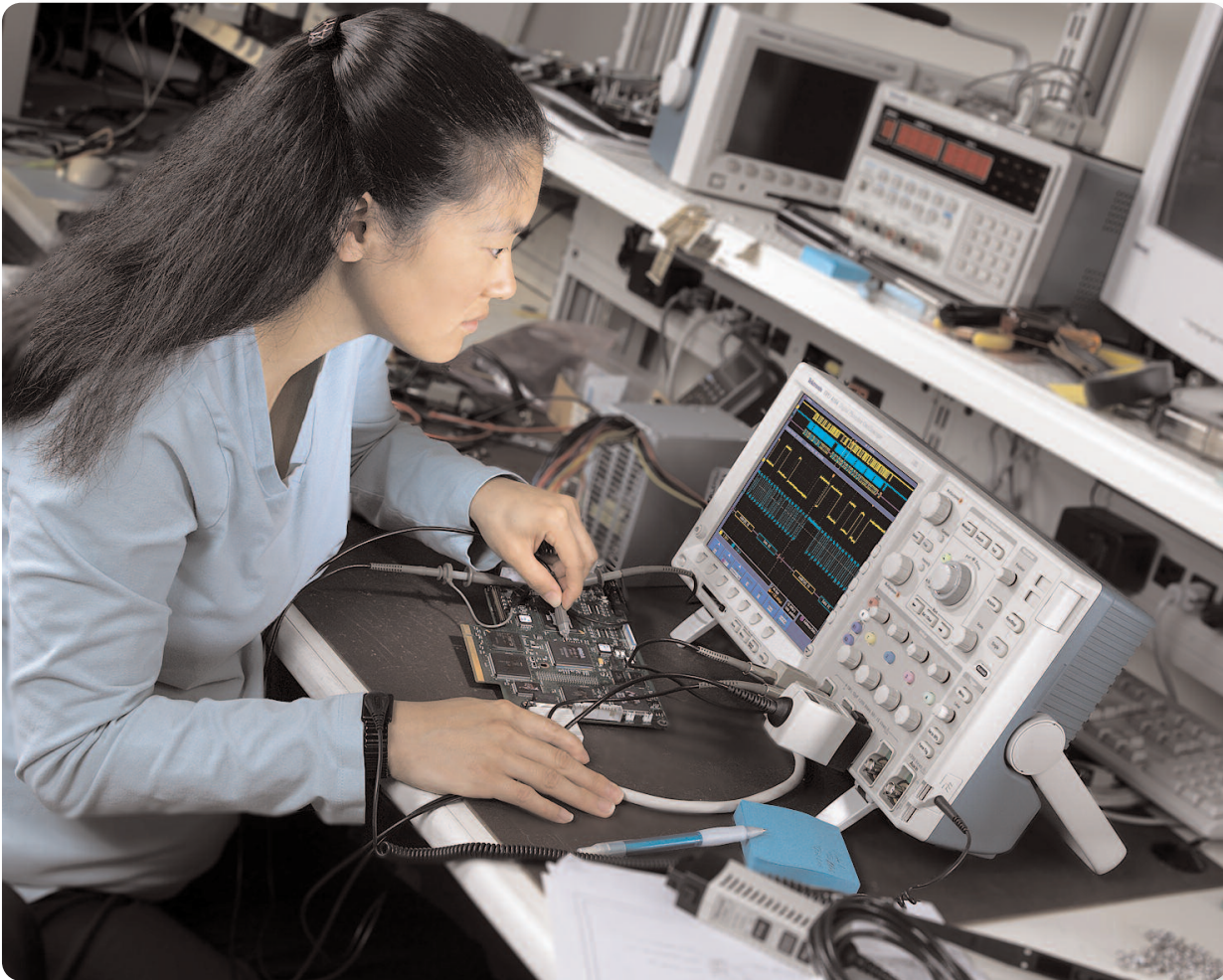


TekVPI™ Technology Delivers Versatility and Ease-of-Use in a New Probe Interface Architecture



TekVPI (Tektronix Versatile Probe Interface) architecture introduces the next generation of Tektronix probe interface architecture with the announcement of a new family of versatile, feature-rich, and easy-to-use TekVPI probes designed for use with Tektronix newest

generation of DPO4000 and mid-range DPO7000 Series DPO™ oscilloscope. The following article describes the evolution of Tektronix probe interfaces, features of TekVPI design, and the new TekVPI probes.

