High-Speed Interface Testing Made Simple with a Modern DMM

When most engineers think of high-speed peripheral interfaces, digital multimeters may not be the first test tool that comes to mind. But for one microprocessor company, a modern DMM became a powerful tool to validate high-speed interfaces using high-performance voltage monitoring on a modern DMM. And thanks to integrated logging and real-time analysis, the new process took just a fraction of time when compared to the legacy test procedure.

In today’s digital world, nearly every device relies on microprocessors and communications busses. These tiny components touch everything from automobiles to home appliances. Peripheral interfaces continue to grow faster, while simultaneously operating at lower power levels. Keeping up with this digital shrink requires test solutions that can make faster measurements with high resolution at ever-lower voltage and current levels.

The microprocessor company needed a way to validate high-speed input/output (I/O) on microprocessors and peripherals. The test engineers were responsible for creating test procedures and methodologies to measure the device under test (DUT), collect and store data, analyze that data, and identify gaps and issues in the design. For each iteration, if the team identifies issues, additional testing may be necessary.

Company:
• Microprocessor company

Key Issues:
• Validating high-speed interfaces
• Monitoring voltage deviations over operating range
• Accessing data
• Using test instruments with slow interfaces

Solutions:
Truevolt 34461A DMM with
• high-speed I/O USB and LAN interface
• built-in statistical tool and graph charting for fast test results

Results:
• Eliminated manual correlation and data logging, improving test throughput by up to 5x
The team needed to measure the voltage over the entire operating range of the DUT. They also needed to analyze the captured voltage measurements to determine whether the DUT was working correctly. The engineers knew that a voltage reading higher or lower than the expected value indicated a fault in the design. To successfully execute the test, the voltage reading had to be constantly monitored, and the meter had to be programmed to different modes during the test.

**The Key Issues: Capturing Data for Fast, Reliable Insights**

Communication between the microprocessor and its peripherals needs to be consistent and reliable. Deviation in voltage readings or falling out of specification means potentially sending the wrong peripheral address, the wrong control information, or the wrong data. Sending the wrong information to any of the three types of I/O bus interfaces would have a detrimental impact on the user's functions or applications. Figure 1 shows how the microprocessor links to its peripherals.

![Microprocessor I/O interface with peripherals](image)

The customer faced various challenges:

1. **Validating the high-speed I/O bus between the microprocessor and its peripherals.** Some I/O buses have RS-232 serial data with a TTL (transistor–transistor logic) interface. Modern digital multimeters (DMMs) must be able to capture and measure this TTL information. Common serial interface speeds range from 1,200 bits per second (bps) to 115,200 bps. The bits-per-second serial speed is commonly known as the baud rate.
2. **Measuring voltage on the circuit over the entire specified operating range.**

Microprocessors are semiconductors. All semiconductors change their electrical properties as temperature and frequency vary. The voltage output on the microprocessor’s I/O interface may vary depending on how fast or hot it operates, but it must remain within the manufacturer’s guaranteed specifications. Hence, it is important for a DMM to be able to monitor the voltage of the microprocessor’s I/O interface over time.

3. **Accessing measured data in formats that can provide faster analysis or insights.**

This is a common issue with old test instruments that do not have utilities to extract or preprocess measured data for test engineers.

4. **Using test instruments with slow and archaic I/O interfaces.**

Some instruments still use RS-232 and GPIB interfaces. While reliable and proven, these interfaces are slow. Newer interfaces provide faster data transfer rates and better real-time remote control of test instruments, without sacrificing reliability.

**The Solution: Advanced DMM Features Capture Fast Signals**

The Keysight 34461A Truevolt DMM met all aspects of the customer’s requirements. Truevolt series DMMs come with a graphical front panel display with built-in trend, histogram, math, and statistical tools for real-time analysis. The engineering team was able to leverage advanced triggering and digitizing features on the Truevolt DMM get more data, faster, resulting in faster time to insights.

Figure 2 shows the graphical trend chart that captures abnormal transient signals. Truevolt DMMs come with advanced triggering and digitizing capabilities that help capture fast signals that other DMMs might miss.

![Digitized voltage measurements to monitor for abnormal transients](image)

*Figure 2. Digitized voltage measurements to monitor for abnormal transients*
Math and statistical functions are also built into the Truevolt DMMs. The DMM captures measurements in real time, so the DMM can process and display simultaneously to show macro-level results, such as the histogram chart, minimum, maximum, average, and standard deviation. Figure 3 shows an example of the histogram chart captured while the measurement was taken.

Figure 3. Keysight 34461A displays the real-time statistical histogram of measurements

The Results: Fast, Precise Measurements

The customer was delighted with the Keysight 34461A Truevolt DMM’s ability to make and record voltage measurements in a time series over the entire operating range of the processor. In addition, the ability to set high and low limits and monitor them in real time helped the team process the data in real time on the meter. Various graphical formats such as trend, bar, and histogram charts helped visualize the data and ensure successful test results.

Going Forward

Collecting and logging data on a modern DMM helped this microprocessor team quickly gather and analyze the data necessary to quickly verify their product was ready for prime-time. Going forward, the customer sees plenty of upside, as the steady growth of the microprocessor and GPU businesses continues to grow at 2.4% or more through 2024.

To learn more about how Truevolt series DMMs can help solve your measurement challenges, check out the Keysight 34465A (6.5 digits of resolution) and 34470A (7.5 digits of resolution). Both models can measure very low current, offer 1 µA range with pA resolution, and allow you to make measurements on very low power devices. They can both measure up to 50,000 readings per second.
Related Information

- Application Note: “Data Logging and Digitizing with a Digital Multimeter (DMM),” publication 5992-2666EN
- Product Fact Sheet: “Keysight Truevolt DMMs: 34460A, 34461A, 34465A, 34470A,” publication 5991-2110EN

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