SIEMENS

# 1M × 32-Bit Dynamic RAM Module (2M × 16-Bit Dynamic RAM Module)

**HYM 321000S/GS-50/-60**

**Advanced Information**

- 1 048 576 words by 32-bit organization
  (alternative 2 097 152 words by 16-bit)
- Fast access and cycle time
  50 ns access time
  90 ns cycle time (-50 version)
  60 ns access time
  110 ns cycle time (-60 version)
- Fast page mode capability with
  35 ns cycle time (-50 version)
  40 ns cycle time (-60 version)
- Single + 5 V (± 10 %) supply
- Low power dissipation
  max 2200 mW active (-50 version)
  max. 1980 mW active (-60 version)
  CMOS – 11 mW standby
  TTL – 22 mW standby
- $\overline{\text{CAS}}$-before-$\overline{\text{RAS}}$ refresh, $\overline{\text{RAS}}$-only-refresh, Hidden refresh
- 2 decoupling capacitors mounted on substrate
- All inputs, outputs and clock fully TTL compatible
- 72 pin Single in-Line Memory Module
- Utilizes two 1M × 16 -DRAMs in SOJ-42 packages
- 1024 refresh cycles/16 ms
- Optimized for use in byte-write non-parity applications
- Tin-Lead contact pads HYM 321000S
- Gold-Lead contact pads HYM 321000GS
- single sided module with 20.32 mm (800 mil) height

The HYM 321000S/GS-50/-60 is a 4 MByte DRAM module organized as 1 048 576 words by 32-bit in a 72-pin single-in-line package comprising two HYB 5118160BSJ 1M × 16 DRAMs in 400 mil wide SOJ-packages mounted together with two 0.2 µF ceramic decoupling capacitors on a PC board.

The HYM 321000S/GS-60/-70 can also be used as a 2 097 152 words by 16-bits dynamic RAM module by means of connecting DQ0 and DQ16, DQ1 and DQ17, DQ2 and DQ18, …, DQ15 and DQ31, respectively.

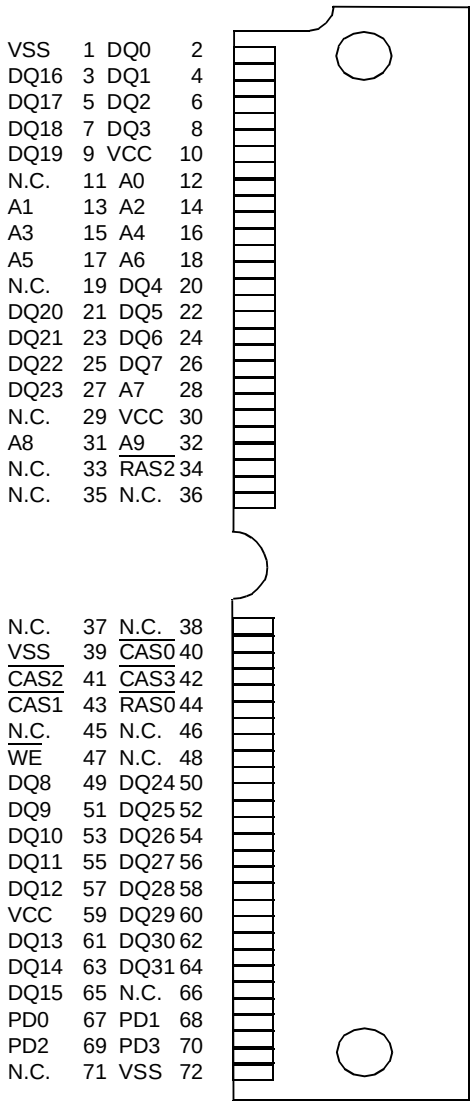
Each HYB 5118160BSJ is described in the data sheet and is fully electrically tested and processed according to Siemens standard quality procedure prior to module assembly. After assembly onto the board, a further set of electrical tests is performed.

The speed of the module can be detected by the use of four presence detect pins.

The common I/O feature on the HYM 321000S/GS-50/-60 dictates the use of early write cycles.

