



## M27C322

### 32 Mbit (2Mb x16) UV EPROM and OTP EPROM

- 5V  $\pm$  10% SUPPLY VOLTAGE in READ OPERATION
- ACCESS TIME: 80ns
- WORD-WIDE CONFIGURABLE
- 32 Mbit MASK ROM REPLACEMENT
- LOW POWER CONSUMPTION
  - Active Current 50mA at 5MHz
  - Stand-by Current 100 $\mu$ A
- PROGRAMMING VOLTAGE: 12V  $\pm$  0.25V
- PROGRAMMING TIME: 50 $\mu$ s/word
- ELECTRONIC SIGNATURE
  - Manufacturer Code: 0020h
  - Device Code: 0034h

#### DESCRIPTION

The M27C322 is a 32 Mbit EPROM offered in the UV range (ultra violet erase). It is ideally suited for microprocessor systems requiring large data or program storage. It is organised as 2 MWords of 16 bit. The pin-out is compatible with a 32 Mbit Mask ROM.

The FDIP42W (window ceramic frit-seal package) has a transparent lid which allows the user to expose the chip to ultraviolet light to erase the bit pattern. A new pattern can then be written rapidly to the device by following the programming procedure.

For applications where the content is programmed only one time and erasure is not required, the M27C322 is offered in PDIP42 package.

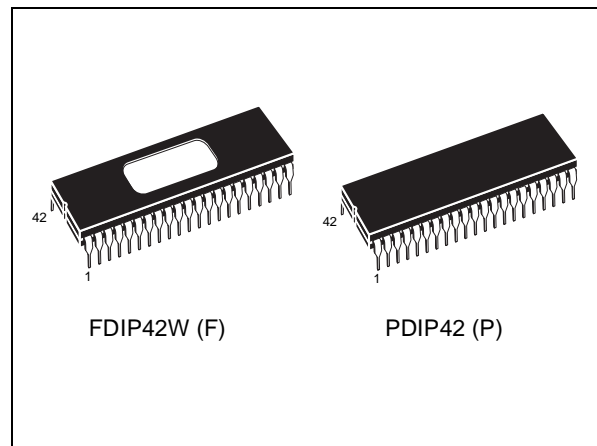


Figure 1. Logic Diagram

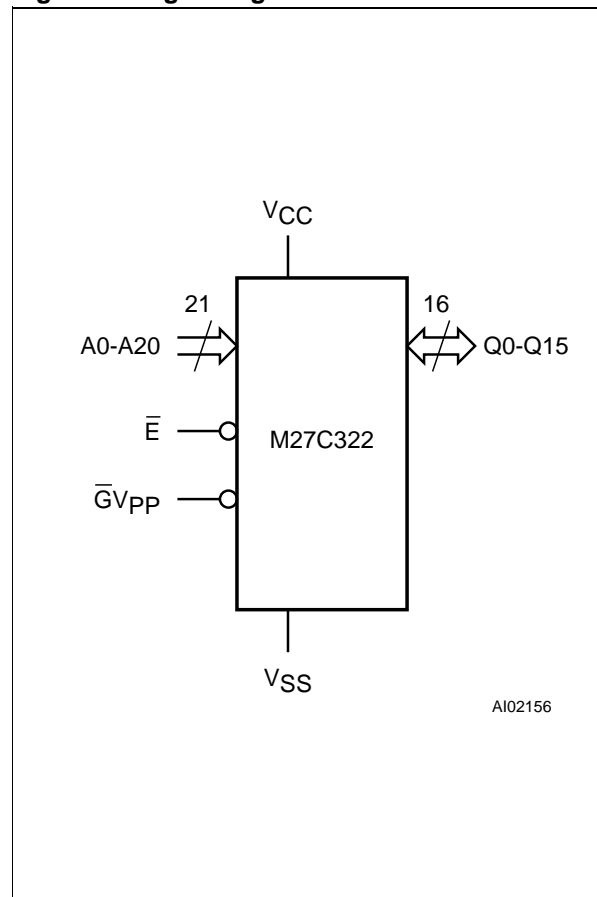
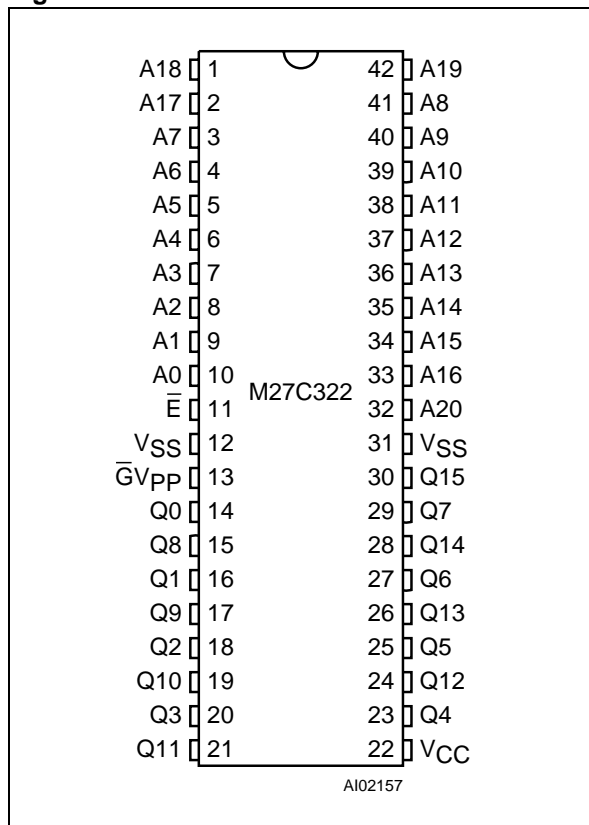


Figure 2A. DIP Connections



## DEVICE OPERATION

The operating modes of the M27C322 are listed in the Operating Modes Table. A single power supply is required in the read mode. All inputs are TTL compatible except for  $V_{PP}$  and 12V on A9 for the Electronic Signature.

