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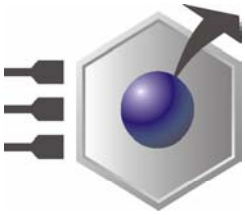

EuroTecH

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Notes on the use of the SSD and ATA / ATAPI interfaces

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ABOUT THIS MANUAL

This application note contains information about the SSD and ATA / ATAPI interfaces.

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Conventions

The following table lists conventions used throughout this application note.

Icon	Notice Type	Description
	**Information note**	Important features or instructions
	**Warning**	Information to alert you to potential damage to a program, system or device or potential personal injury

Mode of the register:
R/W: Read and write register.
RO: Read only register.
W: Meaning of the register when written.
R: Meaning of the register when read.

Name ranges:
A name followed by a range in brackets represents a range of logically related entities.
For example Name [0:2]

Hex Number:
Hexadecimal numbers are represented with an “h” suffix. (For example 11Ch)

Contents

Introduction

The IDE interface present on Eurotech CPU's as indicated in Note 1 are completely compatible with the published specifications for ATA/ATAPI 4 and ATA/ATAPI 6 for modes UDMA4.

These specifications define cables and the characteristics of the signals used for input and output, as well as registers, commands, etc.

Here we intend to underline some of the electrical aspects of the interface, and the consequences involved in using Solid State Disks, as well as to underline possible problems, also we will point out possible solutions.

Chapter 1 The IDE specifications with regards to ATA

Table 1 shows the specifications of the 5.0 Volt TTL signal

Symbol	Description	Min Volts DC	Max Volts DC
ViH	Voltage input high	2.0	5.5
ViL	Voltage input low		0.8
VoH	Voltage output high at IoH min	2.4	
VoL	Voltage output low at IoL min		0.5

Table 1: 5 Volt TTL Specifications

The specifications allow for some pull-ups, their value and the pull-up voltage equal to 5.0 Volts

These specifications are applied both the Host (CPU) and the Device (Disk) to guarantee the compatibility of the different components.

Following are some different types of devices.

Hard Disk

The hard disk has been produced for many years using this type of interface and therefore we can be certain that every hard disk is compatible with every CPU, also without specific documentation (datasheet for the hard disk) to certify the compatibility.

The datasheet of a “HD Medalist 1720” from Seagate specifies:

“Signals that the drive receives must have the following characteristics at the drive connector:
Logic low: 0.0V to 0.7V
Logic High: 2.0V to 5.25V”

This declaration does not specify the differences between the input and output levels, however the specifications are respected.

Solid State Disk or SSD

There are many devices based on flash memories that can be connected to an IDE/ATA interface. Compact Flash, PC Card ATA, M-systems' FFD, Disk On Module, each has a different set of specifications and they state compatibility with PCMCIA ATA or ATA/ATAPI.

The specifications for PCMCIA ATA regulates the operation of a PC Card in the form ATA; the PC-Card, also in the form ATA, is always assumed to be inserted in a special adaptor card with an appropriate interface, that can be different from an ATA/ATAPI interface.

For convenience of this application note we will only be looking at Compact Flash modules, the use of other devices can be easily extrapolated from this example.

We pass therefore to consider a compact flash with CMOS, and subsequently another compact flash that will result TTL.

SSD CMOS: Compact Flash

If we consider the DC signal characteristics of a Compact Flash with regards to the specification for Compact Flash 1.4, and refer to the specifications for the PCMCIA, we see that there are consequently 2 voltage characteristics, 3.3 Volts and 5.0 Volts.

Type	Parameter	Symbol	Min	Type	Max	Min	Type	Max
			Vcc=3.3V			Vcc=5.0V		
1	Input Voltage CMOS	ViH	2.4V			4.0V		
		ViL			0.6V			0.8V
2	Input Voltage CMOS	ViH	1.5V			2.0V		
		ViL			0.6V			0.8V
3	Input Voltage CMOS	ViH		1.8V			2.8V	
	Schmitt Trigger	ViL		1.0V			2.0V	

Table 2: Compact Flash 1.4 Specifications

These devices are manufactured with the CMOS component, or if it has an internal interface, this is manufactured with CMOS components; the characteristics of the DC signals are as specified in Table 1, Type 1.

Connecting the Compact Flash to an IDE/ATA interface and therefore supplying 5.0 Volts it will not receive the minimum level, the Compact Flash device is not guaranteed to boot the Host (CPU).

In fact,
- The minimum level required for input for the device, as seen in Table 2, ViH min is 4.0 Volts.
- The output of the Host CPU, as seen in Table 1 VoH min is equal to 2.4 Volts

Therefore the Compact Flash receives only 2.4Volts, when it actually requires a minimum input level of 4.0 Volts.

Although it is simple to connect an SSD to the IDE interface, the difference in the levels will cause it to malfunction. Generally speaking the other parameters are not a problem, since the output levels of the CMOS components are better than the older ATA/ATAPI standard TTL on which it is based.

SSD TTL-compatible: Another Compact Flash

Conversely there are other SSD's that are completely compatible with the ATA/ATAPI standard.

