

## FEATURES:

- **Organized as 128K x8 / 256K x8 / 512K x8**
- **2.7-3.6V Read Operation**
- **Superior Reliability**
  - Endurance: At least 1000 Cycles
  - Greater than 100 years Data Retention
- **Low Power Consumption:**
  - Active Current: 10 mA (typical)
  - Standby Current: 2  $\mu$ A (typical)
- **Fast Read Access Time:**
  - 70 ns
- **Latched Address and Data**
- **Fast Byte-Program Operation:**
  - Byte-Program Time: 15  $\mu$ s (typical)
  - Chip Program Time:
    - 2 seconds (typical) for GLS37VF010
    - 4 seconds (typical) for GLS37VF020
    - 8 seconds (typical) for GLS37VF040
- **Electrical Erase Using Programmer**
  - Does not require UV source
  - Chip-Erase Time: 100 ms (typical)
- **CMOS I/O Compatibility**
- **JEDEC Standard Byte-wide Flash EEPROM Pinouts**
- **Packages Available**
  - 32-lead PLCC
  - 32-lead TSOP (8mm x 14mm)
  - 32-pin PDIP
  - Non-Pb (lead-free) packages available

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## PRODUCT DESCRIPTION

The GLS37VF010/020/040 devices are 128K x8 / 256K x8 / 512K x8 CMOS, Many-Time Programmable (MTP), low cost flash, manufactured with high performance Super-Flash technology. The split-gate cell design and thick-oxide tunneling injector attain better reliability and manufacturability compared with alternate approaches. The GLS37VF010/020/040 can be electrically erased and programmed at least 1000 times using an external programmer, e.g., to change the contents of devices in inventory. The GLS37VF010/020/040 have to be erased prior to programming. These devices conform to JEDEC standard pinouts for byte-wide flash memories.

Featuring high performance Byte-Program, the GLS37VF010/020/040 provide a typical Byte-Program time of 15  $\mu$ s. Designed, manufactured, and tested for a wide spectrum of applications, these devices are offered with an endurance of at least 1000 cycles. Data retention is rated at greater than 100 years.

The GLS37VF010/020/040 are suited for applications that require infrequent writes and low power nonvolatile storage. These devices will improve flexibility, efficiency, and performance while matching the low cost in nonvolatile applications that currently use UV-EPROMs, OTPs, and mask ROMs.

To meet surface mount and conventional through hole requirements, the GLS37VF010/020/040 are offered in 32-lead PLCC, 32-lead TSOP, and 32-pin PDIP packages. See Figures 2, 3, and 4 for pin assignments.

## Device Operation

The GLS37VF010/020/040 devices are nonvolatile memory solutions that can be used instead of standard flash devices if in-system programmability is not required. It is functionally (Read) and pin compatible with industry standard flash products. The device supports electrical Erase operation via an external programmer.

## Read

The Read operation of the GLS37VF010/020/040 is controlled by CE# and OE#. Both CE# and OE# have to be low for the system to obtain data from the outputs. Once the address is stable, the address access time is equal to the delay from CE# to output ( $T_{CE}$ ). Data is available at the output after a delay of TOE from the falling edge of OE#, assuming the CE# pin has been low and the addresses have been stable for at least  $T_{CE}-T_{OE}$ . When the CE# pin is high, the chip is deselected and a standby current of only 2  $\mu$ A (typical) is consumed. OE# is the output control and is

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used to gate data from the output pins. The data bus is in high impedance state when either CE# or OE# is  $V_{IH}$ . Refer to Figure 5 for the timing diagram.

## Byte-Program Operation

The GLS37VF010/020/040 are programmed by using an external programmer. The programming mode is activated by asserting 11.4-12V on OE# pin and  $V_{L}$  on CE# pin. The device is programmed using a single pulse (WE# pin low) of 15  $\mu$ s per byte. Using the MTP programming algorithm, the Byte-Program process continues byte-by-byte until the entire chip has been programmed. Refer to Figure 11 for the flowchart and Figure 7 for the timing diagram.

## Chip-Erase Operation

The only way to change a data from a “0” to “1” is by electrical erase that changes every bit in the device to “1”. The GLS37VF010/020/040 use an electrical Chip-Erase operation. The entire chip can be erased in 100 ms (WE# pin low). In order to activate erase mode, the 11.4-12V is applied to OE# and  $A_9$  pins while CE# is low. All other address and data pins are “don’t care”. The falling edge of WE# will start the Chip-Erase operation. Once the chip has been erased, all bytes must be verified for FFH. Refer to Figure 10 for the flowchart and Figure 6 for the timing diagram.

## Product Identification Mode

The Product Identification mode identifies the devices as GLS37VF010, GLS37VF020, and GLS37VF040 and manufacturer as Greenliant. This mode may be accessed by the hardware method. To activate this mode, the programming equipment must force  $V_H$  (11.4-12V) on address  $A_9$ . Two identifier bytes may then be sequenced from the device outputs by toggling address line  $A_0$ . For details, see Table 3 for hardware operation.

**TABLE 1: Product Identification**

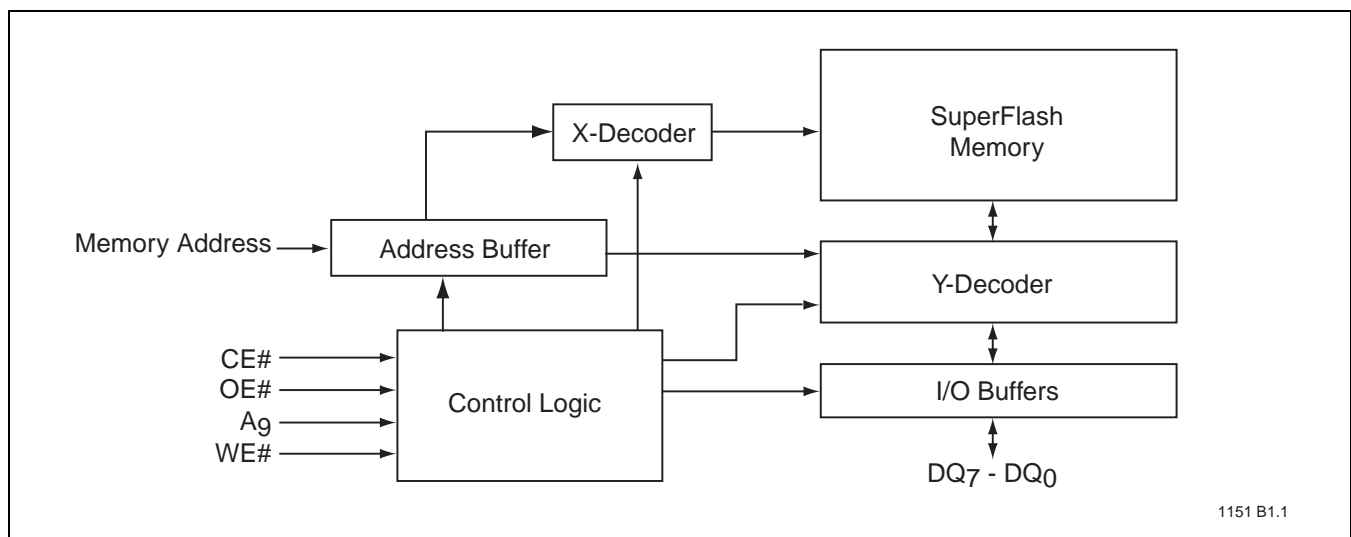
	Address	Data
Manufacturer's ID	0000H	BFH
Device ID		
GLS37VF010	0001H	C5H
GLS37VF020	0001H	C6H
GLS37VF040	0001H	C2H

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## Design Considerations

The GLS37VF010/020/040 should have a 0.1  $\mu$ F ceramic high frequency, low inductance capacitor connected between  $V_{DD}$  and GND. This capacitor should be placed as close to the package terminals as possible.

OE# and  $A_9$  must remain stable at  $V_H$  for the entire duration of an Erase operation. OE# must remain stable at  $V_H$  for the entire duration of the Program operation.