### Read Mode

The M27C322 has a word-wide organization. Chip Enable ( $\bar{E}$ ) is the power control and should be used for device selection. Output Enable ( $\bar{G}$ ) is the output control and should be used to gate data to the output pins independent of device selection. Assuming that the addresses are stable, the address access time ( $t_{AVQV}$ ) is equal to the delay

Table 1. Signal Names

A0-A20	Address Inputs
Q0-Q15	Data Outputs
$\bar{E}$	Chip Enable
$\bar{G}V_{PP}$	Output Enable / Program Supply
$V_{CC}$	Supply Voltage
$V_{SS}$	Ground

from  $\bar{E}$  to output ( $t_{ELQV}$ ). Data is available at the output after a delay of  $t_{GLQV}$  from the falling edge of  $\bar{G}V_{PP}$ , assuming that  $\bar{E}$  has been low and the addresses have been stable for at least  $t_{AVQV} - t_{GLQV}$ .

### Standby Mode

The M27C322 has a standby mode which reduces the supply current from 50mA to 100 $\mu$ A. The M27C322 is placed in the standby mode by applying a CMOS high signal to the  $\bar{E}$  input. When in the standby mode, the outputs are in a high impedance state, independent of the  $\bar{G}V_{PP}$  input.

### Two Line Output Control

Because EPROMs are usually used in larger memory arrays, this product features a 2 line control function which accommodates the use of multiple memory connection. The two line control function allows:

- the lowest possible memory power dissipation,
- complete assurance that output bus contention will not occur.

For the most efficient use of these two control lines,  $\bar{E}$  should be decoded and used as the primary device selecting function, while  $\bar{G}V_{PP}$  should be made a common connection to all devices in the array and connected to the READ line from the system control bus. This ensures that all deselected memory devices are in their low power standby mode and that the output pins are only active when data is required from a particular memory device.

**Table 2. Absolute Maximum Ratings <sup>(1)</sup>**

Symbol	Parameter	Value	Unit
T <sub>A</sub>	Ambient Operating Temperature <sup>(3)</sup>	–40 to 125	°C
T <sub>BIAS</sub>	Temperature Under Bias	–50 to 125	°C
T <sub>STG</sub>	Storage Temperature	–65 to 150	°C
V <sub>IO</sub> <sup>(2)</sup>	Input or Output Voltage (except A9)	–2 to 7	V
V <sub>CC</sub>	Supply Voltage	–2 to 7	V
V <sub>A9</sub> <sup>(2)</sup>	A9 Voltage	–2 to 13.5	V
V <sub>PP</sub>	Program Supply Voltage	–2 to 14	V

Note: 1. Except for the rating "Operating Temperature Range", stresses above those listed in the Table "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only and operation of the device at these or any other conditions above 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.

2. Minimum DC voltage on Input or Output is –0.5V with possible undershoot to –2.0V for a period less than 20ns. Maximum DC voltage on Output is V<sub>CC</sub> +0.5V with possible overshoot to V<sub>CC</sub> +2V for a period less than 20ns.

3. Depends on range.

**Table 3. Operating Modes**

Mode	$\bar{E}$	$\bar{GV}_{PP}$	A9	Q15-Q0
Read	V <sub>IL</sub>	V <sub>IL</sub>	X	Data Out
Output Disable	V <sub>IL</sub>	V <sub>IH</sub>	X	Hi-Z
Program	V <sub>IL</sub> Pulse	V <sub>PP</sub>	X	Data In
Program Inhibit	V <sub>IH</sub>	V <sub>PP</sub>	X	Hi-Z
Standby	V <sub>IH</sub>	X	X	Hi-Z
Electronic Signature	V <sub>IL</sub>	V <sub>IL</sub>	V <sub>ID</sub>	Codes

Note: X = V<sub>IH</sub> or V<sub>IL</sub>, V<sub>ID</sub> = 12V ± 0.5V.

**Table 4. Electronic Signature**

Identifier	A0	Q7	Q6	Q5	Q4	Q3	Q2	Q1	Q0	Hex Data
Manufacturer's Code	V <sub>IL</sub>	0	0	1	0	0	0	0	0	20h
Device Code	V <sub>IH</sub>	0	0	1	1	0	1	0	0	34h

Note: Outputs Q15-Q8 are set to '0'.

Table 5. AC Measurement Conditions

	High Speed	Standard
Input Rise and Fall Times	$\leq 10\text{ns}$	$\leq 20\text{ns}$
Input Pulse Voltages	0 to 3V	0.4V to 2.4V
Input and Output Timing Ref. Voltages	1.5V	0.8V and 2V

