

## ***8-Bit Dual-Supply Bus Transceiver With Configurable Voltage Translation and 3-State Outputs***

***UM3608AO SSOP24***

***UM3608UO TSSOP24***

***UM3608QA QFN24 3.5×5.5***

### **General Description**

UM3608 are octal bus transceivers that utilize deep micron CMOS Technology are intended for bus oriented application. This 8-bit non-inverting bus transceiver uses two separate configurable power-supply rails to implement universal low voltage bidirectional translation between any of the 1.8V, 2.5V, 3.3V and 5.5V voltage nodes. The UM3608 is optimized to operate with  $V_{CCA}$  and  $V_{CCB}$  set at 1.65V to 5.5V. The A port is designed to track  $V_{CCA}$ .  $V_{CCA}$  accepts any supply voltage from 1.65V to 5.5V. The B port is designed to track  $V_{CCB}$ .  $V_{CCB}$  accepts any supply voltage from 1.65V to 5.5V.

The UM3608 is designed for asynchronous communication between two data buses. The logic levels of the direction-control (DIR) input and the output-enable (OE) input activate either the B-port outputs or the A-port outputs or place both output ports into the high-impedance mode. The device transmits data from the A bus to the B bus when the B-port outputs are activated, and from the B bus to the A bus when the A-port outputs are activated. The input circuitry on both A and B ports must have a logic HIGH or LOW level applied to prevent excess  $I_{CC}$  and  $I_{CCZ}$ .

UM3608 is fully specified for partial power down applications using  $I_{off}$ . The  $I_{off}$  circuitry disables the outputs, preventing damaging the current back flow through the device when it is powered down. The  $V_{CC}$  isolation feature ensures that if either  $V_{CC}$  Input is at GND, all outputs are in the high impedance state. To ensure the high impedance state during power up or power down. OE should be tied to  $V_{CC}$  through a pull up resistor. The UM3608 is designed so that the control pins (DIR and OE) are supplied by  $V_{CCA}$ .

The UM3608 series are available in SSOP24, TSSOP24 and QFN24 3.5×5.5 packages.

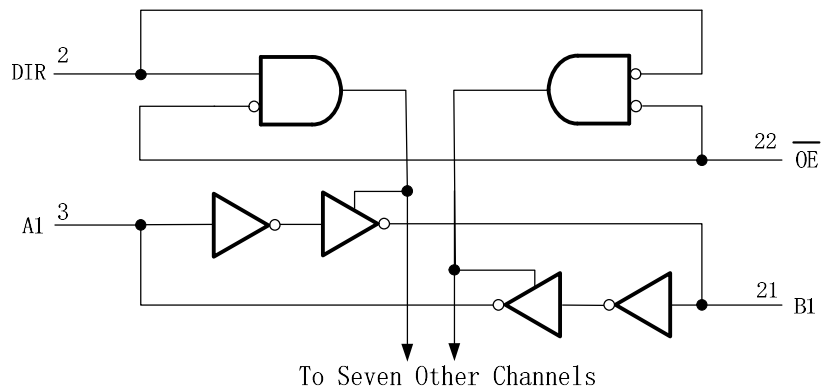
### **Applications**

- Personal Electronic
- Industrial
- Enterprise
- Telecom

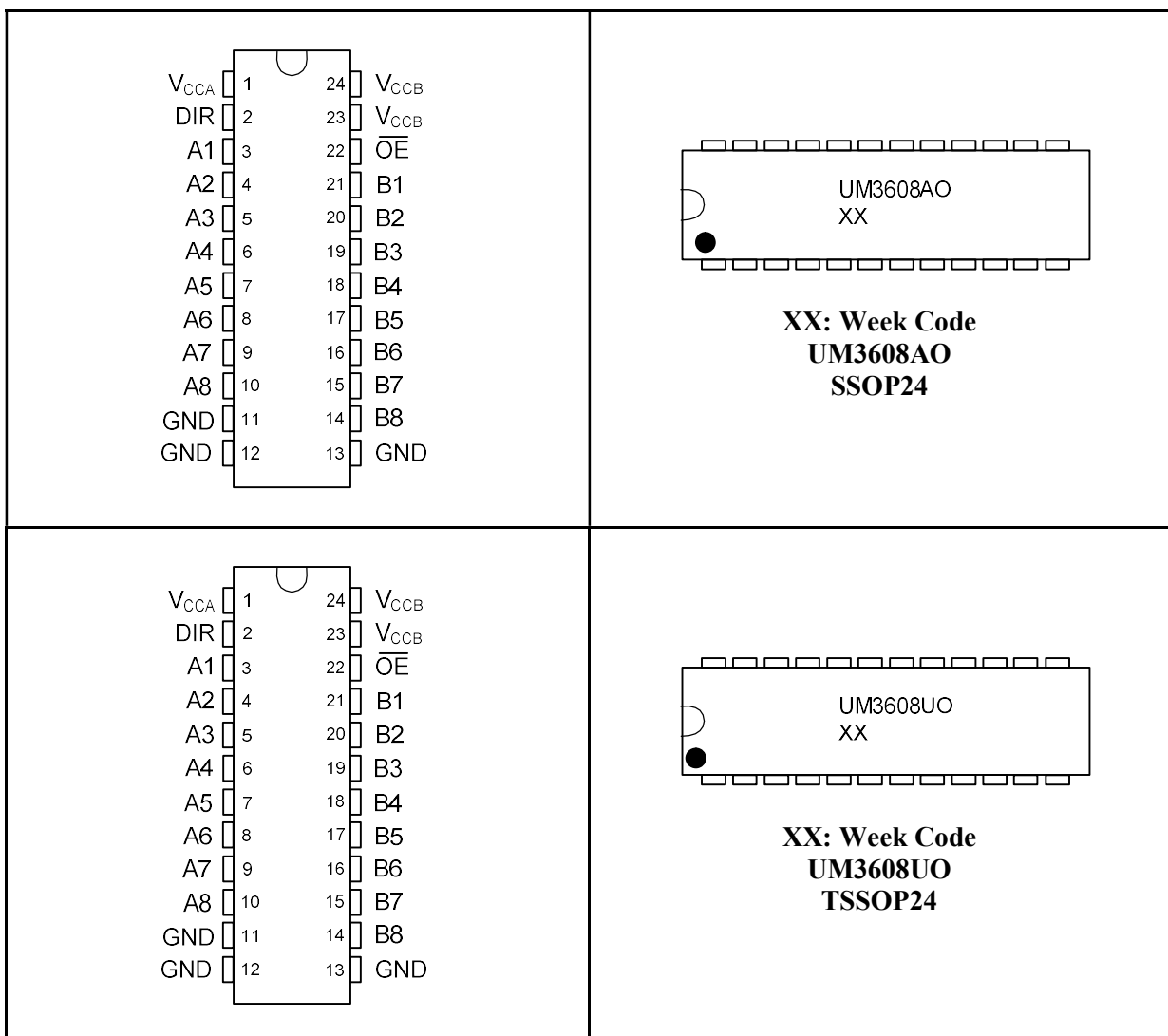
### **Features**

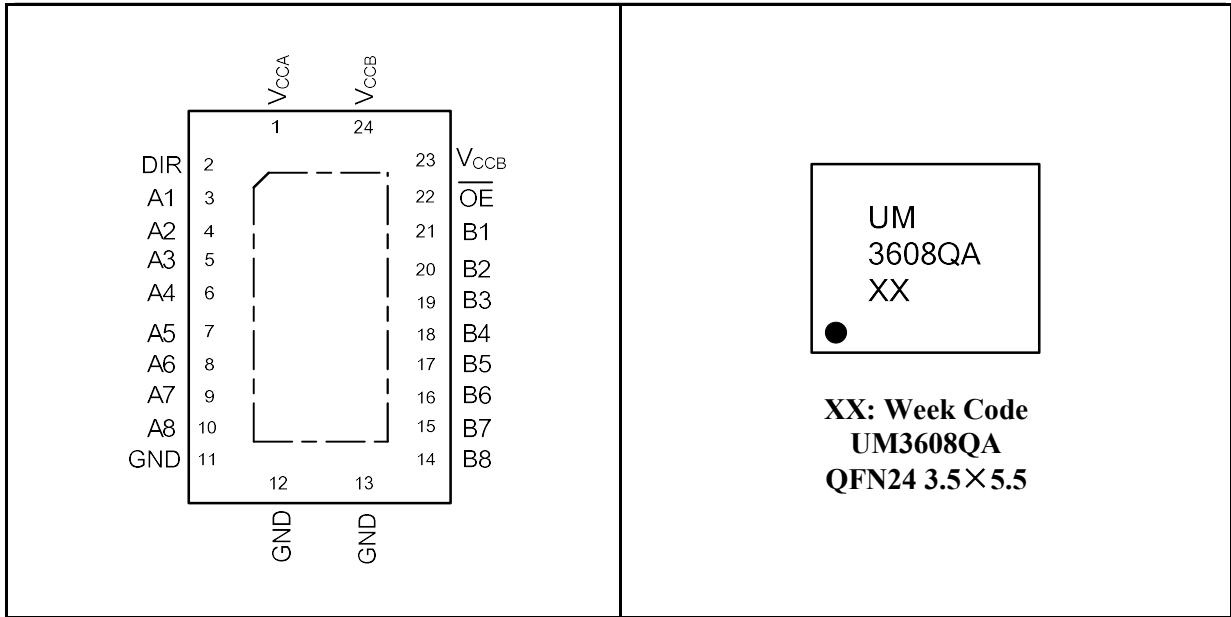
- Control Inputs  $V_{IH}/V_{IL}$  Levels Are Referenced to  $V_{CCA}$  Voltage
- $V_{CC}$  Isolation Feature – If Either  $V_{CC}$  Input Is at GND, All Are in the High-Impedance State
- Fully Configurable Dual-Rail Design Allows Each Port to Operate Over the Full 1.65V to 5.5V Power-Supply Range
- Latch-Up Performance Exceeds 100 mA Per JESD 78, Class II
- ESD Protection Exceeds JESD22  
4000V Human-Body Model (A114-A)  
100V Machine Model (A115-A)  
1000V Charged-Device Model (C101)
- Available in SSOP24, TSSOP24 and QFN24 3.5×5.5 Packages
- Maximum Data Rates  
150 Mbps ( $V_{CCA} < 3.3\text{ V}$  or  $V_{CCB} < 3.3\text{ V}$ )  
220 Mbps ( $V_{CCA} \geq 3.3\text{ V}$  and  $V_{CCB} \geq 3.3\text{ V}$ )

