Aeroflex Colorado Springs Product Advisory

Datasheet Specification Clarification for the UT63M147 5V MIL-STD-1553A/B Bus Transceiver

1.0 Cross Reference of Affected Devices

Table 1: Cross Reference of Affected Product Revisions

Product Name	PIC*	Product Revision	SMD	Device Types	RHA Levels
UT63M147 MIL-STD-1553 Transceiver	JB01	Rev G	5962-93226	-03	F, G, & H
UT63M147 MIL-STD-1553 Transceiver	JB03	Rev A	5962-93226	-03	non-RHA & R

* PIC = Aeroflex Internal Product Identification Code

2.0 Overview

This product advisory is provided by Aeroflex Colorado Springs (Aeroflex) to clarify the test conditions associated with the t_{RXDD}, t_{RCVPD}, and V_{TH} minimum voltage response parameters on the UT63M147 MIL-STD-1553A/B Bus Transceiver. This advisory is only applicable to the stand-alone product revisions indicated in Table 1. The advisory does not apply to any of Aeroflex's SμMMIT multi-chip modules.

3.0 Explanation of Parameter t_{RXDD}

Parameter t_{RXDD} is defined in the UT63M147 datasheet as the skew between RXOUT and $\overline{\text{RXOUT}}$ as shown in Figure 1. This skew is measured by applying the input waveform described in the Zero Crossing Distortion test of the MIL-STD-1553 RT Validation Test Plan (MIL-HDBK-1553A Section 100 paragraph 5.1.2.1.1). Specifically, the input waveform is driven to the receiver input pins RXIN and $\overline{\text{RXIN}}$ in a direct-coupled configuration, whose peak-to-peak, line-to-line amplitude is 3.0V, and whose rise and fall times are 200ns ±20ns with 500ns ideal zero crossings. Given this input waveform, the UT63M147 guarantees t_{RXDD} of no more than ±200ns.

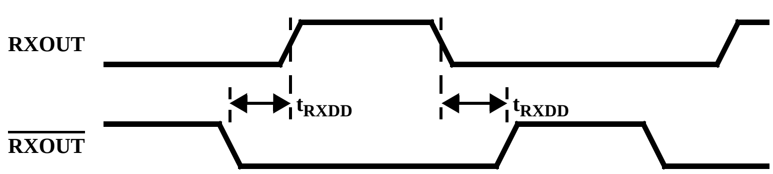

Figure 1. Relationships of t_{RXDD} with RXOUT and $\overline{\text{RXOUT}}$

4.0 Explanation of Parameter t_{RCVPD}

Parameter t_{RCVPD} is defined in the UT63M147 datasheet as the propagation delay from zero-crossing on the MIL-STD-1553 databus to a change in state of the RXOUT and $\overline{\text{RXOUT}}$ pins as shown in Figure 2. The propagation delays are measured by applying the input waveform described in the Zero Crossing Distortion test of the MIL-STD-1553 RT Validation Test Plan (MIL-HDBK-1553A Section 100 paragraph 5.1.2.1.1). Specifically, the input waveform is driven to the receiver input pins RXIN and $\overline{\text{RXIN}}$ in a direct-coupled configuration, whose peak-to-peak, line-to-line amplitude is 3.0V, and whose rise and fall times are 200ns $\pm$20ns with 500ns ideal zero crossings. Given this input waveform, the UT63M147 guarantees t_{RCVPD} of no more than 450ns.