Figure 3. AC Testing Input Output Waveform

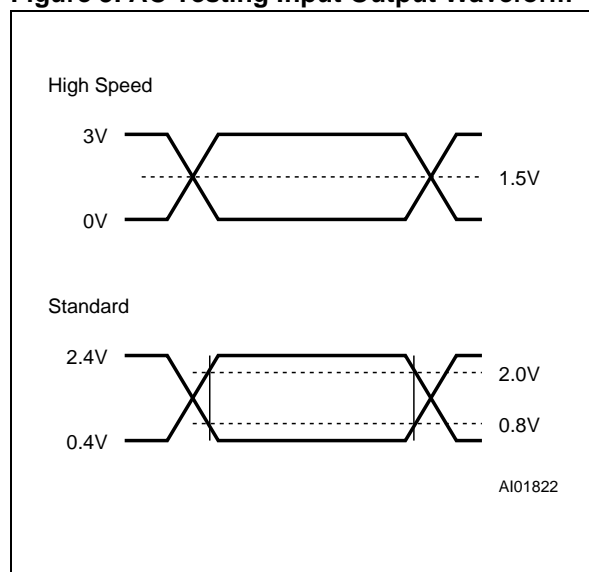
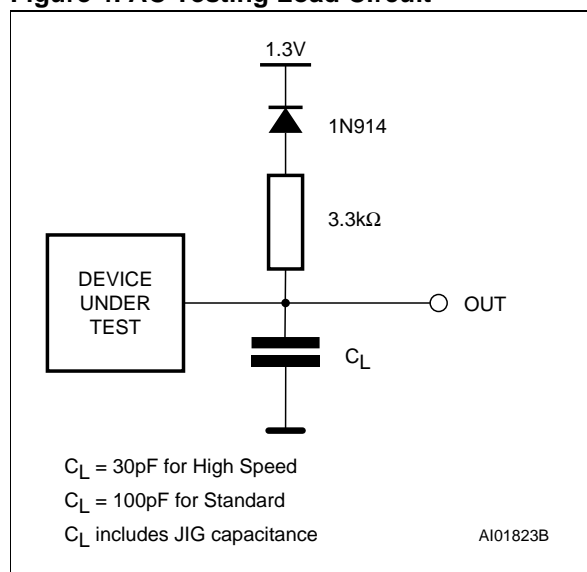


Figure 4. AC Testing Load Circuit

Table 6. Capacitance <sup>(1)</sup> ( $T_A = 25^\circ\text{C}$ ,  $f = 1\text{ MHz}$ )

Symbol	Parameter	Test Condition	Min	Max	Unit
$C_{IN}$	Input Capacitance	$V_{IN} = 0V$		10	pF
$C_{OUT}$	Output Capacitance	$V_{OUT} = 0V$		12	pF

Note: 1. Sampled only, not 100% tested.

### System Considerations

The power switching characteristics of Advanced CMOS EPROMs require careful decoupling of the supplies to the devices. The supply current  $I_{CC}$  has three segments of importance to the system designer: the standby current, the active current and the transient peaks that are produced by the falling and rising edges of  $\bar{E}$ . The magnitude of the transient current peaks is dependent on the capacitive and inductive loading of the device outputs. The associated transient voltage peaks can be suppressed by complying with the two line out-

put control and by properly selected decoupling capacitors. It is recommended that a  $0.1\mu\text{F}$  ceramic capacitor is used on every device between  $V_{CC}$  and  $V_{SS}$ . This should be a high frequency type of low inherent inductance and should be placed as close as possible to the device. In addition, a  $4.7\mu\text{F}$  electrolytic capacitor should be used between  $V_{CC}$  and  $V_{SS}$  for every eight devices. This capacitor should be mounted near the power supply connection point. The purpose of this capacitor is to overcome the voltage drop caused by the inductive effects of PCB traces.

**Table 7. Read Mode DC Characteristics <sup>(1)</sup>**(T<sub>A</sub> = 0 to 70 °C, -40 to 85 °C or -40 to 125 °C; V<sub>CC</sub> = 5V ± 10%; V<sub>PP</sub> = V<sub>CC</sub>)

Symbol	Parameter	Test Condition	Min	Max	Unit
I <sub>LI</sub>	Input Leakage Current	0V ≤ V <sub>IN</sub> ≤ V <sub>CC</sub>		±1	μA
I <sub>LO</sub>	Output Leakage Current	0V ≤ V <sub>OUT</sub> ≤ V <sub>CC</sub>		±10	μA
I <sub>CC</sub>	Supply Current	$\bar{E} = V_{IL}, \bar{G}V_{PP} = V_{IL}, I_{OUT} = 0mA, f = 8MHz$		70	mA
		$\bar{E} = V_{IL}, \bar{G}V_{PP} = V_{IL}, I_{OUT} = 0mA, f = 5MHz$		50	mA
I <sub>CC1</sub>	Supply Current (Standby) TTL	$\bar{E} = V_{IH}$		1	mA
I <sub>CC2</sub>	Supply Current (Standby) CMOS	$\bar{E} > V_{CC} - 0.2V$		100	μA
I <sub>PP</sub>	Program Current	V <sub>PP</sub> = V <sub>CC</sub>		10	μA
V <sub>IL</sub>	Input Low Voltage		-0.3	0.8	V
V <sub>IH</sub> <sup>(2)</sup>	Input High Voltage		2	V <sub>CC</sub> + 1	V
V <sub>OL</sub>	Output Low Voltage	I <sub>OL</sub> = 2.1mA		0.4	V
V <sub>OH</sub>	Output High Voltage TTL	I <sub>OH</sub> = -400μA	2.4		V

Note: 1. V<sub>CC</sub> must be applied simultaneously with or before V<sub>PP</sub> and removed simultaneously or after V<sub>PP</sub>.2. Maximum DC voltage on Output is V<sub>CC</sub> + 0.5V.**Table 8. Read Mode AC Characteristics <sup>(1)</sup>**(T<sub>A</sub> = 0 to 70 °C, -40 to 85 °C or -40 to 125 °C; V<sub>CC</sub> = 5V ± 10%; V<sub>PP</sub> = V<sub>CC</sub>)

