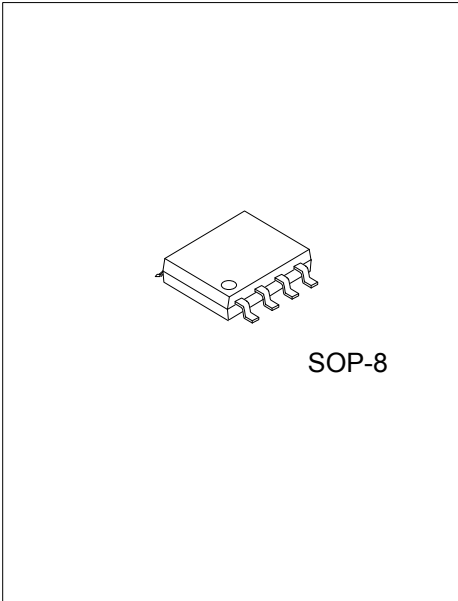




## UTRS3088

CMOS IC

### FAIL-SAFE, 1.0MBPS, RS-485 / RS-422 TRANSCEIVERS WITH $\pm 15KV$ ESD-PROTECTED



SOP-8

#### DESCRIPTION

The UTC **UTRS3088** is a half-duplex transceiver designed for RS-485 data bus network, which contains one transmitter and one receiver. The UTC **UTRS3088** features a fail-safe receiver, which guarantees the receiver to output high when the receiver inputs are open, short or idle.

The UTC **UTRS3088** also features a hot-swap glitch free protection circuits which guarantee outputs of both the transmitter and the receiver in a high impedance state during the power up period. So that the large short current from power to ground will be disable by glitch free function, which will save the power and enhance the efficiency of the power up.

The UTC **UTRS3088** is optimized for signal rates up to 1.0Mbps with differential voltage of 2.3V. The UTC **UTRS3088** also has the thermal shutdown function when the temperature is over 150°C and the protection of the current limitation in the transmitter to protect the itself from the damage by the system-fault conditions during normal operation.

#### FEATURES

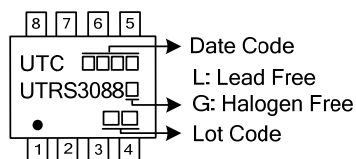
- \* Meet the requirements of the EIA/TIA-485 standards.
- \* 5.0V single power supply.
- \* 1 $\mu$ A low-current shutdown mode.
- \* HBM  $\pm 15kV$  ESD protection for Transmitter Output
- \* True fail-safe receiver while maintaining EIA/TIA-485 compatibility.
- \* Hot-Swap glitch free protection on control inputs.
- \* Up to 256 transceivers on the bus.
- \* Maximum baud rate up to 1.0Mbps.
- \* Transmitter short circuit current limit.
- \* Thermal shutdown for overload protection.

#### ORDERING INFORMATION

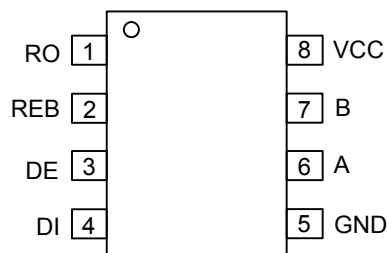
| Ordering Number |                 | Package | Packing   |
|-----------------|-----------------|---------|-----------|
| Lead Free       | Halogen Free    |         |           |
| UTRS3088L-S08-R | UTRS3088G-S08-R | SOP-8   | Tape Reel |

|                 |                  |   |
|-----------------|------------------|---|
| UTRS3088G-S08-R | (1)Packing Type  | (1) R: Tape Reel                                |
|                 | (2)Package Type  | (2) S08: SOP-8                                  |
|                 | (3)Green Package | (3) G: Halogen Free and Lead Free, L: Lead Free |

