Tektronix

IPA 510 Interconnect Parameter Analyzer

A fully integrated environment for measuring, modeling, simulating, and verifying high-speed electrical interconnect systems in the time or frequency domain

- Enhanced accuracy TDR impedance measurements for results to within 1.5%
- Enhanced accuracy measurements provide time- and frequency-domain display capability
- Z-Profile™ algorithm reduces effects of multiple reflections and improves resolution
- Direct readout of inductance, capacitance, and impedance vs. time
- SPICE compatible LC circuits, piece-wise linear sources, and composite files with no direct netlist editing required
- Direct graphical comparison of simulated and measured time-domain waveforms
- Supports extraction of lumped, distributed, mixed, coupled, and lossy-line models
- Powerful waveform math and signal processing capabilities
- Base instrument performance (11801B): 35 ps risetime, fully-differential, multi-channel TDR
- Fixturing support for many popular IC packaging styles
- Compatible with a large variety of fixturing and probing stations
- Microsoft Windows® environment

Faster clock speeds, denser packaging, more complex systems, faster time-to-market, increased price competition… these are but a few of the parameters driving the demand for easier, faster, and more accurate electrical interconnect characterization and modeling.

By integrating the measurement, model extraction, simulation, and verification domains into a single system, the Tektronix IPA 510 Interconnect Parameter Analyzer system allows interconnect design and modeling in just minutes rather than days. With the IPA 510, you can easily optimize your design and simulate the results early in the design process – before building costly prototypes. It provides the ideal "what if…" platform to allow you to actually observe the results of various design choices with minimal time and expense.

When your design is optimized and you're ready to build a physical prototype to test real-life results, the IPA 510 is again the best tool to get the answers you need to "fine-tune" your design and get it ready for production. With a full complement of available fixturing options – from the IPA Nexus PGA-package test fixture to the PPMS-100 probe station – you can measure the actual performance of your prototype and compare it to the simulated response. Using the resultant measured parameters, you can optimize your model to produce the desired results as you commit your design to production.

As you build confidence in the IPA 510 simulation, modeling, and measurement capabilities, you can go from idea to reality with fewer design "turns", improved

accuracy, and optimum quality. The result is reduced time-to-market, reduced expense, and an improved competitive position.

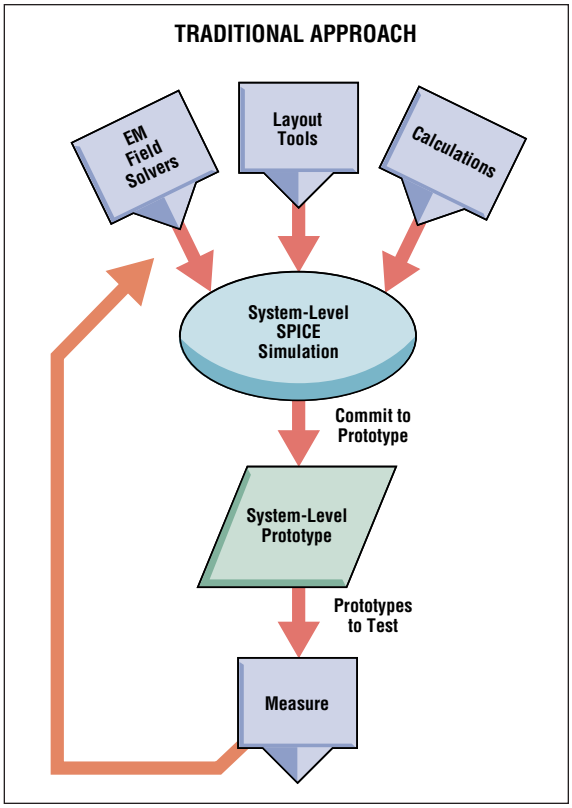


Figure 1. Traditional theoretical approach to interconnect modeling.

The traditional approach – Time consuming and costly

The traditional approach to interconnect design is shown is Figure 1. A variety of generally available layout tools, hand calculations, component-vendor-supplied models, and field-solver programs are used to develop approximate models for simulation. A system-level SPICE simulation is performed and the first system-level prototype is built. The prototypes are then evaluated and the system is redesigned based on system-level measurements. In many cases, these simple models are not adequate for digital systems with clock speeds exceeding 100 MHz and transition times less than 2 ns, or when interconnect densities are high. As a result, considerable redesign is often required – a process that can add weeks, if not months, to your schedule

Expanded role for the IPA 510

By linking an optional field solver, an optional SPICE simulator, a graphical verification environment, and instrument calibration/control into one integrated system, a new level of productivity is achieved in the generation of accurate, verified SPICE models for all kinds of high-speed electrical interconnects.

With a fully configured IPA 510 system, model generation can be started from field-solved solutions with Contec RLGC, simulated on Contec SPICE, and verified through measurement of early prototypes (see Figure 2). With off-the-shelf vendor-supplied interconnect components such as IC packages, MCMs, connectors, and cables, models can be extracted from time-domain measurements (see Figure 3).

By measuring and extracting verified models of interconnect components and validating field-solved models for board-level interconnects before the first system-level prototype is built, considerable time and money can be saved by reducing system-level prototype turns.