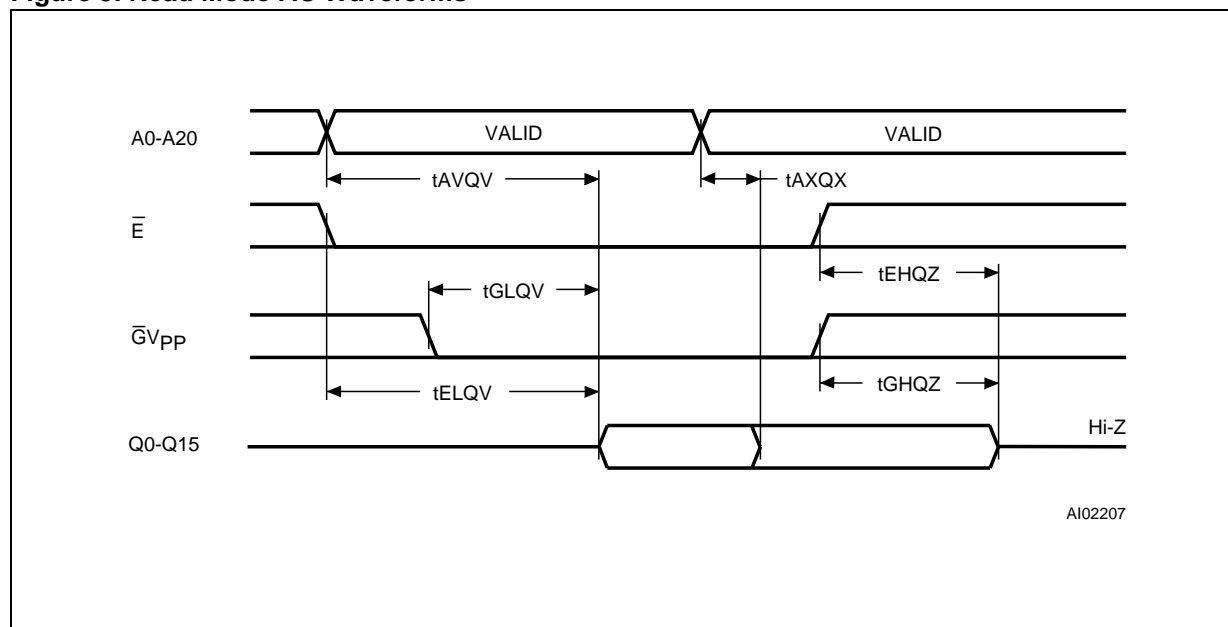
Symbol	Alt	Parameter	Test Condition	M27C322				Unit
				-80 <sup>(3)</sup>		-100		
				Min	Max	Min	Max	
t <sub>AVQV</sub>	t <sub>ACC</sub>	Address Valid to Output Valid	$\overline{E} = V_{IL}, \overline{G}V_{PP} = V_{IL}$		80		100	ns
t <sub>ELQV</sub>	t <sub>CE</sub>	Chip Enable Low to Output Valid	$\overline{G}V_{PP} = V_{IL}$		80		100	ns
t <sub>GLQV</sub>	t <sub>OE</sub>	Output Enable Low to Output Valid	$\overline{E} = V_{IL}$		40		50	ns
t <sub>EHQZ</sub> <sup>(2)</sup>	t <sub>DF</sub>	Chip Enable High to Output Hi-Z	$\overline{G}V_{PP} = V_{IL}$	0	40	0	40	ns
t <sub>GHQZ</sub> <sup>(2)</sup>	t <sub>DF</sub>	Output Enable High to Output Hi-Z	$\overline{E} = V_{IL}$	0	40	0	40	ns
t <sub>AXQX</sub>	t <sub>OH</sub>	Address Transition to Output Transition	$\overline{E} = V_{IL}, \overline{G}V_{PP} = V_{IL}$	5		5		ns

Note: 1. V<sub>CC</sub> must be applied simultaneously with or before V<sub>PP</sub> and removed simultaneously or after V<sub>PP</sub>

2. Sampled only, not 100% tested.

3. Speed obtained with High Speed AC measurement conditions.

Figure 5. Read Mode AC Waveforms

Table 9. Programming Mode DC Characteristics <sup>(1)</sup>(T<sub>A</sub> = 25 °C; V<sub>CC</sub> = 6.25V ± 0.25V; V<sub>PP</sub> = 12V ± 0.25V)

Symbol	Parameter	Test Condition	Min	Max	Unit
I <sub>LI</sub>	Input Leakage Current	V <sub>IL</sub> ≤ V <sub>IN</sub> ≤ V <sub>IH</sub>		±10	μA
I <sub>CC</sub>	Supply Current			50	mA
I <sub>PP</sub>	Program Current	$\bar{E} = V_{IL}$		50	mA
V <sub>IL</sub>	Input Low Voltage		-0.3	0.8	V
V <sub>IH</sub>	Input High Voltage		2.4	V <sub>CC</sub> + 0.5	V
V <sub>OL</sub>	Output Low Voltage	I <sub>OL</sub> = 2.1mA		0.4	V
V <sub>OH</sub>	Output High Voltage TTL	I <sub>OH</sub> = -2.5mA	3.5		V
V <sub>ID</sub>	A9 Voltage		11.5	12.5	V

Note: 1. V<sub>CC</sub> must be applied simultaneously with or before V<sub>PP</sub> and removed simultaneously or after V<sub>PP</sub>.

**Table 10. MARGIN MODE AC Characteristics <sup>(1)</sup>**(T<sub>A</sub> = 25 °C; V<sub>CC</sub> = 6.25V ± 0.25V; V<sub>PP</sub> = 12V ± 0.25V)

Symbol	Alt	Parameter	Test Condition	Min	Max	Unit
t <sub>A9HVP</sub>	t <sub>AS9</sub>	V <sub>A9</sub> High to V <sub>PP</sub> High		2		μs
t <sub>VPHEL</sub>	t <sub>VPS</sub>	V <sub>PP</sub> High to Chip Enable Low		2		μs
t <sub>A10HEH</sub>	t <sub>AS10</sub>	V <sub>A10</sub> High to Chip Enable High (Set)		1		μs
t <sub>A10LEH</sub>	t <sub>AS10</sub>	V <sub>A10</sub> Low to Chip Enable High (Reset)		1		μs
t <sub>EXA10X</sub>	t <sub>AH10</sub>	Chip Enable Transition to V <sub>A10</sub> Transition		1		μs
t <sub>EXVPX</sub>	t <sub>VPH</sub>	Chip Enable Transition to V <sub>PP</sub> Transition		2		μs
t <sub>VXA9X</sub>	t <sub>AH9</sub>	V <sub>PP</sub> Transition to V <sub>A9</sub> Transition		2		μs

