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OCTOBER 2016

# 1Mx16 HIGH-SPEED ASYNCHRONOUS CMOS STATIC RAM WITH 3.3V/1.8V SUPPLY

## FEATURES

- High-speed access time: 10ns, 12ns
- High- performance, low power CMOS process
- Multiple center power and ground pins for greater noise immunity
- Easy memory expansion with CS# and OE#
- TTL compatible inputs and outputs
- Single power supply
  - 1.65V-2.2V VDD (IS61/64WV102416DALL)
  - 2.4V-3.6V VDD (IS61/64WV102416DBLL)
- Packages available :
  - 48 ball mini BGA (6mm x 8mm)
  - 48 pin TSOP (Type I)
- Industrial and Automotive temperature support
- Lead-free available
- Data Control for upper and lower bytes

## DESCRIPTION

The *ISSI* IS61/64WV102416DALL/BLL are high-speed, 16M bit static RAMs organized as 1024K words by 16 bits. It is fabricated using *ISSI*'s high-performance CMOS technology.

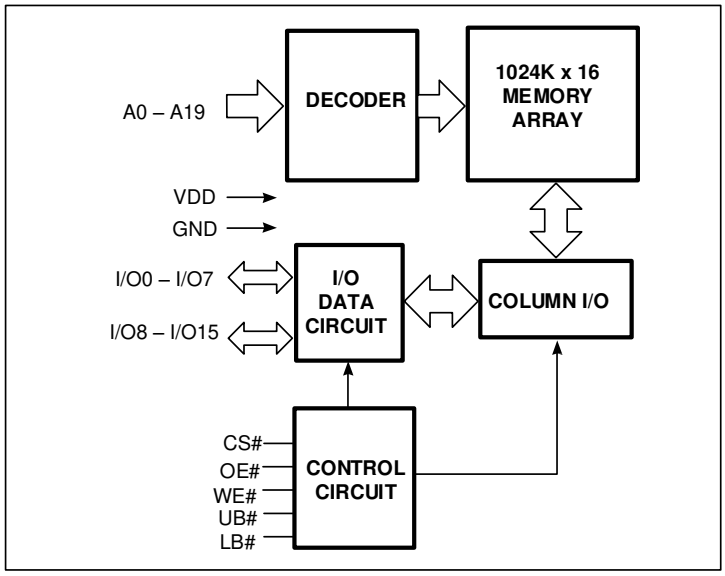
This highly reliable process coupled with innovative circuit design techniques, yields high-performance and low power consumption devices.

When CS# is HIGH (deselected), the device assumes a standby mode at which the power dissipation can be reduced down with CMOS input levels. Easy memory expansion is provided by using Chip Enable and Output Enable inputs. The active LOW Write Enable (WE#) controls both writing and reading of the memory.

A data byte allows Upper Byte (UB#) and Lower Byte (LB#) access.

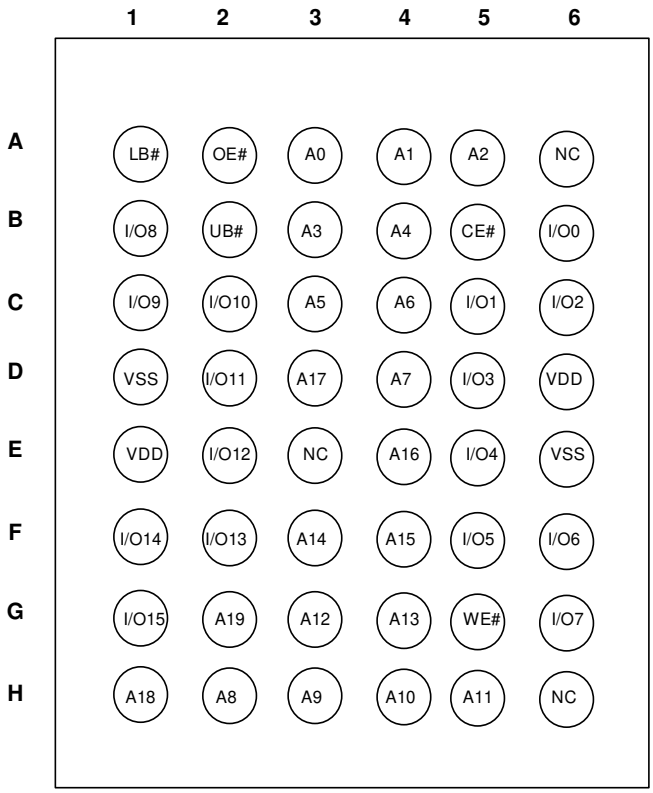
The device is packaged in the JEDEC standard 48-Pin TSOP (TYPE I) and 48-pin mini BGA (6mm x 8mm).

## FUNCTIONAL BLOCK DIAGRAM

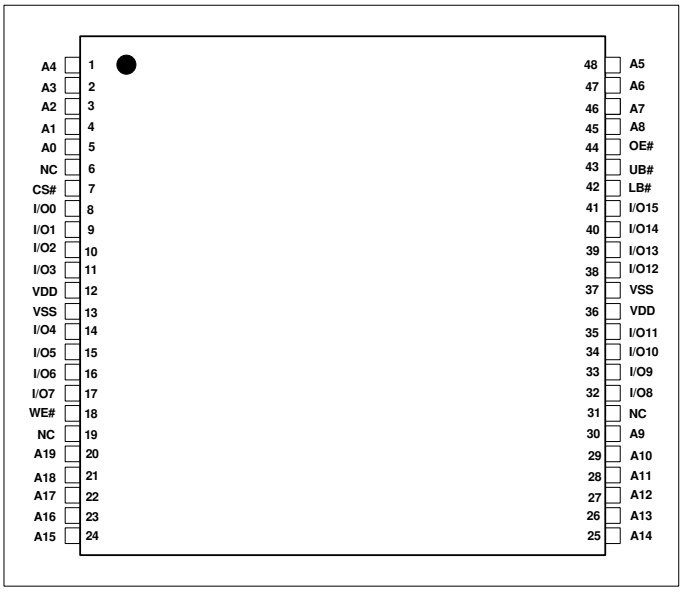


## PIN CONFIGURATIONS

### 48-Pin mini BGA (6mm x 8mm)




### 48-Pin TSOP ,TYPE I ( 12mm x 20mm )




## PIN DESCRIPTIONS

| | |
|---|---|
| A0-A19 | Address Inputs |
| I/O0-I/O15 | Data Inputs/Outputs |
| CS# | Chip Enable Input |
| OE# | Output Enable Input |
| WE# | Write Enable Input |
| LB# | Lower-byte Control (I/O0-I/O7) |
| UB# | Upper-byte Control (I/O8-I/O15) |
| NC | No Connection |
| VDD | Power |
| VSS | Ground |

# FUNCTION DESCRIPTION

SRAM is one of random access memories. Each byte or word has an address and can be accessed randomly. SRAM has three different modes supported. Each function is described below with Truth Table.

