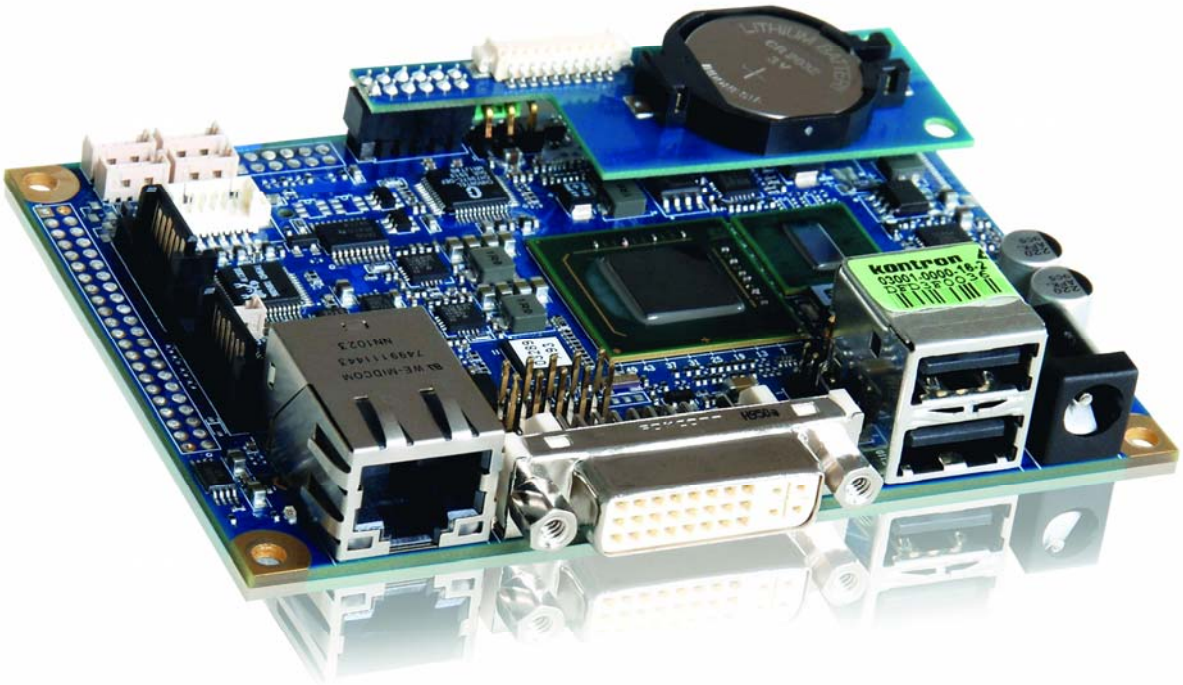
kontron

» Kontron Software Guide «



*p*ITX-SP

KTD-S0003-C

Pico™

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1 User Information

1.1 About This Document

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KONTRON Technology A/S is certified to ISO 9000 standards.

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Within the warranty period the repair of products is free of charge as long as warranty conditions are observed.
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1.6 Life Support Policy

KONTRON Technology's products are not for use as critical components in life support devices or systems without express written approval of the general manager of KONTRON Technology A/S.
As used herein:
Life support devices or systems are devices or systems which
a) are intended for surgical implant into body or
b) support or sustain life and whose failure to perform, when properly used in accordance with instructions for use provided in the labelling, can be reasonably expected to result in significant injury to the user.
A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system or to affect its safety or effectiveness.

1.7 Technical Support

Please consult our web site at **http://www.kontron.com/support** for the latest product documentation, utilities, drivers and support contacts. In any case you can always contact your board supplier for technical support.
Before contacting support please be prepared to provide as much information as possible:
Board identification:

- Type
- Part number (find PN on label)
- Serial number (find SN on label)

Board configuration:

- DRAM type and size
- BIOS revision (find in the BIOS Setup)
- BIOS settings different than default settings (refer to the BIOS Setup section)

System environment:

- O/S type and version
- Driver origin and version
- Attached hardware (drives, USB devices, LCD panels ...)

2 BIOS Update

The AMI and the KONTRON update tool is available for two operating systems: DOS and Windows® (e.g. Windows® XP, Vista 32/64 or Windows® 7).
Software conditions:

Operating System	Tool Name	Required Revision
DOS	AFUDOS.EXE	4.23 or greater
	BF.EXE	7.41 or greater
Windows®	AFUWIN.EXE + UCORESYS.SYS (UCOREW64.SYS)	4.41 or greater
	BF.EXE	7.41 or greater

2.1 AFUDOS (AMI)

Only the following combination of command line arguments has been tested and should be used for the update process. The syntax of the DOS update tool is:

AFUDOS <BIOS filename> **/X /P /B /N /C**

/X = don't check ROM ID
/P = program main BIOS
/B = program boot block
/N = overwrite NVRAM (setup settings)
/C = destroy CMOS checksum

2.2 AFUWIN (AMI)

For 32bit operating systems the file UCORESYS.SYS and for 64bit systems the file UCOREW64.SYS must be used (located in the same folder as AFUWIN.EXE). AFUWIN can either be executed using the same command line parameters as for AFUDOS or it can be executed in GUI mode by double klicking on it.

2.3 BFLASH (KONTRON)

In this manual the abbreviation **BF** is used for BFlash. This also matches with the actual name of the tool (BF.EXE). BF can be used to read and write data to and from BIOS flash. With this tool it's possible to update the BIOS, change DMI codes, setup vendor codes and save copies of all data. The copies can be used as master data for mass production.
Type **BF** <ret> from DOS prompt to see the BFlash version number and the board version. Only the following combination of command line arguments has been tested and should be used for the update process.

BF read <BIOS filename> **0 100000**
BF write <BIOS filename> **0**

3 Graphics Interface

3.1 LCD/LVDS Technology Overview

3.1.1 Detailed Timing Descriptor (EDID or DisplayID™)

The input fields Pixel Clock, Horizontal Active, Horizontal Blank, Horizontal Sync Offset, Horizontal Sync Width, Vertical Active, Vertical Blank, Vertical Sync Offset and Vertical Sync Width must be filled in with the correct values according to the panel's data sheet. In many cases the value for Horizontal/Vertical Blank cannot be read directly from the data sheet. Instead terms such as Display Period (active pixels/lines) or Horizontal/Vertical Total appear.
In this case the following calculation can be made:

⇒ **Blank Value = Total Value – Active Value.**

Sometimes the datasheet does not specify Sync Offset and/or Sync Width. In this case the permissible values can only be determined though testing. However the rule is:

⇒ **The sum of Sync Offset and Sync Width must not exceed the value for Horizontal/Vertical Blank.**

Also datasheets are often different for displays with double pixel clock. If Pixel Clock and Horizontal Values seem to be halved this must be corrected for input:

⇒ **The values must always be entered as though it were a panel with single pixel clock.**

Example 1:

PRIMEVIEW PM070WL4 (single pixel clock)
Data sheet specifications:

Clock Frequency [typ.]	32 MHz	
HSync Period [typ.]	1056 Clocks	(equivalent to Horizontal Total)
HSync Display Period [typ.]	800 Clocks	(equivalent to Horizontal Active)
HSync Pulse Width [typ.]	128 Clocks	
HSync Front Porch [typ.]	42 Clocks	
HSync Back Porch [typ.]	86 Clocks	
VSync Period [typ.]	525 Lines	(equivalent to Vertical Total)
VSync Display Period	480 Lines	(equivalent to Vertical Active)
VSync Pulse Width [typ.]	2 Lines	
VSync Front Porch [typ.]	10 Lines	
VSync Back Porch [typ.]	33 Lines	

Result:

Pixel Clock	32	
Horizontal Active	800	
Horizontal Blank	256	((128 + 42 + 86) → H. Pulse Width + H. Front Porch + H. Back Porch)
Horizontal Sync Offset	42	(H. Front Porch)
Horizontal Sync Width	128	(H. Pulse Width)
Vertical Active	480	
Vertical Blank	45	((2 + 10 + 33) → V. Pulse Width + V. Front Porch + V. Back Porch)
Vertical Sync Offset	10	(V. Front Porch)
Vertical Sync Width	3	(V. Pulse Width)

Example 2 (not useable on *p*ITX-SP):

SHARP LQ190E1LW01 (double pixel clock)
Data sheet specifications (no definition of Sync Offset and Sync Width):

Clock Frequency [typ.]	54 MHz	
Horizontal Period (1) [typ.]	844 Clocks	(equivalent to Horizontal Total)
Horizontal Display Period	640 Clocks	(equivalent to Horizontal Active)
Vertical Period [typ.]	1066 Lines	(equivalent to Vertical Total)
Vertical Display Period	1024 Lines	(equivalent to Vertical Active)

Result:

Pixel Clock	108	(2 x 54 MHz)
Horizontal Active	1280	(2 x 640 Clocks)
Horizontal Blank	408	((844 – 640) x 2 Clocks)
Horizontal Sync Offset	45	(normally approx. 10 – 15 % of Horizontal Blank)
Horizontal Sync Width	140	(normally approx. 30 – 70 % of Horizontal Blank)
Vertical Active	1024	
Vertical Blank	42	(1066 – 1024 Lines)
Vertical Sync Offset	1	(normally approx. 1 – 3 Lines)
Vertical Sync Width	3	(normally approx. 1 – 15 Lines)

Example 3 (not useable on *p*ITX-SP):

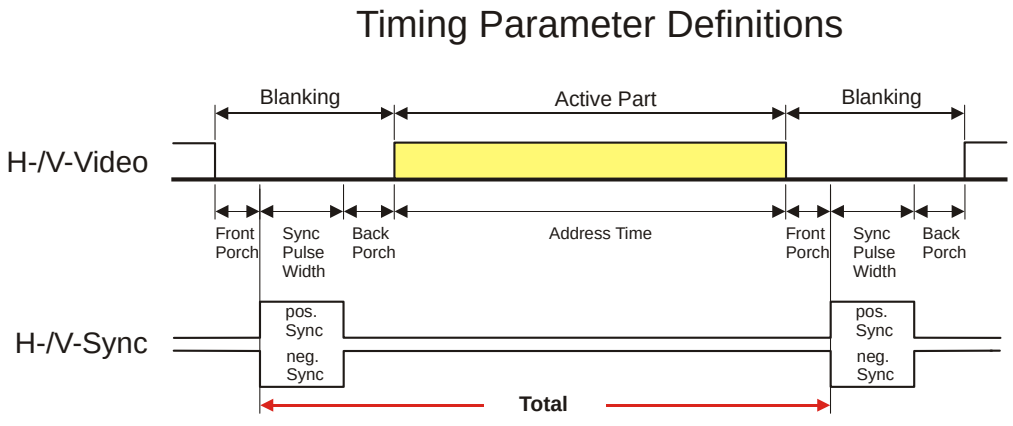
LG-PHILIPS LM170E01-TLA1 (double pixel clock)
Data sheet specifications:

Clock Frequency [typ.]	54 MHz
Hsync Period [typ.]	844 Clocks
Horiz. Valid [typ.]	640 Clocks
Horiz. Back Porch [typ.]	124 Clocks
Horiz. Front Porch [typ.]	24 Clocks
Vsync Period [typ.]	1066 Lines
Vert. Valid [typ.]	1024 Lines
Vert. Back Porch [typ.]	38 Lines
Vert. Front Porch [typ.]	1 Line

Result:

Pixel Clock	108	(2 x 54 MHz)
Horizontal Active	1280	(2 x 640 Clocks → Horizontal Addr. Time)
Horizontal Blank	408	((844 – 640) x 2 Clocks)
Horizontal Sync Offset	48	(2 x 24 Clocks → Horizontal Front Porch)
Horizontal Sync Width	112	(((408/2 – 124 – 24) x 2) → H. Blank – H. Back Porch – H. Front Porch)
Vertical Active	1024	(Vertical Addr. Time)
Vertical Blank	42	(1066 – 1024 Lines)
Vertical Sync Offset	1	(Vertical Front Porch)
Vertical Sync Width	3	(Vertical Blank – Vertical Back Porch – Vertical Front Porch)

The following picture shows the typical video timing.