Evolution of Tektronix Probe Interfaces

Over the past 50 years a variety of oscilloscope probe interface designs have evolved to support the requirements of increasing instrument bandwidth speeds and measurement performance. In the earliest years banana plug and UHF type connectors were commonly used. During the early 1960's plain BNC type connectors became a common type of probe interface because of the BNC's smaller form factor and higher frequency capabilities. BNC probe interfaces are still used today in the design of test and measurement instruments with today's higher quality BNC type connectors providing maximum useable bandwidth capabilities approaching 4 GHz.

In 1969 Tektronix introduced a variation of the plain BNC type of probe interface design with the introduction of the 7000 Series probe interface architecture. 7000 Series designs used a BNC type connector for passing the acquired analog signal, but additionally provided an analog encoded scale factor detection pin as part of the mechanical and electrical interface design which enabled the compatible oscilloscope to automatically detect and change the oscilloscope's displayed vertical attenuation range to incorporate the attenuation range setting of the attached 7000 Series type probe.

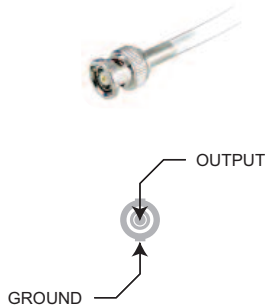
In 1986 probe usability was further enhanced with the introduction of the TekProbe™ probe interface architecture. TekProbe-BNC Level 1 designs provided an analog encoded scale factor detection pin to extend the attenuation ranges available in the 7000 Series interface and to provide support for the legacy 7000 Series probes. TekProbe-BNC Level 2 designs were also introduced to support the required operating power requirements for "active" probe types which contained transistors, IC's,

or other active components as part of the probe's signal conditioning network design. TekProbe-BNC Level 2 further extended the capabilities of Level 1 designs by adding probe communications with the oscilloscope to improve the usability of increasingly sophisticated probe types and to accomplish calibrated offset at the probe tip.

In 2001 the increasing advancement of Tektronix probing capabilities coupled with the requirements for ever-higher probe bandwidth, mechanical and electrical design reliability and improved ease-of-use resulted in the introduction of the TekConnect™ advanced probe interface architecture providing optimum signal fidelity and highest bandwidth. With maximum useable bandwidth of TekProbe interface designs utilizing BNC connectors limited to about 4 GHz the TekConnect interface design architecture utilized a BMA type connector (similar in size and performance to an SMA connector) and capable of supporting high fidelity electrical signal path performance up to at least 18 GHz bandwidth in support of the capabilities of Tektronix highest bandwidth oscilloscope. The TekConnect design incorporated several mechanical design improvements enabling convenient and reliable single-hand attachment of a positive-locking TekConnect probe mechanism to the oscilloscope. And, TekConnect design further extended the capabilities of probe and oscilloscope communication beyond read-only functions providing read and write probe control functions which enabled advanced features such as electronic calibration adjustment, soft switching of probe setup parameters, cascading of other probe accessory adapters, etc. Today, TekConnect design architecture continues to represent the state-of-art in advanced probing capabilities for Tektronix highest performance oscilloscopes.

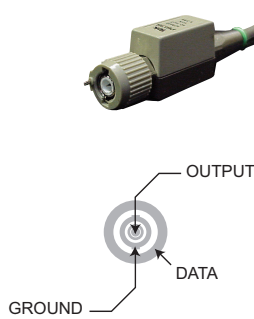
Evolution of Tektronix Probe Interfaces

Plain BNC (early 60s)



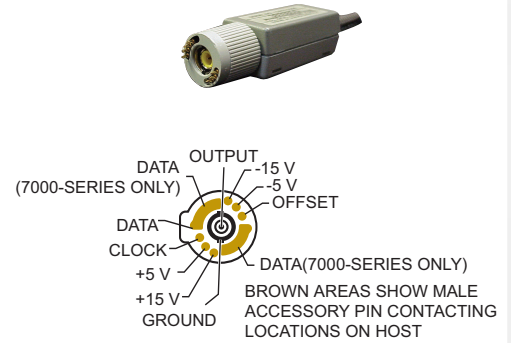
Smaller and higher performance than its predecessor.

7000 Series (1969)



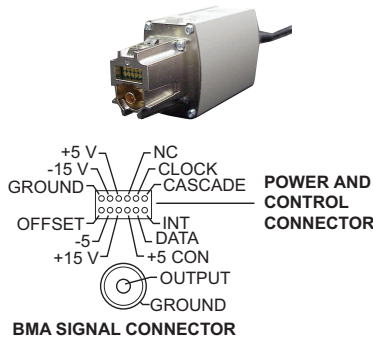
Introduced analog encoded voltage scale factor detection via a spring loaded pin.