The IPA 510 – Enhancements built on the IPA 310A methodology

With the IPA 510, you perform all steps for the development and verification of interconnect models in the familiar

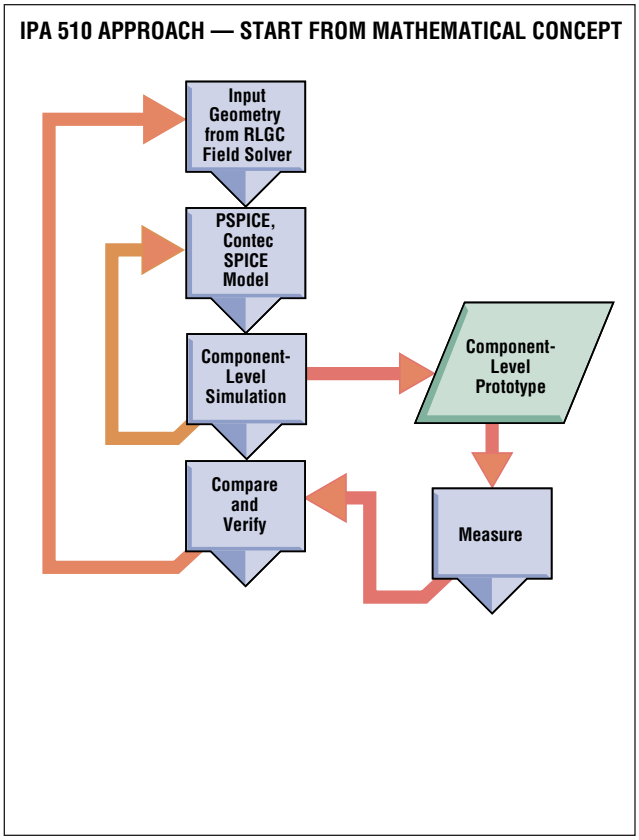


Figure 2. Using EM Field Solvers for interconnect modeling with the IPA 510.

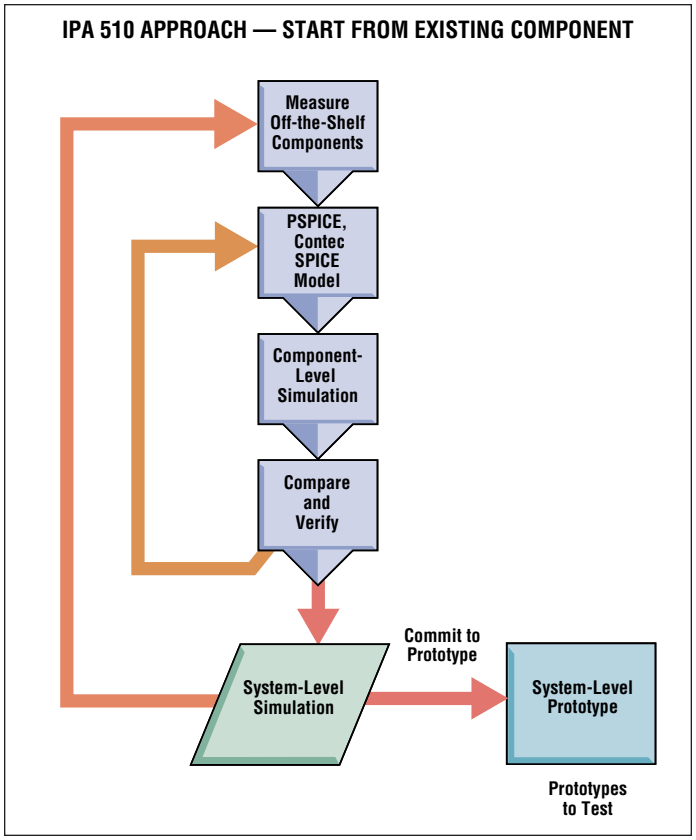


Figure 3. The interactive approach to interconnect modeling with the IPA 510.

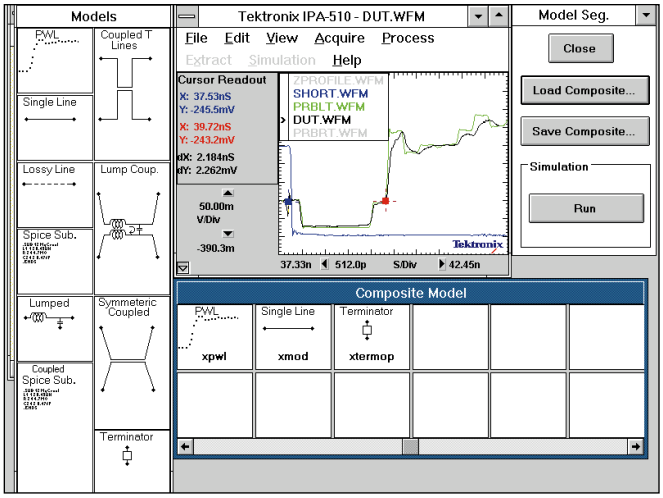


Figure 4. Composite model window.