3.1.2 24 Bit Color Mapping Tips

The double pixel clock or 24-bit color depth can generally be taken from the datasheet. There are two interface modes existing at 24-bit color depth: **FPDI** (Flat Panel Display Interface) or **LDI** (LVDS Display Interface). Some panels use the line SELL LVDS (SELect Lvds data order). The LVDS data assignment in the datasheet can give you an indication by the last channel (e.g. RX3/TX3 – SELL LVDS = low) wether it is a LDI panel (contains the lowest bits). Most panels have a FPDI interface.

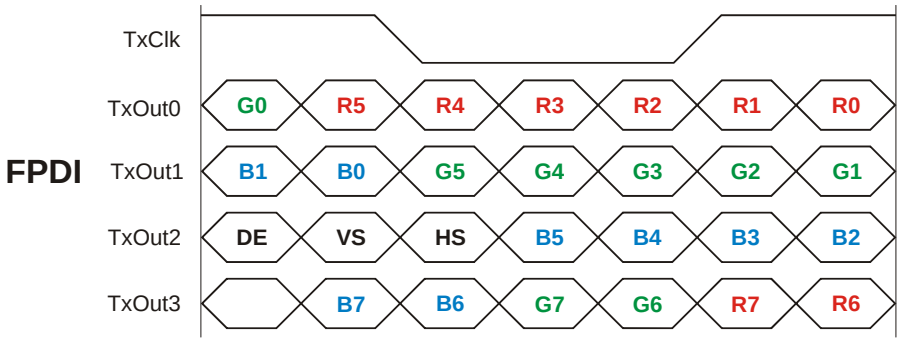
Example:

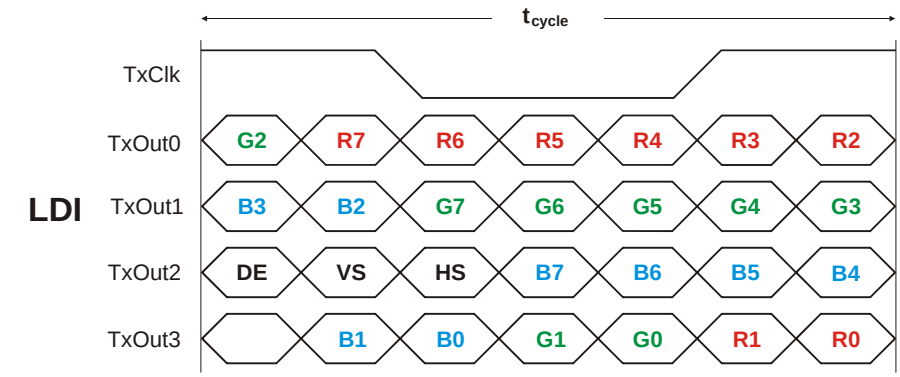
FPDI data assignment (LVDS channel 3 even or odd):

Tx/Rx27	Red 6 (e.g. even: RE6 or ER6)
Tx/Rx5	Red 7
Tx/Rx10	Green 6 (e.g. even: GE6 or EG6)
Tx/Rx11	Green 7
Tx/Rx16	Blue 6 (e.g. even: BE6 or EB6)
Tx/Rx17	Blue 7
Tx/Rx23	not used

LDI data assignment (LVDS channel 3 even or odd):

Tx/Rx27	Red 0 (e.g. even: RE0 or ER0)
Tx/Rx5	Red 1
Tx/Rx10	Green 0 (e.g. even: GE0 or EG0)
Tx/Rx11	Green 1
Tx/Rx16	Blue 0 (e.g. even: BE0 or EB0)
Tx/Rx17	Blue 1
Tx/Rx23	not used





3.2 EDID 1.3 Specification (VESA)

The EDID (Extended Display Identification Data) record has a fixed structure. The first 8 bytes contain the distinctive identification 00h, FFh, FFh, FFh, FFh, FFh, FFh, 00h. The end of the record is marked by the checksum (1 byte). The result of the addition of all bytes including the checksum has to be zero.
For a comprehensive support of the majority of available panels you don't need all fields of the EDID record. The **Detailed Timing Descriptor** (18 bytes) is the most important field. No 24bit panels (FPDI/LDI) are supported though. This means EDID should only be used for 18bit panels.
For further information please consult the official EDID specification from the VESA comitee which has to be payed.

3.3 DisplayID™ Specification (VESA)

Intended as a replacement for all previous EDID versions DisplayID™ contains many new features. It's a structure with several well defined elements (tags). Not every element that is listed in the specification has to be part of the resulting data set (basic section).
KONTRON has decided to use this selection of tags (mandatory presence).

Tag	Description
00h	Product Identification Data Block (Vendor ID, Product Code, Manufacturing Date ...)
03h	Type I Detailed Timing Data Block (Pixel Clock, Horizontal/Vertical Data ...)
0Ch	Display Device Data Block (Device Technology, Operating Mode, Color Depth ...)
0Dh	Interface Power Sequencing Data Block (Power On/Off Timing)
0Fh	Display Interface Data Block (Interface Type, Interface Attribute ...)

3.3.1 DisplayID™ Parameter Summary

Only a part of the parameters used in the DisplayID™ Windows® tool are interpreted by a specific board. The following table shows a summary of the used parameters (valid for *p*ITX-SP).

Group	Parameter	Comment
Type I Timing	**Pixel Clock**	
Type I Timing	**Horizontal Active**	
Type I Timing	**Horizontal Blank**	
Type I Timing	**Horizontal Sync Offset**	Front porch
Type I Timing	**Horizontal Sync Width**	
Type I Timing	**Vertical Active**	
Type I Timing	**Vertical Blank**	
Type I Timing	**Vertical Sync Offset**	Front porch
Type I Timing	**Vertical Sync Width**	
Display Interface 1	**Bits per Pixel**	Color depth (18 or 24bit)
Display Interface 2	**Signal Polarity**	Only H-Sync and V-Sync

3.3.2 DisplayID™ Restrictions

Depending on the graphic controller not all features can be used. The following table shows the most important restrictions.

Restrictions for *p*ITX-SP
Panels with dual or quad clock not supported (2 or 4 Pixel per Clock)
Panels with LDI 24bit color mapping not supported
Only normal DE mode possible
Variable power sequencing not supported

3.3.3 LCD Panel Selection

The choice of an LCD display is basically defined by two parameters.

Parameter	Value
Pixel per Clock (Channels)	**1**
Maximum Pixel Clock	**112 MHz**

Currently this leads to a maximum resolution of

1366 x 768 Pixel (e.g. SHARP LK315T3LA31)

With the GMA driver (see details below) it is not guaranteed that every resolution can be achieved. There can also be differences between the Windows® XP und Windows® Vista driver. KONTRON does not guarantee the correct function of the board for untypical resolution. In principal the use of DisplayID™ allows realizing every special display resolution. For this a valid DisplayID™ dataset must be written to the onboard EEPROM. Additionally the BIOS Setup entry

Advanced/Display Configuration/Flat Panel Type

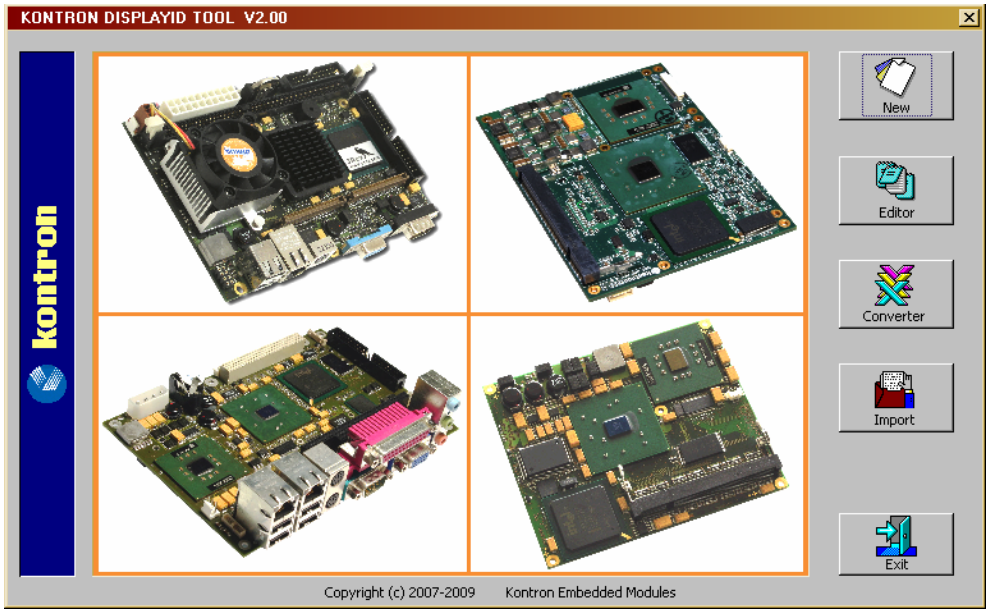
must be set to **Auto**.

Many displays with a resolution up to XGA (1024 x 768) have a digital (TTL) interface. KONTRON offers a special adapter to connect these displays to the LVDS interface (KAB-ADAPT-LVDStoTTL with part number 61029).

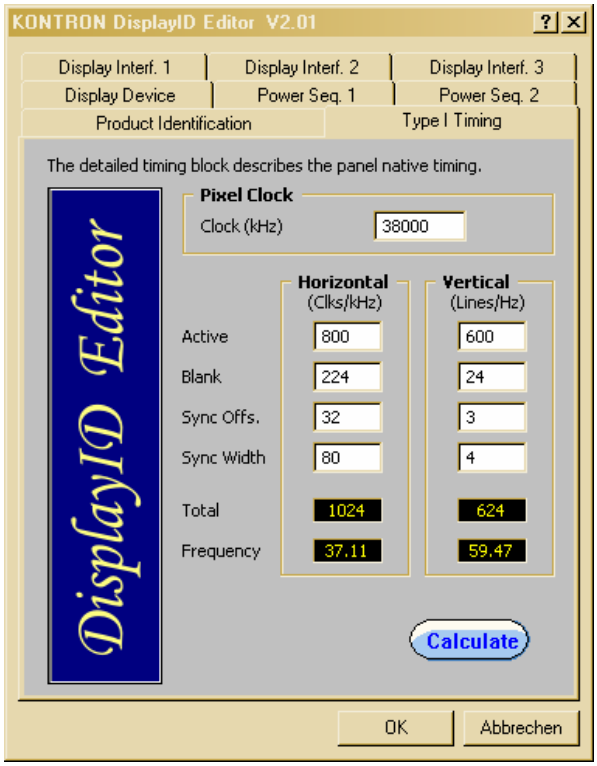
Note: *The fact that a display is mentioned as an example does not mean that this display is approved by KONTRON.*

3.3.4 DisplayID™ Windows® Tool

The DisplayID™ parameter can be modified with the DisplayID™ Windows® tool.