### STANDBY MODE

Device enters standby mode when deselected (CS# HIGH). The input and output pins (I/O0-15) are placed in a high impedance state. CMOS input in this mode will maximize saving power.

### WRITE MODE

Write operation issues with Chip selected (CS#) and Write Enable (WE#) input LOW. The input and output pins (I/O0-15) are in data input mode. Output buffers are closed during this time even if OE# is LOW. UB# and LB# enables a byte write feature. By enabling LB# LOW, data from I/O pins (I/O0 through I/O7) are written into the location specified on the address pins. And with UB# being LOW, data from I/O pins (I/O8 through I/O15) are written into the location.

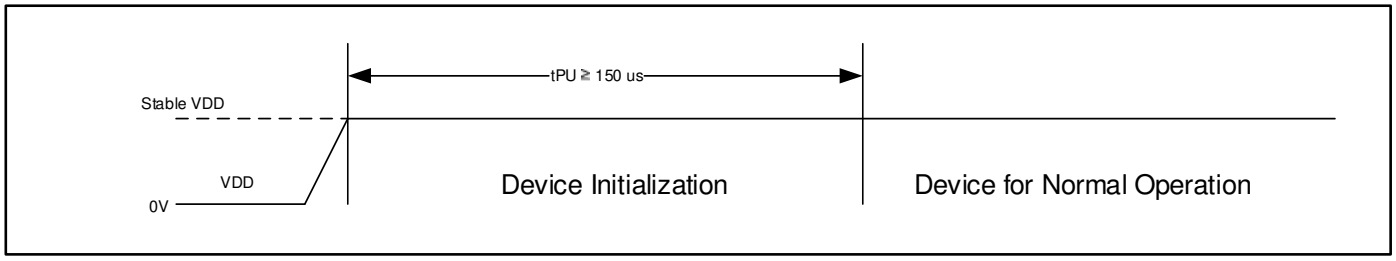
### READ MODE

Read operation issues with Chip selected (CS# LOW) and Write Enable (WE#) input HIGH. When OE# is LOW, output buffer turns on to make data output. Any input to I/O pins during READ mode is not permitted. UB# and LB# enables a byte read feature. By enabling LB# LOW, data from memory appears on I/O0-7. And with UB# being LOW, data from memory appears on I/O8-15.

In the READ mode, output buffers can be turned off by pulling OE# HIGH. In this mode, internal device operates as READ but I/Os are in a high impedance state. Since device is in READ mode, active current is used.

### POWER UP INITIALIZATION

The device includes on-chip voltage sensor used to launch POWER-UP initialization process.
When VDD reaches stable level, the device requires 150us of tPU (Power-Up Time) to complete its self-initialization process.
When initialization is complete, the device is ready for normal operation.




### TRUTH TABLE

| Mode | CS# | WE# | OE# | LB# | UB# | I/O0-I/O7 | I/O8-I/O15 | VDD Current |
|---|---|---|---|---|---|---|---|---|
| Not Selected | H | X | X | X | X | High-Z | High-Z | ISB1, ISB2 |
| Output Disabled | L | H | H | L | L | High-Z | High-Z | ICC |
| | L | H | H | H | L | High-Z | High-Z | |
| Read | L | H | L | L | H | DOUT | High-Z | ICC |
| | L | H | L | H | L | High-Z | DOUT | |
| | L | H | L | L | L | DOUT | DOUT | |
| Write | L | L | X | L | H | DIN | High-Z | ICC |
| | L | L | X | H | L | High-Z | DIN | |
| | L | L | X | L | L | DIN | DIN | |

# ABSOLUTE MAXIMUM RATINGS AND Operating Range

## ABSOLUTE MAXIMUM RATINGS (1)

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| Vterm | Terminal Voltage with Respect to VSS | –0.5 to $V_{DD}$ + 0.5V | V |
| $V_{DD}$ | $V_{DD}$ Related to VSS | –0.3 to 4.0 | V |
| tStg | Storage Temperature | –65 to +150 | °C |
| $P_T$ | Power Dissipation | 1.0 | W |

Notes:

1. Stress greater than those listed under ABSOLUTE MAXIMUM RATINGS may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

## PIN CAPACITANCE (1)

| Parameter | Symbol | Test Condition | Max | Units |
|---|---|---|---|---|
| Input capacitance | $C_{IN}$ | $T_A$ = 25°C, f = 1 MHz, $V_{DD}$ = $V_{DD}$(typ) | 6 | pF |
| DQ capacitance (IO0–IO15) | $C_{I/O}$ | | 8 | pF |

Note:
1. These parameters are guaranteed by design and tested by a sample basis only.

## OPERATING RANGE

| Range | Ambient Temperature | PART NUMBER | VDD | SPEED (MAX) |
|---|---|---|---|---|
| Commercial | 0°C to +70°C | IS61WV102416DALL | 1.65V – 2.2V | 10 ns |
| | | IS61WV102416DBLL | 2.4V – 3.6V | |
| Industrial | -40°C to +85°C | IS61WV102416DALL | 1.65V – 2.2V | 10 ns |
| | | IS61WV102416DBLL | 2.4V – 3.6V | |
| Automotive (A3) | -40°C to +125°C | IS64WV102416DALL | 1.65V – 2.2V | 12 ns |
| | | IS64WV102416DBLL | 2.4V – 3.6V | |

## AC TEST CONDITIONS (OVER THE OPERATING RANGE)

| Parameter | Unit (1.65V~2.2V) | Unit (2.4V~3.6V) |
|---|---|---|
| Input Pulse Level | 0V to $V_{DD}$ | 0V to $V_{DD}$ |
| Input Rise and Fall Time | 1.5 ns | 1.5 ns |
| Output Timing Reference Level | ½ $V_{DD}$ | ½ $V_{DD}$ |
| R1 (ohm) | 13500 | 319 |
| R2 (ohm) | 10800 | 353 |
| $V_{TM}$ (V) | 1.8V | 3.3V |
| Output Load Conditions | Refer to Figure 1 and 2 | |

## AC TEST LOADS

**FIGURE 1**

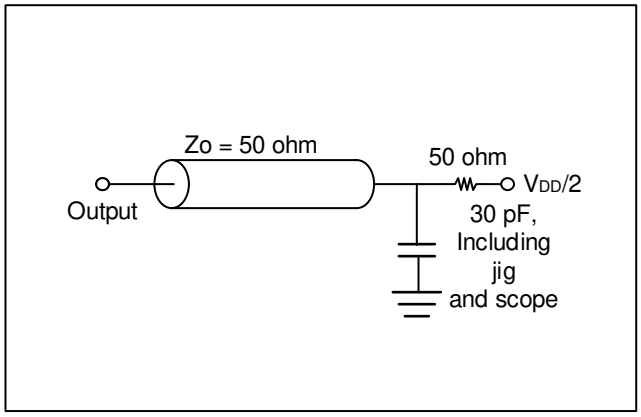
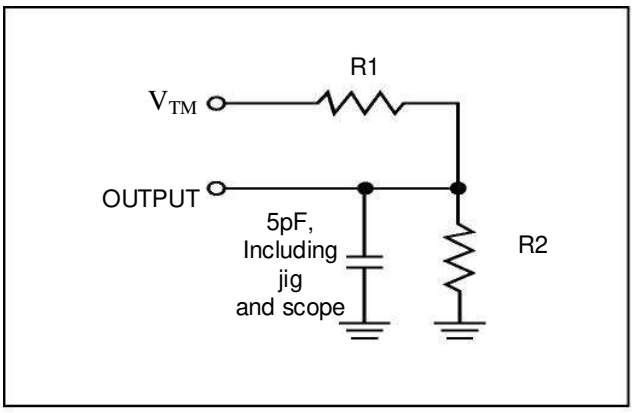



