Proposed Addition to the Integrating Receiver Proposal

Issues:

In reviewing all the posts to date, I see three basic issues with the Integrating Receiver proposal:

1. It is possible for the system to be in a state where the value being driven does not equal the state of the hysteresis receiver. This could be a problem with the initial state, or it could be because noise has flipped the hysteresis receiver since the last transition from the driver. Apparently, much of the noise that could flip a receiver occurs at and immediately after the I/O transitions created by transiting the UpdateDR state, so that is a particularly suspect period.
2. There is no provision for detection of transitions or the lack of transitions.
3. In many cases, there will be no transition out of the driver at the UpdateDR state, meaning that no information has been transferred during that test even though the captured value is correct. This may or may not be a problem, but it does seem to defy the logic of applying a test.

Proposed Additions:

First, modify the driver boundary cell by adding an Exclusive_Or between the update latch and the output to the driver. The second input to the Exclusive_Or would be (AC_EXTEST & RTI). Upon entry to the RTI state in AC_EXTEST, the driver output would toggle to the opposite of the value in the update latch. Upon exit from the RTI state in AC_EXTEST, the driver would again toggle back to the same value in the update state. These extra transitions could be avoided by not transitioning the RTI state. See Figure 1.

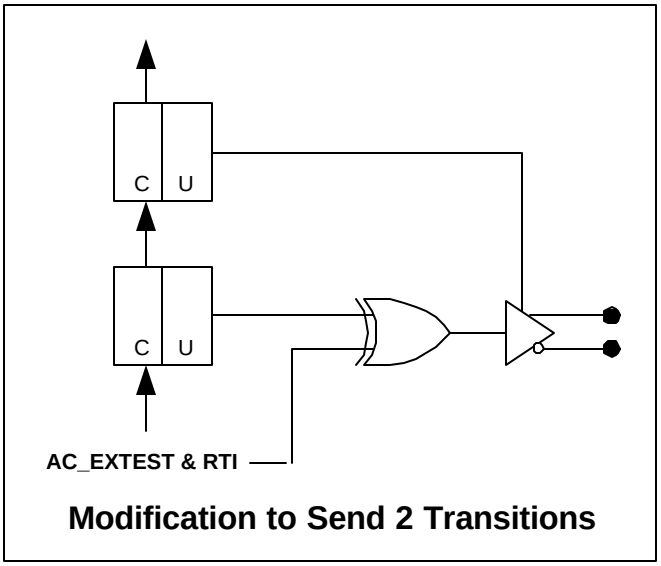

Figure 1.

The timing diagram for this modification to the driver is shown in Figure 2. This shows only a single cycle spent in RTI, but that is not significant for the proposal. It could be many cycles. It also shows the hysteresis receivers at an unknown state prior to UpdateDR, and affected by noise after UpdateDR.