For example: The specification of a Compact Flash from Toshiba, the “THNCFxxxMBA”:

SYMBOL	PARAMETER	MIN	MAX	TYP.	UNIT	TEST CONDITIONS
ViH	Input High Voltage	0.7 x Vcc			V	Vcc = 3.3V
		2.0V			V	Vcc = 5.0V
ViL	Input Low Voltage		0.2 x Vcc		V	Vcc = 3.3V
			0.8V		V	Vcc = 5.0V

Table 3: Toshiba, the “THNCFxxxMBA” specifications.

If this Compact Flash is connected to the IDE/ATA interface, it will receive 5.0 Volts, therefore it will be receiving an input voltage that meets its minimum specification from the Compact Flash and therefore will be guaranteed to boot the Host (CPU).

In fact,
- The minimum input level for the device, referring to Table 3: ViH = 3.0 Volts, which is better than the required 2.0 Volts
- The host output level, referring to Table 1 is VoH min is equal to 2.4 Volts

The Compact Flash receives 2.4 Volts, the specifications calls for at least 2.0 Volts to function; the typical margin of error for the TTL signal is 0.4 Volts.

Chapter 2 The use of HD and SSD with Eurotech CPU's

The IDE interfaces found on suitable Eurotech CPU's (see Note 1) are compliant with the following specifications: ATA/ATAPI 4 and ATA/ATAPI 6, for modes formally UDMA4.

They can function correctly only with a Device whose signal levels are completely compatible with ATA/ATAPI.
Putting it simply they must have TTL levels of 5.0 Volts.

When selecting these devices an evaluation of the datasheet should be made taking careful note of the specifications, a list of components verified by Eurotech is available upon request, if you have a requirement to use devices other than the listed ones you must check the relative datasheet and specifications.

To perform functional tests without first examining the datasheet could cause a false sense of security, problems can be revealed that are in fact caused by secondary factors such as noise, intensity of the test, Input problems etc.

It is also worth noting that with the introduction of 3.3Volt Hard Disks with or without a CMOS interface, an evaluation of the datasheet is now advisable even for this kind of Device, up until now they have all been equally compatible.

Chapter 3 A solution for CMOS SSD

In the section dedicated to Compact Flash with CMOS, we underlined the case in which the SSD is supplied with 5.0 Volts. This choice becomes spontaneous, in how much input is brought to the Device through the connector is 5.0 Volts, and the pull-ups are to 5.0 Volts, therefore applying 3.3 Volts to the SSD you will run into some problems.

Supplying the SSD with 3.3 Volts; if possible, it has the advantage in resolving the problem of compatibility.

In fact, Supplying with 3.3 Volts
- The minimum input level for the device, shown in Table 2: ViH min is equal to 2.0 Volts.
- The output from the Host, Shown in Table 1: VoH min is 2.4 Volts.

Therefore the SSD receives 2.4V and requires a minimum of 2.4 Volts to see the Voltage high signal, in this case a margin of error of 0.0V is acceptable considering that the VoH is smaller than the real voltage for the CPU realized with CMOS fed to 3.3 Volts.

Recent Eurotech CPU's and those listed in Note 2, Send the IDE signals with CMOS driver fed with 3.3 Volts, therefore the level of VoH declared min for compatibility is equal to 2.4 Volts but it has some variation up to 2.8 Volts.

The problems exists that to send the SSD of the largest output signals of the same SSD.

Such signals are those with pull-up to 5.0 Volts, which can commonly induce in the SSD a suitable tide input clamp current through the protection diodes toward the 3.3 Volt input.
Such tide is worth around the difference among the feedings I lead the threshold of the diode of protection divided for the value in ohms of the parallel of the pull-ups to 5 Volts second standards, or:

(5V - 3.3V - 0.9V) / 4.7 kOhms // 10 kOhms
Equal to 0.8 / 3200
Or
0.2mA +/- 10%

The datasheets of the SSD's have poor information regarding the input clamp current. Recalling the Philips datasheet for the logic family HCT, such value is suitable in around 20mA total for chip.

Being very distant from such threshold is probable that the SSD's CMOS can be fed with 3.3 Volts and connected to the IDE interface of the CPU's mentioned without any problem.
We leave the responsibility of determining the acceptable value of the input clamp current to the integrator of the system, as well as to appraise the general functionality of the solutions he visualizes.

Chapter 4 Notes

Note 1:
The following CPU's are compatible with ATA/ATAPI 4 and ATA/ATAPI 6, for modes formally UDMA4:
CPU-1232, CPU-1231, CPU-1230, CPU-1220, CPU-1211, CPU-1210,
CPU-1432, CPU-1420, CPU-1410, CPU-7630, CPU-7610 and CPU-7310

Note 2:
The following CPU's use an IDE interface with 3.3V CMOS outputs:
CPU-1232, CPU-1231, CPU-1230, CPU-1220, CPU-1432, CPU-1420,
CPU-1410, CPU-7630, CPU-7610 and CPU-7310

Whereas the CPU-1211 and CPU-1210 use a 5 Volt buffer

Related Documents

For more information refer to the specific CPU user manual and application notes.

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