FRONTGRADE

APPLICATION NOTE

RELEASE DATE 02/2015

Product Advisory

RHMSI with Schmitt Trigger Inputs: Recommended Max. Input Rise/Fall Time

Table 1.1 Applicable Products

Product Name	Manufacturer Part Number	SMD #	Device Type	Internal PIC* Number
Hex Inverter, Schmitt Trigger Inputs	UT54ACS14 UT54ACS14E UT54ACTS14 UT54ACTS14E	5962-96524 5962-96524 5962-96525 5962-96525	01 02,03 01 02,03	CA014 CE014 LA014 LE014
Quad 2-In NAND Gate, Schmitt Trigger Inputs	UT54ACS132 UT54ACS132E UT54ACTS132 UT54ACTS132E	5962-96542 5962-96542 5962-96543 5962-96543	01 02,03 01 02,03	CA132 CE132 LA132 LE132
Octal Bus Transceivers, Schmitt Trigger Inputs, Tri-State Outputs	UT54ACS245S UT54ACS245SE	5962-96572 5962-96572	01 02,03	CA45S CE45S

* PIC = Frontgrade internal Product Identification Code

1.0 Overview

There are maximum input rise/fall (t_f/t_r) time requirements for RHMSI products with Schmitt Trigger inputs that are not currently reflected in the products' datasheets. While the common practice for digital logic parts is to provide fast signal edges at the logic inputs, some applications may attempt to operate with input edge rates below 1µs. Using extremely slow edge rates on RHMSI Schmitt Trigger inputs can lead to anomalous output behavior. The purpose of this Product Advisory is to document this anomalous output condition and provide boundary conditions for the maximum input rise/fall times.

2.0 Technical Background

Lab characterization shows that an input t_f/t_r of approximately 100µs is the threshold for onset of anomalous behavior at the logic output under nominal conditions. Input t_f/t_r on the order of 100µs can cause the logic gate output to exhibit slow output transitions, oscillations, and/or indeterminate logic values during the transition time.

3.0 Input/Output Waveform Plots vs. Input Rise/Fall Time

The following figures show this condition for the UT54ACTS132 Quad 2-Input NAND gate with Schmitt Trigger Inputs. The oscilloscope plots are in descending order from fastest to slowest t_f/t_r. Operation was at nominal conditions: VDD = 5.0V, ambient room temperature. The output waveforms show anomalous transitions when the input t_f/t_r is approximately 100µs or slower under these conditions. This appears to be the onset of this behavior at nominal conditions. For these conditions and this equipment setup, the anomalous or indeterminate output switching occurred only on the output rising edge (t_r) and was not seen on the falling edge (t_f). Based on a review of the circuit topology, under other conditions this behavior will occur on either the output rising or falling edge. Note that the full waveform plots do not show the anomalous output behavior when the oscilloscope is set to a scale of 0.4 * t_f /t_r (0-100%) to show the complete triangle waveform. The zoomed-in waveform plots at a scale of 2.5ns/div. are required to show detail. Oscilloscope persistence was set to 10s in order to capture several traces.

