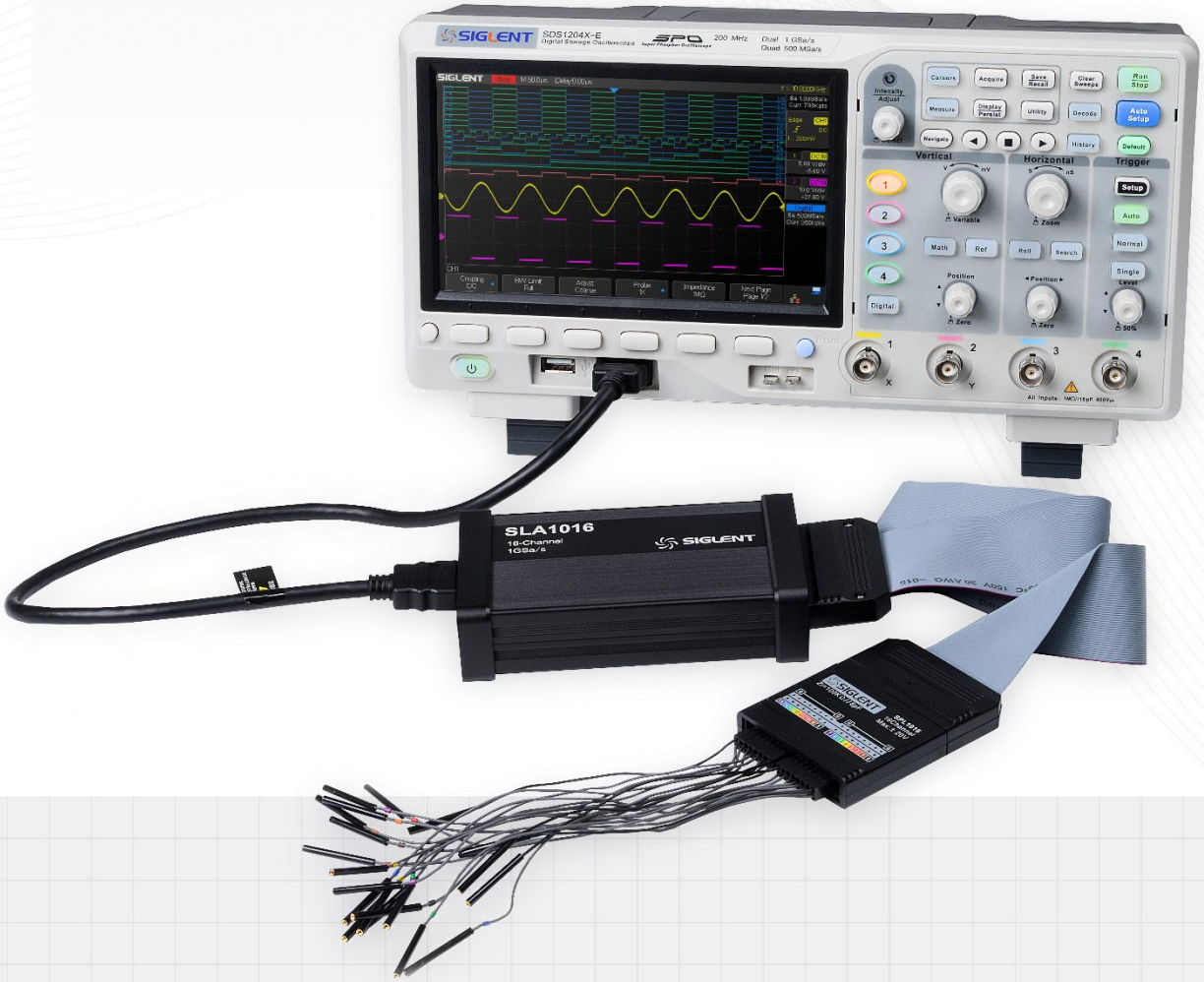
SLA1016 Mixed Signal Oscilloscope Whitepaper



