Technical Memo

TO: KTL
FM: Chris Chattaway

Date: June 14, 2000
Subject: Technical Description of the Halo Asset Tag
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1 Introduction

The purpose of this memo is to give a top-level technical description of the Asset tag. The Asset tag is used with the EXI Assetrac Asset protection system. The following sections describe the form and operation of the Asset tag.

2 Operation

The Asset tag has two modes of operation, in field and tag initiated. First and foremost the Asset tag is an RF transceiver that receives a 307 KHz signal and replies with a 433.92 MHz signal. The tag upon entering a 307 KHz field wakes up and communicates its serial number to the controller (base station). The controller, over the 307 KHz field (channel), transmits wakeup and respond commands to the tag and also initiates and controls the serial number interrogation. The second mode of operation is initiated by the tag's tamper circuitry. The tag is able to transmit to the nearest controller or receiver a message that indicates that the tag is being removed from the device it is protecting. This mode of operation is called Tag Initiated Communications (TIC).

2.1 In field Performance

The Asset tag operates when in the 307 KHz field. When a tag enters the field it is prompted to power up by the wake up word that is transmitted by the controller (over 307 KHz field). Once powered up the tag will respond to the next wake up word with a 350µs pulse. This pulse prompts the controller to issue the serial number interrogation protocol command (bit by bit) and the serial number is extracted from the tag by the controller. Figure 1and Figure 2 illustrate this communication. The top traces show the output from the tag (433.92 MHz) and the bottom traces show the transmissions from the controller (307 KHz). The entire communication takes approximately 120ms (this time varies slightly from tag to tag based on the serial number). Figure 2 illustrates that the tag transmitter is working for approximately 80 ms of these 120 ms. For more information on the bit by bit protocol please refer to document "Bit-by-Bit Interrogation: Protocol Description" document number 970-000001-000.

Now that the tag in the field is identified, the controller must periodically check to see if the tag is still in the field. Approximately every 12 sec. the tag will wake up and respond with a 350µs pulse when it sees the controller transmit a respond command. This communication is shown in Figure 3 and Figure 4. Figure 3 shows a bit by bit communication followed by a respond 11.47 seconds later and Figure 4 illustrates in detail the respond communication pulse. The respond communication will continue until the controller issues a reset command and re-interrogates all the tags in the field. The reset and re-interrogation occurs once per minute. Once again this behavior is detailed in the document "Halo communication Protocol" document number 970-000002-000.