**Ordering Information**

| Type | Ordering Code | Package | Descriptions |
|---|---|---|---|
| HYM 321000S-50 | Q67100 - Q2051 | L-SIM-72-10 | DRAM module (access time50 ns) |
| HYM 321000S-60 | Q67100 - Q2056 | L-SIM-72-10 | DRAM module (access time 60 ns) |
| HYM 321000GS-50 | Q67100 - Q2053 | L-SIM-72-10 | DRAM module (access time 50 ns) |
| HYM 321000GS-60 | Q67100 - Q2058 | L-SIM-72-10 | DRAM module (access time 60 ns) |



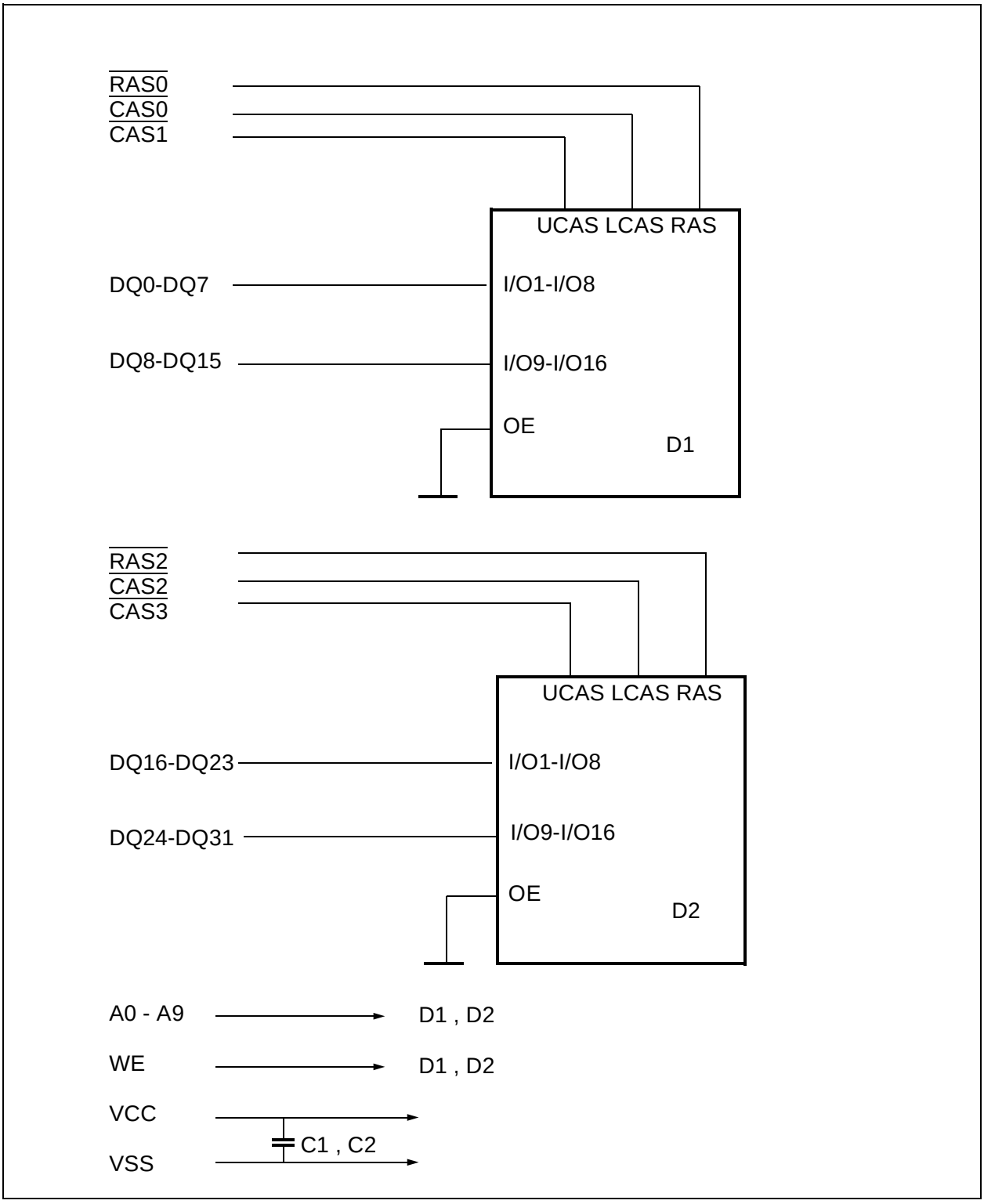

**Pin Names**

| | |
|---|---|
| A0-A9 | Address Inputs |
| DQ0-DQ31 | Data Input/Output |
| $\overline{\text{CAS0}}$ - $\overline{\text{CAS3}}$ | Column Address Strobe |
| $\overline{\text{RAS0}}$, $\overline{\text{RAS2}}$ | Row Address Strobe |
| $\overline{\text{WE}}$ | Read/Write Input |
| $V_{CC}$ | Power (+ 5 V) |
| $V_{SS}$ | Ground |
| PD | Presence Detect Pin |
| N.C. | No Connection |

**Presence Detect Pins**

| | -50 | -60 |
|---|---|---|
| PD0 | $V_{SS}$ | $V_{SS}$ |
| PD1 | $V_{SS}$ | $V_{SS}$ |
| PD2 | $V_{SS}$ | N.C. |
| PD3 | $V_{SS}$ | N.C. |

**Pin Configuration**




**Block Diagram**

**Absolute Maximum Ratings**

Operating temperature range ..... 0 to + 70 °C
Storage temperature range ..... – 55 to + 125 °C
Input/output voltage ..... – 0.5 to min (Vcc + 0.5, 7.0) V
Power supply voltage ..... – 1 to + 7 V
Power dissipation ..... 2.52 W
Data out current (short circuit) ..... 50 mA

