

# ASM5P2304A

## 3.3 V Zero Delay Buffer

### Description

ASM5P2304A is a versatile, 3.3 V zero-delay buffer designed to distribute high-speed clocks in PC, workstation, datacom, telecom and other high-performance applications. It is available in 8-pin package. The part has an on-chip PLL which locks to an input clock presented on the REF. The PLL feedback is required to be driven to FBK pin, and can be obtained from one of the outputs. The input-to-output propagation delay is guaranteed to be less than  $\pm 250$  pS, and the output-to-output skew is guaranteed to be less than 200 pS.

ASM5P2304A has two banks of two outputs each. Multiple ASM5P2304A devices can accept the same input clock and distribute it. In this case the skew between the outputs of the two devices is guaranteed to be less than 500 pS.

ASM5P2304A is available in two different configurations. Refer to *ASM5P2304A Configurations Table*. The ASM5P2304A-1 is the base part, where the output frequencies equal the reference if there is no counter in the feedback path. The ASM5P2304A-1H is the high-drive version of the -1 and the rise and fall times on this device are faster.

ASM5P2304A-2 allows the user to obtain REF and 1/2x or 2x frequencies on each output bank. The exact configuration and output frequencies depend on which output drives the feedback pin.

### Features

- Zero Input-Output Propagation Delay, Adjustable by Capacitive Load on FBK Input
- Multiple Configurations –  
Refer to *ASM5P2304A Configurations Table*
- Input Frequency Range: 10 MHz to 133 MHz
  - Multiple Low-skew Outputs
  - Output-Output Skew less than 200 pS
  - Device-Device Skew less than 500 pS
  - Two Banks of Two Outputs Each
- Less than 200 pS Cycle-to-Cycle Jitter  
(-1, -1H, -2, -2H)
- 8-pin SOIC Package
- 3.3 V Operation
- Commercial and Industrial Temperature Range
- Advanced 0.35  $\mu$ m CMOS Technology
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant



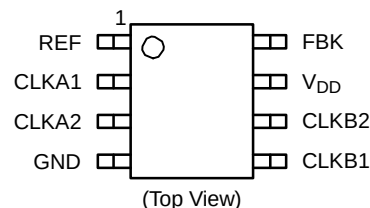
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**SOIC-8  
S SUFFIX  
CASE 751BD**

### PIN CONFIGURATION



### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 8 of this data sheet.

## ASM5P2304A

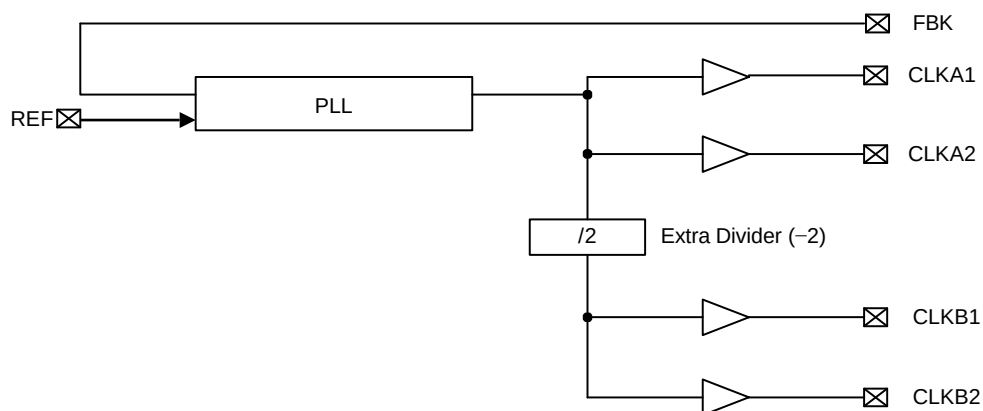


Figure 1. Block Diagram

Table 1. ASM5P2304A CONFIGURATIONS

| Device               | Feedback From    | Bank A Frequency | Bank B Frequency |
|----------------------|------------------|------------------|------------------|
| ASM5P2304A (-1, 1H)  | Bank A or Bank B | Reference        | Reference        |
| ASM5P2304A (-2, -2H) | Bank A           | Reference        | Reference /2     |
| ASM5P2304A (-2, -2H) | Bank B           | 2 x Reference    | Reference        |

### Zero Delay and Skew Control

For applications requiring zero input-output delay, all outputs must be equally loaded.