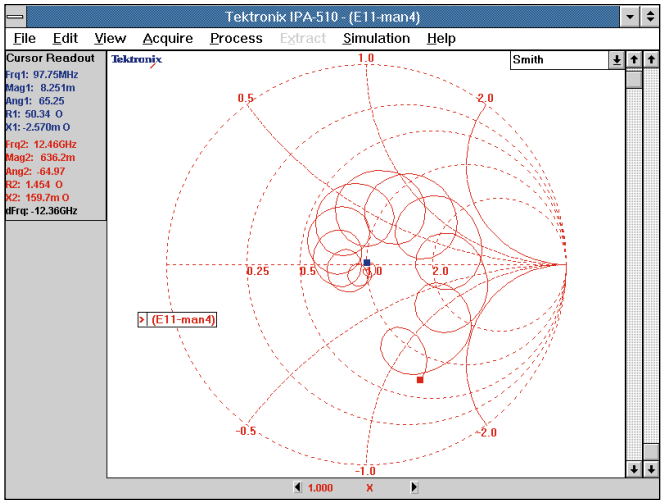


Figure 5. Input impedance vs. frequency for circuit-board interconnect.

time domain – using just one system and outputting Berkeley SPICE compatible models.

As an example (see Typical Interconnect Modeling Session on next page) the IPA 510 measures the actual response of the interconnect via standard Time-Domain Reflectometry and Transmission (TDR/TDT). Using a unique Z-Profile algorithm to enhance its TDR capabilities, the IPA 510 translates the response into a true impedance profile expressed in ohms.

Then, the IPA 510 automatically creates a lumped, distributed, or mixed SPICE model from the displayed Z-Profile waveform. If you want to do it manually, you can use the LCZ cursor to obtain a direct readout of the waveform's inductance, capacitance, impedance, and delay over any section of the impedance profile. In a similar manner, the IPA 510 supports Z-Profile for symmetric coupled lines enabling the accurate simulation of coupling effects.

Also, in a process similar to the above, unique Tektronix methods for extracting single-lumped, lumped coupled, asymmetric-coupled lines, and lossy transmission line models can be used and verified at the risetime of the particular logic family.

All methods use graphical dialog boxes to guide the user through the extraction processes. The SPICE netlist of these individual models and the composite model (see Figure 4) can be edited through these graphical interfaces and launched for successive simulations, enabling the immediate and direct comparison of simulated and measured results.

Extended acquisition capabilities

The IPA 510 supports several means of TDR/TDT signal acquisition in order to meet a broad range of customer needs:

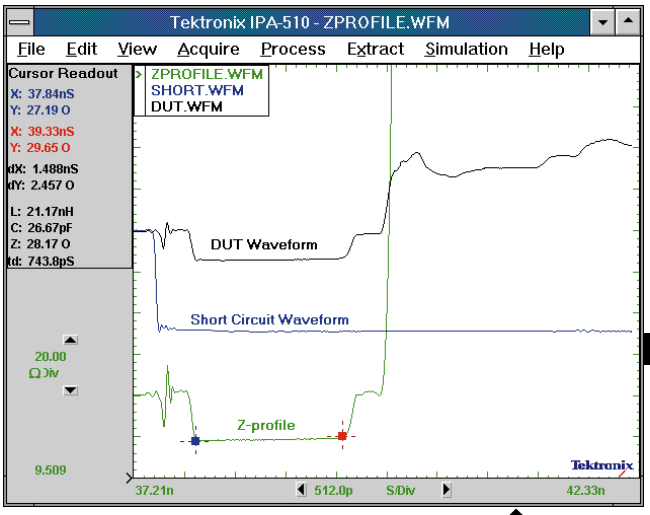
- **Tektronix 11801B Mainframe with SD24 Dual TDR/Sampling Head.** Provides both single-ended and true differential TDR/TDT capability covering the widest range of time-domain applications.
- **Tektronix 11801B Mainframe with SD24 Dual TDR/Sampling Head plus the IPA 510 EA-TDR/TDT (Options 2S, 1U, 2U).** Provides increased accuracy time-domain measurements after a simple vector-network-analyzer-like calibration for one- and two-port measurements. Time-domain measurements made in this mode can be displayed in volts vs. time, and in a number of amplitude/phase vs. frequency formats – DC to 12.5 GHz (see Figure 5). S-parameter data can be exported in Touchstone format for use with linear frequency-domain simulators. Swept-frequency displays can be saved to a file in CSV format for use with standard spreadsheets. This IPA 510 option requires a precision 3.5 mm calibration kit (optional), or any other OSL style calibration kit used for vector network analyzer calibration.
- **Hewlett Packard HP8510 Series Option 010.** Provides time-domain waveform transfer from HP8510 Option 010 network analyzers.

  NOTE: The standard IPA 510 with Option 2S, 1U, or 2U provides improved time-domain acquisition capability over the HP8510 Option 010 at a lower cost. HP8510 time-domain data import capability is provided for those users who have already made the significant capital investment in the HP8510.