Note: 1. V<sub>CC</sub> must be applied simultaneously with or before V<sub>PP</sub> and removed simultaneously or after V<sub>PP</sub>.**Table 11. Programming Mode AC Characteristics <sup>(1)</sup>**(T<sub>A</sub> = 25 °C; V<sub>CC</sub> = 6.25V ± 0.25V; V<sub>PP</sub> = 12V ± 0.25V)

Symbol	Alt	Parameter	Test Condition	Min	Max	Unit
t <sub>AVEL</sub>	t <sub>AS</sub>	Address Valid to Chip Enable Low		1		μs
t <sub>QVEL</sub>	t <sub>DS</sub>	Input Valid to Chip Enable Low		1		μs
t <sub>VCHL</sub>	t <sub>VCS</sub>	V <sub>CC</sub> High to Chip Enable Low		2		μs
t <sub>VPHEL</sub>	t <sub>OES</sub>	V <sub>PP</sub> High to Chip Enable Low		1		μs
t <sub>VPLVPH</sub>	t <sub>PRT</sub>	V <sub>PP</sub> Rise Time		50		ns
t <sub>ELEH</sub>	t <sub>PW</sub>	Chip Enable Program Pulse Width (Initial)		45	55	μs
t <sub>EHQX</sub>	t <sub>DH</sub>	Chip Enable High to Input Transition		2		μs
t <sub>EHVPX</sub>	t <sub>OEH</sub>	Chip Enable High to V <sub>PP</sub> Transition		2		μs
t <sub>VPLEL</sub>	t <sub>VR</sub>	V <sub>PP</sub> Low to Chip Enable Low		1		μs
t <sub>ELQV</sub>	t <sub>DV</sub>	Chip Enable Low to Output Valid			1	μs
t <sub>EHQZ</sub> <sup>(2)</sup>	t <sub>DFP</sub>	Chip Enable High to Output Hi-Z		0	130	ns
t <sub>EHAX</sub>	t <sub>AH</sub>	Chip Enable High to Address Transition		0		ns

Note: 1. V<sub>CC</sub> must be applied simultaneously with or before V<sub>PP</sub> and removed simultaneously or after V<sub>PP</sub>.

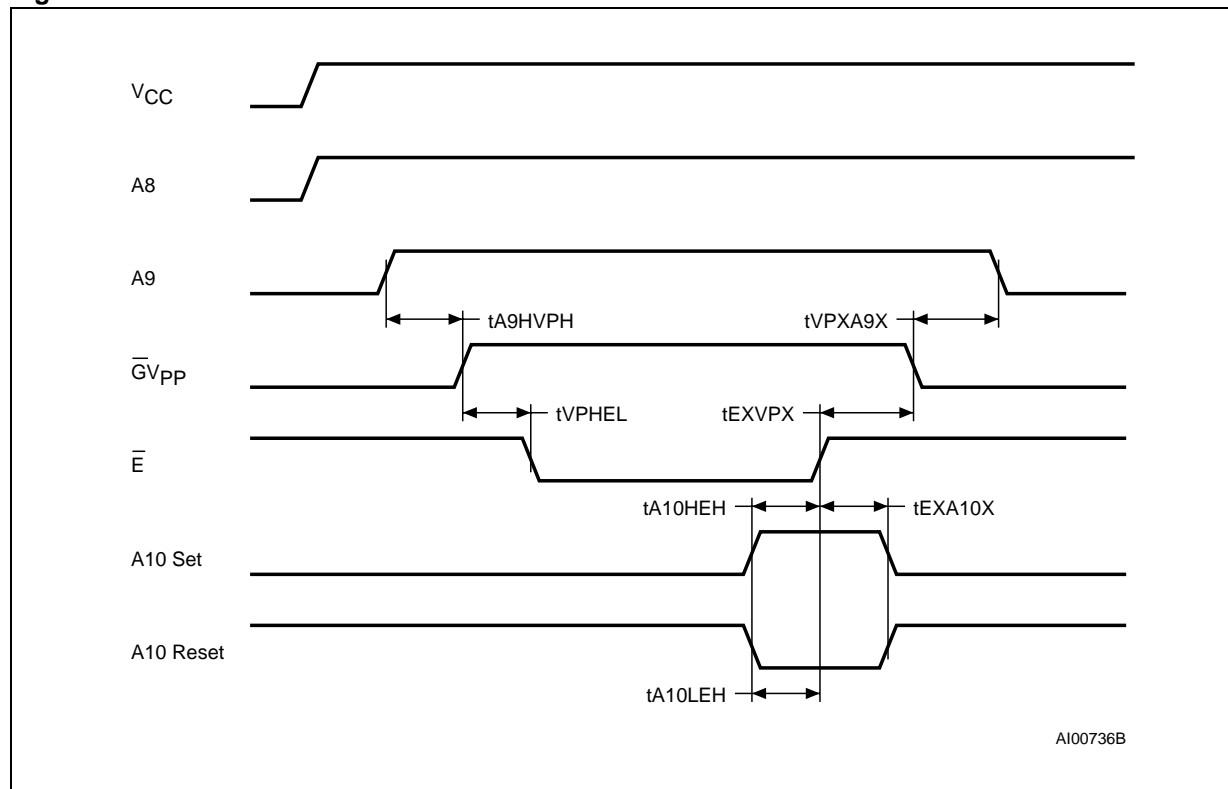
2. Sampled only, not 100% tested.

