is started immediately after system power up and automatically switched off when the POST is finished and the system is ready to load the operating system. If the system does not finish the POST within the time period defined by the POST Watchdog timeout, then the Watchdog generates a reset signal to reboot the system. The granularity of the timeout value is one millisecond and the watchdog timer may have a maximum deviation of 2%.

1.4. Watchdog Configuration, Initialization, and Lifetime

1.4.1. Watchdog Configuration via the CMOS Setup Utility

The setup program for the BIOS provides a CMOS setup screen that is used to configure the Watchdog. Any changes done in the CMOS setup screen will take effect as soon as the new values have been saved to CMOS RAM and the system is restarted.

1.4.2. Watchdog Configuration via the CGOS API

The CGOS API is used to configure and initialize the Runtime Watchdog. Changing the parameters via the CGOS API will take effect immediately. Please keep in mind that any Runtime Watchdog configuration done via the CGOS API will be overwritten by the Watchdog parameters that have been set using the BIOS setup program when the system reboots.

1.4.3. Initialization and Lifetime

If the POST Watchdog is enabled, then it is initialized and started every time the system powers up or reboots. It stays active until the system reaches the end of POST. The POST Watchdog is switched off automatically before the system starts loading the operating system. Additionally, the POST watchdog is switched off automatically when invoking the CMOS setup utility or when entering a BIOS boot menu.

If the Runtime Watchdog is enabled via the CMOS setup utility, then it is initialized and started automatically at the end of POST. Additionally, it can be initialized and started at any time during runtime via the CGOS API. Except for when in the Single Trigger Mode, the Runtime Watchdog stays active as long as it gets triggered and the system continues to run. The Watchdog can be switched off at any time during runtime via the CGOS API. The Watchdog switches off automatically when being triggered in single trigger mode or after generating a RESET EVENT.

1.5. Watchdog Triggering

Triggering the Watchdog within the Watchdog Timeout interval prevents the Watchdog from generating an event. When there are several Watchdog stages defined, then triggering the Watchdog also forces the Watchdog back to the first stage. There are different methods of triggering the Watchdog. Below you will find a description of each trigger method.

1.5.1. Watchdog Triggering via the CGOS API

The usual method of triggering the watchdog is through the use of the CGOS API.

1.5.2. External Trigger Method

This option is not support in the 19-inch Panel PC.

1.6. Notes and cautions

The following notes and cautions should be observed.

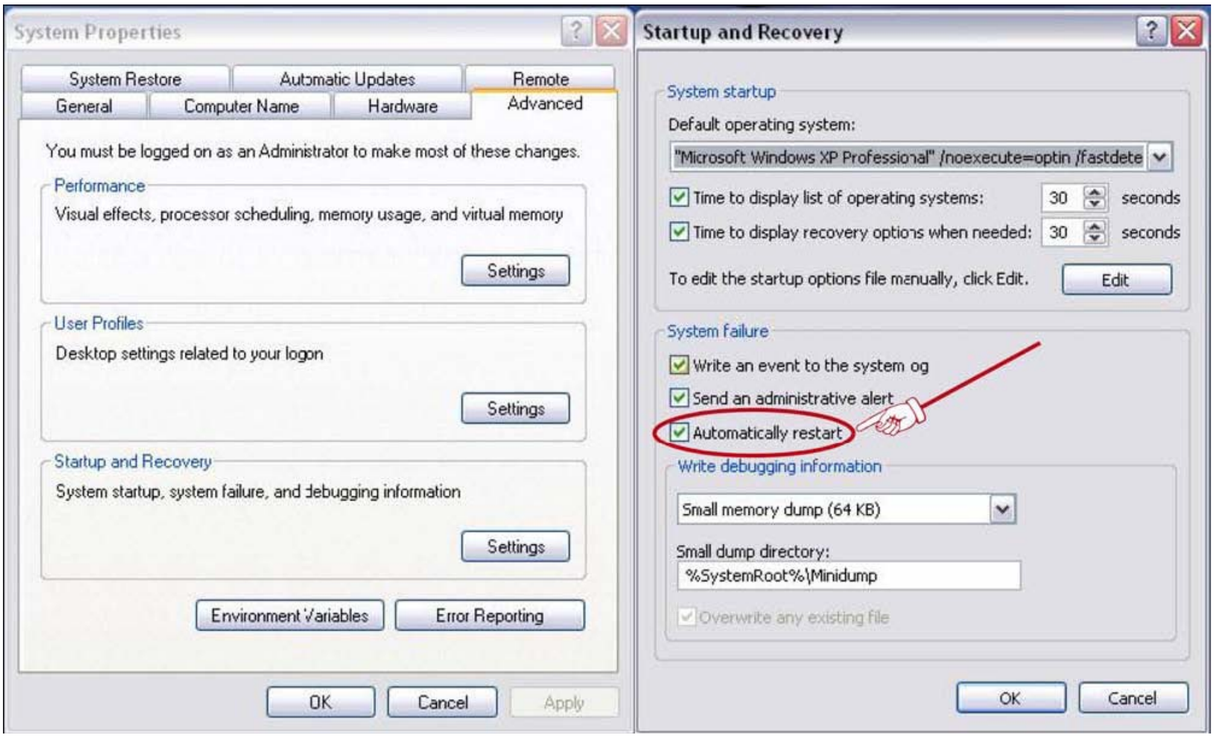
1. In ACPI mode it is not possible for a *Watchdog ACPI Event* handler to directly restart or shutdown the OS. For this reason the BIOS will do one of the following:

   For Shutdown: An over temperature notification is executed. This causes the OS to shut down in an orderly fashion.