Beyond traditional TDR

Traditional TDR is effective in measuring single discontinuities; making measurements via a voltage reflection waveform is usually adequate. However, most TDR measurements of interconnects with multiple discontinuities render these traditional methods ineffective. Multiple small discontinuities which are not observable on traditional TDR can be made easily observable with Z-Profile processing. The IPA 510 Z-Profile algorithm minimizes the effects of multiple reflections and produces an output scaled in ohms. The output of the Z-Profile algorithm can be used to automatically extract lumped inductance and capacitance values for a SPICE model. To streamline manual adjustment of model values, the IPA 510 also provides cursors with direct readout of inductance, capacitance, and impedance. The

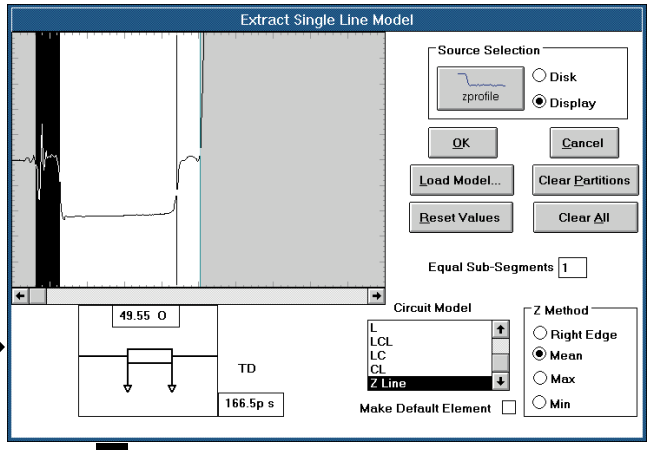
A Typical Interconnect Modeling Session with the IPA 510 and SPICE



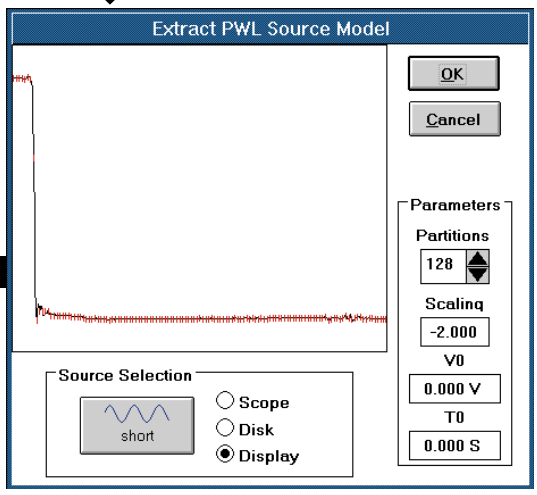
Measure and Process Waveform.
Acquire DUT and Reference-Short waveform using:

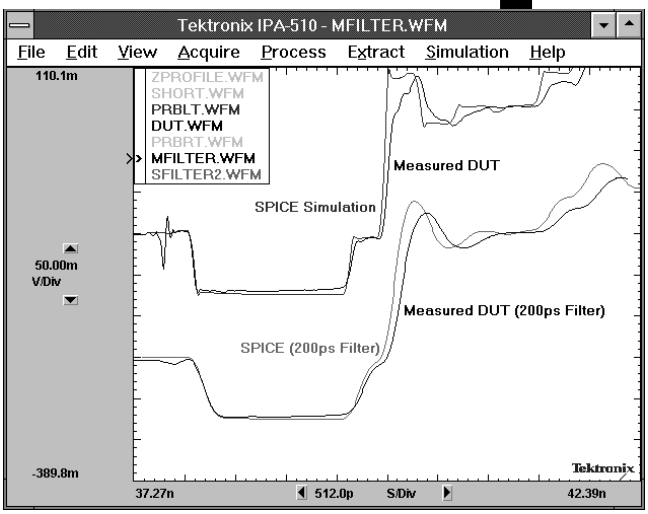
- Standard 11801B TDR/TDT
- IPA 510 EA-TDR/TDT (Options 2S, 1U, 2U)

Use Reference-Short and DUT waveform to calculate Z-Profile (impedance vs. time curve). Place double cursors to measure L, C, Z_0, or ΔT per section of profile.

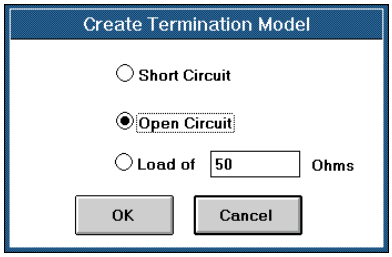


Extract Single-Line SPICE Model. Load Z-Profile and partition it using the mouse to select a circuit model for each segment and Z-method. Click OK to save SPICE model and waveform partitions.

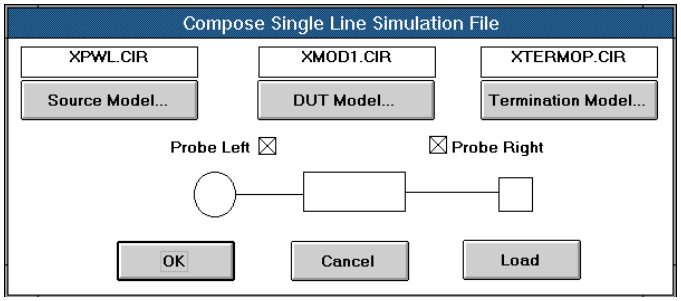




Compare Measured and Simulated Results. Waveforms can be scaled and moved for overlay comparison in the waveform workspace. Filter the simulated and measured waveforms to desired application speed and compare the results.