For an example the following picture shows the input fields for the **Detailed Timing** parameters.



For more information see the documentation of the DisplayID™ tool (software can be downloaded from kontron.com).

The DisplayID™ Editor saves the parameters in a intermediate file format. The file extension is 'KDD' (Kontron DisplayID™ Data). This file format cannot be used to program the onboard EEPROM.
For transfering this file format into the binary file format for the EEPROM apply the Converter.

3.3.5 Building DisplayID™ File

❶ Start the Windows® tool **DisplayID.exe**.
❷ Use the **Editor** if you want to modify an existing DisplayID™ file or select **New** to create a complete new record.
❸ Change respectively enter new parameters.
❹ Save the parameters in a file with the extension 'KDD'.
❺ Open the saved 'KDD'-file using the **Converter**.
❻ Save the binary file with the extension 'KDB' (Kontron DisplayID™ Binary).
❼ Program the onboard EEPROM using the board specific DOS update tool.

3.3.6 Erasing DisplayID™ Record

Programming the first 128 bytes in the EEPROM with the values 00h or FFh deletes a valid DisplayID™ record.

3.3.7 EEPROM Update Tool

The syntax of the DOS EEPROM update tool is:

PXSP-DID <option> <filename>

/W = read a file (must be KDB-format) and write the content to the EEPROM
/R = read the EEPROM and write the content to a file
/C = read a file and compare the content with the EEPROM
/D = clear the EEPROM content (without filename)

3.4 What means GMA and IEGD?

Intel® works with two different strategies for the VGA BIOS and the graphic drivers: GMA (Graphics Media Accelerator) as the standard VGA BIOS for desktop PC´s and IEGD (Intel® Embedded Graphics Driver) for special cases. The GMA VGA BIOS allows also the use of an IEGD graphic driver (Windows® or Linux). Whereas the IEGD VGA BIOS should only be used with the corresponding graphic driver.
The GMA environment supports all available resolution within the operating system - the IEGD environment particularly run with a discrete resolution (lower secondary resolutions can be used). However it is a big benefit that the IEGD SDK is freely available and can be downloaded as freeware from the Intel® website.
The following table shows a list of the most important parameters of the graphic controller which are important for the driver performance respectively the applications based on it (valid for pITX-SP):

Parameter	Value	Comment
Max. Frame Buffer Size	**8 MB**	Shared memory, DMA access
Max. Aperture Space	**256 MB**	Untrusted buffer
No. of Pipes / Ports	**2**	Independent graphic engines
Graphics Clock	**200 MHz**	
Integrated Codecs	**MPEG2, MPEG4, H.264, VC1, WMV9**	
DirectX Support	**10.1**	

3.4.1 The GMA Driver

The GMA driver from Intel® can only be used on Windows® operating systems.

Operating System	Support	Comment
Windows® XP SP2 and SP3	✔	
Windows® VISTA32	✔	
Windows® 7 (32 Bit)	✔	Another driver as is used on VISTA32

The driver supports dual display support. For the synchronous use of both display interfaces in a Windows® operating system the BIOS Setup entry **Boot Display Device** must be set to **LCD only**. The BIOS respectively the driver can't notice whether a LVDS display is connected but a DVI monitor can be detected through the DDC interface and the hotplug pin.

3.4.1.1 DVI Monitor Selection

The following table gives an overview about the possible resolutions which can be displayed on a DVI monitor. Generally the best result can be achieved when the nominal resolution of the DVI-monitor is used.
ATTENTION: These resolutions are not valid for the LVDS interface of the pITX-SP (see chapter LCD Panel Selection).

Resolution	Aspect Ratio
1920 x 1200	16 : 10
1920 x 1080	16 : 9
1680 x 1050	16 : 10
1600 x 1200	4 : 3
1440 x 900	16 : 10
1366 x 768	16 : 9
1280 x 1024	5 : 4
1280 x 960	4 : 3
1152 x 864	4 : 3
1024 x 768	4 : 3

3.4.2 The IEGD Driver

The Intel® Embedded Graphics Drivers are developed specifically for embedded Intel® Architecture-based platforms. IEGD offers embedded customers extended life support that correlates with the extended life support of embedded silicon products. Intel® Embedded Graphics Drivers have been validated on specific Linux distributions and Windows® operating systems. This package also contains a VGA-BIOS which can be configured. What are the new enhancements added to the Intel® Embedded Graphics Drivers?

- OpenGL 2.0 support (Windows® and Linux)
- Improved 3D performance
- Hardware-enabled video decode
- Certified Output Protection Protocol (COPP) support on Windows® XP

The IEGD driver supports a lot more operating system than the GMA driver.

Operating System	Support
Windows® XP SP2	No
Windows® XP SP3	✔
Windows® VISTA32	No
Windows® 7 (32 Bit)	No
Windows® CE 5.0 / 6.0	✔
Linux Fedora® Distribution	✔
Linux Suse® Distribution	No
Linux Ubuntu® Distribution	✔
Linux Red Hat® Embedded	✔
Linux Wind River®	✔

The IEGD package can be downloaded from the website http://edc.intel.com/Software/Downloads/IEGD (KONTRON Technology A/S can't guarantee the availability of these internet address).

Note: *The IEGD driver will not be developed any longer after version 10.3. Intel® plans to release a new version of the GMA driver with several embedded features.*

3.5 H.264 Support for Linux

KONTRON Technology A/S owns a Linux driver that support the H.264 codec.
This implementation has been tested with the Fedora® distribution (Core 11). The conversion to other linux distributions is generally possible. The H.264 codec only supports video files but not the use of a blu-ray drive.

Resolution	Support	Comment
1280 x 720	✔	HDV1 (progressive)
1440 x 1080	Not tested	HDV2 (normally interlaced)
1920 x 1080	✔	Full HD (interlaced / progressive)

For further information please contact your local distributor or KONTRON for technical support

4 Serial-ATA Interface

The Serial-ATA controller supports two operating modes: a native PCI IDE controller and a RAID/AHCI controller.

4.1 Native PCI IDE Controller

In this mode no drivers are needed for a Windows® installation. Interrupt and I/O-addresses can take any value (except the known legacy settings 0x1F0/0x170 respectively IRQ14/15).
Diagnostic tools which bypass the INT13 and directly access registers may cause uncontrolled behaviors. We strongly advise against the use of such tools.

Attention: *For a bootable drive the Option ROM must be enabled.*

4.2 RAID/AHCI Controller

The RAID functionality is not supported but the driver and Option ROM use this expression. A Windows® installation without S-ATA drivers is not possible. To install Windows® XP on a Serial-ATA harddisk the file TXTSETUP.OEM must be supplemented. Without any addition Windows® expects the driver on a legacy floppy drive. The following modifications allows the installation from a USB floppy drive.

```
;--The following lines give additional USB floppy support
id = "USB\VID_03F0&PID_2001", "usbstor" #--HP
id = "USB\VID_08BD&PID_1100", "usbstor" #--Iomega
id = "USB\VID_0409&PID_0040", "usbstor" #--NEC
id = "USB\VID_055D&PID_2020", "usbstor" #--Samsung
id = "USB\VID_0424&PID_0FDC", "usbstor" #--SMSC
id = "USB\VID_054C&PID_002C", "usbstor" #--Sony
id = "USB\VID_057B&PID_0001", "usbstor" #--Y-E Data
```

If a USB floppy drive is still not detected properly the parameters can be determined as follows:
Plugin the USB floppy drive on any Desktop PC running the Windows® XP operating system and open the device manager in the system control panel. The floppy drive should be listed below the entry **Universal Serial Bus Controller**. Goto it's properties, select the details tab, then Hardware IDs where you can see **USB\VID_ ... &PID_ ...**. These values must be added as a new line to the file TXTSETUP.OEM.
Presumeably this addition must correspond with the file **USBSTOR.INF**. If the floppy drive identification is not implemented in this file the installation might fail.

Manufacturer	ID in USBSTOR.INF available
HP	✔
Iomega	**Indefinite**
NEC	✔
Samsung	**Indefinite**
SMSC	✔
Sony	✔
Y-E Data	✔

5 SDIO/microSD Card Interface

The following operating systems allow booting from SDIO/microSD cards: DOS, Linux, Windows® XP/ Windows® 7 and Windows® XP Embedded.

5.1 DOS Boot

All standard DOS programs for partitioning and formating can be used (e.g. FDISK.EXE and FORMAT.COM). However it can not be guaranteed that all functions of INT13h respectively INT21h work correctly. Following steps are necessary to prepare a DOS bootable card.

❶ Partitioning and formating the SDIO/microSD card.

❷ Use the 'HP USB Disk Storage Format Tool' or an other program and a USB Card Reader with SD/MMC support on a host computer to make the card bootable.

The table shows a list of the tested DOS versions.

Operating System	Version	Result
MS-DOS	**6.22**	✔
MS-DOS	**WIN 98 (7.10)**	✔
DR-DOS	**7.03**	✔

5.2 Linux Boot

To successfully boot Linux from an SDIO/microSD card use a kernel version >= **2.6.29**. Following changes are necessary:

❶ In the kernel configuration please make sure that under

Device Drivers
MMC/SD/SDIO card support
MMC block device driver,
Secure Digital Host Controller Interface support and
SDHCI support on PCI bus are enabled.

Please set them to be built into the kernel unless you know how to deal with modules required for boot devices.

❷ For the kernel parameters in the bootloader configuration file please use

/dev/mmcblk0p1

as your root device (MMC block device 0 partition 1, adjust to fit your setup). Moreover it is required to tell the kernel to wait some more time before mounting the root device, since depending on the SD card model it may take up to several seconds until the device is ready. To do this use

rootdelay = xx

on the parameter line. An example line for grub with a system installed on disk 1 partition 1, no separate boot partition and a quite slow card that requires 10 seconds delay could look like this

kernel vmlinuz root = /dev/mmcblk0p1 rootdelay = 10.

Some Linux distributions already offer an extensive SDIO/microSD card support.

Example: Fedora® 11 Live CD

At least a microSD card with 4 Gbyte is needed for the installation. Confirm the icon **Install to Hard Drive** and follow all instructions until you come to the partitioning part. In the combo box field with the default setting **Replace existing Linux system** select the option **Create custom layout**. Any existing partition must be deleted. Afterwards you have to create a boot partition with 200 MByte (/boot) with **ext2** the remaining space can be partitioned with **ext4** (/). After this the standard installation can be proceeded.
The operating system seems to be installed correctly but anyhow the above mentioned modifications must be applied to make the microSD card bootable.

