Validating Controlled Impedance Differential PCB Lines on Gennum 1450C package Using "Comparative Analysis" FA Method

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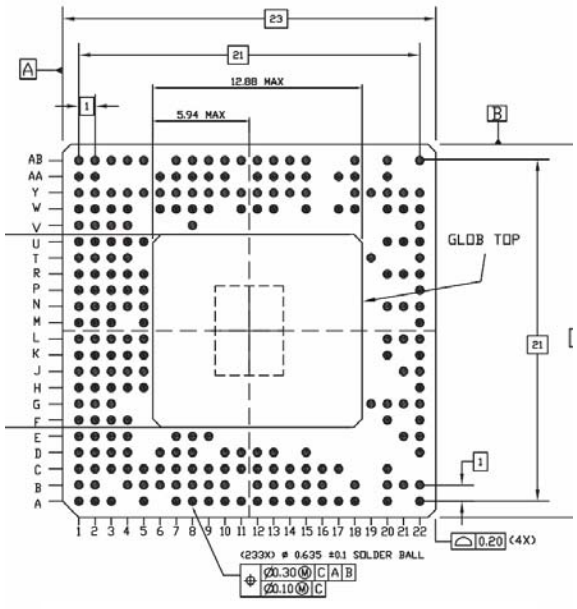
TDR Failure Analysis Testing Objective

Gennum sent two GN1405 device packages to DVT Solutions, LLC to measure 6 differential lines on each package (table 1) and each package was labeled "good" and "reject". The purpose for the measurements is to provide a comparative impedance analysis of each package's respective differential impedances to reveal a potential Failure mode with one or more of the differential pairs. Each package had the die attached so the end of the transmission line cannot be defined. To TDR into the attached die will have an unpredictable result as you may bias a component or circuitry on the die loosing the interconnect detail. Each of the 6 differential sets were acquired and converted to an Impedance plot (Z-line) using the Tektronix IConnect® software to increase the accuracy of the TDR measurement by eliminating the multi path reflection errors. Each differential sets from Table 1 were measured from the "good " and "reject" package and plotted together on separate graphs for this Failure Analysis report.

(Table 1) Differential I/O pins requiring TDR Analysis

PAIR NAME	PIN NAME	PIN #
HR3 pair	HR3+	U22
	HR3-	U21
R2_1 pair	R2_1+	AB7
	R2_1-	AA7
R2_2 pair	R2_2+	Y8
	R2_2-	W8
R2_3 pair	R2_3+	AB9
	R2_3-	AA9
R2_4 pair	R2_4+	AB10
	R2_4-	AA10
R2_CLK pair	R2_CLK+	Y6
	R2_CLK-	W6