   For Restart: An ACPI fatal error is reported to the OS.

   It depends on your particular OS as to how this reported fatal error will be handled when the Restart function is selected. If you are using Windows XP/2000 there is a setting that can be enabled to ensure that the OS will perform a restart when a fatal error is detected. After a very brief blue-screen the system will restart.

   You can enable this setting buy going to the *System Properties* dialog box and choosing the *Advanced* tab. Once there, choose the *Settings* button for the *Startup and Recovery* section. This will open the *Startup and Recovery* dialog box. In this dialog box under *System failure* there are three check boxes that define what Windows will do when a fatal error has been detected. In order to ensure that the system restarts after a *Watchdog ACPI Event* that is set to *Restart*, you must make sure that the check box for the selection *Automatically restart* has been checked. If this option is not selected then Windows will remain at a blue-screen after a *Watchdog ACPI Event* that has been configured for *Restart* has been generated. Below is a Windows screen-shot showing the proper configuration.



2. By using several Watchdog stages it is possible to escalate the Watchdog actions. For example the Watchdog could generate an interrupt as a first event giving some interrupt handler of the application the chance to recover from an error condition. If this handler also fails to trigger the Watchdog, then the Watchdog may generate a reset signal to restart the system.

3. Be careful when selecting a POST Watchdog timeout value. It should be taken into account that the power up time of peripheral devices may vary or option ROMs, such as LAN boot ROMs, may elongate the POST process. Choosing a POST Watchdog timeout value that is too short may be counterproductive. Instead of ensuring that only a recovery from a true malfunction is implemented, the system may reset periodically without a valid reason as a result of an incorrect Watchdog Timeout value.

4. It doesn't make any sense to select Watchdog Event RESET together with Repeated Event Mode because the Watchdog switches off immediately after generating the first reset signal due to the fact that a repeated reset signal is not supported.

5. Under normal circumstances it is not necessary to trigger the POST Watchdog. However it is possible. This may be helpful when writing option ROMs, which need to delay the POST in special situations. The CGOS API is not available in that case, therefore the fast or external trigger methods can only be used.

6. It's possible that two Watchdog stages with Power Button Events could be used to configure defined system on/off times.

7. The Single Trigger Event may be useful for application software, which cannot use the CGOS API but still want to ensure that the operating system boots completely and starts the application code. In that case the CMOS setup utility

must be used to configure the Runtime Watchdog in Single Trigger Mode with one stage and event RESET. Together with a POST watchdog this guarantees that the system is restarted until it makes it to the application code. The only thing that the application code has to do then is to switch off the watchdog via the fast or external trigger method.

1.7. BIOS configuration

The BIOS needs to be configured to enable the Watchdog. The section discusses this.

1.7.1. ACPI Configuration submenu

In the ACPI Configuration Submenu, need to select the event that is initiated by the watchdog ACPI event: Shutdown or Restart. When the watchdog times out, a critical but orderly OS shutdown or restart can be performed.

1.7.2. Watchdog Configuration Submenu

Feature	Options	Description
POST Watchdog	**Disabled** 30sec 1min 2min 5min 10min 30min	Select the timeout value for the POST watchdog. The watchdog is only active during the power-on-self-test of the system and provides a facility to prevent errors during boot up by performing a reset.
Stop Watchdog For User Interaction	No **Yes**	Select whether the POST watchdog should be stopped during the popup boot selection menu or while waiting for setup password insertion.
Runtime Watchdog	**Disabled** One time trigger Single Event Repeated Event	Selects the operating mode of the runtime watchdog. This watchdog will be initialised just before the operating system starts booting. One time trigger: the watchdog will be disabled after the first trigger. Single event: every stage will be executed only once, then the watchdog will be disabled. Repeated event: the last stage will be executed repeatedly until a reset occurs.
Delay	**Disabled** 30sec 1min 2min 5min 10min 30min	Select the delay before the runtime watchdog becomes active. This ensures that an operating system has enough time to load.
Event 1	**NMI** ACPI Event Reset	Selects the type of event that will be generated when timeout 1 is reached. For more information about ACPI Event see section **Error! Reference source not found.**, ***Error!***

	Power Button	***Reference source not found.*** .
Event 2	**Disabled** NMI ACPI Event Reset Power Button	Selects the type of event that will be generated when timeout 2 is reached.
Event 3	**Disabled** NMI ACPI Event Reset Power Button	Selects the type of event that will be generated when timeout 3 is reached.
Timeout1	0.5sec 1sec 2sec 5sec **10sec** 30sec 1min 2min	Selects the timeout value for the first stage watchdog event.
Timeout 2	as above	Selects the timeout value for the second stage watchdog event.
Timeout 3	as above	Selects the timeout value for the third stage watchdog event.

2. CGOS API

This chapter describes version 1.03 of the CGOA API.