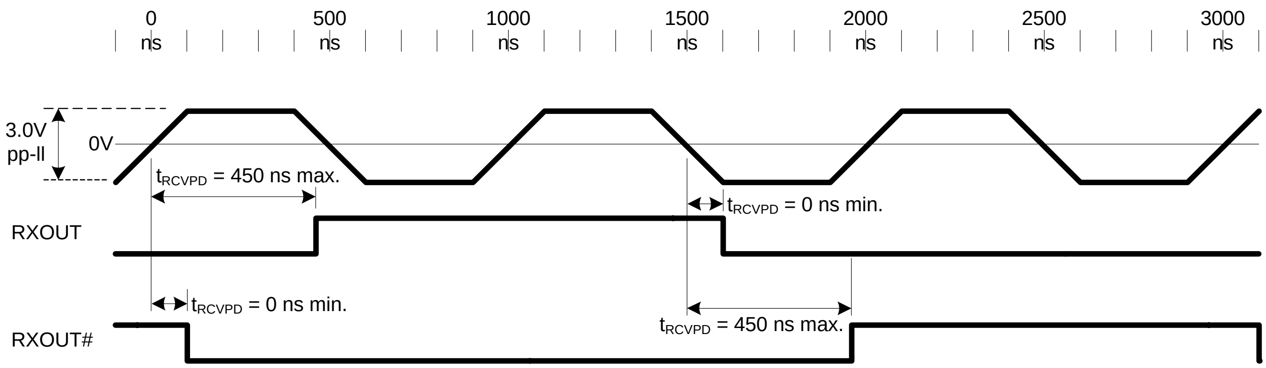

Figure 2. Test Waveform for t_{RCVPD}

In actuality, the typical propagation delay for this test condition ranges from about 200ns from zero crossing to the associated output falling edge and approximately 300ns from the same zero crossing to the complimentary output rising edge. This measurement is not tested by Aeroflex under a minimum receiver amplitude condition of 1.2V pp-ll for a direct-coupled bus (0.86V pp-ll for a transformer-coupled bus). Based on lab evaluation, the minimum amplitude test results in t_{RCVPD} approaching 0ns for the receiver's falling output edge while the rising edge of the complimentary output extends toward 450ns. Depending upon the time it takes for the incoming waveform to reach and stabilize at the minimum direct-coupled response amplitude of 1.2V pp-ll, the propagation delay from zero crossing to the receiver output rising edge will extend beyond 450ns. The following section of this advisory will discuss, in more detail, the effects that minimum input voltage testing has on the UT63M147 receiver.

5.0 Explanation of <u>Minimum</u> Input Threshold Voltage Guaranteed to Generate a Response on RXOUT and $\overline{\text{RXOUT}}$

Aeroflex's pass/fail criteria for a valid "response" at outputs RXOUT and $\overline{\text{RXOUT}}$ during minimum receiver amplitude testing was originally set to pass a minimum output pulse width of 10ns in response to a 1MHz, 50% duty cycle, trapezoidal, input waveform having 200ns rise/fall times with a direct-coupled amplitude of 1.2V pp-ll. Stated differently, a "response" during production testing meant that the RXOUT and $\overline{\text{RXOUT}}$ pulse widths were $\geq$ 10ns when receiving minimum MIL-STD-1553 amplitude, 500ns trapezoidal pulses with 200ns rise and fall times. Conversely, a "no-response" during production testing occurs when the RXOUT and $\overline{\text{RXOUT}}$ pulse widths are less than 10ns while receiving an input waveform of 280mV pp-ll (direct-coupled).

Depicted in figure 3 are the test waveforms used to measure the input voltage threshold response (V_{TH}) conforming to the Amplitude Variations test of the MIL-STD-1553 RT Validation Test Plan (MIL-HDBK-1553A Section 100 paragraph 5.1.2.1.2). The applied signal is a trapezoidal waveform with rise and fall times of 200ns $\pm$ 20ns applied to the receiver in the direct-coupled configuration. Under this test condition, the receiver was guaranteed to produce a response on the receiver output pins RXOUT and $\overline{\text{RXOUT}}$, where the "response", as defined above, was a positive pulse having a minimum width of 10ns.