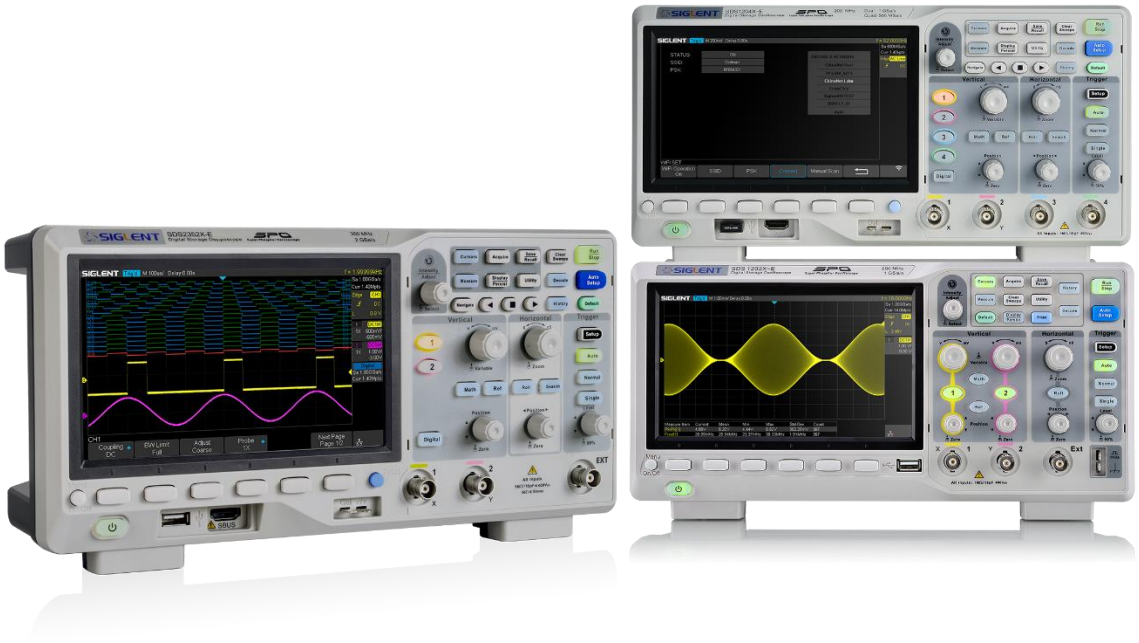
SIGLENT TECHNOLOGIES CO.,LTD

About the Author

Mike is a controls engineer working for a leader in the industrial automation sector, primarily focused on motion control and variable frequency drive (VFD) technology. In his free time Mike has a passion for industrial robotics, electrical design and test, and machining and has a home shop for pursuing these activities. Mike purchased a Siglent SDS1204X-E Super Phosphor Oscilloscope for use at home in designing and troubleshooting his projects.

About Siglent and the SDS1000X-E/SDS2000X-E Oscilloscopes

Siglent is known in both the professional and hobby spaces as a manufacturer of well built, intelligently designed, and affordable electrical test and measurement equipment. The SDS1000X-E and SDS2000X-E Super Phosphor Oscilloscopes are well known in the high-end hobby market and professional markets for being one of the most featured oscilloscopes in the price range and the best value one can find. The features available on these oscilloscopes rival those of many large domestic electrical test and measurement manufacturers at a fraction of the price.