The CGOS API is an application program interface that allows access to certain hardware features on the processor module. The API works under any version of Win32. Driver support is provided for:

- Microsoft Windows Vista 32
- Microsoft Windows XP
- Microsoft Windows XP embedded
- Microsoft Windows 2000
- Microsoft Windows NT
- Microsoft Windows CE 5.0
- Microsoft Windows CE 6.0
- Linux (Kernel Version 2.4.x and 2.6.x)
- QNX 6.x
- Windriver VxWorks
- On Time RTOS-32

2.1. Installing the CGOS API

Running the sample application CGOSDUMP.EXE will dynamically install the drivers. It is also possible to perform a dynamic installation in your own application as well. When using Windows NT/2000/XP it is necessary to have “Administrative Rights” in order to install the drivers, for example when running CGOSDUMP.EXE for the first time.

The CgosLibInstall function within the CGOS API, allows you to execute the necessary steps to setup the required drivers in an operating system independent manner. The required files must be present in the operating system dependent directory before calling CgosLibInstall.

The following sections lists the driver files and installation functions for those who do not want to use the CGOS install functionality. The cgos.h header file is the same for all operating system variants.

CGOS.DLL is binary compatible between Windows 9x and NT/2000/XP/Vista, a different version with the same name is made available for Windows CE. On some occasions it's necessary for Motium to provide updated CGOS library files or drivers for individual operating systems and/or product variants. When this occurs, these individual updates may not be immediately incorporated into the CGOS API package so it's important that you also check for individual updates when checking for new revisions of the CGOS API package.

2.1.1. Microsoft Windows NT/2000/XP/XP embedded/Vista

Copy all files from the Cgos\WIN\BIN folder to folder Windows\System32. Running CgosDump, as long as you have "Administrative Rights", will automatically install the driver. This can also be accomplished by calling the function CgosLibInstall from any CGOS application. Do not remove the files afterwards because the driver must reside in the directory where it was initially installed.

During installation, some keys are written to the registry to specify the location of the driver and the library. Once installed, moving the driver and/or the library to a new location will result in an inaccessible CGOS interface. Moreover, it's assumed that the driver (cgos.sys) and library (cgos.dll) resides in the same directory. However, if required the registry values can easily be removed by calling `CgosLibInstall(0)`.

2.2. Additional Programs

2.2.1. CGOSDUMP

The CGOSDUMP.EXE tool prints out a lot of information about the CPU module and the CGOS interface itself, such as the BIOS version,serial number of the module, the CGOS driver and library version, the running time meter, available I2C buses and storage areas plus more.

CGOSDUMP.EXE is a sample program and was not designed to serve any applicable purpose. The source code has been provided for a better understanding of how this sample program works.

The CGOSDUMP.EXE is a sample program that has been created strictly for the use of software developers and should never be distributed to end users in it's current form.

2.2.2. CGOSMON

The CGOSMON.EXE tool provides information about the different voltage and temperature sensors on the CPU module.

CGOSMON.EXE is a sample program and was not designed to serve any applicable purpose. The source code has been provided for a better understanding of how this sample program works.

The CGOSMON.EXE is a sample program that has been created strictly for the use of software developers and should never be distributed to end users in it's current form.

2.2.3. CGOSUNINST

When executing any CGOS application without proper installation of the CGOS API in a Windows environment, the system will dynamically install the drivers. In some cases this is not desired because the location of the driver files will be fixed by a registry entry. The cgosuninst tool can be used to remove all the CGOS related entries from the Windows registry. It's especially helpful when the location of the CGOS API files should be changed.

The cgosuninst tool only removes the registry entries, files are not deleted or removed.

2.3. Programming

All the API functions are exported from the CGOS.DLL/cgos.so dynamic link library and UNICODE is supported. CGOS.DLL is binary compatible between Windows 9x and NT/2000/XP but a different version with the same name is made available for Windows CE.

In the INC and LIB directories you will find a header file cgos.h and import library CGOS.LIB for C/C++. The cgos.h header file is the same for all Windows operating system variants.

Within the files of CGOSDUMP you will find a sample project, which demonstrates CGOS functionality under Microsoft Visual C++. Most of following source code examples are taken from CGOSDUMP.

2.3.1. Installing the DLL

In order to use another API it is necessary to initialize and install the DLL by using the CgosLibInitialize function. Additionally, it is also necessary to use the function CgosLibUninitialize before the application terminates. This guarantees that a proper resource cleanup has taken place before the actual termination of the application.

Code example for installing/removing the library:

```
if (!CgosLibInitialize()) {
    if (!CgosLibInstall(1)) {
        //error: the driver could not be installed. Check your rights.
        exit(-1);
        }
// the driver has been installed
if (!CgosLibInitialize()) {
        //error: the driver still could not be opened, a reboot might be
            required
        exit(-1);
        }
    }

// CgosLibInitialize successful
// open board, access watchdog & VGA functions, etc.
...

// close board
...

// remove DLL
CgosLibUninitialize();
```

There are some other function calls which belong to the library management:

- CgosLibGetVersion — determines the version of the library
- CgosLibGetDrvVersion — determines the version of the low level cgos driver
- CgosLibIsAvailable — determines if the library is already installed
- CgosLibGetLastError — returns the last interface error
- CgosLibSetLastErrorAddress — fills a variable with the last interface error

2.3.2. Obtaining access to the processor module

Board Name
In the CGOS concept, a system consist of one or more CGOS compliant boards. A board is a physical hardware component. Each board in the system is identified by a unique board name with a maximum size of CGOS_BOARD_MAX_SIZE_ID_STRING characters.