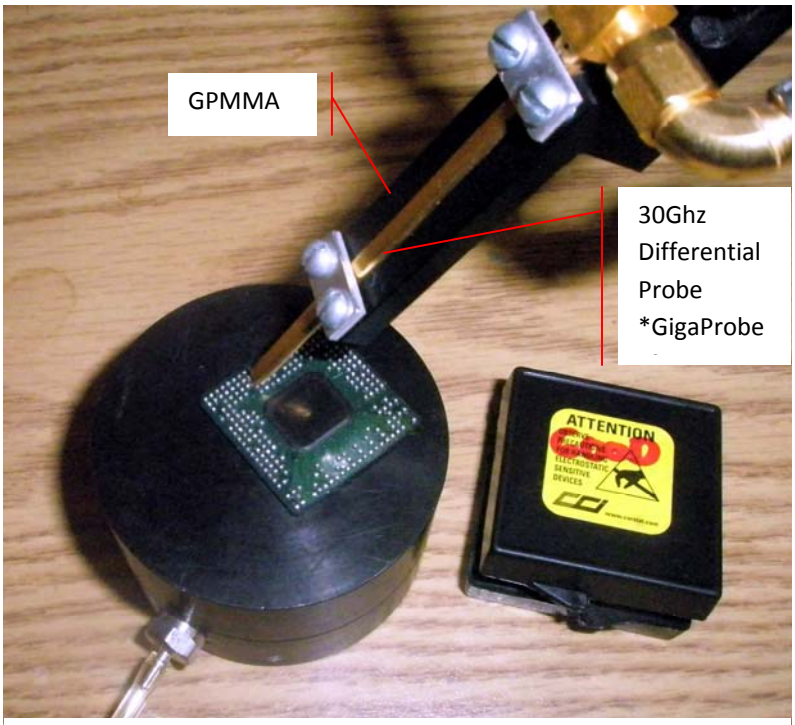


Gennum GN1405 device package bottom side layout

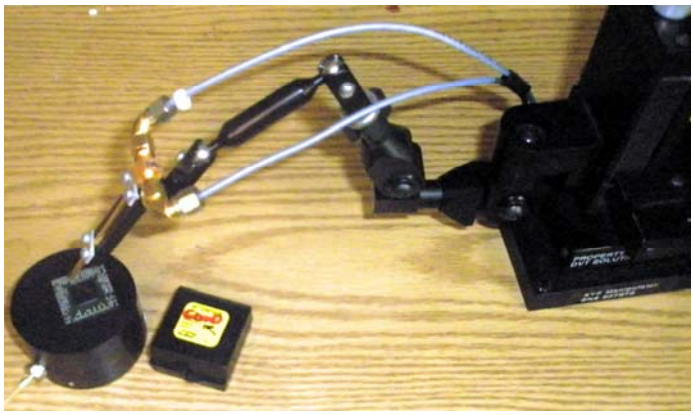
Test Equipment Configuration and Measurement Methodology

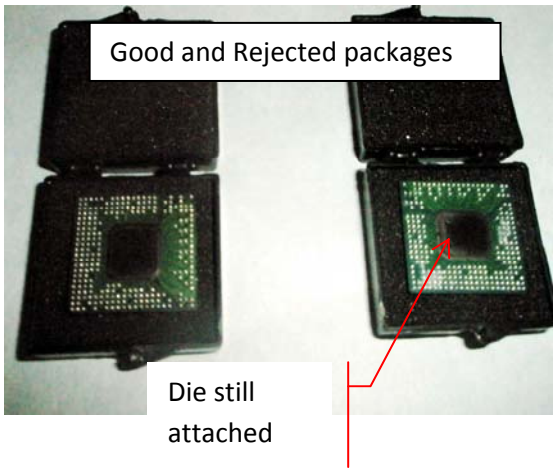
The 30 GHz Differential TDR Probes (GigaProbes®) were installed in probe holder manipulator using the GigaProbeMicroManipulator (GPMMA) accessory for hand free probing of the package pads. A sampling head extender cable connected the SD26 20GHz TDR sampling head to the Tektronix 11801C mainframe. The cable moved the TDR Sampling Module closer to the PCB so we could use two 12" 25 GHz ultra-flex cables to connect the GigaProbes® to the TDR sampling head. The TDR system provided and odd mode differential 35ps pulse at the output of the differential TDR probe tips. Once the measurements were acquired for each package pin sets, the waveforms were transferred to the Tektronix IConnect® software and converted into impedance waveforms for accurate impedance vs. time graphs.

The waveform table to the right of each graph shows the waveforms that were acquired to make the measurements. The Z-Line waveforms are the results of converting the voltage waveform into a (ZLine) impedance waveform using IConnect for more accurate impedance measurements. To be consistent, the Red waveforms are measured from the "good" package and the Black Waveforms are from the Rejected package.