Compose Composite SPICE Models. Create source and termination models; link with DUT model to create composite simulation file. Top: Piece-wise linear model generation; Center: Termination model generation; Bottom: Composing composite simulation file from PWL, DUT, and Terminator models.
Run the SPICE Simulation.



It's That Easy! – Now you have a design that you can commit to production with confidence and assurance that even your first prototypes will achieve your desired performance goals.

end result is faster model development and more accurate models, verified with actual measurements.

Device-Under-Test Interfaces

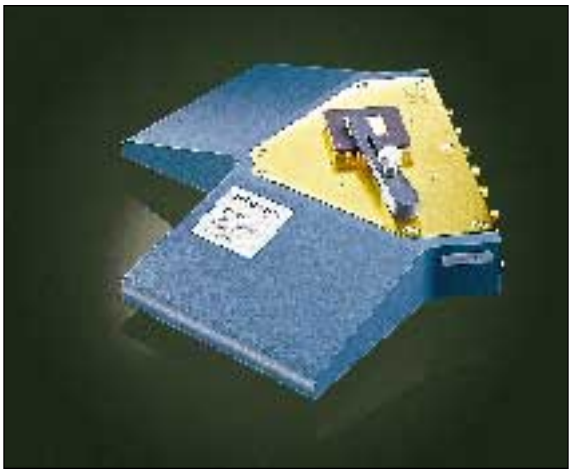
One of the most challenging aspects of measuring high-speed digital interconnects is obtaining a reliable and high-fidelity connection to the Device-Under-Test (DUT). Measurement accuracy and repeatability depend on the clean transmission of sub-nanosecond voltage steps to and from the DUT. The IPA 510 provides a number of DUT interface options depending on the particular size and geometry of your interconnect:

- **IPA Nexus with QFP Adapter.** A precision multiline interface to larger PGA and QFP packages.
- **Coaxial Positioning System (CPS).** This system provides excellent support for true differential measurement and extraction of small and large IC package parameters with minimum package preparation.
- **PPMS-100 Probing Station.** A highly flexible optional accessory that can be configured to meet specific needs. The PPMS-100 provides precision 50-ohm capability when used with industry-standard microwave probes. The PPMS-100 is used when component geometries are very small and the highest performance measurements need to be made.
- **Simple Coax Probe Kit.** Provides a starter kit of 12 semi-rigid, 50-ohm coax probes with the following number/inch diameter (4/0.047, 4/0.085, 4/0.141) for general use in probing ECBs and ECB-mounted connectors. These probes can easily be modified and soldered directly into circuits to meet your specific measurement requirements.
- **SMA Adapter Kit.** Provides high-performance cabling (2), simple coax probes, differential calibration tee, male/female terminations, male/female shorts, and wrenches. This kit enables standard SMA connection to DUT fixturing or probes.

Table I — Available DUT Test Fixtures for the IPA 510

DUT Test Fixture	IC Packages	MCMs	ECBs	Connectors	Cables
Nexus + QFP	●				
Simple Coax Probe Kit	●	●	●	●	
Coax Positioning System	●	●			
PPMS-100 Probe Station	●	●	●		
SMA Adapter Kit	●	●	●	●	●

An Overview of Available IPA 510 Fixturing



IPA Nexus PGA Fixture

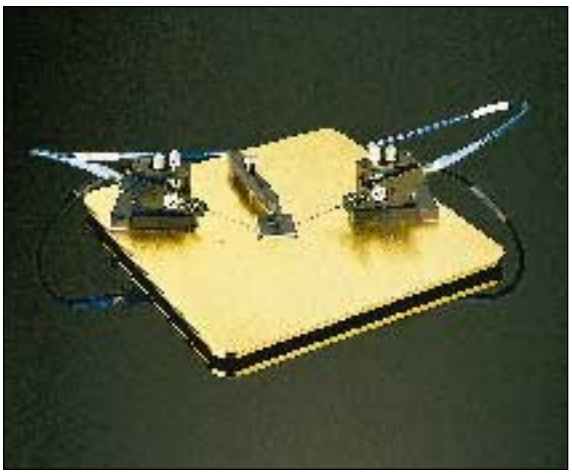
Supports up to 12 signal lines for 100 mil pitch PGA-IC packages.

QFP2/4 Adapter for IPA Nexus

QFP IC package making contact to coplanar test lines. Two- and four-contact adapters for measuring larger fine pitch QFP-IC packages with lead spacing ranging from 100 to 15 mils.

Coax Positioning System

Provides very flexible probing of smaller as well as larger IC packages such as QFPs, LCCs, SOICs, and SOTs. 0ne to four 0.047 mil diameter, 50-ohm probes can be manually positioned at one time with lead spacing down to 15-mil pitch.



PPMS-100 High-Resolution Probing System

Provides hands-free access to MCMs, hybrids, interconnects, SMT packages, and ICs. When coupled with industry standard coaxial microwave probes and calibration substrates from GGB Industries, an ideal environment for measuring MCMs and other miniature interconnects is established.