5.3 Windows® XP and Windows® 7 Boot

Direct installation of Windows® XP and Windows® 7 on a microSD card is not possible at the moment. To boot Windows® an existing installation can be transferred to the microSD card. At request KONTRON delivers a tool to copy a running installation to microSD card and make the necessary modifications to the OS image. For further information please contact your local distributor or KONTRON for technical support.

5.4 Windows® XP Embedded or Windows® 7 Embedded Boot

KONTRON Technology A/S owns a driver that support microSD card boot. For further information please contact your local distributor or KONTRON for technical support.

6 CPLD Interface

Various functions are implemented in the CPLD: e.g. watchdog, digital I/O and fan control. Access to the CPLD register is via an index-data register pair using only two I/O byte locations (fixed addresses).

Index Register	Data Register
0xA80	0xA81

Register overview:

Index	Type	Reset	Function
0x00	RO	---	CPLD version
0x9F	RW	0x81 [1)]	GPIO control register **Bit 0** GPIO control **0** = disabled **1** = enabled **Bit 1** Autostart jumper status (RO) **Bit 2** Autostart function **0** = do nothing **1** = restart **Bit 3** GPIO interrupt control **0** = disabled **1** = enabled **Bit 4** Reserved **Bit 5** Reserved **Bit 6** Wake on LAN control (State S5) **0** = enabled **1** = disabled **Bit 7** Reserved
0xA0	RO	0x0F [1)]	GPIO input register **Bit 0** = GPIO0 ... **Bit 7** = GPIO7 **0** = low level **1** = high level
0xA1	RW	0x00 [1)]	GPIO output register **Bit 0** = GPIO0 ... **Bit 7** = GPIO7 **0** = low level **1** = high level
0xA2	RW	0x10	Watchdog control register **Bit 0** Watchdog time value **Bit 1** Watchdog time value **Bit 2** Reserved **Bit 3** Reserved **Bit 4** Watchdog time base **0** = seconds **1** = minutes **Bit 5** Reserved **Bit 6** Watchdog control **0** = disabled **1** = enabled **Bit 7** Trigger control **0** = disabled **1** = enabled
0xA4	RW	0xF0 [1)]	GPIO data direction register **Bit 0** = GPIO0 ... **Bit 7** = GPIO7 **0** = define input **1** = define output
0xA5	RW	0x00 [1)]	GPIO tri-state register **Bit 0** = GPIO0 ... **Bit 7** = GPIO7 **0** = normal output **1** = tri-state output
0xA6	RW	0x00 [1)]	GPIO interrupt register **Bit 0** = GPIO0 ... **Bit 7** = GPIO7 **0** = interrupt disabled **1** = interrupt enabled
0xA7	RW	0x00	GPIO interrupt polarity register **Bit 0** = GPIO0 ... **Bit 7** = GPIO7 **0** = falling edge **1** = rising edge

0xF4	RW	0x3F [1)]	Fan control register **Bit 0 - 4** Fan output value **Bit 5** Reserved **Bit 6 - 7** Fan divisor **00** = divisor = 1 **10** = divisor = 2 **01** = divisor = 4 **11** = divisor = 8
0xF5	RO	---	Fan speed register **Bit 0 - 7** Fan speed

Note: *1) Default Setup settings.*

6.1 Special Hints

The following remarks must be considered (especically the first hint).

6.1.1 Reserved Bits

Every bit which is marked as **Reserved** may not be changed (exception: watchdog control). These bits must be masked. Not observing this hint can in the worst case lead to system crashes, e.g. after a warm boot.

6.1.2 GPIO Input Register

The input register reflects the status of the pins which are defined as output. Example: if GPIO7 defined as an output the GPIO7 bit in the input register reads back low level when the output has low level and a high level when the output has high level.

6.1.3 Fan Divisor

The base time for the divisor is 1 second (divisor = 1). To calculate the fan speed in rounds per minute (rpm) the speed value must be multiplicated by 60. Increasing the divisor leads to smaller base times (0.5 seconds and so on).

6.2 Programming Examples

The following examples (DOS programs) show the access to the CPLD features (C compiler: BORLAND C++).
Note: These programs cannot be run on Linux and Windows®.

6.2.1 Watchdog Example

```
#include <stdio.h>
#include <dos.h>

#define CPLD_BASE_ADDR                  0xA80
#define WDT_INDEX                       0xA2
#define WDT_ENABLE                      0x40
#define WDT_TRIGGER                     0x80

#define WDT_1SEC                        0x00
#define WDT_5SEC                        0x01
#define WDT_10SEC                       0x02
#define WDT_30SEC                       0x03
#define WDT_1MIN                        0x10
#define WDT_5MIN                        0x11
#define WDT_10MIN                       0x12

void ActivateWatchdog (void)
{
    outp (CPLD_BASE_ADDR, WDT_INDEX);
    outp (CPLD_BASE_ADDR+1, WDT_10SEC);
    delay (1);                          // wait one millisecond
    outp (CPLD_BASE_ADDR+1, WDT_ENABLE);
}

void TriggerWatchdog (void)
{
    outp (CPLD_BASE_ADDR, WDT_INDEX);
    outp (CPLD_BASE_ADDR+1, WDT_TRIGGER | WDT_ENABLE);
    delay (1);                          // wait one millisecond
    outp (CPLD_BASE_ADDR+1, WDT_ENABLE);
}

void main (void)
{
    int i;

    ActivateWatchdog ();
    for (i = 0; i < 5; i++)             // wait half of expiry time (= 5 seconds)
      delay (1000);                     // wait 1 second
    TriggerWatchdog ();                 // trigger the watchdog - total expiry time now 15 seconds
}
```

6.2.2 Digital I/O Example

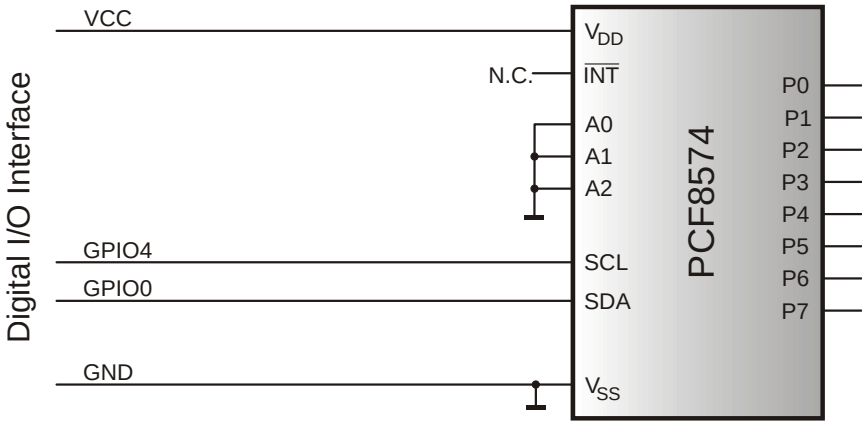
BIOS Setup settings (entry **Advanced/Onboard Device Configuration/GPIO Configuration**):

GPIO Pin 0 - 3	***Input***
GPIO Pin 4 - 7	***Output***
Default Output State	***Low***

```
#include <stdio.h>
#include <dos.h>
#include <conio.h>

#define CPLD_BASE_ADDR                  0xA80
#define GPIO_INPUT_INDEX                0xA0
#define GPIO_OUTPUT_INDEX               0xA1
#define GPIO_INPUT_MASK                 0x0F

void WriteDigitalIO (unsigned char value)
{
    outp (CPLD_BASE_ADDR, GPIO_OUTPUT_INDEX);
    outp (CPLD_BASE_ADDR+1, value);
}

unsigned char ReadDigitalIO (void)
{
    unsigned char value;

    outp (CPLD_BASE_ADDR, GPIO_INPUT_INDEX);
    value = inp (CPLD_BASE_ADDR+1);
    return value;
}

void main (void)
{
    unsigned char val;

    WriteDigitalIO (0x50);
    getch ();
    WriteDigitalIO (0xA0);
    getch ();
    val = ReadDigitalIO () & GPIO_INPUT_MASK;
    printf ("\nInput value = %02X\n", val);
}
```

6.2.3 I2C with GPIOs Example

This example demonstrates the GPIO usage as an I2C bus.



BIOS Setup settings (entry **Advanced/Onboard Device Configuration/GPIO Configuration**):

GPIO Pin 0	***Tri-State***
GPIO Pin 4	***Tri-State***
Default Output State	***High***

```
#include <conio.h>
#include <dos.h>
#include <stdio.h>

#define CPLD_BASE_ADDR          0xA80
#define GPIO_INPUT              0xA0
#define GPIO_OUTPUT             0xA1
#define I2C_CLOCK               0x10
#define I2C_DATA                0x01
#define I2C_DELAY_VAL           50
#define I2C_OK                  0
#define I2C_ERR_NAK             1
#define TRUE                    1
#define FALSE                   0
#define DEVICE_PCF8574          0x40

int i2c_bits, i2c_error;

//*********************************************************
//* Sets clock line high
//*********************************************************
void SCL_High (void)
{
    i2c_bits |= I2C_CLOCK;
    outp (CPLD_BASE_ADDR+1, i2c_bits);
}
```

```
//*************************************************************
//* Sets clock line low
//*************************************************************
void SCL_Low (void)
{
    i2c_bits &= ~I2C_CLOCK;
    outp (CPLD_BASE_ADDR+1, i2c_bits);
}

//*************************************************************
//* Sets data line high
//*************************************************************
void SDA_High (void)
{
    i2c_bits |= I2C_DATA;
    outp (CPLD_BASE_ADDR+1, i2c_bits);
}

//*************************************************************
//* Sets data line low
//*************************************************************
void SDA_Low (void)
{
    i2c_bits &= ~I2C_DATA;
    outp (CPLD_BASE_ADDR+1, i2c_bits);
}

//*************************************************************
//* Reads data line
//*************************************************************
int SDA_Read (void)
{
    int i2c_val;

    outp (CPLD_BASE_ADDR, GPIO_INPUT);
    i2c_val = inp (CPLD_BASE_ADDR+1);
    i2c_val &= I2C_DATA;
    outp (CPLD_BASE_ADDR, GPIO_OUTPUT);
    return i2c_val;
}

//*************************************************************
//* Delay routine
//*************************************************************
void I2C_Delay (void)
{
    _asm  push  cx
    _asm  xor    ah, ah
    _asm  mov  cx, I2C_DELAY_VAL
_Loop:
    _asm  in     al, 61h
    _asm  and  al, 0010000b
    _asm  cmp  al, ah
    _asm  je     _Loop
```

```
    _asm mov  ah, al
    _asm loop  _Loop
    _asm pop   cx
}

//*************************************************************
//* Makes sure that the bus is in a known condition
//*************************************************************
void I2C_Reset (void)
{
    outp (CPLD_BASE_ADDR, GPIO_OUTPUT);
    i2c_bits = 0;
    i2c_error = I2C_OK;

    SCL_Low ();
    SDA_Low ();
    I2C_Delay ();
    SCL_High ();
    I2C_Delay ();
    SDA_High ();
}

//*************************************************************
//* Generates a start condition on the bus
//*************************************************************
void I2C_Start (void)
{
    SDA_High ();
    I2C_Delay ();
    SCL_High ();
    I2C_Delay ();
    SDA_Low ();
    I2C_Delay ();
    SCL_Low ();
    I2C_Delay ();
}

//*************************************************************
//* Generates a stop condition on the bus
//*************************************************************
void I2C_Stop (void)
{
    SCL_Low ();
    I2C_Delay ();
    SDA_Low ();
    I2C_Delay ();
    SCL_High ();
    I2C_Delay ();
    SDA_High ();
    I2C_Delay ();
}
```

```
//*************************************************************
//* Clock out one bit
//*************************************************************
void I2C_Bit_Out (int bit_out)
{
    if (bit_out)
      SDA_High ();
    else
      SDA_Low ();
    I2C_Delay ();
    SCL_High ();
    I2C_Delay ();
    SCL_Low ();
    I2C_Delay ();
}

//*************************************************************
//* Clock in one bit
//*************************************************************
int I2C_Bit_In (void)
{
    int bit_in;

    SDA_High ();
    SCL_High ();
    I2C_Delay ();
    bit_in = SDA_Read ();
    I2C_Delay ();
    SCL_Low ();
    I2C_Delay ();
    return bit_in;
}

//*************************************************************
//* Send one byte on the bus. No start or stop conditions
//* are generated here but i2c_error will be set according
//* to the result. Returns 1 on success, 0 if we lose the
//* arbitration or if the slave doesn't acknowledge the
//* byte. Check i2c_error for the actual result on error
//*************************************************************
int I2C_Byte_Out (int byte_out)
{
    int bit_count = 8, bit_in;

    while (bit_count)
    {
      if (byte_out & 0x80)
        I2C_Bit_Out (TRUE);
      else
        I2C_Bit_Out (FALSE);
      byte_out <<= 1;
      bit_count--;
    }
```

