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Edition 2.0 2008-02

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Semiconductor devices – Integrated circuits –
Part 2-20: Digital integrated circuits – Family specification – Low voltage integrated circuits

Dispositifs à semiconducteurs – Circuits intégrés –
Partie 2-20: Circuits intégrés numériques – Spécification de famille – Circuits intégrés basse tension

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SEMICONDUCTOR DEVICES –
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Part 2-20: Digital integrated circuits –
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FOREWORD

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International Standard IEC 60748-2-20 has been prepared by subcommittee 47A: Integrated circuits, of IEC technical committee 47: Semiconductor devices.

This second edition of IEC 60748-2-20 cancels and replaces the first edition published in 2000. This edition constitutes a technical revision.

This edition includes the following significant changes with respect to the previous edition:

– Expansion of power supply voltages down to nominal 1,0 V
– Addition of Schmitt-trigger input specification

The text of this standard is based on the following documents:

CDV	Report on voting
47A/770/CDV	47A/777A/RVC

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

This standard is a family specification for low voltage integrated circuits.

A list of all the parts in the IEC 60748 series, under the general title *Semiconductor devices – Integrated circuits*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

INTRODUCTION

The dimensions of integrated circuit devices are continuing to be reduced, both vertically and horizontally, to obtain better performance and higher density. However, if the supply voltages and interface levels are not reduced, the electric fields within the die (chip) will increase, which leads to reduced reliability. These increased fields will also, together with the higher system-clock rate, lead to increased electromagnetic interference and noise induced on the supply leads and the ground plane, which leads to lower noise immunity and a higher probability of malfunction. To continue this trend of scaling down the size of semiconductor devices, lower power supply voltages are essential.

For systems operating at lower supply voltage, the tolerances on the supply voltage and the input and output voltages must be specified more closely. Also, since the market for battery-operated equipment is expected to grow considerably, it is important to include specifications that cover this field. By setting standard values at this stage, manufacturing costs can be reduced and users can design systems more economically.

After the publication of first edition of this standard, scaling of digital ICs has still been drastically proceeding, and nowadays, state-of-the art digital ICs are operated at 1,2 V, and Schmitt trigger interface is widely used. In light of the situation, this second edition expands the specification of nominal power supply voltage down to 1,0 V and includes specifications of Schmitt trigger interface.

SEMICONDUCTOR DEVICES – INTEGRATED CIRCUITS –

Part 2-20: Digital integrated circuits – Family specification – Low voltage integrated circuits

1 Scope

This standard aims at giving DC interface specifications for various sets of values, where each comprises the nominal value of power supply voltage, its tolerance, and the worst-case limit values of the input and output voltages for low voltage integrated circuits.

It also provides two categories of interface specification for each nominal supply voltage – normal range and wide range. The normal range is based on the nominal industry standard with typical tolerance of about 10 %. The wide range covers battery operation that extends the lower limit to a practical value at which the battery will continue to operate.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60748-2:1997, *Semiconductor devices – Integrated circuits – Part 2: Digital integrated circuits*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
absolute maximum continuous ratings
conditions from which damage to the circuit may occur, if the circuit is exposed to such conditions

3.2
operating conditions
conditions under which the circuit functions normally with appropriate degree of reliability

3.3
output characteristics
requirements for the circuit to fulfil under the operating condition

4 Interface specifications for low supply voltage below 3,3 V

4.1 Specifications for 3,3 V nominal power supply voltage

4.1.1 General

These specifications apply to LVTTL- and LVCMOS-compatible circuits over the full operating temperature range specified by manufacturer to be commercial, industrial, and/or military grade.

4.1.2 Absolute maximum continuous ratings

Table 1 specifies absolute maximum continuous ratings of the circuits.

Table 1 – Absolute maximum continuous ratings for nominal 3,3 V

Parameters	Symbol	Min.	Max.	Unit
Power supply voltage	V_{DD}	-0,5	4,6	V
DC input voltage	V_{IN}	-0,5	V_{DD} + 0,5 (4,6 V max)	V
DC output voltage	V_{OUT}	-0,5	V_{DD} + 0,5 (4,6 V max)	V
Storage temperature range [a]	T_{STG}	—	—	°C
[a] Storage temperature range shall be specified by manufacturer for various purposes.				

4.1.3 Normal range of operating supply voltage

Table 2 and Table 3 specify operating conditions and output characteristics for normal range power supply, respectively.

Table 2 – Operating conditions for 3,3 V normal range

Parameters		Symbol	Min.	Max.	Unit
Power supply voltage		V_{DD}	3,0	3,6	V
Normal input	High-level input voltage	V_{IH}	2,0	V_{DD} + 0,3	V
	Low-level input voltage	V_{IL}	-0,3	0,8	V
Schmitt trigger input	Positive going threshold voltage	V_{ITP}	0,9	2,1	V
	Negative going threshold voltage	V_{ITN}	0,7	1,9	V
	Hysteresis voltage	V_{hys}	0,2	1,4	V
Operating temperature range [a]		T_a	—	—	°C
[a] Operating temperature range shall be specified by manufacturer for various purposes.					