IPA 510 System Overview

Instrument Interface Types

- ❒ 11801A/B or CSA 803/A Digital Sampling Oscilloscope with SD-24 Dual-Channel TDR Sampling Head
- ❒ HP8510 Option 010 Network Analyzer with time-domain option (recommended only for existing HP8510 installations)

Enhanced Accuracy Time Domain Reflection/Transmission (EA-TDR/TDT)

- ❒ Higher accuracy TDR impedance measurements
- ❒ Highly repeatable user-specified TDR step risetime (30 ps typical at calibration reference plane)
- ❒ Abberations due to source and DUT cable and connector interfaces practically eliminated
- ❒ EA-TDR/TDT data can be displayed in several network analyzer frequency domain formats from DC to 12.5 GHz
- ❒ Optional 3.5 mm calibration kit available

Model Types

- ❒ Models built from either LC and/or transmission line segments
- ❒ Lumped coupled models
- ❒ Lumped coupled LC and coupled transmission line models for simulating crosstalk
- ❒ Lossy transmission line models using standard RLC SPICE components (includes DC, skin loss, and dispersion effects)
- ❒ Automatic piece-wise linear voltage source waveforms
- ❒ Termination model to emulate actual measured response
- ❒ Automatic generation of composite SPICE files for two- and four-port interconnects with terminations
- ❒ Multiple interconnect models can be linked to simulate more complex two- and four-port interconnect networks
- ❒ Berkeley SPICE compatible subcircuits from other field solvers

Processing Capabilities

- ❒ Z-profile for enhanced TDR resolution and true impedance profile vs. time
- ❒ Filtering to view measured and simulated response at user-specified risetime
- ❒ Waveform math includes integration, add, subtract, multiply, and divide on two waveforms
- ❒ Flip waveform for analysis of longer interconnect structures from both ends
- ❒ Calculation of self-inductance, mutual inductance, total capacitance, and mutual capacitance
- ❒ Many additional waveform math functions provided by 11801B Digital Sampling Oscilloscope
- ❒ Powerful 11K Series Measurement System included in 11801B provides statistical database, statistical measurements, mask testing, timing, voltage, and area/energy measurements

High-Speed Interface to Device-Under-Test

- ❒ IPA Nexus for interfacing to larger PGA, QFP, LCC package styles (50, 25, 20, and 15 mil pitches)
- ❒ Coax positioning system for interfacing to smaller SOIC, QFP, LCC, and DIP package styles – supports both single-ended and differential package measurements
- ❒ PPMS-100 High Resolution Probing Station (optional) for convenient positioning of microwave probes on MCMs, hybrids, circuit boards, and ball-grid array adapters
- ❒ Direct connection to SMA interfaces for characterizing connectors and cables
- ❒ Semi-rigid coax probe kit for simple interface to PCBs, connectors, and IC packages

Display Formats

- ❒ Volts vs. time
- ❒ Log Mag vs. frequency
- ❒ Linear Mag vs. time
- ❒ Real part vs. frequency
- ❒ Imaginary part vs. frequency
- ❒ Polar frequency
- ❒ Smith chart
- ❒ Inverted Smith chart

Cursor Capabilities

- ❒ Volts, time, Δ V, Δ t
- ❒ Amplitude (linear, log, mag) vs. frequency, Δ amplitude, Δ frequency
- ❒ Impedance (real, imaginary, R + –jX, G + –jB), Δ impedance, Δ conductance, Δ frequency
- ❒ Single or double cursors
- ❒ Ability to lock cursors to the waveform or float on the display
- ❒ Cursor types include vertical, horizontal, or cross-hair with dot or solid options

Simulator Support

- ❒ Integrated interface for simulator launch and display of output
- ❒ Supports PSPICE and Contec SPICE

User Interface

- ❒ Annotation labels for waveforms and comments
- ❒ Cut and paste waveform display for use in other applications
- ❒ Microsoft Windows environment
- ❒ User-definable waveform color
- ❒ User-selectable graticule options
- ❒ Waveform legend for selecting, viewing, or hiding waveforms
- ❒ Auto-scale, zoom in, zoom out, and lock waveform scaling options
- ❒ Ability to drag and overlay time-domain waveforms for comparing simulated and measured results
- ❒ Frequency-domain data saveable to Touchstone exportable file format
- ❒ Time-domain data saveable to file
- ❒ Complete SPICE netlists generated from high-level graphical dialogue interfaces – no direct netlist editing required

File Formats

- ❒ Waveform formats: Tektronix 11K, time-voltage, amplitude-phase-frequency
- ❒ Scope settings saved to disk in Tektronix 11K format
- ❒ PSPICE ".out" and Contec SPICE ".raw" automatically converted to IPA ".wfm" and plotted
- ❒ Berkeley SPICE compatible netlists

Storage Capabilities

- ❒ Save and load standard and enhanced-accuracy waveforms to disk
- ❒ Save and load 11801B scope settings to disk
- ❒ Save and load IPA software setups to disk

Printer Support

- ❒ Support for Tektronix Phaser 200e Color Printer
- ❒ Support for any graphics printer capable of bitmap printing with Windows print driver installed (no support for pen plotters)

Documentation Support

- ❒ Tutorials with examples on disk
- ❒ IPA 510 User Manual
- ❒ 11801B Manuals
- ❒ PSPICE Manuals
- ❒ Complete printer documentation
- ❒ Reference book "High Speed Digital System Design – A Handbook of Black Magic"

Individual IPA 510 System Component Characteristics

Enhanced Accuracy Mode (Options 2S, 1U, or 2U)

Reflected Step Response –

Thru Risetime: 30 ps ±1.5 ps.