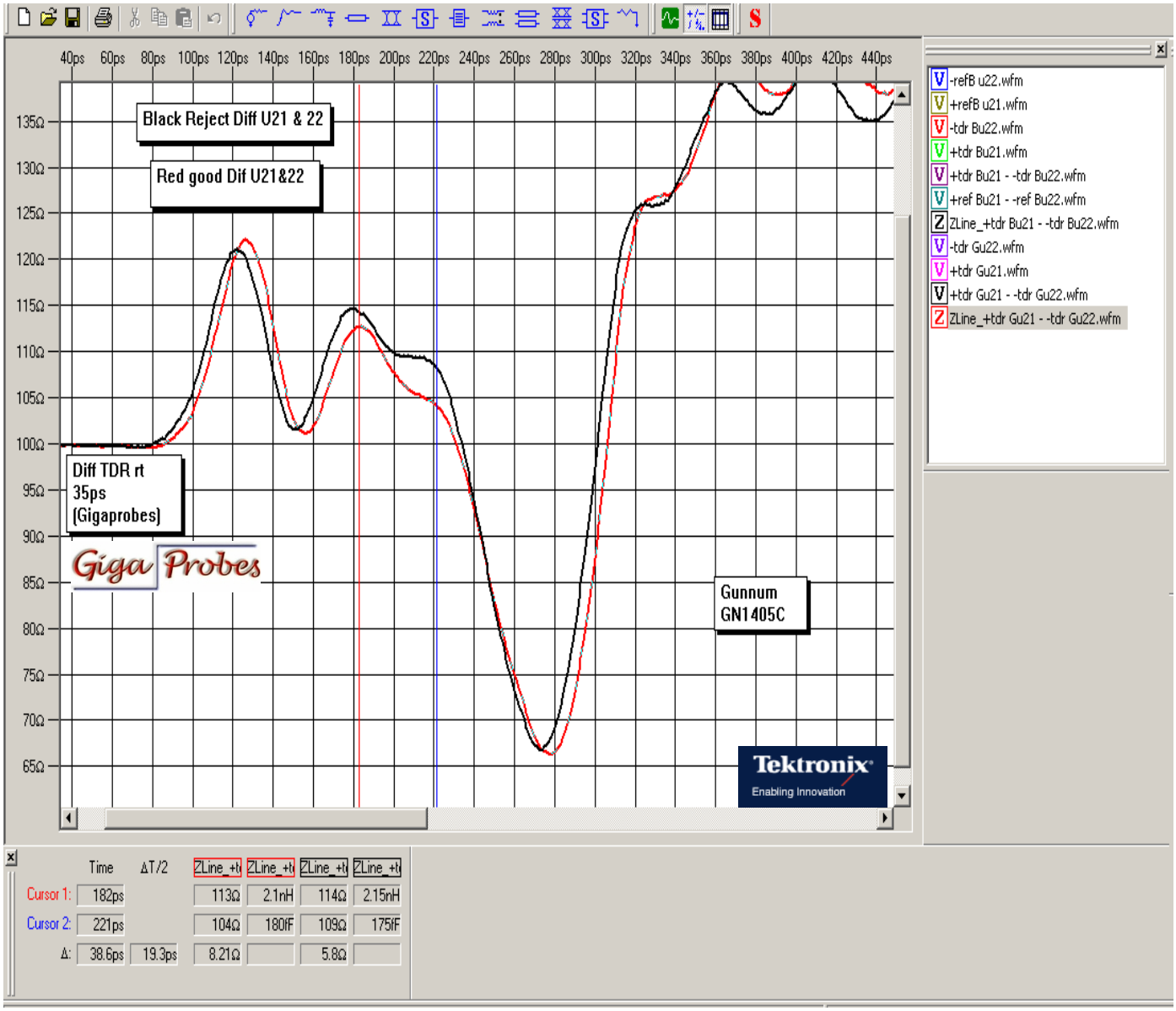
Using Probe Manipulator to hold GigaProbes® for hands free probing of solder balls on package. It also controls the amount of force applied to solder balls so as not to flatten or distort their form. If flatten they may short out adjacent solder balls





