



# M24512-x M24256-Bx

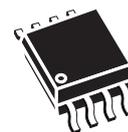
512 Kbit and 256 Kbit serial I<sup>2</sup>C bus EEPROM  
with three Chip Enable lines

## Features

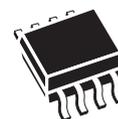
- Supports the I<sup>2</sup>C bus 100 kHz Standard-mode, 400 kHz Fast-mode and 1 MHz Fast-mode Plus
- Supply voltage ranges:
  - 1.7 V to 5.5 V (M24256-BF)
  - 1.8 V to 5.5 V (M24xxx-R)
  - 2.5 V to 5.5 V (M24xxx-W)
- Write Control input
- Byte and Page Write
- Random and sequential read modes
- Self-timed programming cycle
- Automatic address incrementing
- Enhanced ESD/latch-up protection
- More than 1 000 000 write cycles
- More than 40-year data retention
- Packages
  - ECOPACK<sup>®</sup> (RoHS compliant)

**Table 1. Device summary**

Reference	Part numbers
M24512-x	M24512-R, M24512-HR, M24512-W
M24256-Bx	M24256-BF, M24256-BR, M24256-BHR, M24256-BW



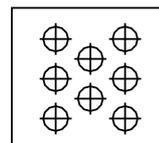
SO8 (MW)  
208 mils width



SO8 (MN)  
150 mils width



TSSOP8 (DW)



WLCSP (CS)

# 1 Description

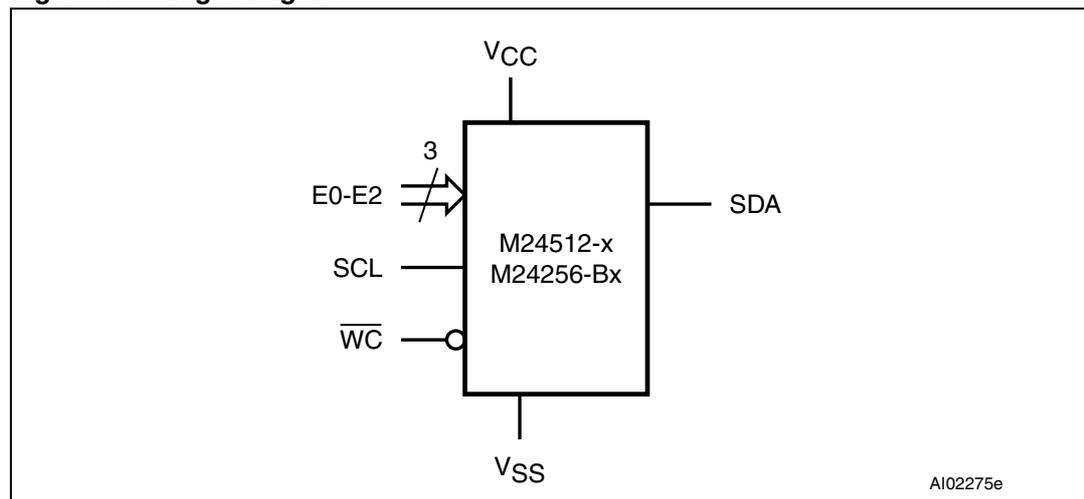
The M24512-W, M24512-R, M24512-HR, M24256-BF, M24256-BW, M24256-BR and M24256-BHR devices are I<sup>2</sup>C-compatible electrically erasable programmable memories (EEPROM). They are organized as 64 Kb × 8 bits and 32 Kb × 8 bits, respectively.

I<sup>2</sup>C uses a two-wire serial interface, comprising a bidirectional data line and a clock line. The devices carry a built-in 4-bit Device Type Identifier code (1010) in accordance with the I<sup>2</sup>C bus definition.

The device behaves as a slave in the I<sup>2</sup>C protocol, with all memory operations synchronized by the serial clock. Read and Write operations are initiated by a Start condition, generated by the bus master. The Start condition is followed by a device select code and Read/Write bit ( $\overline{RW}$ ) (as described in [Table 3](#)), terminated by an acknowledge bit.

When writing data to the memory, the device inserts an acknowledge bit during the 9<sup>th</sup> bit time, following the bus master's 8-bit transmission. When data is read by the bus master, the bus master acknowledges the receipt of the data byte in the same way. Data transfers are terminated by a Stop condition after an Ack for Write, and after a NoAck for Read.