**FIGURE 2**



# DC ELECTRICAL CHARACTERISTICS

## DC ELECTRICAL CHARACTERISTICS-I (OVER THE OPERATING RANGE)

**VDD = 1.65V – 2.2V**

| Symbol | Parameter | Test Conditions | Min. | Max. | Unit |
|---|---|---|---|---|---|
| $V_{OH}$ | Output HIGH Voltage | $I_{OH}$ = -0.1 mA | 1.4 | — | V |
| $V_{OL}$ | Output LOW Voltage | $I_{OL}$ = 0.1 mA | — | 0.2 | V |
| $V_{IH}$(1) | Input HIGH Voltage | | 1.4 | $V_{DD}$ + 0.2 | V |
| $V_{IL}$(1) | Input LOW Voltage | | –0.2 | 0.4 | V |
| $I_{LI}$ | Input Leakage | GND < $V_{IN}$ < $V_{DD}$ | –1 | 1 | µA |
| $I_{LO}$ | Output Leakage | GND < $V_{IN}$ < $V_{DD}$, Output Disabled | –1 | 1 | µA |

Note:
1. VILL(min) = -1.0V AC (pulse width < 10ns). Not 100% tested.
   VIHH (max) = VDD + 1.0V AC (pulse width < 10ns). Not 100% tested.

## DC ELECTRICAL CHARACTERISTICS-I (OVER THE OPERATING RANGE)

**VDD = 2.4V – 3.6V**

| Symbol | Parameter | | Test Conditions | Min. | Max. | Unit |
|---|---|---|---|---|---|---|
| $V_{OH}$ | Output HIGH Voltage | 2.4V ~ 2.7V | $V_{DD}$ = Min., $I_{OH}$ = -1.0 mA | 2.0 | — | V |
| | | 2.7V ~ 3.6V | $V_{DD}$ = Min., $I_{OH}$ = -4.0 mA | 2.2 | | |
| $V_{OL}$ | Output LOW Voltage | 2.4V ~ 2.7V | $V_{DD}$ = Min., $I_{OL}$ = 2.0 mA | — | 0.4 | V |
| | | 2.7V ~ 3.6V | $V_{DD}$ = Min., $I_{OL}$ = 8.0 mA | — | 0.4 | |
| $V_{IH}$(1) | Input HIGH Voltage | 2.4V ~ 2.7V | | 2.0 | $V_{DD}$ + 0.3 | V |
| | | 2.7V ~ 3.6V | | 2.0 | | |
| $V_{IL}$(1) | Input LOW Voltage | 2.4V ~ 2.7V | | –0.3 | 0.6 | V |
| | | 2.7V ~ 3.6V | | –0.3 | 0.8 | |
| $I_{LI}$ | Input Leakage | | VSS < $V_{IN}$ < $V_{DD}$ | –2 | 2 | µA |
| $I_{LO}$ | Output Leakage | | VSS < $V_{IN}$ < $V_{DD}$, Output Disabled | –2 | 2 | µA |

Note:
1. VIL(min) = -0.3V DC ; VIL(min) = -2.0V AC (pulse width 2.0ns). Not 100% tested.
   VIH (max) = VDD + 0.3V DC ; VIH(max) = VDD + 2.0V AC (pulse width 2.0ns). Not 100% tested.

## POWER SUPPLY CHARACTERISTICS-II FOR POWER [1, 2] (OVER THE OPERATING RANGE)

**IS61/64WV102416DALL (VDD = 1.65V – 2.2V) & IS61/64WV102416DBLL (VDD = 2.4V – 3.6V)**

| Symbol | Parameter | Test Conditions | Grade | -10 Max. | -12 Max. | Unit |
|---|---|---|---|---|---|---|
| ICC | $V_{DD}$ Dynamic Operating Supply Current | $V_{DD}$ = MAX, $I_{OUT}$ = 0 mA, f = $f_{MAX}$ | Com. | 90 | 85 | mA |
| | | | Ind. | 100 | 95 | |
| | | | Auto. | 140 | 135 | |
| ICC1 | Operating Supply Current | $V_{DD}$ = MAX, $I_{OUT}$ = 0 mA, f = 0 | Com. | 80 | 80 | mA |
| | | | Ind. | 90 | 90 | |
| | | | Auto. | 110 | 110 | |
| ISB1 | TTL Standby Current (TTL Inputs) | $V_{DD}$ = MAX, $V_{IN}$ = $V_{IH}$ or $V_{IL}$ CS# ≥ $V_{IH}$, f = 0 | Com. | 60 | 60 | mA |
| | | | Ind. | 70 | 70 | |
| | | | Auto. | 110 | 110 | |
| ISB2 | CMOS Standby Current (CMOS Inputs) | $V_{DD}$ = MAX, CS# ≥ $V_{DD}$ - 0.2V $V_{IN}$ ≥ $V_{DD}$ - 0.2V, or $V_{IN}$ ≤ 0.2V , f = 0 | Com. | 50 | 50 | mA |
| | | | Ind. | 60 | 60 | |
| | | | Auto. | 100 | 100 | |
| | | | Typ. [2] | 10 | | |

Notes:
1. At f = fMAX, address and data inputs are cycling at the maximum frequency, f = 0 means no input line change.
2. Typical values are measured at $V_{DD}$ = 3.0V/1.8V, $T_A$ = 25 °C and not 100% tested.

