LH28F016LL

16M (1M × 16, 2M × 8) Flash Memory

FEATURES

- User-Configurable x8 or x16 Operation
- 3 V Write/Erase Operation (3 V V_{PP})
  – 2.7 - 3.6 V Write-Erase Operation
- 120 ns Maximum Access Time (V_{CC} = 3.0 V)
- 150 ns Maximum Access Time (V_{CC} = 2.7 V)
- 32 Independently Lockable Blocks (64K)
- 0.48 MB/sec Write Transfer Rate
- 100,000 Erase Cycles per Block
- Revolutionary Architecture
  – Pipelined Command Execution
  – Write During Erase
  – Command Superset of Sharp LH28F016SU
- 10 µA (MAX.) I_{CC} in CMOS Standby
- 5 µA (MAX.) Deep Power-Down
- State-of-the Art 0.6 µm ETOX™ Flash Technology
- 56-Pin, 1.2 mm × 14 mm × 20 mm TSOP (Type I) Package

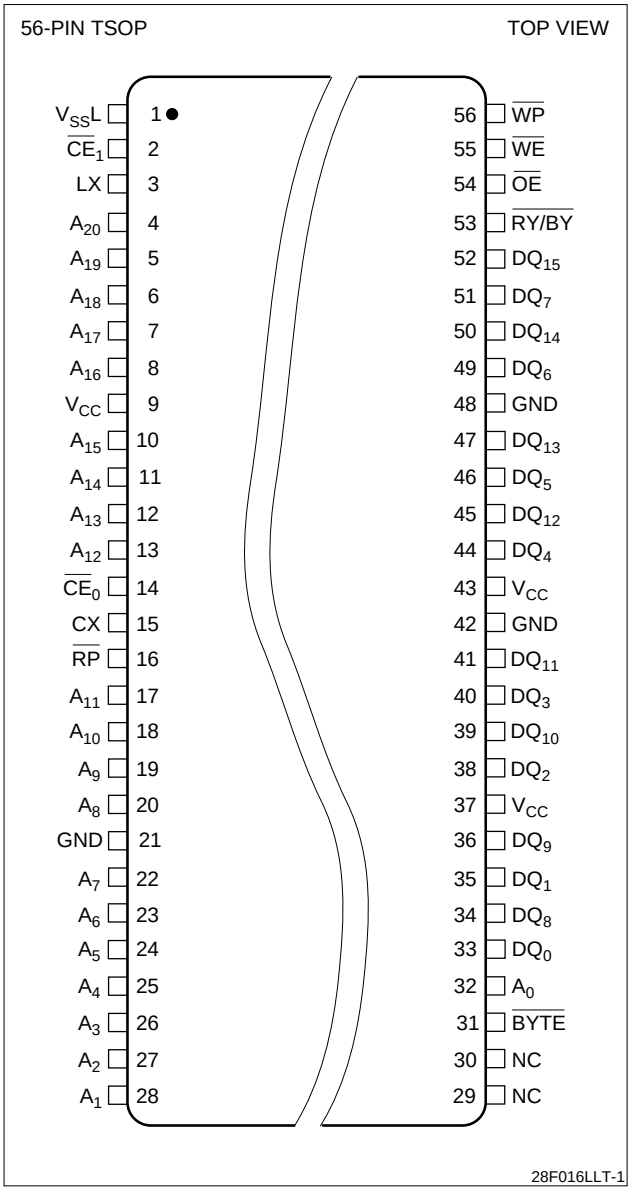


Figure 1. TSOP Configuration

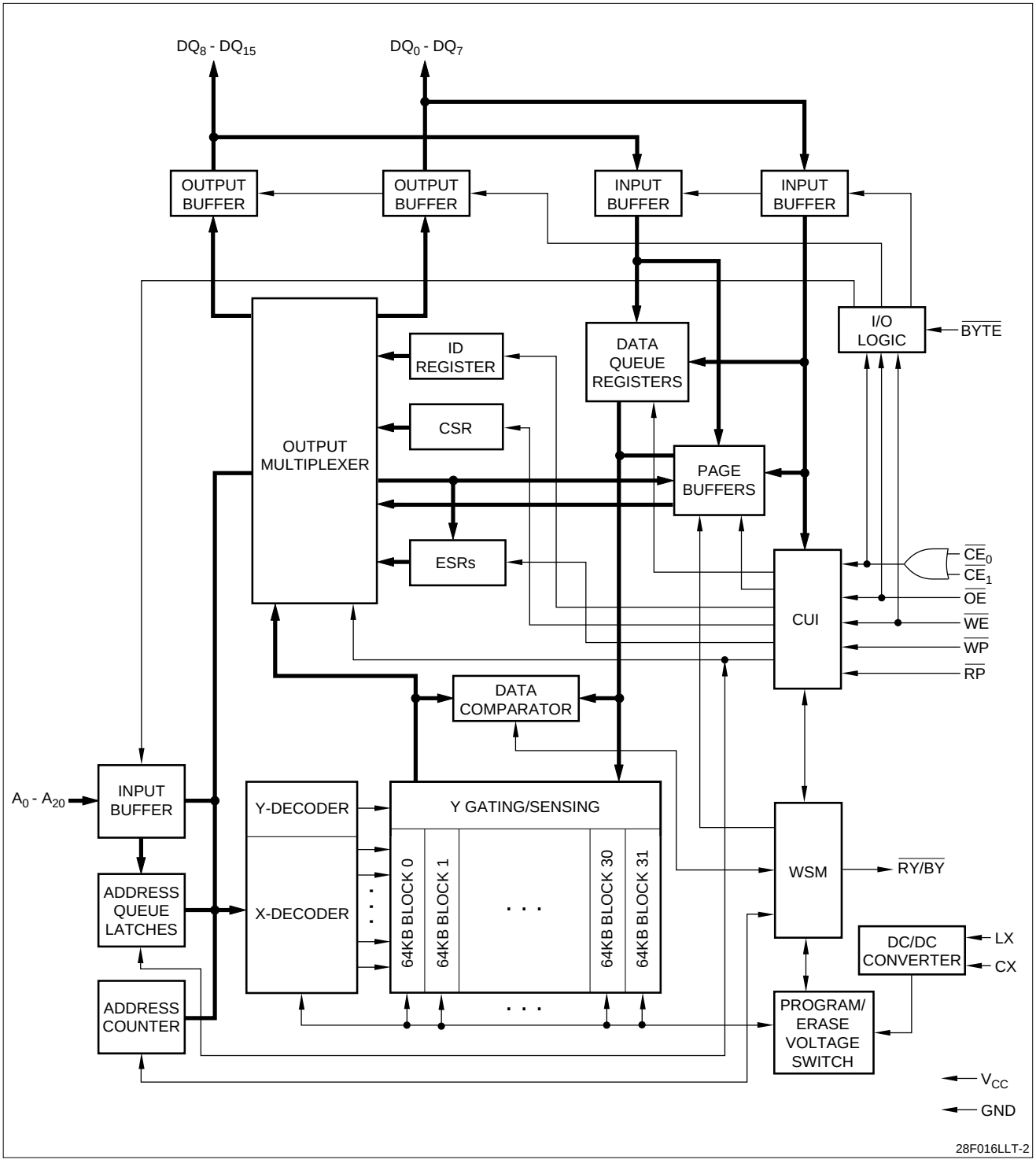


Figure 2. LH28F016LL Block Diagram (Architectural Evolution Includes Page Buffers, Queue Registers and Extended Status Registers)

PIN DESCRIPTION

SYMBOL	TYPE	NAME AND FUNCTION
A_0	INPUT	**BYTE-SELECT ADDRESS:** Selects between high and low byte when device is in x8 mode. This address is latched in x8 Data Writes. Not used in x16 mode (i.e., the A_0 input buffer is turned off when $\overline{BYTE}$ is high).
A_1 - A_{15}	INPUT	**WORD-SELECT ADDRESSES:** Select a word within one 64K block. A_6 - A_{15} selects 1 of 1024 rows, and A_1 - A_5 selects 16 of 512 columns. These addresses are latched during Data Writes.
A_{16} - A_{20}	INPUT	**BLOCK-SELECT ADDRESSES:** Select 1 of 32 Erase blocks. These addresses are latched during Data Writes, Erase and Lock-Block operations.
DQ_0 - DQ_7	INPUT/OUTPUT	**LOW-BYTE DATA BUS:** Inputs data and commands during CUI write cycles. Outputs array, buffer, identifier or status data in the appropriate Read mode. Floated when the chip is de-selected or the outputs are disabled.
DQ_8 - DQ_{15}	INPUT/OUTPUT	**HIGH-BYTE DATA BUS**: Inputs data during x16 Data-Write operations. Outputs array, buffer or identifier data in the appropriate Read mode; not used for Status register reads. Floated when the chip is de-selected or the outputs are disabled.
$\overline{CE}_0$, $\overline{CE}_1$	INPUT	**CHIP ENABLE INPUTS**: Activate the device's control logic, input buffers, decoders and sense amplifiers. With either $\overline{CE}_0$ or $\overline{CE}_1$ high, the device is de-selected and power consumption reduces to Standby levels upon completion of any current Data-Write or Erase operations. Both $\overline{CE}_0$, $\overline{CE}_1$ must be low to select the device. All timing specifications are the same for both signals. Device Selection occurs with the latter falling edge of $\overline{CE}_0$ or $\overline{CE}_1$. The first rising edge of $\overline{CE}_0$ or $\overline{CE}_1$ disables the device.
$\overline{RP}$	INPUT	**RESET/POWER-DOWN:** $\overline{RP}$ low places the device in a Deep Power-Down state. All circuits that burn static power, even those circuits enabled in standby mode, are turned off. When returning from Deep Power-Down, a recovery time of 5 ns is required to allow these circuits to power-up for Read mode, and another 395 ns is required to enter Program or Erase mode. When $\overline{RP}$ goes low, any current or pending WSM operation(s) are terminated, and the device is reset. All Status registers return to ready (with all status flags cleared).
$\overline{OE}$	INPUT	**OUTPUT ENABLE:** Gates device data through the output buffers when low. The outputs float to tri-state off when $\overline{OE}$ is high. **NOTE:** $\overline{CE}_X$ overrides $\overline{OE}$, and $\overline{OE}$ overrides $\overline{WE}$.
$\overline{WE}$	INPUT	**WRITE ENABLE:** Controls access to the CUI, Page Buffers, Data Queue Registers and Address Queue Latches. $\overline{WE}$ is active low, and latches both address and data (command or array) on its rising edge.
$\overline{RY}/\overline{BY}$	OPEN DRAIN OUTPUT	**READY/BUSY:** Indicates status of the internal WSM. When low, it indicates that the WSM is busy performing an operation. $\overline{RY}/\overline{BY}$ high indicates that the WSM is ready for new operations (or WSM has completed all pending operations), or Erase is Suspended, or the device is in deep power-down mode. This output is always active (i.e., not floated to tri-state off when $\overline{OE}$ or $\overline{CE}_0$, $\overline{CE}_1$ are high), except if a $\overline{RY}/\overline{BY}$ Pin Disable command is issued.