About the SLA1016

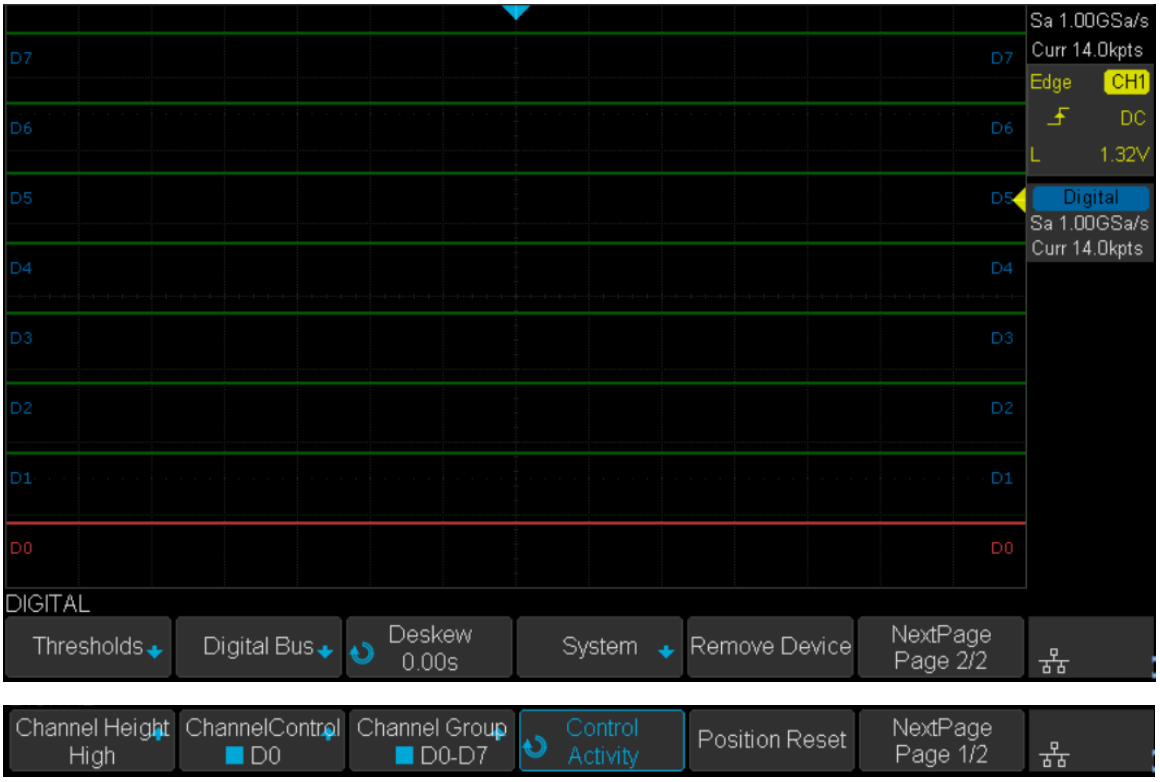
The SLA1016 is an optional Mixed Signal Oscilloscope (MSO) accessory for the SDS1000X-E and SDS2000X-E oscilloscopes. The SLA1016 consists of a logic module, probe set, and connection cables which allow the user of the scope to add (16) channels of digital measurement in addition to the standard analog channels of the oscilloscope. This allows for the measurement and troubleshooting of more complex digital designs (e.g., parallel data busses, sequential logic, etc.) while maintaining the same timebase as the analog measurements.

The SLA1016 is designed to measure digital logic levels up to 5.0VDC and comes with preconfigured thresholds for TTL, CMOS, LVCMOS3.3, and LVCMOS2.5. The user may also select custom voltage thresholds for their unique needs. The SLA1016 has (2) banks of (8) channels which may be independently configured for the desired voltage threshold. With a sampling rate of 1GSa/s and 1.4Mpts deep memory, the SLA1016 can easily capture high frequency digital signals and save the data for later investigation. Like the analog channels, the SLA1016 will dynamically update the sample rate as the oscilloscope timebase is adjusted to maximize the sample memory of the channels.