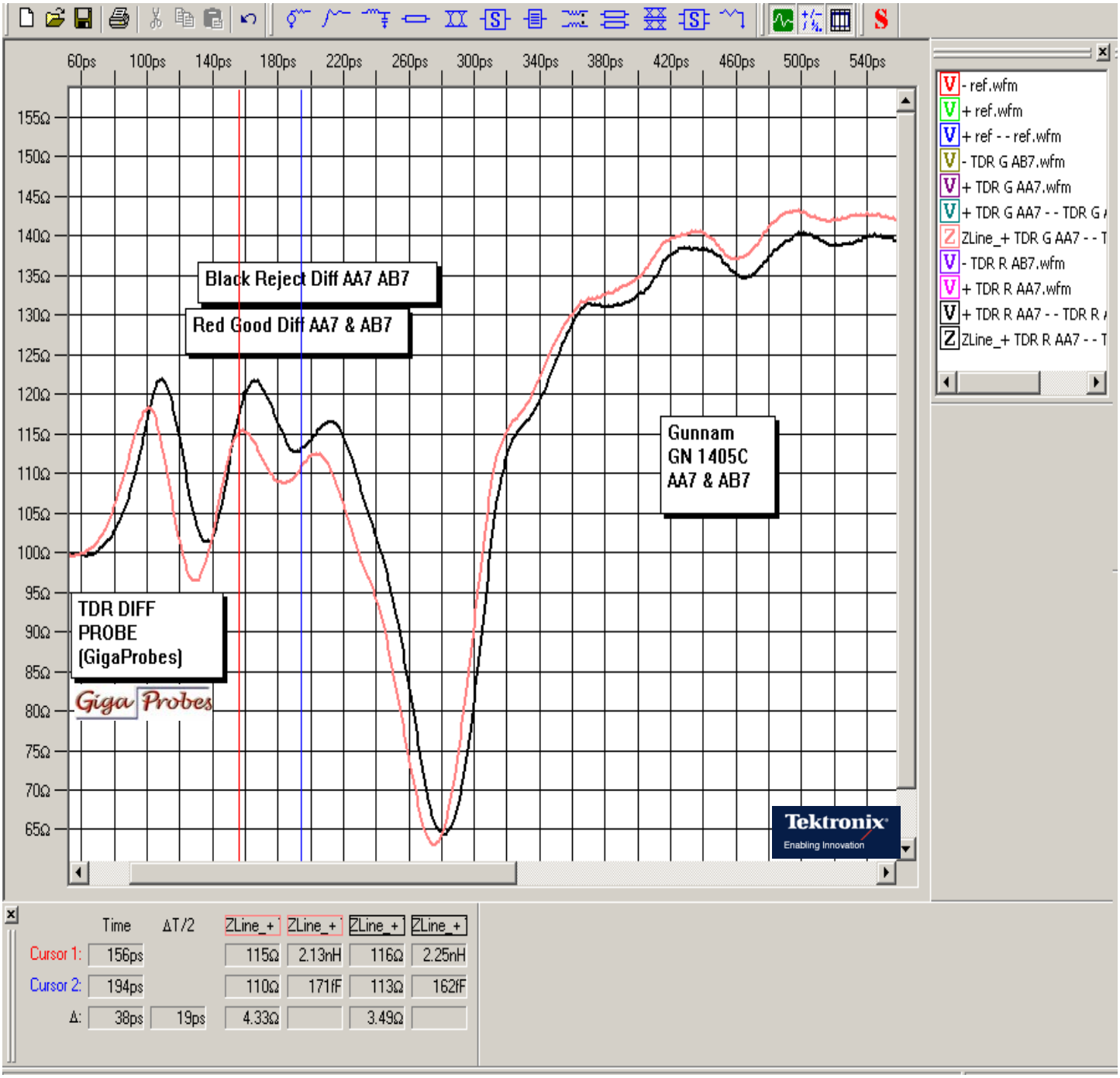
Impedance Waveforms from Part Number GN1405C