### MARKING



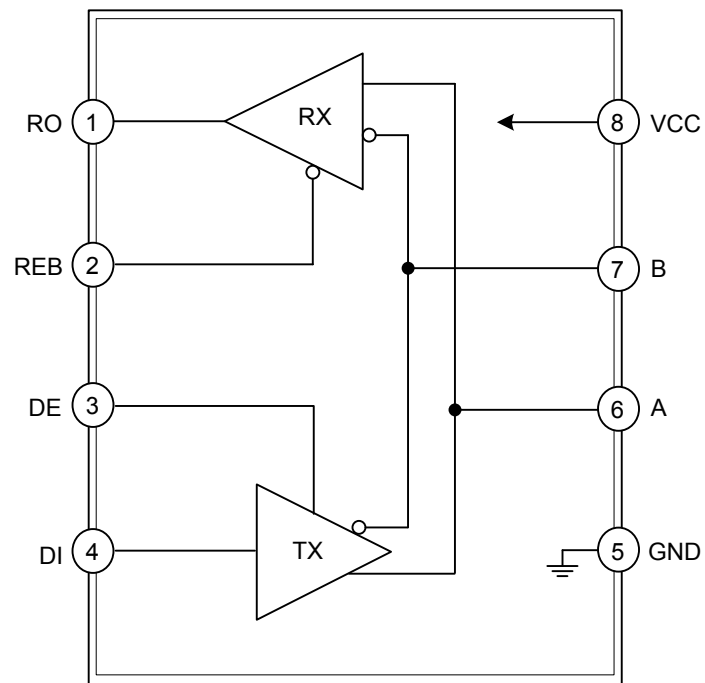
### PIN CONFIGURATION



### PIN DESCRIPTION

| PIN NO. | PIN NAME        | DESCRIPTION   |
|---------|-----------------|---|
| 1       | RO              | Receiver Output: When REB is low and if (A-B) ≥ -50mV, RO is high; if (A-B) ≤ -200mV, RO is low.  |
| 2       | REB             | Receiver Output Enable: REB is low to enable the Receiver; REB is high to disable the Receiver.   |
| 3       | DE              | Transmitter Output Enable: DE is high to enable the transmitter; DE is low to disable the transmitter.  |
| 4       | DI              | Transmitter Input: When DE is high, a low on DI forces A output low and B output high. Similarly, a high on DI forces A output high and B output low. |
| 5       | GND             | Ground pin. Must be connected to 0V.  |
| 6       | A               | Non-inverting Receiver Input and Non-inverting Transmitter Output   |
| 7       | B               | Inverting Receiver Input and Inverting Transmitter Output   |
| 8       | V <sub>CC</sub> | Power Supply Input 5.0V.  |

■ BLOCK DIAGRAM



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## ■ ABSOLUTE MAXIMUM RATING

| PARAMETER                  | SYMBOL    | RATINGS               | UNIT |
|----------------------------|-----------|-----------------------|------|
| Power Supply $V_{CC}$      | $V_{CC}$  | -0.3~8.0              | V    |
| Control Input Voltage      | REB, DE   | -0.3~( $V_{CC}+0.3$ ) | V    |
| Receiver Input Voltage     | A, B      | $\pm 13$              | V    |
| Receiver Output Voltage    | RO        | -0.3~( $V_{CC}+0.3$ ) | V    |
| Transmitter Output Voltage | A, B      | $\pm 13$              | V    |
| Transmitter Input          | DI        | -0.3~( $V_{CC}+0.3$ ) | V    |
| Operating Temperature      | $T_{OP}$  | -40~+85               | °C   |
| Storage Temperature        | $T_{STG}$ | -65~+150              | °C   |

Note: Absolute maximum ratings are those values beyond which the device could be permanently damaged. Absolute maximum ratings are stress ratings only and functional device operation is not implied.

## ■ DC ELECTRICAL CHARACTERISTICS

( $V_{CC}=5.0V \pm 5\%$  with  $T_A = T_{MIN}$  to  $T_{MAX}$ , unless otherwise specified. Typical values are at  $V_{CC}=5.0V$  and  $T_{AMB}=25^\circ C$ .)