### Logic Diagram (Positive Logic)



## Pin Configurations





## Pin Descriptions

| Pin No. | Pin Name         | Function                                                                                                         |
|---------|------------------|------------------------------------------------------------------------------------------------------------------|
| 1       | V <sub>CCA</sub> | A-port supply voltage. $1.65\text{ V} \leq V_{CCA} \leq 5.5\text{ V}$ .                                          |
| 2       | DIR              | Direction-control signal.                                                                                        |
| 3       | A1               | Input/output A1. Referenced to V <sub>CCA</sub> .                                                                |
| 4       | A2               | Input/output A2. Referenced to V <sub>CCA</sub> .                                                                |
| 5       | A3               | Input/output A3. Referenced to V <sub>CCA</sub> .                                                                |
| 6       | A4               | Input/output A4. Referenced to V <sub>CCA</sub> .                                                                |
| 7       | A5               | Input/output A5. Referenced to V <sub>CCA</sub> .                                                                |
| 8       | A6               | Input/output A6. Referenced to V <sub>CCA</sub> .                                                                |
| 9       | A7               | Input/output A7. Referenced to V <sub>CCA</sub> .                                                                |
| 10      | A8               | Input/output A8. Referenced to V <sub>CCA</sub> .                                                                |
| 11-13   | GND              | Ground.                                                                                                          |
| 14      | B8               | Input/output B8. Referenced to V <sub>CCB</sub> .                                                                |
| 15      | B7               | Input/output B7. Referenced to V <sub>CCB</sub> .                                                                |
| 16      | B6               | Input/output B6. Referenced to V <sub>CCB</sub> .                                                                |
| 17      | B5               | Input/output B5. Referenced to V <sub>CCB</sub> .                                                                |
| 18      | B4               | Input/output B4. Referenced to V <sub>CCB</sub> .                                                                |
| 19      | B3               | Input/output B3. Referenced to V <sub>CCB</sub> .                                                                |
| 20      | B2               | Input/output B2. Referenced to V <sub>CCB</sub> .                                                                |
| 21      | B1               | Input/output B1. Referenced to V <sub>CCB</sub> .                                                                |
| 22      | OE               | 3-state output-mode enables. Pull OE high to place all outputs in 3-state mode. Referenced to V <sub>CCA</sub> . |
| 23-24   | V <sub>CCB</sub> | B-port supply voltage. $1.65\text{ V} \leq V_{CCB} \leq 5.5\text{ V}$ .                                          |

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**Ordering Information**

| Part Number | Marking  | Package Type  | Shipping Qty                  |
|-------------|----------|---------------|-------------------------------|
| UM3608AO    | UM3608AO | SSOP24        | 2000pcs/13Inch<br>Tape & Reel |
| UM3608UO    | UM3608UO | TSSOP24       | 3000pcs/13Inch<br>Tape & Reel |
| UM3608QA    | UM3608QA | QFN24 3.5×5.5 | 3000pcs/13Inch<br>Tape & Reel |

**Absolute Maximum Ratings (Note 1)**

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

| Symbol    | Parameter                                                                             |           | Value                     | Unit |
|-----------|---------------------------------------------------------------------------------------|-----------|---------------------------|------|
| $V_{CCA}$ | Supply Voltage Range                                                                  |           | -0.5 to +6.5              | V    |
| $V_{CCB}$ | Supply Voltage Range                                                                  |           | -0.5 to +6.5              | V    |
| $V_I$     | Input Voltage Range (Note 2)                                                          | A ports   | -0.5 to +6.5              | V    |
|           |                                                                                       | B ports   | -0.5 to +6.5              |      |
| $V_O$     | Voltage Range Applied to Any Output in the High-Impedance or Power-Off State (Note 2) | A ports   | -0.5 to +6.5              | V    |
|           |                                                                                       | B ports   | -0.5 to +6.5              |      |
| $V_O$     | Voltage Range Applied to Any Output in the High or Low State (Note 2, 3)              | A ports   | -0.5 to ( $V_{CCA}+0.5$ ) | V    |
|           |                                                                                       | B ports   | -0.5 to ( $V_{CCB}+0.5$ ) |      |
| $I_{IK}$  | Input Clamp Current                                                                   | $V_I < 0$ | -50                       | mA   |
| $I_{OK}$  | Output Clamp Current                                                                  | $V_O < 0$ | -50                       | mA   |
| $I_O$     | Continuous Output Current                                                             |           | $\pm 50$                  | mA   |
|           | Continuous Current through $V_{CCA}$ , $V_{CCB}$ , or GND                             |           | $\pm 100$                 | mA   |
| $T_{OP}$  | Operating Temperature Range                                                           |           | -40 to +85                | °C   |
| $T_J$     | Operating Junction Temperature                                                        |           | -40 to +125               | °C   |
| $T_{STG}$ | Storage Temperature Range                                                             |           | -65 to +150               | °C   |

Note 1: Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

Note 2: The input and output negative-voltage ratings may be exceeded if the input and output current ratings are observed.

Note 3: The value of  $V_{CCA}$  and  $V_{CCB}$  are provided in the recommended operating conditions table.

**Package Thermal Impedance**

| Symbol               | Parameter                                 |               | Value | Unit |
|----------------------|-------------------------------------------|---------------|-------|------|
| $R_{\theta JA}$      | Junction-to-ambient thermal resistance    | SSOP24        | 88.5  | °C/W |
|                      |                                           | TSSOP24       | 90.6  |      |
|                      |                                           | QFN24 3.5×5.5 | 37.4  |      |
| $R_{\theta JC(top)}$ | Junction-to-case (top) thermal resistance | SSOP24        | 48.7  | °C/W |
|                      |                                           | TSSOP24       | 27.6  |      |
|                      |                                           | QFN24 3.5×5.5 | 38.1  |      |
| $R_{\theta JB}$      | Junction-to-board thermal resistance      | SSOP24        | 44.1  | °C/W |
|                      |                                           | TSSOP24       | 45.3  |      |
|                      |                                           | QFN24 3.5×5.5 | 15.2  |      |

**ESD Rating**

| Symbol         | Parameter                  | Value          | Unit |
|----------------|----------------------------|----------------|------|
| ESD Protection | Human body model (HBM)     | -4000 to +4000 | V    |
|                | Charged device model (CDM) | -1000 to +1000 |      |