The Black (rejected Pkg.) Traces U21/22 vs. Red (Good Pkg.) Trace U21/22



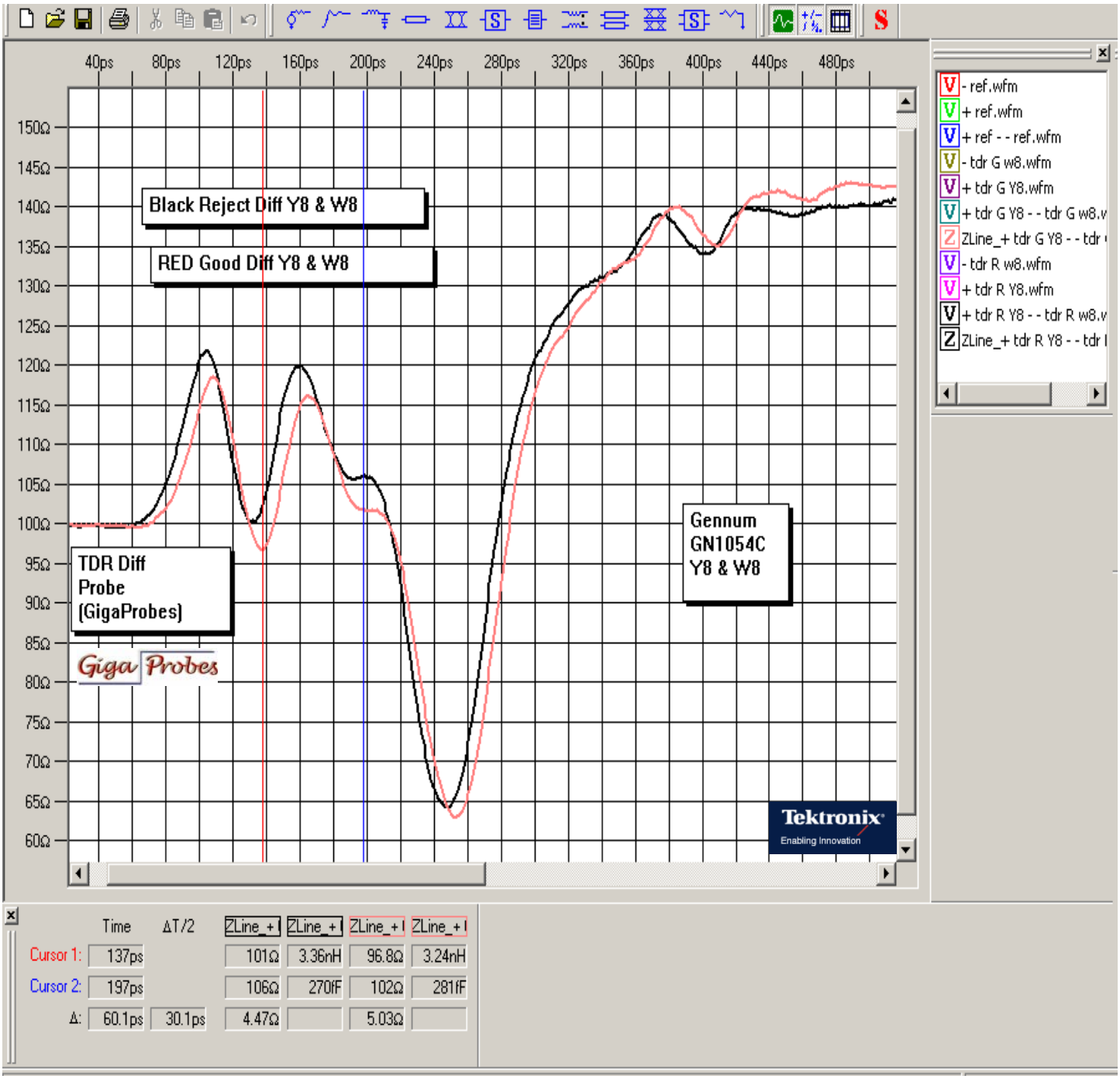
Impedance Waveforms from Part Number GN1405C