| PARAMETER  | SYMBOL          | TEST CONDITIONS                        | MIN          | TYP | MAX      | UNIT       |
|--|-----------------|--|--------------|-----|----------|------------|
| <b>TRANSMITTER</b>                                 |                 |  |              |     |          |            |
| Differential Transmitter Output                    | $V_{OD1}$       | No Load                                |              |     | 5.0      | V          |
| Differential Transmitter Output                    | $V_{OD2}$       | Fig.1, $R_L=27\Omega$                  | 1.5          |     |          | V          |
| Change in Magnitude of Differential Output Voltage | $\Delta V_{OD}$ | Fig.1, $R_L=27\Omega$                  |              |     | 0.2      | V          |
| Transmitter Common- Mode Output Voltage            | $V_{OC}$        | Fig.1, $R_L=27\Omega$                  |              |     | 3.0      | V          |
| Change in Magnitude of Common- Mode Voltage        | $\Delta V_{OC}$ | Fig.1, $R_L=27\Omega$                  |              |     | 0.2      | V          |
| Input High Voltage                                 | $V_{IH}$        | DE, DI, REB                            | 2.0          |     |          | V          |
| Input Low Voltage                                  | $V_{IL}$        | DE, DI, REB                            |              |     | 0.8      | V          |
| Input Current                                      | $I_{IN1}$       | DI                                     |              |     | $\pm 1$  | $\mu A$    |
| Input Current                                      | $I_{IN2}$       | DE, REB                                |              |     | $\pm 50$ | $\mu A$    |
| DI Input Hysteresis                                | $V_{HYS}$       |  |              | 100 |          | mV         |
| Input Current (A and B)                            | $I_{IN3}$       | DE=GND,<br>VCC=GND or 5.25V            | $V_{IN}=12V$ |     | 125      | $\mu A$    |
|  |                 |  | $V_{IN}=-7V$ |     | -75      | $\mu A$    |
| Transmitter Short-Circuit Output Current           | $I_{OS}$        | $-7V \leq V_{OUT} \leq V_{CC}$         | -250         |     |          | mA         |
|  |                 | $0V \leq V_{OUT} \leq 12V$             |              |     | 250      | mA         |
| <b>RECEIVER</b>                                    |                 |  |              |     |          |            |
| Receiver Differential Threshold Voltage            | $V_{TH}$        | $V_{CM}=+2.5V$                         | -200         |     | -20      | mV         |
| Receiver Input Hysteresis                          | $\Delta V_{TH}$ |  |              | 25  |          | mV         |
| Receiver Output High Voltage                       | $V_{OH}$        | $I_{O}=-4mA, V_{ID}=-20mV$             | $V_{CC}-1.5$ |     |          | V          |
| Receiver Output Low Voltage                        | $V_{OL}$        | $I_{O}=4mA, V_{ID}=-200mV$             |              |     | 0.5      | V          |
| Three- State Output Current at Receiver            | $I_{OZR}$       | $0.4V \leq V_{CM} \leq 2.4V$           |              |     | $\pm 1$  | $\mu A$    |
| Receiver Input Resistance                          | $R_{IN}$        | $-7V \leq V_{CM} \leq +12V$            | 96           |     |          | k $\Omega$ |
| Receiver Output Short-Circuit Current              | $I_{OSR}$       | Fig.6, $0V \leq V_{RO} \leq V_{CC}$    | $\pm 7$      |     | $\pm 95$ | mA         |
| <b>SUPPLY CURRENT</b>                              |                 |  |              |     |          |            |
| Supply Current                                     | $I_{CC}$        | No Load,<br>REB=GND,<br>DI=VCC or GND. | DE=VCC       | 420 | 600      | $\mu A$    |
|  |                 |  | DE=GND       | 320 | 500      | $\mu A$    |
| Supply Current in Shutdown Mode                    | $I_{SHDN}$      | REB=VCC, DE=GND                        |              | 1.0 | 15       | $\mu A$    |

### ■ SWITCHING CHARACTERISTICS

( $V_{CC}=5.0V \pm 5\%$  with  $T_A = T_{MIN}$  to  $T_{MAX}$ , unless otherwise specified. Typical values are at  $V_{CC}=5.0V$  and  $T_{AMB}=25^\circ C$ .)