Board Classes
The class of the board describes the functionality the board offers. Currently, there are the classes CPU, VGA, and IO. In most cases, a physical board offers more functionality than that of just one single class. For instance a 945 processor board offers CPU and VGA functionality. In the CGOS concept, therefore, each board has exactly one primary class and may have several secondary classes. In the case of the 945, the primary class is of type CGOS_BOARD_CLASS_CPU and the secondary class of type CGOS_BOARD_CLASS_VGA. The function CgosBoardCount might be used to determine the number of boards either for a given class or the entire system.

Once the library is initialized, the API functions CgosBoardOpen or CgosBoardOpenByName are used to obtain a valid board handle. The board handle is the tight relation between the CGOS driver and the application until it is closed by CgosBoardClose.

Code example for opening/closing a CGOS board:

```
// board handle
HCGOS hCgos=0;

// open the board
if (!CgosBoardOpen(0,0,0,&hCgos)) {
   //error: could not open a board
   ...
   }

// put in your code here (e.g. setup & trigger the watchdog, etc.)
...

// close
if (hCgos) CgosBoardClose(hCgos);
```

2.3.3. Generic Board Functions

Numerous CgosBoard* functions are designed to allow you to retrieve general board class independent information about the board.

CgosBoardGetNamedetermines the version the board name for a given handle.

The CgosBoardGetInfo function call is used to get the information about the current configuration and state of the board. It takes a pointer to an instance of structure CGOSBOARDINFO, which is defined as follows:

`CGOSBOARDINFO`

`unsigned long dwSize`
size of the structure itself, must be initialized with sizeof(CGOSBOARDINFO)

`unsigned long dwFlags`
reserved. Always set to 0.

`char szReserved[CGOS_BOARD_MAX_SIZE_ID_STRING]`
reserved. Always set to 0.

`char szBoard[CGOS_BOARD_MAX_SIZE_ID_STRING]`
the name of the board, extracted from the BIOS id

`char szBoardSub[CGOS_BOARD_MAX_SIZE_ID_STRING]`
the sub name of the board, extracted from the manufacturing data

`char szManufacturer[CGOS_BOARD_MAX_SIZE_ID_STRING]`
the name of the processor module manufacturer

`CGOSTIME stManufacturingDate`
the date of manufacturing

`CGOSTIME stLastRepairDate`
the date of last repair

`char szSerialNumber[CGOS_BOARD_MAX_SIZE_SERIAL_STRING]`
the serial number of the board, e.g. 000000050000

`unsigned short wProductRevision`
the product revision in ASCII notation, major revision in high-byte, minor revision in low-byte, e.g. 0x4130 for revision A.0

`unsigned short wSystemBiosRevision`
the revision of the system BIOS, major revision in high-byte, minor revision in low-byte, e.g. 0x0110 for revision 110

`unsigned short wBiosInterfaceRevision`
the revision of CGOS API BIOS interface, major revision in high-byte, minor revision in low-byte, e.g. 0x0100 for revision 100

`unsigned short wBiosInterfaceBuildRevision`
the build counter of CGOS API BIOS interface, e.g. 0x001 for build 001 unsigned long dwClasses this entry represents an or-ed value of all the supported board classes see also section "Board classes" for more information about board classes

`unsigned long dwPrimaryClass`
this entry represents the primary board class, e.g. CGOS_BOARD_CLASS_CPU

`unsigned long dwRepairCounter`
the repair counter

`char szPartNumber[CGOS_BOARD_MAX_SIZE_PART_STRING]`
the part number, e.g. TBC in the case of 945

`char szEAN[CGOS_BOARD_MAX_SIZE_EAN_STRING]`
the EAN code of the board

```
unsigned long dwManufacturer
```
the sub manufacturer of the board

CgosBoardGetBootCounter delivers the boot counter value

CgosBoardGetRunningTimeMeter delivers the running time of the board measured in hours

2.3.4. Watchdog

Refer to the chapter earlier in this document that describes the watchdog features, to become more familiar with the basic Watchdog features, its implementations and the differences between the operation modes on different products.

The CGOS Library API provides the following functions, which are used to control the behaviour or to get information about the state of the Watchdog:

```
CgosWDogCount
CgosWDogIsAvailable
CgosWDogTrigger
CgosWDogGetConfigStruct
CgosWDogSetConfigStruct
CgosWDogSetConfig
CgosWDogDisable
CgosWDogGetInfo
```

2.3.4.1. Mode

The mode defines the major behavior of the watchdog:

CGOS_WDOG_MODE_REBOOT_PC	the watchdog just restarts the board
CGOS_WDOG_MODE_STAGED	the watchdog operates in staged mode (preferred)

2.3.4.2. Operation Modes

In staged mode, the Watchdog might offer one or more various operation modes:

```
CGOS_WDOG_OPMODE_DISABLED
CGOS_WDOG_OPMODE_ONETIME_TRIG
CGOS_WDOG_OPMODE_SINGLE_EVENT
CGOS_WDOG_OPMODE_EVENT_REPEAT
```