**Recommended Operating Conditions (Note 1, 2,3,4)**

| Symbol           | Parameter                          |                                                                 | V <sub>CCI</sub> | V <sub>CCO</sub> | Min                    | Max              | Unit |
|------------------|------------------------------------|-----------------------------------------------------------------|------------------|------------------|------------------------|------------------|------|
| V <sub>CCA</sub> | Supply Voltage                     |                                                                 |                  |                  | 1.65                   | 5.5              | V    |
| V <sub>CCB</sub> |                                    |                                                                 |                  |                  | 1.65                   | 5.5              |      |
| V <sub>IH</sub>  | High Level Input Voltage           | Data Inputs <sup>(5)</sup>                                      | 1.65 V to 1.95 V |                  | V <sub>CCI</sub> ×0.65 |                  | V    |
|                  |                                    |                                                                 | 2.3 V to 2.7 V   |                  | 1.7                    |                  |      |
|                  |                                    |                                                                 | 3 V to 3.6 V     |                  | 2                      |                  |      |
|                  |                                    |                                                                 | 4.5 V to 5.5 V   |                  | V <sub>CCI</sub> ×0.7  |                  |      |
| V <sub>IL</sub>  | Low Level Input Voltage            | Data Inputs <sup>(5)</sup>                                      | 1.65 V to 1.95 V |                  | V <sub>CCI</sub> ×0.35 |                  | V    |
|                  |                                    |                                                                 | 2.3 V to 2.7 V   |                  | 0.7                    |                  |      |
|                  |                                    |                                                                 | 3 V to 3.6 V     |                  | 0.8                    |                  |      |
|                  |                                    |                                                                 | 4.5 V to 5.5 V   |                  | V <sub>CCI</sub> ×0.3  |                  |      |
| V <sub>IH</sub>  | High Level Input Voltage           | Control inputs (referenced to V <sub>CCA</sub> ) <sup>(6)</sup> | 1.65 V to 1.95 V |                  | V <sub>CCI</sub> ×0.65 |                  | V    |
|                  |                                    |                                                                 | 2.3 V to 2.7 V   |                  | 1.7                    |                  |      |
|                  |                                    |                                                                 | 3 V to 3.6 V     |                  | 2                      |                  |      |
|                  |                                    |                                                                 | 4.5 V to 5.5 V   |                  | V <sub>CCI</sub> ×0.7  |                  |      |
| V <sub>IL</sub>  | Low Level Input Voltage            | Control inputs (referenced to V <sub>CCA</sub> ) <sup>(6)</sup> | 1.65 V to 1.95 V |                  | V <sub>CCI</sub> ×0.35 |                  | V    |
|                  |                                    |                                                                 | 2.3 V to 2.7 V   |                  | 0.7                    |                  |      |
|                  |                                    |                                                                 | 3 V to 3.6 V     |                  | 0.8                    |                  |      |
|                  |                                    |                                                                 | 4.5 V to 5.5 V   |                  | V <sub>CCI</sub> ×0.3  |                  |      |
| V <sub>I</sub>   | Input voltage                      | Control Inputs                                                  |                  |                  | 0                      | 5.5              | V    |
| V <sub>I/O</sub> | Input/output voltage               | Active state                                                    |                  |                  | 0                      | V <sub>CCO</sub> | V    |
|                  |                                    | Three-State                                                     |                  |                  | 0                      | 5.5              |      |
| I <sub>OH</sub>  | High-level output current          |                                                                 |                  | 1.65 V to 1.95 V |                        | -4               | mA   |
|                  |                                    |                                                                 |                  | 2.3 V to 2.7 V   |                        | -8               |      |
|                  |                                    |                                                                 |                  | 3 V to 3.6 V     |                        | -24              |      |
|                  |                                    |                                                                 |                  | 4.5 V to 5.5 V   |                        | -32              |      |
| I <sub>OL</sub>  | Low-level output current           |                                                                 |                  | 1.65 V to 1.95 V |                        | 4                | mA   |
|                  |                                    |                                                                 |                  | 2.3 V to 2.7 V   |                        | 8                |      |
|                  |                                    |                                                                 |                  | 3 V to 3.6 V     |                        | 24               |      |
|                  |                                    |                                                                 |                  | 4.5 V to 5.5 V   |                        | 32               |      |
| Δt/ΔV            | Input Transition Rise or Fall Time | Data Inputs                                                     | 1.65 V to 1.95 V |                  |                        | 20               | ns/V |
|                  |                                    |                                                                 | 2.3 V to 2.7 V   |                  |                        | 20               |      |
|                  |                                    |                                                                 | 3 V to 3.6 V     |                  |                        | 10               |      |
|                  |                                    |                                                                 | 4.5 V to 5.5 V   |                  |                        | 5                |      |

Note 1: V<sub>CCI</sub> is the V<sub>CC</sub> associated with the data input port.

Note 2: V<sub>CCO</sub> is the V<sub>CC</sub> associated with the output port.

Note 3: All unused or driven (floating) data inputs (I/Os) of the device must be held at logic HIGH or LOW (preferably V<sub>CCI</sub> or GND) to ensure proper device operation and minimize power.

Note 4: All unused control inputs must be held at V<sub>CCA</sub> or GND to ensure proper device operation and minimize power consumption.

Note 5: For V<sub>CCI</sub> values not specified in the data sheet, V<sub>IH</sub> min = V<sub>CCI</sub> × 0.7 V, V<sub>IL</sub> max = V<sub>CCI</sub> × 0.3 V.

Note 6: For V<sub>CCA</sub> values not specified in the data sheet, V<sub>IH</sub> min = V<sub>CCA</sub> × 0.7 V, V<sub>IL</sub> max = V<sub>CCA</sub> × 0.3 V.

**Electrical Characteristics (Note 1, 2)**

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

| Parameter                          |                | Test Conditions                                                                   | V <sub>CCA</sub> | V <sub>CCB</sub> | T <sub>A</sub> =25°C |     | -40°C to 85°C         |     | Unit |
|------------------------------------|----------------|-----------------------------------------------------------------------------------|------------------|------------------|----------------------|-----|-----------------------|-----|------|
|                                    |                |                                                                                   |                  |                  | Typ                  | Max | Min                   | Max |      |
| V <sub>OH</sub>                    |                | I <sub>OH</sub> =-100μA, V <sub>I</sub> =V <sub>IH</sub>                          | 1.65V to 4.5V    | 1.65V to 4.5V    |                      |     | V <sub>CCO</sub> -0.1 |     | V    |
|                                    |                | I <sub>OH</sub> =-4mA, V <sub>I</sub> =V <sub>IH</sub>                            | 1.65V            | 1.65V            |                      |     | 1.2                   |     |      |
|                                    |                | I <sub>OH</sub> =-8mA, V <sub>I</sub> =V <sub>IH</sub>                            | 2.3V             | 2.3V             |                      |     | 1.9                   |     |      |
|                                    |                | I <sub>OH</sub> =-24mA, V <sub>I</sub> =V <sub>IH</sub>                           | 3V               | 3V               |                      |     | 2.4                   |     |      |
|                                    |                | I <sub>OH</sub> =-32mA, V <sub>I</sub> =V <sub>IH</sub>                           | 4.5V             | 4.5V             |                      |     | 3.8                   |     |      |
| V <sub>OL</sub>                    |                | I <sub>OL</sub> =100μA, V <sub>I</sub> =V <sub>IL</sub>                           | 1.65V to 4.5V    | 1.65V to 4.5V    |                      |     | 0.1                   |     | V    |
|                                    |                | I <sub>OL</sub> =4mA, V <sub>I</sub> =V <sub>IL</sub>                             | 1.65V            | 1.65V            |                      |     | 0.45                  |     |      |
|                                    |                | I <sub>OL</sub> =8mA, V <sub>I</sub> =V <sub>IL</sub>                             | 2.3V             | 2.3V             |                      |     | 0.3                   |     |      |
|                                    |                | I <sub>OL</sub> =24mA, V <sub>I</sub> =V <sub>IL</sub>                            | 3V               | 3V               |                      |     | 0.55                  |     |      |
|                                    |                | I <sub>OL</sub> =32mA, V <sub>I</sub> =V <sub>IL</sub>                            | 4.5V             | 4.5V             |                      |     | 0.55                  |     |      |
| I <sub>I</sub>                     | DIR            | V <sub>I</sub> = V <sub>CCA</sub> or GND                                          | 1.65V to 5.5V    | 1.65V to 5.5V    | ±1                   |     | ±2                    |     | μA   |
| I <sub>off</sub>                   | A or B Port    | V <sub>I</sub> or V <sub>O</sub> = 0 to 5.5 V                                     | 0V               | 0V to 5.5V       | ±1                   |     | ±2                    |     | μA   |
|                                    |                |                                                                                   | 0V to 5.5V       | 0V               | ±1                   |     | ±2                    |     |      |
| I <sub>OZ</sub>                    | A or B Port    | V <sub>O</sub> = V <sub>CCO</sub> or GND, OE = V <sub>IH</sub>                    | 1.65V to 5.5V    | 1.65V to 5.5V    | ±1                   |     | ±2                    |     | μA   |
| I <sub>CCA</sub>                   |                | V <sub>I</sub> =V <sub>CCI</sub> or GND<br>I <sub>O</sub> =0                      | 1.65V to 5.5V    | 1.65 V to 5.5 V  |                      |     | 15                    |     | μA   |
|                                    |                |                                                                                   | 5 V              | 0 V              |                      |     | 15                    |     |      |
|                                    |                |                                                                                   | 0 V              | 5 V              |                      |     | -2                    |     |      |
| I <sub>CCB</sub>                   |                | V <sub>I</sub> =V <sub>CCI</sub> or GND<br>I <sub>O</sub> =0                      | 1.65V to 5.5V    | 1.65 V to 5.5 V  |                      |     | 15                    |     | μA   |
|                                    |                |                                                                                   | 5 V              | 0 V              |                      |     | -2                    |     |      |
|                                    |                |                                                                                   | 0 V              | 5 V              |                      |     | 15                    |     |      |
| I <sub>CCA</sub> +I <sub>CCB</sub> |                | V <sub>I</sub> =V <sub>CCI</sub> or GND<br>I <sub>O</sub> =0                      | 1.65V to 5.5V    | 1.65V to 5.5V    |                      |     | 25                    |     | μA   |
| ΔI <sub>CCA</sub>                  | A port         | One A port at V <sub>CCA</sub> – 0.6 V, DIR at V <sub>CCA</sub> , B port = open   | 3V to 5.5V       | 3V to 5.5V       |                      |     | 50                    |     | μA   |
|                                    | DIR            | DIR at V <sub>CCA</sub> – 0.6 V, B port = open, A port at V <sub>CCA</sub> or GND |                  |                  |                      |     | 50                    |     |      |
| ΔI <sub>CCB</sub>                  | B port         | One B port at V <sub>CCB</sub> – 0.6 V, DIR at GND, A port = open                 | 3V to 5.5V       | 3V to 5.5V       |                      |     | 50                    |     | μA   |
| C <sub>i</sub>                     | Control inputs | V <sub>I</sub> =V <sub>CCI</sub> or GND                                           | 3.3V             | 3.3V             | 4                    |     | 5                     |     | pF   |
| C <sub>iO</sub>                    | A or B Port    | V <sub>O</sub> = V <sub>CCA/B</sub> or GND                                        | 3.3V             | 3.3V             | 8.5                  |     | 10                    |     | pF   |