TekProbe-BNC (1986)



Added power for active probes and better communications with the scope.

TekConnect (2001)



Addressed bandwidth limitations of its BNC counterparts for optimal signal integrity and improved communications to high performance scopes.

TekVPI (2006)



Cost-reduced probe interface architecture adds reliability and improved communications to mid-range performance scopes.

▶ **Figure 1.** Evolution of Tektronix probe interfaces.

Introducing TekVPI the Next Generation of Tektronix Probe Interface

In 2006 Tektronix introduced its newest generation of Digital Phosphor Oscilloscopes: the DPO4000 and mid-range models of the DPO7000 Series oscilloscope families featuring TekVPI (Tektronix Versatile Probe Interface) as the new probe interface architecture designed to provide ease-of-use, versatility, and other performance features important to users of this category of oscilloscope. TekVPI leverages more than 50 years of Tektronix probe product design experience combining features and benefits of both the TekProbe and TekConnect probe categories to create the new TekVPI series of probes.

Features of TekVPI

Versatility and ease-of-use are the hallmarks of TekVPI probe design, enabled by intelligent bi-directional oscilloscope/probe communications with its TekVPI oscilloscope host instrument. TekVPI probe designs are microprocessor based with EEROM memory and bi-directional serial interface communications capability. The design architecture of TekVPI provides users improved ease-of-use in probe setup, easy selection of displayed probe status and setup information, as well as accurate probe measurement performance results all intended to simplify and improve the performance of the user's test and measurement experience:

TekVPI Probe Setups and User Interface

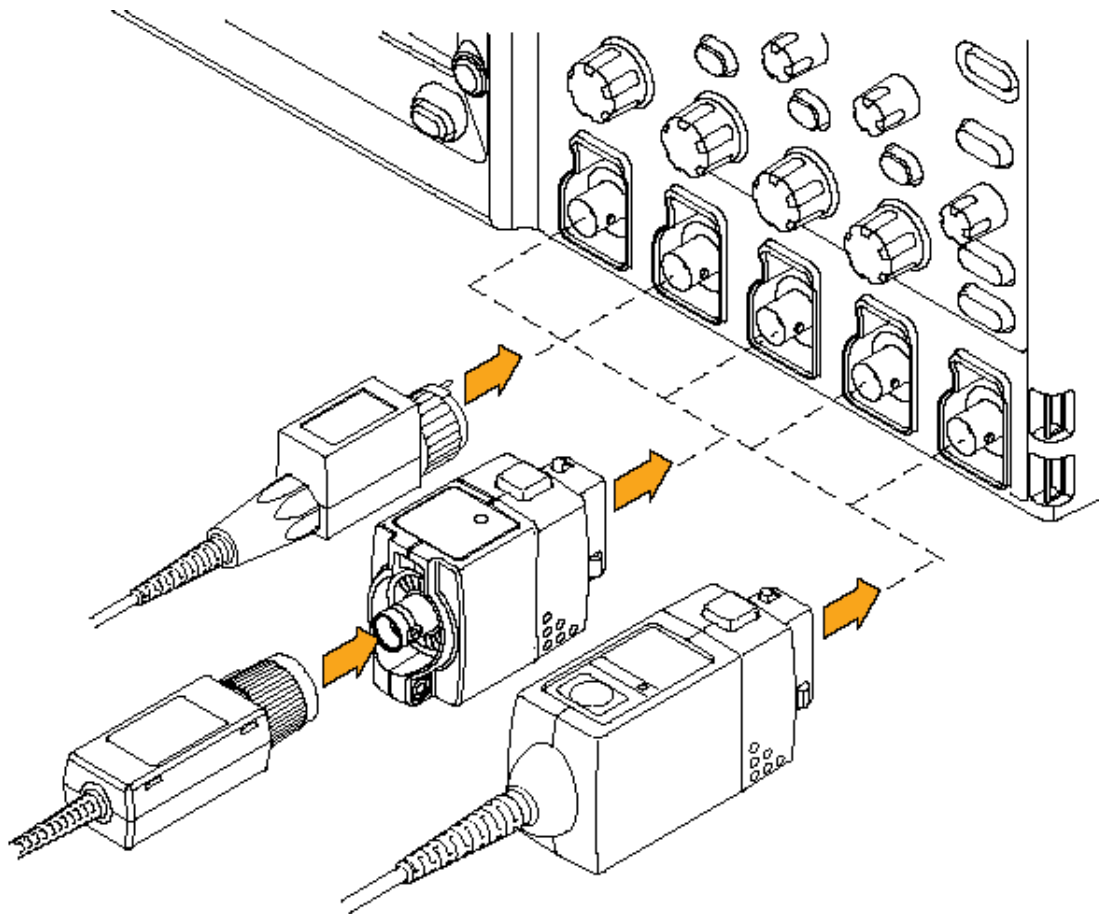
Each TekVPI probe features a rich set of probe compensation box (“comp box”) located controls and indicators designed to provide users quick and easy access to the probe’s most commonly required setup controls and operating status. Sealed membrane keypad buttons on the probe’s comp box are clearly labeled and finger-sized to enable user’s simple probe setup control. Highly visible bi-colored or tri-colored LED indicator lights on the probe’s comp box are clearly labeled to provide the user easy to understand probe setup and key operating status information.