The supported modes can be determined through the CGOS Library API function call CgosWDogGetInfo. The returned value CGOSWDINFO:dwOpModes represents a bit mask of all supported modes. To check if the “repeated event mode” is supported by the board controller watchdog, the following example can be used:

```
CGOSWDINFO      dwi;
if (CgosWDogGetInfo(hCgos, CGOS_WDOG_TYPE_BC, &dwi))
{
    if (dwi.dwOpModes & (1<<CGOS_WDOG_OPMODE_EVENT_REPEAT))
    {
    /* watchdog supports repeated event mode */
    }
}
```

2.3.4.3. Events

An event is implemented by the onboard hardware during the situation when a Watchdog timeout occurs. Following events are defined:

`CGOS_WDOG_EVENT_INT`
defines a NMI or IRQ event

Depending on the hardware implementation, this event releases a NMI (non maskable interrupt) or an IRQ (normal hardware interrupt). It's up to the user to install an appropriate IRQ handler which is able to handle this type of event.

`CGOS_WDOG_EVENT_SCI`
defines a SMI or a SCI event

Depending on the hardware implementation, this event releases a SMI (system management interrupt) or a SCI (ACPI interrupt). It's up to the user to install an appropriate software handler which is able to handle this type of event.

`CGOS_WDOG_EVENT_RST`
defines a system reset event

This event issues a system reset. Depending on the hardware implementation, this reset will be applied to the complete system or only to parts of the system.

`CGOS_WDOG_EVENT_BTN`
defines a power button event

This event activates the power button signal. It can be used to switch off and even to switch on the board again in the case of a multistage Watchdog implementation.

2.3.4.4. Stages

Depending on the implementation the Watchdog might offer multiple stages for executing events. Each stage has it's own timeout value and event definition. If a stage times out, the configured event for this stage will be executed and the next stage will be entered. This offers the ability to implement a more refined error handling.

It is possible to define IRQ as first stage event and power button as second stage event: If the timeout for the first stage occurs, an IRQ is generated and stage 2 becomes active. At the same time the appropriate IRQ handler will be activated and might solve the problem (e.g. by restarting a crashed application and triggering the Watchdog). If the triggering of the Watchdog doesn't occur and as well the second stage times out then the system will be shut down.

2.3.4.5. Watchdog Types

Following watchdog types are currently defined:

CGOS_WDOG_TYPE_UNKNOWN	used when the type is not known
CGOS_WDOG_TYPE_BC	the watchdog is implemented via the onboard controller
CGOS_WDOG_TYPE_CHIPSET	the watchdog functionality is available just through the board's chipset

2.3.4.6. Information Structure

The CgosWDogGetInfo function call is used to get information about the current configuration and state of the Watchdog. It takes a pointer to an instance of structure CGOSWDINFO, which is defined as follows:

CGOSWDINFO

`unsigned long dwSize`
size of the structure itself, must be initialized with sizeof(CGOSWDINFO)

`unsigned long dwFlags`
reserved. Always set to 0.

`unsigned long dwMinTimeout`
this value depends on the hardware implementation of the Watchdog and specifies the minimum value for the Watchdog trigger timeout.

`unsigned long dwMaxTimeout`
this value depends on the hardware implementation of the Watchdog and specifies the maximum value for the Watchdog trigger timeout.

`unsigned long dwMinDelay`
this value depends on the hardware implementation of the Watchdog and specifies the minimum value for the Watchdog enable delay.

`unsigned long dwMaxDelay`
this value depends on the hardware implementation of the Watchdog and specifies the maximum value for the Watchdog enable delay.

`unsigned long dwOpModes`
the mask of the supported operation modes, see section 2.3.4.2 Operation Modes

`unsigned long dwMaxStageCount`
the amount of supported Watchdog stages, see section 2.3.4.4 Stages

`unsigned long dwEvents`
the mask of the supported Watchdog events, see section 2.3.4.3 Events

`unsigned long dwType`
see section 2.3.4.5 Watchdog Types

2.3.4.7. Configuration

The CgosWDogSetConfigStruct and CgosWDogGetConfigStruct function calls are used to set and to determine the Watchdog configuration. Both of them take a pointer to an instance of structure CGOSWDCONFIG which is defined as follows:

`CGOSWDCONFIG`

`unsigned long dwSize`

size of the structure itself, must be initialized with sizeof(CGOSWDCONFIG)

`unsigned long dwTimeout`

it specifies the value for the Watchdog timeout. It must be in the range CGOSWDINFO:dwMinTimeout and CGOSWDINFO:dwMaxTimeout. In case of multiple stages, this value is not used because the configuration occurs through the appropriate stage structure.

`unsigned long dwDelay`

this value specifies the value for the Watchdog enable delay, see also figure 1 or figure 2 from Watchdog Timing Chart, earlier in this manual.

`unsigned long dwMode`

the current mode, see section 2.3.4.1 Mode

`unsigned long dwOpMode`

the mask of the supported operation modes, see section 2.3.4.2 Operation Modes this value is only used in multistage mode

`unsigned long dwStageCount`

the number of available Watchdog stages, see section 2.3.4.4 Stages this value is only used in multistage mode

`CGOSWDSTAGE stStages[CGOS_WDOG_EVENT_MAX_STAGES]`

this array holds the state definition of each defined stage these values are only used in multistage mode

The CgosWDogSetConfig and the config structure contain time values with a millisecond resolution. timeout is the basic time during which a CgosWDogTrigger function must be called. delay adds an initial time period for the first trigger call.