 Note 1: V<sub>CCI</sub> is the supply voltage associated with the input port.

 Note 2: V<sub>CCO</sub> is the supply voltage associated with the output port.

## Switching Characteristics

Over recommended operating free-air temperature range,  $V_{CCA} = 1.8V \pm 0.15V$  (unless otherwise noted)

| Parameter | From<br>(Input) | To<br>(Output) | $V_{CCB}=1.8V \pm 0.15V$ |      | $V_{CCB}=2.5V \pm 0.2V$ |      | $V_{CCB}=3.3V \pm 0.3V$ |      | $V_{CCB}=5V \pm 0.5V$ |      | Unit |
|-----------|-----------------|----------------|--------------------------|------|-------------------------|------|-------------------------|------|-----------------------|------|------|
|           |                 |                | Min                      | Max  | Min                     | Max  | Min                     | Max  | Min                   | Max  |      |
| $t_{PLH}$ | A               | B              | 1.7                      | 21.9 | 1.3                     | 9.2  | 1                       | 7.4  | 0.8                   | 7.1  | ns   |
| $t_{PHL}$ |                 |                |                          |      |                         |      |                         |      |                       |      |      |
| $t_{PLH}$ | B               | A              | 0.9                      | 23.8 | 0.8                     | 23.6 | 0.7                     | 23.4 | 0.7                   | 23.4 | ns   |
| $t_{PHL}$ |                 |                |                          |      |                         |      |                         |      |                       |      |      |
| $t_{PHZ}$ | $\overline{OE}$ | A              | 1.5                      | 29.6 | 1.5                     | 29.4 | 1.5                     | 29.3 | 1.4                   | 29.2 | ns   |
| $t_{PLZ}$ |                 |                |                          |      |                         |      |                         |      |                       |      |      |
| $t_{PHZ}$ | $\overline{OE}$ | B              | 2.4                      | 32.2 | 1.9                     | 18.2 | 1.7                     | 17.6 | 1.3                   | 16.3 | ns   |
| $t_{PLZ}$ |                 |                |                          |      |                         |      |                         |      |                       |      |      |
| $t_{PZH}$ | $\overline{OE}$ | A              | 0.4                      | 26.5 | 0.4                     | 25.8 | 0.4                     | 25.7 | 0.4                   | 25.7 | ns   |
| $t_{PZL}$ |                 |                |                          |      |                         |      |                         |      |                       |      |      |
| $t_{PZH}$ | $\overline{OE}$ | B              | 1.8                      | 32   | 1.5                     | 17.5 | 1.2                     | 16.6 | 0.9                   | 15.8 | ns   |
| $t_{PZL}$ |                 |                |                          |      |                         |      |                         |      |                       |      |      |

## Switching Characteristics

Over recommended operating free-air temperature range,  $V_{CCA} = 2.5V \pm 0.2V$  (unless otherwise noted)

| Parameter | From<br>(Input) | To<br>(Output) | $V_{CCB}=1.8V \pm 0.15V$ |      | $V_{CCB}=2.5V \pm 0.2V$ |      | $V_{CCB}=3.3V \pm 0.3V$ |      | $V_{CCB}=5V \pm 0.5V$ |      | Unit |
|-----------|-----------------|----------------|--------------------------|------|-------------------------|------|-------------------------|------|-----------------------|------|------|
|           |                 |                | Min                      | Max  | Min                     | Max  | Min                     | Max  | Min                   | Max  |      |
| $t_{PLH}$ | A               | B              | 1.5                      | 21.4 | 1.2                     | 9    | 0.8                     | 6.2  | 0.6                   | 4.8  | ns   |
| $t_{PHL}$ |                 |                |                          |      |                         |      |                         |      |                       |      |      |
| $t_{PLH}$ | B               | A              | 1.2                      | 9.3  | 1                       | 9.1  | 1                       | 8.9  | 0.9                   | 8.8  | ns   |
| $t_{PHL}$ |                 |                |                          |      |                         |      |                         |      |                       |      |      |
| $t_{PHZ}$ | $\overline{OE}$ | A              | 1.4                      | 17.8 | 1.4                     | 17.7 | 1.4                     | 16.5 | 1.4                   | 16.6 | ns   |
| $t_{PLZ}$ |                 |                |                          |      |                         |      |                         |      |                       |      |      |
| $t_{PHZ}$ | $\overline{OE}$ | B              | 2.3                      | 29.6 | 1.8                     | 13.3 | 1.7                     | 11.7 | 0.9                   | 11.5 | ns   |
| $t_{PLZ}$ |                 |                |                          |      |                         |      |                         |      |                       |      |      |
| $t_{PZH}$ | $\overline{OE}$ | A              | 1                        | 16.5 | 1                       | 16.5 | 1                       | 16.5 | 1                     | 16.4 | ns   |
| $t_{PZL}$ |                 |                |                          |      |                         |      |                         |      |                       |      |      |
| $t_{PZH}$ | $\overline{OE}$ | B              | 1.7                      | 28.2 | 1.5                     | 12.9 | 1.2                     | 11.1 | 1                     | 10.5 | ns   |
| $t_{PZL}$ |                 |                |                          |      |                         |      |                         |      |                       |      |      |

**Switching Characteristics**

Over recommended operating free-air temperature range,  $V_{CCA} = 3.3V \pm 0.3V$  (unless otherwise noted)

| Parameter | From<br>(Input) | To<br>(Output) | $V_{CCB}=1.8V \pm 0.15V$ |      | $V_{CCB}=2.5V \pm 0.2V$ |      | $V_{CCB}=3.3V \pm 0.3V$ |      | $V_{CCB}=5V \pm 0.5V$ |      | Unit |
|-----------|-----------------|----------------|--------------------------|------|-------------------------|------|-------------------------|------|-----------------------|------|------|
|           |                 |                | Min                      | Max  | Min                     | Max  | Min                     | Max  | Min                   | Max  |      |
| $t_{PLH}$ | A               | B              | 1.5                      | 21.2 | 1.1                     | 8.8  | 0.8                     | 6.3  | 0.5                   | 4.4  | ns   |
| $t_{PHL}$ |                 |                |                          |      |                         |      |                         |      |                       |      |      |
| $t_{PLH}$ | B               | A              | 0.8                      | 7.2  | 0.8                     | 6.2  | 0.7                     | 6.1  | 0.6                   | 6    | ns   |
| $t_{PHL}$ |                 |                |                          |      |                         |      |                         |      |                       |      |      |
| $t_{PHZ}$ | $\overline{OE}$ | A              | 1.6                      | 14.6 | 1.6                     | 14.5 | 1.6                     | 14.3 | 1.6                   | 14.2 | ns   |
| $t_{PLZ}$ |                 |                |                          |      |                         |      |                         |      |                       |      |      |
| $t_{PHZ}$ | $\overline{OE}$ | B              | 2.1                      | 29   | 1.7                     | 10.8 | 1.5                     | 10.1 | 0.8                   | 12.1 | ns   |
| $t_{PLZ}$ |                 |                |                          |      |                         |      |                         |      |                       |      |      |
| $t_{PZH}$ | $\overline{OE}$ | A              | 0.8                      | 13.7 | 0.8                     | 13.5 | 0.8                     | 13.3 | 0.8                   | 13.2 | ns   |
| $t_{PZL}$ |                 |                |                          |      |                         |      |                         |      |                       |      |      |
| $t_{PZH}$ | $\overline{OE}$ | B              | 1.8                      | 27.7 | 1.4                     | 12.4 | 1.1                     | 9.5  | 0.9                   | 8.9  | ns   |
| $t_{PZL}$ |                 |                |                          |      |                         |      |                         |      |                       |      |      |