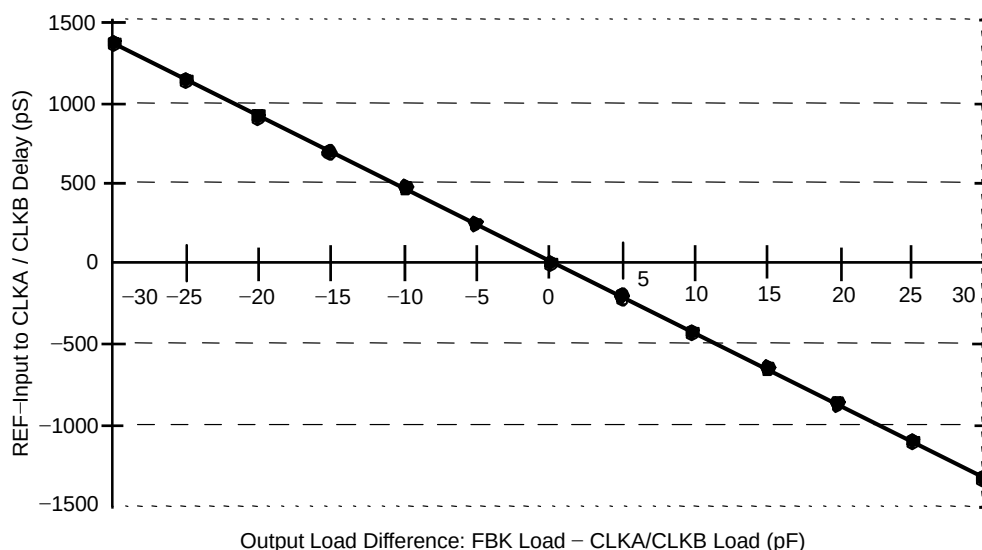


Figure 2. REF Input to CLKA/CLKB Delay vs. Difference in Loading between FBK Pin and CLKA/CLKB Pins

To close the feedback loop of the ASM5P2304A, the FBK pin can be driven from any of the four available clock outputs. The output driving the FBK pin will be driving a total load of 7 pF plus any additional load that it drives. The relative loading of this output (with respect to the remaining outputs) can adjust the input-output delay. This is shown in the above graph.

For applications requiring zero input-output delay, all outputs including the one providing feedback should be equally loaded. If input-output delay adjustments are required, use the above graph to calculate loading differences between the feedback output and remaining outputs. For zero output-output skew, be sure to load outputs equally.

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**Table 2. PIN DESCRIPTION**

| Pin # | Pin Name        | Description                                         |
|-------|-----------------|-----------------------------------------------------|
| 1     | REF (Note 1)    | Input reference clock frequency, 5 V tolerant input |
| 2     | CLKA1 (Note 2)  | Buffered clock output, bank A                       |
| 3     | CLKA2 (Note 2)  | Buffered clock output, bank A                       |
| 4     | GND             | Ground                                              |
| 5     | CLKB1 (Note 2)  | Buffered clock output, bank B                       |
| 6     | CLKB2 (Note 2)  | Buffered clock output, bank B                       |
| 7     | V <sub>DD</sub> | 3.3 V supply                                        |
| 8     | FBK             | PLL feedback input                                  |

1. Weak pull-down.
2. Weak pull-down on all outputs.

**Table 3. ABSOLUTE MAXIMUM RATINGS**

| Parameter                                             | Min  | Max                   | Unit |
|-------------------------------------------------------|------|-----------------------|------|
| Supply Voltage to Ground Potential                    | -0.5 | +4.6                  | V    |
| DC Input Voltage (Except REF)                         | -0.5 | V <sub>DD</sub> + 0.5 | V    |
| DC Input Voltage (REF)                                | -0.5 | 7                     | V    |
| Storage Temperature                                   | -65  | +150                  | °C   |
| Max. Soldering Temperature (10 sec)                   |      | 260                   | °C   |
| Junction Temperature                                  |      | 150                   | °C   |
| Static Discharge Voltage (As per JEDEC STD22- A114-B) |      | 2000                  | V    |