| PARAMETER  | SYMBOL               | TEST CONDITIONS  | MIN | TYP | MAX  | UNIT |
|--|----------------------|--|-----|-----|------|------|
| Transmitter Input to Output                        | $t_{DPLH}, t_{DPHL}$ | Fig.2 and 7, $R_{DIFF}=54\Omega$ ,<br>$C_{L1}=C_{L2}=100pF$                |     | 70  | 200  | ns   |
| Transmitter Output Skew<br>$ t_{DPLH} - t_{DPHL} $ | $t_{DSKEW}$          | Fig.2 and 7, $R_{DIFF}=54\Omega$ ,<br>$C_{L1}=C_{L2}=100pF$                |     | 10  |      | ns   |
| Transmitter Rise or Fall Time                      | $t_{DF}, t_{DR}$     | Fig.2 and 7, $R_{DIFF}=54\Omega$ ,<br>$C_{L1}=C_{L2}=100pF$                |     | 40  | 150  | ns   |
| Maximum Data Rate                                  | $f_{MAX}$            |  |     | 1.0 |      | Mbps |
| Transmitter Enable to Output Low                   | $t_{DZL}$            | Fig.4 and 8, $C_{DL}=100pF$ , S1 Closed                                    |     |     | 150  | ns   |
| Transmitter Enable to Output High                  | $t_{DZH}$            | Fig.4 and 8, $C_{DL}=100pF$ , S2 Closed                                    |     |     | 150  | ns   |
| Transmitter Disable Time from Low                  | $t_{DLZ}$            | Fig.4 and 8, $C_{DL}=15pF$ , S1 Closed                                     |     |     | 150  | ns   |
| Transmitter Disable Time from High                 | $t_{DHZ}$            | Fig.4 and 8, $C_{DL}=15pF$ , S2 Closed                                     |     |     | 150  | ns   |
| Receiver Input to Output                           | $t_{RPLH}, t_{RPHL}$ | Fig.5 and 9, $ V_{ID} \geq 2.0V$ ; Rise and Fall Time of $V_{ID}\leq 15ns$ |     | 900 | 1200 | ns   |
| $ t_{RPLH} - t_{RPHL} $ Different Receiver Skew    | $t_{RSKD}$           | Fig.5 and 9, $ V_{ID} \geq 2.0V$ ; Rise and Fall Time of $V_{ID}\leq 15ns$ |     | 10  |      | ns   |
| Receiver Enable to Output Low                      | $t_{RZL}$            | Fig.3 and 10, $C_{RL}=100pF$ , S1 Closed                                   |     | 60  | 150  | ns   |
| Receiver Enable to Output High                     | $t_{RZH}$            | Fig.3 and 10, $C_{RL}=100pF$ , S2 Closed                                   |     | 60  | 150  | ns   |
| Receiver Disable Time from Low                     | $t_{RLZ}$            | Fig.3 and 10, $C_{RL}=100pF$ , S1 Closed                                   |     | 60  | 150  | ns   |
| Receiver Disable Time from High                    | $t_{RHZ}$            | Fig.3 and 10, $C_{RL}=100pF$ , S2 Closed                                   |     | 60  | 150  | ns   |
| Time to Shutdown                                   | $t_{SHDN}$           |  |     | 500 | 1000 | ns   |
| Transmitter Enable from Shutdown to Output Low     | $t_{DZL(SHDN)}$      | Fig.4 and 8, $C_{DL}=15pF$ , S1 Closed                                     |     |     | 2500 | ns   |
| Transmitter Enable from Shutdown to Output High    | $t_{DZH(SHDN)}$      | Fig.4 and 8, $C_{DL}=15pF$ , S2 Closed                                     |     |     | 2500 | ns   |
| Receiver Enable from Shutdown to Output Low        | $t_{RZL(SHDN)}$      | Fig.3 and 10, $C_{RL}=100pF$ , S1 Closed                                   |     |     | 3500 | ns   |
| Receiver Enable from Shutdown to Output High       | $t_{RZH(SHDN)}$      | Fig.3 and 10, $C_{RL}=100pF$ , S2 Closed                                   |     |     | 3500 | ns   |

■ FUNCTION TABLE

| TRANSMITTING |    |    |          |        |
|--------------|----|----|----------|--------|
| INPUTS       |    |    | OUTPUTS  |        |
| REB          | DE | DI | A        | B      |
| X            | 1  | 0  | 0        | 1      |
| X            | 1  | 1  | 1        | 0      |
| 0            | 0  | X  | High-Z   | High-Z |
| 1            | 0  | X  | Shutdown |        |

| RECEIVING |    |               |          |
|-----------|----|---------------|----------|
| INPUTS    |    |               | OUTPUT   |
| REB       | DE | A-B           | RO       |
| 0         | X  | $\geq -0.02V$ | 1        |
| 0         | X  | $\leq -0.2V$  | 0        |
| 0         | X  | Open/Shorted  | 1        |
| 1         | 1  | X             | High-Z   |
| 1         | 0  | X             | Shutdown |

