

Comprehensive Technical Guide to Agilent 16700B and 16702B Logic Analysis Systems: Architecture, Application, and Troubleshooting

Published: January 21, 2026 | Index ID: #399

In the high-stakes world of digital system design and embedded engineering, the ability to observe the internal state of a circuit in real-time is not just a luxury—it is a fundamental requirement for validation and debugging. The **Agilent Technologies 16700B and 16702B Logic Analysis Systems** represent a pivotal era in electronic measurement, providing a scalable, modular platform designed to tackle the most complex digital design challenges. These systems were engineered to help design teams overcome time-to-market obstacles by offering high-performance state and timing analysis, integrated oscilloscope functions, and sophisticated triggering mechanisms.

The Evolution of Logic Analysis: Understanding the 16700B Series

The transition from standalone logic analyzers to integrated **Logic Analysis Systems** marked a significant shift in how engineers interacted with digital hardware. The Agilent 16700B series was designed to be more than just a measurement tool; it was a networked workstation specifically optimized for hardware-software integration. By combining multiple measurement modules into a single, tightly coupled frame, Agilent provided a unified view of system behavior that was previously unattainable with disparate instruments.

The Modular Architecture

At the heart of the 16700B and 16702B is a modular backplane. Unlike fixed-configuration analyzers, these mainframes allow users to populate slots with a variety of measurement modules tailored to specific tasks. This modularity ensures that the system can evolve alongside the user's requirements. The **16700B** is typically used as a desktop unit requiring an external monitor, while the **16702B** features a built-in 12.1-inch flat-panel display and integrated touch screen, providing a more self-contained solution for lab environments where space is at a premium.

Technical Specifications and Comparison

To understand which mainframe best suits a specific engineering environment, it is essential to compare the physical and functional characteristics of the 16700B and 16702B. While they share the same internal architecture and software compatibility, their form factors differ significantly.

Feature	Agilent 16700B	Agilent 16702B
Display	External (VGA/XGA)	Built-in 12.1-inch LCD (Touchscreen)
Form Factor	Desktop Mainframe	Integrated Portable Mainframe
Expansion Slots	5 Slots	5 Slots
Maximum Slots (with 16701B)	Up to 20 Slots	Up to 20 Slots
Storage	Hard Drive / 40x CD-ROM	Hard Drive / 40x CD-ROM
Interface	Mouse/Keyboard	Touchscreen / Mouse / Keyboard
Operating System	HP-UX (Real-time UNIX)	HP-UX (Real-time UNIX)

The 16701B Expansion Frame

For projects requiring massive channel counts—such as debugging wide memory buses or complex multiprocessor systems—the **16701B Expansion Frame** can be connected to either the 16700B or 16702B. This expansion capability allows for a total of up to 20 slots, enabling the synchronization of hundreds of channels with picosecond-level timing accuracy across the entire system. This "tightly coupled" nature ensures that data captured in slot 1 is time-correlated with data captured in slot 20, providing a holistic view of the system under test.

Core Theoretical Framework: State vs. Timing Analysis

To effectively utilize the Agilent 16700B series, one must master the distinction between **State Analysis** and **Timing Analysis**, the two primary modes of operation for these instruments.

Synchronous State Analysis

State analysis is synchronous to the system clock of the Device Under Test (DUT). In this mode, the logic analyzer acts like a part of the system, capturing data only when the clock signal transitions. This is critical for debugging software execution flow, bus transactions, and protocol compliance. The 16700B series excels here by offering high-speed state clocks, ensuring that even high-speed DDR memory or processor buses can be accurately tracked.

Asynchronous Timing Analysis

Timing analysis uses an internal clock within the logic analyzer, independent of the DUT's clock. This mode is used to measure the physical timing relationships between signals, such as setup and hold times, propagation delays, and glitches. The 16700B series modules offer high-resolution timing (e.g., 500 ps or better), allowing engineers to spot signal integrity issues that would be invisible in state mode.

Measurement Module Ecosystem

The power of the 16700B/16702B lies in the modules. The system supports a wide array of cards, including:

- Logic Analyzer Modules: Provide the primary state and timing capture capabilities.
- Oscilloscope Modules (e.g., 16533A/34A): These modules allow for the simultaneous capture of digital logic and analog waveforms. This is vital for "Cross-Domain Analysis," where an engineer needs to see how a specific digital pattern affects the analog signal integrity of a power rail or data line.

- Pattern Generator Modules: Used to stimulate the DUT with specific digital sequences, allowing for functional testing before the rest of the system is fully operational.
- Post-Processing Toolsets: Software-based modules that perform protocol decoding (e.g., PCI, USB, Ethernet) and performance analysis.

Integration of the 16533A/34A Oscilloscope Module

The **Agilent 16533A** and **16534A** oscilloscope modules are particularly noteworthy. When installed in a 16700B mainframe, they function as either master or expander cards. This integration allows the logic analyzer to trigger the oscilloscope, or vice versa. For example, the system can be programmed to trigger the scope only when a specific, rare illegal state is detected on a 64-bit bus. This "precision triggering" saves hours of manual searching through analog waveforms.

Step-by-Step Technical Workflow: Setting Up a Measurement

Operating a high-end system like the 16702B requires a structured approach to ensure data integrity and accurate triggering.

1. Physical Probing

The first and most critical step is the connection between the analyzer and the DUT. Using **Agilent Soft-Touch probes** or Mictor connectors is recommended to minimize capacitive loading. High capacitive loading can distort the signals of the DUT, leading to false negatives in debugging.

2. Configuration and Labeling

Through the 16700B interface, the user must define the "Buses" and "Signals." Instead of looking at individual pins, the engineer labels a group of 32 pins as "Address_Bus." This abstraction is essential for making sense of complex processor architectures.