PIN DESCRIPTION (Continued)

SYMBOL	TYPE	NAME AND FUNCTION
$\overline{WP}$	INPUT	**WRITE PROTECT:** Erase blocks can be locked by writing a non-volatile lock-bit for each block. When $\overline{WP}$ is low, those locked blocks as reflected by the Block-Lock Status bits (BSR.6), are protected from inadvertent Data Writes or Erases. When $\overline{WP}$ is high, all blocks can be Written or Erased regardless of the state of the lock-bits. The $\overline{WP}$ input buffer is disabled when $\overline{RP}$ transitions low (deep power-down mode).
$\overline{BYTE}$	INPUT	**BYTE ENABLE:** $\overline{BYTE}$ low places device in x8 mode. All data is then input or output on DQ_0 - DQ_7, and DQ_8 - DQ_{15} float. Address A_0 selects between the high and low byte. $\overline{BYTE}$ high places the device in x16 mode, and turns off the A_0 input buffer. Address A_1, then becomes the lowest order address.
LX	INPUT	**INPUT FROM OUTSIDE INDUCTOR:** Input pin for outside inductor in DC/DC converter circuit. Connect 1.8 (µH) inductor from V_{CC}.
LC	INPUT	**INPUT FROM OUTSIDE CAPACITOR:** Input pin for outside capacitor in DC/DC converter circuit. Ground at 22000 (pF) capacitor.
V_{CC}	SUPPLY	**DEVICE POWER SUPPLY 3.0 V (2.7 V to 3.6 V)**: Do not leave any power pins floating.
GND	SUPPLY	**GROUND FOR ALL INTERNAL CIRCUITRY:** Do not leave any ground pins floating.
NC		**NO CONNECT:** No internal connection to die, lead may be driven or left floating.
V_{SS}L		**GROUND**

INTRODUCTION

Sharp's LH28F016LL 16M Flash Memory is a revolutionary architecture which enables the design of truly mobile, high performance, personal computing and communication products. With innovative capabilities, 3 V single voltage operation and very high read/write performance, the LH28F0166LL is also the ideal choice for designing embedded mass storage flash memory systems.

The LH28F016LL is very high density, highest performance non-volatile read/write solution for solid-state storage applications. Its symmetrically blocked architecture (100% compatible with the LH28F016SU 16M Flash memory), extended cycling, minimum power 2.7 V operation, very fast write and read performance and selective block locking provide a highly flexible memory component suitable for battery operation portable equipment such as digital still camera, PDA, cellular phone, and memory card. Its x8/x16 architecture allows the optimization of memory to processor interface. The flexible block locking option enables bundling of executable of executable application software in a Resident Flash Array or memory card. Manufactured on Sharp's 0.6 µm ETOX™ process technology, the LH28F016LL is the most cost-effective, high-density 3 V single power operation flash memory.

DESCRIPTION

The LH28F016LL is a high performance 16M (16,777,216 bit) block erasable non-volatile random access memory organized as either 1M × 16 or 2M x 8. The LH28F016LL includes thirty-two 64K (65,536) blocks or thirty-two 32-KW (32,768) blocks. A chip memory map is shown in Figure 3.

The implementation of a new architecture, with many enhanced features, will improve the device operating characteristics and results in greater product reliability and ease of use.

Among the significant enhancements of the LH28F016LL:

- 3 V Write/Erase Operation (3 V V_{PP})
- 3 V Low Power Capability
- Improved Write Performance
- Dedicated Block Write/Erase Protection

The LH28F016LL will be available in a 56-pin, 1.2 mm thick × 14 mm × 20 mm TSOP (Type I) package. This form factor and pinout allow for very high board layout densities.

A Command User Interface (CUI) serves as the system interface between the microprocessor or microcontroller and the internal memory operation.

Internal Algorithm Automation allows Byte/Word Writes and Block Erase operations to be executed using a Two-Write command sequence to the CUI in the same way as the LH28F008SA 8M Flash memory.

A Superset of commands have been added to the basic LH28F008SA command-set to achieve higher write performance and provide additional capabilities. These new commands and features include:

- Page Buffer Writes to Flash
- Command Queuing Capability
- Automatic Data Writes During Erase
- Software Locking of Memory Blocks
- Two-Byte Successive Writes in 8-bit Systems
- Erase All Unlocked Blocks

Writing of memory data is performed in either byte or word increments typically within 9 µs, a 15% improvement over the LH28F008SA.

Each block can be written and erased a minimum of 100,000 cycles. Systems can achieve 1,000,000 Block Erase Cycles by providing wear-leveling algorithms and graceful block retirement. These techniques have already been employed in many flash file systems and Hard Disk Drive designs.

The LH28F016LL incorporates two Page Buffers of 256 Bytes (128 Words) each to allow page data writes. This feature can improve a system write performance by up to 4.8 times over previous flash memory devices.

All operations are started by a sequence of Write commands to the device. Three Status Registers (described in detail later) and a $\overline{RY}/\overline{BY}$ output pin provide information on the progress of the requested operation.

While the LH28F008SA requires an operation to complete before the next operation can be requested, the LH28F016LL allows queuing of the next operation while the memory executes the current operation. This eliminates system overhead when writing several bytes in a row to the array or erasing several blocks at the same time. The LH28F016LL can also perform write operations to one block of memory while performing erase of another block.

The LH28F016LL provides user-selectable block locking to protect code or data such as Device Drivers, PCMCIA card information, ROM-Executable O/S or Application Code. Each block has an associated non-volatile lock-bit which determines the lock status of the block. In addition, the LH28F016LL has a master Write Protect pin ($\overline{WP}$) which prevents any modifications to memory blocks whose lock-bits are set.

The LH28F016LL contains three types of Status Registers to accomplish various functions:

- A Compatible Status Register (CSR) which is 100% compatible with the LH28F008SA Flash memory's Status Register. This register, when used alone, provides a straightforward upgrade capability to the LH28F016LL from a LH28F008SA-based design.
- A Global Status Register (GSR) which informs the system of command Queue status. Page Buffer status, and overall Write Status Machine (WSM) status.
- 32 Block Status Registers (BSRs) which provide block-specific status information such as the block lock-bit status.

The GSR and BSR memory maps for Byte-Wide and Word-Wide modes are shown in Figures 4 and 5.

The LH28F016LL incorporates an open drain $\overline{RY}/\overline{BY}$ output pin. This feature allows the user to OR-tie many $\overline{RY}/\overline{BY}$ pins together in a multiple memory configuration such as a Resident Flash Array.

The LH28F016LL also incorporates a dual chip-enable function with two input pins, $\overline{CE}_0$ and $\overline{CE}_1$. These pins have exactly the same functionality as the regulary chip-enable pin $\overline{CE}$ on the LH28F008SA. For minimum chip designs, $\overline{CE}_1$ may be tied to ground and use $\overline{CE}_0$ as the chip enable input. The LH28F016LL uses the logical combination of these two signals to enable or disable the entire chip. Both $\overline{CE}_0$ and $\overline{CE}_1$ must be active low to enable the device and if either one becomes inactive, the chip will be disabled. This feature, along with the open drain $\overline{RY}/\overline{BY}$ pin, allows the system designer to reduce the number of control pins used in a large array of 16M devices.

The $\overline{BYTE}$ pin allows either x8 or x16 read/writes to the LH28F016LL. $\overline{BYTE}$ at logic low selects 8-bit mode with address A_0 selecting between low byte and high byte. On the other hand, $\overline{BYTE}$ at logic high enables 16-bit operation with address A_1 becoming the lowest order address and address A_0 is not used (don't care). A device diagram is shown in Figure 1.

The LH28F016LL is specified for a maximum access time (t_{ACC})150 ns, in operating voltage 2.7 V to 3.6 V and in operating temperature 0°C to +70°C.

The LH28F016LL incorporates an Automatic Power Saving (APS) feature which substantially reduces the active current when the device is in static mode of operation (address not switching).

In APS mode, the typical I_{CC} current is 1 mA at 3.0 V.

A Deep Power-Down mode of operation is invoked when the $\overline{RP}$ (called $\overline{PWD}$ on the LH28F008SA) pin transitions low. This mode brings the device power consumption to less than 5 µA typically, and provides additional write protection by acting as a device reset pin during power transitions. A reset time of 480 ns is required from $\overline{RP}$ switching high until outputs are again valid. In the Deep Power-Down state, the WSM is reset (any current operation will abort) and the CSR, GSR and BSR registers are cleared.

A CMOS Standby mode of operation is enabled when either $\overline{CE}_0$ or $\overline{CE}_1$ transitions high and $\overline{RP}$ stays high with all input control pins at CMOS levels. In this mode, the device typically draws an I_{CC} standby current of 10 µA.

MEMORY MAP

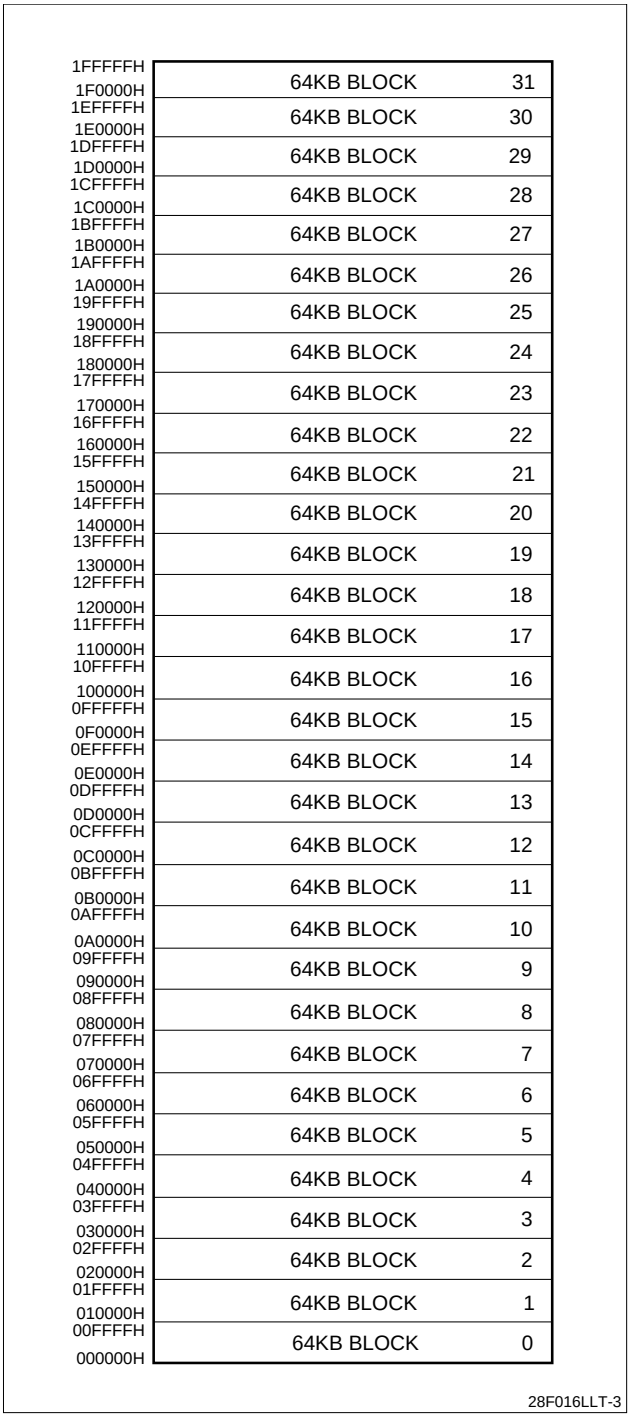


Figure 3. LH28F016LL Memory Map

Extended Status Registers Memory Map

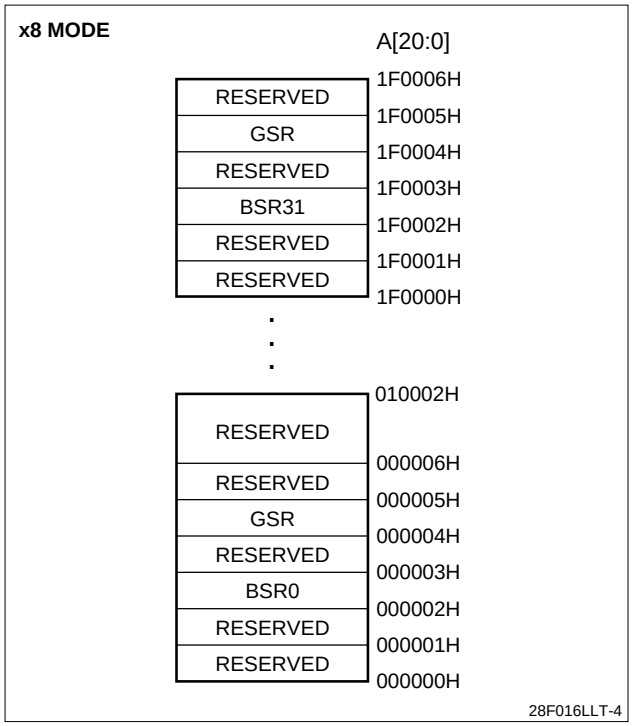


Figure 4. Extended Status Register Memory Map (Byte-Wide Mode)

