
M24256 and M24512 EEPROM devices: compatibility with the I²C-bus specification at 400 kHz and 1 MHz

Introduction

The I²C-bus specification, defined by NXP/Philips, defines how the I²C-bus can be used at various serial clock frequency values.

This note describes how the M24256 and M24512 EEPROM devices are compatible with the 1 MHz and 400 kHz I²C-bus specification.

Table 1. Applicable products

Device	RPN
M24256	M24256-BF
	M24256-BR
	M24256-BW
M24512	M24512-R
	M24512-W

1 M24xxx EEPROM: 400 kHz and 1 MHz clock

1.1 M24xxx 400 kHz AC tables until 2007

In the last revisions of the I²C-bus specification, defined by NXP/Philips, one can see that the 1 MHz serial clock rate was introduced in 2007:

- January 2000: the I²C-bus specification defines a clock rate of either 100 kHz, 400 kHz or 3.4 MHz^(a).
- June 2007: the I²C-bus specification defines a new table offering all timings related to the 1 MHz clock.

Before 2007, the M24xxx EEPROM devices offered by ST were specified with an AC table based on a 400 kHz (max) clock rate.

Two main differences appear when comparing the 400 kHz M24xxx AC table with the I²C-bus specification AC table (see [Table 2](#)):

- the min value of Data out hold time (t_{CLQX});
- the max value of Pulse width ignored (t_{NS}).

Table 2. Access time and Noise filter parameters specified in the 400 kHz AC table

Symbol	Alt	Parameter	M24xxx		I ² C-bus		Unit
			Min	Max	Min	Max	
t_{CLQV}	t_{AA}	Data valid time	-	900	-	900	ns
t_{CLQX}	$t_{HD:DAT}$	Data out hold time	100	-	0	-	ns
t_{NS}	t_{SP}	Pulse width ignored (input filter on SCL and SDA)	-	50 (or more)	0	50	ns

Why such differences?

The M24xxx devices are designed to offer the best performances compatible with the I²C-bus specification, that is:

- t_{CLQX}

The min value of t_{CLQX} provides a delay for the data out time (from the falling edge of the serial clock SCL: time for the data line SDA to hold the previous bit value before changing state). This min value pushes away the SDA change from the SCL falling edge: that is a safe timing condition, as SDA and SCL must never switch at the same time (such an event is a critical event for the I²C-bus, as it could be randomly decoded as either a Start, a Stop or a Data-in event).

- t_{NS}

The greater the value of t_{NS} , the better the filter can screen out spikes added on the I²C bus.

a. The 3.4 MHz clock rate is not supported by the M24xxx EEPROM.

1.2 M24xxx 1 MHz AC tables after 2007

The M24xxx devices running with a 1 MHz clock frequency were introduced by STMicroelectronics from year 2007. Here again, the M24xxx compatible with the new 1 MHz I²C-bus specification were designed with timings able to offer the best performances.

Now, when comparing the 1 MHz I²C-bus specification and the M24xxx AC table, the t_{CLQV} and t_{NS} timing values are as shown in [Table 3](#):

Table 3. Access time and Noise filter parameters specified in the 1 MHz AC table

Symbol	Alt	Parameter	M24xxx		I ² C-bus		Unit
			Min.	Max.	Min.	Max.	
t_{CLQV}	t_{AA}	Data valid time	-	500	-	450	ns
t_{CLQX}	$t_{HD:DAT}$	Data out hold time	50 (or more)	-	0	-	ns
t_{NS}	t_{SP}	Pulse width ignored (input filter on SCL and SDA)		50 (or more)	0	50	ns

- $t_{CLQX}(\text{min})$ is here again specified with a positive value (as this offers a safe timing condition, as explained for the previous 400 kHz table).
- t_{NS} is now equal or better than the value defined in the I²C-bus specification.

1.3 Compatibility of 400 kHz and 1 MHz AC timing specifications

It is important to note that:

- all M24xxx products specified at 1 MHz can run at lower frequencies, and therefore can run at 400 kHz ;
- old products designed only for the 400 kHz AC tables (AC tables before 2007) cannot run at 1 MHz.

[Table 4](#) lists the M24xxx devices that run at 400 kHz only (and hence that cannot be used in any application running at 1 MHz).