# AC CHARACTERISTICS (OVER OPERATING RANGE)

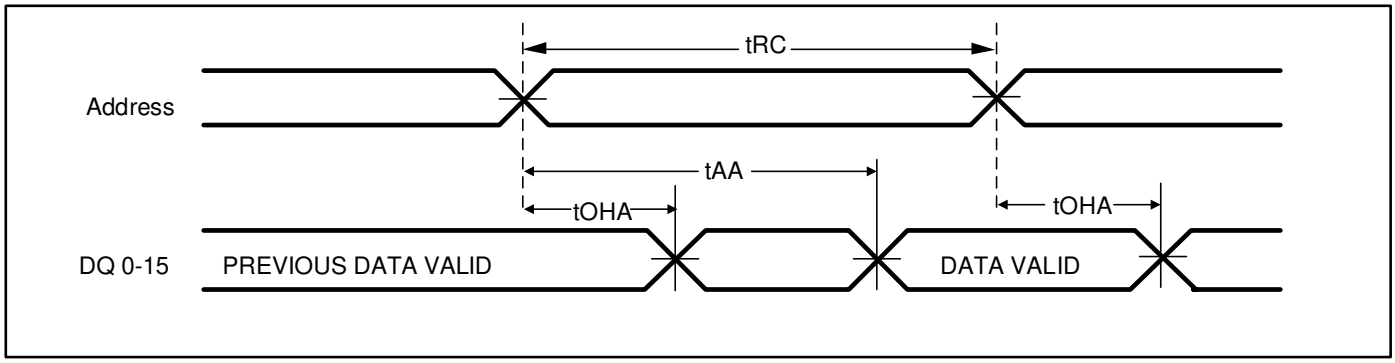
## READ CYCLE AC CHARACTERISTICS

| Parameter | Symbol | -10[1] | | -12[1] | | unit | notes |
|---|---|---|---|---|---|---|---|
| | | Min | Min | Min | Max | | |
| Read Cycle Time | tRC | 10 | - | 12 | - | ns | |
| Address Access Time | tAA | - | 10 | - | 12 | ns | |
| Output Hold Time | tOHA | 2.5 | - | 2.5 | - | ns | |
| CS# Access Time | tACE | - | 10 | - | 12 | ns | |
| OE# Access Time | tDOE | - | 6 | - | 7 | ns | |
| OE# to High-Z Output | tHZOE | 0 | 5 | 0 | 6 | ns | 2 |
| OE# to Low-Z Output | tLZOE | 0 | - | 0 | - | ns | 2 |
| CS# to High-Z Output | tHZCE | 0 | 5 | 0 | 6 | ns | 2 |
| CS# to Low-Z Output | tLZCE | 3 | - | 3 | - | ns | 2 |
| UB#, LB# Access Time | tBA | - | 6 | - | 7 | ns | |
| UB#, LB# to High-Z Output | tHZB | 0 | 5 | 0 | 6 | ns | 2 |
| UB#, LB# to Low-Z Output | tLZB | 0 | - | 0 | - | ns | 2 |

Notes:
1. Test conditions assume signal transition times of 1.5 ns or less, timing reference levels of $V_{DD}/2$, input pulse levels of 0V to $V_{DD}$ and output loading specified in Figure 1.
2. Tested with the load in Figure 2. Transition is measured ±500 mV from steady-state voltage. Not 100% tested.

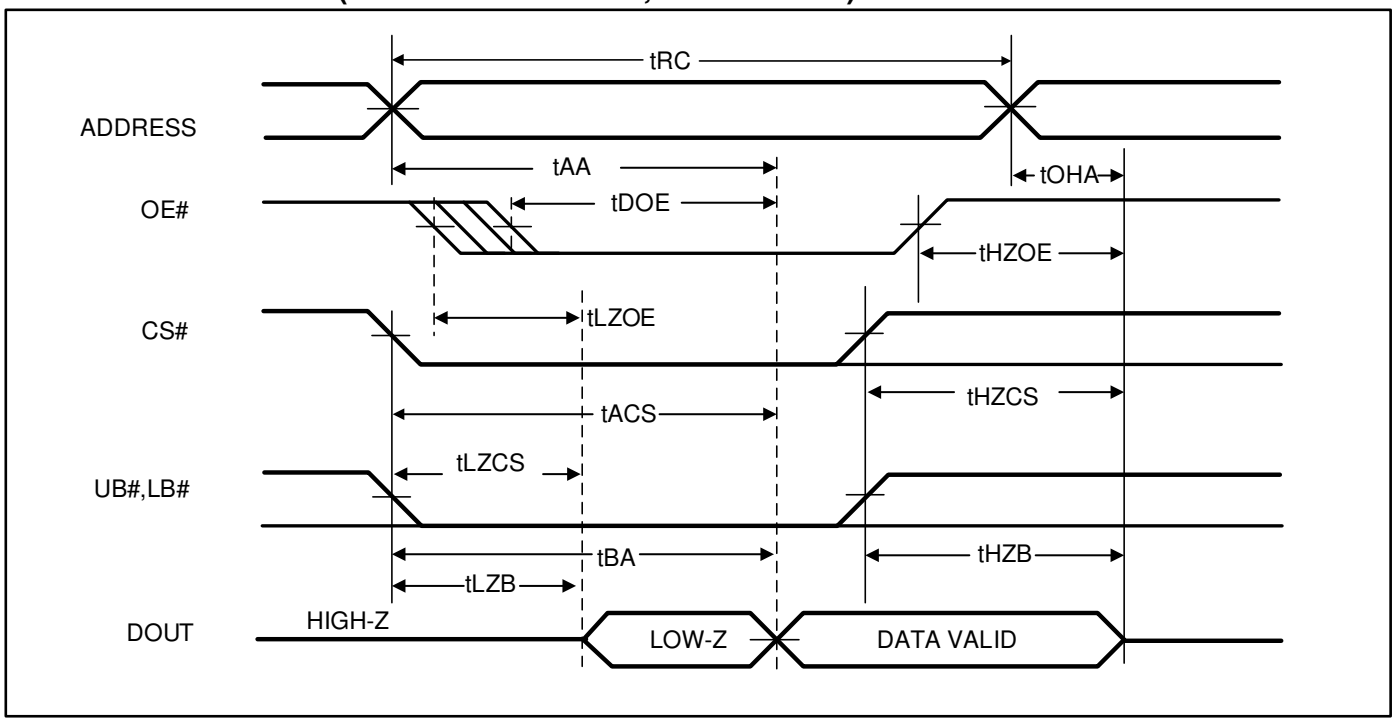
## AC WAVEFORMS

### READ CYCLE NO. 1[1] (Address Controlled, CS# = OE# = UB# = LB# = LOW, WE# = HIGH)




Notes:
1. The device is continuously selected.

### READ CYCLE NO. 2[1] (OE# CONTROLLED, WE# = HIGH)




Notes:
1. Address is valid prior to or coincident with CS# LOW transition.