In case of a multistage Watchdog implementation the array stStages of type CGOSWDSTAGE contains the stage structures which incorporates the timeout and event value for each stage. Refer also to figure 2 in the Watchdog Timing Chart section and the definition below:

CGOSWDSTAGE

`unsigned long dwTimeout`

it specifies the time value for the affected stage. The value must be in the range CGOSWDINFO:dwMinTimeout and CGOSWDINFO:dwMaxTimeout

`unsigned long dwEvent`

it contains the event definition for the affected stage, see section 4.7.3 Events If the mode is set to staged then up to three stages can be defined. The stages are run in the order they are specified after each timeout value has expired without triggering the Watchdog.

The CgosWDogSetConfig function call is provided for convenience. It offers a fast and easy way for setting up a single staged Watchdog without the necessity to handle a complex configuration structure. However, it's recommended to use CgosWDogSetConfigStruct to benefit from the features of a multistage Watchdog implementation.

2.3.4.8. Triggering

After configuring the Watchdog by CgosWDogSetConfigStruct the application must continuously call CgosWDogTrigger that triggers the Watchdog.

2.3.4.9. Disabling the Watchdog

An enabled Watchdog can be disabled by calling CgosWDogDisable.

2.4. CGOS Library API Programmer's Reference

The CGOS Library API provides access to specific board information and features.

All functions provide a Cgos*Count() function to retrieve the number of available units. All other functions within that group require a dwUnit parameter. In all cases this can simply be the zero based unit number.

Some functions and structures contain version numbers. All 16 bit version numbers contain the major number in the high byte and the minor in the low byte in BCD. BIOS and board controller version numbers should simply be treated as 3 BCD digits as only that combination together with the board name yields useful information.

All 32 bit version numbers contain the 16 bit version number in the high word and a build or subversion number in the low word.

For function call details and parameters also refer to the cgos.h header file.

2.4.1.1. Return Values

Unless they return a count or version number, all Cgos* functions return 1 for success and 0 for failure. Other return values are stored in pointers passed to the function.

2.4.1.2. Board Classes

In a system with several CGOS compliant boards, the board class is used to distinguish between the hardware types of the installed boards. Currently, board classes are defined for CPU, VGA and IO boards, respectively:

```
CGOS_BOARD_CLASS_CPU

CGOS_BOARD_CLASS_VGA

CGOS_BOARD_CLASS_IO
```

2.4.1.3. Information Structures

The API defines several information structures in cgos.h They are used to store the returned values during Cgos*GetInfo calls. Before using these structures, the dwSize entry of each info structure must be initialized with the size of the structure itself (sizeof(CGOS*INFO)). This provides independence between the application and the library if the structure is extended in future releases of the library.

2.4.1.4. Unit numbers

Almost all function calls take a unique unit number that is used to identify a dedicated unit. Usually the unit number is between 0 and the return value -1 of the related Cgos*Count function call. It can be taken as an index for devices of the same type. The following example shows how to determine the current value of the CPU temperature sensor:

Example 1:

```
static CGOSTEMPERATUREINFO temperatureInfo = {0};
unsigned long dwUnit, monCount = 0, dwTemp, dwState;

temperatureInfo.dwSize = sizeof (temperatureInfo);
```

```
// determine number of temperature sensors
monCount = CgosTemperatureCount(hCgos);
printf("Number of temperature monitors: %d\n", monCount);
if(monCount != 0)

{
for(dwUnit = 0; dwUnit < monCount; dwUnit++)
{
    if(CgosTemperatureGetInfo(hCgos, dwUnit, &temperatureInfo))
    {
        if (temperatureInfo.dwType == CGOS_TEMP_CPU)
        {
            // temperatureInfo now contains the info structure of the cpu
                  sensor
            // dwUnit points to the cpu temperature sensor
            if (CgosTemperatureGetCurrent(hCgos, dwUnit, &dwTemp, &dwState)
            {
                    // dwTemp and dwState contain the actual values of the
                          cpu sensor
            }
            }
        }
    }
}
```

A device enumeration can always be set up as shown above. Additionally, some function calls such as all of the CgosStorageArea* and CgosI2C* function calls can take a type number as dwUnit parameter.

The following examples used to determine the storage area size of the user EEPROM (type CGOS_STORAGE_AREA_EEPROM) are equivalent:

Example 2:

```
unsigned long dwUnit;
unsigned long dwSize;
unsigned long areaCount =
    CgosStorageAreaCount(hCgos,CGOS_STORAGE_AREA_UNKNOWN);
for(dwUnit = 0; dwUnit < areaCount; dwUnit++)
{
    if (CgosStorageAreaType(hCgos,dwUnit) == CGOS_STORAGE_AREA_EEPROM))
    {
        dwSize = CgosStorageAreaSize(hCgos,dwUnit);
    }
}
```

Example 3:

```
unsigned long dwSize;
dwSize = CgosStorageAreaSize(hCgos,CGOS_STORAGE_AREA_EEPROM);
```

The device enumeration as shown in Example 1 is the preferred way to obtain access to the unit information and works for all function groups. Example 3 shows a convenient way to access the unit through its type definition but keep in mind that this method is not available for all function groups.