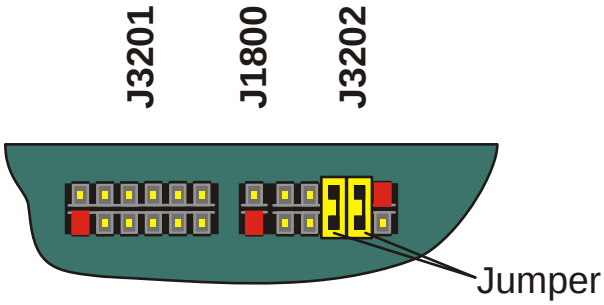
```
    SDA_High ();
    I2C_Delay ();

    bit_in = I2C_Bit_In ();
    if (bit_in)
      i2c_error = I2C_ERR_NAK;
    return i2c_error;
}

//*********************************************************
//* Reads one byte in from the slave. Ack must be 1 if this
//* is the last byte to be read during this transfer, 0
//* otherwise (as per I2C bus specification, the receiving
//* master must acknowledge all but the last byte during a
//* transfer)
//*********************************************************
int I2C_Byte_In (void)
{
    int bit_count = 8, byte_in = 0;

    SDA_High ();
    I2C_Delay ();

    while (bit_count)
    {
      byte_in <<= 1;
      if (I2C_Bit_In ())
        byte_in |= TRUE;
      bit_count--;
    }

    SDA_High ();
    I2C_Delay ();
    I2C_Bit_In ();                                  // Set acknowledge
    return byte_in;
}

//*********************************************************
//* Writes a byte to I2C device (main routine)
//*********************************************************
int WriteI2CDevice (int device_addr, int byte_write)
{
    I2C_Reset ();
    I2C_Stop ();
    I2C_Start ();
    if (I2C_Byte_Out (device_addr))
      return FALSE;
    if (I2C_Byte_Out (byte_write))
      return FALSE;
    I2C_Stop ();
    return TRUE;
}
```

```
//*********************************************************
//* Reads a byte from I2C device (main routine)
//*********************************************************
void ReadI2CDevice (int device_addr)
{
    int  byte_read;

    I2C_Reset ();
    I2C_Stop ();
    I2C_Start ();
    I2C_Byte_Out (device_addr | 1);
    byte_read = I2C_Byte_In ();
    I2C_Stop ();

    do something
}

void main (void)
{
    if (WriteI2CDevice (DEVICE_PCF8574, 0xA5))
       ReadI2CDevice (DEVICE_PCF8574);
}
```

6.2.4 GPIO IRQ Example

It's very simple to check the interrupt feature. The picture shows how the jumper must be set. For testing remove a jumper (breaks IRQ generation) and set it again. The interrupt assignment to IRQ7 is not changeable.

Attention: *Set the entry* ***Advanced/Onboard DeviceConfiguration/Chipset Configuration/Serial IRQ Mode*** *to* ***Continuous****.*



BIOS Setup settings (entry **Advanced/Onboard Device Configuration/GPIO Configuration**):

GPIO Pin 0	***IRQ Input***
GPIO Pin 1	***IRQ Input***
GPIO Pin 5	***Output***
GPIO Pin 6	***Output***
Default Output State	***High***

```
#include <conio.h>
#include <stdio.h>
#include <dos.h>

#define CPLD_BASE_ADDR                  0xA80
#define GPIO_CONTROL                    0x9F
#define GPIO_INPUT                      0XA0
#define GPIO_OUTPUT                     0xA1
#define GPIO_IRQ_POLARITY               0xA7
#define IRQ_FALLING_EDGE                0x00
#define IRQ_ENABLE                      0x08
#define IRQ_BIT5                        0x20
#define IRQ_BIT6                        0x40
#define IRQ_TIMEOUT                     10000
#define VECTOR_IRQ7                     15
#define CTRL_8259                       0x20
#define IMR_8259                        0x21
#define EOI                             0x20
#define IRQ_MASK                        0x80        // Mask for IRQ7

#define __CPPARGS
```

```
int flag = 0, reg_val;

void interrupt (*oldISR)(__CPPARGS);

void interrupt gpioISR(__CPPARGS)
{
    outp (CPLD_BASE_ADDR, GPIO_OUTPUT);
    reg_val |= (IRQ_BIT5 + IRQ_BIT6);
    outp (CPLD_BASE_ADDR+1, reg_val);
    flag++;
    outp (CTRL_8259, EOI);
}

void main (void)
{
    int i, count5 = 0, count6 = 0, old_mask, ctrl_val;

    clrscr ();
    _disable ();
    oldISR = _dos_getvect (VECTOR_IRQ7);
    _dos_setvect (VECTOR_IRQ7, gpioISR );
    old_mask = inp (IMR_8259);
    outp (IMR_8259, (old_mask & ~IRQ_MASK));
    _enable ();

    outp (CPLD_BASE_ADDR, GPIO_IRQ_POLARITY);
    outp (CPLD_BASE_ADDR+1, IRQ_FALLING_EDGE);

    outp (CPLD_BASE_ADDR, GPIO_OUTPUT);
    reg_val = inp (CPLD_BASE_ADDR+1);
    reg_val |= (IRQ_BIT5 + IRQ_BIT6);
    outp (CPLD_BASE_ADDR+1, reg_val);

    outp (CPLD_BASE_ADDR, GPIO_CONTROL);
    ctrl_val = inp (CPLD_BASE_ADDR+1);
    ctrl_val |= IRQ_ENABLE;
    outp (CPLD_BASE_ADDR+1, ctrl_val);

    while (! kbhit ())
    {
      flag = 0;
      outp (CPLD_BASE_ADDR, GPIO_OUTPUT);
      reg_val &= ~IRQ_BIT5;
      outp (CPLD_BASE_ADDR+1, reg_val);
      for (i = 0; i < IRQ_TIMEOUT; i++)
        if (flag) break;
      if (i != IRQ_TIMEOUT)
      {
        gotoxy (1, 2);
        printf ("Interrupt Count GPIO 5 = %d", ++count5);
      }
      delay (500);
```

```
      flag = 0;
      outp (CPLD_BASE_ADDR, GPIO_OUTPUT);
      reg_val &= ~IRQ_BIT6;
      outp (CPLD_BASE_ADDR+1, reg_val);
      for (i = 0; i < IRQ_TIMEOUT; i++)
        if (flag) break;
      if (i != IRQ_TIMEOUT)
      {
        gotoxy (1, 3);
        printf ("Interrupt Count GPIO 6 = %d", ++count6);
      }
      delay (500);
    }

    outp (CPLD_BASE_ADDR, GPIO_CONTROL);
    reg_val = inp (CPLD_BASE_ADDR+1);
    reg_val &= ~IRQ_ENABLE;
    outp (CPLD_BASE_ADDR+1, reg_val);

    _disable ();
    _dos_setvect (VECTOR_IRQ7, oldISR );
    outp (IMR_8259, old_mask );
    _enable ();
}
```

6.2.5 Fan Control Example

```
#include <stdio.h>
#include <dos.h>
#include <conio.h>

#define CPLD_BASE_ADDR                  0xA80
#define FAN_CTRL_INDEX                  0xF4
#define FAN_MASK                        0x1F
#define RESERVED_MASK                   0xE0

void SetFanVal (unsigned char value)
{
    unsigned char reg;

    outp (CPLD_BASE_ADDR, FAN_CTRL_INDEX);
    reg = inp (CPLD_BASE_ADDR+1);
    reg &= RESERVED_MASK;
    value &= FAN_MASK;
    value |= reg;
    outp (CPLD_BASE_ADDR+1, value);
}

void main (void)
{
    SetFanVal (0x05);
    getch ();
    SetFanVal (0x15);
}
```

6.2.6 Fan Speed Example

```
#include <stdio.h>
#include <dos.h>
#include <conio.h>

#define CPLD_BASE_ADDR          0xA80
#define FAN_CTRL_INDEX          0xF4
#define FAN_SPEED_INDEX         0xF5
#define CTRL_MASK               0x3F
#define DIVISOR_SHIFT           6
#define SPEED_OVERFLOW          255
#define MAX_DIVISOR             3
#define ESC_CHAR                0x1B
#define UPDATE_TIME             1000        // 1 second
#define REFRESH_TIME            500         // 0.5 seconds
#define TRUE                    1

unsigned char ReadFanSpeed (unsigned char divisor)
{
    unsigned char value;

    outp (CPLD_BASE_ADDR, FAN_CTRL_INDEX);
    value = inp (CPLD_BASE_ADDR+1);
    value &= CTRL_MASK;
    divisor = divisor << DIVISOR_SHIFT;
    value |= divisor;
    outp (CPLD_BASE_ADDR+1, value);

    outp (CPLD_BASE_ADDR, FAN_SPEED_INDEX);
    value = inp (CPLD_BASE_ADDR+1);
    return value;
}

void main (void)
{
    unsigned char divisor = 0;
    int speed, key;

    clrscr ();

    while (TRUE)
    {
      speed = (int) ReadFanSpeed (divisor);
      if (speed < SPEED_OVERFLOW)
        break;
      divisor++;
      if (divisor > MAX_DIVISOR)
        break;
      delay (UPDATE_TIME);
    }
```

```
    while (TRUE)
    {
      speed = (int) ReadFanSpeed (divisor);
      speed *= 60;

      // speed must be divided by pulses per round

      gotoxy (1,1);
      printf ("Divisor = %d   Speed = %d       ", (1 << divisor), speed);
      if (kbhit ())
      {
        key = getch ();
        if (key == ESC_CHAR)
          break;
      }
      delay (REFRESH_TIME);
    }
}
```