The Black (rejected Pkg.) Traces AA7/AB7 vs. Red (Good Pkg.) Traces AA7/AB7



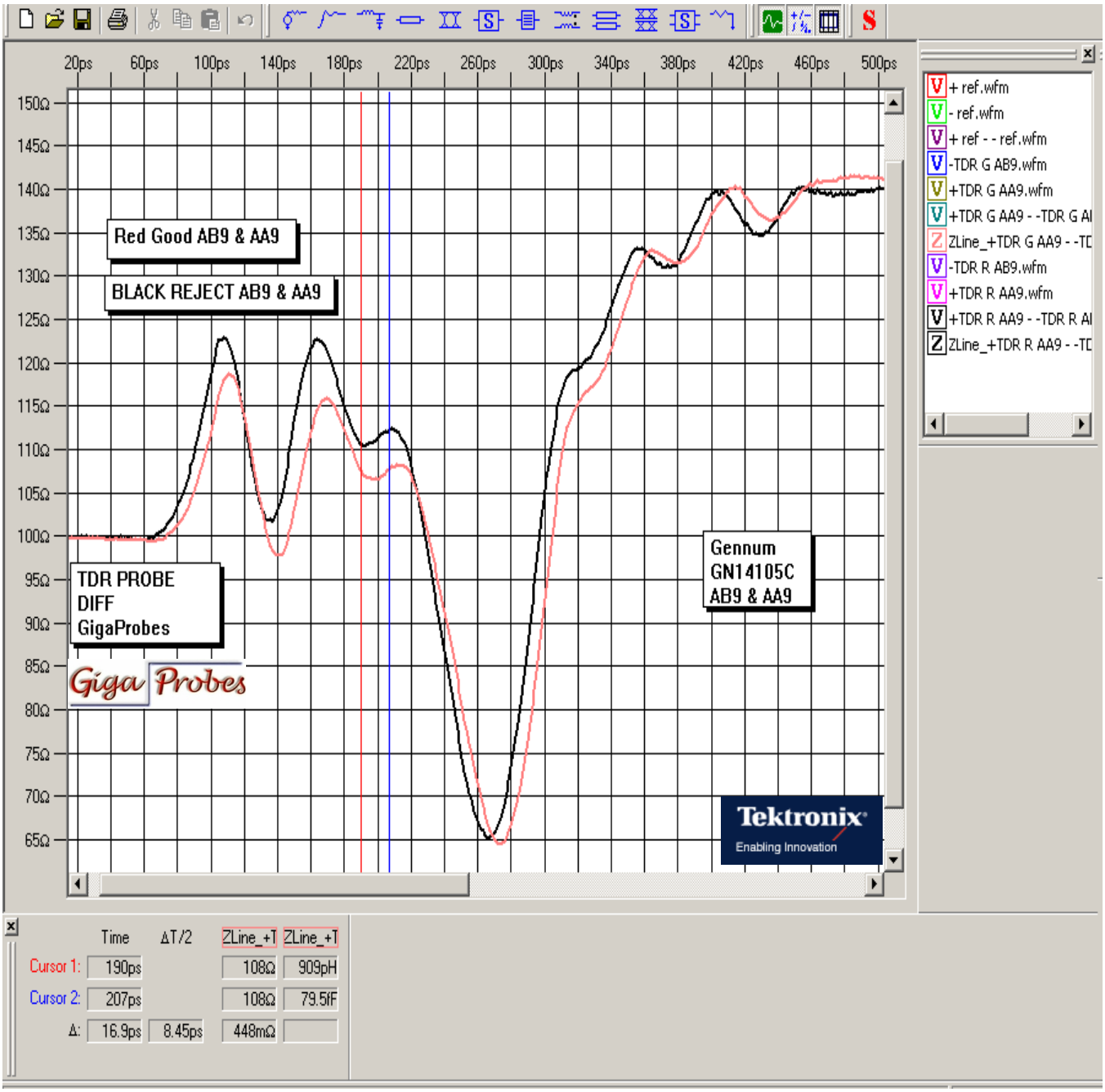
Impedance Waveforms from Part Number GN1405C