## Programming

When delivered (and after each erasure for UV EPROM), all bits of the M27C322 are in the "1" state. Data is introduced by selectively programming "0"s into the desired bit locations. Although only "0"s will be programmed, both "1"s and "0"s can be present in the data word. The only way to change a "0" to a "1" is by die exposition to ultravi-

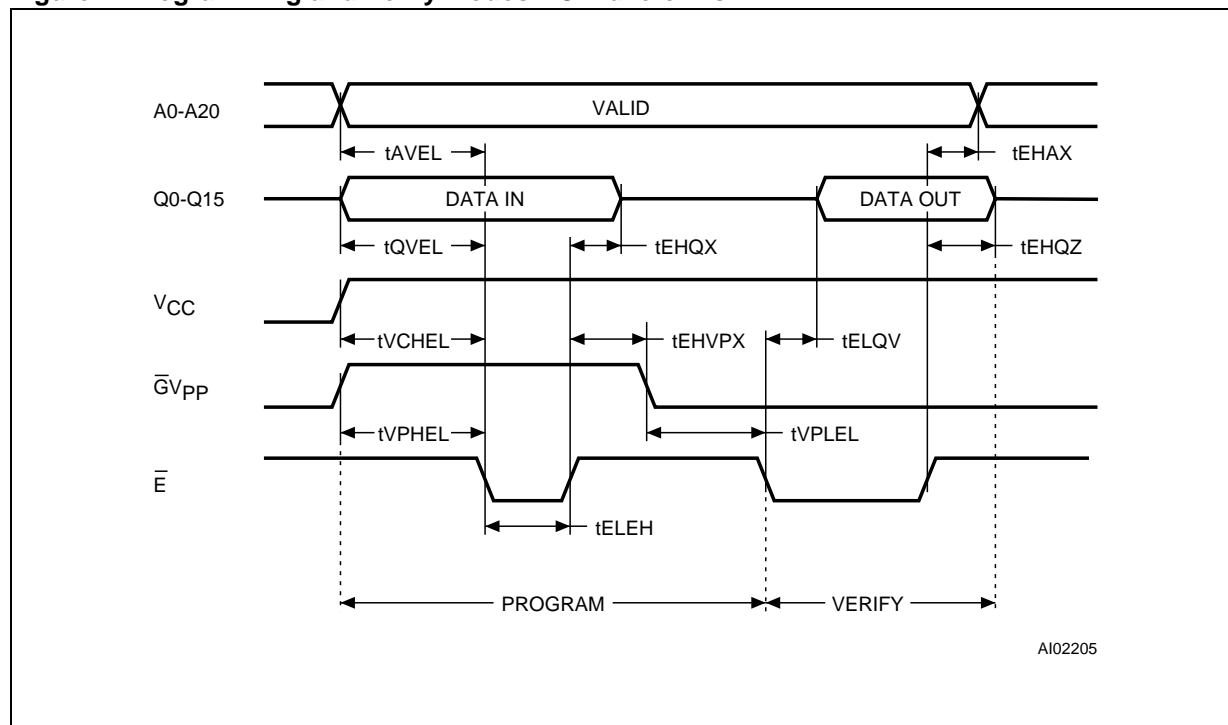
olet light (UV EPROM). The M27C322 is in the programming mode when V<sub>PP</sub> input is at 12.V, GV<sub>PP</sub> is at V<sub>IH</sub> and  $\bar{E}$  is pulsed to V<sub>IL</sub>. The data to be programmed is applied to 16 bits in parallel to the data output pins. The levels required for the address and data inputs are TTL. V<sub>CC</sub> is specified to be 6.25V ± 0.25V.

Figure 6. MARGIN MODE AC Waveforms



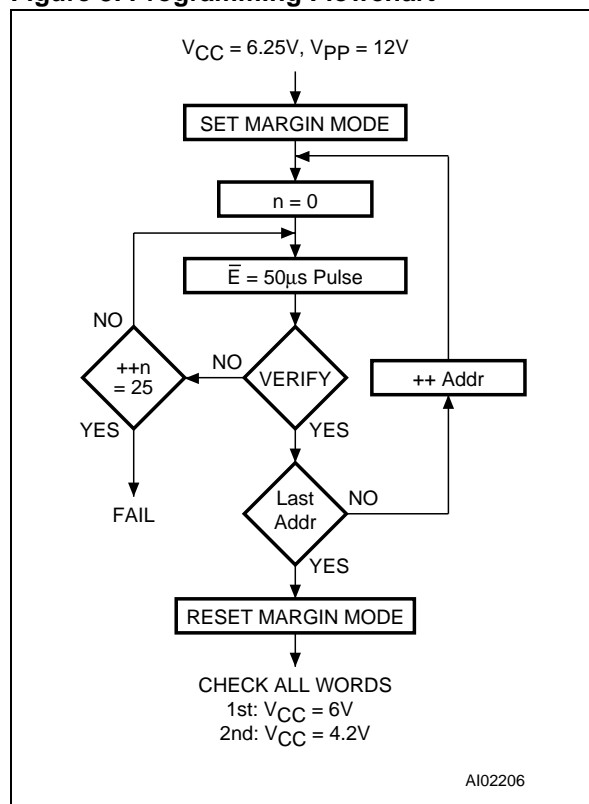
Note: A8 High level = 5V; A9 High level = 12V.

Figure 7. Programming and Verify Modes AC Waveforms



Note:  $\overline{\text{BYTE}} = V_{IH}$ .



**Figure 8. Programming Flowchart****PRESTO III Programming Algorithm**

The PRESTO III Programming Algorithm allows the whole array to be programmed with a guaranteed margin in a typical time of 100 seconds. Programming with PRESTO III consists of applying a sequence of 50µs program pulses to each word until a correct verify occurs (see Figure 8). During programming and verify operation a MARGIN MODE circuit must be activated to guarantee that each cell is programmed with enough margin. No overprogram pulse is applied since the verify in MARGIN MODE provides the necessary margin to each programmed cell.