7 Tri-Axis Accelerometer Example

The accelerometer is not available before hardware revision 3.0 (only the **Plus** variant). The sensor chip ML8953 (OKI) based on a piezo-resistive sensing principle. Acceleration measurement range: ±3g.

```
#include <dos.h>
#include <stdio.h>
#include <conio.h>
#include <stdlib.h>

#define ESC_CHAR                27
#define FALSE                   0
#define TRUE                    1

#define SMBUS_ENTRY             0xF8
#define DEVICE_ADDR             0x6E
#define SMBUS_READ_BYTE         0x00
#define SMBUS_WRITE_BYTE        0x01
#define INT_SERVICE             0x15

#define PAGE_REG                0x1E
#define OP_MODE_REG             0x03
#define STATUS_REG              0x01
#define XAXIS_REG               0x0A
#define YAXIS_REG               0x0C
#define ZAXIS_REG               0x0E
#define COMPOSITE_REG           0x10

#define PAGE0                   0x00
#define PAGE1                   0x01
#define START_MEASURE           0x08

typedef unsigned char byte;
typedef unsigned int  word;
typedef unsigned long dword;

void WriteReg (byte reg, byte val)
{
    union REGS regs;

    regs.h.ah = SMBUS_ENTRY;
    regs.h.al = SMBUS_WRITE_BYTE;
    regs.h.bh = DEVICE_ADDR;
    regs.h.bl = reg;
    regs.h.cl = val;
    int86 (INT_SERVICE, &regs, &regs);
}
```

```
byte ReadReg (byte reg)
{
    union REGS regs;

    regs.h.ah = SMBUS_ENTRY;
    regs.h.al = SMBUS_READ_BYTE;
    regs.h.bh = DEVICE_ADDR;
    regs.h.bl = reg;
    int86 (INT_SERVICE, &regs, &regs);
    return regs.h.cl;
}

double TransformValue (word val, word *sg)
{
    *sg = FALSE;
    if (val & 0x8000)
    {
      *sg  = TRUE;
      val ^= 0xFFFF;
      val &= 0x1FFF;
      val ++;
    }
    return ((double) val / (double) 1024);
}

void main (void)
{
    word     acc, sign;
    byte     acc_lo, acc_hi;
    double   resX, resY, resZ, resAll;
    int      ch;
    char     str [64];

    clrscr ();
    gotoxy (1,1);
    printf ("Accelerometer Test Program");

    while (TRUE)
    {
      WriteReg (PAGE_REG, PAGE0);                  // Set page 0
      WriteReg (OP_MODE_REG, START_MEASURE);       // Start measurement
      delay (1);
      WriteReg (PAGE_REG, PAGE1);                  // Set page 1
      while (TRUE)
      {
        if (! ReadReg (STATUS_REG))                // Read status
          break;
      }
      acc_lo = ReadReg (XAXIS_REG);                // Read X value
      acc_hi = ReadReg (XAXIS_REG+1);
      acc = ((word) acc_hi * 256) + (word) acc_lo;
      resX = TransformValue (acc, &sign);
```

```
        gotoxy (1,2);
        sprintf (str, "Acceleration X Vector = %1.4f", resX);
        if (sign)
          sprintf (str, "Acceleration X Vector = -%1.4f", resX);
        printf (str);

        acc_lo = ReadReg (YAXIS_REG);                    // Read Y value
        acc_hi = ReadReg (YAXIS_REG+1);
        acc = ((word) acc_hi * 256) + (word) acc_lo;
        resY = TransformValue (acc, &sign);
        gotoxy (1,3);
        sprintf (str, "Acceleration Y Vector = %1.4f", resY);
        if (sign)
          sprintf (str, "Acceleration Y Vector = -%1.4f", resY);
        printf (str);

        acc_lo = ReadReg (ZAXIS_REG);                    // Read Z value
        acc_hi = ReadReg (ZAXIS_REG+1);
        acc = ((word) acc_hi * 256) + (word) acc_lo;
        resZ = TransformValue (acc, &sign);
        gotoxy (1,4);
        sprintf (str, "Acceleration Z Vector = %1.4f", resZ);
        if (sign)
          sprintf (str, "Acceleration Z Vector = -%1.4f", resZ);
        printf (str);

        acc_lo = ReadReg (COMPOSITE_REG);                // Read Comp value
        acc_hi = ReadReg (COMPOSITE_REG+1);
        acc = ((word) acc_hi * 256) + (word) acc_lo;
        resAll = TransformValue (acc, &sign);
        gotoxy (1,5);
        sprintf (str, "Acceleration Composite Vector = %1.4f", resAll);
        printf (str);

        delay (500);
        if (kbhit ())
        {
          ch = getch ();
          if (ch == ESC_CHAR)
            exit (EXIT_SUCCESS);
        }
      }
}
```

8 DOS Problems

Not all DOS versions run without problems. The most common reason is:

- The absence of a keyboard controller (8042 compatible) and acording to this the missing I/O addresses 60h/64h can cause problems with keyboard drivers.

8.1 Keyboard Driver

Most DOS versions do not accept switching to different character sets - this means the US character set (default) remains. A bootable MS-DOS 8.0 floppy disk can be created using Windows® XP.

Operating System	Version	Character Set Switching
MS-DOS	**6.22**	Not possible
MS-DOS	**WIN 98 (7.10)**	Not possible
MS-DOS	**WIN ME (8.0)**	Possible
DR-DOS	**7.03**	Not possible

8.2 DR-DOS 7.03

For the installing DR-DOS 7.03 the following default settings should be modified:

Memory Manager Options

i386/i486/586 Memory Manager	**OFF**
Load DPMS Software	**OFF**
Location of DOS Software	**Conventional Memory**

Subsequent HIMEM.SYS can be activated.

8.3 Gate A20 and LAN Boot

When the Gate A20 is set to enabled LAN boot via a network connection from a PXE server is not possible. The PXE Option ROM aborts with an error message.

9 ACPI Thermal Management

The ACPI thermal management supports two modes: passive cooling (decrease the system performance, but produce no noise) and active cooling (no performance loss, but noise production).

9.1 Passive Cooling

Passive cooling controls the processor temperature by activating the automatic thermal throttling after the processor reaches a certain temperature. You can specify the temperature level when throttling starts, define a hysteresis value to get back to full processor performance and specify the percentage for the performance in throttling mode. This mode does not require additional drivers or programs.

9.2 Active Cooling

Only from hardware revision 4.00 on (see PCB) the fan is switched on and off mostly by the hardware. On older boards this is realized through software. The operating system continuously polls the temperature using the ACPI method '_TZP' (Thermal Zone Polling). This is done automatically by Linux - for Windows® operating systems an additional tool is needed as Windows® ignores the ACPI method '_TZP'.
For example the tool

CPUID HWMonitor Vers. 1.14.0 or greater

can be used. From hardware revision 4.00 on no additional tool is needed for a Windows® operating system. This approach accounts the total control of the fan through the temperature control and the fan can not be switched seperatly on and off by the ACPI methods. This is only possible when inside the BIOS Setup the setting **Advanced/ACPI Configuration/ACPI Cooling Options/Active Trip Point** is set to **Disabled**.

9.3 Temperature Limits

All three trip points have the setting **Disabled**. This is not a real deactivating of the trip points but the corresponding value is set to 125°C which is the internal catastrophic temperature.

9.4 Temperature Identifier

Within operating systems (e.g. Linux) the temperature can be determined through the identifier **THRM**:

cat /proc/acpi/thermal_zone/**THRM**/temperature

10 ACPI Wakeup

Two wake events are possible: Wake On LAN (WOL) and Wake On USB (the Wake On USB event requires the CPLD version 0x10 or greater, see BIOS Setup entry **Main/Board Information**).

10.1 Wake On USB

10.1.1 Windows® XP

By default Windows® XP and Windows® Server 2003 enable USB devices, e.g. keyboard and mouse, to wake up the board after sleep. The default behavior permits the board to enter the S1 power state for standby, not the S3 state. Result: the operating system generates no wake event in S3. A registry entry exists to override this selection.
Create or modify the following registry entry (key):

HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\usb

and create or modify the DWORD value:

USBBIOSx = 0x00000000

Note: Other values than 0x00000000 are reserved for future use. This entry is applied globally to all USB host controllers.
Another registry DWORD value named **USBBIOSHacks** is unsupported and must not be used.

10.1.2 Linux

Linux normally disables the wake functionality. This can be verified within the terminal with

```
cat /proc/acpi/wakeup
```

The following command allows the activation of a wake function (example **USB0**):

```
echo USB0 > /proc/acpi/wakeup
```

11 JIDA32 Interface

Most KONTRON single board computers (SBCs) are equipped with unique hardware features that cannot be accessed with standard API. The JIDA32 interface allows you to access this features in a hardware independent manner under popular 32-bit operating systems.
Not mentioned parts of the JIDA32 interface are not supported and can lead to wrong results.

Note: *For the driver installation on Windows® VISTA or Windows® 7 you need to be the administrator.*

11.1 Generic Part

Each SBC has a unique seven letter name that corresponds directly with the physical type of board. Examples are **PLX8**, **PDOT**, **BQBA** and **B690**. Boards are also divided into classes. The currently defined classes are **CPU**, **VGA** and **IO**. Each board has one primary class but it can also have any number of secondary classes. This allows you to talk to a class of boards that has a particular functionality without knowing the exact name of the board.

Identifier	Value
Board name	**IPSP**
Primary class	**CPU**
Secondary class	**VGA**
Boot counter	**0 ... 65535**

Note: *The boot counter is only incremented when a cold boot is performed. For a warm boot this value is not changed.*

11.2 Display Part

In this part only the backlight control can be used. The contrast control is generally not supported (modern graphic controllers don't anymore contain a STN LCD interface).

Identifier	Value	Comment
Backlight on/off	**On or Off**	Not supported on **Basic** variant
Backlight brightness	**0 ... 255**	Not supported on **Basic** variant
Contrast on/off	**Not supported**	
Contrast value	**Not supported**	
End of dark boot	**Not supported**	

11.3 I2C-Bus Part

This part allows the access to serial busses. A write access is not allowed on every device though. KONTRON does not guarantee the correct function of the component respectively the warranty claim is lost in case of unallowed write cycles.

Bus Number	Technology	Type	Device Count	Comment
0	I2C (primary)	JIDA	1	
1	SMBus	Generic	2	
2	I2C	JILI	1	Not supported on **Basic** variant

11.3.1 Bus Number 0 (JIDA)

This bus allows access to the JIDA EEPROM in which KONTRON specific manufacturing parameters are stored. A damage of these parameters leads to a loss of warranty. Due to this a write cycle may only be performed above a defined address.