**Figure 1. Logic diagram**



**Table 2. Signal names**

Signal name	Function	Direction
E0, E1, E2	Chip Enable	Inputs
SDA	Serial Data	I/O
SCL	Serial Clock	Input
$\overline{WC}$	Write Control	Input
V <sub>CC</sub>	Supply voltage	
V <sub>SS</sub>	Ground	

## 4 Initial delivery state

The device is delivered with all bits in the memory array set to 1 (each byte contains FFh).

## 5 Maximum rating

Stressing the device outside the ratings listed in [Table 7](#) may cause permanent damage to the device. These are stress ratings only, and operation of the device at these, or any other conditions outside those indicated in the operating sections of this specification, is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability. Refer also to the STMicroelectronics SURE Program and other relevant quality documents.

**Table 7. Absolute maximum ratings**

Symbol	Parameter	Min.	Max.	Unit
$T_A$	Ambient operating temperature	-40	130	°C
$T_{STG}$	Storage temperature	-65	150	°C
$T_{LEAD}$	Lead temperature during soldering	See note <sup>(1)</sup>		°C
$V_{IO}$	Input or output range	-0.50	$V_{CC} + 0.6$	V
$V_{CC}$	Supply voltage	-0.50	6.5	V
$V_{ESD}$	Electrostatic discharge voltage (human body model) <sup>(2)</sup>	-4000	4000	V

1. Compliant with JEDEC Std J-STD-020D (for small body, Sn-Pb or Pb assembly), the ST ECOPACK<sup>®</sup> 7191395 specification, and the European directive on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS) 2002/95/EC.

2. AEC-Q100-002 (compliant with JEDEC Std JESD22-A114, C1 = 100 pF, R1 = 1500  $\Omega$ , R2 = 500  $\Omega$ )

## 6 DC and AC parameters

This section summarizes the operating and measurement conditions, and the dc and ac characteristics of the device. The parameters in the DC and AC characteristic tables that follow are derived from tests performed under the measurement conditions summarized in the relevant tables. Designers should check that the operating conditions in their circuit match the measurement conditions when relying on the quoted parameters.

**Table 8. Operating conditions (M24xxx-W)**

Symbol	Parameter	Min.	Max.	Unit
$V_{CC}$	Supply voltage	2.5	5.5	V
$T_A$	Ambient operating temperature (device grade 6)	-40	85	°C
	Ambient operating temperature (device grade 3)	-40	125	°C

**Table 9. Operating conditions (M24xxx-R and M24xxx-HR)**

Symbol	Parameter	Min.	Max.	Unit
$V_{CC}$	Supply voltage	1.8	5.5	V
$T_A$	Ambient operating temperature	-40	85	°C

**Table 10. Operating conditions (M24256-BF)**

Symbol	Parameter	Min.	Max.	Unit
$V_{CC}$	Supply voltage	1.7	5.5	V
$T_A$	Ambient operating temperature	-40	85	°C

**Table 11. AC test measurement conditions**

Symbol	Parameter	Min.	Max.	Unit
$C_L$	Load capacitance	100		pF
	Input rise and fall times		50	ns
	Input levels	0.2 $V_{CC}$ to 0.8 $V_{CC}$		V
	Input and output timing reference levels	0.3 $V_{CC}$ to 0.7 $V_{CC}$		V

**Figure 12. AC test measurement I/O waveform**

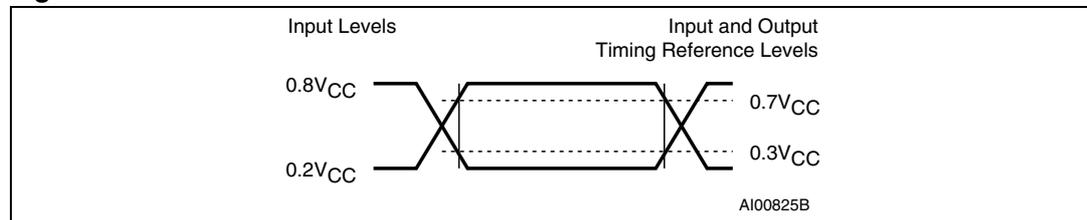


Table 12. Input parameters

Symbol	Parameter <sup>(1)</sup>	Test condition	Min.	Max.	Unit
$C_{IN}$	Input capacitance (SDA)			8	pF
$C_{IN}$	Input capacitance (other pins)			6	pF
$Z_L^{(2)}$	Input impedance (E2, E1, E0, $\overline{WC}$ )	$V_{IN} < 0.3V_{CC}$	30		k $\Omega$
$Z_H^{(2)}$	Input impedance (E2, E1, E0, $\overline{WC}$ )	$V_{IN} > 0.7V_{CC}$	500		k $\Omega$