The Black (rejected Pkg.) Traces Y8/W8 vs. Red (Good Pkg.) Traces Y8/W8



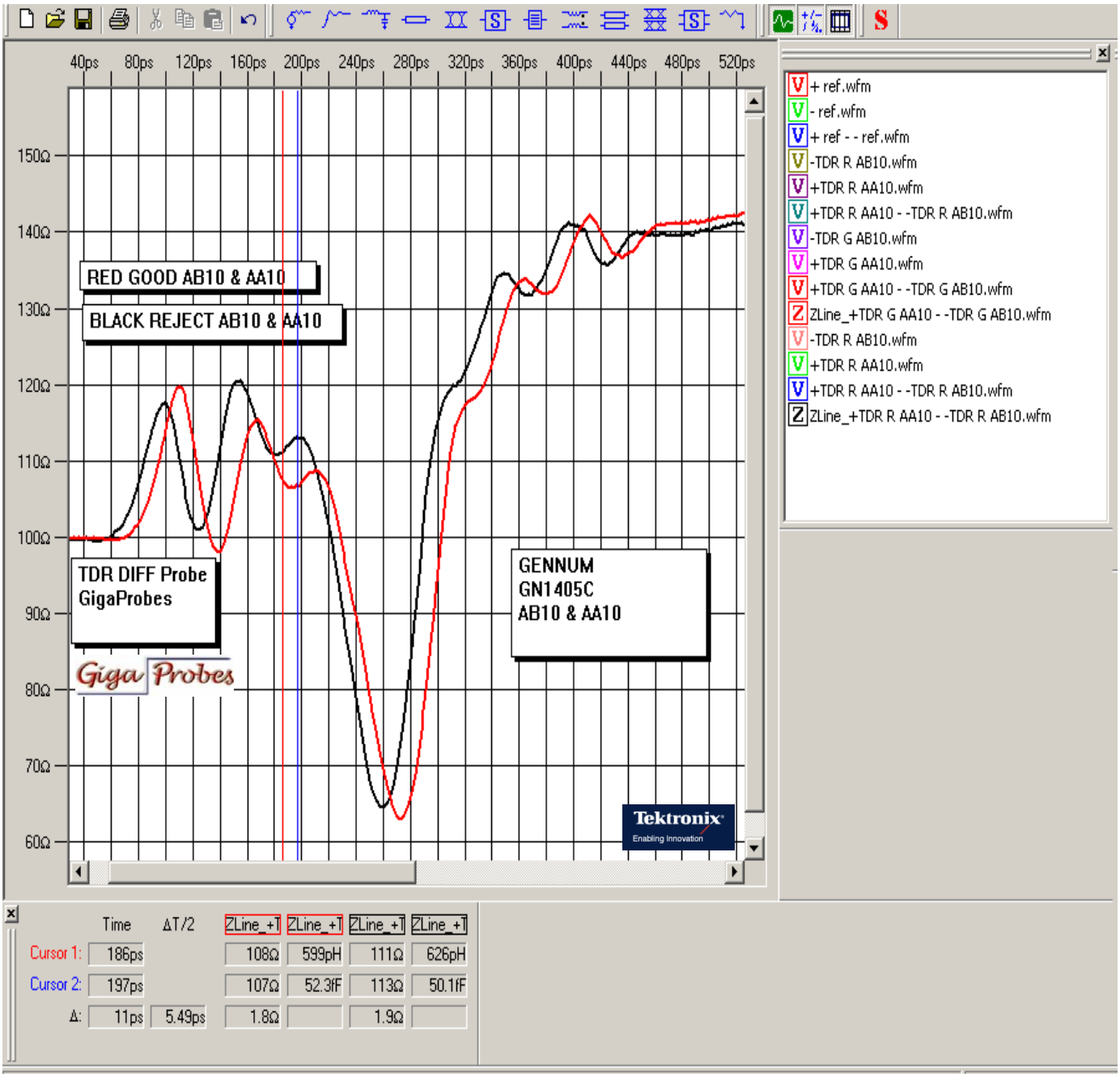
Impedance Waveforms from Part Number GN1405C