RHMSI with Schmitt Trigger Inputs: Recommended Max. Input Rise/Fall Time

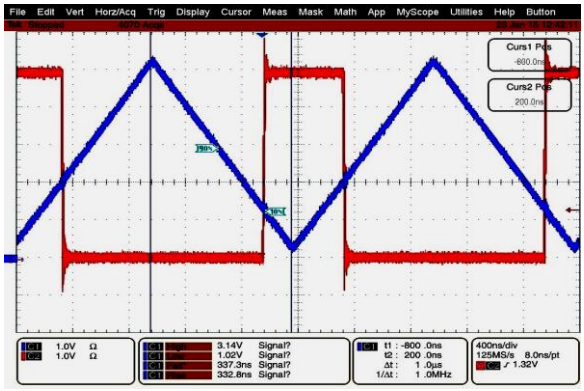
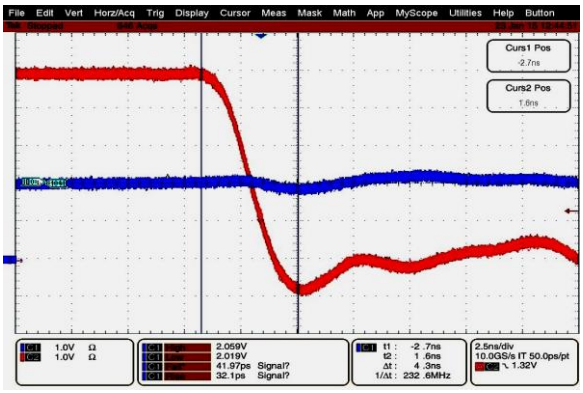


Figure 1. UT54ACTS132E Quad 2-Input NAND, Schmitt Trigger Inputs: Input (Triangle Wave/Blue) and Output (Pulse/Red) Waveforms Input tr,tf (0-100%) = 1µs (1Mz), 5V. Horizontal scale: 400ns/div.



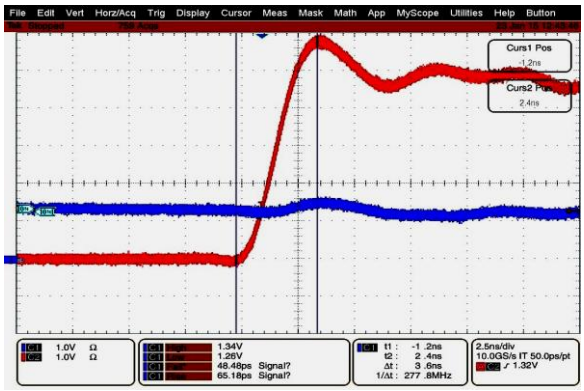


Figure 2. UT54ACTS132E Quad 2-Input NAND, Schmitt Trigger Inputs: Input/Output Waveforms, Input tr,tf (0-100%) = 1µs (1MHz), 5V No anomalous output on rising or falling edges. Horizontal scale: 2.5ns/div.

RHMSI with Schmitt Trigger Inputs: Recommended Max. Input Rise/Fall Time

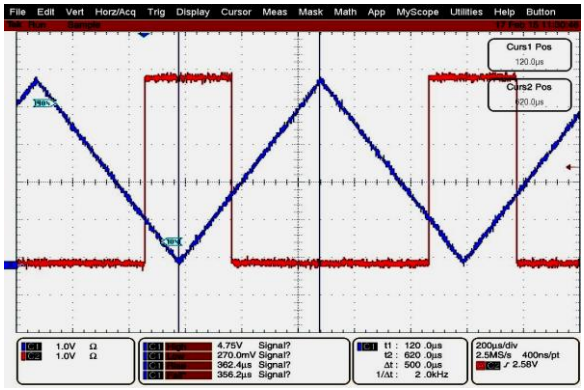


Figure 3. UT54ACTS132E Quad 2-Input NAND, Schmitt Trigger Inputs: Input (Triangle Wave/Blue) and Output (Pulse/Red) Waveforms Input tr,tf (0-100%) = 500µs (2kHz), 5V. Horizontal scale: 200µs/div.