X = Don't care

Shutdown mode, driver and receiver outputs high impedance

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■ TEST CIRCUIT

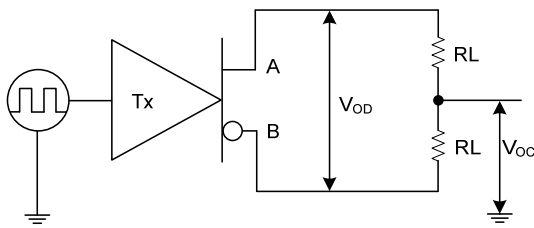


Fig. 1 Transmitter DC Test Circuit

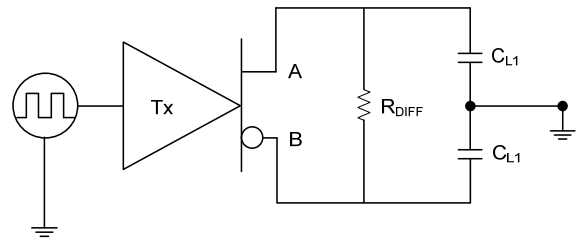


Fig. 2 Transmitter Timing Test Circuit

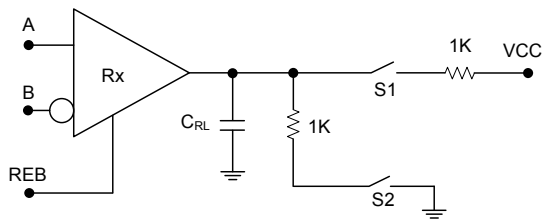


Fig. 3 Receiver Enable/Disable Timing Test Circuit

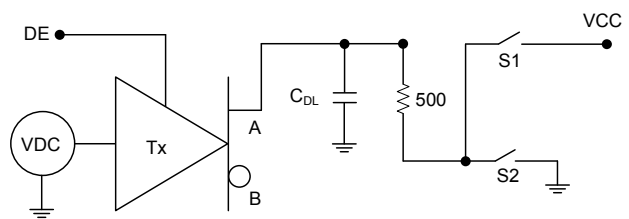


Fig. 4 Transmitter Enable/Disable Timing Test Circuit

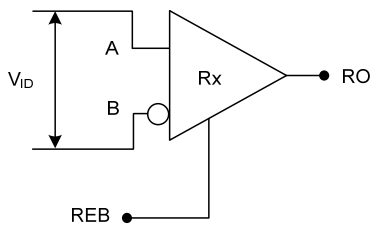


Fig. 5 Receiver Timing Test Circuit

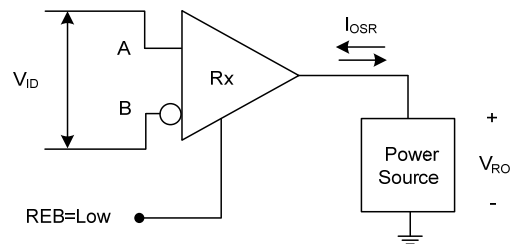


Fig. 6 Receiver Output Short Circuit

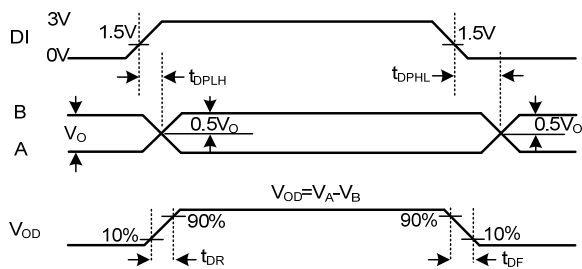


Fig. 7 Transmitter Propagation Delays

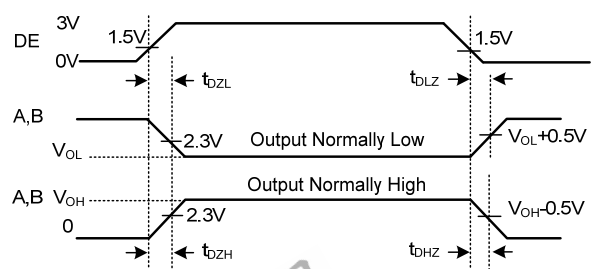


Fig. 8 Transmitter Enable and Disable Times

■ TEST CIRCUIT (Cont.)

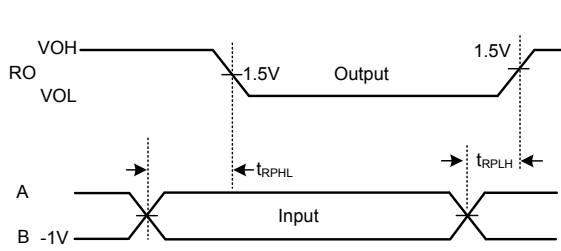


Fig. 9 Receiver Propagation Delays

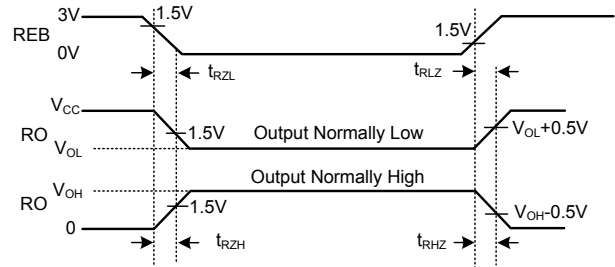


Fig. 10 Receiver Enable and Disable Times

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