



## DDR 14-Bit Registered Buffer

### Features

- Fully JEDEC JC40 - JC42.5 compliant for DDR1 applications to include: PC1600, PC2100, PC2700 & PC3200 ( > JEDEC defined DDR 400 @ 200MHz )
- Low voltage operation; VDD: 2.3V - 2.7V.
- SSTL\_2 Class II outputs.
- Differential clock inputs.
- Available in 48 pin TSSOP and TVSOP packages.

### Product Description

The ASM4SSTVF16857 is a universal 14-bit register (D F/F based), designed for 2.3V to 2.7V  $V_{DD}$ . The device supports SSTL\_2 I/O levels, and is fully compliant with the JEDEC JC40, JC42.5 DDR I specifications covering PC1600, PC2100, PC2700, and PC3200 operational ranges. 14-bit refers to 2Q outputs for each D input - designed for use in Stacked Registers (stacked memory devices), Buffered DIMM applications.

Data flow from D to Q is controlled by the differential clock (CLK/CLKB) along with a controlled reset (RESETB). The positive edge of CLK is used to trigger the data transfer, and CLKB is used to maintain sufficient noise margins, whereas the RESETB input is designed and intended for use at power-up.

The ASM4SSTVF16857 supports a low power standby mode of operation. A logic low level at RESETB, assures that all internal registers and outputs (Q) are reset to a logic low state, and that all input receivers, data (D) buffers, and clock (CLK/CLKB) are switched off. Note that RESETB should be supported with a

LVC MOS level at a valid logic state since VREF may not be stable during power-up.

To ensure that outputs are at a defined logic state before a stable clock has been supplied, RESETB must be held at a logic low level during power-up.

In the JEDEC defined Registered DDR DIMM application, RESETB is specified to be asynchronous with respect to CLK/CLKB; therefore, no timing relationship can be guaranteed between the two signals. When entering a low-power standby mode, the register will be cleared and the outputs will be driven to a logic low level quickly relative to the time to disable the differential input receivers. This ensures there are no "glitches" on any output. However, when coming out of low power standby mode, the register will become active quickly relative to the time taken to enable the differential input receivers. When the data inputs are at a logic level low and the clock is stable during the low-to-high transition of RESETB until the input receivers are fully enabled, the design ensures that the outputs will remain at a logic low level.

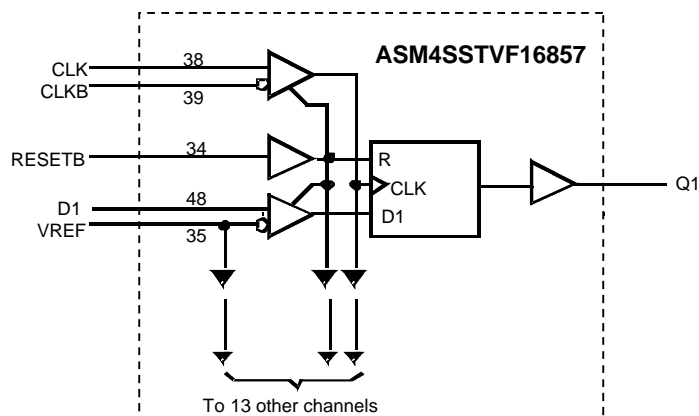
### Applications

- JEDEC and Non JEDEC DDR Memory Modules
  - Planar configurations
  - Supports PC1600 - PC2100 - PC2700 - PC3200
- SSTL\_2 I/O
- Provides a complete support solution for JEDEC JC42.5 (JC45) DDR I RDIMMs' when used with the ASM5CVF857 Zero Delay Buffer.