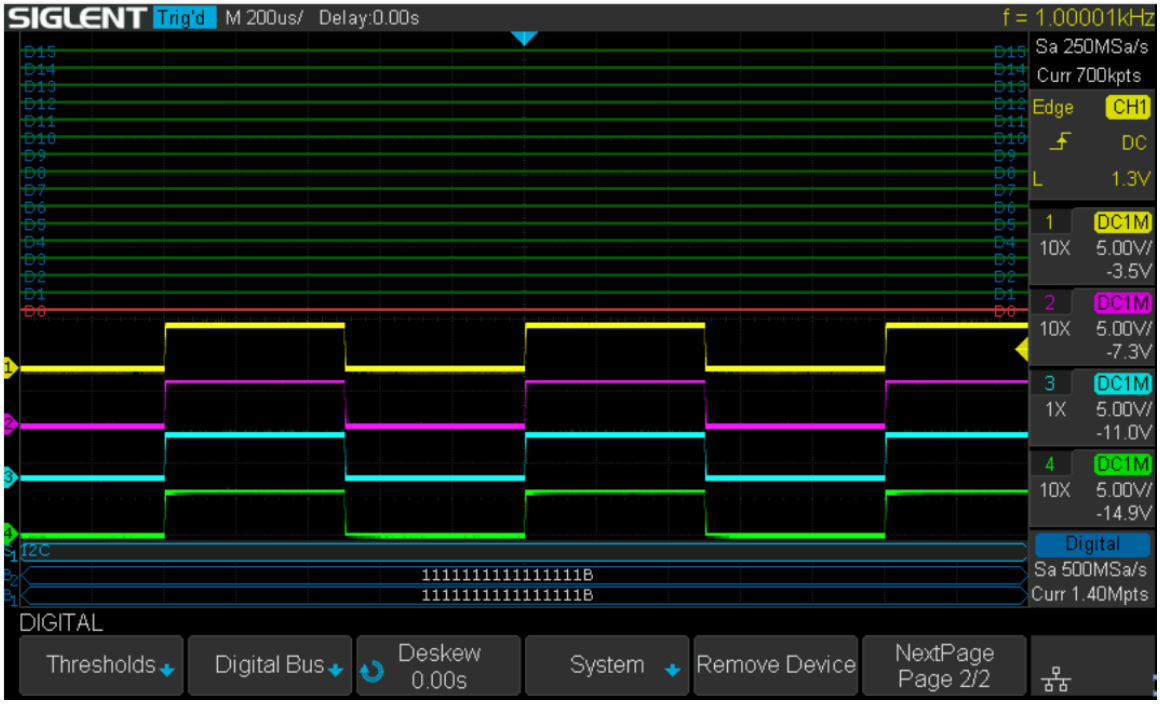
The SLA1016 is provided with probes which can attach to standard 0.1” header pins, and included spring loaded clips can optionally be connected for measuring wires or legs of larger integrated circuits.

Features of the SLA1016

The SLA1016 can display digital waveforms on the oscilloscope in banks of either (4), (8), or (16) channels, trading waveform height for additional data on screen. The standard features of the oscilloscope such as cursors, measurements, decode, and triggering can all be used on the digital channels. Additional features specific to the MSO capabilities of the oscilloscope can be found in the
“Digital” menu. These include parallel data bus decoding, deskew control, channel enable, channel height control, and channel positioning on the screen. Channels may be individually enabled/disabled and rearranged in any order desired.



The oscilloscope can be configured to display all channels at the same time (4 analog + 16 digital) in addition to serial bus decoding and 2 parallel bus decoding displays. The screen can become quite full in this configuration; however, the advanced oscilloscope user quickly sees the power and value in having this much data available at their fingertips. When all the channels are not needed, the MSO signals can be configured to be more spread out to make them easier to read.



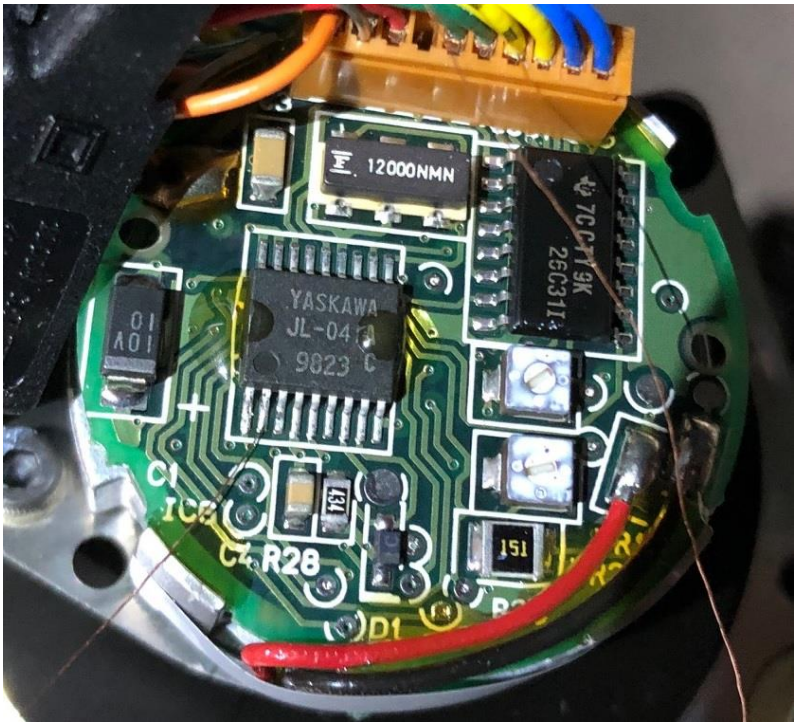
Comparison of SLA1016 vs Logic Analyzers

The SLA1016 Mixed Signal option module competes against other traditional logic analyzers, both standalone units as well as PC based USB logic analyzers. Compared to purchasing a standalone logic analyzer, the SLA1016 is a fraction of the price and paired with the capabilities of the SDS1000X-E and SDS2000X-E oscilloscopes has a very expansive set of features. Standalone logic analyzers do not typically offer analog channels for measurement which may limit their capabilities depending on the project.