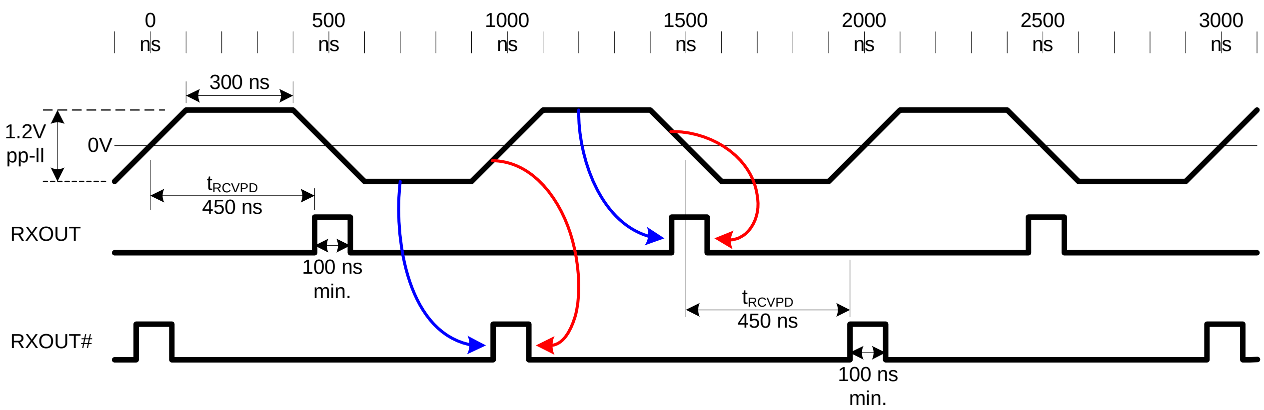

Figure 3. Aeroflex Test Waveform for Minimum Receiver Input Voltage Response with Revised Pulse Width Screen to $\geq$ 100ns

Recognizing that a 10ns minimum output pulse is insufficient for most MIL-STD-1553 decoders, Aeroflex has modified its screening process to ensure a minimum pulse width of $\geq$ 100ns for RXOUT and $\overline{\text{RXOUT}}$ when the received input waveform complies with the requirements outlined above. With a minimum output pulse width of 100ns, the UT63M147 is compatible with all Aeroflex protocol devices (e.g. SμMMIT E/DXE/LXE/XTE, BCRT, BCRTM, BCRTMP, RTR, RTS, RTI, and RTMP). The new screening method has been applied to all UT63M147 products as of Date Code 0816.

6.0 Ensuring a Clear Status Remote Terminal Response During a Minimum Receiver Amplitude Test Condition

A MIL-STD-1553 remote terminal using the UT63M147 can reliably operate under the minimum receiver amplitude levels described in MIL-HDBK-1553A Section 100 paragraph 5.1.2.1.2 when proper waveform conditions are satisfied, and the protocol decoding circuitry is designed to distinguish the minimum pulse widths associated with each of the three unique pulse streams defined in MIL-STD-1553. Table 2 describes the MIL-STD-1553 bit patterns that correlate to each of the three unique pulse streams.

Table 2: MIL-STD-1553 Bit Pattern to Pulse Stream Comparison

MIL-STD-1553 Bit Patterns	Description of Bit Pattern	Corresponding MIL-STD-1553 Pulse Stream
Command and Status Sync-Pulse	1.5 bit times high followed by 1.5 bit times low	**1.5μs Pulses:** 1.5μs High - 1.5μs Low
Data Sync-Pulse	1.5 bit times low followed by 1.5 bit times high	**1.5μs Pulses:** 1.5μs Low - 1.5μs High
Alternating ...1-0-1-0... Bit Pattern	No level transition occurs on bit time boundaries; an edge is only observed in the middle of a bit time. The bit stream will look like a 500kHz, 50% duty cycle clock.	**1μs Pulses:** 1μs High -1μs Low -1μs High - ...

Table 2: MIL-STD-1553 Bit Pattern to Pulse Stream Comparison

MIL-STD-1553 Bit Patterns	Description of Bit Pattern	Corresponding MIL-STD-1553 Pulse Stream
Solid ...1-1-1-1... or ...0-0-0-0... Bit Pattern	An edge transition will occur at each bit boundary and in the middle of each bit-time. The bit stream will look like a 1MHz, 50% duty cycle clock.	**500ns Pulses:** 500ns High -500ns Low - 500ns High - 500ns Low -...

In addition to providing consideration for the three unique pulse streams described in table 2, the MIL-STD-1553 decoder design must factor-in the actual pulse durations that the UT63M147 will present on the RXOUT/$\overline{\text{RXOUT}}$ pins in response to the various electrical conditions on the MIL-STD-1553 data bus. Table 3 provides a cross reference between incoming pulse widths and the resulting RXOUT/$\overline{\text{RXOUT}}$ pulse widths. To ensure successful extraction of each bit from the incoming bit pattern, the decoder must be able to interpret the RXOUT/$\overline{\text{RXOUT}}$ pulses and separate them into the appropriate bit times.