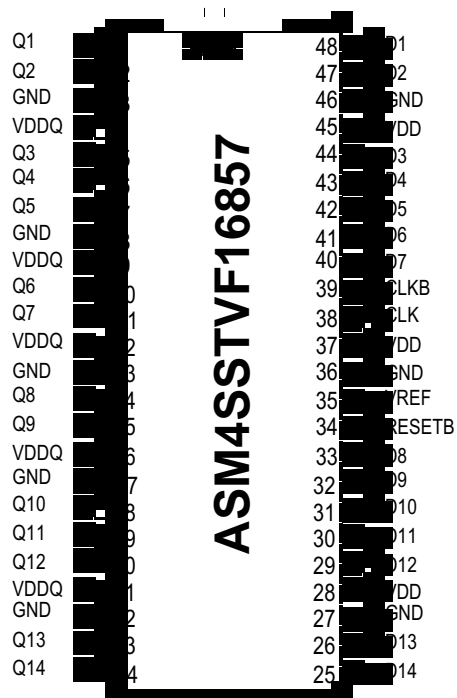


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## Block Diagram



## Pin Configurations



48-pin TSSOP &amp; TVSOP

6.10 mm body, 0.50 mm pitch - TSSOP

4.40mm body, 0.40mm pitch - TSSOP (TVSOP)



## Pin Descriptions

| Pin #  | Pin Name | Type | Description              |
|--|----------|------|--------------------------|
| 1, 2, 5, 6, 7, 10, 11, 14, 15, 18, 19, 20, 23, 24      | Q (14:1) | O    | Data output.             |
| 3, 8, 13, 17, 22, 27, 36, 46                           | GND      | P    | Ground to entire chip.   |
| 4, 9, 12, 16, 21                                       | VDDQ     | P    | Output supply voltage.   |
| 25, 26, 29, 30, 31, 32, 33, 40, 41, 42, 43, 44, 47, 48 | D(14:1)  | I    | Data input.              |
| 38   | CLK      | I    | Positive clock input.    |
| 39   | CLKB     | I    | Negative clock input.    |
| 28, 37, 45   | VDD      | P    | Core supply voltage.     |
| 34   | RESETB   | I    | Rest Active low.         |
| 35   | VREF     | I    | Input reference voltage. |

## Truth Table<sup>1</sup>

| Inputs  |               |               |               | Q Outputs                   |
|---|---------------|---------------|---------------|-----------------------------|
| RESETB  | CLK           | CLKB          | D             | Q                           |
| L   | X or floating | X or floating | X or floating | L                           |
| H   |               |               | H             | H                           |
| H   |               |               | L             | L                           |
| H   | L or H        | L or H        | X             | Q <sub>0</sub> <sup>2</sup> |
| Note:<br>1. H=High signal level, L=Low signal level, = transition from low to high, = transition from high to low, X = don't care<br>2. Output level before the indicated steady state input conditions were established. |               |               |               |                             |



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**Absolute Maximum Ratings**

| Parameter  | Min  | Max                   | Unit |
|--|------|-----------------------|------|
| Storage Temperature  | -65  | +150                  | °C   |
| Supply Voltage   | -0.5 | 3.6                   | V    |
| Input Voltage <sup>1</sup>   | -0.5 | V <sub>DD</sub> + 0.5 | V    |
| Output Voltage <sup>1,2</sup>  | -0.5 | V <sub>DD</sub> + 0.5 | V    |
| Input Clamp Current  | ± 50 |                       | mA   |
| Output Clamp Current   | ±50  |                       | mA   |
| Continuous Output Current  | ±50  |                       | mA   |
| VDD, VDDQ or GND current/pin   | 100  |                       | mA   |
| Package Thermal Impedance <sup>3</sup>   | 55   |                       | °C/W |
| Note:<br>1. The input and output negative voltage ratings may be excluded if the input and output clamp ratings are observed.<br>2. This current will flow only when the output is in the high state level V <sub>0</sub> > V <sub>DDQ</sub> .<br>3. The package thermal impedance is calculated in accordance with JESD 51.<br>These are stress ratings only and functional operation is not implied. Exposure to absolute maximum ratings for prolonged periods can affect device reliability. |      |                       |      |



## Recommended Operating Conditions

Guaranteed by design. Not 100% tested in production.