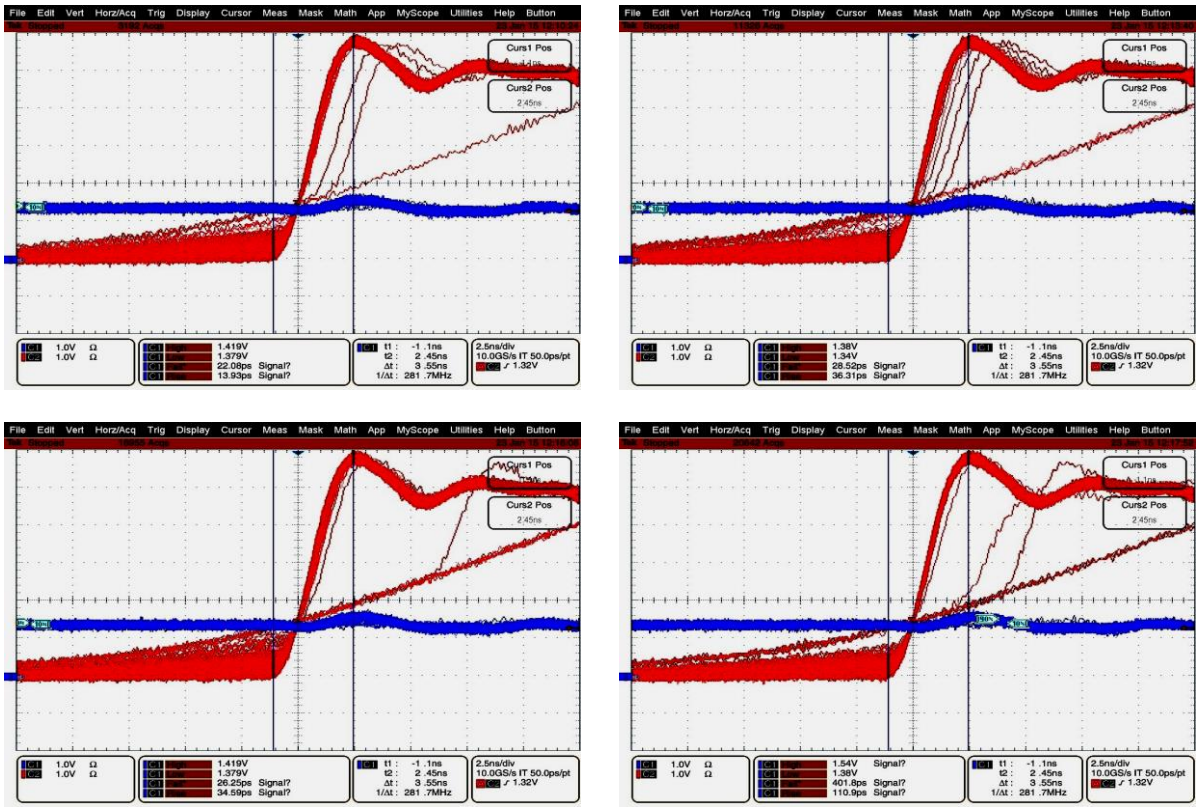


Figure 4. UT54ACTS132E Quad 2-Input NAND, Schmitt Trigger Inputs: Input/Output Waveforms, Input tr,tf (0-100%) = 500µs (2kHz), 5V. Horizontal scale: 2.5ns/div. Anomalous output on rising edge.