Device	Address	Size	Read Access	Write Access
JIDA EEPROM	**A0h**	512 Bytes	Yes	Yes, between 28h to 1C8h

11.3.2 Bus Number 1 (Generic)

Through this bus several devices can be handled.
Note: The accelerometer is not available before hardware revision 3.0 (only **Plus** variant).

Device	Address	Size	Read Access	Write Access
Accelerometer	**6Eh**	32 Bytes	Yes	Yes
Temp. sensor	**98h**	256 Bytes	Yes	Yes
SPD EEPROM	**A0h**	256 Bytes	Yes	No, forbidden

11.3.3 BusNumber 2 (JILI)

The JILI EEPROM refers to the LCD/LVDS interface. It contains the panel specific timing parameters (e.g. a DisplayID™ record).

Device	Address	Size	Read Access	Write Access
JILI EEPROM	**A0h**	512 Bytes	Yes	Yes

11.4 CPU Performance Part

This part implements power management functions. The CPU frequency and the CPU throttling can be controlled.

Function	Supported
CPU throttling	**Yes**
CPU frequency	**No**

11.5 Hardware Monitor Part

The hardware monitor part contains in most cases several subsections.

Section	Sensor Count
Temperature	**2**
Fan	**Not supported**
Voltage	**Not supported**

11.5.1 Temperature

The term On-Chip diode designates the chip temperature of the temperature sensor (with no dependence to the CPU temperature).

Sensor	Number	Abs. Thermal Limit
On-Chip diode	**0**	0 to +80^0 C
CPU diode	**1**	0 to +90^0 C

11.6 Digital I/O Part

This part defines the availability of digital input/output lines.

Type	Port	Pin Count	Position
Input or Output	**0**	8	Bit 0 - 7
Input/Output	**1 - 7**	Not supported	

11.7 Watchdog Part

The watchdog can be programmed with discrete timeout values on boards with CPLD implementation or in millisecond resolution with boards using a Super-I/O. In the discrete value scenario if there is no exact match to the timeout value the next higher one is used (Example pITX-SP: programmed value = 12 seconds, activated value = 30 seconds).

Type	Steps	Timeout Values	Result
CPLD	7	**1, 5, 10, 30** seconds **1, 5, 10** minutes	RESET NMI not supported

11.8 JIDA32 Windows® Programming

For further information see the actual JIDA32 documentation (JIDA32.pdf).

11.8.1 Program Language C

The demo program reads and shows the board name and the first 16 bytes of SPD EEPROM (SMBus). The program uses the static linked library JIDA.LIB.

Example:

```
#include <windows.h>
#include "jida.h"

#define I2C_BUS      1
#define DEV_ADDR   0xA0

INT WINAPI WinMain (HINSTANCE hInstance, HINSTANCE hPrevInstance, LPSTR lpCmdLine, INT nCmdShow)
{
    BOOL    bRet;
    HJIDA   hJida = (DWORD) NULL;
    CHAR    szStr1 [128],
            szStr2 [32],
            szVal [JIDA_BOARD_MAX_SIZE_ID_STRING];
    UCHAR  uVal [32];

    if (JidaDllInitialize ())
    {
      if (JidaDllIsAvailable ())
      {
        if (JidaBoardOpen (JIDA_BOARD_CLASS_CPU, 0, JIDA_BOARDINFO_FLAGS_DEFAULT, &hJida))
        {
          bRet = JidaBoardGetName (hJida, (LPTSTR) szVal, JIDA_BOARD_MAX_SIZE_ID_STRING);
          wsprintf (szStr1, "JidaBoardGetName = %d / %s", bRet, szVal);
          lstrcpy (szStr2, "DEMO");
          MessageBox (NULL, szStr1, szStr2, MB_OK | MB_ICONEXCLAMATION);
          JidaI2CRead (hJida, I2C_BUS, DEV_ADDR, (LPBYTE) &uVal[0], 16);
          wsprintf (szStr1, "JidaI2CRead = %02X %02X %02X %02X %02X %02X %02X %02X",
                                                    uVal[0], uVal [1], uVal[2], uVal [3],
                                                    uVal[4], uVal [5], uVal[6], uVal [7]);
          MessageBox (NULL, szStr1, szStr2, MB_OK | MB_ICONEXCLAMATION);
          JidaBoardClose (hJida);
        }
      }
      JidaDllUninitialize ();
    }
    return (INT) FALSE;
}
```

11.8.2 Program Language DELPHI

The demo program activates the watchdog (timeout = 30 seconds). The keyword 'var' passes the argument by reference.

Example:

```
unit mainU;

interface

uses
    Windows, Messages, SysUtils, Variants, Classes, Graphics, Controls, Forms, Dialogs, StdCtrls;

type
    HJIDA = LongInt;

type
    TForm1 = class (TForm)
    Button1: TButton;
    procedure Button1Click (Sender: TObject);
private
    { Private-Deklarationen }
public
    hJida: HJIDA;
    { Public-Deklarationen }
end;

function JidaDllInitialize : Boolean {$IFDEF WIN32} stdcall {$ENDIF}; external 'JIDA.DLL';
function JidaDllUninitialize : Boolean {$IFDEF WIN32} stdcall {$ENDIF}; external 'JIDA.DLL';
function JidaDllIsAvailable : Boolean {$IFDEF WIN32} stdcall {$ENDIF}; external 'JIDA.DLL';
function JidaBoardOpen (pszClass:PChar; dwNum:LongInt; dwFlags:LongInt; var phJida:HJIDA) : Boolean
                        {$IFDEF WIN32} stdcall {$ENDIF}; external 'JIDA.DLL';
function JidaWDogSetConfig (hJida:HJIDA; dwType:LongInt; dwTimeout:LongInt; dwDelay:LongInt;
                        dwMode:LongInt) : Boolean {$IFDEF WIN32} stdcall {$ENDIF}; external 'JIDA.DLL';

var
    Form1: TForm1;
const
    JIDA_BOARD_CLASS_CPU = 'CPU'#0;
    JIDA_FLAGS_DEFAULT = 0;
    JIDA_TIMEOUT_VALUE = 30000;
    JIDA_DELAY_VALUE = 0;                   // Delay not supported
    JIDA_REBOOT_MODE = 0;                   // NMI not supported

implementation

{$R *.dfm}
```

```
procedure TForm1.Button1Click(Sender: TObject);
begin
{Method 1}
    if JidaDLLInitialize () then
    begin
      if JidaDllIsAvailable () then
      begin
        if JidaBoardOpen (JIDA_BOARD_CLASS_CPU, 0, JIDA_FLAGS_DEFAULT, hJida) then
          JidaWDogSetConfig (hJida, 0, JIDA_TIMEOUT_VALUE, JIDA_DELAY_VALUE, JIDA_REBOOT_MODE);
      end;
    JidaDllUninitialize ();
    end;
end;

end.
```

The associated DFM file:

```
object Form1: TForm1
    Left = 196
    Top = 107
    Width = 367
    Height = 390
    Caption = 'KONTRON JIDA32 TEST'
    Color = clBtnFace
    Font.Charset = DEFAULT_CHARSET
    Font.Color = clWindowText
    Font.Height = -11
    Font.Name = 'MS Sans Serif'
    Font.Style = []
    OldCreateOrder = False
    PixelsPerInch = 96
    TextHeight = 13
    object Button1: TButton
      Left = 104
      Top = 128
      Width = 75
      Height = 25
      Caption = 'Test JIDA32'
      TabOrder = 0
      OnClick = Button1Click
    end
end
```

The associated DPR file:

```
program Jidatest;

uses
    Forms,
    mainU in 'mainU.pas' {Form1};

{$R *.res}

begin
    Application.Initialize;
    Application.CreateForm (TForm1, Form1);
    Application.Run;
end.
```

11.8.3 Program Language VISUAL BASIC (VB.NET)

The demo program shows the board count value and activates the watchdog (timeout = 10 seconds).

Example:

```
Public Class JidaTest

    Declare Auto Function JidaDllInitialize Lib "JIDA.DLL" () As Boolean
    Declare Auto Function JidaDllUninitialize Lib "JIDA.DLL" () As Boolean
    Declare Auto Function JidaDllIsAvailable Lib "JIDA.DLL" () As Boolean
    Declare Auto Function JidaBoardCount Lib "JIDA.DLL" _
            (ByVal classstr As String, ByVal flags As UInteger) As UInteger
    Declare Auto Function JidaBoardOpen Lib "JIDA.DLL" _
            (ByVal classstr As String, ByVal num As UInteger, ByVal flags As UInteger, _
            ByRef handle As UInteger) As Boolean
    Declare Auto Function JidaBoardClose Lib "JIDA.DLL" (ByVal handle As UInteger) As Boolean
    Declare Auto Function JidaWDogSetConfig Lib "JIDA.DLL" (ByVal handle As UInteger, _
            ByVal type As UInteger, ByVal timeout As UInteger, ByVal delay As UInteger, _
            ByVal mode As UInteger) As Boolean

    Public Sub Button1_Click(ByVal sender As System.Object, ByVal e As System.EventArgs) Handles Button1.Click
      Const JIDA_BOARD_CLASS_CPU = "CPU"
      Const JIDA_BOARD_OPEN_FLAGS_PRIMARYONLY = 1
      Const JIDA_BOARDINFO_FLAGS_DEFAULT = 0
      Const TIMEOUT_VALUE = 10000
      Const DELAY_VALUE = 0                         'Delay not supported
      Const REBOOT_BOARD = 0                        'NMI not supported
      Dim handle As UInteger

      If JidaDllInitialize() Then
        If JidaDllIsAvailable() Then
          If JidaBoardOpen(JIDA_BOARD_CLASS_CPU, 0, JIDA_BOARDINFO_FLAGS_DEFAULT, handle) Then
            MsgBox("BoardCount = " & JidaBoardCount(JIDA_BOARD_CLASS_CPU, _
                                                    JIDA_BOARD_OPEN_FLAGS_PRIMARYONLY))
            JidaWDogSetConfig(handle, 0, TIMEOUT_VALUE, DELAY_VALUE, REBOOT_BOARD)
            JidaBoardClose(handle)
          End If
        End If
        JidaDllUninitialize()
      End If
    End Sub

End Class
```

The associated Designer file:

```
<Global.Microsoft.VisualBasic.CompilerServices.DesignerGenerated()> Partial Class JidaTest
    Inherits System.Windows.Forms.Form

    <System.Diagnostics.DebuggerNonUserCode()> Protected Overrides Sub Dispose(ByVal disposing As Boolean)
      Try
        If disposing AndAlso components IsNot Nothing Then
          components.Dispose()
        End If
        Finally
        MyBase.Dispose(disposing)
      End Try
    End Sub

    Private components As System.ComponentModel.IContainer

    <System.Diagnostics.DebuggerStepThrough()> Private Sub InitializeComponent()
      Me.Button1 = New System.Windows.Forms.Button
      Me.SuspendLayout()
      '
      'Button1
      '
      Me.Button1.Location = New System.Drawing.Point(38, 39)
      Me.Button1.Name = "Button1"
      Me.Button1.Size = New System.Drawing.Size(75, 23)
      Me.Button1.TabIndex = 0
      Me.Button1.Text = "Run Test"
      Me.Button1.UseVisualStyleBackColor = True
      '
      'JidaTest
      '
      Me.AutoScaleDimensions = New System.Drawing.SizeF(6.0!, 13.0!)
      Me.AutoScaleMode = System.Windows.Forms.AutoScaleMode.Font
      Me.ClientSize = New System.Drawing.Size(154, 96)
      Me.Controls.Add(Me.Button1)
      Me.Name = "JidaTest"
      Me.Text = "JidaTest"
      Me.ResumeLayout(False)
    End Sub
    Friend WithEvents Button1 As System.Windows.Forms.Button

End Class
```