| Parameter    | Description                                    |                              | Min                 | Typ       | Max                 | Unit |
|--------------|--|------------------------------|---------------------|-----------|---------------------|------|
| $V_{DD}$     | Supply voltage                                 |                              | 2.3                 | 2.5       | 2.7                 | V    |
| $V_{DDQ}$    | Output supply voltage                          | PC1600,<br>PC2100,<br>PC2700 | 2.3                 |           | 2.7                 | V    |
|              |  | PC3200                       | 2.5                 |           | 2.7                 |      |
| $V_{REF}$    | Reference voltage<br>( $V_{REF} = V_{DDQ}/2$ ) | PC1600,<br>PC2100,<br>PC2700 | 1.15                | 1.25      | 1.35                | V    |
|              |  | PC3200                       | 1.25                | 1.3       | 1.35                |      |
| $V_{TT}$     | Termination voltage                            |                              | $V_{REF} - 0.04$    | $V_{REF}$ | $V_{REF} + 0.004$   | V    |
| $V_I$        | Input voltage                                  |                              | 0                   |           | $V_{DD}$            | V    |
| $V_{IH(DC)}$ | DC input high voltage                          | Data<br>Inputs               | $V_{REF} + 0.15$    |           |                     | V    |
| $V_{IH(AC)}$ | AC input high voltage                          |                              | $V_{REF} + 0.31$    |           |                     | V    |
| $V_{IL(DC)}$ | DC input low voltage                           |                              |                     |           | $V_{REF} - 0.15$    | V    |
| $V_{IL(AC)}$ | AC input low voltage                           |                              |                     |           | $V_{REF} - 0.31$    | V    |
| $V_{IH}$     | Input high voltage level                       | RESETB                       | 1.7                 |           |                     | V    |
| $V_{IL}$     | Input low voltage level                        |                              |                     |           | 0.7                 | V    |
| $V_{ICR}$    | Common mode input range                        | CLK                          | 0.97                |           | 1.53                | V    |
| $V_{ID}$     | Differential input voltage                     | CLKB                         | 0.36                |           |                     | V    |
| $V_{IX}$     | Cross-point voltage of differential clock pair |                              | $(V_{DDQ}/2) - 0.2$ |           | $(V_{DDQ}/2) + 0.2$ | V    |
| $I_{OH}$     | High-level output current                      |                              |                     |           | -20                 | mA   |
| $I_{OI}$     | Low-level output current                       |                              |                     |           | 20                  | mA   |
| $T_A$        | Operating free-air temperature                 |                              | 0                   |           | 70                  | °C   |



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## DC Electrical Characteristics - PC1600, PC2100, PC2700

$T_A = 0^\circ\text{C}$  to  $70^\circ\text{C}$ ,  $V_{DD} = 2.5 \pm 0.2\text{V}$ , and  $V_{DDQ} = 2.5 \pm 0.2\text{V}$  (unless otherwise stated)

Guaranteed by design. Not 100% production tested.