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**FIGURE 1: Functional Block Diagram**

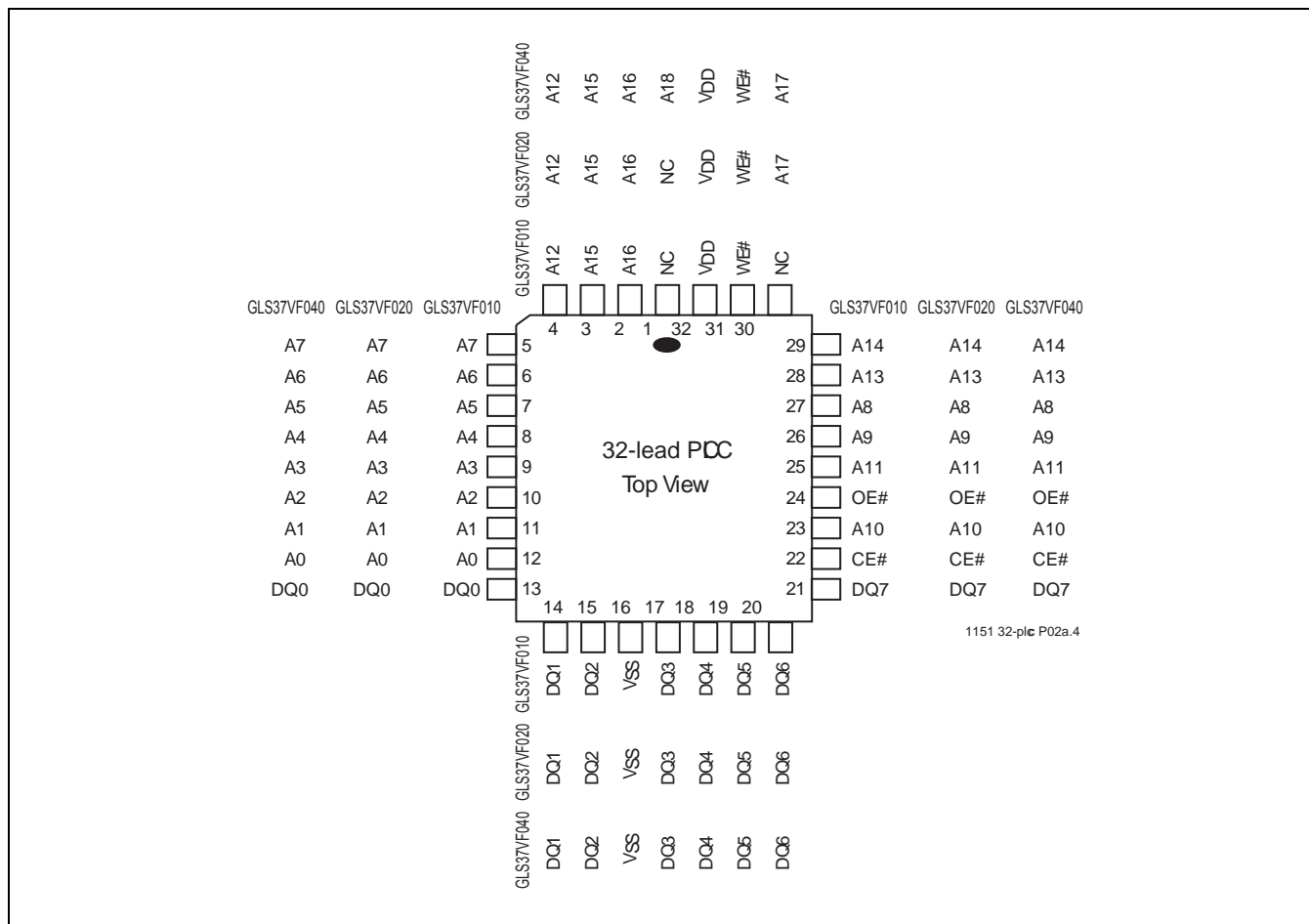


FIGURE 2: Pin Assignments for 32-lead PLCC

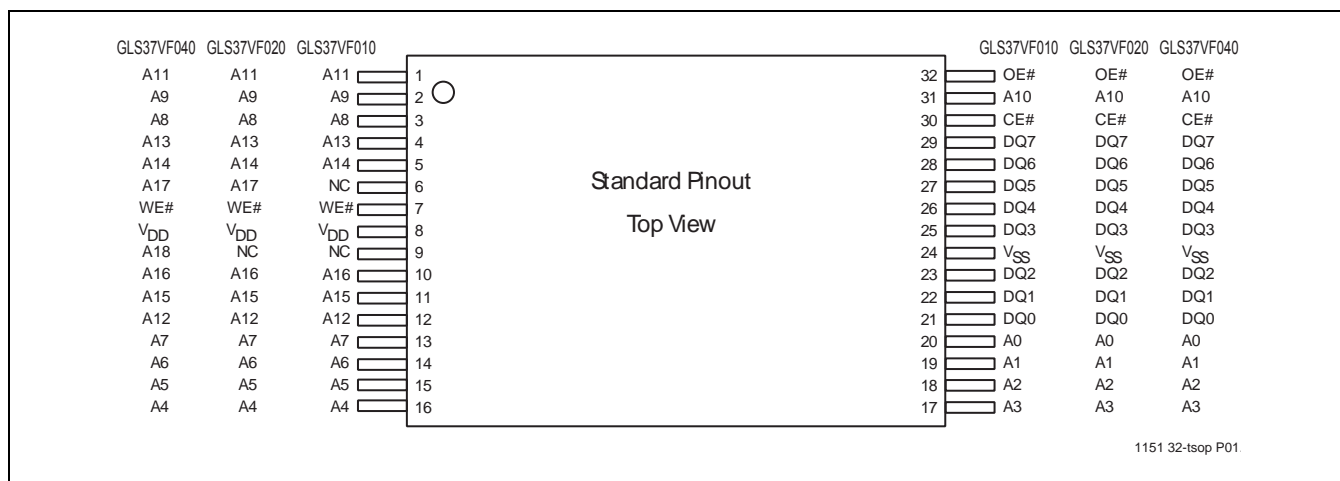
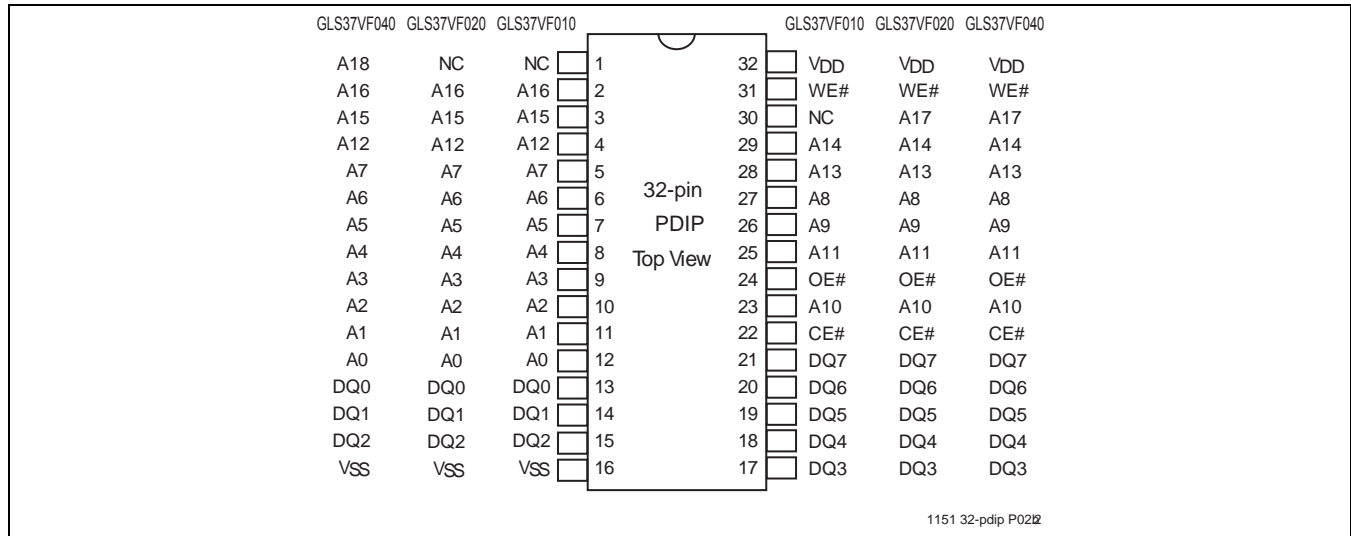


FIGURE 3: Pin Assignments for 32-lead TSOP (8mm x 14mm)



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**FIGURE 4: Pin Assignments for 32-pin PDIP**

**TABLE 2: Pin Description**

Symbol	Pin Name	Functions
$A_{MS}^1-A_0$	Address Inputs	To provide memory addresses.
DQ7-DQ0	Data Input/output	To output data during Read cycles and receive input data during Program cycles. The outputs are in tri-state when OE# or CE# is high.
CE#	Chip Enable	To activate the device when CE# is low.
WE#	Write Enable	To program or erase (WE# = $V_{IL}$ pulse during Program or Erase)
OE#	Output Enable	To gate the data output buffers during Read operation when low
$V_{DD}$	Power Supply	To provide 3.0V supply (2.7-3.6V)
$V_{SS}$	Ground	
NC	No Connection	Unconnected pins.