**Switching Characteristics**

Over recommended operating free-air temperature range,  $V_{CCA} = 5V \pm 0.5V$  (unless otherwise noted)

| Parameter | From<br>(Input) | To<br>(Output) | $V_{CCB}=1.8V \pm 0.15V$ |      | $V_{CCB}=2.5V \pm 0.2V$ |      | $V_{CCB}=3.3V \pm 0.3V$ |      | $V_{CCB}=5V \pm 0.5V$ |      | Unit |
|-----------|-----------------|----------------|--------------------------|------|-------------------------|------|-------------------------|------|-----------------------|------|------|
|           |                 |                | Min                      | Max  | Min                     | Max  | Min                     | Max  | Min                   | Max  |      |
| $t_{PLH}$ | A               | B              | 1.5                      | 21.4 | 1                       | 8.8  | 0.7                     | 6    | 0.4                   | 4.2  | ns   |
| $t_{PHL}$ |                 |                |                          |      |                         |      |                         |      |                       |      |      |
| $t_{PLH}$ | B               | A              | 0.7                      | 7    | 0.4                     | 4.8  | 0.3                     | 4.5  | 0.3                   | 4.3  | ns   |
| $t_{PHL}$ |                 |                |                          |      |                         |      |                         |      |                       |      |      |
| $t_{PHZ}$ | $\overline{OE}$ | A              | 0.3                      | 11.6 | 0.3                     | 11.5 | 0.3                     | 11.3 | 0.3                   | 11.2 | ns   |
| $t_{PLZ}$ |                 |                |                          |      |                         |      |                         |      |                       |      |      |
| $t_{PHZ}$ | $\overline{OE}$ | B              | 2                        | 28.7 | 1.6                     | 9.7  | 1.4                     | 8.9  | 0.7                   | 7.8  | ns   |
| $t_{PLZ}$ |                 |                |                          |      |                         |      |                         |      |                       |      |      |
| $t_{PZH}$ | $\overline{OE}$ | A              | 0.7                      | 10.7 | 0.7                     | 10.5 | 0.7                     | 10.4 | 0.7                   | 10.2 | ns   |
| $t_{PZL}$ |                 |                |                          |      |                         |      |                         |      |                       |      |      |
| $t_{PZH}$ | $\overline{OE}$ | B              | 1.5                      | 27.6 | 1.3                     | 11.4 | 1                       | 8.8  | 0.9                   | 8.1  | ns   |
| $t_{PZL}$ |                 |                |                          |      |                         |      |                         |      |                       |      |      |

**Operating Characteristics**

$T_A = 25^\circ C$

| Parameter    |                                | Test<br>Conditions                                              | $V_{CCA}=V_{CCB}=1.8V$ | $V_{CCA}=V_{CCB}=2.5V$ | $V_{CCA}=V_{CCB}=3.3V$ | $V_{CCA}=V_{CCB}=5V$ | Unit |
|--------------|--------------------------------|-----------------------------------------------------------------|------------------------|------------------------|------------------------|----------------------|------|
|              |                                |                                                                 | Typ                    | Typ                    | Typ                    | Typ                  |      |
| $C_{pdA(i)}$ | A-port input,<br>B-port output | $C_L = 0,$<br>$f = 10\text{ MHz},$<br>$t_r = t_f = 1\text{ ns}$ | 4                      | 4                      | 4                      | 4                    | PF   |
|              | B-port input,<br>A-port output |                                                                 | 55                     | 55                     | 55                     | 55                   |      |
| $C_{pdB(i)}$ | A-port input,<br>B-port output |                                                                 | 55                     | 55                     | 55                     | 55                   |      |
|              | B-port input,<br>A-port output |                                                                 | 4                      | 4                      | 4                      | 4                    |      |

(1) Power dissipation capacitance per transceiver

## Typical Characteristics

Figure 1  $V_{OL}$  Voltage vs  $I_{OL}$  Current

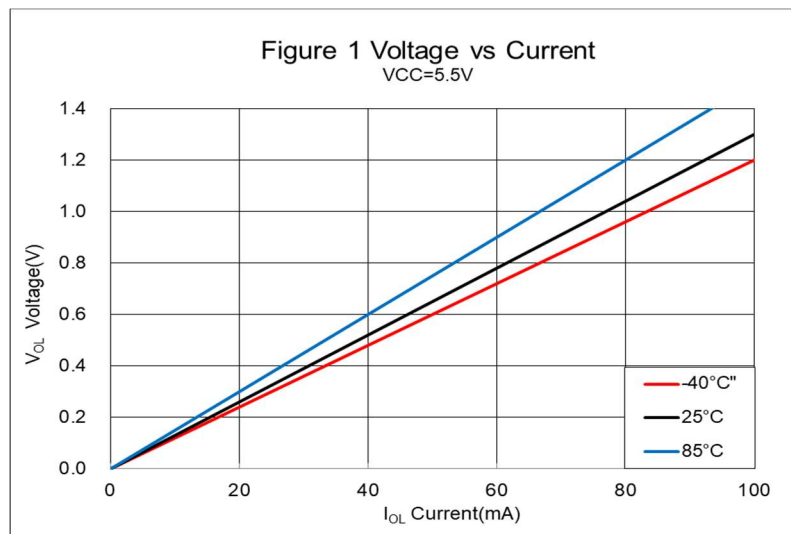
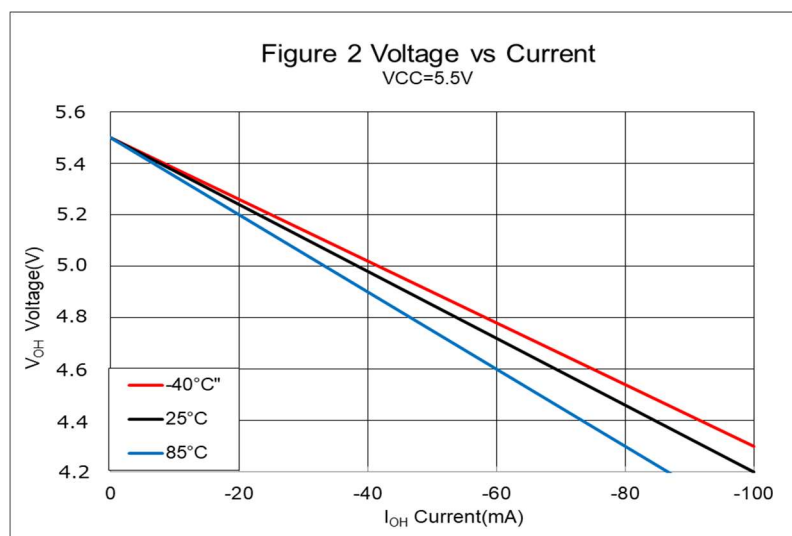
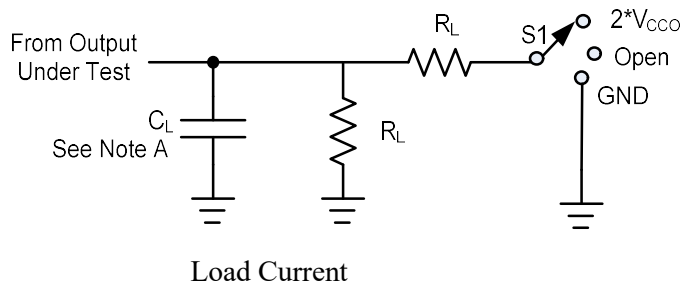


Figure 2  $V_{OH}$  Voltage vs  $I_{OH}$  Current

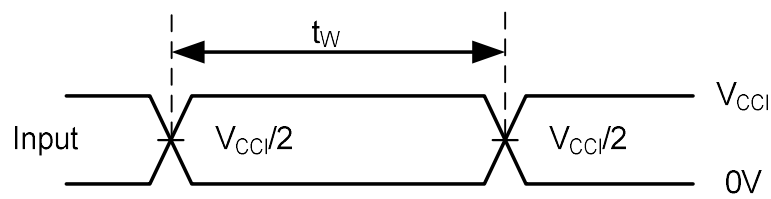


## Parameter Measurement Information

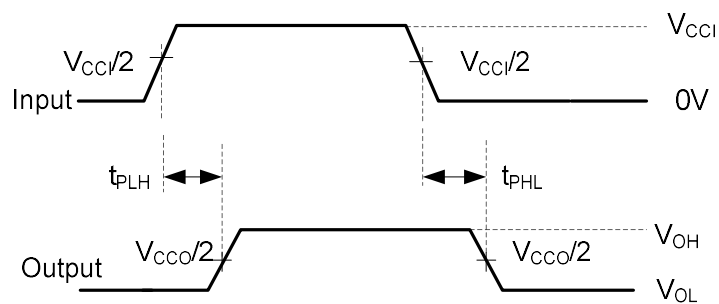


| TEST              | S1                 |
|-------------------|--------------------|
| tpd               | Open               |
| $t_{PLZ}/t_{PZL}$ | $2 \times V_{CCO}$ |
| $t_{PHZ}/t_{PZH}$ | GND                |