1. Sampled only, not 100% tested.

2. E2,E1,E0: Input impedance when the memory is selected (after a Start condition).

Table 13. DC characteristics (M24xxx-W)

Symbol	Parameter	Test conditions (see Table 8 and Table 11)	Min.	Max.	Unit
$I_{LI}$	Input leakage current (SCL, SDA, E0, E1, E2)	$V_{IN} = V_{SS}$ or $V_{CC}$ device in Standby mode		$\pm 2$	$\mu A$
$I_{LO}$	Output leakage current	SDA in Hi-Z, external voltage applied on SDA: $V_{SS}$ or $V_{CC}$		$\pm 2$	$\mu A$
$I_{CC}$	Supply current (Read)	$V_{CC} = 2.5 V$ , $f_c = 400 kHz$ (rise/fall time < 50 ns)		1	mA
		$V_{CC} = 5.5 V$ , $f_c = 400 kHz$ (rise/fall time < 50 ns)		2	mA
$I_{CC0}$	Supply current (Write)	During $t_W$ , $2.5 V < V_{CC} < 5.5 V$		5 <sup>(1)</sup>	mA
$I_{CC1}$	Standby supply current	Device not selected <sup>(2)</sup> , $V_{IN} = V_{SS}$ or $V_{CC}$ , $V_{CC} = 2.5 V$	Device grade 3	5	$\mu A$
			Device grade 6	2	
		$V_{IN} = V_{SS}$ or $V_{CC}$ , $V_{CC} = 5.5 V$		5	$\mu A$
$V_{IL}$	Input low voltage (SCL, SDA, $\overline{WC}$ )		-0.45	$0.3V_{CC}$	V
$V_{IH}$	Input high voltage (SCL, SDA, $\overline{WC}$ )		$0.7V_{CC}$	$V_{CC}+0.6$	V
$V_{OL}$	Output low voltage	$I_{OL} = 2.1 mA$ , $V_{CC} = 2.5 V$		0.4	V

1. Characterized value, not tested in production.

2. The device is not selected after power-up, after a READ command (after the Stop condition), or after the completion of the internal write cycle  $t_W$  ( $t_W$  is triggered by the correct decoding of a WRITE command).

**Table 16. AC characteristics (M24xxx-W, M24xxx-R, M24256-BF see [Table 8](#), [Table 9](#), [Table 10](#) and [Table 11](#))**

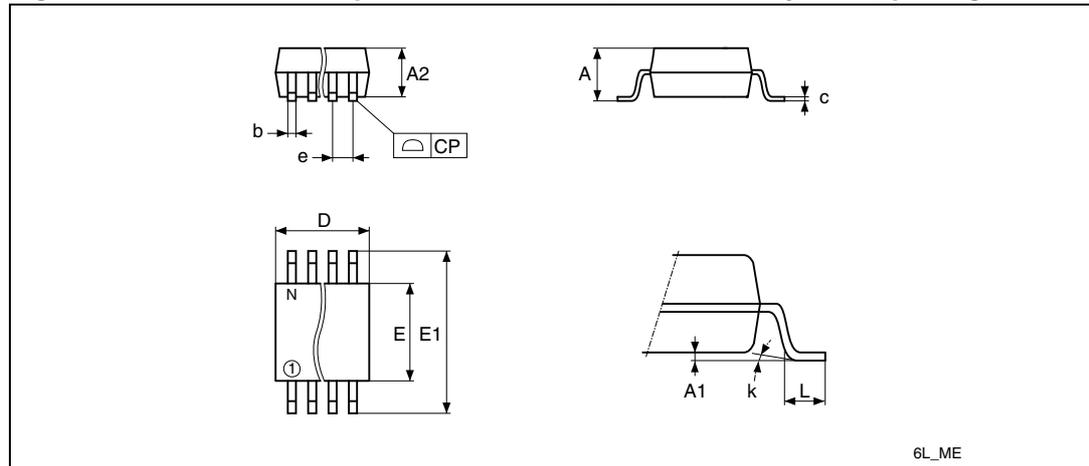
Symbol	Alt.	Parameter	Min.	Max.	Unit
$f_C$	$f_{SCL}$	Clock frequency		400	kHz
$t_{CHCL}$	$t_{HIGH}$	Clock pulse width high	600		ns
$t_{CLCH}$	$t_{LOW}$	Clock pulse width low	1300		ns
$t_{DL1DL2}^{(1)}$	$t_F$	SDA (out) fall time	20	100	ns
$t_{XH1XH2}^{(2)}$	$t_R$	Input signal rise time	20	300	ns
$t_{XL1XL2}^{(2)}$	$t_F$	Input signal fall time	20	300	ns
$t_{DXCX}$	$t_{SU:DAT}$	Data in set up time	100		ns
$t_{CLDX}$	$t_{HD:DAT}$	Data in hold time	0		ns
$t_{CLQX}$	$t_{DH}$	Data out hold time	200		ns
$t_{CLQV}^{(3)}$	$t_{AA}$	Clock low to next data valid (access time)	200	900	ns
$t_{CHDX}^{(4)}$	$t_{SU:STA}$	Start condition set up time	600		ns
$t_{DLCL}$	$t_{HD:STA}$	Start condition hold time	600		ns
$t_{CHDH}$	$t_{SU:STO}$	Stop condition set up time	600		ns
$t_{DHDL}$	$t_{BUF}$	Time between Stop condition and next Start condition	1300		ns
$t_W$	$t_{WR}$	Write time		5	ms
$t_{NS}$		Pulse width ignored (input filter on SCL and SDA) - single glitch		100	ns