Table 3: Cross Reference of MIL-STD-1553 Bus Electrical Characteristics to Receiver Output Results

MIL-STD-1553 Bus Electrical Characteristics	RXOUT/$\overline{\text{RXOUT}}$ High Pulse Widths	Reference
Sync Pulses: Zero Crossing-to-Zero Crossing Duration: • 1.5µs High - 1.5µs Low • 200ns +/-20ns Rise & Fall Times Direct-Coupled Amplitude: 1.2 Vpp-ll Transformer-Coupled Amplitude: 0.86 Vpp-ll	Min. High Pulse = 1.1µs Max. High Pulse = 1.5µs (Theoretical)	Figure 4
Alternating ...1-0-1-0... Pulses: Zero Crossing-to-Zero Crossing Duration: • 1.0µs High - 1.0µs Low • 200ns +/-20ns Rise & Fall Times Direct-Coupled Amplitude: 1.2 Vpp-ll Transformer-Coupled Amplitude: 0.86 Vpp-ll	Min. High Pulse = 600ns Max. High Pulse = 1.0µs (Theoretical)	Figure 5
Solid ...1-1-1... or ...0-0-0...Pulses: Zero Crossing-to-Zero Crossing Duration: • 500ns High - 500ns Low • 200ns +/-20ns Rise & Fall Times Direct-Coupled Amplitude: 1.2 Vpp-ll Transformer-Coupled Amplitude: 0.86 Vpp-ll	Min. High Pulse = 100ns Max. High Pulse = 500ns (Theoretical)	Figure 6

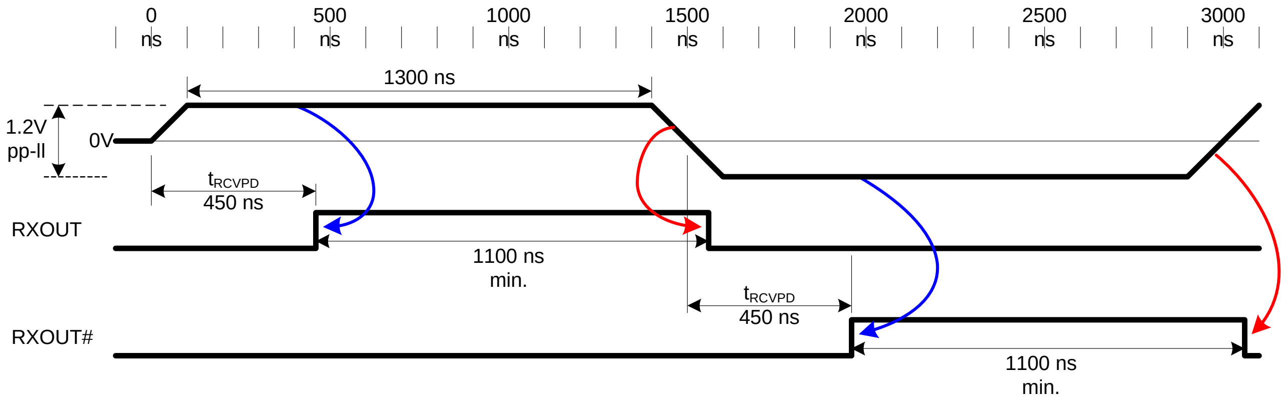

Figure 4. RXOUT/$\overline{\text{RXOUT}}$ Worst Case Pulse Width When Receiving a MIL-STD-1553 Sync Pulse During Minimum Receiver Amplitude Testing