RHMSI with Schmitt Trigger Inputs: Recommended Max. Input Rise/Fall Time

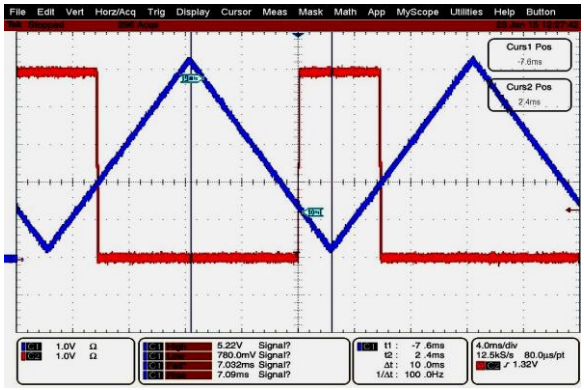
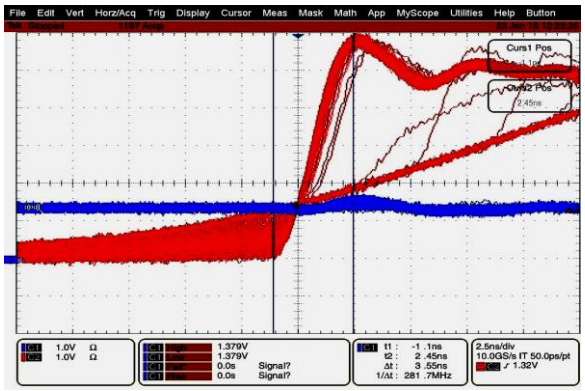
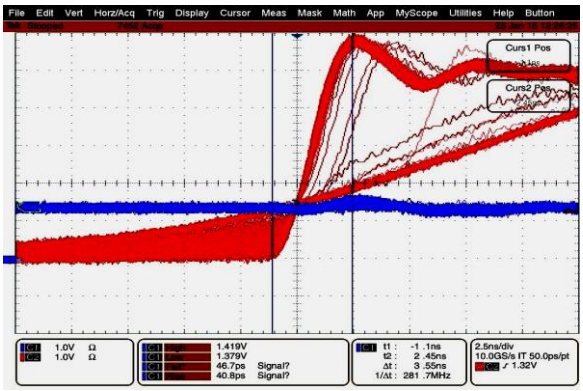


Figure 5. UT54ACTS132E Quad 2-Input NAND, Schmitt Trigger Inputs: Input (Triangle Wave/Blue) and Output (Pulse/Red) Waveforms Input/Output Waveforms, Input tr,tf (0-100%) = 10ms (100Hz), 5V. Horizontal scale: 4.0ms/div.





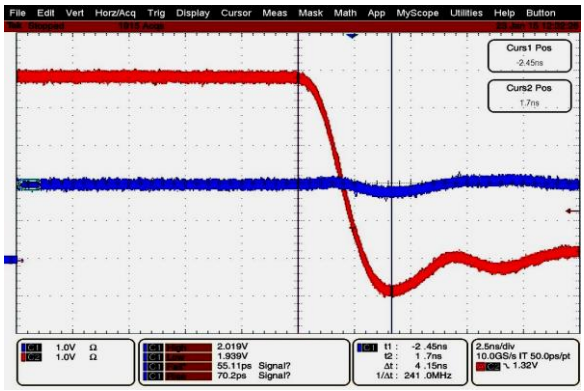


Figure 6. UT54ACTS132E Quad 2-Input NAND, Schmitt Trigger Inputs: Input/Output Waveforms, Input tr,tf (0-100%) = 10ms (100Hz), 5V. Horizontal scale: 2.5ns/div. Anomalous output on rising edge.

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4.0 Recommended Solutions

Based on measurements and a review of the circuit characteristics, users of RHMSI products with Schmitt Trigger inputs must observe a maximum tr,tf of 1µs (0-100%) in order to avoid the anomalous and indeterminate switching characteristics as described in this Product Advisory under Section 2.

5.0 Summary and Conclusion

There are maximum input rise/fall (t_f/t_r) time requirements for RHMSI products with Schmitt Trigger inputs that are not currently reflected in the product's datasheets. While the common practice for digital logic parts is to provide fast signal edges at the logic inputs, some users may attempt to operate with input edges slower than 1µs (0-100%). Using the RHMSI Schmitt Trigger input parts in this way can lead to anomalous output behavior. Limiting the logic input signal t_f/t_r to a maximum value of 1µs (0-100%) will avoid this undesired output behavior. Additional UT54ACTS132 measurements have been performed over voltage (V) and temperature (T). Based on all measurements and a review of general circuit characteristics, the maximum value of 1µs (0-100%) is representative of worst-case circuit operation for the RHMSI with Schmitt Trigger input parts. Therefore, these findings and recommendations may be applied to all similar parts in this logic family.

Revision History

Date	Revision	Author	Change Description
02/2015	1.0.0	RS	Initial Release
06/12/2023	1.1.0	RS	Updated to Frontgrade template