| Symbol            | Parameter   | Test conditions  |   | V <sub>DD</sub> | Min                   | Typ  | Max  | Units                         |
|-------------------|---|--|---|-----------------|-----------------------|------|------|-------------------------------|
| V <sub>IK</sub>   |   | I <sub>I</sub> = -18 mA  |   | 2.3 V           |                       |      | -1.2 | V                             |
| V <sub>OH</sub>   |   | I <sub>OH</sub> = -100 μA  |   | 2.3 V to 2.7 V  | V <sub>DD</sub> - 0.2 |      |      | V                             |
|                   |   | I <sub>OH</sub> = -16 mA   |   | 2.3 V           | 1.95                  |      |      | V                             |
| V <sub>OL</sub>   |   | I <sub>OL</sub> = 100 μA   |   | 2.3 V to 2.7 V  |                       |      | 0.2  | V                             |
|                   |   | I <sub>OL</sub> = 16 mA  |   | 2.3 V           |                       |      | 0.35 | V                             |
| I <sub>I</sub>    | All inputs  | V <sub>I</sub> = V <sub>DD</sub> or GND  |   | 2.7 V           |                       |      | ± 5  | μA                            |
| I <sub>DD</sub>   | Standby (static)  | RESETB = GND   | I <sub>O</sub> = 0                      | 2.7 V           |                       |      | 0.01 | μA                            |
|                   | Operating (static)  | V <sub>I</sub> = V <sub>IH(AC)</sub> or V <sub>IL(AC)</sub> ,<br>RESETB = V <sub>DD</sub>  |   | 2.7 V           |                       |      | 25   | mA                            |
| I <sub>DDO</sub>  | Dynamic operating (clock only)                              | RESETB = V <sub>DD</sub> ,<br>V <sub>I</sub> = V <sub>IH(AC)</sub> or V <sub>IL(AC)</sub> ,<br>CLK and CLKB switching<br>50% duty cycle  |   | 2.7 V           |                       | 28   |      | μA/clock<br>MHz               |
|                   | Dynamic operating (per each data input)                     | RESETB = V <sub>DD</sub> , V <sub>I</sub> = V <sub>IH(AC)</sub> or<br>V <sub>IL(AC)</sub> , CLK and CLKB =<br>switching 50% duty cycle;<br>One data input switching at half<br>clock frequency, 50% duty cycle |   | 2.7 V           |                       | 15   |      | μA/clock<br>MHz/data<br>input |
| r <sub>OH</sub>   | Output high   | I <sub>OH</sub> = -20 mA   |   | 2.3 V to 2.7 V  | 7                     | 13.5 | 20   | Ω                             |
| r <sub>OL</sub>   | Output low  | I <sub>OL</sub> = 20 mA  |   | 2.3 V to 2.7 V  | 7                     |      | 20   | Ω                             |
| r <sub>O(D)</sub> | r <sub>OH</sub> - r <sub>OL</sub>  <br>each<br>separate bit | I <sub>O</sub> = 20 mA, T <sub>A</sub> = 25° C   |   | 2.5 V           |                       |      | 4    | Ω                             |
| C <sub>i</sub>    | Data inputs   | V <sub>I</sub> = V <sub>REF</sub> ± 310 mV, V <sub>ICR</sub> = 1.25 V,<br>V <sub>I(PP)</sub> = 360 mV  |   | 2.5 V           | 2.5                   |      | 3.5  | pF                            |
|                   | CLK & CLKB  |  |   | 2.5 V           | 2.5                   |      | 3.5  | pF                            |
|                   |   | RESETB   | V <sub>I</sub> = V <sub>DD</sub> or GND |                 | 2.5V                  | 2.5  |      | 3.5                           |



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## DC Electrical Characteristics -PC3200

$T_A = 0^\circ\text{C}$  to  $70^\circ\text{C}$ ,  $V_{DD} = 2.6 \pm 0.2\text{V}$ , and  $V_{DDQ} = 2.6 \pm 0.2\text{V}$  (unless otherwise stated)

Guaranteed by design. Not 100% production tested.