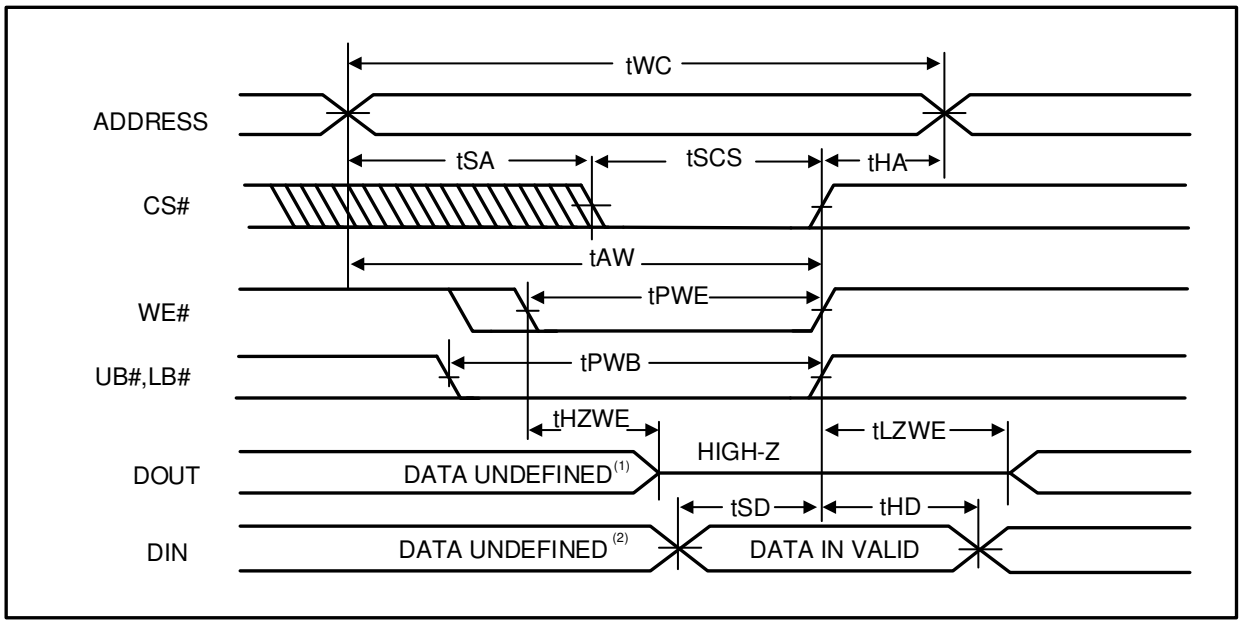
## WRITE CYCLE AC CHARACTERISTICS

| Parameter | Symbol | -10(1) | | -12(1) | | unit | notes |
|---|---|---|---|---|---|---|---|
| | | Min | Max | Min | Max | | |
| Write Cycle Time | tWC | 10 | - | 12 | - | ns | |
| CS# to Write End | tSCS | 8 | - | 9 | - | ns | |
| Address Setup Time to Write End | tAW | 8 | - | 9 | - | ns | |
| UB#,LB# to Write End | tPWB | 8 | - | 9 | - | ns | |
| Address Hold from Write End | tHA | 0 | - | 0 | - | ns | |
| Address Setup Time | tSA | 0 | - | 0 | - | ns | |
| WE# Pulse Width | tPWE1 | 8 | - | 9 | - | ns | |
| WE# Pulse Width (OE# = LOW) | tPWE2 | 10 | - | 12 | - | ns | 2 |
| Data Setup to Write End | tSD | 6 | - | 7 | - | ns | |
| Data Hold from Write End | tHD | 0 | - | 0 | - | ns | |
| WE# LOW to High-Z Output | tHZWE | - | 4 | - | 5 | ns | |
| WE# HIGH to Low-Z Output | tLZWE | 2 | - | 2 | - | ns | |

Notes:
1 The internal write time is defined by the overlap of CS# = LOW, UB# or LB# = LOW, and WE# = LOW. All conditions must be in valid states to initiate a Write, but any condition can go inactive to terminate the Write. The Data Input Setup and Hold timing are referenced to the rising or falling edge of the signal that terminates the write.
2 Tested tPWE > tHZWE + tSD when OE# is LOW.