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- $A_{MS}$  = Most significant address  
 $A_{MS}$  =  $A_{16}$  for GLS37VF010,  $A_{17}$  for GLS37VF020, and  $A_{18}$  for GLS37VF040

**TABLE 3: Operation Modes Selection**

Mode	CE#	WE#	$A_9$	OE#	DQ	Address
Read	$V_{IL}$	$V_{IH}$	$A_{IN}$	$V_{IL}$	D <sub>OUT</sub>	$A_{IN}$
Output Disable	$V_{IL}$	X	X	$V_{IH}$	High Z	$A_{IN}$
Standby	$V_{IH}$	X	X	X	High Z	X
Chip-Erase	$V_{IL}$	$V_{IL}$	$V_H$	$V_H$	High Z	X
Byte-Program	$V_{IL}$	$V_{IL}$	$A_{IN}$	$V_H$	D <sub>IN</sub>	$A_{IN}$
Program/Erase Inhibit	X	$V_{IH}$	X	X	High Z	X
	X	X	X	$V_{IL}$ or $V_{IH}$	High Z/ D <sub>OUT</sub>	X
Product Identification	$V_{IL}$	$V_{IH}$	$V_H$	$V_{IL}$	Manufacturer's ID (BFH) Device ID <sup>1</sup>	$A_{MS}^2 - A_1 = V_{IL}$ , $A_0 = V_{IL}$ $A_{MS}^2 - A_1 = V_{IL}$ , $A_0 = V_{IH}$

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- Device ID = C5H for GLS37VF020, C6H for GLS37VF020, and C2H for GLS37VF040
- $A_{MS}$  = Most significant address  
 $A_{MS}$  =  $A_{16}$  for GLS37VF010,  $A_{17}$  for GLS37VF020, and  $A_{18}$  for GLS37VF040

**Note:** X =  $V_{IL}$  or  $V_{IH}$  (or  $V_H$  in case of OE# and  $A_9$ )  
 $V_H$  = 11.4-12V

**Absolute Maximum Stress Ratings** (Applied conditions greater than those listed under “Absolute Maximum Stress Ratings” may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these conditions or conditions greater than those defined in the operational sections of this data sheet is not implied. Exposure to absolute maximum stress rating conditions may affect device reliability.)

Temperature Under Bias	-55°C to +125°C
Storage Temperature	-65°C to +150°C
D. C. Voltage on Any Pin to Ground Potential	-0.5V to V <sub>DD</sub> +0.5V
Transient Voltage (<20 ns) on Any Pin to Ground Potential	-2.0V to V <sub>DD</sub> +2.0V
Voltage on A <sub>9</sub> Pin to Ground Potential	-0.5V to 13.2V
Package Power Dissipation Capability (T <sub>A</sub> = 25°C)	1.0W
Through Hole Lead Soldering Temperature (10 Seconds)	300°C
Surface Mount Solder Reflow Temperature:	“with-Pb” units <sup>1</sup> : 240°C for 3 seconds
	“non-Pb” units: 260°C for 3 seconds
Output Short Circuit Current <sup>2</sup>	50 mA

1. Certain “with-Pb” package types are capable of 260°C for 3 seconds; please consult the factory for the latest information.  
 2. Outputs shorted for no more than one second. No more than one output shorted at a time.

**OPERATING RANGE**

Range	Ambient Temp	V <sub>DD</sub>
Commercial	0°C to +70°C	2.7-3.6V

**AC CONDITIONS OF TEST**

Input Rise/Fall Time	5 ns
Output Load	C <sub>L</sub> = 100 pF
See Figures 8 and 9	

**TABLE 4: Read Mode DC Operating Characteristics V<sub>DD</sub>=2.7-3.6V (T<sub>A</sub> = 0°C to +70°C (Commercial))**

Symbol	Parameter	Limits			Test Conditions
		Min	Max	Units	
I <sub>DD</sub>	V <sub>DD</sub> Read Current		12	mA	Address input=V <sub>ILT</sub> /V <sub>IHT</sub> , at f=1/T <sub>RC</sub> Min V <sub>DD</sub> =V <sub>DD</sub> Max CE#=V <sub>IL</sub> , OE#=V <sub>IHT</sub> , all I/Os open
I <sub>SB</sub>	Standby V <sub>DD</sub> Current		15	µA	CE#=V <sub>IHC</sub> , V <sub>DD</sub> =V <sub>DD</sub> Max
I <sub>LI</sub>	Input Leakage Current		1	µA	V <sub>IN</sub> =GND to V <sub>DD</sub> , V <sub>DD</sub> =V <sub>DD</sub> Max
I <sub>LO</sub>	Output Leakage Current		10	µA	V <sub>OUT</sub> =GND to V <sub>DD</sub> , V <sub>DD</sub> =V <sub>DD</sub> Max
V <sub>IL</sub>	Input Low Voltage		0.8	V	V <sub>DD</sub> =V <sub>DD</sub> Min
V <sub>IH</sub>	Input High Voltage	0.7 V <sub>DD</sub>		V	V <sub>DD</sub> =V <sub>DD</sub> Max
V <sub>IHC</sub>	Input High Voltage (CMOS)	V <sub>DD</sub> -0.3		V	V <sub>DD</sub> =V <sub>DD</sub> Max
V <sub>OL</sub>	Output Low Voltage		0.2	V	I <sub>OL</sub> =100 µA, V <sub>DD</sub> =V <sub>DD</sub> Min
V <sub>OH</sub>	Output High Voltage	V <sub>DD</sub> -0.3		V	I <sub>OH</sub> =-100 µA, V <sub>DD</sub> =V <sub>DD</sub> Min
I <sub>H</sub>	Supervoltage Current for A <sub>9</sub>		200	µA	CE#=OE#=V <sub>IL</sub> , A <sub>9</sub> =V <sub>H</sub> Max

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**TABLE 5: Program/Erase DC Operating Characteristics  $V_{DD}=2.7-3.6V$  ( $T_A = 25^{\circ}C \pm 5^{\circ}C$ )**

Symbol	Parameter	Limits			Test Conditions
		Min	Max	Units	
$I_{DD}$	$V_{DD}$ Erase or Program Current		20	mA	$CE\#=V_{IL}$ , $OE\#=V_H$ , $V_{DD}=V_{DD} \text{ Max}$ , $WE\#=V_{IL}$
$I_{LI}$	Input Leakage Current		1	$\mu A$	$V_{IN}=GND$ to $V_{DD}$ , $V_{DD}=V_{DD} \text{ Max}$
$I_{LO}$	Output Leakage Current		10	$\mu A$	$V_{OUT}=GND$ to $V_{DD}$ , $V_{DD}=V_{DD} \text{ Max}$
$V_H$	Supervoltage for $A_9$ and $OE\#$	11.4	12	V	
$I_{HA9}$	Supervoltage Current for $A_9$		200	$\mu A$	$OE\#=V_H \text{ Max}$ , $A_9=V_H \text{ Max}$ , $V_{DD}=V_{DD} \text{ Max}$ , $CE\#=V_{IL}$
$I_{HOE\#}$	Supervoltage Current for $OE\#$		3	mA	$CE\#=V_{IL}$ , $OE\#=11.4-12V$ , $V_{DD}=V_{DD} \text{ Max}$ , $WE\#=V_{IL}$

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**TABLE 6: Recommended System Power-up Timings**

Symbol	Parameter	Minimum	Units
$T_{PU-READ}^1$	Power-up to Read Operation	100	$\mu s$
$T_{PU-WRITE}^1$	Power-up to Write Operation	100	$\mu s$

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1. This parameter is measured only for initial qualification and after a design or process change that could affect this parameter.