| Symbol            | Parameters  | Test conditions   |                    | V <sub>DD</sub> (V) | Min                   | Typ  | Max  | Units                   |
|-------------------|---|---|--------------------|---------------------|-----------------------|------|------|-------------------------|
| V <sub>IK</sub>   |   | I <sub>I</sub> = -18 mA   |                    | 2.5                 |                       |      | -1.2 | V                       |
| V <sub>OH</sub>   |   | I <sub>OH</sub> = -100 μA   |                    | 2.5 V to 2.7        | V <sub>DD</sub> - 0.2 |      |      | V                       |
|                   |   | I <sub>OH</sub> = -8 mA   |                    | 2.5                 | 1.95                  |      |      | V                       |
| V <sub>OL</sub>   |   | I <sub>OL</sub> = 100 μA  |                    | 2.5 V to 2.7        |                       |      | 0.2  | V                       |
|                   |   | I <sub>OL</sub> = 8 mA  |                    | 2.5                 |                       |      | 0.35 | V                       |
| I <sub>I</sub>    | All inputs  | V <sub>I</sub> = V <sub>DD</sub> or GND   |                    | 2.7                 |                       |      | ± 5  | μA                      |
| I <sub>DD</sub>   | Standby (static)                                      | RESETB = GND  | I <sub>O</sub> = 0 | 2.7                 |                       |      | 0.01 | μA                      |
|                   | Operating (static)                                    | V <sub>I</sub> = V <sub>IH(AC)</sub> or V <sub>IL(AC)</sub> ,<br>RESETB = V <sub>DD</sub>   |                    | 2.7                 |                       |      | 25   | mA                      |
| I <sub>DD</sub>   | Dynamic operating (clock only)                        | RESETB = V <sub>DD</sub> ,<br>V <sub>I</sub> = V <sub>IH(AC)</sub> or V <sub>IL(AC)</sub> ,<br>CLK and CLKB switching 50% duty cycle  |                    | 2.7                 |                       | 328  |      | μA/clock MHz            |
|                   | Dynamic operating (per each data input)               | RESETB = V <sub>DD</sub> ,<br>V <sub>I</sub> = V <sub>IH(AC)</sub> or V <sub>IL(AC)</sub> ,<br>CLK and CLKB = switching 50% duty cycle;<br>One data input switching at half clock frequency, 50% duty cycle |                    | 2.7                 |                       | 15   |      | μA/clock MHz/data input |
| r <sub>OH</sub>   | Output high   | I <sub>OH</sub> = -20 mA  |                    | 2.5 V to 2.7        | 7                     | 13.5 | 20   | Ω                       |
| r <sub>OL</sub>   | Output low  | I <sub>OL</sub> = 20 mA   |                    | 2.5 V to 2.7        | 7                     |      | 20   | Ω                       |
| r <sub>O(D)</sub> | r <sub>OH</sub> - r <sub>OL</sub>   each separate bit | I <sub>O</sub> = 20 mA, T <sub>A</sub> = 25° C  |                    | 2.6                 |                       |      | 4    | Ω                       |
| C <sub>i</sub>    | Data inputs   | V <sub>I</sub> = V <sub>REF</sub> ± 310 mV, V <sub>ICR</sub> = 1.25 V, V <sub>I(PP)</sub> = 360 mV  |                    | 2.6                 | 2.5                   |      | 3.5  | pF                      |
|                   | CLK & CLKB  |   |                    | 2.6                 | 2.5                   |      | 3.5  | pF                      |
|                   | RESETB  | V <sub>I</sub> = V <sub>DD</sub> or GND   |                    | 2.6                 | 2.5                   |      | 3.5  | pF                      |



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## Timing Requirements

(Over recommended operating free-air temperature range, unless otherwise noted).

Guaranteed by design. Not 100% production tested.

\* this parameter is not necessarily production tested.

| Symbol  | Parameters   |                         | V <sub>DDQ</sub> = 2.5V±0.2V |     | V <sub>DDQ</sub> = 2.6V±0.1V |     | Unit     |
|---|--|-------------------------|------------------------------|-----|------------------------------|-----|----------|
|   |  |                         | Min                          | Max | Min                          | Max |          |
| f <sub>CLOCK</sub>  | Clock frequency                                    |                         |                              | 200 |                              | 270 | MHz      |
| t <sub>W</sub>  | Pulse duration, CK, CKLB high or low               |                         | 2.5                          |     | 2.5                          |     | ns       |
| t <sub>ACT</sub> *  | Differential inputs active time                    |                         |                              | 22  |                              | 22  | ns       |
| t <sub>INACT</sub> *  | Differential inputs inactive time                  |                         |                              | 22  |                              | 22  | ns       |
| t <sub>s</sub>  | Setup time, fast slew rate                         | Data before CLK↑, CLKB↓ | 0.75                         |     | 0.4                          |     | ns<br>ns |
|   | Setup time, slow slew rate                         |                         | 0.9                          |     | 0.6                          |     |          |
| t <sub>h</sub>  | Hold time, fast slew rate                          | Data after CLK↑, CLKB↓  | 0.75                         |     | 0.4                          |     | ns<br>ns |
|   | Hold time, slow slew rate                          |                         | 0.9                          |     | 0.6                          |     |          |
| t <sub>SL</sub>   | Output slew rate, measurement point at 20% and 80% |                         | 1                            | 4   | 1                            | 4   | V/ns     |
| Note:<br>1. Data inputs must be low for a minimum time of t <sub>ACT</sub> max, after which RESETB is taken high.<br>2. Data and clock inputs must be held at valid levels (not floating) for a minimum time of t <sub>INACT</sub> max after which RESETB is taken low.<br>3. For data signal input slew rate >=V/ns<br>4. For data signal input slew rate >=0.5 V/ns and < 1V/ns<br>5. CLK,CLKB signals input slew rates are >=1V/ns |  |                         |                              |     |                              |     |          |