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

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**Table 4. OPERATING CONDITIONS**

| Parameter       | Description                                    |                        | Min | Max | Unit |
|-----------------|------------------------------------------------|------------------------|-----|-----|------|
| V <sub>DD</sub> | Supply Voltage                                 |                        | 3.0 | 3.6 | V    |
| T <sub>A</sub>  | Operating Temperature<br>(Ambient Temperature) | Commercial temperature | 0   | 70  | °C   |
|                 |                                                | Industrial temperature | −40 | 85  |      |
| C <sub>L</sub>  | Load Capacitance, below 100 MHz                |                        |     | 30  | pF   |
| C <sub>L</sub>  | Load Capacitance, from 100 MHz to 133 MHz      |                        |     | 15  | pF   |
| C <sub>IN</sub> | Input Capacitance (Note 3)                     |                        |     | 7   | pF   |

3. Applies to both Ref Clock and FBK.

**Table 5. ELECTRICAL CHARACTERISTICS**

| Parameter       | Description                  | Test Conditions                                                         |                  | Min | Max | Unit |
|-----------------|------------------------------|-------------------------------------------------------------------------|------------------|-----|-----|------|
| V <sub>IL</sub> | Input LOW Voltage            |                                                                         |                  |     | 0.8 | V    |
| V <sub>IH</sub> | Input HIGH Voltage           |                                                                         |                  | 2.2 |     | V    |
| I <sub>IL</sub> | Input LOW Current            | V <sub>IN</sub> = 0 V                                                   |                  |     | 50  | !!A  |
| I <sub>IH</sub> | Input HIGH Current           | V <sub>IN</sub> = V <sub>DD</sub>                                       |                  |     | 100 | !!A  |
| V <sub>OL</sub> | Output LOW Voltage (Note 4)  | I <sub>OL</sub> = 8 mA (−1, −2)<br>I <sub>OL</sub> = 12 mA (−1H, −2H)   |                  |     | 0.4 | V    |
| V <sub>OH</sub> | Output HIGH Voltage (Note 4) | I <sub>OH</sub> = −8 mA (−1, −2)<br>I <sub>OH</sub> = −12 mA (−1H, −2H) |                  | 2.4 |     | V    |
| I <sub>DD</sub> | Supply Current               | Unloaded outputs @ 100 MHz                                              | Commercial temp. |     | 35  | mA   |
|                 |                              |                                                                         | Industrial temp. |     | 40  |      |
|                 |                              | Unloaded outputs @ 66 MHz,<br>(−1, −1H, −2, −2H)                        | Commercial temp. |     | 25  |      |
|                 |                              |                                                                         | Industrial temp. |     | 30  |      |
|                 |                              | Unloaded outputs @ 33 MHz,<br>(−1, −1H, −2, −2H)                        | Commercial temp. |     | 16  |      |
|                 |                              |                                                                         | Industrial temp. |     | 20  |      |

4. Parameter is guaranteed by design and characterization. Not 100% tested in production.

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**Table 6. SWITCHING CHARACTERISTICS** (Notes 5, 6)