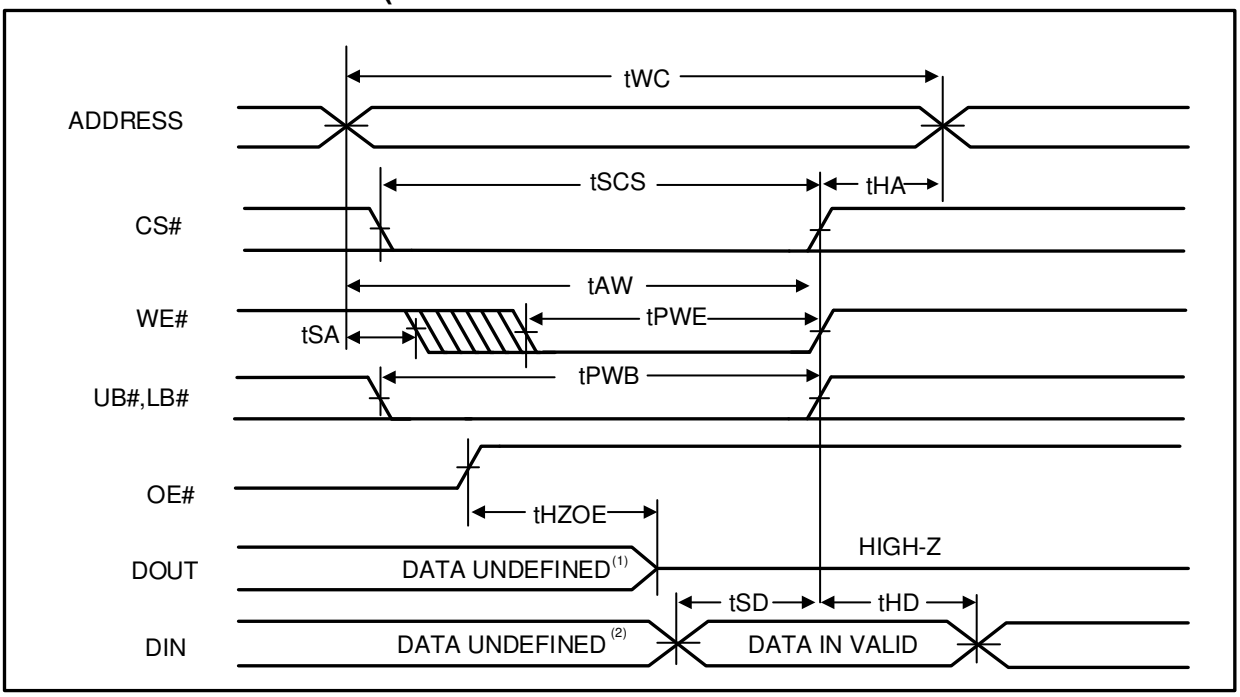
## AC WAVEFORMS

## WRITE CYCLE NO. 1(1) (CS# CONTROLLED, OE# = HIGH OR LOW)



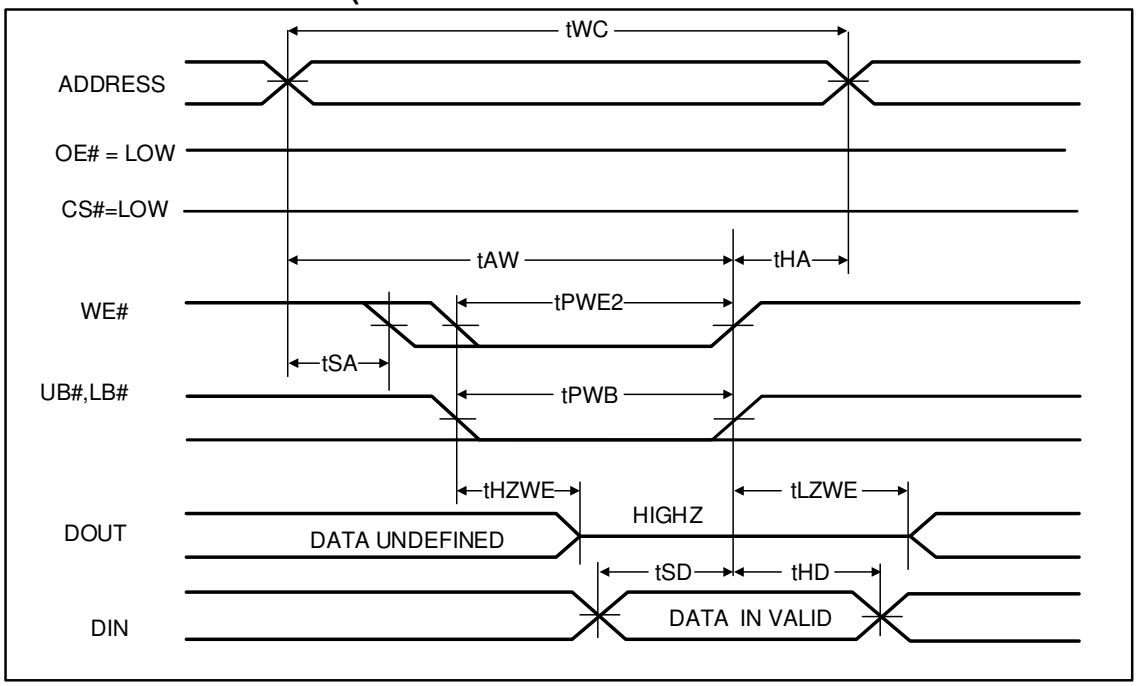

Note:
1. tHZWE is is based on the assumption when tSA=0nS after READ operation. Actual DOUT for tHZWE may not appear if OE# goes high before Write Cycle.

## WRITE CYCLE NO. 2[1, 2] (WE# CONTROLLED: OE# IS HIGH DURING WRITE CYCLE)



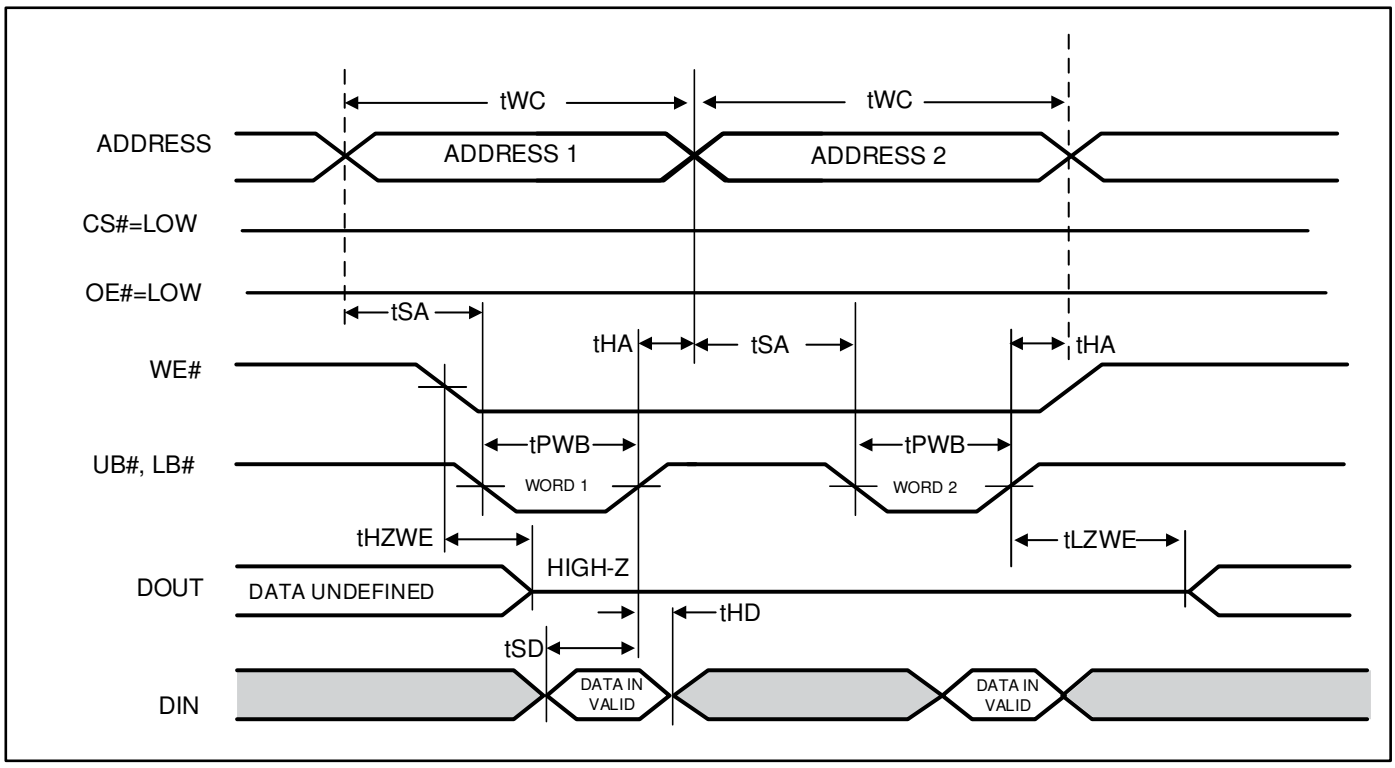

Notes:
1. tHZOE is the time DOUT goes to High-Z after OE# goes high.
2. During this period the I/Os are in output state. Do not apply input signals.

## WRITE CYCLE NO. 3[1] (WE# CONTROLLED: OE# IS LOW DURING WRITE CYCLE)




Note:
1. If OE# is low during write cycle, tHZWE must be met in the application. Do not apply input signal during this period. Data output from the previous READ operation will drive IO BUS.