### Switching Characteristics - PC1600, PC2100, PC2700

(Over recommended operating free-air temperature range unless otherwise noted.)

| Symbol           | From (input) | To (output) | VDD = 2.5 V $\pm$ 0.2 V |     |     | Units |
|------------------|--------------|-------------|-------------------------|-----|-----|-------|
|                  |              |             | Min                     | Typ | Max |       |
| f <sub>max</sub> |              |             | 200                     | –   | –   | MHz   |
| t <sub>PD</sub>  | CLK, CLKB    | Q           | 1.1                     |     | 2.8 | ns    |
| t <sub>phl</sub> | RESETB       | Q           | –                       | –   | 5.0 | ns    |

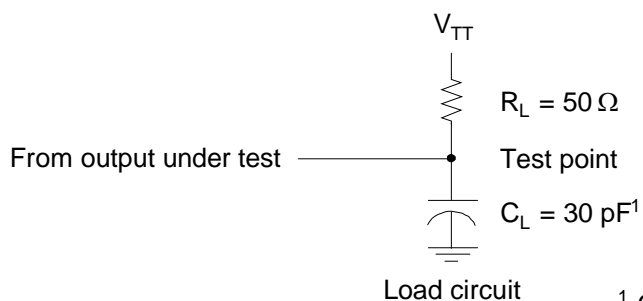
### Switching Characteristics - PC3200

(Over recommended operating free-air temperature range unless otherwise noted.)

| Symbol           | From (input) | To (output) | VDD = 2.6 V $\pm$ 0.1 V |     |     | Units |
|------------------|--------------|-------------|-------------------------|-----|-----|-------|
|                  |              |             | Min                     | Typ | Max |       |
| f <sub>max</sub> |              |             | 280                     |     |     | MHz   |
| t <sub>PD</sub>  | CLK, CLKB    | Q           | 1.1                     |     | 2.2 | ns    |
| t <sub>phl</sub> | RESETB       | Q           |                         |     | 5.0 | ns    |



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**Parameter Measurement Information ( $V_{DD} = 2.5 \text{ V} \pm 0.2\text{V}$ )**<sup>1</sup>  $C_L$  includes probe and jig capacitance.**Voltage and Current Waveforms**

In the following waveforms, note that all input pulses are supplied by generators having the following characteristics:  $\text{PRR} \leq 10 \text{ MHz}$ ,  $Z_o = 50 \Omega$ , input slew rate =  $1 \text{ V/ns} \pm 20\%$  (unless otherwise specified).

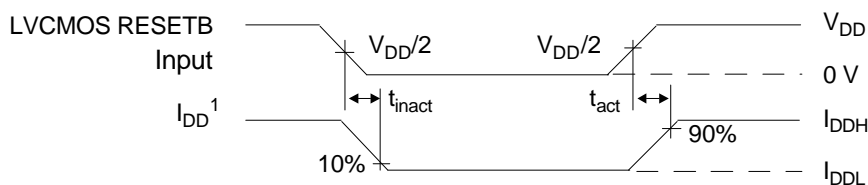
The outputs are measured one at a time with one transition per measurement.

$V_{TT} = V_{REF} = V_{DDQ}/2$ .

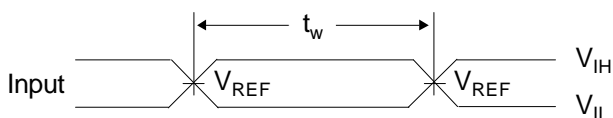
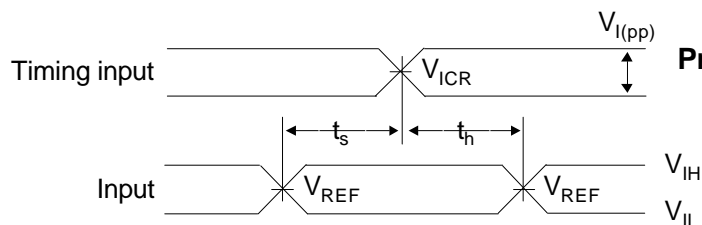
$V_{IH} = V_{REF} + 310 \text{ mV}$  (AC voltage levels) for differential inputs.  $V_{IH} = V_{DD}$  for LVCMOS input.