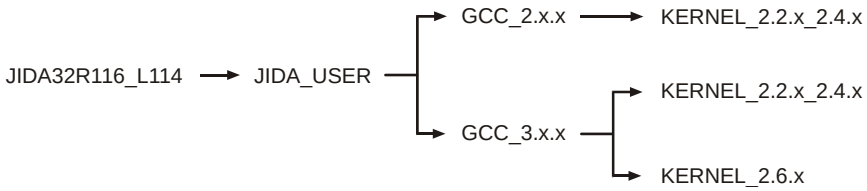
11.8.4 Module Definition File

The calling program can refer to the function by name or by ordinal value. The tool IMPDEF.EXE (e.g. BORLAND C++) make it possible to generate the DEF-file (from JIDA.DLL 06/07/2004, in newer DLLs the ordinal value can be changed).

```
EXPORTS
    JidaBoardClose                  @9
    JidaBoardCount                  @6
    JidaBoardCountA                 @50
    JidaBoardCountW                 @55
    JidaBoardGetBootCounter         @12
    JidaBoardGetBootErrorLog        @75
    JidaBoardGetInfo                @11
    JidaBoardGetInfoA               @54
    JidaBoardGetInfoW               @59
    JidaBoardGetName                @10
    JidaBoardGetNameA               @53
    JidaBoardGetNameW               @58
    JidaBoardGetOption              @14
    JidaBoardGetRunningTimeMeter    @13
    JidaBoardOpen                   @7
    JidaBoardOpenA                  @51
    JidaBoardOpenByName             @8
    JidaBoardOpenByNameA            @52
    JidaBoardOpenByNameW            @57
    JidaBoardOpenW                  @56
    JidaBoardSetOption              @15
    JidaDllGetVersion               @2
    JidaDllInitialize               @3
    JidaDllInstall                  @40
    JidaDllIsAvailable              @5
    JidaDllUninitialize             @4
    JidaFanCount                    @83
    JidaFanGetCurrent               @85
    JidaFanGetInfo                  @84
    JidaFanSetLimits                @86
    JidaI2CCount                    @29
    JidaI2CIsAvailable              @30
    JidaI2CRead                     @31
    JidaI2CReadRegister             @33
    JidaI2CType                     @63
    JidaI2CWrite                    @32
    JidaI2CWriteReadCombined        @69
    JidaI2CWriteRegister            @34
    JidaIOCount                     @35
    JidaIOGetDirection              @70
    JidaIOGetDirectionCaps          @72
    JidaIOGetNameA                  @73
    JidaIOGetNameW                  @74
```

11.9 JIDA32 Linux Programming

Please note that the JIDA32 package does not include full sources. Instead precompiled objects are provided that can be used to build a JIDA32 package for a certain environment (GCC, kernel, libc).
In order to handle GCC version incompatibilities and different kernel module build environments the package includes different branches (you can use the GCC_3.x.x subdirectory for GCC 4.x.x compiler versions).



Under each branch four subdirectories can be found:

JidaDrv: Includes the necessary source, library and build files to create the JIDA32 kernel driver module (jida.ko for kernels 2.6.x, jida.o for kernels 2.2.x and 2.4.x).

JidaLib: Includes the necessary source, library and build files to create the JIDA32 interface library (libjida.so, libjida.a).

JidaTst: Includes the necessary source and build files to create a simple JIDA32 test application (jidatst).

JWdogTst: Includes the necessary source and build files to create a simple watchdog test application (jwdogtst).

In order to build the JIDA32 kernel driver module (jida.ko/jida.o) you must install the complete kernel sources for the destination kernel under **/usr/src/linux** or alternatively provide an environment variable **KERNELDIR** that contains the path of the kernel sources.
After installation of the sources please configure, build and install the respective kernel and modules on your system. Having done so please reboot and start the system using the new kernel.

In order to build the JIDA32 kernel driver, interface library and test applications go to the
./JIDAR116_L114/JIDA_USER/'GCC_VERSION'/'KERNEL_VERSION'
directory and enter 'make all'.

In order to automatically copy the created files to their destination directories please enter 'make install' afterwards. This will copy the following files:

jida.ko to **/lib/modules/$(KERNELRELEASE)/extra/** (for kernel 2.6.x)
or
jida.o to **/lib/modules/$(KERNELRELEASE)/misc/** (for kernel 2.2.x/2.4.x)

libjida.so + libjida.a to **/usr/lib/**

jidatst + jwdogtst to **/usr/bin/**

jida.h + jwindefs.h to **/usr/include/**

You can provide a prefix for the above named directories with the **INSTALL_MOD_PATH** environment variable if you want to install the files into an alternative root file system. (Note: kernel 2.6.x only)
After successfull build and installation you should run the sample application jidatst which will display the following message:

JIDA system driver is incompatible or not installed.
Would you like to install it? (yes or no)

If you answer this question with 'yes' or 'y' the device node **/dev/jida** will be created and the driver module loaded. Afterwards some basic JIDA32 test calls will be performed which display their results on the screen. If you see this output the JIDA32 interface is operational.
If you have problems running JIDA please check if the device node **/dev/jida** is created with the correct major/minor number and is accessible by the active user. Since version JIDAR115_L113 we are using 10/250 for device nodes if a kernel of the 2.6.x branch is used. JIDA drivers for older kernels or JIDA32 revisions use 99/0 for the device node.

Note: *JIDA won't be detected automatically on kernel startup. You have to load it by yourself. You can either use the JidaDllInstall function to do it or use "**modprobe jida**" before starting your application. Most Linux distributions provide other possibilities to automatically load kernel modules. For Debian simply add a line with "**jida**" to the **/etc/modules** file.*

Note: *If you are using **udev** with a 2.6 kernel the device node will automatically be created. The default major/minor will be 10/250 which is reserved for local use. If this is conflicting with your own driver you can redefine the minor id to something else by providing the minor=x parameter when loading the module. Example: modprobe jida minor=254.*

12 Linux Support

12.1 openSUSE® 11.1

Kernel: 2.6.27.7-9-pae i686

Device	Supported
Poulsbo Chipset	✔
DVI/LVDS Support	✔
LAN Controller	✔
HD Audio Controller	✔
USB Controller	✔
Parallel-ATA Controller	✔
Serial-ATA Controller	✔
SDIO (microSD) Controller	✔

12.2 Fedora® 11

Kernel: 2.6.29.4-167.fc11.i586

Device	Supported
Poulsbo Chipset	✔
DVI/LVDS Support	✔
LAN Controller	✔
HD Audio Controller	✔
USB Controller	✔
Parallel-ATA Controller	✔
Serial-ATA Controller	✔
SDIO (microSD) Controller	✔

Attention: *If you have some problems with the Serial-ATA controller (e.g. formatting the disk) disable the Serial-ATA Option ROM.*

12.3 Reboot Problem

Most Linux distributions will freeze after a restart or a shutdown command is issued right at the very end of the process forcing the system to do a hard reset. By default the Linux kernel uses the **reboot=kbd** method i.e. it tries to look for a keyboard controller and issue a reset/shutdown command to it. The *p*ITX-SP board doesn't have a keyboard controller and a fix is required.
The reboot behavior can be corrected within the BIOS Setup through the entry **Advanced/Onboard Device Configuration/Chipset Configuration/Linux Reboot Fix**. When this entry is set to **Enabled** a small part of the port 64h access is emulated. This is not a complete emulation of the keyboard controller which means that side effects might occure. The following table shows a small overview about system behavior of different linux systems:

Distribution	Result
Fedora®	✔
Suse®	Long timeout during start up
Ubuntu®	✔

As an alternative solution other reboot methods can be used within Linux operating systems.
In order to solve the problem you should append the following parameter to the kernel in the form of **reboot=<parameter>** at the time of boot (possible a keystroke is necessary):

reboot = acpi use the RESET_REG in the FADT

reboot = pci use the PCI reset register 0xCF9

Once your system boots you can verify whether the parameter was correctly passed or not with the following command:

cat /proc/cmdline

Result (example):

root = ... reboot = bios

You can find the list of all the above parameters in the **reboot.c** file in the Linux kernel source. When the GRUB bootloader is used the reboot command can be entered into the file **/boot/grub/grub.conf**.

Appendix A: Reference Documents

KONTRON Technology A/S can't guarantee the availability of internet addresses.

Document	Internet Address
Advanced Configuration and Power Interface (ACPI)	http://www.acpi.info/spec.htm
AT Attachment Storage Interface Specification (ATA)	http://t13.org
Digital Visual Interface (DVI)	http://www.ddwg.org
High Definition Audio Specification (HD Audio)	http://www.intel.com/standards/hdaudio
High Speed Serialized AT Attachment (S-ATA)	http://www.sata-io.org/developers
IEEE 802.3 Specification (Ethernet)	http://standards.ieee.org/getieee802
Low Pin Count Interface Specification (LPC-Bus)	http://developer.intel.com/design/chipsets/industry/lpc.htm
Open LVDS Display Interface Standard Spec. (Open LDI)	http://www.national.com/analog/displays/open_ldi
PCI Express Base Specification (PCI Express)	http://www.pcisig.com/specifications
SD Specification (SD Card)	http://www.sdcard.org/developers/tech/sdio/sdio_spec
System Management Bus Specification (SMBus)	http://www.smbus.org/specs
Universal Serial Bus Specification (USB)	http://www.usb.org/developers/docs

Appendix B: Document Revision History

Revision	Date	Author	Changes
S0003-C	11/04/10	M. Hüttmann	Replaced the JIDA32 Delphi example
S0003-B	05/26/10	M. Hüttmann	Created the chapter 'CPLD Interface'
S0003-A	03/18/10	M. Hüttmann	Added chapter 'ACPI Thermal Management' as well as 'ACPI Wakeup' and supplemented chapter 'Linux Reboot Problem' as well as 'S-ATA Interface'
S0003-0	12/17/09	M. Hüttmann	Adapted to KONTRON Technology A/S guidelines
0.3	10/27/09	M. Hüttmann	Added chapter 'Linux Support / Reboot Problem'
0.2	09/28/09	M. Hüttmann	Added chapter 'Graphics Interface / DisplayID Specification / LCD Panel Selection', 'Graphics Interface / What means GMA and IEGD' and 'Graphics Interface / H.264 Support for Linux'
0.1	08/17/09	M. Hüttmann	Created preliminary manual

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