Table 3 – Output characteristics for 3,3 V normal range

Characteristics	Symbol	Condition	LVTTL		LVCMOS		Unit
			Min.	Max.	Min.	Max.	
High-level output voltage	V_{OH}	I_{OH} = -2 mA	2,4	—	—	—	V
		I_{OH} = -100 µA	—	—	V_{DD} – 0,2	—	V
Low-level output voltage	V_{OL}	I_{OL} = 2 mA	—	0,4	—	—	V
		I_{OL} = 100 µA	—	—	—	0,2	V

4.1.4 Wide range of operating supply voltage

Table 4 and Table 5 specify operating conditions and output characteristics for wide range power supply, respectively.

Table 4 – Operating conditions for 3,3 V wide range

Parameters		Symbol	Min.	Max.	Unit
Power supply voltage		V_{DD}	2,7	3,6	V
Normal input	High-level input voltage	V_{IH}	2,0	V_{DD} + 0,3	V
	Low-level input voltage	V_{IL}	-0,3	0,8	V
Schmitt trigger input	Positive going threshold voltage	V_{ITP}	0,9	2,1	V
	Negative going threshold voltage	V_{ITN}	0,7	1,9	V
	Hysteresis voltage	V_{hys}	0,2	1,4	V
Operating temperature range [a]		T_a	—	—	°C
[a] Operating temperature range shall be specified by manufacturer for various purposes.					

Table 5 – Output characteristics for 3,3 V wide range

Characteristics	Symbol	Condition	LVCMOS		Unit
			Min.	Max.	
High-level output voltage	V_{OH}	I_{OH} = -100 µA	V_{DD} – 0,2	—	V
Low-level output voltage	V_{OL}	I_{OL} = 100 µA	—	0,2	V

4.2 Specifications for 2,5 V nominal power supply voltage

4.2.1 General

These specifications apply to CMOS-compatible circuits over the full operating temperature range specified by manufacturer to be commercial, industrial, and/or military grade.

4.2.2 Absolute maximum continuous ratings

Table 6 specifies absolute maximum continuous ratings of the circuits.

Table 6 – Absolute maximum continuous ratings for nominal 2,5 V

Parameters	Symbol	Min.	Max.	Unit
Power supply voltage	V_{DD}	-0,5	3,6	V
DC input voltage	V_{IN}	-0,5	V_{DD} + 0,5 (3,6 V max)	V
DC output voltage	V_{OUT}	-0,5	V_{DD} + 0,5 (3,6 V max)	V
Storage temperature range [a]	T_{STG}	—	—	°C
[a] Storage temperature range shall be specified by manufacturer for various purposes.				

4.2.3 Normal range of operating supply voltage

Table 7 and Table 8 specify operating conditions and output characteristics for normal range power supply, respectively.

Table 7 – Operating conditions for 2,5 V normal range

Parameters		Symbol	Min.	Max.	Unit
Power supply voltage		V_{DD}	2,3	2,7	V
Normal input	High-level input voltage	V_{IH}	1,7	V_{DD} + 0,3	V
	Low-level input voltage	V_{IL}	-0,3	0,7	V
Schmitt trigger input	Positive going threshold voltage	V_{ITP}	0,9	1,7	V
	Negative going threshold voltage	V_{ITN}	0,7	1,5	V
	Hysteresis voltage	V_{hys}	0,2	1,0	V
Operating temperature range [a]		T_a	—	—	°C
[a] Operating temperature range shall be specified by manufacturer for various purposes.					

Table 8 – Output characteristics for 2,5 V normal range

Characteristics	Symbol	Condition	Min.	Max.	Unit
High-level output voltage	V_{OH}	I_{OH} = -100 µA	2,1	—	V
		I_{OH} = -1 mA	2,0	—	V
		I_{OH} = -2 mA	1,7	—	V
Low-level output voltage	V_{OL}	I_{OL} = 100 µA	—	0,2	V
		I_{OL} = 1 mA	—	0,4	V
		I_{OL} = 2 mA	—	0,7	V

4.2.4 Wide range of operating supply voltage

Table 9 and Table 10 specify operating conditions and output characteristics for wide range power supply, respectively.

Table 9 – Operating conditions for 2,5 V wide range

Parameters		Symbol	Min.	Max.	Unit
Power supply voltage		V_{DD}	1,8	2,7	V
Normal input	High-level input voltage	V_{IH}	0,7 x V_{DD}	V_{DD} + 0,3	V
	Low-level input voltage	V_{IL}	-0,3	0,2 x V_{DD}	V
Schmitt trigger input	Positive going threshold voltage	V_{ITP}	0,25 x V_{DD}	0,75 x V_{DD}	V
	Negative going threshold voltage	V_{ITN}	0,15 x V_{DD}	0,65 x V_{DD}	V
	Hysteresis voltage	V_{hys}	0,1 x V_{DD}	0,6 x V_{DD}	V
Operating temperature range [a]		T_a	—	—	°C
[a] Operating temperature range shall be specified by manufacturer for various purposes.					

Table 10 – Output characteristics for 2,5 V wide range

Characteristics	Symbol	Condition	Min.	Max.	Unit
High-level output voltage	V_{OH}	I_{OH} = -100 µA	V_{DD} – 0,2	—	V
Low-level output voltage	V_{OL}	I_{OL} = 100 µA	—	0,2	V