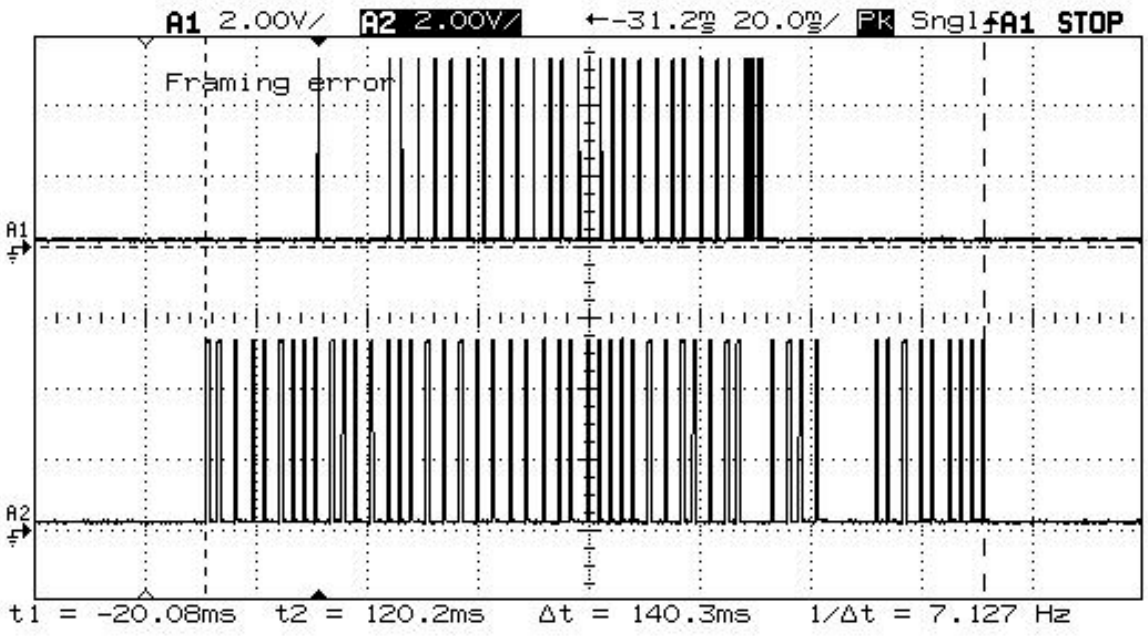

Figure 1: Bit by Bit communication example 1

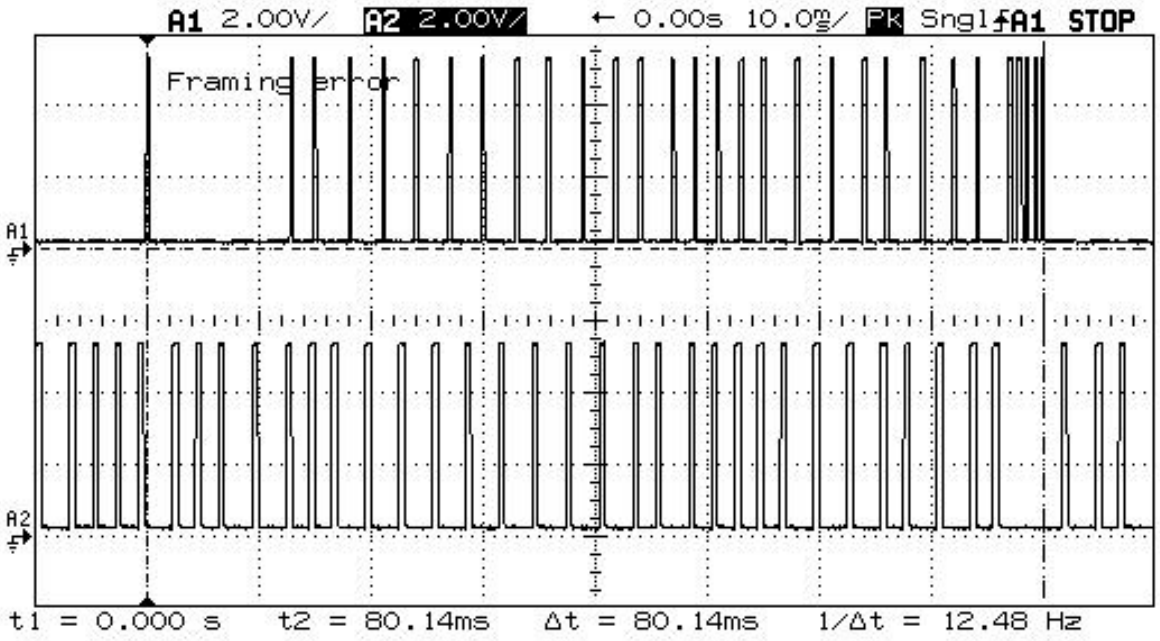

Figure 2: Bit by Bit communication example 2

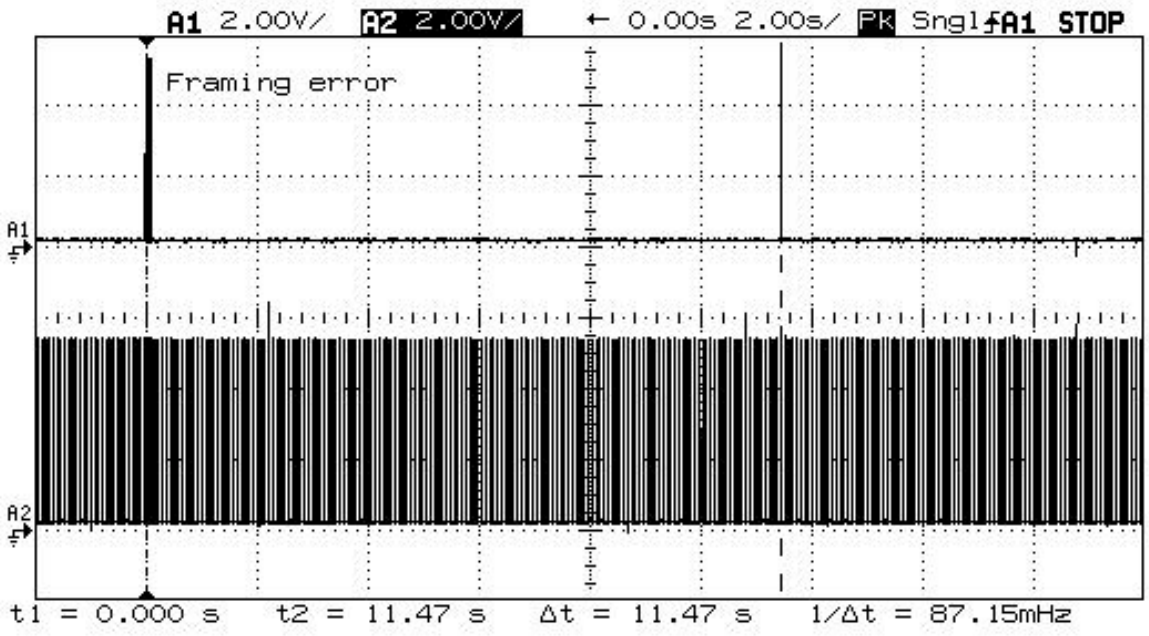

Figure 3: Bit By Bit communication followed by first respond

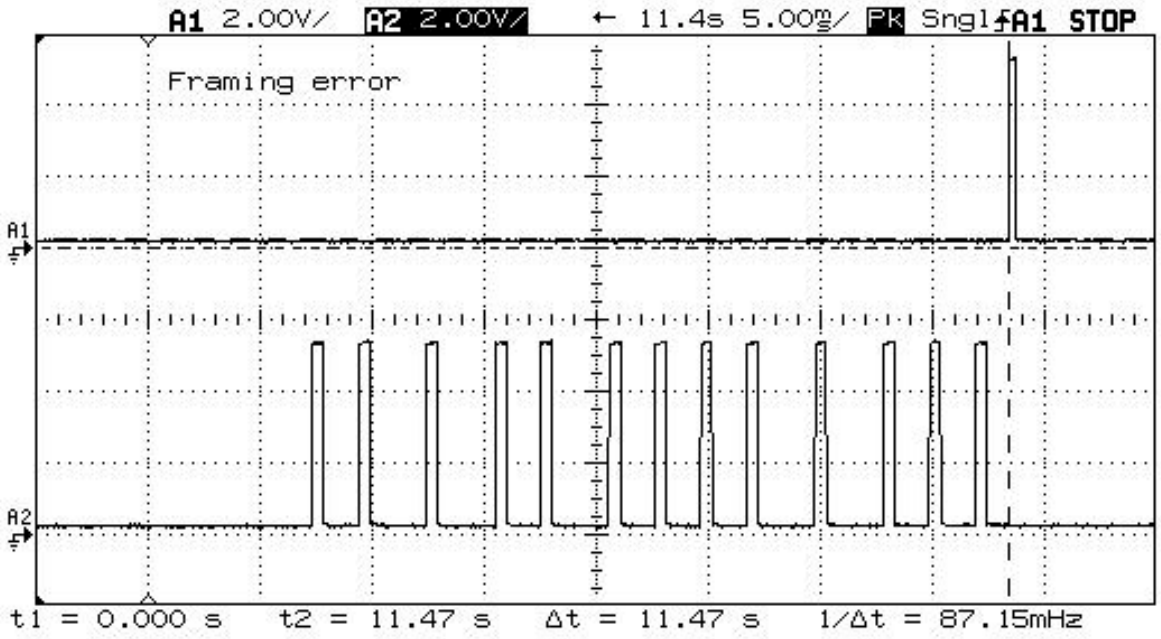

Figure 4: Respond Communication Example

2.2 TIC performance

A TIC alarm is transmitted any time the tamper switch is closed. The switch protrudes from the bottom of the case and is intended to close when the tag is removed form the device it is protecting. Typically the tag will be adhered to a device and if the tag is tamper with or removed the switch will close. This switch closure powers up the tag and causes it to transmit its serial number to any/all controllers or receivers that are in range. The nature of the transmission is

shown in Figure 5. This waveform shows that the transmitter is in use for approximately 48 ms (this varies slightly with serial number). The transmitter will then turn off for approximately 12 seconds and then, assuming the tamper switch is still closed, will transmit the signal shown in Figure 5 again. This sequence will continue with the time between TICs doubling each time as long as the tamper switch remains closed. Figure 6 and Figure 7 show three consecutive TIC transmissions and show the time between TICs 1 and two (13.59 sec.) and TICs 2and 3 (26.53 sec.) respectively.