## WRITE CYCLE NO. 4[1, 2, 3] (UB# & LB# Controlled, CS# = OE# = LOW)



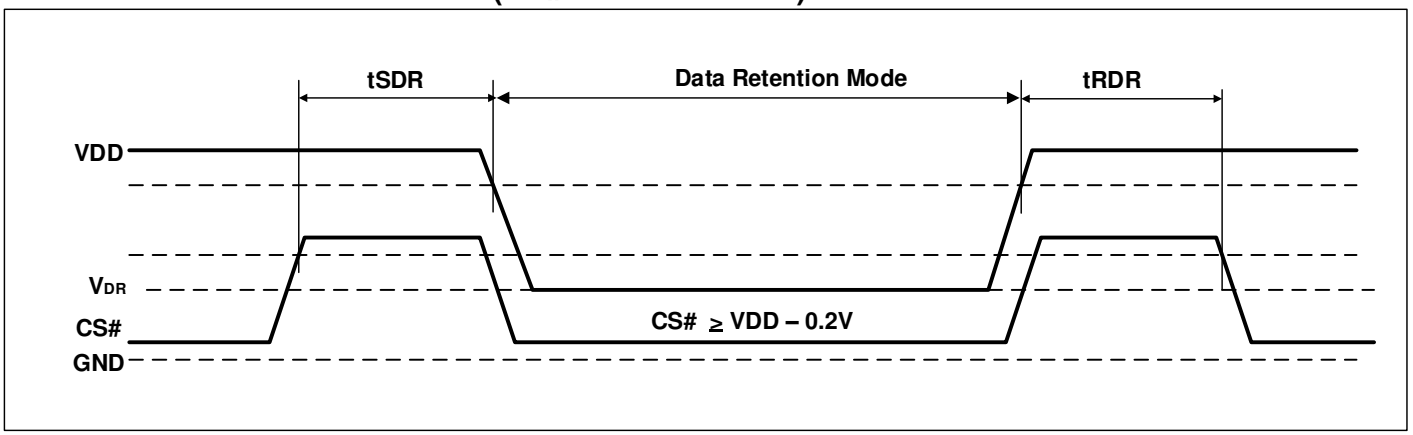

Notes:
1. If OE# is low during write cycle, tHZWE must be met in the application. Do not apply input signal during this period. Data output from the previous READ operation will drive IO BUS.
2. Due to the restriction of note1, OE# is recommended to be HIGH during write period.
3. WE# stays LOW in this example. If WE# toggles,, tPWE and tHZWE must be considered

## DATA RETENTION CHARACTERISTICS

| Symbol | Parameter | Test Condition | OPTION | Min. | Typ.(2) | Max. | Unit |
|---|---|---|---|---|---|---|---|
| $V_{DR}$ | $V_{DD}$ for Data Retention | See Data Retention Waveform | $V_{DD}$ = 2.4V to 3.6V | 2.0 | | 3.6 | V |
| | | | $V_{DD}$ = 1.65V to 2.2V | 1.2 | | 3.6 | |
| $I_{DR}$ | Data Retention Current | $V_{DD}$= $V_{DR}$(min), CS# ≥ $V_{DD}$ – 0.2V | Com. | - | 10 | 50 | mA |
| | | | Ind. | - | - | 60 | |
| | | | Auto | - | - | 100 | |
| $t_{SDR}$ | Data Retention Setup Time | See Data Retention Waveform | | 0 | - | - | ns |
| $t_{RDR}$ | Recovery Time | See Data Retention Waveform | | tRC | - | - | ns |

Note:
1. If CS# ≥ VDD–0.2V, all other inputs including UB# and LB# must meet this condition.
2. Typical values are measured at $V_{DD}$ = $V_{DR}$ (Min), $T_A$ = 25 °C and not 100% tested.

## DATA RETENTION WAVEFORM (CS# CONTROLLED)



# ORDERING INFORMATION

## IS61/64WV102416DALL (1.65V – 2.2V)

### Commercial Range: 0°C to +70°C

| Speed (ns) | Order Part No. | Package |
|---|---|---|
| 10 | IS61WV102416DALL-10B | mini BGA (6mm x 8mm) |
| 10 | IS61WV102416DALL-10BL | mini BGA (6mm x 8mm), Lead-free |
| 10 | IS61WV102416DALL-10TL | TSOP (Type I), Lead-free |

### Industrial Range: -40°C to +85°C

| Speed (ns) | Order Part No. | Package |
|---|---|---|
| 10 | IS61WV102416DALL-10BI | mini BGA (6mm x 8mm) |
| 10 | IS61WV102416DALL-10BLI | mini BGA (6mm x 8mm), Lead-free |
| 10 | IS61WV102416DALL-10TLI | TSOP (Type I), Lead-free |

### Automotive (A3) Range: –40°C to +125°C

| Speed (ns) | Order Part No. | Package |
|---|---|---|
| 12 | IS64WV102416DALL-12BA3 | mini BGA (6mm x 8mm) |
| 12 | IS64WV102416DALL-12BLA3 | mini BGA (6mm x 8mm), Lead-free |
| 12 | IS64WV102416DALL-12CTLA3 | TSOP (Type I), Copper Lead-frame, Lead-free |

# IS61/64WV102416DBLL (2.2V - 3.6V)

## Commercial Range: 0°C to +70°C

| Speed (ns) | Order Part No. | Package |
|---|---|---|
| 10 | IS61WV102416DBLL-10B | mini BGA (6mm x 8mm) |
| 10 | IS61WV102416DBLL-10BL | mini BGA (6mm x 8mm), Lead-free |
| 10 | IS61WV102416DBLL-10TL | TSOP (Type I), Lead-free |