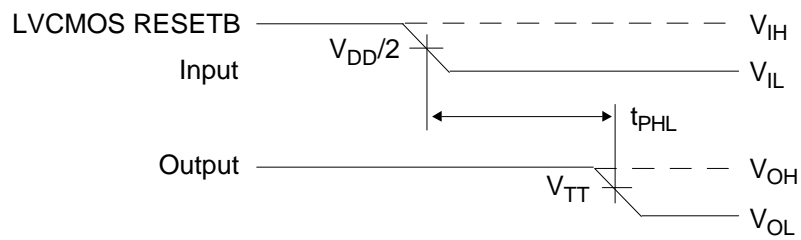
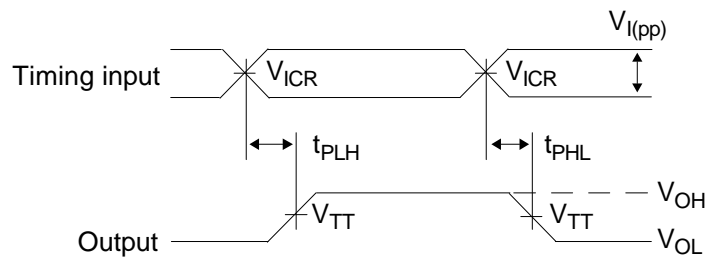
$V_{IL} = V_{REF} - 310 \text{ mV}$  (AC voltage levels) for differential inputs.  $V_{IL} = \text{GND}$  for LVCMOS input.

$t_{PLH}$  and  $t_{PHL}$  are the same as  $t_{pd}$ .

**Input active and inactive times**

<sup>1</sup>  $I_{DD}$  tested with clock and data inputs held at  $V_{DD}$  or GND, and  $I_O = 0 \text{ mA}$ .

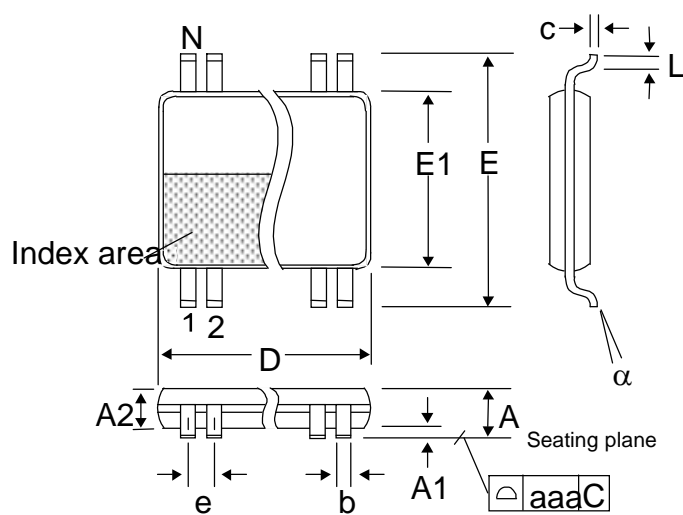
**Pulse duration****Setup and hold times****Propagation delay times**





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## Package Dimensions (48- Pin TSSOP)



6.10 mm (240 mil) body,  
0.50 mm (0.020 mil) pitch TSSOP

| Symbol | Millimeters          |      | Inches      |       |
|--------|----------------------|------|-------------|-------|
|        | Min                  | Max  | Min         | Max   |
| A      | —                    | 1.20 | —           | 0.047 |
| A1     | 0.05                 | 0.15 | 0.002       | 0.006 |
| A2     | 0.80                 | 1.05 | 0.32        | 0.041 |
| b      | 0.17                 | 0.27 | 0.007       | 0.011 |
| c      | 0.09                 | 0.20 | 0.0035      | 0.008 |
| D      | See variations below |      |             |       |
| E      | 8.10 basic           |      | 0.319 basic |       |
| E1     | 6.00                 | 6.20 | 0.236       | 0.244 |
| e      | 0.50 basic           |      | 0.020 basic |       |
| L      | 0.45                 | 0.75 | 0.018       | 0.030 |
| N      | See variations below |      |             |       |
| a      | 0°                   | 8°   | 0°          | 8°    |
| aaa    | —                    | 0.10 | —           | 0.004 |