| Parameter                                                         |           | Test Conditions                                                   |                                       | Min | Typ  | Max  | Unit |
|-------------------------------------------------------------------|-----------|-------------------------------------------------------------------|---------------------------------------|-----|------|------|------|
| Output Frequency                                                  |           | 30 pF load                                                        | (−1, −1H) devices                     | 10  |      | 100  | MHz  |
|                                                                   |           |                                                                   | (−2, −2H) devices                     | 12  |      | 100  |      |
|                                                                   |           | 15 pF load                                                        | (−1, −1H) devices                     | 10  |      | 133  |      |
|                                                                   |           |                                                                   | (−2, −2H) devices                     | 12  |      | 133  |      |
| Duty Cycle (Note 7)<br>(−1, −2, −1H, −2H)                         |           | Measured at 1.4 V,<br>F <sub>OUT</sub> < 66.66 MHz, 30 pF load    |                                       | 40  | 50   | 60   | %    |
| Duty Cycle (Note 7)<br>(−1, −2, −1H, −2H)                         |           | Measured at 1.4 V,<br>F <sub>OUT</sub> ≤ 50 MHz, 15 pF load       |                                       | 45  | 50   | 55   | %    |
| Output Rise Time (Note 7)<br>(−1, −2)                             |           | Measured between 0.8 V<br>and 2.0 V, 30 pF load                   | Commercial temp.                      |     |      | 2.2  | nS   |
|                                                                   |           |                                                                   | Industrial temp.                      |     |      | 2.5  |      |
| Output Rise Time (Note 7)<br>(−1H, −2H)                           |           | Measured between 0.8 V<br>and 2.0 V, 30 pF load                   | Commercial temp.,<br>Industrial temp. |     | 1.5  | 2    | nS   |
| Output Rise Time (Note 7)<br>(−1, −2)                             |           | Measured between 0.8 V<br>and 2.0 V, 15 pF load                   |                                       |     |      | 1.5  | nS   |
| Output Fall Time (Note 7)<br>(−1, −2)                             |           | Measured between 2.0 V<br>and 0.8 V, 30 pF load                   | Commercial temp.                      |     |      | 2.2  | nS   |
|                                                                   |           |                                                                   | Industrial temp.                      |     |      | 2.5  |      |
| Output Fall Time (Note 7)<br>(−1H, −2H)                           |           | Measured between 2.0 V<br>and 0.8 V, 30 pF load                   | Commercial temp.,<br>Industrial temp. |     | 1.25 | 1.5  | nS   |
| Output Fall Time (Note 7)<br>(−1, −2)                             |           | Measured between 2.0 V<br>and 0.8 V, 15 pF load                   |                                       |     |      | 1.5  | nS   |
| Output-to-output skew on same bank<br>(−1, −1H, −2, −2H) (Note 7) |           | All outputs equally loaded                                        |                                       |     |      | 200  | pS   |
| Output bank A −to− output bank B<br>skew (−1, −1H)                |           | All outputs equally loaded                                        |                                       |     |      | 200  |      |
| Output bank A to output Bank B<br>skew (−2, −2H) (Note 7)         |           | All outputs equally loaded                                        |                                       |     |      | 400  |      |
| Delay, REF Rising Edge to FBK<br>Rising Edge (Note 7)             |           | Measured at V <sub>DD</sub> /2                                    |                                       |     | 0    | ±250 | pS   |
| Device-to-Device Skew (Note 7)                                    |           | Measured at V <sub>DD</sub> /2 on the FBK pins of the device      |                                       |     | 0    | 500  | pS   |
| Cycle-to-Cycle Jitter<br>(Note 7)                                 | (−1, −1H) | Measured at 66.67 MHz, loaded outputs, 15 pF load                 |                                       |     |      | 180  | pS   |
|                                                                   |           | Measured at 66.67 MHz, loaded outputs, 30 pF load                 |                                       |     |      | 200  |      |
|                                                                   |           | Measured at 133 MHz, loaded outputs, 15 pF load                   |                                       |     |      | 125  |      |
|                                                                   | (−2, −2H) | Measured at 66.67 MHz, loaded outputs, 15 pF load                 |                                       |     |      | 380  |      |
|                                                                   |           | Measured at 66.67 MHz, loaded outputs, 30 pF load                 |                                       |     |      | 400  |      |
| PLL Lock Time (Note 7)                                            |           | Stable power supply, valid clock presented on<br>REF and FBK pins |                                       |     |      | 1.0  | mS   |