**TABLE 7: Capacitance ( $T_A = 25^{\circ}C$ ,  $f=1 \text{ Mhz}$ , other pins open)**

Parameter	Description	Test Condition	Maximum
$C_{I/O}^1$	I/O Pin Capacitance	$V_{I/O} = 0V$	12 pF
$C_{IN}^1$	Input Capacitance	$V_{IN} = 0V$	6 pF

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1. This parameter is measured only for initial qualification and after a design or process change that could affect this parameter.

**TABLE 8: Reliability Characteristics**

Symbol	Parameter	Minimum Specification	Units	Test Method
$N_{END}^1$	Endurance	10,000	Cycles	JEDEC Standard A117
$T_{DR}^1$	Data Retention	100	Years	JEDEC Standard A103
$I_{LTH}^1$	Latch Up	$100 + I_{DD}$	mA	JEDEC Standard 78

T8.3 1151

1. This parameter is measured only for initial qualification and after a design or process change that could affect this parameter.

## AC CHARACTERISTICS

**TABLE 9: Read Cycle Timing Parameters  $V_{DD} = 2.7-3.6V$  ( $T_A = 0^\circ C$  to  $+70^\circ C$  (Commercial))**

Symbol	Parameter	GLS37VF010-70 GLS37VF020-70 GLS37VF040-70		Units
		Min	Max	
$T_{RC}$	Read Cycle Time	70		ns
$T_{CE}$	Chip Enable Access Time		70	ns
$T_{AA}$	Address Access Time		70	ns
$T_{OE}$	Output Enable Access Time		35	ns
$T_{CLZ}^1$	CE# Low to Active Output	0		ns
$T_{OLZ}^1$	OE# Low to Active Output	0		ns
$T_{CHZ}^1$	CE# High to High-Z Output		25	ns
$T_{OHZ}^1$	OE# High to High-Z Output		25	ns
$T_{OH}^1$	Output Hold from Address Change	0		ns

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1. This parameter is measured only for initial qualification and after a design or process change that could affect this parameter.

**TABLE 10: Program/Erase Cycle Timing Parameters  $V_{DD} = 2.7-3.6V$  ( $T_A = 25^\circ C \pm 5^\circ C$ )**

Symbol	Parameter	Min	Max	Units
$T_{BP}$	Byte-Program Time		20	$\mu s$
$T_{CES}$	CE# Setup Time	1		$\mu s$
$T_{CEH}$	CE# Hold Time	1		$\mu s$
$T_{AS}$	Address Setup Time	1		$\mu s$
$T_{AH}$	Address Hold Time	1		$\mu s$
$T_{DS}$	Data Setup Time	1		$\mu s$
$T_{DH}$	Data Hold Time	1		$\mu s$
$T_{PRT}$	OE# Rise Time for Program and Erase	50		ns
$T_{VPS}$	OE# Setup Time for Program and Erase	1		$\mu s$
$T_{VPH}$	OE# Hold Time for Program and Erase	1		$\mu s$
$T_{PW}$	WE# Program Pulse Width	15	25	$\mu s$
$T_{EW}$	WE# Erase Pulse Width	100	200	ms
$T_{VR}$	OE#/A <sub>9</sub> Recovery Time for Erase	1		$\mu s$
$T_{ART}$	A <sub>9</sub> Rise Time to 12V during Erase	50		ns
$T_{A9S}$	A <sub>9</sub> Setup Time during Erase	1		$\mu s$
$T_{A9H}$	A <sub>9</sub> Hold Time during Erase	1		$\mu s$

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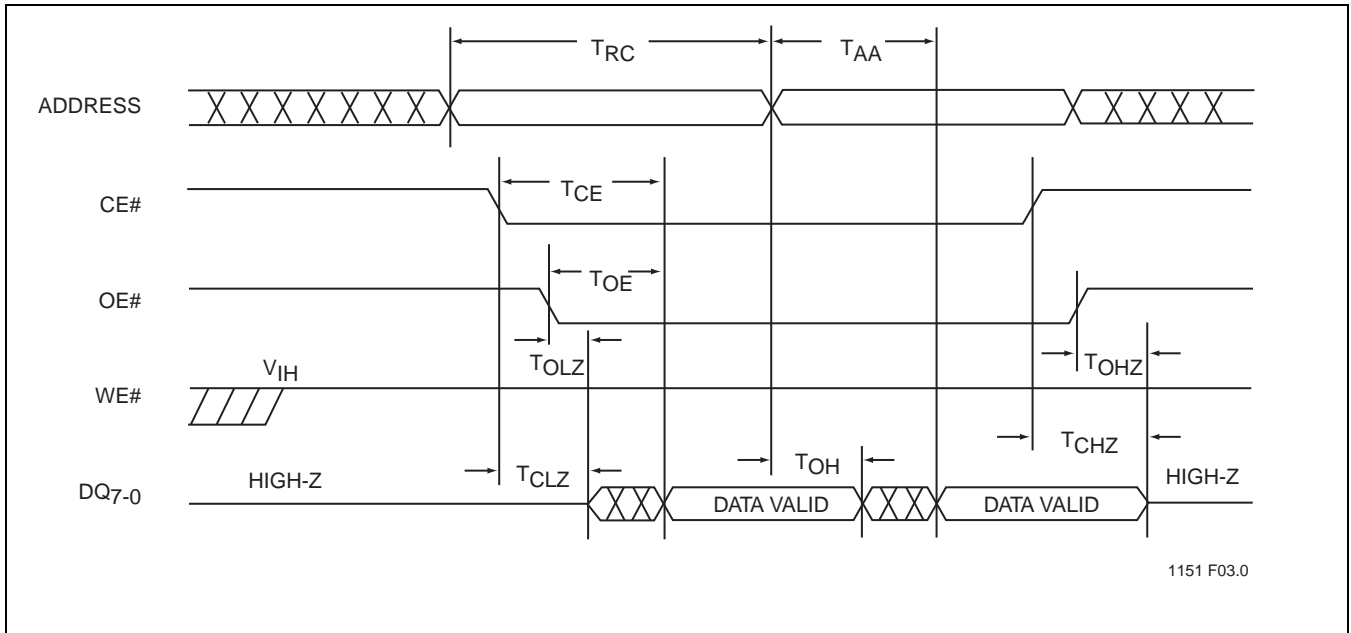