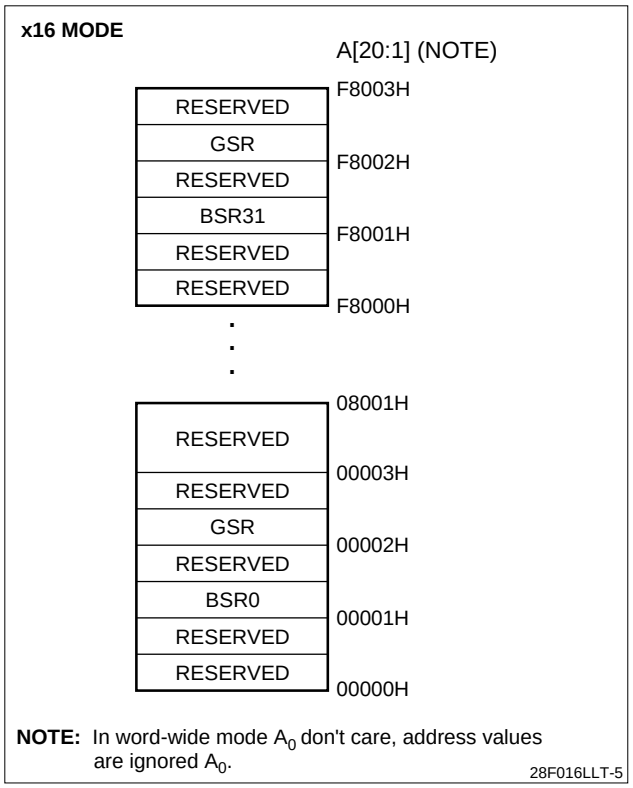


Figure 5. Extended Status Register Memory Map (Word-Wide Mode)

BUS OPERATIONS, COMMANDS AND STATUS REGISTER DEFINITIONS

Bus Operations for Word-Wide Mode ($\overline{BYTE} = V_{IH}$)

MODE	$\overline{RP}$	$\overline{CE}_1$	$\overline{CE}_0$	$\overline{OE}$	$\overline{WE}$	A_1	DQ_0 - DQ_{15}	$\overline{RY}/\overline{BY}$	NOTE
Read	V_{IH}	V_{IL}	V_{IL}	V_{IL}	V_{IH}	X	D_{OUT}	X	1, 2
Output Disable	V_{IH}	V_{IL}	V_{IL}	V_{IH}	V_{IH}	X	High-Z	X	1, 6
Standby	V_{IH}	V_{IL} V_{IH} V_{IH}	V_{IH} V_{IL} V_{IH}	X	X	X	High-Z	X	1, 6
Deep Power-Down	V_{IL}	X	X	X	X	X	High-Z	V_{OH}	1, 3
Manufacturer ID	V_{IH}	V_{IL}	V_{IL}	V_{IL}	V_{IH}	V_{IL}	00B0H	V_{OH}	4
Device ID	V_{IH}	V_{IL}	V_{IL}	V_{IL}	V_{IH}	V_{IH}	6688H	V_{OH}	4
Write	V_{IH}	V_{IL}	V_{IL}	V_{IH}	V_{IL}	X	D_{IN}	X	1, 5, 6

Bus Operations For Byte-Wide Mode ($\overline{BYTE} = V_{IL}$)

MODE	$\overline{RP}$	$\overline{CE}_1$	$\overline{CE}_0$	$\overline{OE}$	$\overline{WE}$	A_0	DQ_0 - DQ_7	$\overline{RY}/\overline{BY}$	NOTE
Read	V_{IH}	V_{IL}	V_{IL}	V_{IL}	V_{IH}	X	D_{OUT}	X	1, 2
Output Disable	V_{IH}	V_{IL}	V_{IL}	V_{IH}	V_{IH}	X	High-Z	X	1, 6
Standby	V_{IH}	V_{IL} V_{IH} V_{IH}	V_{IH} V_{IL} V_{IH}	X	X	X	High-Z	X	1, 6
Deep Power-Down	V_{IL}	X	X	X	X	X	High-Z	V_{OH}	1, 3
Manufacturer ID	V_{IH}	V_{IL}	V_{IL}	V_{IL}	V_{IH}	V_{IL}	B0H	V_{OH}	4
Device ID	V_{IH}	V_{IL}	V_{IL}	V_{IL}	V_{IH}	V_{IH}	88H	V_{OH}	4
Write	V_{IH}	V_{IL}	V_{IL}	V_{IH}	V_{IL}	X	D_{IN}	X	1, 5, 6

NOTES:

1. X can be V_{IH} or V_{IL} for address or control pins except for $\overline{RY}/\overline{BY}$, which is either V_{OL} or V_{OH}.
2. $\overline{RY}/\overline{BY}$ output is open drain. When the WSM is ready, Erase is suspended or the device is in deep power-down mode, $\overline{RY}/\overline{BY}$ will be at V_{OH} if it is tied to V_{CC} through a resistor. When the $\overline{RY}/\overline{BY}$ at V_{OH} is independent of $\overline{OE}$ while a WSM operation is in progress.
3. $\overline{RP}$ at GND ± 0.2 V ensures the lowest deep power-down current.
4. A_0 and A_1 at V_{IL} provide manufacturer ID codes in x8 and x16 modes respectively. All other addresses are set to zero. A_0 and A_1, at V_{IH} provide device ID codes in x8 and x16 modes respectively. All other addresses are set to zero.
5. Commands for different Erase operations, Data Write operations of Lock-Block operations can only be successfully completed when $V_{PP} = V_{PPH}$.
6. While the WSM is running, $\overline{RY}/\overline{BY}$ in Level-Mode (default) stays at V_{OL} until all operations are complete. $\overline{RY}/\overline{BY}$ goes to V_{OH} when the WSM is not busy or in erase suspend mode.

LH28F008SA-Compatible Mode Command Bus Definitions

COMMAND	FIRST BUS CYCLE			SECOND BUS CYCLE			NOTE
	OPER.	ADDRESS	DATA	OPER.	ADDRESS	DATA	
Read Array	Write	X	FFH	Read	AA	AD	
Intelligent Identifier	Write	X	90H	Read	IA	ID	1
Read Compatible Status Register	Write	X	70H	Read	X	CSRD	2
Clear Status Register	Write	X	50H				3
Word/Byte Write	Write	X	40H	Write	WA	WD	
Alternate Word/Byte Write	Write	X	10H	Write	WA	WD	
Block Erase/Confirm	Write	X	20H	Write	BA	D0H	
Erase Suspend/Resume	Write	X	B0H	Write	X	D0H	

ADDRESS
AA = Array Address
BA = Block Address
IA = Identifier Address
WA = Write Address
X = Don't Care

DATA
AD = Array Data
CSRD = CSR Data
ID = Identifier Data
WD = Write Data

NOTES:
1. Following the intelligent identifier command, two Read operations access the manufacturer and device signature codes.
2. The CSR is automatically available after device enters Data Write, Erase or Suspend operations.
3. Clears CSR.3, CSR.4, and CSR.5. Also clears GSR.5 and all BSR.5 and BSR.2 bits. See Status register definitions.
4. While device performs Block Erase, if you issue Erase Suspend command (B0H), be sure to confirm ESS (Erase-Suspend-Status) is set to 1 on compatible status register. In the case, ESS bit was not set to 1, also completed the Erase (ESS = 0, WASM = 1), be sure to issue Resume command (D0H) after completed next Erase command. Beside, when the Erase Suspend command is issued, while the device is not in Erase, be sure to issue Resume command (D0H) after the next erase completed. When you use Erase Suspend/ Resume command, we recommend to issue serial Block Erase command (20H, D0H) and Resume command (D0H). (Refer to Performance Enhancement Command Bus Definitions.)

LH28F800SU Performance Enhancement Command Bus Definitions

COMMAND	MODE	FIRST BUS CYCLE			SECOND BUS CYCLE			THIRD BUS CYCLE			NOTE
		OPER.	ADDR.	DATA	OPER.	ADDR.	DATA	OPER.	ADDR.	DATA	
Read Extended Status Register		Write	X	71H	Read	RA	GSRD BSRD				1
Page Buffer Swap		Write	X	72H							7
Read Page Buffer		Write	X	75H	Read	PA	PD				
Single Load to Page Buffer		Write	X	74H	Write	PA	PD				
Sequential Load to Page Buffer	x8	Write	X	E0H	Write	X	BCL	Write	X	BCH	4, 6, 10
	x16	Write	X	E0H	Write	X	WCL	Write	X	WCH	4, 5, 6, 10
Page Buffer Write to Flash	x8	Write	X	0CH	Write	A0	BC (L, H)	Write	WA	BC (H, L)	3, 4, 9, 10
	x16	Write	X	0CH	Write	X	WCL	Write	WA	WCH	4, 5, 10
Two-Byte Write	x8	Write	X	FBH	Write	A0	WD (L, H)	Write	WA	WD (H, L)	3
Block Erase/Confirm		Write	X	20H	Write	BA	D0H	Write	X	D0H	11
Lock Block/Confirm		Write	X	77H	Write	BA	D0H				
Upload Status Bits/Confirm		Write	X	97H	Write	X	D0H				2
Upload Device Information		Write	X	99H	Write	X	D0H				
Erase All Unlocked Blocks/Confirm		Write	X	A7H	Write	X	D0H				
$\overline{RY}/\overline{BY}$ Enable to Level-Mode		Write	X	96H	Write	X	01H				8
$\overline{RY}/\overline{BY}$ Pulse-On-Write		Write	X	96H	Write	X	02H				8
$\overline{RY}/\overline{BY}$ Pulse-On-Erase		Write	X	96H	Write	X	03H				8
$\overline{RY}/\overline{BY}$ Disable		Write	X	96H	Write	X	04H				8
Sleep		Write	X	F0H							
Abort		Write	X	80H							

ADDRESS
BA = Block Address
PA = Page Buffer Address
RA = Extended Register Address
WA = Write Address
X = Don't Care

DATA
AD = Array Data
PD = Page Buffer Data
BSRD = BSR Data
GSRD = GSR Data
WC (L, H) = Word Count (Low, High)
BC (L, H) = Byte Count (Low, High)
WD (L, H) = Write Data (Low, High)

NOTES:
1. RA can be the GSR address or any BSR address. See Figure 4.1 and 4.2 for Extended Status Register Memory Maps.
2. Upon device power-up, all BSR lock-bits come up locked. The Uploaded Status Bits command must be written to reflect the actual lock-bit status.
3. A_0 is automatically complemented to load second byte of data. $\overline{BYTE}$ must be at V_{IL}. A_0 value determines which WD/BC is supplied first: A_0 = 0 looks at the WDL/BCL, A_0 = 1 looks at the WDH/BCH.
4. BCH/WCH must be at 00H for this product because of the 256-Byte (128 Word) Page Buffer size and to avoid writing the Page Buffer contents into more than one 256-Byte segment within an array block. They are simply shown for future Page Buffer expandability.
5. In x16 mode, only the lower byte DQ_0 - DQ_7 is used for WCL and WCH. The upper byte DQ_8 - DQ_{15} is a don't care.
6. PA and PD (Whose count is given in cycles 2 and 3) are supplied starting in the 4th cycle which is not shown.
7. This command allows the user to swap between available Page Buffers (0 or 1).
8. These commands reconfigure $\overline{RY}/\overline{BY}$ output to one of two pulse-modes or enable and disable the $\overline{RY}/\overline{BY}$ function.
9. Write address, WA, is the Destination address in the flash array which must match the Source address in the Page Buffer. Refer to the LH28F016SU User's Manual.
10. BCL = 00H corresponds to a Byte count of 1. Similarly, WCL = 00H corresponds to a Word count of 1.
11. Unless you issue erase suspend command, it is not necessary to input D0H on third bus cycle.