**Note**: *Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.*

**DC Characteristics** [1)]

$T_A$ = 0 to 70 °C; $V_{CC}$ = 5 V ± 10 %

| Parameter | Symbol | Limit Values | | Unit | Test Condition |
|---|---|---|---|---|---|
| | | min. | max. | | |
| Input high voltage | $V_{IH}$ | 2.4 | 5.5 | V | – |
| Input low voltage | $V_{IL}$ | – 1.0 | 0.8 | V | – |
| Output high voltage ($I_{OUT}$ = – 5 mA) | $V_{OH}$ | 2.4 | – | V | – |
| Output low voltage ($I_{OUT}$ = 4.2 mA) | $V_{OL}$ | – | 0.4 | V | – |
| Input leakage current (0 V < $V_{IN}$ < 6.5 V, all other pins = 0 V) | $I_{I(L)}$ | – 10 | 10 | µA | – |
| Output leakage current (DO is disabled, 0 V < $V_{OUT}$ < 5.5 V) | $I_{O(L)}$ | – 10 | 10 | µA | – |
| Average $V_{CC}$ supply current: | $I_{CC1}$ | | | | 2), 3),4) |
| HYM 321000S/GS-50 | | – | 400 | mA | |
| HYM 321000S/GS-60 | | – | 360 | mA | |
| | | – | | | |
| ($\overline{RAS}$, $\overline{CAS}$, address cycling, $t_{RC}$ = $t_{RC}$ min.) | | | | | |
| Standby $V_{CC}$ supply current ($\overline{RAS}$ = $\overline{CAS}$ = $V_{IH}$) | $I_{CC2}$ | – | 4 | mA | – |
| Average $V_{CC}$ supply current during $\overline{RAS}$ only refresh cycles: | $I_{CC3}$ | | | | 2),4) |
| HYM 321000S/GS-50 | | – | 400 | mA | |
| HYM 321000S/GS-60 | | – | 360 | mA | |
| | | – | | | |
| ($\overline{RAS}$ cycling, $\overline{CAS}$ = $V_{IH}$, $t_{RC}$ = $t_{RC}$ min.) | | | | | |