FIGURE 5: Read Cycle Timing Diagram

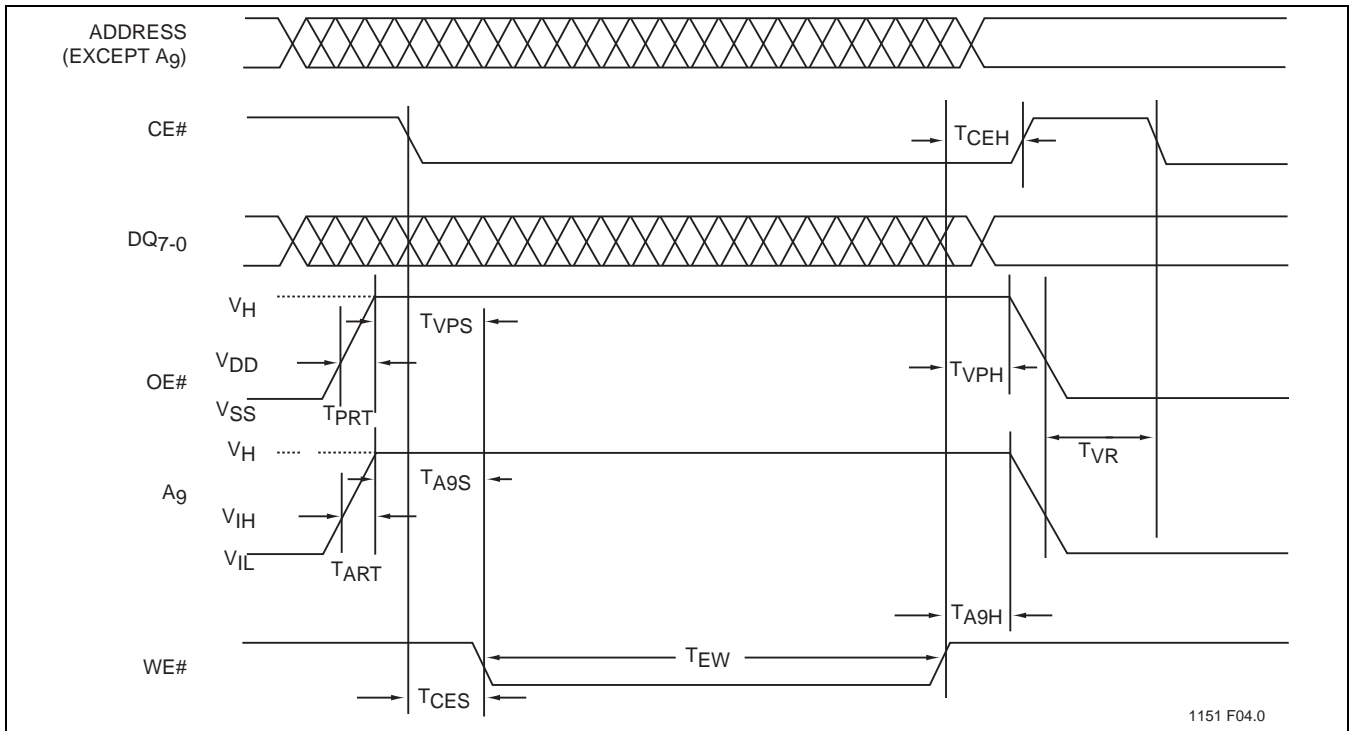


FIGURE 6: Chip-Erase Timing Diagram



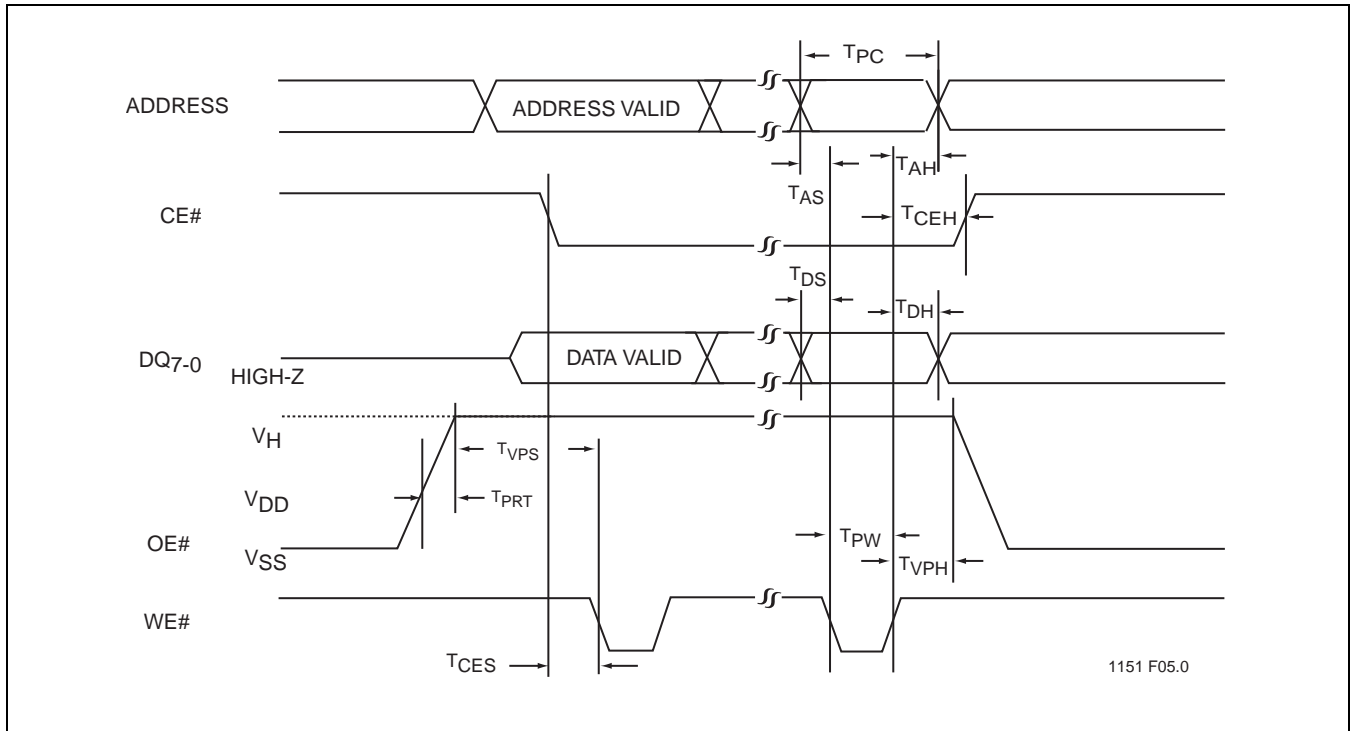
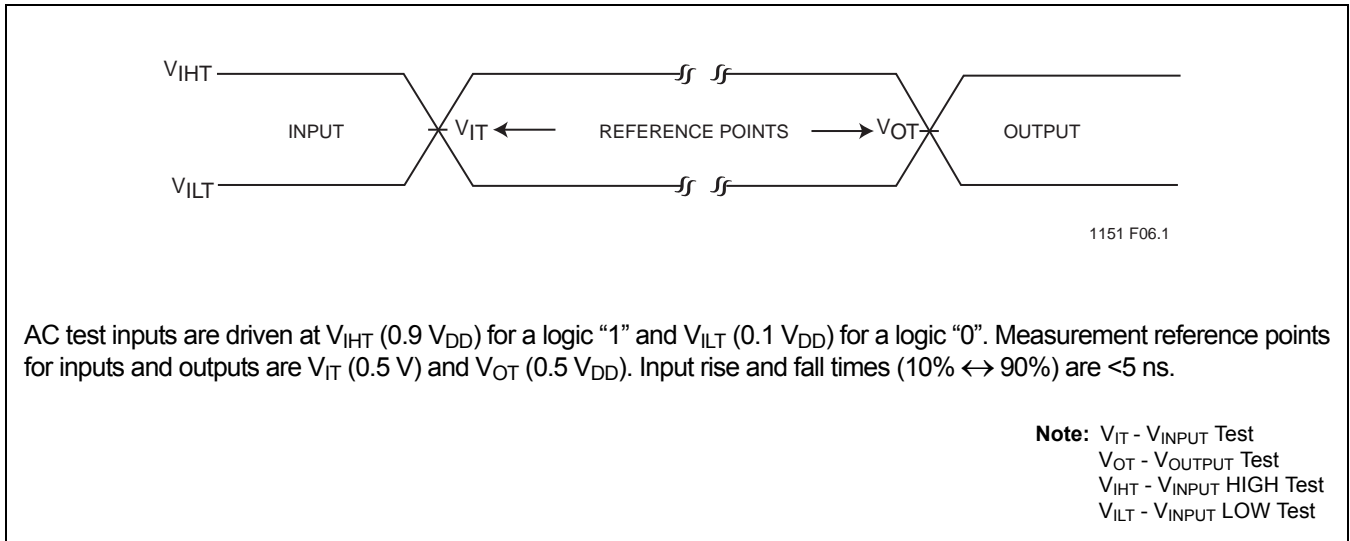