1. Sampled only, not 100% tested.
2. Values recommended by I<sup>2</sup>C-bus/Fast-Mode specification.
3. To avoid spurious Start and Stop conditions, a minimum delay is placed between SCL=1 and the falling or rising edge of SDA.
4. For a re-Start condition, or following a Write cycle.

## 7 Package mechanical data

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK<sup>®</sup> packages, depending on their level of environmental compliance. ECOPACK<sup>®</sup> specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK<sup>®</sup> is an ST trademark.

**Figure 14. SO8W – 8-lead plastic small outline, 208 mils body width, package outline**



1. Drawing is not to scale.

**Table 18. SO8W – 8-lead plastic small outline, 208 mils body width, package data**

Symbol	millimeters			inches <sup>(1)</sup>		
	Typ	Min	Max	Typ	Min	Max
A			2.5			0.0984
A1		0	0.25		0	0.0098
A2		1.51	2		0.0594	0.0787
b	0.4	0.35	0.51	0.0157	0.0138	0.0201
c	0.2	0.1	0.35	0.0079	0.0039	0.0138
CP			0.1			0.0039
D			6.05			0.2382
E		5.02	6.22		0.1976	0.2449
E1		7.62	8.89		0.3	0.35
e	1.27	-	-	0.05	-	-
k		0°	10°		0°	10°
L		0.5	0.8		0.0197	0.0315
N (number of pins)	8			8		

1. Values in inches are converted from mm and rounded to 4 decimal digits.

# 8 Part numbering

**Table 22. Ordering information scheme**

Example:	M24512-	H	W	MW	6	T	P	/AB
<b>Device type</b> M24 = I <sup>2</sup> C serial access EEPROM								
<b>Device function</b> 512- = 512 Kbit (64 Kb × 8) 256-B = 256 Kbit (32 Kb × 8)								
<b>Clock frequency</b> Blank: f <sub>C</sub> max = 400 kHz H: f <sub>C</sub> max = 1 MHz								
<b>Operating voltage</b> W = V <sub>CC</sub> = 2.5 to 5.5 V R = V <sub>CC</sub> = 1.8 to 5.5 V F = V <sub>CC</sub> = 1.7 to 5.5 V								
<b>Package</b> MW = SO8 (208 mils width) MN = SO8 (150 mils body width) DW = TSSOP8 CS = WLCSP								
<b>Device grade</b> 6 = Industrial temperature range, -40 to 85 °C. Device tested with standard test flow 3 = Automotive: device tested with high reliability certified flow <sup>(1)</sup> over -40 to 125 °C								
<b>Option</b> blank = standard packing T = tape and reel packing								
<b>Plating technology</b> P or G = ECOPACK® (RoHS compliant)								
<b>Process<sup>(2)</sup></b> /A = F8L in CSP package /AB = F8L for device grade 3								

1. ST strongly recommends the use of the Automotive Grade devices for use in an automotive environment. The High Reliability Certified Flow (HRCF) is described in the quality note QNEE9801. Please ask your nearest ST sales office for a copy.
2. Used only for device grade 3 and WLCSP packages.