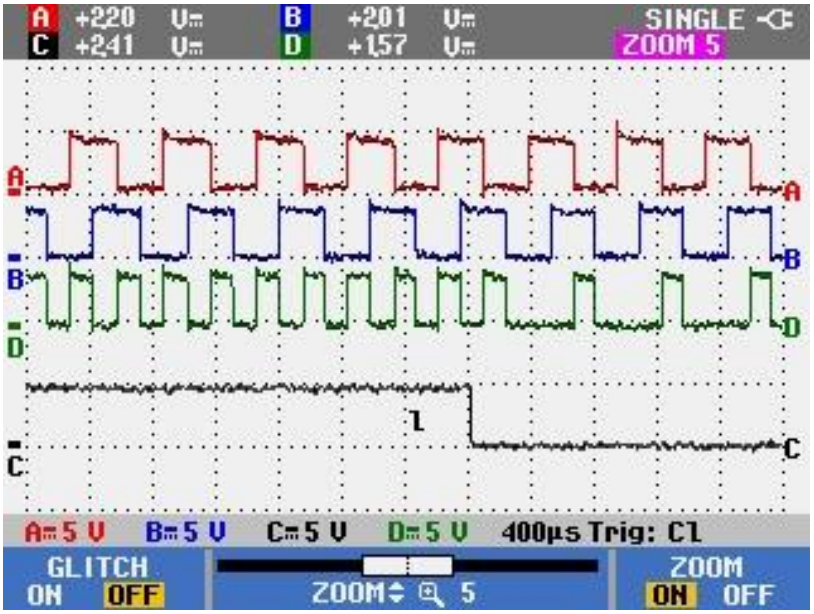
Compared to the variety of PC based USB logic analyzers, the SLA1016 offers superior performance and integration to other options in its price range. Typical USB logic analyzers offer no more than 100MSa/s where the SLA1016 boasts 1GSa/s. There are few USB logic analyzers which offer analog channels, and the bandwidth and performance of these unit is a fraction of what is achievable with the SLA1016 paired with an SDS1000X-E or SDS2000X-E.

Case Study of the SDS1204X-E & SLA1016

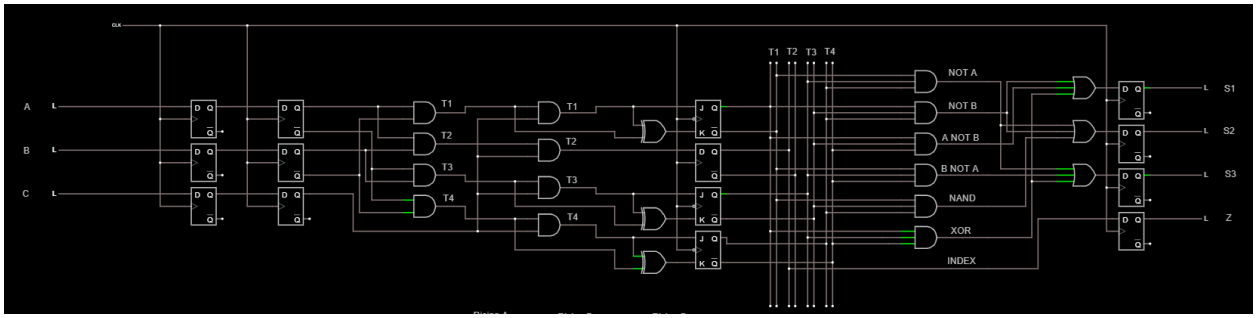
While working on one of his industrial robots, the author had the need to develop an AC servo motor encoder converter board to use legacy encoders with a proprietary “multiplexed” data format paired with modern 3rd party AC servo drives. The robot encoders use a proprietary protocol which is only supported by the original manufacturer’s servo drives.