**Program Inhibit**

Programming of multiple M27C322s in parallel with different data is also easily accomplished. Except for  $\bar{E}$ , all like inputs including  $\bar{G}V_{PP}$  of the parallel M27C322 may be common. A TTL low level pulse applied to a M27C322's  $\bar{E}$  input and  $V_{PP}$  at 12V, will program that M27C322. A high level  $\bar{E}$  input inhibits the other M27C322s from being programmed.

**Program Verify**

A verify (read) should be performed on the programmed bits to determine that they were correctly programmed. The verify is accomplished with

$\bar{G}V_{PP}$  at  $V_{IL}$ . Data should be verified with  $t_{ELQV}$  after the falling edge of  $\bar{E}$ .

**On-Board Programming**

The M27C322 can be directly programmed in the application circuit. See the relevant Application Note AN620.

**Electronic Signature**

The Electronic Signature (ES) mode allows the reading out of a binary code from an EPROM that will identify its manufacturer and type. This mode is intended for use by programming equipment to automatically match the device to be programmed with its corresponding programming algorithm. The ES mode is functional in the  $25^{\circ}\text{C} \pm 5^{\circ}\text{C}$  ambient temperature range that is required when programming the M27C322. To activate the ES mode, the programming equipment must force 11.5V to 12.5V on address line A9 of the M27C322, with  $V_{PP} = V_{CC} = 5\text{V}$ . Two identifier bytes may then be sequenced from the device outputs by toggling address line A0 from  $V_{IL}$  to  $V_{IH}$ . All other address lines must be held at  $V_{IL}$  during Electronic Signature mode.

Byte 0 ( $A0 = V_{IL}$ ) represents the manufacturer code and byte 1 ( $A0 = V_{IH}$ ) the device identifier code. For the STMicroelectronics M27C322, these two identifier bytes are given in Table 4 and can be read-out on outputs Q0 to Q7.

**ERASURE OPERATION (applies to UV EPROM)**

The erasure characteristics of the M27C322 is such that erasure begins when the cells are exposed to light with wavelengths shorter than approximately 4000 Å. It should be noted that sunlight and some type of fluorescent lamps have wavelengths in the 3000-4000 Å range. Research shows that constant exposure to room level fluorescent lighting could erase a typical M27C322 in about 3 years, while it would take approximately 1 week to cause erasure when exposed to direct sunlight. If the M27C322 is to be exposed to these types of lighting conditions for extended periods of time, it is suggested that opaque labels be put over the M27C322 window to prevent unintentional erasure. The recommended erasure procedure for M27C322 is exposure to short wave ultraviolet light which has a wavelength of 2537 Å. The integrated dose (i.e. UV intensity x exposure time) for erasure should be a minimum of 30 W-sec/cm<sup>2</sup>. The erasure time with this dosage is approximately 30 to 40 minutes using an ultraviolet lamp with 12000 µW/cm<sup>2</sup> power rating. The M27C322 should be placed within 2.5cm (1 inch) of the lamp tubes during the erasure. Some lamps have a filter on their tubes which should be removed before erasure.

## M27C322

**Table 12. Ordering Information Scheme**

Example:

	M27C322	-80	F	1
<b>Device Type</b>				
M27				
<b>Supply Voltage</b>				
C = 5V ±10%				
<b>Device Function</b>				
322 = 32 Mbit (2Mb x16)				
<b>Speed</b>				
-80 <sup>(1)</sup> = 80 ns				
-100 = 100 ns				
<b>Package</b>				
F = FDIP42W				
P = PDIP42				
<b>Temperature Range</b>				
1 = 0 to 70 °C				
3 = -40 to 125 °C				
6 = -40 to 85 °C				

Note: 1. High Speed, see AC Characteristics section for further information.

For a list of available options (Speed, Package, etc...) or for further information on any aspect of this device, please contact the STMicroelectronics Sales Office nearest to you.

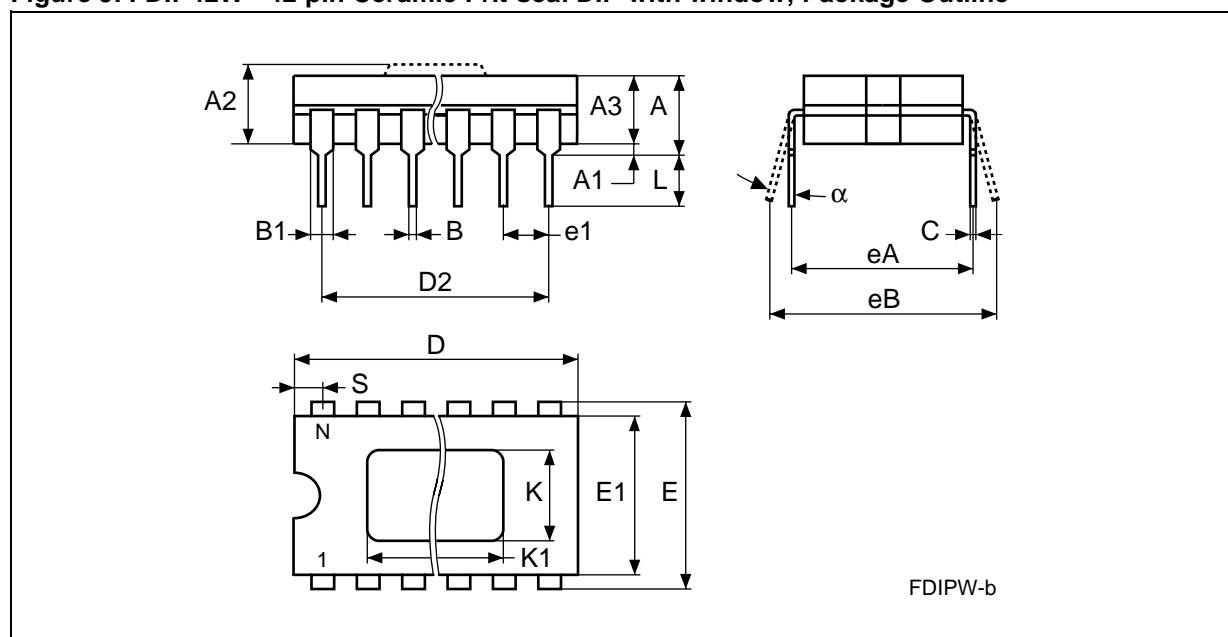
**Table 13. Revision History**

Date	Revision Details
July 1999	First Issue
02/24/00	Programming Time changed Programming Flowchart changed (Figure 8) Presto III Programming Algorithm paragraph changed
04/04/00	-40 to 85 °C and -40 to 125 °C temperature ranges added (Table 7, 8 and 12) 80ns speed class in High Speed AC measurement conditions