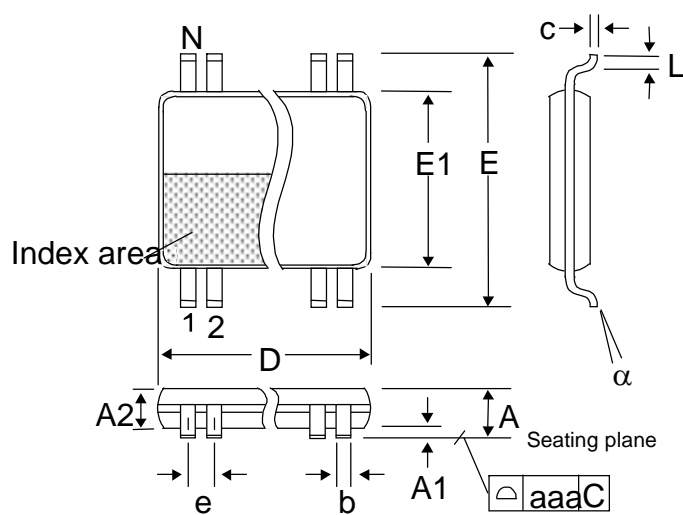
## Variations:

| N  | D (mm) |       | D (inch) |       |
|----|--------|-------|----------|-------|
|    | Min    | Max   | Min      | Max   |
| 48 | 12.40  | 12.60 | 0.488    | 0.496 |



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## Package Dimensions (Alternate size)



4.40 mm (173 mil) body,  
0.40 mm (16 mil) pitch TVSOP

| Symbol | Millimeters          |      | Inches      |       |
|--------|----------------------|------|-------------|-------|
|        | Min                  | Max  | Min         | Max   |
| A      | —                    | 1.20 | —           | 0.047 |
| A1     | 0.05                 | 0.15 | 0.002       | 0.006 |
| A2     | 0.80                 | 1.05 | 0.32        | 0.041 |
| b      | 0.13                 | 0.23 | 0.005       | 0.009 |
| c      | 0.09                 | 0.20 | 0.0035      | 0.008 |
| D      | See variations below |      |             |       |
| E      | 6.40 basic           |      | 0.252 basic |       |
| E1     | 4.30                 | 4.50 | 0.169       | 0.177 |
| e      | 0.40 basic           |      | 0.016 basic |       |
| L      | 0.45                 | 0.75 | 0.018       | 0.030 |
| N      | See variations below |      |             |       |
| a      | 0°                   | 8°   | 0°          | 8°    |
| aaa    | —                    | 0.08 | —           | 0.003 |

## Variations

| N  | D (mm) |      | D (inch) |       |
|----|--------|------|----------|-------|
|    | Min    | Max  | Min      | Max   |
| 48 | 9.60   | 9.80 | 0.378    | 0.386 |

**Ordering Codes**

| Ordering Number     | Marking        | Package Type                | Quantity per reel | Temperature |
|---------------------|----------------|-----------------------------|-------------------|-------------|
| ASM4SSTVF16857-48TT | AS4SSTVF16857T | 48-pin TSSOP, tube          |                   | 0°C to 70°C |
| ASM4SSTVF16857-48TR | AS4SSTVF16857T | 48-pin TSSOP, tape and reel | 2500              | 0°C to 70°C |
| ASM4SSTVF16857-48VT | AS4SSTVF16857V | 48-pin TVSOP, tube          |                   | 0°C to 70°C |
| ASM4SSTVF16857-48VR | AS4SSTVF16857V | 48-pin TVSOP, tape and reel | 2500              | 0°C to 70°C |



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