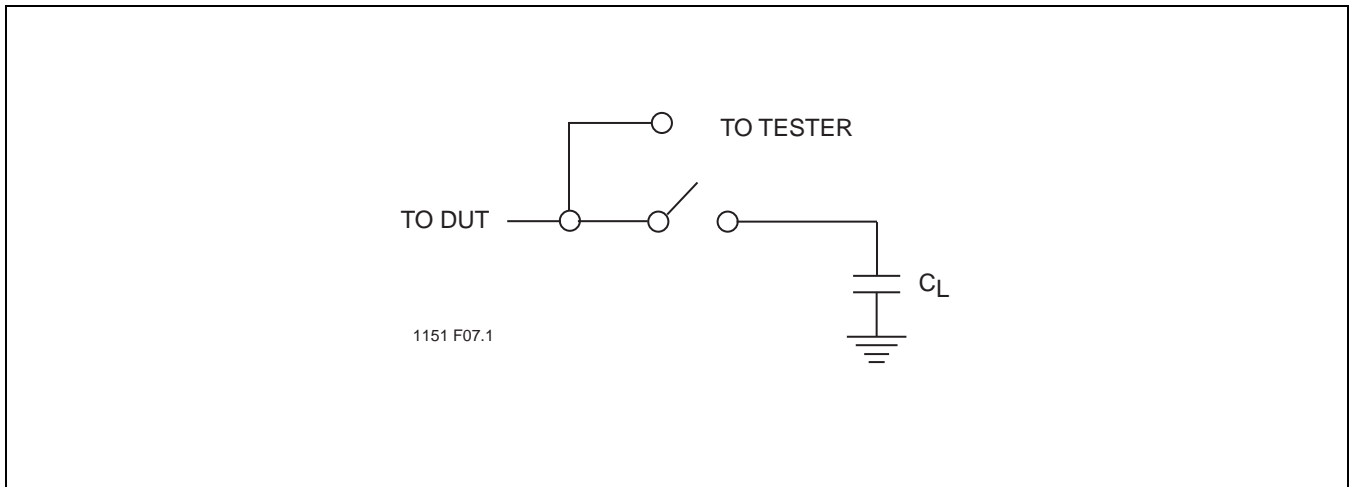
FIGURE 7: Byte-Program Timing Diagram



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**FIGURE 8: AC Input/Output Reference Waveforms**



**FIGURE 9: A Test Load Example**

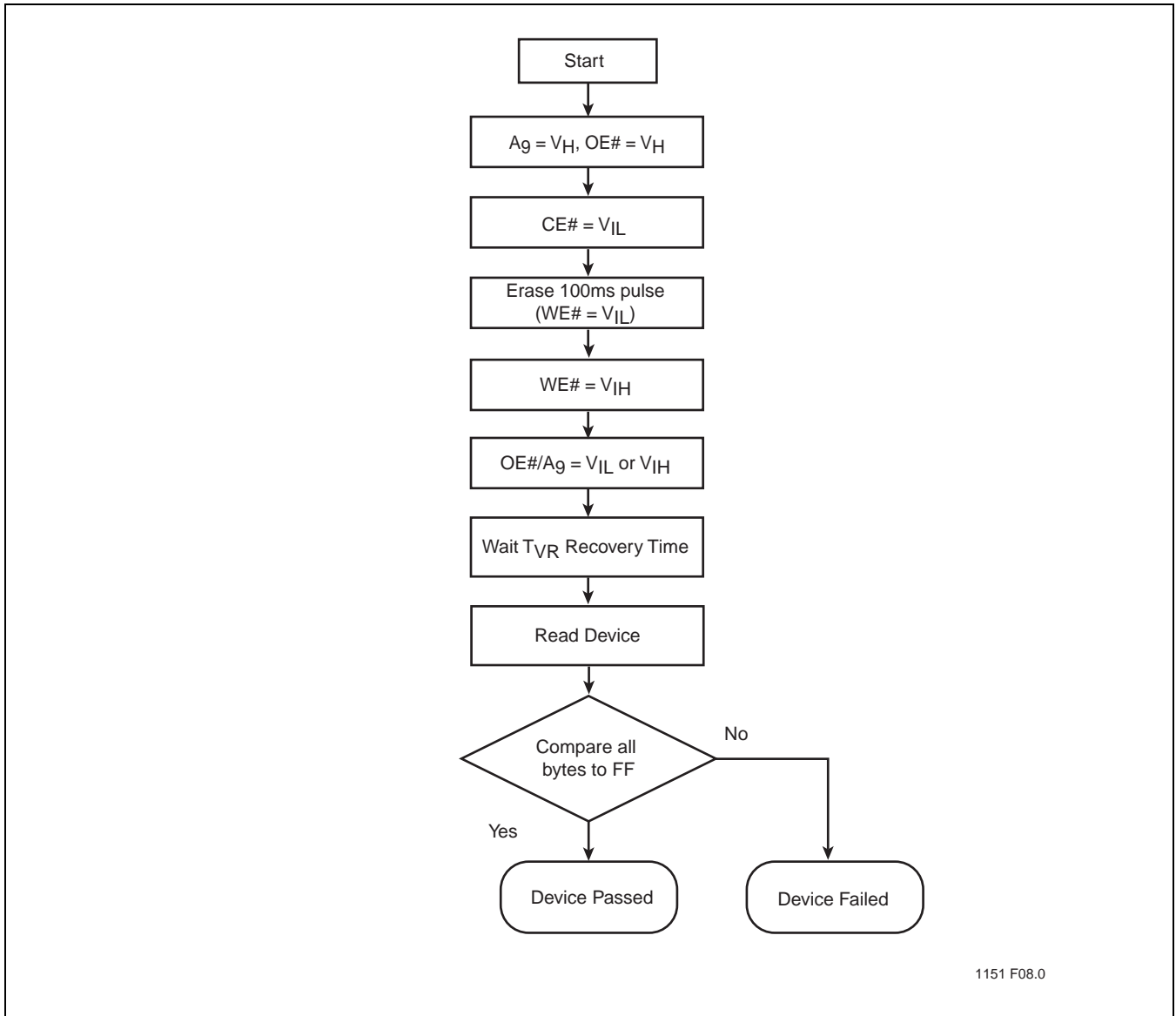
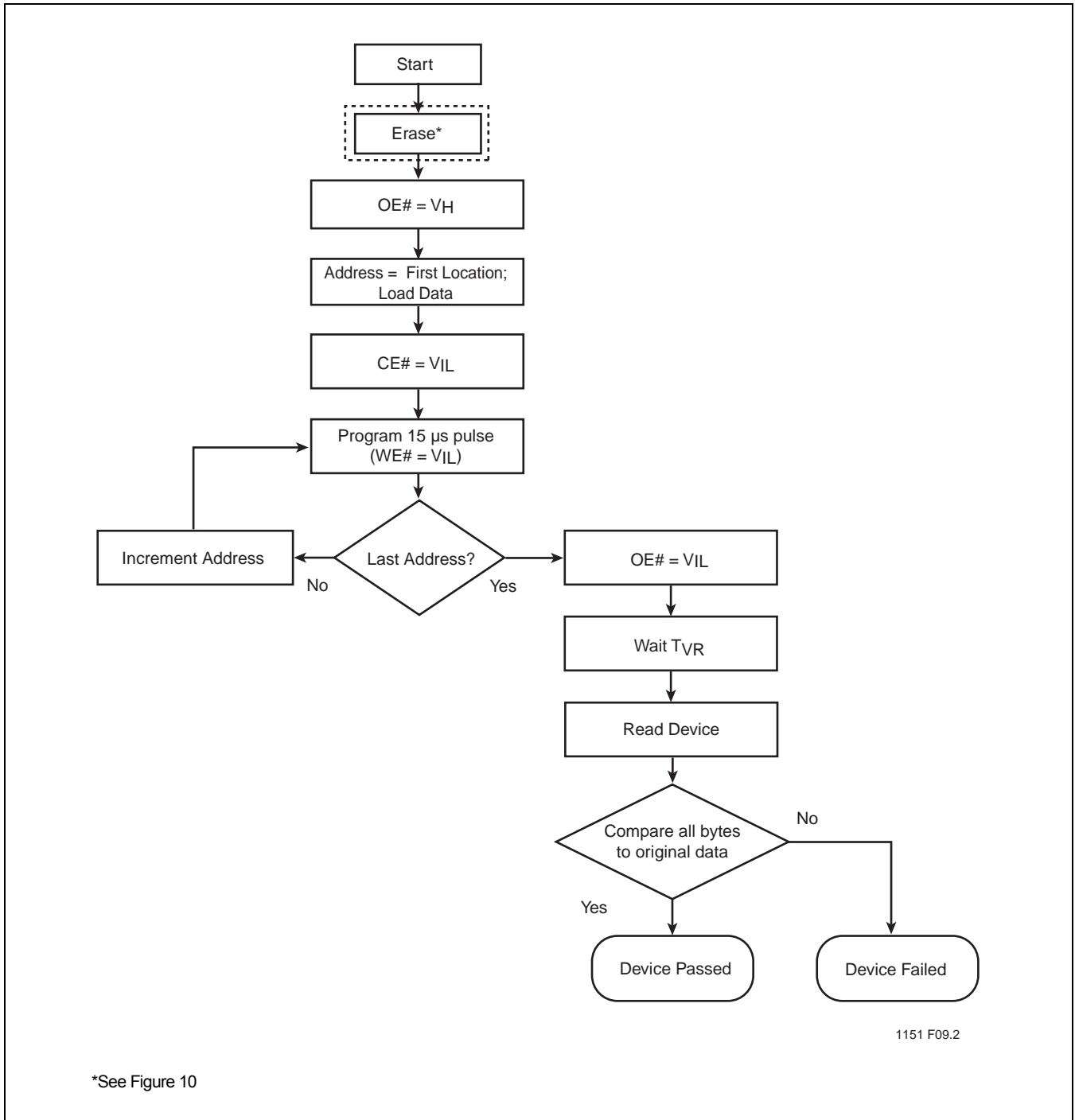