Table 4. I²C EEPROM and max operating clock frequency

	400 kHz only	400 kHz and 1 MHz
M24C01	Process letter G or S	Not significant (1 MHz not specified in the data sheet)
M24C02	Process letter G or S	Not significant (1 MHz not specified in the data sheet)
M24C04	Process letter G or S	Not significant (1 MHz not specified in the data sheet)
M24C08	Process letter G or S	Not significant (1 MHz not specified in the data sheet)
M24C16	Process letter G or S	Not significant (1 MHz not specified in the data sheet)
M24C32	Process letter P or A	Process letter K
M24C64	Process letter P or A	Process letter K
M24C128	Process letter P or A	Process letter K
M24256	Process letter A	Process letter K
M24512	Process letter A or B	Process letter K
M24M01		Process letters A and K
M24M02		Process letter K

2 Revision history

Table 5. Document revision history

Date	Revision	Changes
17-Dec-2010	1	Initial release.
21-Feb-2014	2	Revised Table 2 and Table 3 with insertion of t_{CQLX} parameter Revised Section 1.1 and Section 1.2 Revised Table 4

Please Read Carefully:

Information in this document is provided solely in connection with ST products. STMicroelectronics NV and its subsidiaries ("ST") reserve the right to make changes, corrections, modifications or improvements, to this document, and the products and services described herein at any time, without notice.

All ST products are sold pursuant to ST's terms and conditions of sale.

Purchasers are solely responsible for the choice, selection and use of the ST products and services described herein, and ST assumes no liability whatsoever relating to the choice, selection or use of the ST products and services described herein.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted under this document. If any part of this document refers to any third party products or services it shall not be deemed a license grant by ST for the use of such third party products or services, or any intellectual property contained therein or considered as a warranty covering the use in any manner whatsoever of such third party products or services or any intellectual property contained therein.

UNLESS OTHERWISE SET FORTH IN ST'S TERMS AND CONDITIONS OF SALE ST DISCLAIMS ANY EXPRESS OR IMPLIED WARRANTY WITH RESPECT TO THE USE AND/OR SALE OF ST PRODUCTS INCLUDING WITHOUT LIMITATION IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE (AND THEIR EQUIVALENTS UNDER THE LAWS OF ANY JURISDICTION), OR INFRINGEMENT OF ANY PATENT, COPYRIGHT OR OTHER INTELLECTUAL PROPERTY RIGHT.

ST PRODUCTS ARE NOT DESIGNED OR AUTHORIZED FOR USE IN: (A) SAFETY CRITICAL APPLICATIONS SUCH AS LIFE SUPPORTING, ACTIVE IMPLANTED DEVICES OR SYSTEMS WITH PRODUCT FUNCTIONAL SAFETY REQUIREMENTS; (B) AERONAUTIC APPLICATIONS; (C) AUTOMOTIVE APPLICATIONS OR ENVIRONMENTS, AND/OR (D) AEROSPACE APPLICATIONS OR ENVIRONMENTS. WHERE ST PRODUCTS ARE NOT DESIGNED FOR SUCH USE, THE PURCHASER SHALL USE PRODUCTS AT PURCHASER'S SOLE RISK, EVEN IF ST HAS BEEN INFORMED IN WRITING OF SUCH USAGE, UNLESS A PRODUCT IS EXPRESSLY DESIGNATED BY ST AS BEING INTENDED FOR "AUTOMOTIVE, AUTOMOTIVE SAFETY OR MEDICAL" INDUSTRY DOMAINS ACCORDING TO ST PRODUCT DESIGN SPECIFICATIONS. PRODUCTS FORMALLY ESCC, QML OR JAN QUALIFIED ARE DEEMED SUITABLE FOR USE IN AEROSPACE BY THE CORRESPONDING GOVERNMENTAL AGENCY.

Resale of ST products with provisions different from the statements and/or technical features set forth in this document shall immediately void any warranty granted by ST for the ST product or service described herein and shall not create or extend in any manner whatsoever, any liability of ST.

ST and the ST logo are trademarks or registered trademarks of ST in various countries.

Information in this document supersedes and replaces all information previously supplied.

The ST logo is a registered trademark of STMicroelectronics. All other names are the property of their respective owners.

© 2014 STMicroelectronics - All rights reserved

STMicroelectronics group of companies

Australia - Belgium - Brazil - Canada - China - Czech Republic - Finland - France - Germany - Hong Kong - India - Israel - Italy - Japan - Malaysia - Malta - Morocco - Philippines - Singapore - Spain - Sweden - Switzerland - United Kingdom - United States of America

www.st.com