Beyond the more traditional probe control and indicator capabilities described above, TekVPI also introduces a significant new feature for ease-of-use -- the Probe Menu Button. All TekVPI probes feature a dedicated probe comp box located Menu Button that enables users to quickly and easily access a graphical probe menu display on the TekVPI host oscilloscope instrument. The instrument probe menu display and other displayed notification icons provide comprehensive probe information including: Probe Model Type, Probe Serial Number, Attached Probe Channel Number, Probe Operating

Status and Warnings, and Probe Diagnostics to aid troubleshooting events. Additionally, all probe setup control functions can be set, changed, or monitored from the instrument display. To aid the users setup of the applied test and measurement configuration, the TekVPI host instrument also records and saves a setup file (Save Setups) of probe configurations enabling users to easily re-construct the test configuration (Recall Setups) applied during their test application’s measurement acquisition.

TekVPI Probe Remote Control Support

Enabled by TekVPI’s bi-directional oscilloscope/probe communications and the TekVPI host instrument’s network communications capabilities (USB, GPIB, Ethernet) TekVPI probe setups can be remotely controlled and monitored to simplify the automation of testing applications in the user’s ATE environment. Remotely controlling and changing setup functions like probe attenuation range, DC offset auto-zeroing, or degaussing the residual magnetic fields in current probe types are all easily accomplished with TekVPI assuring users of optimal probe performance and measurement accuracy.



► Left to Right – Plain BNC or 7000 Series or TekProbe-BNC Level 1 connection; TekProbe-BNC Level 2 connection via new TPA-BNC adapter; and new TekVPI connection

TekVPI Legacy Probe Support

The evolution of Tektronix probe interfaces over the last 50 years has resulted in four distinct BNC legacy probe interface types being applied with Tektronix oscilloscope for applications up to 4 GHz in bandwidth: the BNC connector, 7000 Series, TekProbe-BNC Level 1, and TekProbe-BNC Level 2 probe types.

Tektronix recognizes the importance of providing users the versatility to apply legacy (or already owned) probe types with Tektronix newest generation of TekVPI oscilloscope instruments. To protect the user's previous investments, TekVPI is designed to provide legacy probe interface support for the plain BNC connector, 7000 Series, TekProbe-BNC Level 1, and TekProbe-BNC Level 2 probe types.

- Plain BNC connected probes, 7000 Series probes, and TekProbe-BNC Level 1 probes (types having the single analog encoded scale factor detection pin) are connected directly to the TekVPI probe channel input connector on TekVPI oscilloscope. All performance features and capabilities of these connected probe types are supported and available to the user.
- TekProbe-BNC Level 2 probes are connected to the TekVPI oscilloscope by using the new TPA-BNC TekProbe-BNC to TekVPI probe interface adapter. This adapter passes the attached TekProbe's acquired analog measurement signal thru a BNC interface on the oscilloscope's TekVPI probe channel connector. Additionally, the TPA-BNC adapter converts and supplies the required probe power resources necessary for the operation of the attached TekProbe-BNC Level 2 probe type. All performance features and capabilities of the connected TekProbe-BNC Level 2 probe types are supported and available to the user.



► TPA-BNC TekProbe-BNC Level 2 to TekVPI Probe Interface Adapter

TekVPI Probe Power Management

The sophistication of modern “active probe” designs required to provide probe communication, or to achieve higher bandwidths necessary for accurately measuring faster signaling rates, or to minimize probe loading affects imposed upon the connected device under test, or to provide “bucking currents” necessary to prevent transformer core saturation and to extend the measurement range of current measurement probe types all generally require power resources to be externally provided in support of the probe’s operation. “Active probes” are probes containing transistors, or IC’s, or other active components as part of the probe’s signal conditioning network design. Traditionally, the power resources necessary to support the operation of active probes have been provided, allocated, and managed by the designed-in capabilities of the host oscilloscope instrument.