FIGURE 10: Chip-Erase Algorithm

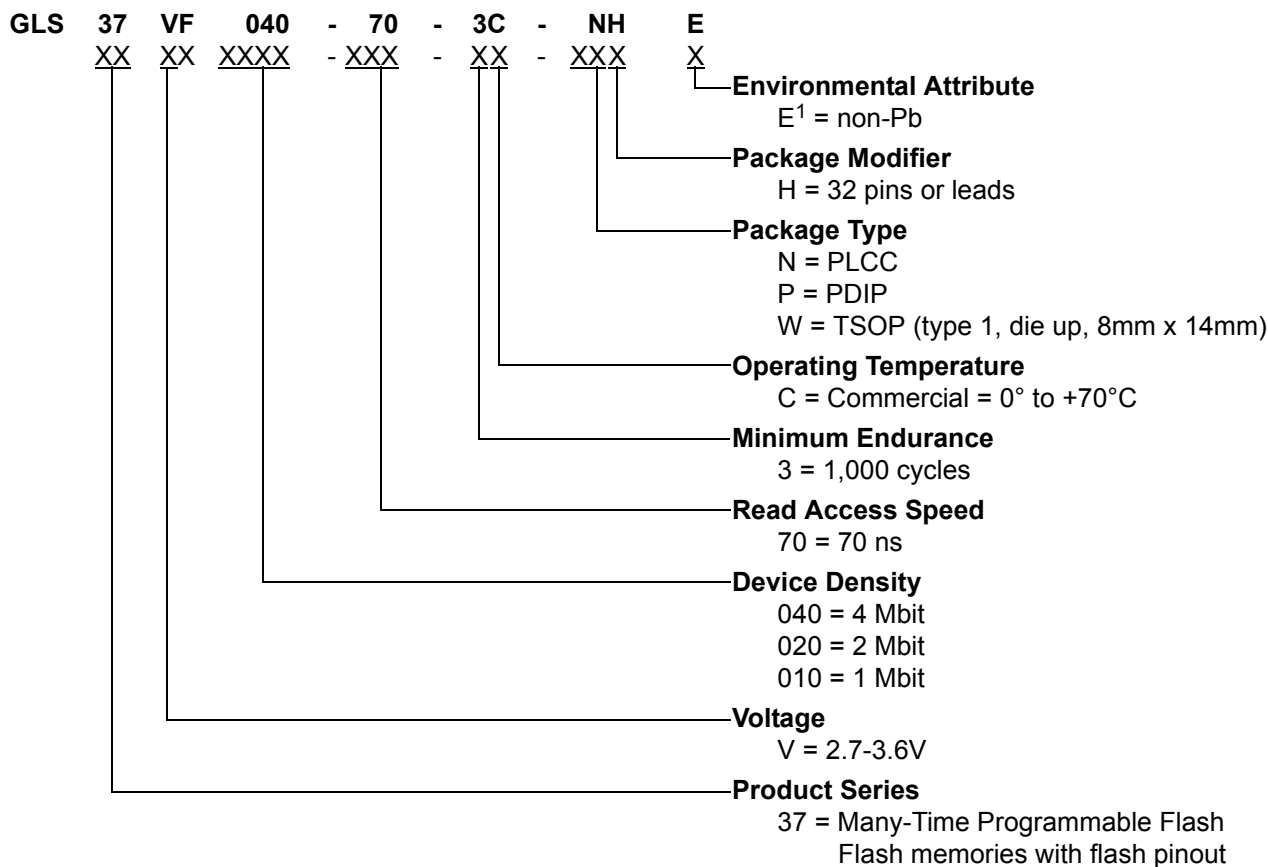


\*See Figure 10

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FIGURE 11: Byte-Program Algorithm

**PRODUCT ORDERING INFORMATION**



1. Environmental suffix "E" denotes non-Pb solder. Greenliant non-Pb solder devices are "RoHS Compliant".

**Valid combinations for GLS37VF010**

GLS37VF010-70-3C-NHE    GLS37VF010-70-3C-WHE    GLS37VF010-70-3C-PHE

**Valid combinations for GLS37VF020**

GLS37VF020-70-3C-NHE    GLS37VF020-70-3C-WHE    GLS37VF020-70-3C-PHE

**Valid combinations for GLS37VF040**

GLS37VF040-70-3C-NHE    GLS37VF040-70-3C-WHE    GLS37VF040-70-3C-PHE

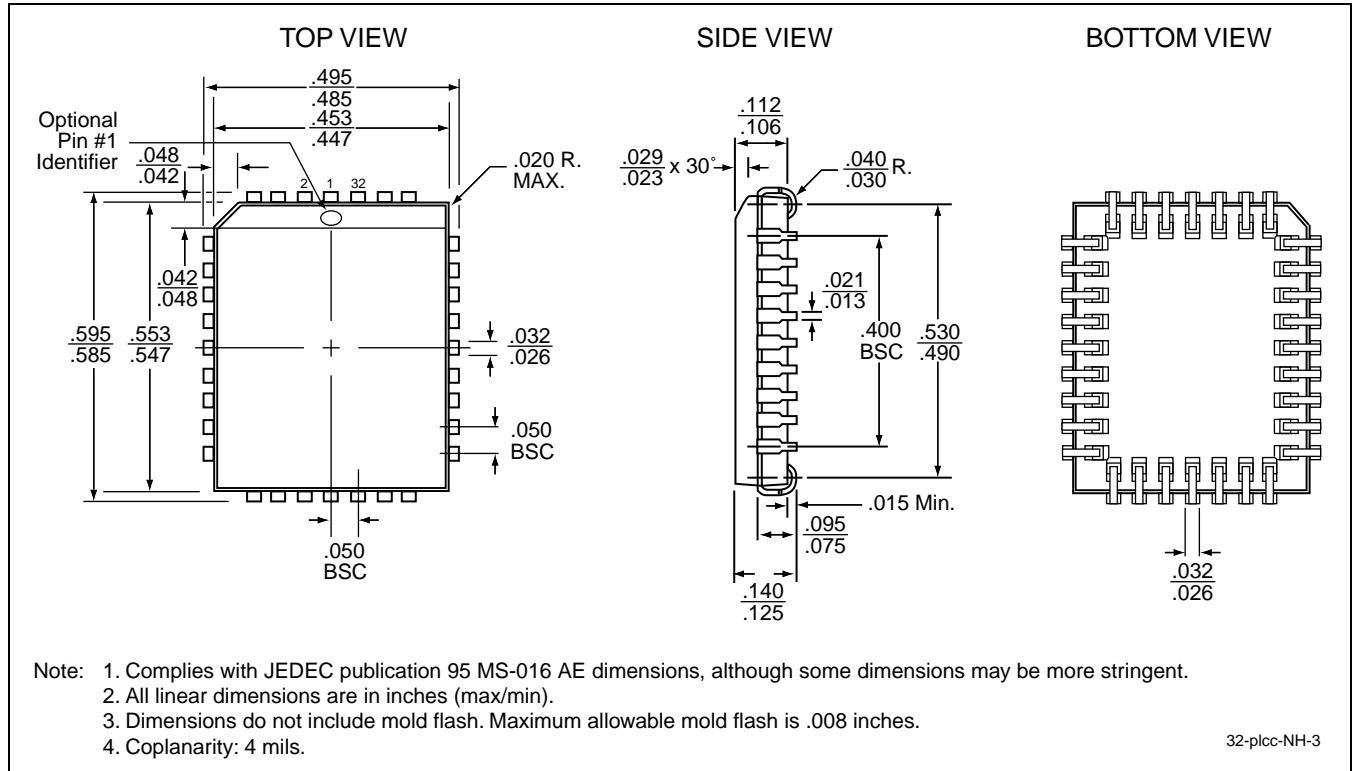
**Note:** Valid combinations are those products in mass production or will be in mass production. Consult your Greenliant sales representative to confirm availability of valid combinations and to determine availability of new combinations.