2.4.2. Function Group CgosLib*

The CgosLib* functions are used to initialize and to remove the CGOS Library. The library provides the basic layer for the application to access all the CGOS API functions. The library must be installed before any call to CGOS API functions can be executed successfully.

2.4.2.1. CgosLibGetVersion

Declaration

```
ulong CgosLibGetVersion(void)
```

Remark

Returns the version of the CGOS API library. This 32 bit version number contains the 16 bit version number in the high word and a build or subversion number in the low word.

2.4.2.2. CgosLibInitialize

Declaration

```
bool CgosLibInitialize(void)
```

Remark

Initializes the CGOS API library.

2.4.2.3. CgosLibUninitialize

Declaration

```
bool CgosLibUninitialize(void)
```

Remark

De-initializes the CGOS API library and removes it from memory.

2.4.2.4. CgosLibIsAvailable

Declaration

```
bool CgosLibIsAvailable(void)
```

Remark

Checks if the CGOS API library has already been initialized by a prior call to function CgosLibInitialize.

2.4.2.5. CgosLibInstall

Declaration

```
bool CgosLibInstall(unsigned int install)
```

Input

install	1 – installs the low level CGOS driver
	0 – removes the low level CGOS driver

Remark

This function can be used to install the low level CGOS driver if a prior call of CgosLibInitialize failed. Keep in mind that you might need administrative privileges for executing this function successfully. See also section *Installing the DLL* for a more detailed description about installing the CGOS API library.

2.4.2.6. CgosLibGetDrvVersion

Declaration

```
ulong CgosLibGetDrvVersion(void)
```

Remark

Returns the version of the low level CGOS driver.

2.4.2.7. CgosLibGetLastError

Declaration

```
ulong CgosLibGetLastError(void)
```

Remark

Returns the last known error code of the low level CGOS driver. Notice that this function really delivers the code of the last known CGOS driver error and not the result of the last CGOS API function call. A succeeding CGOS API call doesn't affect the return value of this function.

The following error codes are currently defined:

description	error code
`generic error`	`-1 (0xFFFF FFFF)`
`invalid parameter`	`-2 (0xFFFF FFFE)`
`function not found`	`-3 (0xFFFF FFFD)`
`read error`	`-4 (0xFFFF FFFC)`
`write error`	`-5 (0xFFFF FFFB)`
`timeout`	`-6 (0xFFFF FFFA)`

2.4.2.8. CgosLibSetLastErrorAddress

Declaration

```
bool CgosLibSetLastErrorAddress(unsigned long *pErrNo)
```

Input

pErrNo	buffer where the error code will be stored

Remark

With this function it's possible to specify a local memory location in the context of the application where the last error code will be stored. It provides a convenient way of implementing error handling without calling the CgosLibGetLastError function after each regular CGOS API function call. See section *CgosLibGetLastError* for a detailed list of valid error codes.

2.4.3. Function Group CgosBoard*

The CgosBoard* routines are used to obtain a handle to a dedicated board and specific board information like the number of boots or the total running time.

2.4.3.1. CgosBoardCount

Declaration

```
ulong CgosBoardCount(unsigned long dwClass,unsigned long
dwFlags)
```

Input

dwClass — the hardware class of the board, see also 4.2 subsection *Board classes*

dwFlags — either CGOS_BOARD_OPEN_FLAGS_DEFAULT or

CGOS_BOARD_OPEN_FLAGS_PRIMARYONLY

CGOS_BOARD_OPEN_FLAGS_DEFAULT

counts all boards of the given hardware class

CGOS_BOARD_OPEN_FLAGS_PRIMARYONLY

counts only boards which primary board class matches the given hardware class

Remark

Returns the number of installed CGOS compliant boards with the specified board class dwClass. In case of dwClass is 0, the total number of boards in the system will be returned.

2.4.3.2. CgosBoardOpen

Declaration

```
bool CgosBoardOpen(unsigned long dwClass, unsigned long dwNum,
unsigned long dwFlags, HCGOS *phCgos)
```

Input

dwClass — the hardware class of the board, see also 4.2 subsection *Board classes*

dwNum — the subsequent number of the selected board in it's class, starting from 0

dwFlags — either CGOS_BOARD_OPEN_FLAGS_DEFAULT or

CGOS_BOARD_OPEN_FLAGS_PRIMARYONLY

CGOS_BOARD_OPEN_FLAGS_DEFAULT

scans for all boards of the specified hardware class, regardless if it's the primary class or the secondary class

CGOS_BOARD_OPEN_FLAGS_PRIMARYONLY

scans for boards which primary board class matches the specified hardware class

phCgos	buffer where the board handle will be stored

Remark

Each CGOS compliant board in the system will be addressed by its own unique board handle. This function is used to open such a board and to obtain a valid board handle. If there is more then one CGOS board in the system, each board can be individually selected by its board class dwClass and a subsequent enumeration of dwNum. On success, the function returns the board handle in *phCgos.