Compatible Status Register

WSMS	ESS	ES	DWS	VPPS	R	R	R
7	6	5	4	3	2	1	0

CSR.7 = WRITE STATE MACHINE STATUS (WSMS)
1 = Ready
0 = Busy

CSR.6 = ERASE-SUSPEND STATUS (ESS)
1 = Erase Suspended
0 = Erase in Progress/Completed

CSR.5 = ERASE STATUS (ES)
1 = Error in Block Erasure
0 = Successful Block Erase

CSR.4 = DATA-WRITE STATUS (DWS)
1 = Error in Data Write
0 = Data Write Successful

CSR.3 = V_{PP} STATUS (VPPS)
1 = V_{PP} Low Detect, Operation Abort
0 = V_{PP} OK

NOTES:
1. $\overline{RY}/\overline{BY}$ output or WSMS bit must be checked to determine completion of an operation (Erase Suspend, Erase or Data Write) before the appropriate Status bit (ESS, ES or DWS) is checked for success.
2. If DWS and ES are set to '1' during an erase attempt, an improper command sequence was entered. Clear the CSR and attempt the operation again.
3. The VPPS bit, unlike an A/D converter, does not provide continuous indication of V_{PP} level. The WSM interrogates V_{PP}'s level only after the Data-Write or Erase command sequences have been entered, and informs the system if V_{PP} has not been switched on. VPPS is not guaranteed to report accurate feedback between V_{PPL} and V_{PPH}.
4. CSR.2 - CSR.0 = Reserved for future enhancements. These bits are reserved for future use and should be masked out when polling the CSR.

GLOBAL STATUS REGISTER

WSMS	OSS	DOS	DSS	QS	PBAS	PBS	PBSS
7	6	5	4	3	2	1	0

GSR.7 = WRITE STATE MACHINE STATUS (WSMS)
1 = Ready
0 = Busy

GSR.6 = OPERATION SUSPEND STATUS (OSS)
1 = Operation Suspended
0 = Operation in Progress/Completed

GSR.5 = DEVICE OPERATION STATUS (DOS)
1 = Operation Unsuccessful
0 = Operation Successful or Currently Running

GSR.4 = DEVICE SLEEP STATUS(DSS)
1 = Device in Sleep
0 = Device Not in Sleep

MATRIX 5/4
00 = Operation Successful or Currently Running
01 = Device in Sleep Mode or Pending Sleep
10 = Operation Unsuccesful
11 = Operation Unsuccessful or Aborted

GSR.3 = QUEUE STATUS (QS)
1 = Queue Full
0 = Queue Available

GSR.2 = PAGE BUFFER AVAILABLE STATUS (PBAS)
1 = One or Two Page Buffers Available
0 = No Page Buffer Available

GSR.1 = PAGE BUFFER STATUS (PBS)
1 = Selected Page Buffer Ready
0 = Selected Page Buffer Busy

GSR.0 = PAGE BUFFER SELECT STATUS (PBSS)
1 = Page Buffer 1 Selected
0 = Page buffer 0 Selected

NOTES:
1. $\overline{RY}/\overline{BY}$ output or WSMS bit must be checked to determine completion of an operation (Block Lock, Suspend, any $\overline{RY}/\overline{BY}$ reconfiguration, Upload Status Bits, Erase or Data Write) before the appropriate Status bit (OSS or DOS) is checked for success.
2. If operation currently running, then GSR.7 = 0.
3. If device pending sleep, then GSR.7 = 0.
4. Operation aborted: Unsucccessful due to Abort command.
5. The device contains two Page Buffers.
6. Selected Page Buffer is currently busy with WSM operation.
7. When multiple operations are queued, checking BSR.7 only provides indication of completion for that particular block. GSR.7 provides indication when all queued operations are completed.

BLOCK STATUS REGISTER

BS	BLS	BOS	BOAS	QS	VPPS	R	R
7	6	5	4	3	2	1	0

BSR.7 = 1BLOCK STATUS (BS)
1 = Ready
0 = Busy

BSR.6 = BLOCK-LOCK STATUS (BLS)
1 = Block Unlocked for Write/Erase
0 = Block Locked for Write/Erase

BSR.5 = BLOCK OPERATION STATUS (BOS)
1 = Operation Unsuccessful
0 = Operation Successful or Currently Running

BSR.4 = BLOCK OPERATION ABORT STATUS (BOAS)
1 = Operation Aborted
0 = Operation Not Aborted

MATRIX 5/4
00 = Operation Successful or Currently Running
01 = Not a valid Combination
10 = Operation Unsuccessful
11 = Operation Aborted

BSR.3 = QUEUE STATUS (QS)
1 = Queue Full
0 = Queue Available

BSR.2 = V_{PP} STATUS (V_{PPS})
1 = V_{PP} Low Detect, Operation Abort
0 = V_{PP} OK

NOTES:
1. $\overline{RY}/\overline{BY}$ output or BS bit must be checked to determine completion of an operation (Block Lock, Suspend, Erase or Data Write) before the appropriate Status bits (BOS, BLS) is checked for success.
2. The BOAS bit will not be set until BSR.7 = 1.
3. Operation halted via Abort command.
4. BSR.1-0 = RESERVED FOR FUTURE ENHANCEMENTS
These bits are reserved for future use; mask them out when polling the BSRs.
5. When multiple operations are queued, checking BSR.7 only provides indication of completion for that particular block. GSR.7 provides indication when all queued operations are completed.

ELECTRICAL SPECIFICATIONS[1]

Absolute Maximum Ratings*

Temperature under bias ..... 0°C to +80°C

Storage temperature ..... -65°C to +125°C

**WARNING: Stressing the device beyond the "Absolute Maximum Ratings" may cause permanent damage. These are stress ratings only. Operation beyond the "Operating Conditions" is not recommended and extended exposure beyond the "Operating Conditions" may affect device reliability.*

V_{CC} = 3.3 V ±0.3 V Systems[4]

SYMBOL	PARAMETER	MIN.	MAX.	UNITS	TEST CONDITIONS	NOTE
T_A	Operating Temperature, Commercial	0	70.0	°C	Ambient Temperature	1
V_{CC}	V_{CC} with Respect to GND	-0.2	7.0	V		2
V_{PP}	V_{PP} Supply Voltage with Respect to GND	-0.2	7.0	V		2
V	Voltage on any Pin (Except V_{CC}, V_{PP}) with Respect to GND	-0.5	V_{CC} + 0.5	V		2
I	Current into any Non-Supply Pin		±30	mA		
I_{OUT}	Output Short Circuit Current		100.0	mA		3

NOTES:
1. Operating temperature is for commercial product defined by this specification.
2. Minimum °C voltage is -0.5 V on input/output pins. During transitions, this level may undershoot to -2.0 V for periods < 20 ns. Maximum °C voltage on input/output pins is V_{CC} + 0.5 V which, during transitions, may overshoot to V_{CC} + 2.0 V for periods < 20 ns.
3. Output shorted for no more than one second. No more than one output shorted at a time.
4. AC specifications are valid at both voltage ranges. See DC Characteristics tables for voltage range-specific specifications.

Capacitance

For 3.3 V Systems

SYMBOL	PARAMETER	TYP.	MAX.	UNITS	TEST CONDITIONS	NOTE
C_{IN}	Capacitance Looking into an Address/Control Pin	6	8	pF	T_A = 25°C, f = 1.0 MHz	1
C_{OUT}	Capacitance Looking into an Output Pin	8	12	pF	T_A = 25°C, f = 1.0 MHz	1
C_{LOAD}	Load Capacitance Driven by Outputs for Timing Specifications		50	pF	For V_{CC} = 3.3 V ±0.3 V	1
	Equivalent Testing Load Circuit		2.5	ns	50 Ω transmission line delay	

NOTE:
1. Sampled, not 100% tested.

Timing Nomenclature

All 3.3 V system timings are measured from where signals cross 1.5 V. For 5.0 V systems use the standard JEDEC cross point definitions. Each timing parameter consists of 5 characters. Some common examples are defined below:

t_{CE} t_{ELQV} time (t) from $\overline{CE}$ (E) going low (L) to the outputs (Q) becoming valid (V)

t_{OE} t_{GLQV} time (t) from $\overline{OE}$ (G) going low (L) to the outputs (Q) becoming valid (V)

t_{ACC} t_{AVQV} time (t) from address (A) valid (V) to the outputs (Q) becoming valid (V)

t_{AS} t_{AVWH} time (t) from address (A) valid (V) to $\overline{WE}$ (W) going high (H)

t_{DH} t_{WHDX} time (t) from $\overline{WE}$ (W) going high (H) to when the data (D) can become undefined (X)

	PIN CHARACTERS		PIN STATES
A	Address Inputs	H	High
D	Data Inputs	L	Low
Q	Data Outputs	V	Valid
E	$\overline{CE}$ (Chip Enable)	X	Driven, but not necessarily valid
G	$\overline{OE}$ (Output Enable)	Z	High Impedance
W	$\overline{WE}$ (Write Enable)		
P	$\overline{RP}$ (Deep Power-Down Pin)		
R	$\overline{RY}/\overline{BY}$ (Ready/Busy)		
V	Any Voltage Level		
3 V	V_{CC} at 3.0 V Min.		