Table 14. FDIP42W - 42 pin Ceramic Frit-seal DIP with window, Package Mechanical Data

Symbol	mm			inches		
	Typ	Min	Max	Typ	Min	Max
A			5.72			0.225
A1		0.51	1.40		0.020	0.055
A2		3.91	4.57		0.154	0.180
A3		3.89	4.50		0.153	0.177
B		0.41	0.56		0.016	0.022
B1	1.45	–	–	0.057	–	–
C		0.23	0.30		0.009	0.012
D		54.41	54.86		2.142	2.160
D2	50.80	–	–	2.000	–	–
E	15.24	–	–	0.600	–	–
E1		14.50	14.90		0.571	0.587
e	2.54	–	–	0.100	–	–
eA	14.99	–	–	0.590	–	–
eB		16.18	18.03		0.637	0.710
L		3.18	4.10		0.125	0.161
S		1.52	2.49		0.060	0.098
K	8.00	–	–	0.315	–	–
K1	16.00	–	–	0.630	–	–
$\alpha$		4°	11°		4°	11°
N		42			42	

Figure 9. FDIP42W - 42 pin Ceramic Frit-seal DIP with window, Package Outline

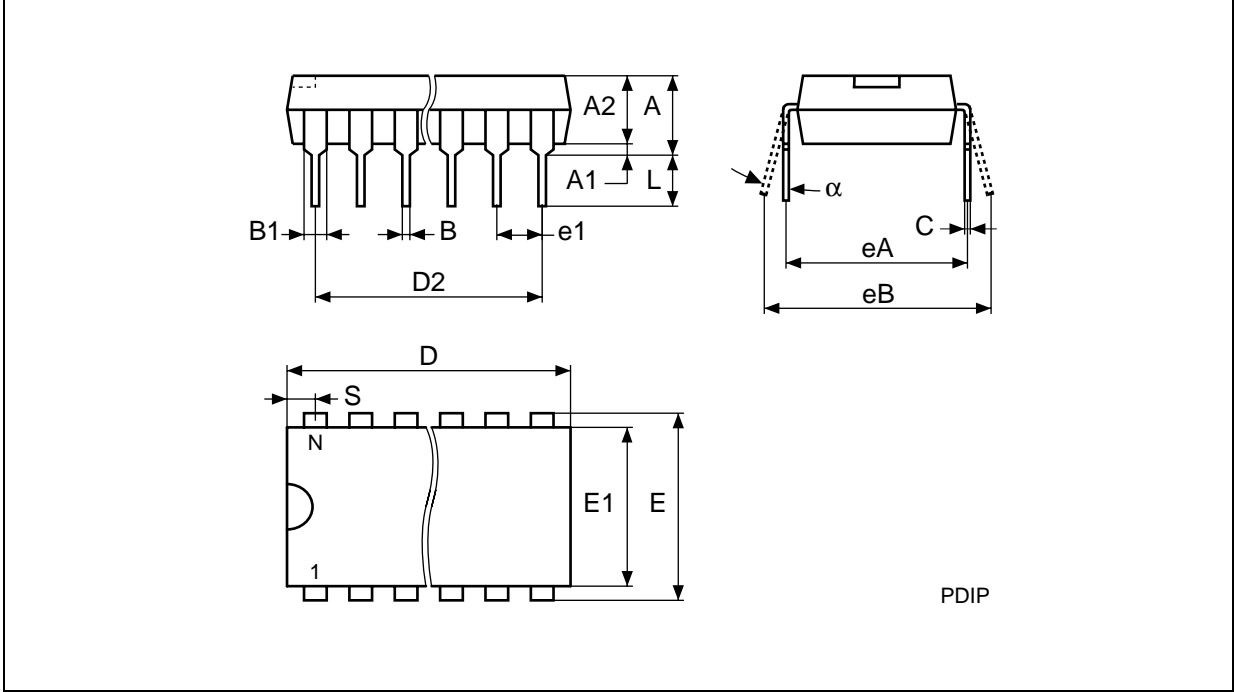


Note: Drawing is not to scale.

Table 15. PDIP42 - 42 pin Plastic DIP, 600 mils width, Package Mechanical Data

Symbol	mm			inches		
	Typ	Min	Max	Typ	Min	Max
A		–	5.08		–	0.200
A1		0.25	–		0.010	–
A2		3.56	4.06		0.140	0.160
B		0.38	0.53		0.015	0.021
B1		1.27	1.65		0.050	0.065
C		0.20	0.36		0.008	0.014
D		52.20	52.71		2.055	2.075
D2	50.80	–	–	2.000	–	–
E	15.24	–	–	0.600	–	–
E1		13.59	13.84		0.535	0.545
e1	2.54	–	–	0.100	–	–
eA	14.99	–	–	0.590	–	–
eB		15.24	17.78		0.600	0.700
L		3.18	3.43		0.125	0.135
S		0.86	1.37		0.034	0.054
$\alpha$		0°	10°		0°	10°
N	42			42		

Figure 10. PDIP42 - 42 pin Plastic DIP, 600 mils width, Package Outline



Note: Drawing is not to scale.

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