CGOS_BOARD_OPEN_FLAGS_PRIMARYONLY might be used for dwFlags to select a board of a dedicated board class. Together with an enumerated counter starting from 0 the board can be addressed exactly. For instance, the call to open the 2nd (cgos compliant) vga board would be:

```
HCGOS hcgos;

CgosBoardOpen(CGOS_BOARD_CLASS_VGA,1,CGOS_BOARD_OPEN_FLAGS_PRIMARYONLY,&hc
gos);
```

2.4.3.3. CgosBoardOpenByName

Declaration

```
bool CgosBoardOpenByName(const char *pszName, HCGOS *phCgos)
```

Input

pszName	the name of the board, e.g. “X945” in case of a 945 CPU module
phCGOS	buffer where the board handle will be stored

Remark

This function behaves like CgosBoardOpen except that the board is specified by its name. On success, the function returns the board handle in *phCgos.

2.4.3.4. CgosBoardClose

Declaration

```
bool CgosBoardClose(HCGOS hCgos)
```

Input

hCgos	the board handle

Remark

Closes a board which was previously opened by either CgosBoardOpen or CgosBoardOpenByName.

2.4.3.5. CgosBoardGetName

Declaration

```
bool CgosBoardGetName(HCGOS hCgos, const char *pszName,
unsigned long dwSize)
```

Input

hCgos	the board handle
pszName	buffer where the board name will be stored
dwSize	size of the buffer in bytes, should be at least CGOS_BOARD_MAX_SIZE_ID_STRING

Remark

Determines the name of the board addressed by hCgos.

2.4.3.6. CgosBoardGetInfo

Declaration

```
bool CgosBoardGetInfo(HCGOS hCgos, CGOSBOARDINFO *pBoardInfo)
```

Input

hCgos	the board handle
pBoardInfo	the buffer where the board information will be stored

Remark

Gets the board information of a CGOS API compliant board addressed by hCgos. See section 4.3 Generic Board Functions for a detailed description of the CGOSBOARDINFO structure.

2.4.3.7. CgosBoardGetBootCounter

Declaration

```
bool CgosBoardGetBootcounter(HCGOS hCgos, unsigned long
*pdwCount)
```

Input

hCgos	the board handle
pdwCount	the variable where the boot counter value will be stored

Remark

Gets the current value of the boot counter.

2.4.3.8. CgosBoardGetRunningTimeMeter

Declaration

```
bool CgosBoardGetRunningTimeMeter(HCGOS hCgos,
unsigned long *pdwCount)
```

Input

hCgos	the board handle
pdwCount	the variable where the value of the running time meter will be stored

Remark

Gets the current running time of the board measured in hours.

2.4.4. Function Group CgosWDog*

2.4.4.1. CgosWDogCount

Declaration

```
ulong CgosWDogCount(HCGOS hCgos)
```

Input

hCgos	the board handle

Remark

Returns the number of installed Watchdogs in the system.

2.4.4.2. CgosWDogIsAvailable

Declaration

```
bool CgosWDogIsAvailable(HCGOS hCgos, unsigned longdwUnit)
```

Input

hCgos	the board handle
dwUnit	unit number

Remark

Determines if the Watchdog is present.

2.4.4.3. CgosWDogTrigger

Declaration

```
bool CgosWDogTrigger(HCGOS hCgos, unsigned long dwUnit)
```

Input

hCgos	the board handle
dwUnit	unit number

Remark

Triggers the Watchdog.

2.4.4.4. CgosWDogGetConfigStruct

Declaration

```
bool CgosWDogGetConfigStruct(HCGOS hCgos, unsigned long dwUnit,
CGOSWDCONFIG *pConfig)
```

Input

hCgos	the board handle
dwUnit	unit number
pConfig	the pointer to the configuration structure

Remark

Determines the configuration of the Watchdog.

2.4.4.5. CgosWDogSetConfigStruct

Declaration

```
bool CgosWDogSetConfigStruct(HCGOS hCgos, unsigned long dwUnit,
CGOSWDCONFIG *pConfig)
```

Input

hCgos	the board handle
dwUnit	unit number
pConfig	the pointer to the configuration structure

Remark

Sets the configuration of the Watchdog.

2.4.4.6. CgosWDogSetConfig

Declaration

```
bool CgosWDogSetConfig(HCGOS hCgos, unsigned long dwUnit,
unsigned long timeout, unsigned long delay, unsigned long mode)
```

Input

hCgos	the board handle
dwUnit	unit number
timeout	the value in milliseconds before the Watchdog times out. An application which is observed by the Watchdog must call CgosWDogTrigger within the specified time.
delay	the delay before the Watchdog starts working. This is required to prevent a reboot while the operating system or the application initializes.

Remark

Sets the configuration of the Watchdog. While CgosWDogSetConfigStruct takes a complete structure, CgosWDogSetConfig takes single values. Use CgosWDogSetConfigStruct to benefit from the advantages of a staged Watchdog.

2.4.4.7. CgosWDogDisable

Declaration

```
bool CgosWDogDisable(HCGOS hCgos, unsigned long dwUnit)
```

Input

hCgos	the board handle
dwUnit	unit number

Remark

Disables the Watchdog.

2.4.4.8. CgosWDogGetInfo

Declaration

```
bool CgosWDogGetInfo(HCGOS hCgos, unsigned long dwUnit,
CGOSWDINFO *pInfo)
```

Input

hCgos	the board handle
dwUnit	unit number
pInfo	pointer to the Watchdog information structure

Remark

Gets the information structure of the Watchdog.