**DC Characteristics** (cont'd) [1)]

| Parameter | Symbol | Limit Values | | Unit | Test Condition |
|---|---|---|---|---|---|
| | | min. | max. | | |
| Average $V_{CC}$ supply current during fast page mode: | $I_{CC4}$ | | | | 2), 3),4) |
| HYM 321000S/GS-50 | | – | 110 | mA | |
| HYM 321000S/GS-60 | | – | 100 | mA | |
| | | – | | | |
| ($\overline{RAS}$ = $V_{IL}$, $\overline{CAS}$, address cycling $t_{PC}$ = $t_{PC}$ min.) | | | | | |
| Standby $V_{CC}$ supply current ($\overline{RAS}$ = $\overline{CAS}$ = $V_{CC}$ – 0.2 V) | $I_{CC5}$ | – | 2 | mA | – |
| Average $V_{CC}$ supply current during $\overline{CAS}$-before-$\overline{RAS}$ refresh mode: | $I_{CC6}$ | | | | 2),4) |
| HYM 321000S/GS-50 | | – | 400 | mA | |
| HYM 321000S/GS-60 | | – | 360 | mA | |
| | | – | | | |
| ($\overline{RAS}$, $\overline{CAS}$ cycling, $t_{RC}$ = $t_{RC}$ min.) | | | | | |

**Capacitance**
$T_A$ = 0 to 70 °C; $V_{CC}$ = 5 V ± 10 %; $f$ = 1 MHz

| Parameter | Symbol | Limit Values | | Unit |
|---|---|---|---|---|
| | | min. | max. | |
| Input capacitance (A0 to A9) | $C_{I1}$ | – | 25 | pF |
| Input capacitance ($\overline{RAS0}$, $\overline{RAS2}$) | $C_{I2}$ | – | 20 | pF |
| Input capacitance ($\overline{CAS0}$-$\overline{CAS3}$) | $C_{I3}$ | – | 20 | pF |
| Input capacitance ($\overline{WE}$) | $C_{I4}$ | – | 25 | pF |
| I/O capacitance (DQ0-DQ31) | $C_{IO1}$ | – | 15 | pF |

**AC Characteristics** [5)6)] M16F

$T_A$ = 0 to 70 °C, $V_{CC}$ = 5 V ± 10 %, $t_T$ = 5 ns

| Parameter | Symbol | Limit Values | | | | Unit | Note |
|---|---|---|---|---|---|---|---|
| | | -50 | | -60 | | | |
| | | min. | max. | min. | max. | | |
| ***common parameters*** | | | | | | | |
| Random read or write cycle time | $t_{RC}$ | 90 | – | 110 | – | ns | |
| $\overline{RAS}$ precharge time | $t_{RP}$ | 30 | – | 40 | – | ns | |
| $\overline{RAS}$ pulse width | $t_{RAS}$ | 50 | 10k | 60 | 10k | ns | |
| $\overline{CAS}$ pulse width | $t_{CAS}$ | 13 | 10k | 15 | 10k | ns | |
| Row address setup time | $t_{ASR}$ | 0 | – | 0 | – | ns | |
| Row address hold time | $t_{RAH}$ | 8 | – | 10 | – | ns | |
| Column address setup time | $t_{ASC}$ | 0 | – | 0 | – | ns | |
| Column address hold time | $t_{CAH}$ | 10 | – | 15 | – | ns | |
| $\overline{RAS}$ to $\overline{CAS}$ delay time | $t_{RCD}$ | 18 | 37 | 20 | 45 | | |
| $\overline{RAS}$ to column address delay time | $t_{RAD}$ | 13 | 25 | 15 | 30 | ns | |
| $\overline{RAS}$ hold time | $t_{RSH}$ | 13 | | 15 | – | ns | |
| $\overline{CAS}$ hold time | $t_{CSH}$ | 50 | | 60 | – | ns | |
| $\overline{CAS}$ to $\overline{RAS}$ precharge time | $t_{CRP}$ | 5 | – | 5 | – | ns | |
| Transition time (rise and fall) | $t_T$ | 3 | 50 | 3 | 50 | ns | 7 |
| Refresh period | $t_{REF}$ | – | 16 | – | 16 | ms | |
| ***Read Cycle*** | | | | | | | |
| Access time from $\overline{RAS}$ | $t_{RAC}$ | – | 50 | – | 60 | ns | 8, 9 |
| Access time from $\overline{CAS}$ | $t_{CAC}$ | – | 13 | – | 15 | ns | 8, 9 |
| Access time from column address | $t_{AA}$ | – | 25 | – | 30 | ns | 8,10 |
| Column address to $\overline{RAS}$ lead time | $t_{RAL}$ | 25 | – | 30 | – | ns | |
| Read command setup time | $t_{RCS}$ | 0 | – | 0 | – | ns | |
| Read command hold time | $t_{RCH}$ | 0 | – | 0 | – | ns | 11 |
| Read command hold time referenced to $\overline{RAS}$ | $t_{RRH}$ | 0 | – | 0 | – | ns | 11 |
| $\overline{CAS}$ to output in low-Z | $t_{CLZ}$ | 0 | – | 0 | – | ns | 8 |
| Output buffer turn-off delay | $t_{OFF}$ | 0 | 13 | 0 | 15 | ns | 12 |