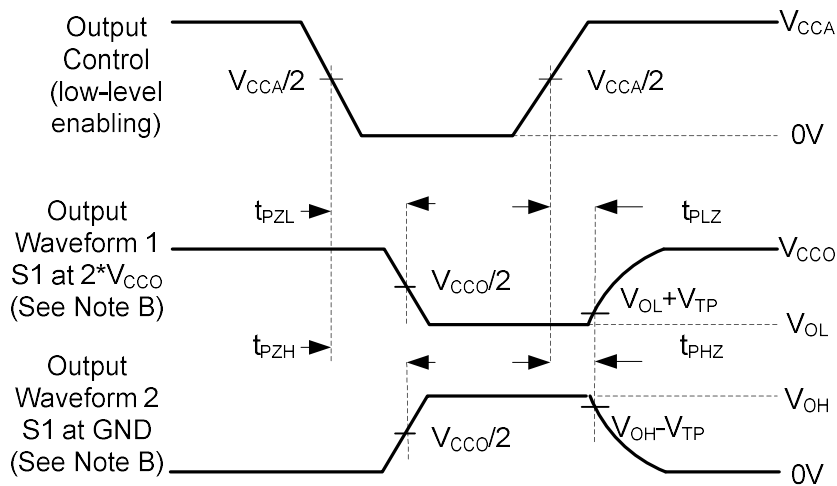
| $V_{CCO}$                          | $C_L$ | $R_L$       | $V_{TP}$ |
|------------------------------------|-------|-------------|----------|
| $1.8 \text{ V} \pm 0.15 \text{ V}$ | 15PF  | 2k $\Omega$ | 0.15V    |
| $2.5 \text{ V} \pm 0.2 \text{ V}$  | 15PF  | 2k $\Omega$ | 0.15V    |
| $3.3 \text{ V} \pm 0.3 \text{ V}$  | 15PF  | 2k $\Omega$ | 0.3V     |
| $5 \text{ V} \pm 0.5 \text{ V}$    | 15PF  | 2k $\Omega$ | 0.3V     |



VOLTAGE WAVEFORMS PULSE DURATION



VOLTAGE WAVEFORMS PROPAGATION DELAY TIMES



VOLTAGE WAVEFORMS ENABLE AND DISABLE TIMES

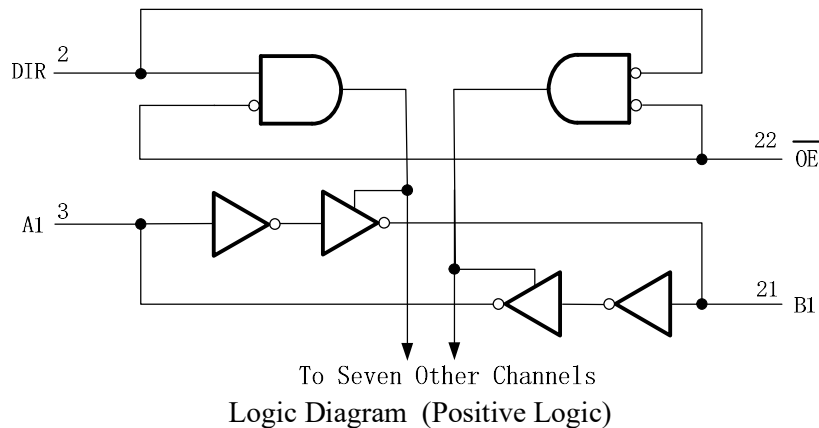
## NOTES:

- $C_L$  includes probe and jig capacitance.
- Waveform 1 is for an output with internal conditions such that the output is low, except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high, except when disabled by the output control.
- All input pulses are supplied by generators having the following characteristics:  $PRR \leq 10 \text{ MHz}$ ,  $Z_o = 50\Omega$ ,  $dv/dt \geq 1 \text{ V/ns}$ .
- The outputs are measured one at a time, with one transition per measurement.
- $t_{PLZ}$  and  $t_{PHZ}$  are the same as  $t_{dis}$ .
- $t_{PZL}$  and  $t_{PZH}$  are the same as  $t_{en}$ .
- $t_{PLH}$  and  $t_{PHL}$  are the same as  $t_{pd}$ .
- $V_{CCI}$  is the  $V_{CC}$  associated with the input port.
- $V_{CCO}$  is the  $V_{CC}$  associated with the output port.
- All parameters and waveforms are not applicable to all devices.

## Detailed Description

The UM3608 is an 8-bit, dual supply non-inverting bus transceiver. Pin A and direction control pin are support by  $V_{CCA}$  and pin B is support by  $V_{CCB}$ . The A port is able to accept I/O voltages ranging from 1.65 V to 5.5 V, while the B port can accept I/O voltages from 1.65 V to 5.5 V. The high on DIR allows data transmission from A to B and a low on DIR allows data transmission from B to A.

## Functional Block Diagram



## Feature Description

### Fully Configurable Dual-Rail Design Allows Each Port to Operate Over the Full 1.65V to 5.5V Power-Supply Range

Both  $V_{CCA}$  and  $V_{CCB}$  can be supplied at any voltage between 1.65V and 5.5V making the device suitable for translating between any of the voltage nodes (1.8V, 2.5V, 3.3V and 5V).

### $I_{off}$ Supports Partial-Power-Down Mode Operation

$I_{off}$  prevents backflow current by disabling I/O output circuits when device is in partial-power-down mode.

## Device Functional Modes

The UM3608 is bus transceiver that can operate from 1.65V to 5.5V ( $V_{CCA}$ ) and 1.65V to 5.5V ( $V_{CCB}$ ). The signal translation between 1.65V and 5.5V requires direction control and output enable control. When OE is low and DIR is high, data transmission is from A to B. When OE is low and DIR is low, data transmission is from B to A. When OE is high, both output ports will be high-impedance.

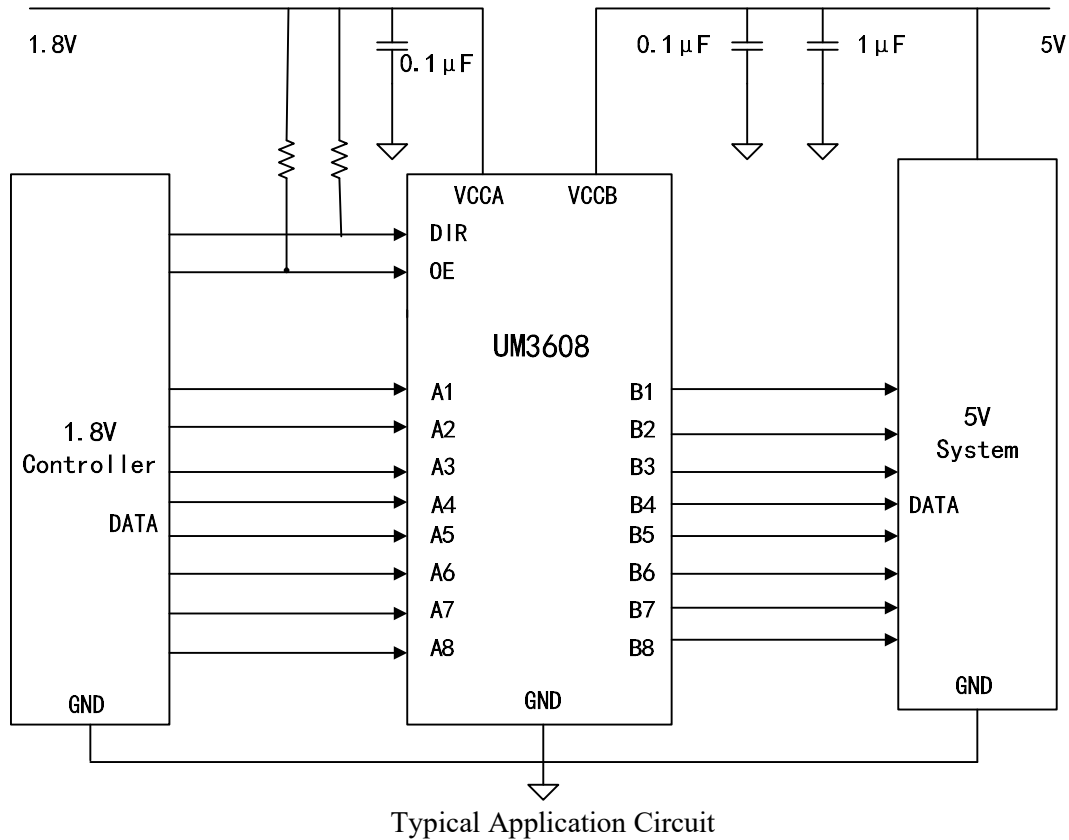
**Table 1. Function Table(1)**  
(Each 8-Bit Section)

| CONTROL INPUTS |     | OUTPUT CIRCUITS |         | OPERATION       |
|----------------|-----|-----------------|---------|-----------------|
| OE             | DIR | A PORT          | B PORT  |                 |
| L              | L   | Enabled         | Hi-Z    | B data to A bus |
| L              | H   | Hi-Z            | Enabled | A data to B bus |
| H              | X   | Hi-Z            | Hi-Z    | Isolation       |

(1) Input circuits of the data I/Os are always active.