3. Trigger Specification

Modern digital problems are often intermittent. The 16700B's triggering engine allows for complex multi-level sequences. A typical trigger might be: *"Trigger when Address_Bus = 0xABCD AND R/W Line is High, but only if this occurs after the Reset Line has gone Low."*

4. Data Capture and Visualization

Once the trigger condition is met, the system fills its acquisition memory. The 16702B display can then show this data in several formats: **Waveform View**: Standard timing diagrams. **Listing View**: Hexadecimal or binary tables of state data. **Protocol View**: Decoded bus transactions (e.g., "Memory Read from 0x1234"). **Chart View**: Plotting a variable's value over time, useful for observing DAC outputs or sensor data.

Advanced Engineering Principles: Timing Resolution and Memory Depth

When selecting modules for the 16700B/16702B, two mathematical constraints define the limits of what can be captured: **Sample Rate** and **Memory Depth**.

The Nyquist-Shannon Implication in Timing

While the Nyquist theorem is often associated with analog-to-digital conversion, in logic analysis, the timing resolution must be significantly higher than the fastest signal transition to account for jitter and skew. A 2 GHz timing sampler (500 ps resolution) is generally required to accurately characterize a 200 MHz signal with 5% precision on pulse width.

Memory Depth Equations

The total capture time is defined by the formula: **Capture Time = Memory Depth / Sample Rate** For complex system boot-ups or long-running protocol sequences, deep memory (e.g., 32M or 64M samples) is required. The 16700B series supports various memory configurations, allowing users to trade off channel count for memory depth in certain "Half-Channel" modes.

Troubleshooting and Maintenance of Legacy Systems

Given that the 16700B and 16702B are now considered legacy or obsolete by the manufacturer, maintaining their operational integrity requires specific technical knowledge.

Common Failure Modes

- **Power Supply Degradation:** The high-wattage power supplies in these mainframes are subject to capacitor aging. Regular voltage rail checks are recommended.
- **Hard Drive Failures:** These systems use older SCSI or IDE interfaces. Many engineers now replace the mechanical drives with Industrial CF or SD-to-IDE adapters to improve reliability and speed.
- **Display Backlight:** The CCFL backlights in the 16702B can dim over time. LED conversion kits are a common aftermarket upgrade for these units.
- **Calibration Errors:** If the system fails its self-test (Service Guide Chapter 3), it often relates to the "PV" (Performance Verification) tests. This usually points to a specific module or a dirty backplane connector.

Operational Checklist for Service

1. Verify all cooling fans are operational to prevent overheating of the acquisition ASICs.
2. Run the internal self-test suite via the System Admin menu after any module change.
3. Ensure the HP-UX file system is shut down correctly to prevent database corruption on the hard drive.
4. Clean the 16702B touchscreen with non-abrasive, electronics-grade isopropyl alcohol to maintain sensitivity.

The Impact of the 16700B Series on Design Cycles

Before the widespread adoption of modular systems like the 16700B, hardware and software teams often worked in silos. The logic analyzer was the "hardware tool," and the debugger was the "software tool." The Agilent 16700B bridged this gap through features like **Source Correlation**. By importing the compiler's symbol table, the 16700B could show the actual C++ or Assembly code line that triggered a specific hardware state. This drastically reduced the "Mean Time to Resolution" (MTTR) for complex system crashes.

Field Guide: Integration into Modern Lab Environments

Despite their age, these systems remain highly functional in modern labs, especially for FPGA debugging and legacy system maintenance. Integrating them into a 21st-century workflow involves:

- **LAN Connectivity:** Using the built-in Ethernet port to export data to a modern PC via FTP or NFS.
- **X-Windows Support:** The 16700B software can be displayed on a modern Windows PC using an X-Server (like eXceed or Xming), allowing for remote operation.
- **Bench Setup:** Using the 16702B as a centralized hub for multiple instruments via GPIB (General Purpose Interface Bus) control.

Comparative Analysis of Contemporary Alternatives

While modern PC-based logic analyzers (like those from Saleae or Digilent) offer portability and USB connectivity,

they often lack the raw performance of the 16700B series in several areas:

Metric	Legacy Agilent 16700B/16702B	Modern Entry-Level USB Analyzers
Triggering Complexity	10+ Levels, If/Then/Else, Timers	Simple Edge/Pattern
Channel Count	Up to 1000+	8 to 32
Voltage Swing	Adjustable Thresholds (e.g., -5V to +5V)	Fixed (usually 1.8V/3.3V/5V)
Probing	Active/Low-Loading Probes	Flying Leads (High Loading)
Standalone Operation	Yes (16702B)	No (Requires PC)

For high-speed, multi-channel synchronous analysis, the robust backplane architecture of the 16700B series remains superior to many low-cost modern alternatives, explaining its continued presence in secondary markets and specialized research facilities.

The Enduring Legacy of Agilent Measurement Systems

The Agilent 16700B and 16702B Logic Analysis Systems represent a masterclass in modular instrumentation design. They were built for a time when digital complexity was exploding, and they provided the necessary visibility to ensure that the devices we rely on today—from telecommunications infrastructure to automotive ECUs—could be developed reliably. For the technical professional, understanding the operation, capabilities, and underlying theory of these systems is a lesson in the core principles of digital engineering: observation, correlation, and validation.

By leveraging the deep technical insights provided in the service guides and understanding the mechanics of state and timing analysis, engineers can still utilize these powerful frames to solve modern problems. Whether it is through the integrated 12.1-inch touch display of the 16702B or the scalable architecture of the 16700B, the ability to see into the heart of a digital system remains the ultimate advantage in electronic design.

Tags: #Agilent 16700B #Logic Analyzer #Digital Debugging #Agilent 16702B #Test and Measurement