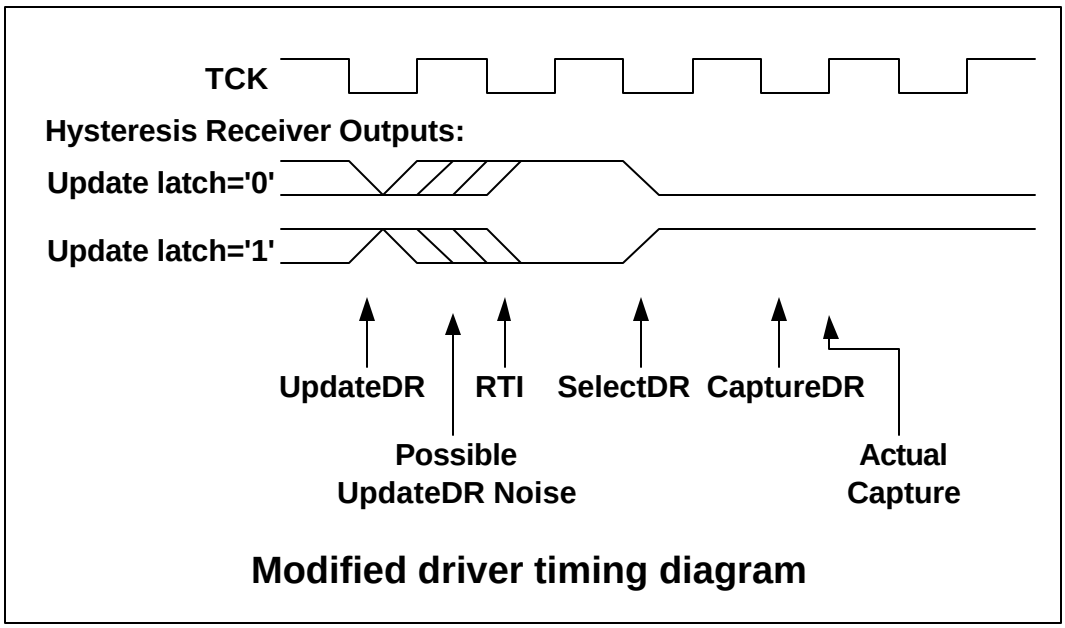

Figure 2.

Second, add an additional flop in the receiver boundary cell that captures the value on the pad at the rising TCK during RTI. The output of this flop can be used to "clobber" the value captured at CaptureDR. Alternately, the inverted value on the net may be simply captured in a separate observation cell in the boundary scan chain. See Figure 3. (This addition requires the first, but is much less important than the first.)

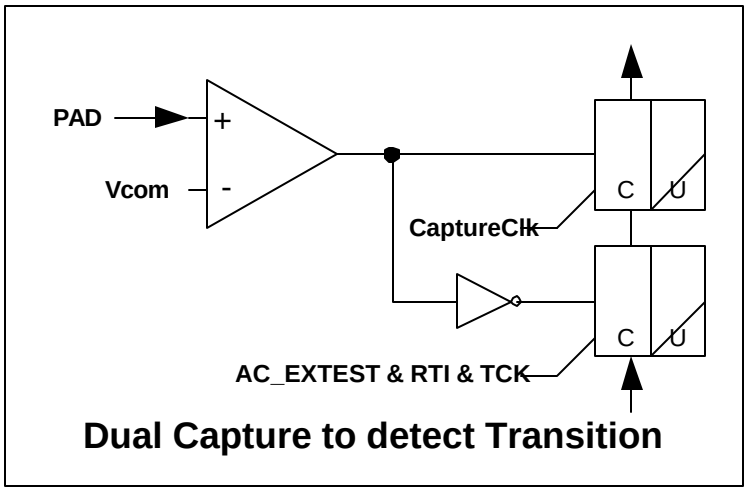

Figure 3.

Pros:

Advantages of the first addition include:

- There will always be at least two transitions on the net.
- The first of these two transitions occur one TCK cycle after the UpdateDR transition that caused the I/O's to switch, avoiding the noisy period immediately after UpdateDR.
- The state of the hysteresis receiver immediately before or after UpdateDR no longer matters, because the two transitions will take it to the opposite of the desired state and then back to the desired state.
- This eliminates any dependency upon the previous state of the hysteresis receiver, and in particular eliminates any incorrect initial state or incorrect state that has been caused by noise prior to transiting the RTI state.

The advantage of the second addition is to explicitly detect the lack of transitions on the net. Depending on defect detection achievable in both EXTEST and AC_EXTEST, this may not be necessary.

Cons:

The disadvantage of these additions is increased complexity, not only because of the added circuits but because we must once again consider some form of AC test control cell.

In addition, the change to the driver cell assumes that the number of AC tested signals is small compared to the total number of signals. This reduces the concern with noise generated by the transitions entering and leaving RTI.

Finally, a part compliant with 1149.1 may not be able to be used as the driver for an AC_EXTEST. However, I would suggest a permission in the rules to allow drivers that have not been modified to do the extra switching, and a permission for receivers that comply with the original proposal and do not include the transition detection flop. These permissions would permit testing boards that contained a mix of old and new parts that are AC coupled if adequate noise control could be exercised. For new parts, however, these modifications provide a significant protection against noise.