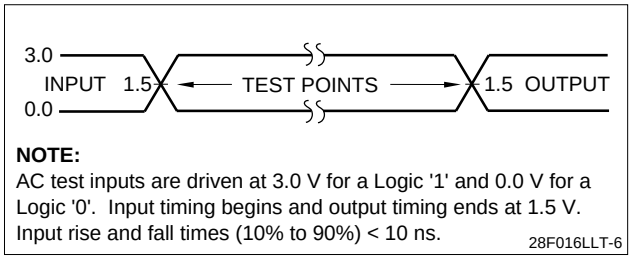


Figure 6. Transient Input/Output Reference Waveform (V_{CC} = 3.3 V)

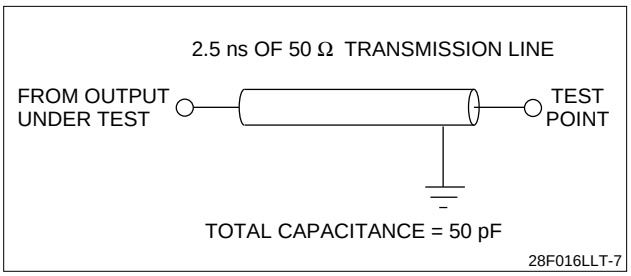


Figure 7. Transient Equivalent Testing Load Circuit (V_{CC} = 3.3 V)

DC Characteristics

V_{CC} = 3.3 V ± 0.3 V, T_A = 0°C to +70°C

SYMBOL	PARAMETER	TYP.	MIN.	MAX.	UNITS	TEST CONDITIONS	NOTE
I_{IL}	Input Load Current			±1	µA	V_{CC} = V_{CC} MAX., V_{IN} = V_{CC} or GND	1
I_{LO}	Output Leakage Current			±10	µA	V_{CC} = V_{CC} MAX., V_{IN} = V_{CC} or GND	1
I_{CCS}	V_{CC} Standby Current	4		8	µA	V_{CC} = V_{CC} MAX., $\overline{CE}_0$, $\overline{CE}_1$, $\overline{RP}$ = V_{CC} ±0.2 V $\overline{BYTE}$, $\overline{WP}$, $\overline{3/5}$ = V_{CC} ±0.2 V or GND ±0.2 V	1, 4
		1		4	mA	V_{CC} = V_{CC} MAX., $\overline{CE}_0$, $\overline{CE}_1$, $\overline{RP}$ = V_{IH} $\overline{BYTE}$, $\overline{WP}$, $\overline{3/5}$ = V_{IH} or V_{IL}	
I_{CCD}	V_{CC} Deep Power-Down Current	1		5	µA	$\overline{RP}$ = GND ±0.2 V	1
I_{CCR}[1]	V_{CC} Read Current	30		35	mA	V_{CC} = V_{CC} MAX., CMOS: $\overline{CE}_0$, $\overline{CE}_1$ = GND ±0.2 V $\overline{BYTE}$ = GND ±0.2 V or V_{CC} ±0.2 V Inputs = GND ±0.2 V or V_{CC} ±0.2 V TTL: $\overline{CE}_0$, $\overline{CE}_1$ = V_{IL}, $\overline{BYTE}$ = V_{IL} or V_{IH} Inputs = V_{IL} or V_{IH} f = 8 MHz, I_{OUT} = 0 mA	1, 3, 4
I_{CCR}[2]	V_{CC} Read Current	15		20	mA	V_{CC} = V_{CC} MAX., CMOS: $\overline{CE}_0$, $\overline{CE}_1$ = GND ±0.2 V $\overline{BYTE}$ = V_{CC} ±0.2 V or GND ±0.2 V Inputs = GND ±0.2 V or V_{CC} ±0.2 V TTL: $\overline{CE}_0$, $\overline{CE}_1$ = V_{IL}, $\overline{BYTE}$ = V_{IH} or V_{IL} Inputs = V_{IL} or V_{IH} f = 4 MHz, I_{OUT} = 0 mA	1, 3, 4
I_{CCW}	V_{CC} Write Current	8		12	mA	Word/Byte Write in Progress	1
I_{CCE}	V_{CC} Block Erase Current	6		10	mA	Block Erase in Progress	1
I_{CCES}	V_{CC} Erase Suspend Current	3		6	mA	$\overline{CE}_0$, $\overline{CE}_1$ = V_{IH} Block Erase Suspended	1, 2
I_{PPS}	V_{PP} Standby Current	0.2		5	µA	V_{PP} ≤ V_{CC}	1
I_{PPD}	V_{PP} Deep Power-Down Current	0.2		5	µA	$\overline{RP}$ = GND ±0.2 V	1

DC Characteristics (Continued)

V_{CC} = 3.3 V ± 0.3 V, TA = 0°C to +70°C

SYMBOL	PARAMETER	TYPE	MIN.	MAX.	UNITS	TEST CONDITIONS	NOTE
I_{PPR}	V_{PP} Read Current			5	µA	$V_{PP} > V_{CC}$	1
I_{PPW}	V_{PP} Write Current	50		**	mA	$V_{PP} = V_{PPH}$, Word/Byte Write in Progress	1
I_{PPE}	V_{PP} Erase Current	30		65	mA	$V_{PP} = V_{PPH}$, Block Erase in Progress	1
I_{PPES}	V_{PP} Erase Suspend Current			200	µA	$V_{PP} = V_{PPH}$, Block Erase Suspended	1
V_{IL}	Input Low Voltage		-0.3	0.8	V		
V_{IH}	Input High Voltage		2.0	V_{CC} + 0.3	V		
V_{OL}	Output Low Voltage			0.4	V	$V_{CC} = V_{CC}$ MIN. and I_{OL} = 4 mA	
V_{OH}^1	Output High Voltage		2.4		V	I_{OH} = 2.0 mA $V_{CC} = V_{CC}$ MIN.	
V_{OH}^2			V_{CC} - 0.2		V	I_{OH} = 100 µA $V_{CC} = V_{CC}$ MIN.	
V_{PPL}	V_{PP} during Normal Operations		0.0	5.5	V		
V_{PPH}	V_{PP} during Write/Erase Operations	5.0	4.5	5.5	V		
V_{LKO}	V_{CC} Erase/Write Lock Voltage		2.0		V		

NOTES:
1. All currents are in RMS unless otherwise noted. Typical values at $V_{CC} = V_{PP}$ = 3.3 V, T = 25°C. All I_{PP} stands for outside inductor's current.
2. I_{CCES} is specified with the device de-selected. If the device is read while in erase suspend mode, current draw is the sum of I_{CCES} and I_{CCR}.
3. Automatic Power Saving (APS) reduces I_{CCR} to less than 1 mA in Static operation.

**To be Determined

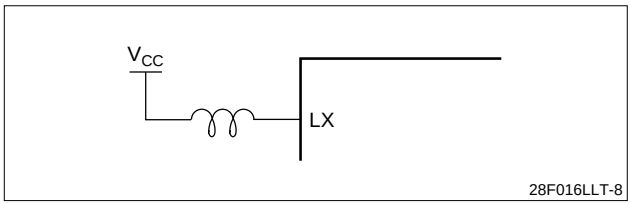


Figure 8. Transient Equivalent Testing Load Circuit (V_{CC} = 3.3 V)

AC Characteristics - Read Only Operations[1]

V_{CC} = 3.3 V, T_A = 0°C to +70°C

SYMBOL	PARAMETER	V_{CC} = 3.3 V ± 0.3 V		UNITS	NOTE
		MIN.	MAX.		
t_{AVAV}	Read Cycle Time	100		ns	
t_{AVEL}	Address Setup to $\overline{CE}$ Going Low	10		ns	3, 4
t_{AVGL}	Address Setup to $\overline{OE}$ Going Low	0		ns	3, 4
t_{AVQV}	Address to Output Delay		100	ns	
t_{ELQV}	$\overline{CE}$ to Output Delay		100	ns	2
t_{PHQV}	$\overline{RP}$ High to Output Delay		620	ns	
t_{GLQV}	$\overline{OE}$ to Output Delay		45	ns	2
t_{ELQX}	$\overline{CE}$ to Output in Low Z	0		ns	3
t_{EHQZ}	$\overline{CE}$ to Output in High Z		50	ns	3
t_{GLQX}	$\overline{OE}$ to Output in Low Z	0		ns	3
t_{GHQZ}	$\overline{OE}$ to Output in High Z		30	ns	3
t_{OH}	Output Hold from Address, $\overline{CE}$ or $\overline{OE}$ change, whichever occurs first	0		ns	3
t_{FLQV} t_{FHQV}	$\overline{BYTE}$ to Output Delay		120	ns	3
t_{FLQZ}	$\overline{BYTE}$ Low to Output in High Z		30	ns	3
t_{ELFL} t_{ELFH}	$\overline{CE}$ Low to $\overline{BYTE}$ High or Low		5	ns	3

NOTES:
1. See AC Input/Output Reference Waveforms for timing measurements.
2. $\overline{OE}$ may be delayed up to t_{ELQV} - t_{GLQV} after the falling edge of $\overline{CE}$ without impact on t_{ELQV}.
3. Sampled, not 100% tested.
4. This timing parameter is used to latch the correct BSR data onto the outputs.