## Application Information

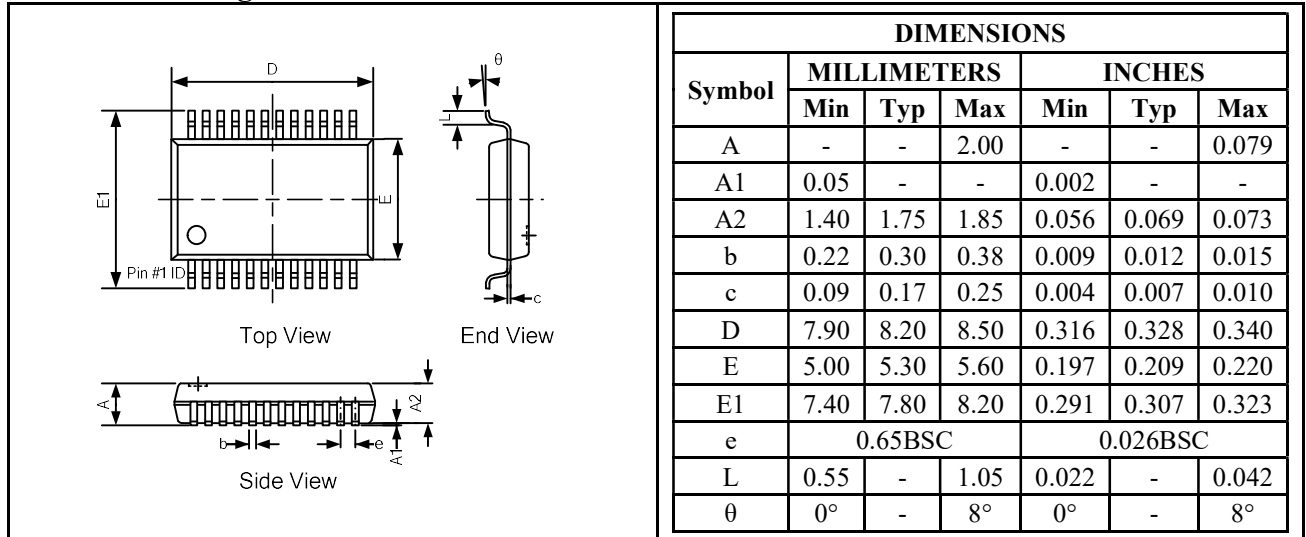
The UM3608 device can be used in level-translation applications for interfacing devices or systems operating at different interface voltages with one another. The maximum output current can be up to 32 mA when device is powered by 5 V.