The design architecture of TekVPI provides a new technique for probe power management enabling several benefits and ease-of-use features for TekVPI oscilloscope and probe users. The TekVPI host oscilloscope distributes +5 VDC and +12 VDC bulk power supply resources amongst the available TekVPI probe input channel connections of the instrument. Since each probe input channel has equal access to the bulk power

supply resources no input channel is restricted to what probe type may be connected to that channel or what combination of probe types may be configured to the oscilloscope. The infrastructure for probe power management and the necessary voltage conversions to support the power resource requirements of individual probe types is performed within each TekVPI probe and not within the host oscilloscope. This distributed architecture of probe power management as accomplished within the TekVPI probes reduces the design overhead and associated costs of the TekVPI host oscilloscope.

One example illustrating the significant benefit of TekVPI’s probe power management design is found with the new TCP0030, 30 Ampere AC/DC current probe. Traditionally, current probes of this measurement range required external power supplies to provide the necessary resources required for “bucking currents” and to perform degaussing operations necessary to maintain accurate measurement capability. The TCP0030 TekVPI current probe now eliminates this need for an external power supply. The TCP0030 simply connects directly to any probe input channel on a TekVPI host oscilloscope, reducing the complexity of the user’s test equipment configuration, and saving the user valuable bench space.

TekVPI Mechanical Design

TekVPI probes provide attractive and ergonomically designed packaging and a reliable mechanical interface design. The TekVPI probe or adapter attachment is made by inserting the nose piece of the probe connector into the mating bucket of the TekVPI oscilloscope probe input channel connector. A spring-assisted pull-in force on the bucket side of the interface assures a reliable connection, and a lock mechanism in the interface nose piece securely retains the attachment until release is desired. TekVPI probe or adapter attachment and release is an easy single-handed user operation in which a thumb push-button lock release is pressed at the same time the TekVPI probe or adapter is either to be attached or released. To assure electrical signal integrity of the probe interface connections gold-plated spring-contact pins on the TekVPI probe or adapter nose piece mate with gold-plated contact pads on a small circuit board on the TekVPI oscilloscope's probe input channel bucket side.

TekVPI Embeds the Probes Characteristics within the Oscilloscope

Enabled by the microprocessor, memory, and bi-directional communications capabilities of the TekVPI probe, tighter integration between the oscilloscope and the connected TekVPI probe is now possible to compensate for known gain offsets or propagation delays characteristic of the connected TekVPI probe type. This capability provides users easy-to-use and more accurate probe measurement results.

One example of this TekVPI probe design benefit concerns propagation time delay parameters measured during TekVPI probe manufacturing and stored within the probe's memory for later use by the connected TekVPI oscilloscope. De-skewing of signal delay timing differences between voltage and current measurement probe types for accurate power measurement analysis results is an important but sometimes difficult to accomplish or even a neglected step of the testing setup. TekVPI probes communicate their stored propagation time delay characteristics to their host TekVPI oscilloscope and this information is then used to achieve de-skewed time alignment within less than 1 nanosecond of accuracy for the measured voltage and current signals waveform phase relationship. (More precise timing de-skew capabilities are achievable using an external de-skew calibration accessory fixture.)

TekVPI™ Delivers Versatility and Ease-of-Use in a New Probe Interface Architecture

► Technical Brief



► TCP0030



► TAP2500 (and typical of TAP1500)

New TekVPI Probe Types

At product introduction in 2006 the initial TekVPI probe type offerings are summarized as follows: (Refer to individual product datasheets for specifications, illustrations, applications, and features & benefits descriptions.)

– TCP0030 - AC/DC Current Probe

- Directly connects to TekVPI oscilloscope
- 1mA to 30A measurement range
- >120 MHz bandwidth
- 50A peak pulse capability

– TAP1500 - 1.5 GHz Active Voltage Probe

- ≤ 267 ps rise time
- ± 8 V input dynamic range
- ≤ 1 pF input capacitance
- $1 \text{ M}\Omega$ input resistance
- Compact probe head for accessing small design geometries

– TAP2500 - 2.5 GHz Active Voltage Probe

- <140 ps rise time
- ± 4 V input dynamic range
- ≤ 0.8 pF input capacitance
- $40 \text{ k}\Omega$ input resistance
- Compact probe head for accessing small design geometries

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Tektronix maintains a comprehensive, constantly expanding collection of application notes, technical briefs and other resources to help engineers working on the cutting edge of technology. Please visit www.tektronix.com



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