\* Not recommended for new designs.

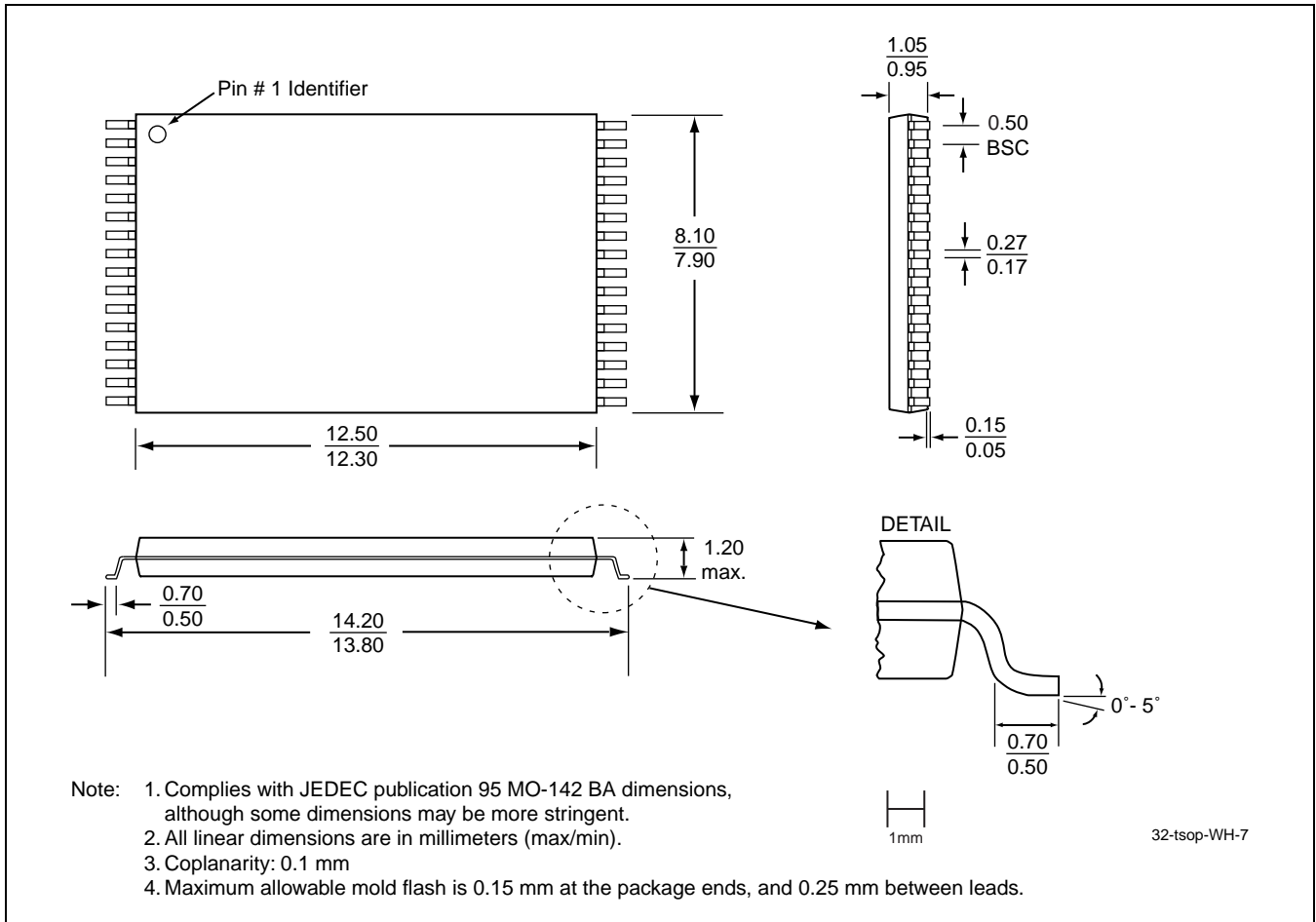


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**PACKAGING DIAGRAMS**



**FIGURE 12: 32-lead Plastic Lead Chip Carrier (PLCC)**  
**Greenliant Package Code: NH**



**FIGURE 13: 32-lead Thin Small Outline Package (TSOP) 8mm x 14mm  
 Greenliant Package Code: WH**



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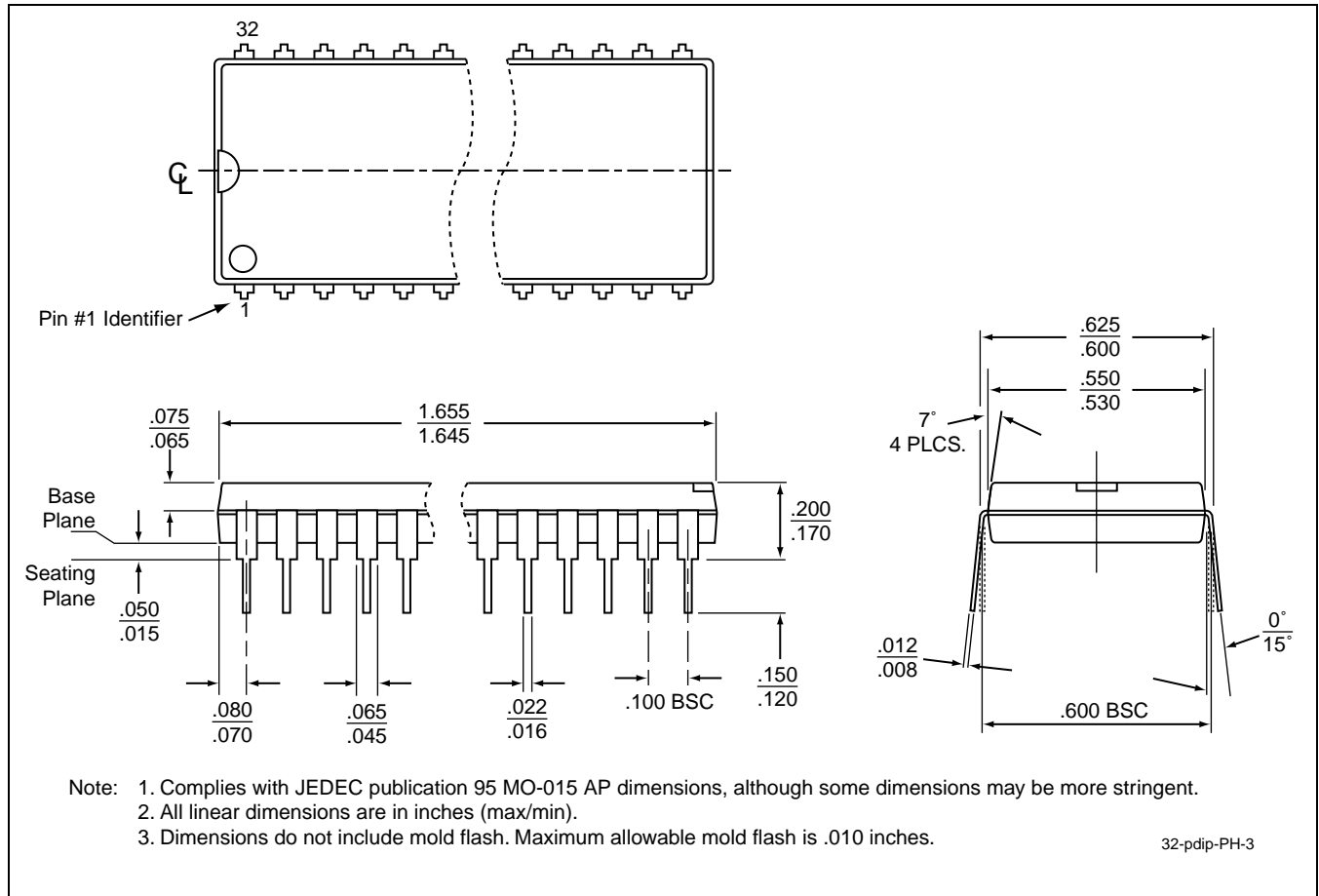


FIGURE 14: 32-pin Plastic Dual In-line Pins (PDIP)  
Greenliant Package Code: PH