5. For all measurements use Test Circuit #1.

6. All parameters are specified at Commercial and Industrial temperature unless stated otherwise.

7. Parameter is guaranteed by design and characterization. Not 100% tested in production.

# ASM5P2304A

## Switching Waveforms

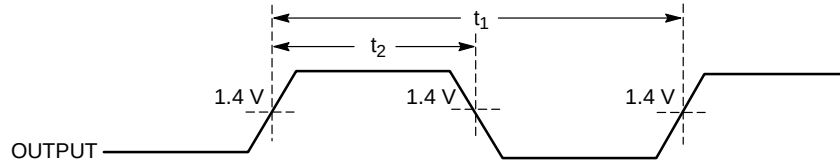


Figure 3. Duty Cycle Timing

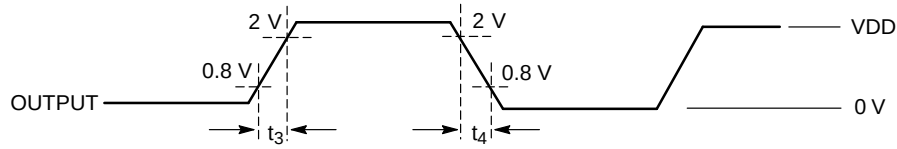


Figure 4. All Outputs Rise/Fall Time

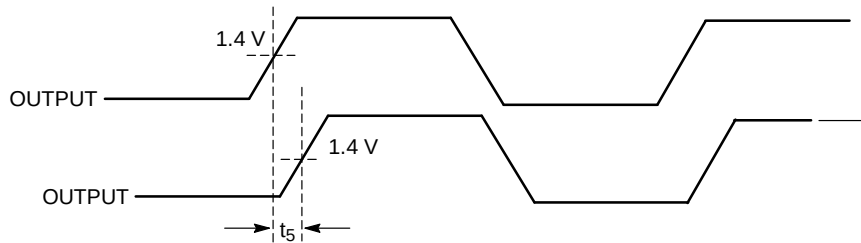


Figure 5. Output-Output Skew

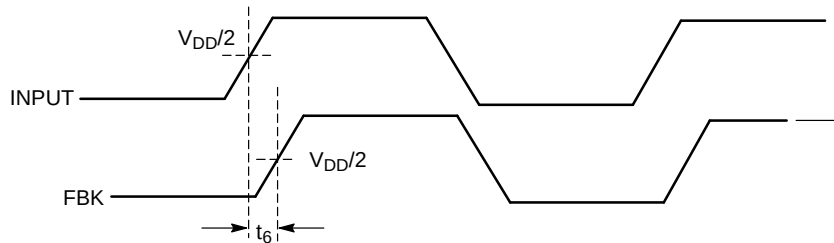


Figure 6. Input-Output Propagation Delay

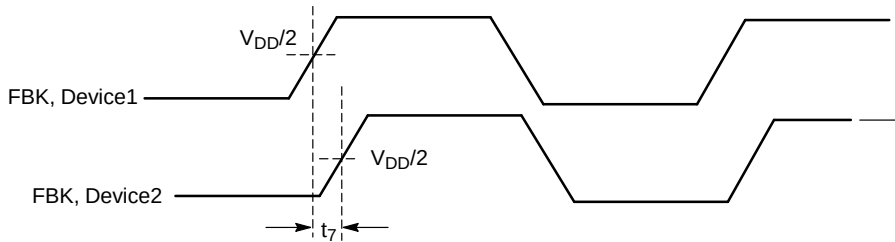


Figure 7. Device-Device Skew

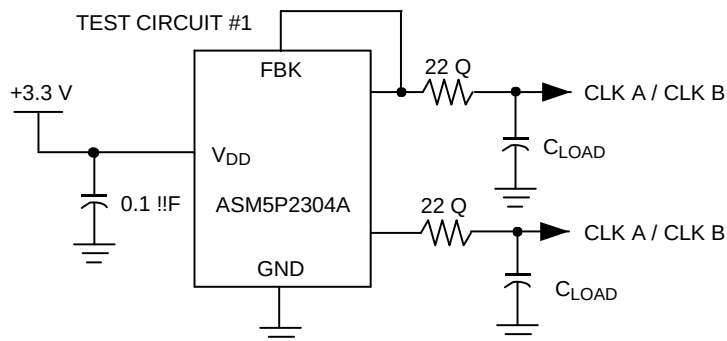
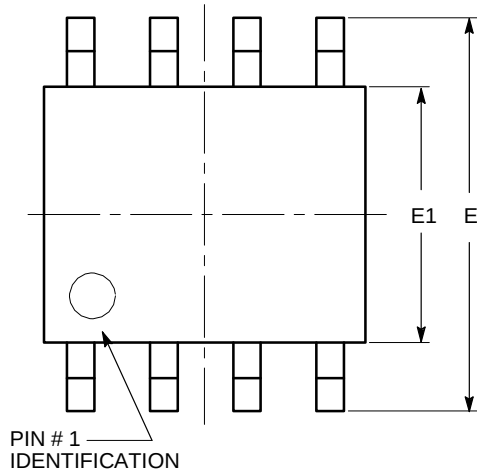