**AC Characteristics** (cont'd) [5)6)] M16F

$T_A$ = 0 to 70 °C, $V_{CC}$ = 5 V ± 10 %, $t_T$ = 5 ns

| Parameter | Symbol | Limit Values | | | | Unit | Note |
|---|---|---|---|---|---|---|---|
| | | -50 | | -60 | | | |
| | | min. | max. | min. | max. | | |
| ***Early Write Cycle*** | | | | | | | |
| Write command hold time | $t_{WCH}$ | 8 | – | 10 | – | ns | |
| Write command pulse width | $t_{WP}$ | 8 | – | 10 | – | ns | |
| Write command setup time | $t_{WCS}$ | 0 | – | 0 | – | ns | 13 |
| Write command to $\overline{RAS}$ lead time | $t_{RWL}$ | 13 | – | 15 | – | ns | |
| Write command to $\overline{CAS}$ lead time | $t_{CWL}$ | 13 | – | 15 | – | ns | |
| Data setup time | $t_{DS}$ | 0 | – | 0 | – | ns | 14 |
| Data hold time | $t_{DH}$ | 10 | – | 10 | – | ns | 14 |
| ***Fast Page Mode Cycle*** | | | | | | | |
| Fast page mode cycle time | $t_{PC}$ | 35 | – | 40 | – | ns | |
| $\overline{CAS}$ precharge time | $t_{CP}$ | 10 | – | 10 | – | ns | |
| Access time from $\overline{CAS}$ precharge | $t_{CPA}$ | – | 30 | – | 35 | ns | 7 |
| $\overline{RAS}$ pulse width | $t_{RAS}$ | 50 | 200k | 60 | 200k | ns | |
| $\overline{CAS}$ precharge to $\overline{RAS}$ Delay | $t_{RHCP}$ | 30 | – | 35 | – | ns | |
| ***$\overline{CAS}$-before-$\overline{RAS}$ Refresh Cycle*** | | | | | | | |
| $\overline{CAS}$ setup time | $t_{CSR}$ | 10 | – | 10 | – | ns | |
| $\overline{CAS}$ hold time | $t_{CHR}$ | 10 | – | 10 | – | ns | |
| $\overline{RAS}$ to $\overline{CAS}$ precharge time | $t_{RPC}$ | 5 | – | 5 | – | ns | |
| Write to $\overline{RAS}$ precharge time | $t_{WRP}$ | 10 | – | 10 | – | ns | |
| Write hold time referenced to $\overline{RAS}$ | $t_{WRH}$ | 10 | – | 10 | – | ns | |

**Notes:**

1) All voltages are referenced to VSS.

2) ICC1, ICC3, ICC4 and ICC6 depend on cycle rate.

3) ICC1 and ICC4 depend on output loading. Specified values are measured with the output open.

4) Address can be changed once or less while $\overline{RAS}$ = VIL. In the case of ICC4 it can be changed once or less during a fast page mode cycle (tPC).

5) An initial pause of 200 µs is required after power-up followed by 8 $\overline{RAS}$ cycles of which at least one cycle has to be a refresh cycle, before proper device operation is achieved. In case of using internal refresh counter, a minimum of 8 $\overline{CAS}$-before-$\overline{RAS}$ initialization cycles instead of 8 $\overline{RAS}$ cycles are required.

6) AC measurements assume tT = 5 ns.