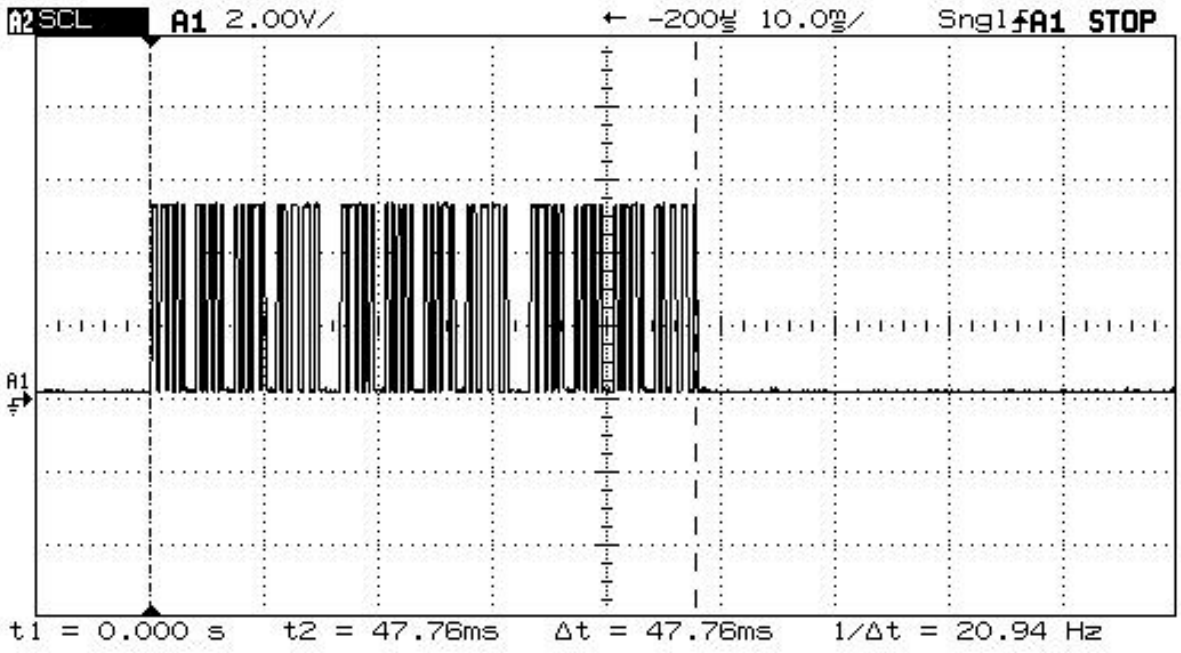

Figure 5: Waveform for single TIC Transmission

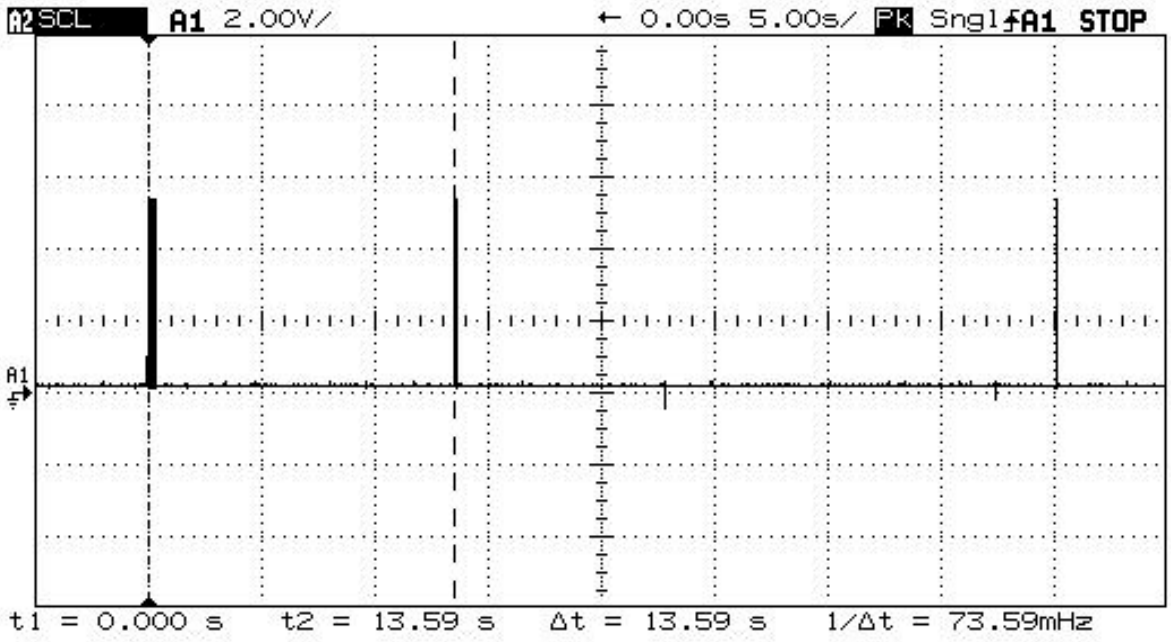

Figure 6: TIC example - Time Between First and Second TIC Transmission

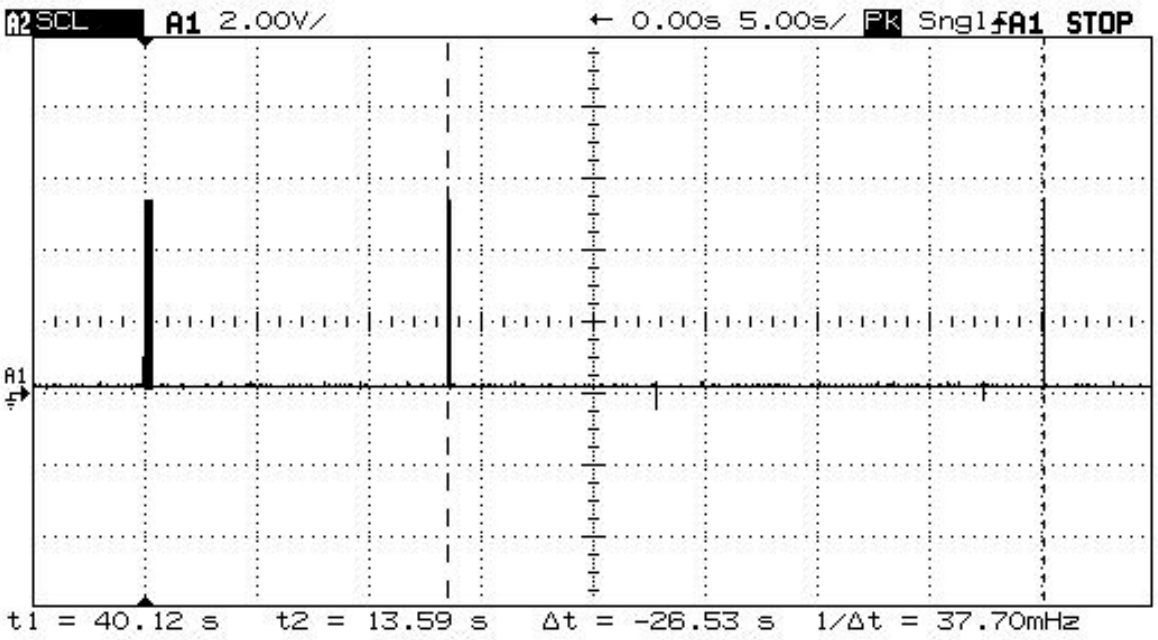

Figure 7: TIC example - Time Between Second and Third TIC Transmission

3 Cases and markings

Figure 8 illustrates the case design that will be used for the Asset tag. The diagram shows where the FCC identification will appear.

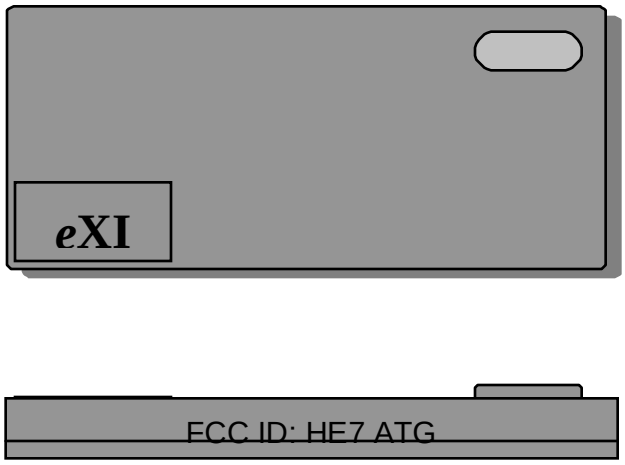

Figure 8: Case and Markings for the Asset tag