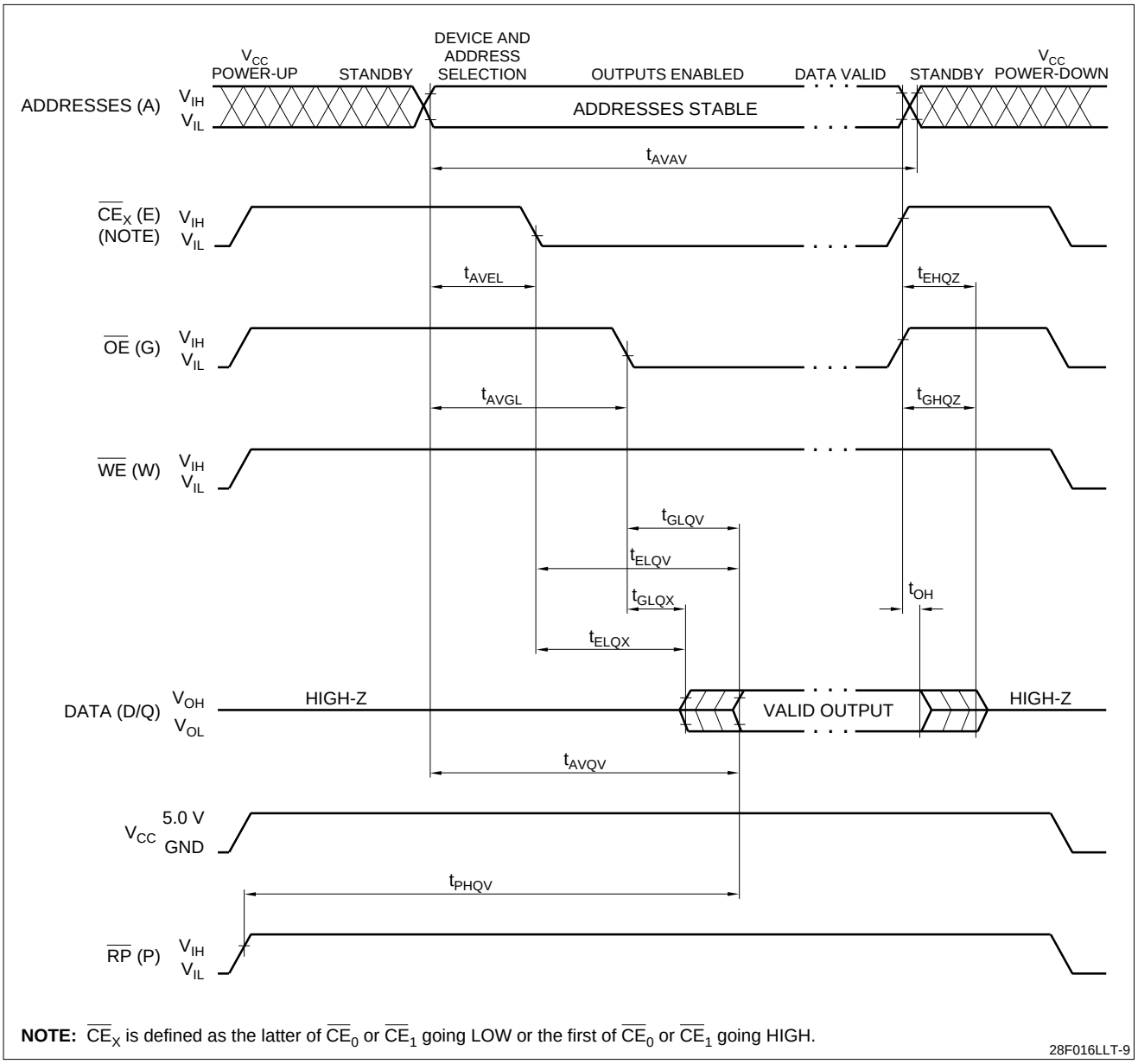


Figure 9. Read Timing Waveforms

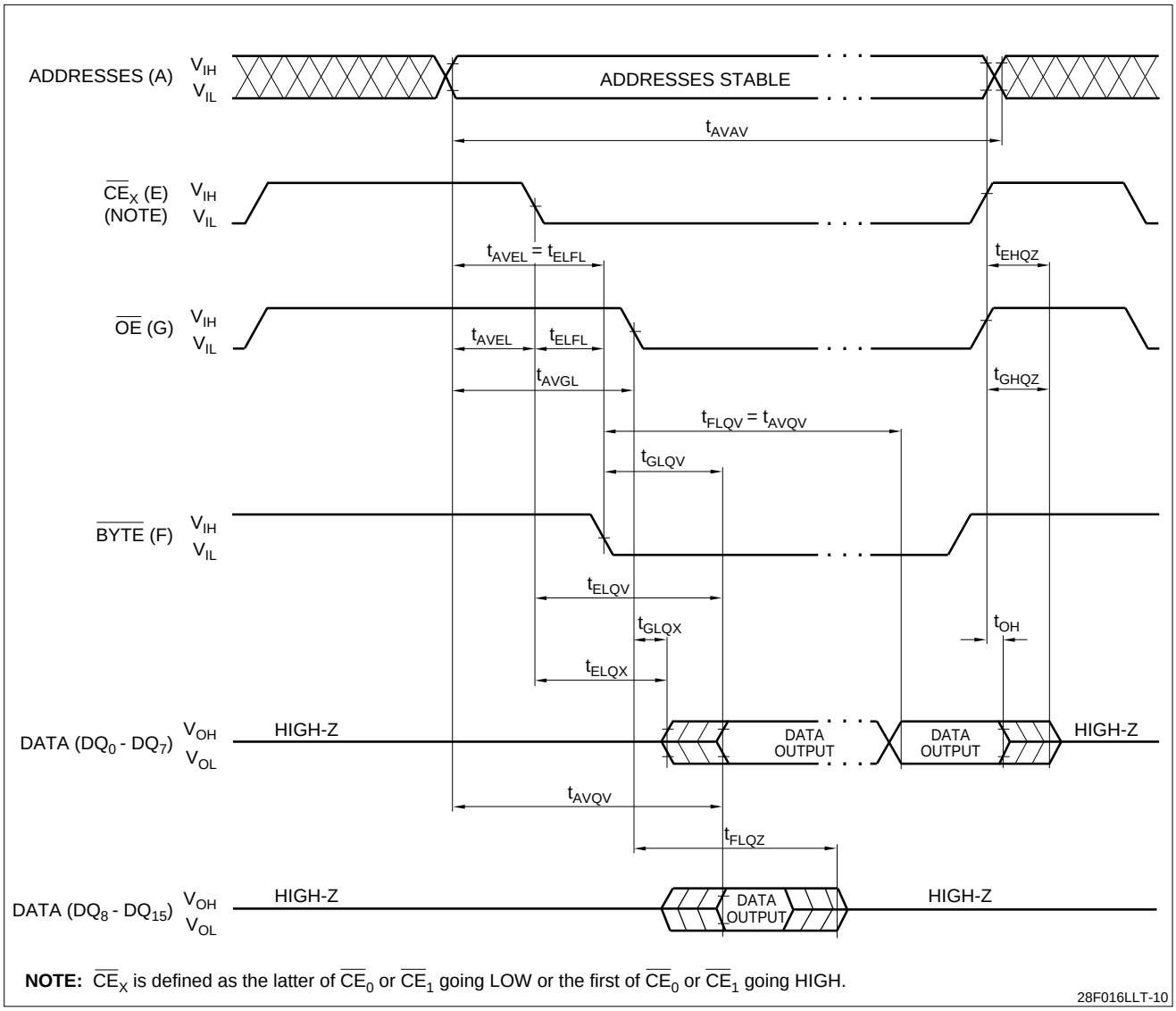


Figure 10. BYTE Timing Waveforms

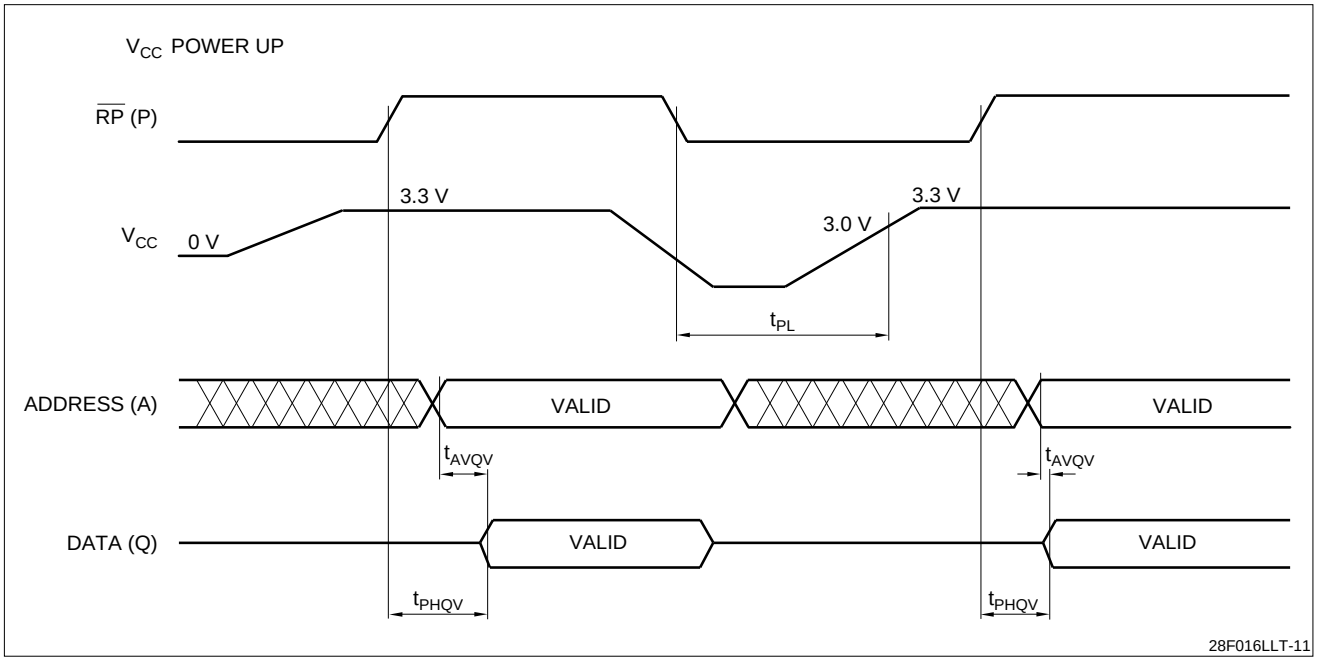


Figure 11. V_{CC} Power-Up and $\overline{RP}$ Reset Waveforms

SYMBOL	PARAMETER	MIN.	MAX.	UNIT	NOTE
t_{PL}	$\overline{RP}$ Low to V_{CC} at 3.0 V Minimum	0		µs	1
t_{AVQV}	Address Valid to Data Valid for V_{CC} = 2.7 V to 3.6 V		**	ns	2
t_{PHQV}	$\overline{RP}$ High to Data Valid for V_{CC} = 2.7 V to 3.6 V		**	ns	2

NOTES:
$\overline{CE}_0$, $\overline{CE}_1$ and $\overline{OE}$ are switched low after Power-Up.
1. The power supply may start to switch concurrently with $\overline{RP}$ going Low.
2. Refer to the AC Characteristics Read Only Operations for detail information.
**To be Determined

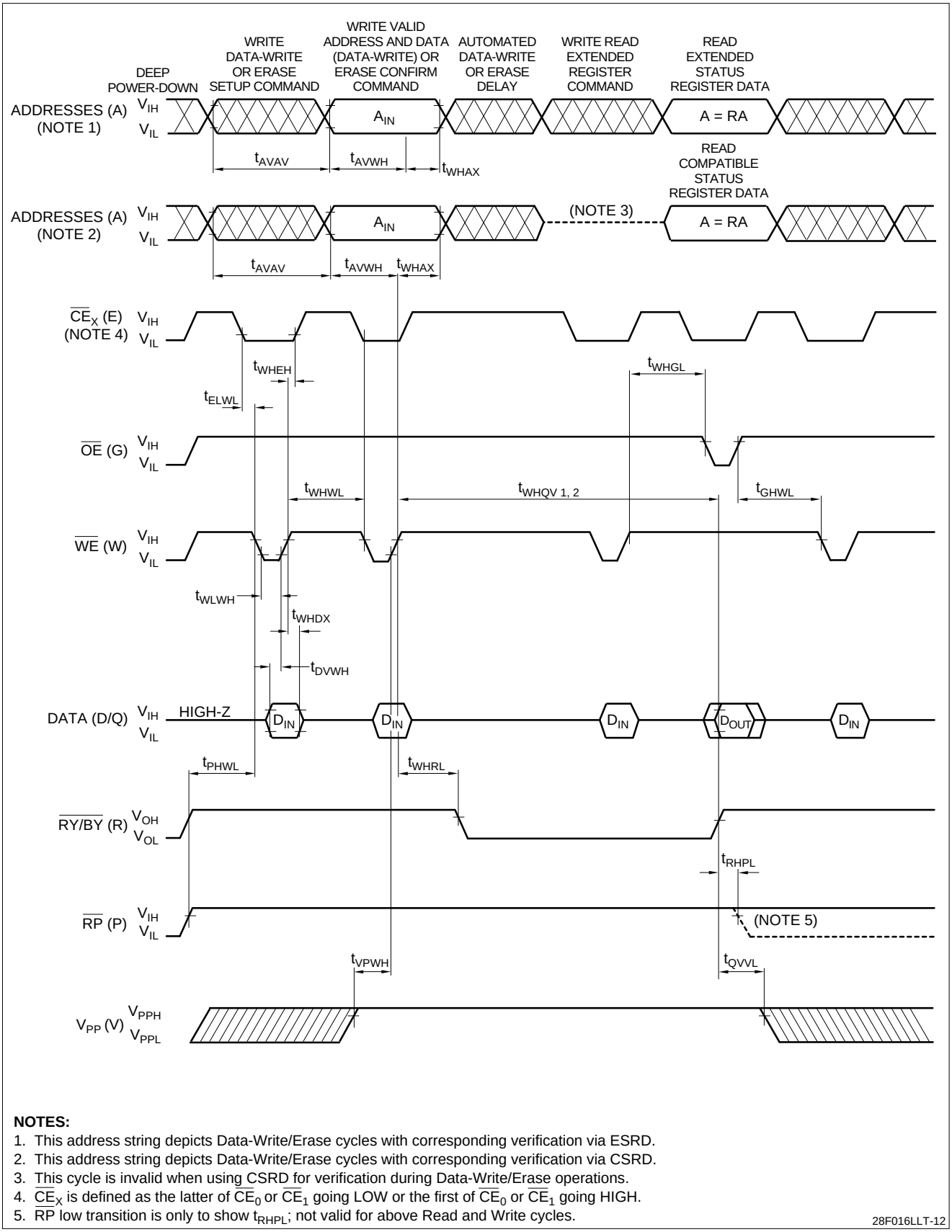
AC Characteristics for $\overline{WE}$ - Controlled Command Write Operations[1]