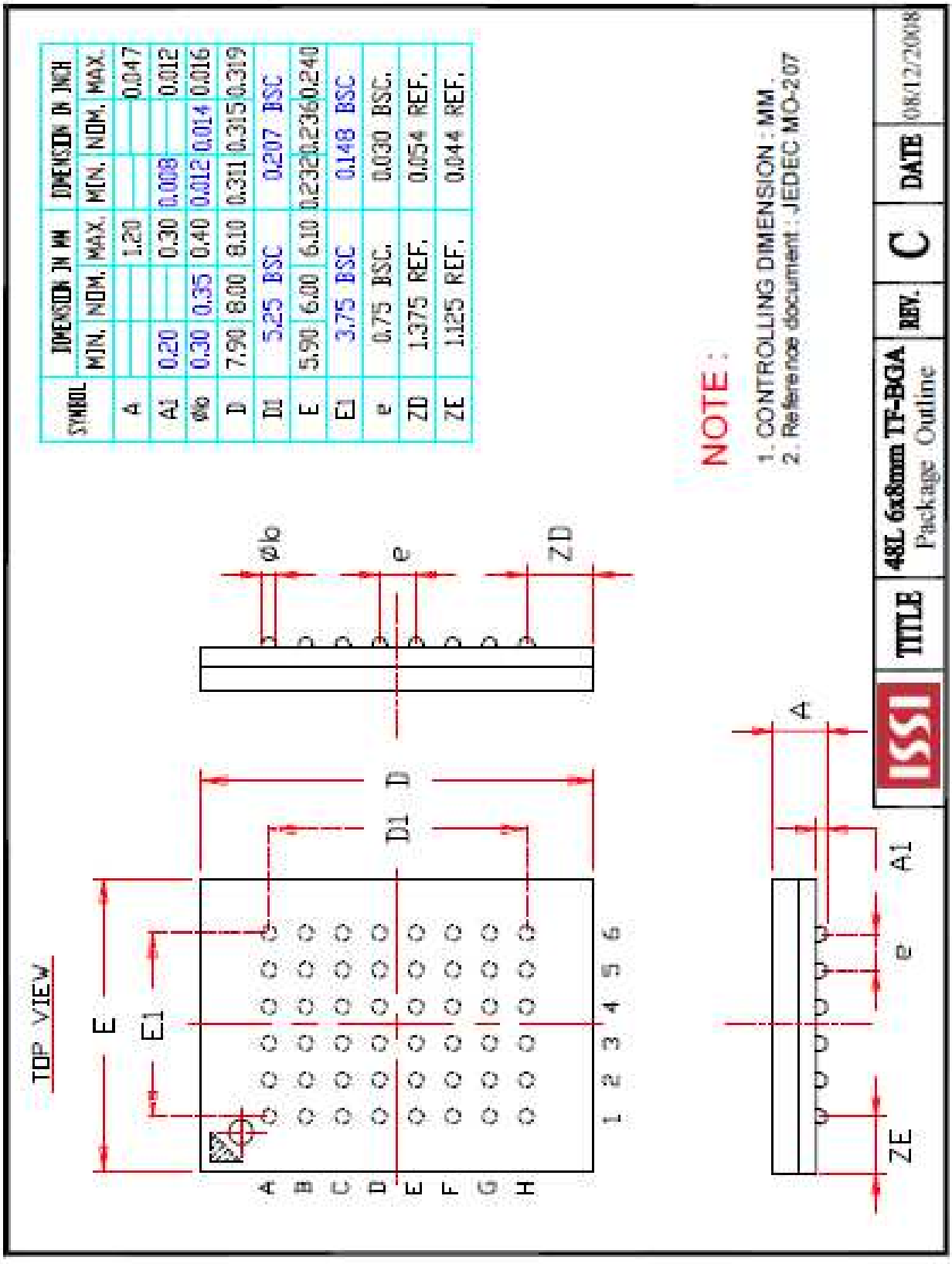
## Industrial Range: -40°C to +85°C

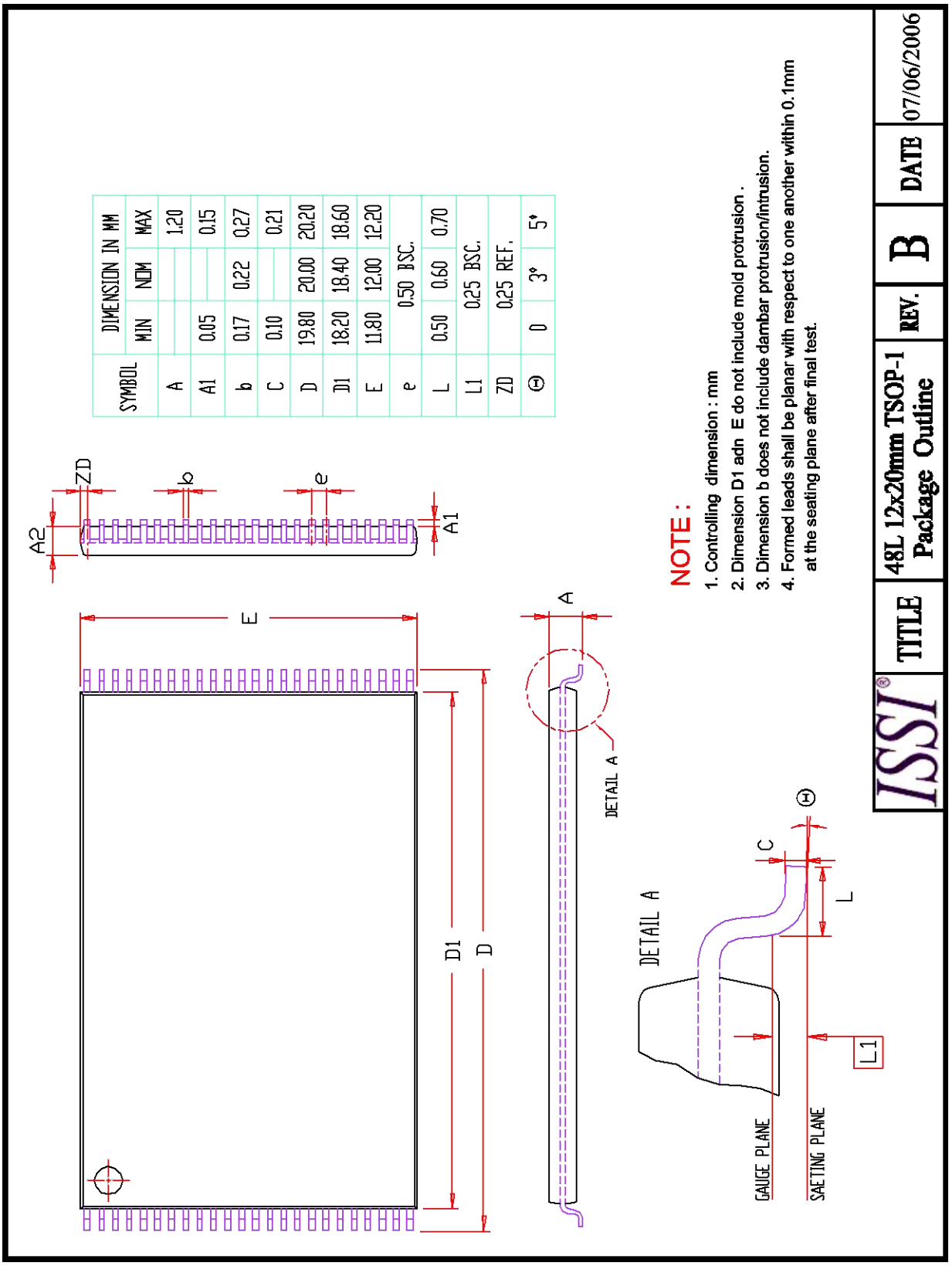
| Speed (ns) | Order Part No. | Package |
|---|---|---|
| 10 | IS61WV102416DBLL-10BI | mini BGA (6mm x 8mm) |
| 10 | IS61WV102416DBLL-10BLI | mini BGA (6mm x 8mm), Lead-free |
| 10 | IS61WV102416DBLL-10TLI | TSOP (Type I), Lead-free |

## Automotive (A3) Range: –40°C to +125°C

| Speed (ns) | Order Part No. | Package |
|---|---|---|
| 12 | IS64WV102416DBLL-12BA3 | mini BGA (6mm x 8mm) |
| 12 | IS64WV102416DBLL-12BLA3 | mini BGA (6mm x 8mm), Lead-free |
| 12 | IS64WV102416DBLL-12CTLA3 | TSOP (Type I), Copper Lead-frame, Lead-free |

## PACKAGE INFORMATION




DIMENSION IN MM
SYMBOL MIN NOM MAX
A 1.20
A1 0.05 0.15
b 0.17 0.22 0.27
C 0.10 0.21
D 19.80 20.00 20.20
D1 18.20 18.40 18.60
E 11.80 12.00 12.20
e 0.50 BSC.
L 0.50 0.60 0.70
L1 0.25 BSC.
ZD 0.25 REF.
θ 0° 3° 5°
NOTE:
1. Controlling dimension : mm
2. Dimension D1 adn E do not include mold protrusion .
3. Dimension b does not include dambar protrusion/intrusion.
4. Formed leads shall be planar with respect to one another within 0.1mm at the seating plane after final test.
ISSI
TITLE
48L 12x20mm TSOP-1 Package Outline
REV. B
DATE 07/06/2006
A2
ZD
b
e
A1
E
D1
D
A
DETAIL A
DETAIL A
C
θ
L
L1
GAUGE PLANE
SAETING PLANE