Reflected Risetime: 30 ps ±1.5 ps.

Aberration Thru:

<±1.0%, 10 ns to 20 ps before step.
<±1.5%, less than 200 ps after step.
<±0.75%, 200 ps to 100 ns after step.
<±0.75% elsewhere.

Reflected Aberrations: Same as Aberration Thru specifications.

Reflected Impedance at Reference Calibration Plane: 50Ω ±1.5%.

Displayed Frequency Domain Bandwidth – 12.5 GHz.

System Dynamic Range (typical) –

<2.0 GHz	70 dB
2 GHz to 5 GHz	60 dB
5 GHz to 10 GHz	50 dB

Source Match (typical) –

<2.0 GHz	45 dB
2 GHz to 5 GHz	38 dB
5 GHz to 10 GHz	38 dB

Isolation (typical) –

<2.0 GHz	90 dB
2 GHz to 5 GHz	80 dB
5 GHz to 10 GHz	70 dB

Transmission Tracking (typical) –

<2.0 GHz	0.05 dB
2 GHz to 5 GHz	0.15 dB
5 GHz to 10 GHz	0.15 dB

Test Environment – ±5° C.

Display Characteristics (Option 02, 03, 04)

U.S. and Pacific Rim – NEC Multisync SVGA Monitor (120 V).

15-inch monitor.

17-inch monitor.

Trio Pitch: 0.28 mm.

Europe – NEC Multisync SVGA Monitor (240 V).

15-inch monitor.

Trio Pitch: 0.28 mm.

Computer Characteristics: Compaq Personal Computer (Option 1S)

Processor – Pentium 75 or greater.

Memory – 16 Mbyte, 70 ns enhanced page RAM. Expandable to 32 Mbyte on the system board.

Graphics – High-resolution graphics with 1024 x 768 resolution with 256 colors. Backward compatible with VGA at 640 x 480 or 800 x 600.

Expansion Slots – Three 16-bit ISA expansion slots available for expansion boards.

Storage Devices – 3 1/2" 1.44 Mbyte diskette drive, 720 Mbyte or larger hard drive, 340/680 Mbyte tape backup.

Interfaces – Two serial, one parallel, one pointing device (mouse), one keyboard.

Warranty – Three-year limited warranty.

GPIB Characteristics: National Instruments (Option 1G)

Complete IEEE 488.2 controller capability using NAT5882 and Turbo488 ASICs – includes NI-488.2 for MS-DOS and NI-488.2 for Windows.

Printer Characteristics

See individual specifications for Tektronix Phaser 200- and 300-series color printers.

IPA Nexus Characteristics (Option 28)

Number of High Speed Lines – 12.

Reflected Open Circuit Risetime – <50 ps measured with SD-24, t_r 20 to 80%.

Electrical Length – <±20 ps delta between all lines.

Coax Line Impedance – 50 Ω ±1Ω.

Maximum Reflection at DUT – ≤±55 millirho.

Maximum Reflection at SMA – ≤±40 millirho.

DC Resistance – ≤50 mΩ.

DUT Connection Repeatability – <–30 dB difference between repeated connections.

Connector Type – SMA Style (>18 GHz modding frequency).

Environmental Characteristics –
Operating: +15° C to +30° C.
Non-operating: –20° C to +60° C.

QFP Adapter Characteristics when Installed on Nexus (Options 29, 30, 31, 32, 33, 34)

Number of High Speed Lines – 2 or 4.

Reflected Open Circuit Risetime – <55 ps measured with SD-24, t_r 20 to 80%.

Electrical Length – <±20 ps delta between all lines.

Maximum Reflection at DUT – ≤±55 millirho.

Coax Positioning System Characteristics Option 35)

Number of High Lines – One to four 0.047 in. diameter probes.

Reflected Open Circuit Risetime – <50 ps measured with SD-24, t_r 20 to 80%.

Connector Type – SMA Type (>18 GHz modding frequency).

Maximum Reflection at SMA Connector – ≤±40 millirho.

Simple Coax Probe Kit Characteristics (Option 36)

Number of High Speed Lines –
Four 0.141 in. diameter probes.
Four 0.086 in. diameter probes.
Four 0.047 in. diameter probes.

Reflected Open Circuit Risetime – <50 ps measured with SD-24, t_r 20 to 80%.

Electrical Length (nominal) – 950 ps.

Maximum Reflection at SMA Connector – ≤±40 millirho.

IPA 510 Characteristics

Environmental

Operational Environment – Suitable for operation in a controlled laboratory environment.

Temperature –
Operating: +15° C to +30° C.
Non-operating: –20° C to +60° C.

Humidity – 30 to 80% RH (non-condensing).

Altitude –
Operating: 0 to 3,000 m (0 to 10,000 ft).
Non-operating: 0 to 13,700 m (0 to 45,000 ft).

Electromagnetic Capability (EMC)

Emissions – Meets or exceeds the EMC requirement of the following standards:
FCC Rules and Regulations, Part 15, Subpart B, Class A.
VFG243.