V_{CC} = 3.3 V, T_A = 0°C to +70°C

SYMBOL	PARAMETER	TYP.	MIN.	MAX.	UNITS	NOTE
t_{AVAV}	Write Cycle Time		100		ns	
t_{VPWH}	V_{PP} Setup to $\overline{WE}$ Going High		100		ns	3
t_{PHEL}	$\overline{RP}$ Setup to $\overline{CE}$ Going Low		480		ns	
t_{ELWL}	$\overline{CE}$ Setup to $\overline{WE}$ Going Low		10		ns	
t_{AVWH}	Address Setup to $\overline{WE}$ Going High		65		ns	2, 6
t_{DVWH}	Data Setup to $\overline{WE}$ Going High		65		ns	2, 6
t_{WLWH}	$\overline{WE}$ Pulse Width		75		ns	
t_{WHDX}	Data Hold from $\overline{WE}$ High		10		ns	2
t_{WHAX}	Address Hold from $\overline{WE}$ High		10		ns	2
t_{WHEH}	$\overline{CE}$ Hold from $\overline{WE}$ High		10		ns	
t_{WHWL}	$\overline{WE}$ Pulse Width High		35		ns	
t_{GHWL}	Read Recovery before Write		0		ns	
t_{WHRL}	$\overline{WE}$ High to $\overline{RY}/\overline{BY}$ Going Low			100	ns	
t_{RHPL}	$\overline{RP}$ Hold from Valid Status Register (CSR, GSR, BSR) Data and $\overline{RY}/\overline{BY}$ High		0		ns	3
t_{PHWL}	$\overline{RP}$ High Recovery to $\overline{WE}$ Going Low		1		µs	
t_{WHGL}	Write Recovery before Read		95		ns	
t_{QVVL}	V_{PP} Hold from Valid Status Register (CSR, GSR, BSR) Data and $\overline{RY}/\overline{BY}$ High		0		µs	
$t_{WHQV}{}^{1}$	Duration of Word/Byte Write Operation	**	**		µs	4, 5
$t_{WHQV}{}^{2}$	Duration of Block Erase Operation		**		s	4

NOTES:
$\overline{CE}$ is defined as the latter of $\overline{CE}_0$ or $\overline{CE}_1$ going Low or the first of $\overline{CE}_0$ or $\overline{CE}_1$ going High.
1. Read timing during write and erase are the same as for normal read.
2. Refer to command definition tables for valid address and data values.
3. Sampled, but not 100% tested.
4. Write/Erase durations are measured to valid Status Register (CSR) Data.
5. Word/Byte write operations are typically performed with 1 Programming Pulse.
6. Address and Data are latched on the rising edge of $\overline{CE}$ for all Command Write Operations.

**To be Determined



NOTES:
1. This address string depicts Data-Write/Erase cycles with corresponding verification via ESRD.
2. This address string depicts Data-Write/Erase cycles with corresponding verification via CSRD.
3. This cycle is invalid when using CSRD for verification during Data-Write/Erase operations.
4. $\overline{CE}_X$ is defined as the latter of $\overline{CE}_0$ or $\overline{CE}_1$ going LOW or the first of $\overline{CE}_0$ or $\overline{CE}_1$ going HIGH.
5. $\overline{RP}$ low transition is only to show t_{RHPL}; not valid for above Read and Write cycles.

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Figure 12. AC Waveforms for Command Write Operations

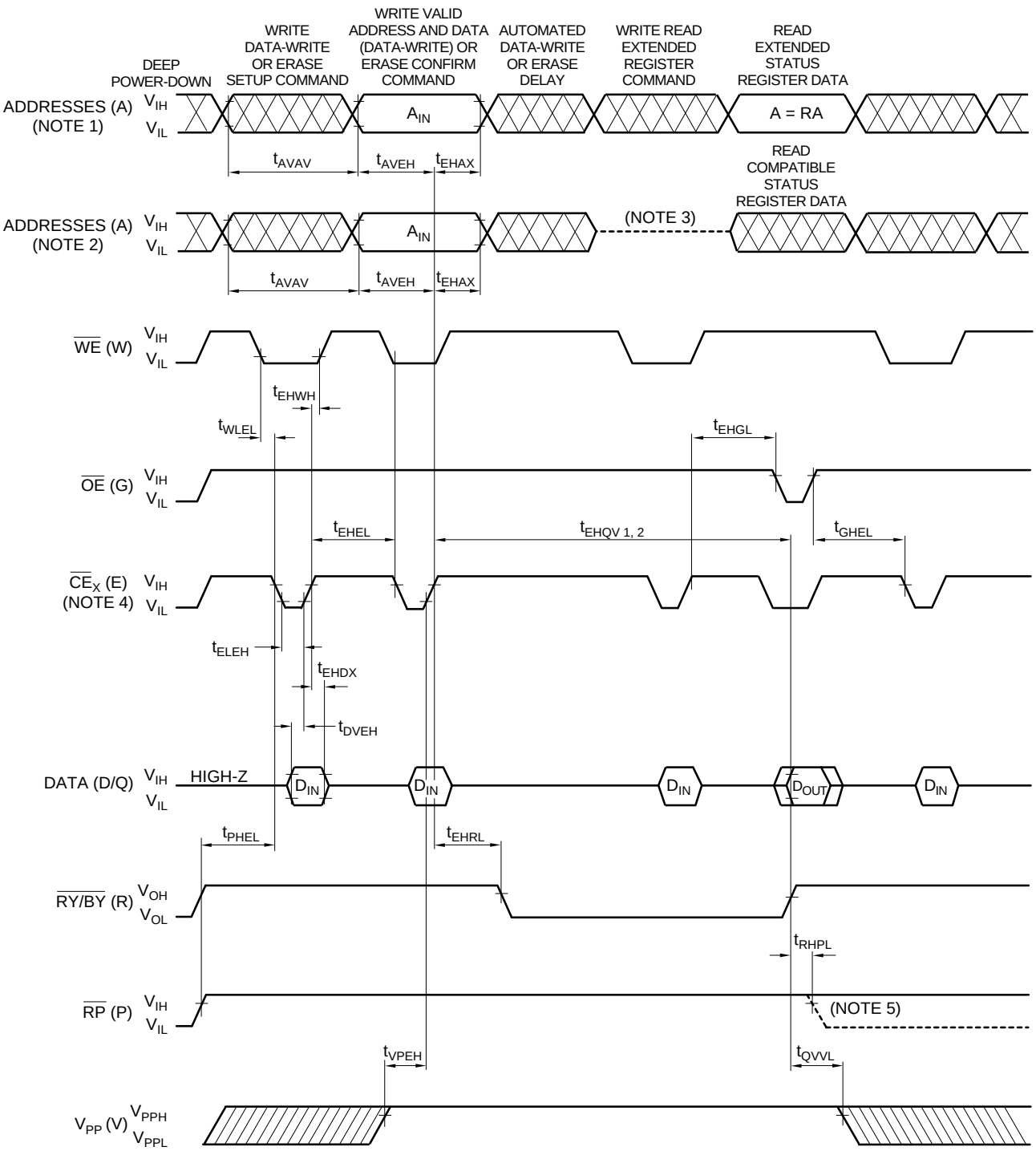
AC Characteristics for $\overline{CE}$ - Controlled Command Write Operations[1]

V_{CC} = 3.3 V ± 0.3 V, T_A = 0°C to +70°C

SYMBOL	PARAMETER	TYP.	MIN.	MAX.	UNITS	NOTE
t_{AVAV}	Write Cycle Time		100		ns	
t_{PHWL}	$\overline{RP}$ Setup to $\overline{WE}$ Going Low		480		ns	3
t_{VPEH}	V_{PP} Set up to $\overline{CE}$ Going High		100		ns	3
t_{WLEL}	$\overline{WE}$ Setup to $\overline{CE}$ Going Low		0		ns	
t_{AVEH}	Address Setup to $\overline{CE}$ Going High		75		ns	2, 6
t_{DVEH}	Data Setup to $\overline{CE}$ Going High		75		ns	2, 6
t_{ELEH}	$\overline{CE}$ Pulse Width		75		ns	
t_{EHDX}	Data Hold from $\overline{CE}$ High		10		ns	2
t_{EHAX}	Address Hold from $\overline{CE}$ High		10		ns	2
t_{EHWH}	$\overline{WE}$ Hold from $\overline{CE}$ High		10		ns	
t_{EHEL}	$\overline{CE}$ Pulse Width High		45		ns	
t_{GHEL}	Read Recovery before Write		0		ns	
t_{EHRL}	$\overline{CE}$ High to $\overline{RY}/\overline{BY}$ Going Low			100	ns	
t_{RHPL}	$\overline{RP}$ Hold from Valid Status Register (CSR, GSR, BSR) Data and $\overline{RY}/\overline{BY}$ High		0		ns	3
t_{PHEL}	$\overline{RP}$ High Recovery to $\overline{CE}$ Going Low		1		µs	
t_{EHGL}	Write Recovery before Read		95		ns	
t_{QVVL}	V_{PP} Hold from Valid Status Register (CSR, GSR, BSR) Data and $\overline{RY}/\overline{BY}$ High		0		µs	
t_{EHQV}[1]	Duration of Word/Byte Write Operation	**	**		µs	4, 5
t_{EHQV}[2]	Duration of Block Erase Operation		**		s	4

NOTES:
$\overline{CE}$ is defined as the latter of $\overline{CE}_0$ or $\overline{CE}_1$ going Low or the first of $\overline{CE}_0$ or $\overline{CE}_1$ going High.
1. Read timing during write and erase are the same as for normal read.
2. Refer to command definition tables for valid address and data values.
3. Sampled, but not 100% tested.
4. Write/Erase durations are measured to valid Status Register (CSR) Data.
5. Word/Byte write operations are typically performed with 1 Programming Pulse.
6. Address and Data are latched on the rising edge of $\overline{CE}$ for all Command Write Operations.

**To be Determined



NOTES:
1. This address string depicts Data-Write/Erase cycles with corresponding verification via ESRD.
2. This address string depicts Data-Write/Erase cycles with corresponding verification via CSRD.
3. This cycle is invalid when using CSRD for verification during Data-Write/Erase operations.
4. $\overline{CE}_X$ is defined as the latter of $\overline{CE}_0$ or $\overline{CE}_1$ going LOW or the first of $\overline{CE}_0$ or $\overline{CE}_1$ going HIGH.
5. $\overline{RP}$ low transition is only to show t_{RHPL}; not valid for above Read and Write cycles.