The Black (rejected Pkg.) Traces AB9/AA9 vs. Red (Good Pkg.) Traces AB9/AA9



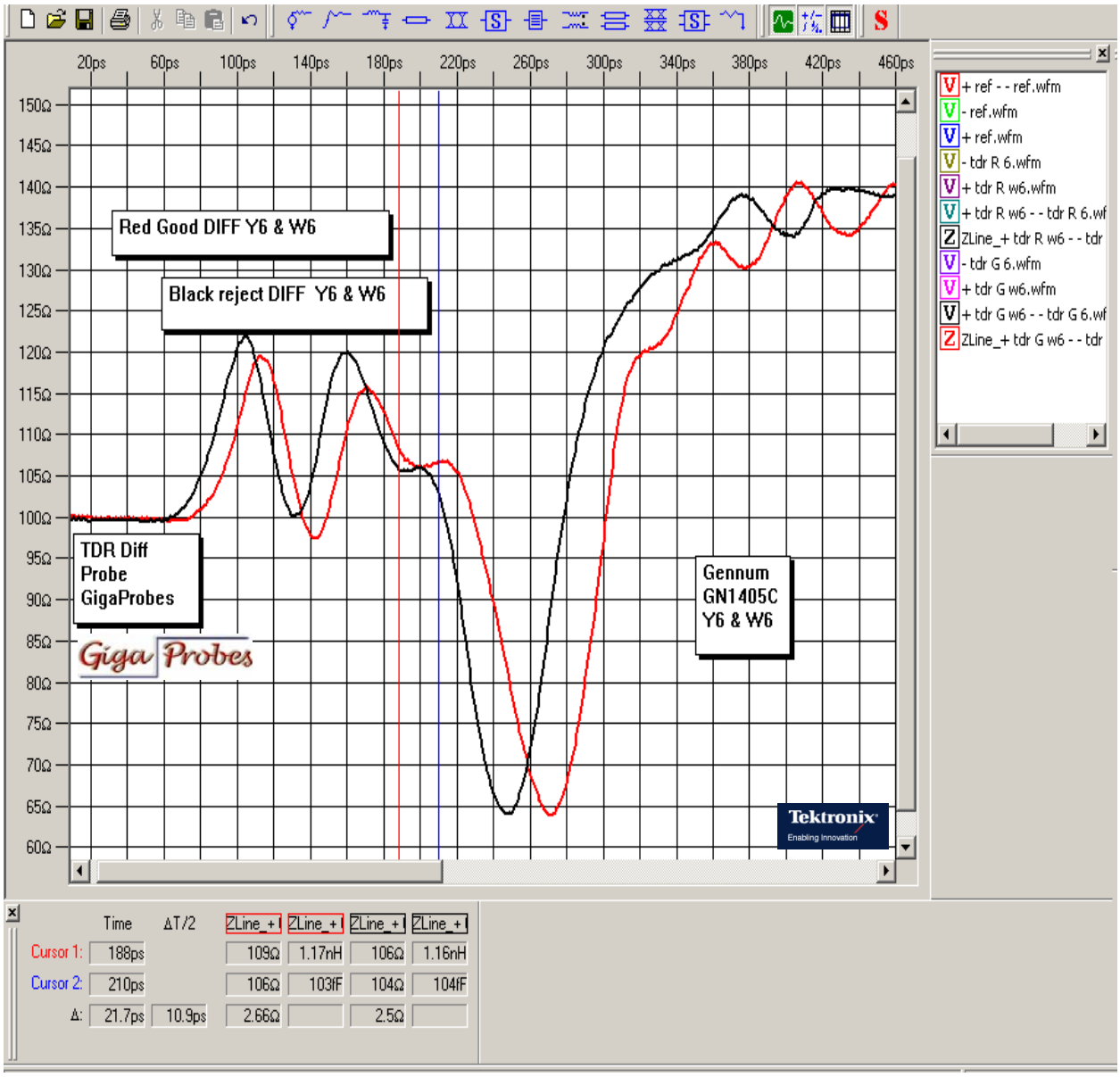
Impedance Waveforms from Part Number GN1405C

The Black (rejected Pkg.) Traces AB10/AA10 vs. Red (Good Pkg.) Traces AB10/AA10



Impedance Waveforms from Part Number GN1405C

The Black (rejected Pkg.) Traces Y6/W6 vs. Red (Good Pkg.) Traces Y6/W6



Test Summary & Observations

1) Each package was not the same length so you see a time Skew in each waveform set. I believe it was mentioned that one package was larger than the other so a time skew would be normal. If these packages were exactly the same then this time skew may cause a timing failure.

2) There seems to be no sorts or opens. I assume that after or before the large capacitive dip trace was connected to the die. No information was provided to make this determination.
3) The package had the die attached so it was not possible to make out the end of the trace that would define the connection to the die.
    - This can be corrected by removing the die and retesting each differential pair.
4) The measurements from the “good” package is defined by the Red trace seems to have an overall lower impedance value, closer to 100 ohms, than the traces that were acquired from the Black or Rejected package. The lower impedance may match the input of the die reducing reflection and jitter.