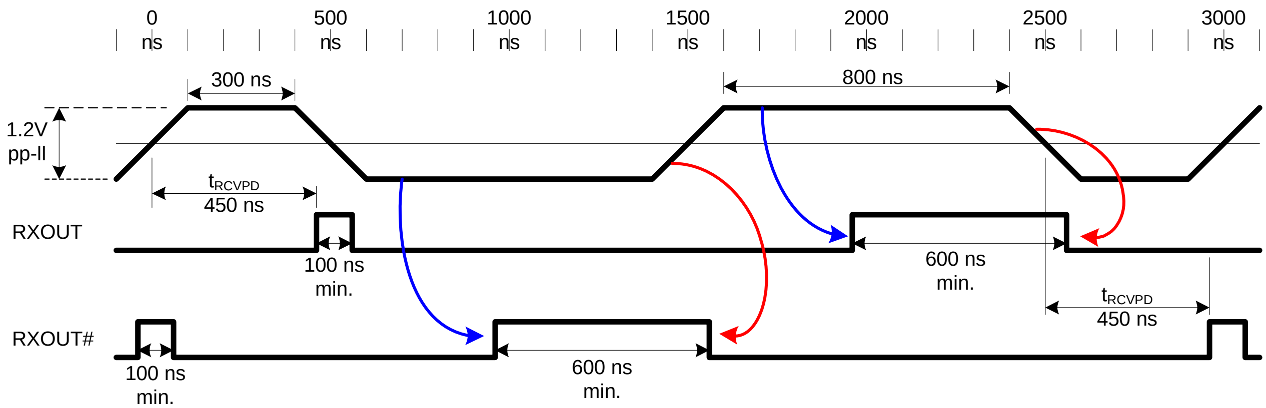

Figure 5. RXOUT/$\overline{\text{RXOUT}}$ Worst Case Pulse Widths When Receiving a MIL-STD-1553 Pattern of x-1-0-1-x During Minimum Receiver Amplitude Testing

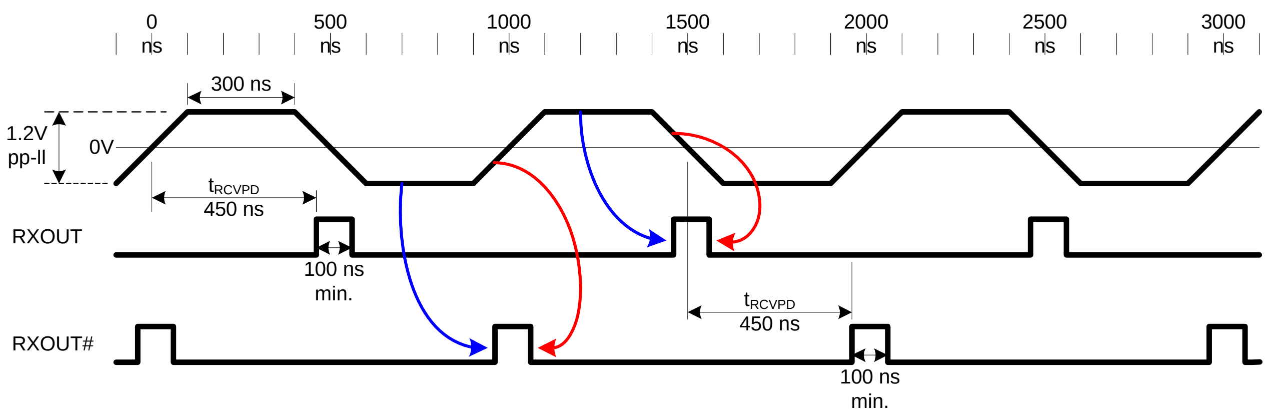

Figure 6. RXOUT/$\overline{\text{RXOUT}}$ Worst Case Pulse Widths When Receiving a MIL-STD-1553 Pattern of x-1-1-1-x During Minimum Receiver Amplitude Testing

Along with the critical nature of the decoder design, the electrical characteristics of the incoming waveform on the MIL-STD-1553 bus also play a significant role in the RXOUT/$\overline{\text{RXOUT}}$ pulse widths - particularly during minimum amplitude response testing. Specifically, if the incoming waveform takes longer than 220ns to reach a minimum response amplitude of 0.86V and 1.2V for the transformer- and direct-coupled configurations, respectively, then the RXOUT/$\overline{\text{RXOUT}}$ pulse widths may correspondingly shrink below the durations presented in table 3. In general, the UT63M147 requires the incoming waveform to remain at the minimum response amplitude for at least 200ns before the RXOUT/$\overline{\text{RXOUT}}$ pins will transition to the appropriate states. After the incoming waveform has been stable for a minimum of 200ns, the RXOUT/$\overline{\text{RXOUT}}$ pins will resolve to their proper values on a ns-for-ns basis until the input waveform drops below the minimum response amplitude, at which time the UT63M147 will quickly respond by driving RXOUT and $\overline{\text{RXOUT}}$ low.

If the MIL-STD-1553 protocol device is unable to detect and segregate pulse widths from the UT63M147 as described in table 3, then it would most likely result in a “no-response” failure during the Amplitude Variations portion of the RT Validation Test as the input signal approaches the minimum threshold for response condition.