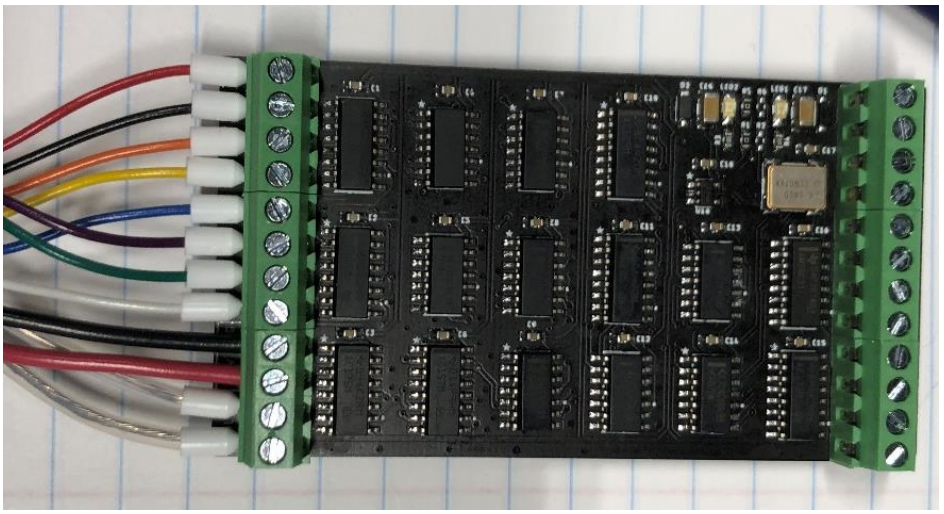
The encoder protocol was reverse engineered by a tedious process of scoping the channels and working out exactly how the data is transmitted from the robot to the controller. The image below shows two incremental tracks (Channels A & B) along with the multiplexed track (Channel D) containing motor index and commutation data.



From there, a complex sequential logic circuit was designed using online circuit logic tools. The circuit converted the proprietary data format into industry standard motor feedback: incremental quadrature with hall effect commutation signals.