Electrostatic Discharge Susceptibility – See individual system component specs.

Ordering Information

IPA 510 Interconnect Parameter Analyzer

Includes: IPA Interconnect Parameter Analyzer Software, IPA Quick Start Demo Board, Coax Adapter Kit, Torque Wrench, evaluation copy of PSPICE, PSPICE Manuals, IPA User Manuals, Reference Book "High Speed Digital System Design – A Handbook of Black Magic"

IPA 510 Options – Analysis Software Related

Option 2S – Add Enhanced Accuracy TDR/TDT Software (EA-TDR/TDT) when Option 26 Selected.

Option 1U – Add Enhanced Accuracy TDR/TDT Software (EA-TDR/TDT) for Owners of Existing 11800 Mainframes.

Option 2U – Add Enhanced Accuracy TDR/TDT Software (EA-TDR/TDT) for Owners of Existing CSA 803 Mainframes.

Option 2E – Add Enhanced Accuracy Coaxial Calibration Kit. Contains: Microwave standards, 1 ea female open, female short, female 50Ω termination, male open, male short, male termination, female-to-female thru adapter, 7.5 cm 50Ω reference airline.

Option 3S – Add Contec SPICE Simulator Software plus 1-yr Annual Support Fee (U.S.).

Option 4S – Add Contec SPICE Simulator Software plus 1-yr Annual Support Fee (Europe).

Option 5S – Add Contec SPICE Simulator Software plus 1-yr Annual Support Fee (Japan).

Option 6S – Add Contec SPICE Simulator Software plus 1-yr Annual Support Fee (International).

Option 1F – Add Contec RLGC Field Solver Software plus 1-yr Annual Support Fee (U.S.).

Option 2F – Add Contec RLGC Field Solver Software plus 1-yr Annual Support Fee (Europe).

Option 3F – Add Contec RLGC Field Solver Software plus 1-yr annual support fee (Japan).

Option 4F – Add Contec RLGC Field Solver Software plus 1-yr annual support fee (International).

IPA 510 Options – Measurement Hardware Related

Use existing 11801A or 11801B Sampling Oscilloscope (supply model and serial number).

Use existing CSA 803 or CSA 803A Communications Analyzer (supply model and serial number).

Option 26 – Add 11801B Oscilloscope with Option 1T.

Option 27 – Add SD-24, 20-GHz Two-channel TDR/Sampling Head.

Option 1E – Additional Coax Adapter Kit.

Option 1R – Add 11801B Rackmount Kit.

Option 1M – Add 11801B SM-11 Compatibility.

Option A1 to A5 – Add International Power.

IPA 510 Options – Fixturing Related

Option 28 – Add IPA Nexus PGA Fixture.

Option 29 – Add QFP2-25 Adapter.

Option 30 – Add QFP4-25 Adapter.

Option 31 – Add QFP2-50 Adapter.

Option 32 – Add QFP4-50 Adapter.

Option 33 – Add QFP4-20 Adapter.

Option 34 – Add QFP4-15 Adapter.

Option 35 – Add Coax Positioning System. Contains: 1 ea left-hand and right-hand probe holders, 12" x 12" probing plate; 4 ea 0.047" dia. coax probes.

Option 36 – Add Simple Coax Probe Kit. Contains: 4 ea 0.141" dia. coax probes, 0.085" dia. coax probes, 0.047" dia. coax probes.

IPA 510 Options – System Integration

Option 1S – Add System Integration. Includes: Compaq Pentium-75 PC or greater, DOS and Windows Software (current version), On-site installation, GPIB card and cable, 90-day on-site system warranty (display not included).

Option 02 – Add NEC SVGA 17" Display.

Option 03 – Add NEC SVGA 15" Display.

Option 04 – Add NEC SVGA 15' Display (240V, Europe only).

Option 1C – Add Test Station Table.

Option 1G – Add S3FG220 GPIB Card/Cable.

IPA 510 Recommended Accessories

- ☐ **SD-14 Sampling Head.** 2.5 GHz High-Impedance (100 kΩ/0.47 pf) Dual-channel Probe Sampler.
- ☐ **SD-20 Sampling Head.** 20 GHz Single-channel Loop-through Sampling Head.
- ☐ **SD-22 Sampling Head.** 12.5 GHz dual-channel Low-noise Sampling Head.
- ☐ **SD-26 Sampling Head.** 20 GHz dual-channel sampling head.
- ☐ **SD-30 Sampling Head.** 40 GHz Single-channel Sampling Head.
- ☐ **SD-32 Sampling Head.** 50 GHz Single-channel Sampling Head.
- ☐ **SIU 800 Static Isolation Unit.** Input Protection Relay.
- ☐ **1 Meter Sampling Head Extender Cable –** 012-1220-00.
- ☐ **2 Meter Sampling Head Extender Cable –** 012-1221-00.
- ☐ **Color Printer –** Tektronix Phaser 200- or 300-series Color Printer. Contact Tektronix Account Manager for name and location of local printer distributor.

For further information, contact:

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P.O. Box 500
Beaverton, Oregon 97077-0001
For additional literature, or the address and phone number of the Tektronix Sales Office nearest you, call:
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(503) 627-7111

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