7) VIH (min.) and VIL (max.) are reference levels for measuring timing of input signals. Transition times are also measured between VIH and VIL.

8) Measured with a load equivalent to 2 TTL loads and 100 pF.

9) Operation within the tRCD (max.) limit ensures that tRAC (max.) can be met. tRCD (max.) is specified as a reference point only: If tRCD is greater than the specified tRCD (max.) limit, then access time is controlled by tCAC.

10) Operation within the tRAD (max.) limit ensures that tRAC (max.) can be met. tRAD (max.) is specified as a reference point only: If tRAD is greater than the specified tRAD (max.) limit, then access time is controlled by tAA.

11) Either tRCH or tRRH must be satisfied for a read cycle.

12) tOFF (max.) define the time at which the outputs achieve the open-circuit condition and are not referenced to output voltage levels

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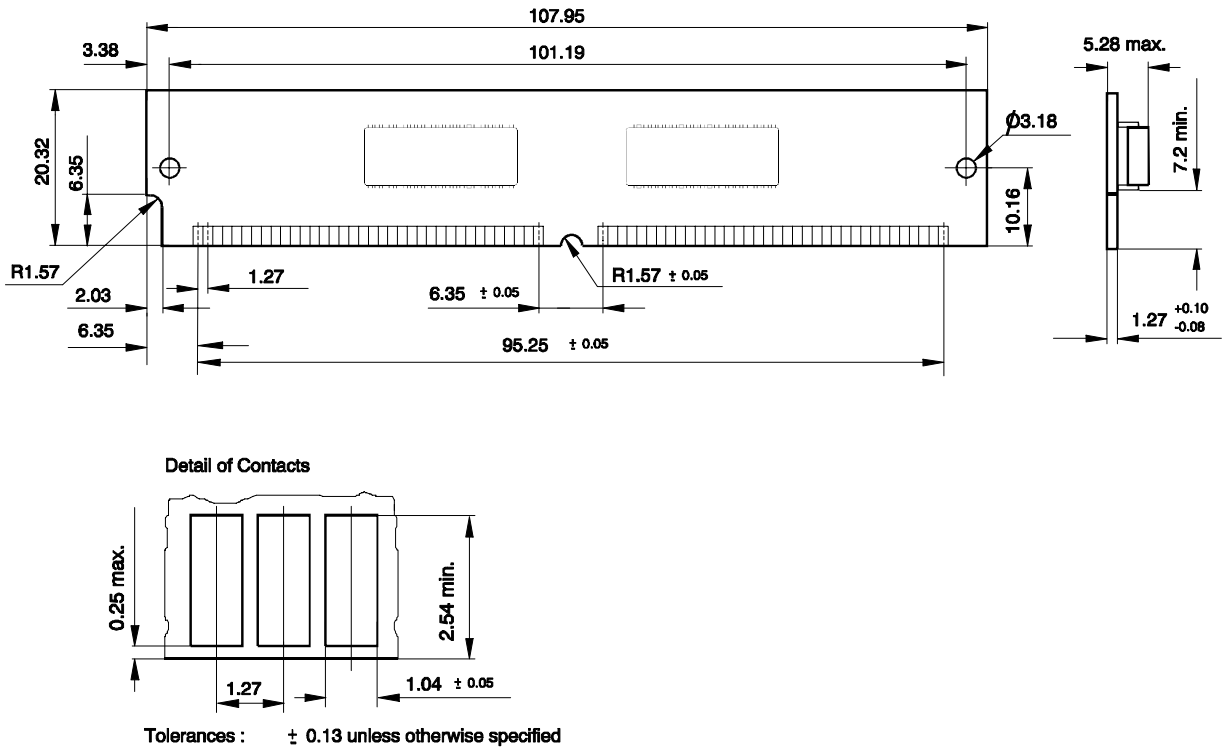
13) tWCS is not a restrictive operating parameter. This is included in the data sheet as electrical characteristics only. If tWCS > tWCS (min.), the cycle is an early write cycle and the I/O pin will remain open-circuit (high impedance) through the entire cycle.

14) These parameters are referenced to the $\overline{CAS}$ leading edge.

**L-SIM-72-10**
**Module package**
**(single in-line memory module)**

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