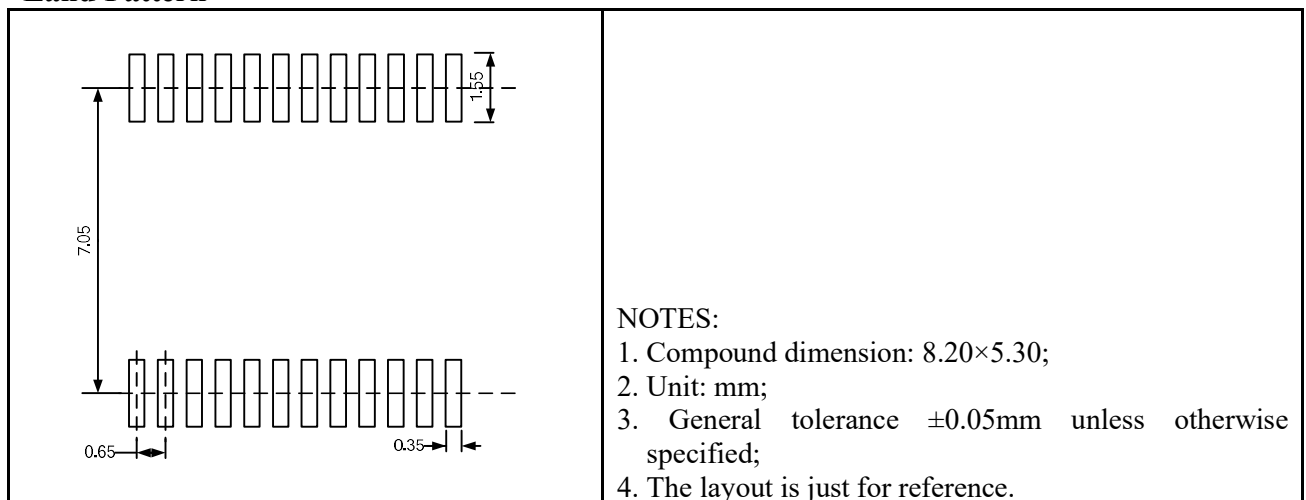
## Package Information

### UM3608AO SSOP24

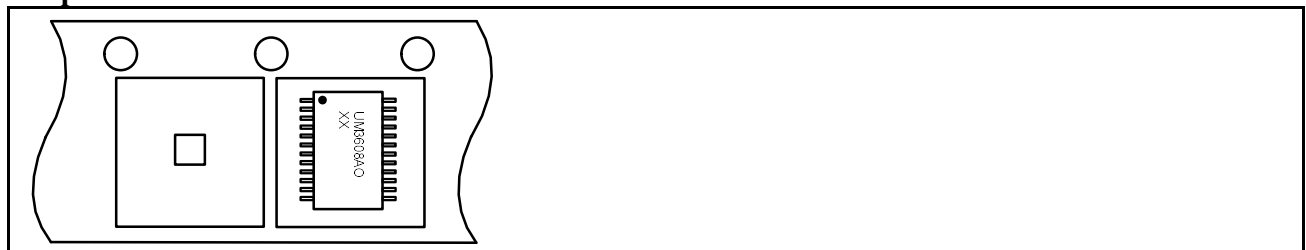
#### Outline Drawing



#### Land Pattern

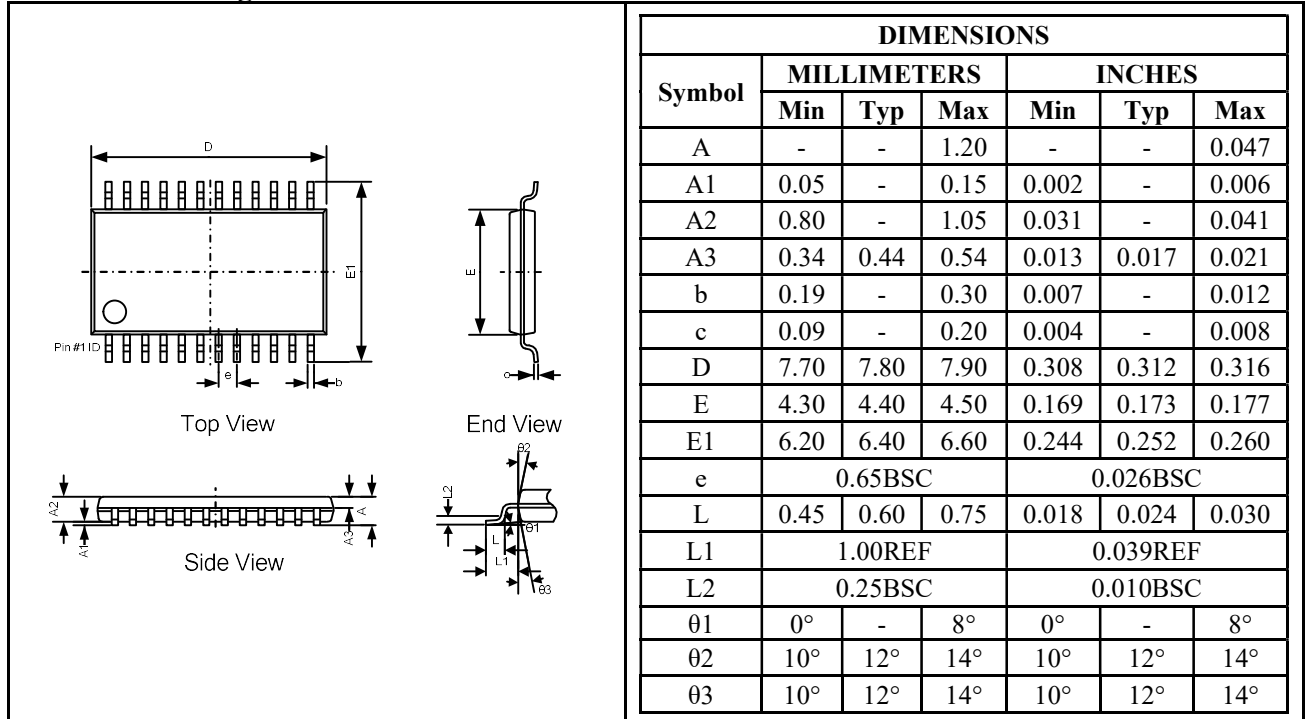


#### Tape and Reel Orientation

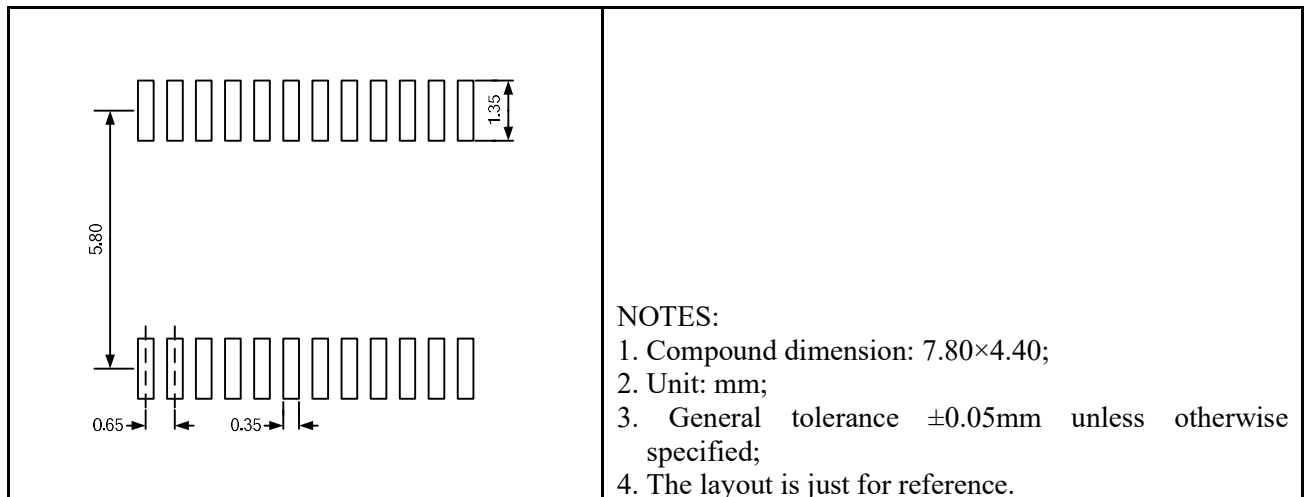


## UM3608UO TSSOP24

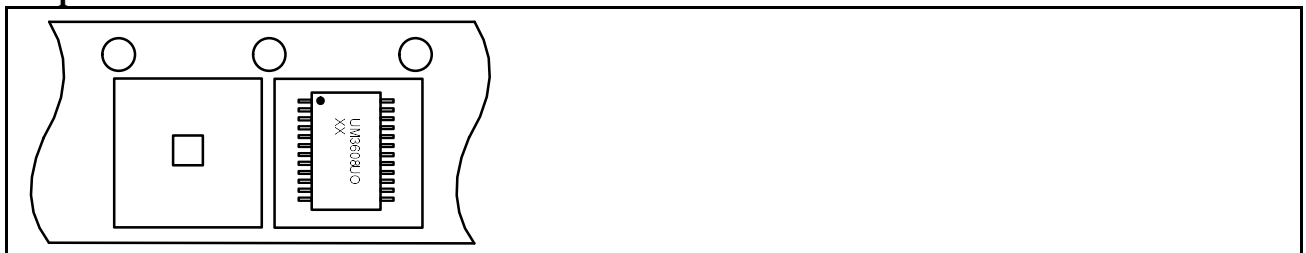
### Outline Drawing



### Land Pattern

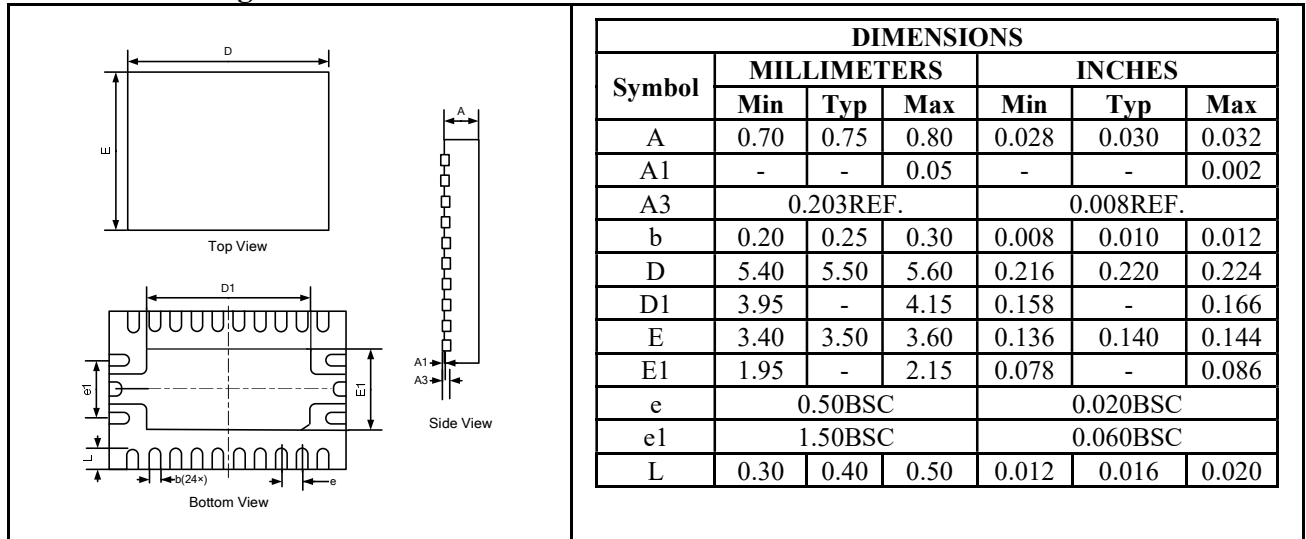


### Tape and Reel Orientation

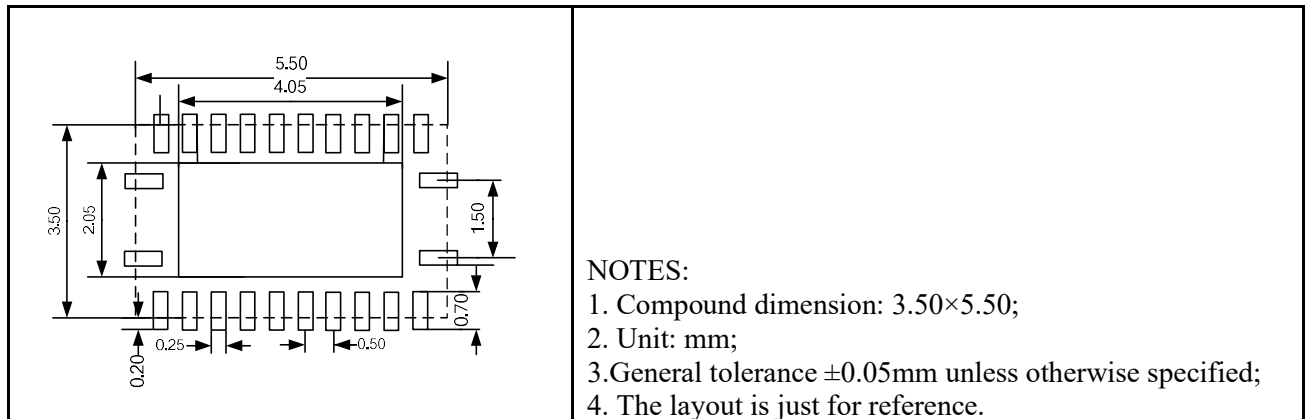


## UM3608QA QFN24 3.5×5.5

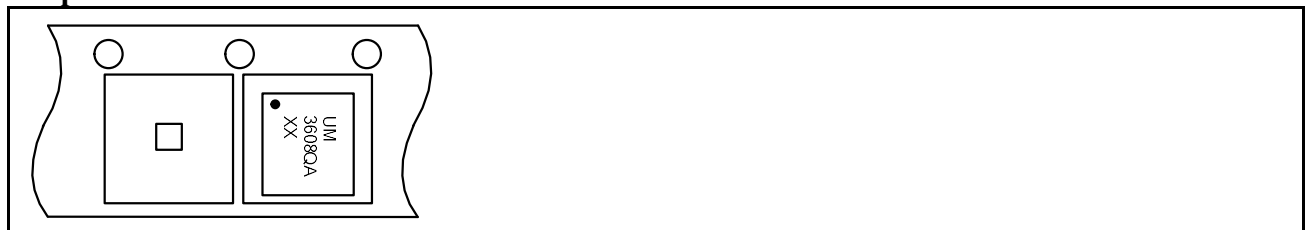
### Outline Drawing



### Land Pattern



### Tape and Reel Orientation



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