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Figure 13. AC Waveforms for Command Write Operations

AC Characteristics for Page Buffer Write Operations[1]

V_{CC} = 3.3 V ± 0.3 V, T_A = 0°C to +70°C

SYMBOL	PARAMETER	TYP.	MIN.	MAX.	UNITS	NOTE
t_{AVAV}	Write Cycle Time		120		ns	
t_{ELWL}	$\overline{CE}$ Setup to $\overline{WE}$ Going Low		10		ns	
t_{AVWL}	Address Setup to $\overline{WE}$ Going Low		0		ns	3
t_{DVWH}	Data Setup to $\overline{WE}$ Going High		75		ns	2
t_{WLWH}	$\overline{WE}$ Pulse Width		75		ns	
t_{WHDX}	Data Hold from $\overline{WE}$ High		10		ns	2
t_{WHAX}	Address Hold from $\overline{WE}$ High		10		ns	2
t_{WHEH}	$\overline{CE}$ Hold from $\overline{WE}$ High		10		ns	
t_{WHWL}	$\overline{WE}$ Pulse Width High		45		ns	
t_{GHWL}	Read Recovery before Write		0		ns	
t_{WHGL}	Write Recovery before Read		95		ns	

NOTES:
$\overline{CE}$ is defined as the latter of $\overline{CE}_0$ or $\overline{CE}_1$ going Low or the first of $\overline{CE}_0$ or $\overline{CE}_1$ going High.
1. These are $\overline{WE}$ controlled write timings, equivalent $\overline{CE}$ controlled write timings apply.
2. Sampled, but not 100% tested.
3. Address must be valid during the entire $\overline{WE}$ Low pulse.

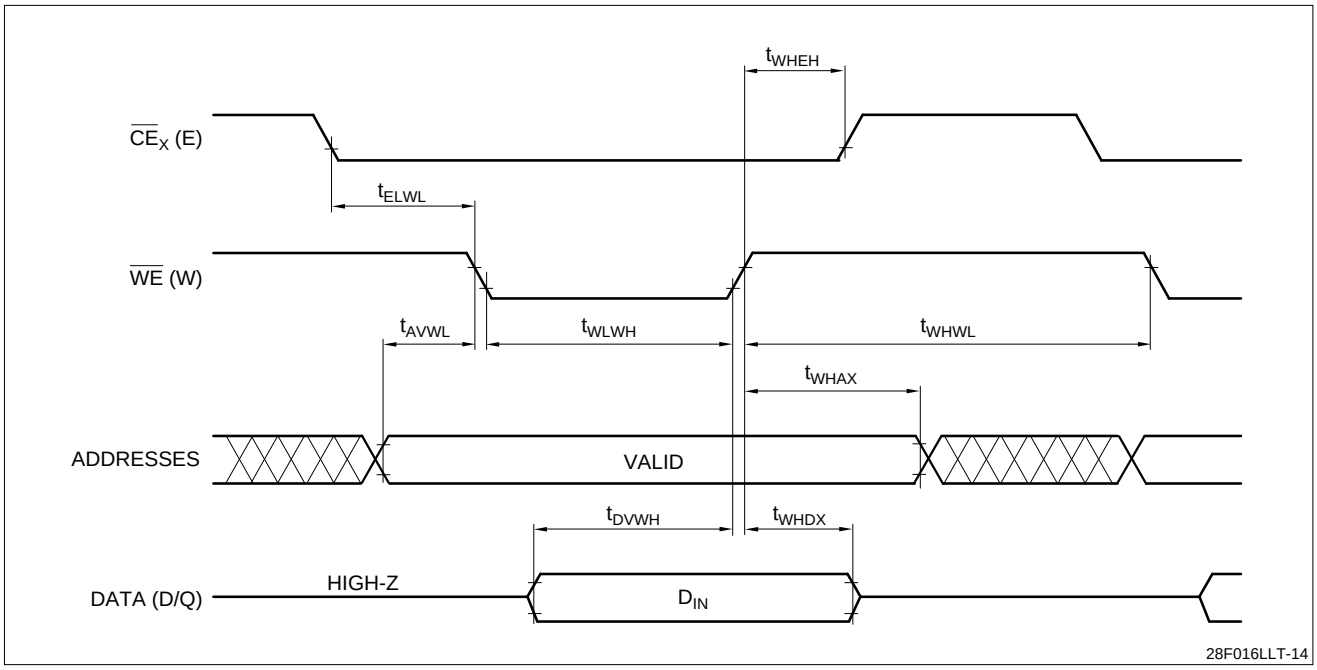


Figure 14. Page Buffer Write Timing Waveforms

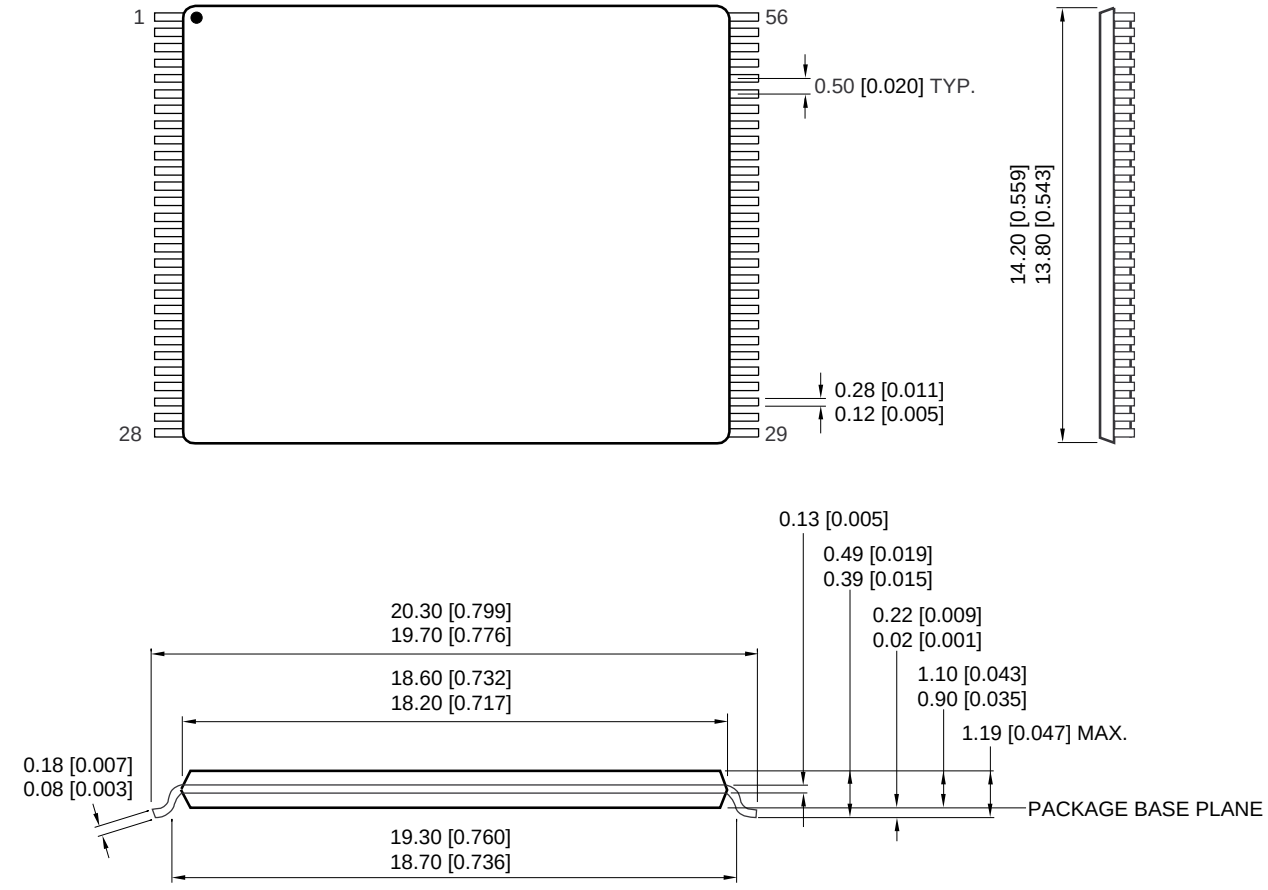
Erase and Word/Byte Write Performance

V_{CC} = 3.3 V ± 0.3 V, T_A = 0°C to +70°C

SYMBOL	PARAMETER	TYP.(1)	MIN.	MAX.	UNITS	TEST CONDITIONS	NOTE
t_{WHRH}^1	Word/Byte Write Time	12			µs		2
t_{WHRH}^2	Block Write Time	0.8		2.1	s	Byte Write Mode	2
t_{WHRH}^3	Block Write Time	0.4		1.0	s	Word Write Mode	2
	Block Erase Time	**		10	s		2
	Full Chip Erase Time	**			s		2

NOTES:
1. 25°C, V_{PP} = 3.3 V Sampled.
2. Excludes System-Level Overhead.
**To be Determined

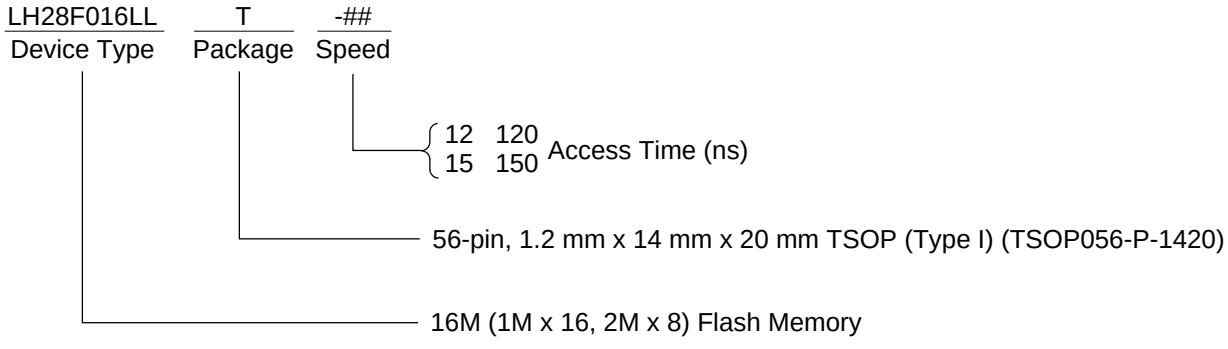
56TSOP (TSOP056-P-1420)



DIMENSIONS IN MM [INCHES] MAXIMUM LIMIT / MINIMUM LIMIT

56TSOP

ORDERING INFORMATION



Example: LH28F016LLT-12 (16M (1M x 16, 2M x 8) Flash Memory, 120 ns, 56-pin TSOP)

28F016LLT-15

LIFE SUPPORT POLICY

SHARP components should not be used in medical devices with life support functions or in safety equipment (or similiar applications where component failure would result in loss of life or physical harm) without the written approval of an officer of the SHARP Corporation.

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SHARP®

NORTH AMERICA

SHARP Electronics Corporation
Microelectronics Group
5700 NW Pacific Rim Blvd., M/S 20
Camas, WA 98607, U.S.A.
Phone: (360) 834-2500
Telex: 49608472 (SHARPCAM)
Facsimile: (360) 834-8903
http://www.sharpmeg.com

EUROPE

SHARP Electronics (Europe) GmbH
Microelectronics Division
Sonninstraße 3
20097 Hamburg, Germany
Phone: (49) 40 2376-2286
Telex: 2161867 (HEEG D)
Facsimile: (49) 40 2376-2232

ASIA

SHARP Corporation
Integrated Circuits Group
2613-1 Ichinomoto-Cho
Tenri-City, Nara, 632, Japan
Phone: (07436) 5-1321
Telex: LABOMETA-B J63428
Facsimile: (07436) 5-1532

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