Figure 8. Test Circuit

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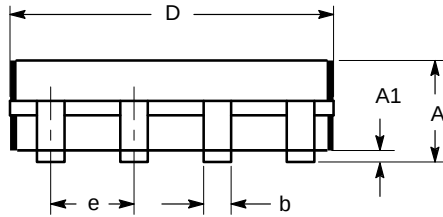
## PACKAGE DIMENSIONS

SOIC 8, 150 mils  
CASE 751BD-01  
ISSUE O

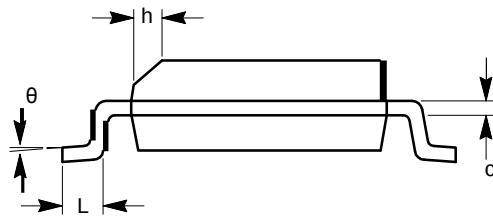


TOP VIEW

| SYMBOL   | MIN      | NOM | MAX  |
|----------|----------|-----|------|
| A        | 1.35     |     | 1.75 |
| A1       | 0.10     |     | 0.25 |
| b        | 0.33     |     | 0.51 |
| c        | 0.19     |     | 0.25 |
| D        | 4.80     |     | 5.00 |
| E        | 5.80     |     | 6.20 |
| E1       | 3.80     |     | 4.00 |
| e        | 1.27 BSC |     |      |
| h        | 0.25     |     | 0.50 |
| L        | 0.40     |     | 1.27 |
| $\theta$ | 0°       |     | 8°   |



SIDE VIEW



END VIEW

### Notes:

- (1) All dimensions are in millimeters. Angles in degrees.
- (2) Complies with JEDEC MS-012.

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**Table 7. ORDERING INFORMATION**

| Part Number          | Marking     | Package Type                              | Temperature |
|----------------------|-------------|-------------------------------------------|-------------|
| P5P2304AF-1-08SR     | 5P2304AF-1  | 8-pin 150-mil SOIC-TAPE & REEL, Pb free   | Commercial  |
| ASM5P2304AF-1-08-ST  | 5P2304AF-1  | 8-pin 150-mil SOIC-TUBE, Pb free          | Commercial  |
| ASM5I2304AF-1-08-SR  | 5I2304AF-1  | 8-pin 150-mil SOIC-TAPE & REEL, Pb free   | Industrial  |
| ASM5I2304AF-1-08-ST  | 5I2304AF-1  | 8-pin 150-mil SOIC-TUBE, Pb free          | Industrial  |
| P5P2304AF-1H08SR     | 5P2304AF-1H | 8-pin 150-mil SOIC-TAPE & REEL, Pb free   | Commercial  |
| ASM5P2304AF-1H-08-ST | 5P2304AF-1H | 8-pin 150-mil SOIC-TUBE, Pb free          | Commercial  |
| P5I2304AF-1H08SR     | 5I2304AF-1H | 8-pin 150-mil SOIC-TAPE & REEL, Pb free   | Industrial  |
| ASM5I2304AF-1H-08-ST | 5I2304AF-1H | 8-pin 150-mil SOIC-TUBE, Pb free          | Industrial  |
| P5P2304AF-2-08SR     | 5P2304AF-2  | 8-pin 150-mil SOIC-TAPE & REEL, Pb free   | Commercial  |
| P5P2304AF-2-08ST     | 5P2304AF-2  | 8-pin 150-mil SOIC-TUBE, Pb free, Pb free | Commercial  |
| ASM5I2304AF-2-08-SR  | 5I2304AF-2  | 8-pin 150-mil SOIC-TAPE & REEL, Pb free   | Industrial  |
| P5I2304AF-2-08ST     | 5I2304AF-2  | 8-pin 150-mil SOIC-TUBE, Pb free          | Industrial  |
| ASM5P2304AF-2H-08-SR | 5P2304AF-2H | 8-pin 150-mil SOIC-TAPE & REEL, Pb free   | Commercial  |
| ASM5P2304AF-2H-08-ST | 5P2304AF-2H | 8-pin 150-mil SOIC-TUBE, Pb free          | Commercial  |
| ASM5I2304AF-2H-08-SR | 5I2304AF-2H | 8-pin 150-mil SOIC-TAPE & REEL, Pb free   | Industrial  |
| ASM5I2304AF-2H-08-ST | 5I2304AF-2H | 8-pin 150-mil SOIC-TUBE, Pb free          | Industrial  |

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