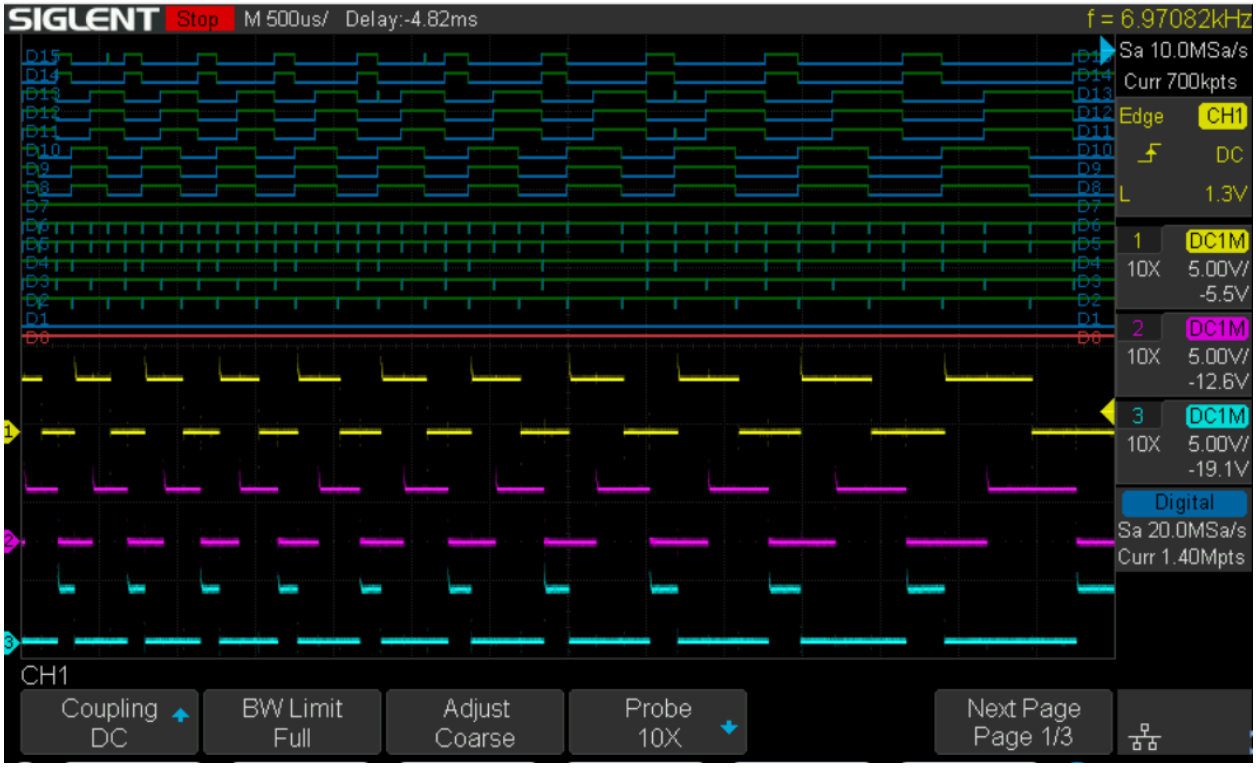


The design was implemented in 74AC series discrete logic chips and PCBs were fabricated.



It was at this point in their project, that the author purchased a Siglent SDS1204X-E oscilloscope. This was timely as the original design of the encoder interface board had a glitch in the logic which prevented proper operation. Due to the design of this circuit, 3 channels of the scope were always needed to measure the input signals, leaving only 1 channel to probe within the circuit to troubleshoot where the issue hid. While this was resolved with only the analog channels of the oscilloscope, the SLA1016 option module would have made the troubleshooting substantially easier as an additional 16 channels of time correlated data could be displayed alongside the input signals.

The author did not own the SLA1016 at the time of completing this project, however they did recreate the necessary measurements to exemplify the capabilities of the module. In the example below, a prototype circuit is measured including 3 input channels (Channels 1,2,3) and 16 points (D0-D15) within a section of the circuit designed to eliminate glitches due to reconvergence of synchronized parallel signals.



In the capture below, we can see action of a sample gating circuit (measured by the SLA1016) when the input signal (yellow, CH1) switches. The exact logic of this circuit is unimportant for this discussion, but the example is illustrative of the value in having digital channels tied to the same timebase as the analog channels.

For the author's future projects, the SLA1016 will be a go-to tool for digital logic analysis, design, and troubleshooting.

Notable features of the SLA1016

- 1GSa/S sample rate allows confidence in the timing of the acquired signals.
- When the oscilloscope is in STOP, digital channels can be individually disabled to allow the vertical height of the remaining channels to increase and declutter the screen. The enabled channels do not need to be sequential or from the same channel group. Channels can later be re-enabled without loss of saved data.
- Probe clips are a perfect size to permit scoping of every pin on a DIP IC on 0.1" pitch. Very handy when troubleshooting on a breadboard.
- When using the probes without spring clips, the probes fit perfectly on 0.1" header pins. This allows very compact probing setup.
- Quality and feel of the probes and SLA1016 module are excellent.
- Software integration with the SDS1000X-E and SDS2000X-E oscilloscopes is seamless and well designed.

Conclusion:

In conclusion, the SLA1016 is an essential tool for the serious hobbyist or professional who is already using a Siglent SDS1000X-E or SDS2000X-E oscilloscope. The SLA1016 greatly expands the functionality of the oscilloscope and offers better visibility into the behavior of complex digital circuits. The SLA1016 outperforms both standalone logic analyzers by offering digital data time correlated with analog measurements, and PC based USB logic analyzers in terms of versatility and sampling performance.

About SIGLENT

SIGLENT is an international high-tech company, concentrating on R&D, sales, production and services of electronic test & measurement instruments.

SIGLENT first began developing digital oscilloscopes independently in 2002. After more than a decade of continuous development, SIGLENT has extended its product line to include digital oscilloscopes, isolated handheld oscilloscopes, function/arbitrary waveform generators, RF/MW signal generators, spectrum analyzers, vector network analyzers, digital multimeters, DC power supplies, electronic loads and other general purpose test instrumentation. Since its first oscilloscope was launched in 2005, SIGLENT has become the fastest growing manufacturer of digital oscilloscopes. We firmly believe that today SIGLENT is the best value in electronic test & measurement.

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