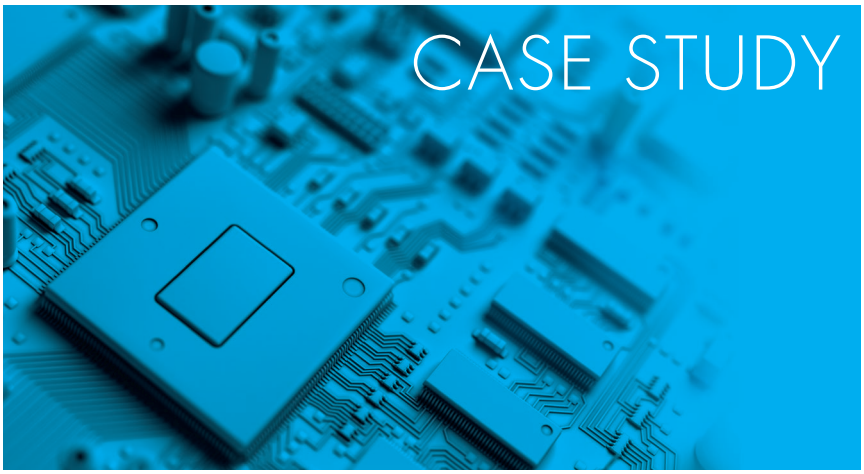
Advanced Cable Tester v2 / USBFireWire.com



Company:
USBFireWire.com

CHALLENGE

USBFireWire creates and provides specially-made cables fit for their customers' specific applications. To ensure each cable produced not only meets specific cable parameters but also aligns with their customers' requirements, their team required a cable testing tool to help them perform a comprehensive set of tests on a mass scale at various points in the product life cycle to identify underlying issues and ensure it passed their inspection.

SOLUTION

USBFireWire acquired the Advanced Cable Tester v2 to help them quickly and comprehensively test USB and HDMI cables at an individual level, including cables subjected to various conditions in the lab as well as the final product on the production line.

BENEFIT

Having the ability to comprehensively and affordably test each cable at an individual level has allowed USBFireWire to establish themselves as a go-to cable designer and manufacturer for quality-made and reliable products that their clients can depend on.

USBFireWire.com is a design and build manufacturer of computer cables and custom cable assemblies that include USB, FireWire, Ethernet, HDMI, and waterproof power cables and connectors. USBFireWire works alongside engineers and creative product developers within healthcare, pharmaceutical, manufacturing, robotics, aerospace, transport, telecommunications, agriculture, and defense industries to help design and build made-to-fit cables that address their clients' cable requirements, including the length, angle, and connector type for specific applications.

To ensure the cables designed and manufactured by USBFireWire meet the company's top-tier quality standards as well as address their clients' needs, their team required a tool to allow them to easily perform quality control testing during the development and manufacturing processes.

Background/Problem:

USBFireWire designs and manufactures a variety of different cable types, including USB, FireWire, Ethernet, HDMI, and waterproof power cables and connectors. They supply their customers with quality computer cables with unique configurations that include right-angled, short, and long-length attributes made for a diverse set of applications. In addition, USBFireWire specializes in building custom-made cables to meet their clients' needs, which can include customization for prototyping as well as production line uses. Customers can design the right fitting cable for their application with the exact length, angle, and connector type they require.

USBFireWire works with customers from a variety of industries, including healthcare, pharmaceutical, manufacturing, robotics, aerospace, transport, telecommunications, agriculture, and defense. Many of these customers rely on cables that offer a high bandwidth and power throughput, therefore it is important they are provided with well-built cables that are quality-made, safe, and reliable to use on a day-to-day basis. As part of USBFireWire's mission to provide their customers with industry-leading, high-quality cables, it is vital that they produce a cable that not only meets their standards, but their customers' standards as well.

In cable manufacturing, it is an industry standard to rely on good manufacturing processes and to spot check cables during multiple stages of the product development process. USBFireWire specifically needed a way to test out wire-build quality from manufacturers when they construct new wire designs, and to also test each finished good on a mass scale.

To do so, USBFireWire required a cable testing tool that could meet these demands and thoroughly test various aspects of a cable at different stages of the product development process, including in the lab and on the production line.



Cable Testing and Validation in Lab Environments

The **Advanced Cable Tester v2** is well-suited for various testing applications in laboratory environments. Some of these uses include spot testing, statistical process control, and performing cable validation under different cable conditions and scenarios. The cable tester offers a comprehensive look into the cable as a whole, highlighting areas that do not conform to the cable specification, including incorrect pin wiring, unsafe/insufficient power measurements, and poor signal quality. This allows testers to more easily pinpoint areas that require adjustment.

USBFireWire uses the Advanced Cable Tester v2 within their in-house testing lab to get a more detailed look into the cables and how they test against the cable specification after being subjected to different conditions and scenarios, such as cable operating temperature, storage temperature, flex life, bending radius, material types, etc.

For example, if a cable operates within the cable specification at 0°C, their team also verifies how it will perform at –20°C or –40°C. Additionally, their team verifies the signal quality and how that is affected when cables are flexed in different ways or have certain bending radiuses to ensure the durability of their Robotic-Flex Rated Wire Material.

Testing Finished Cables on the Production Line

USBFireWire not only evaluates cables under development in the laboratory, their team also uses the Advanced Cable Tester v2 for spot testing and larger-scale evaluations on the production line.

The Advanced Cable Tester v2 is optimized for production environments as it can:

- Test cables in seconds at a low cost per test.
- Operate using stand-alone mode that doesn't require a PC.
- Collect and store up to 1,000,000 test results using local storage.
- Offer serialized cards and dates/timestamps that allow for easy testing traceability.

These capabilities have allowed USBFireWire to integrate this tool within their production line environments to help standardize and expedite their quality testing procedures.

Advanced Cable Tester v2 Reporting

USBFireWire found the Advanced Cable Tester v2's reporting particularly helpful when assessing each cable.

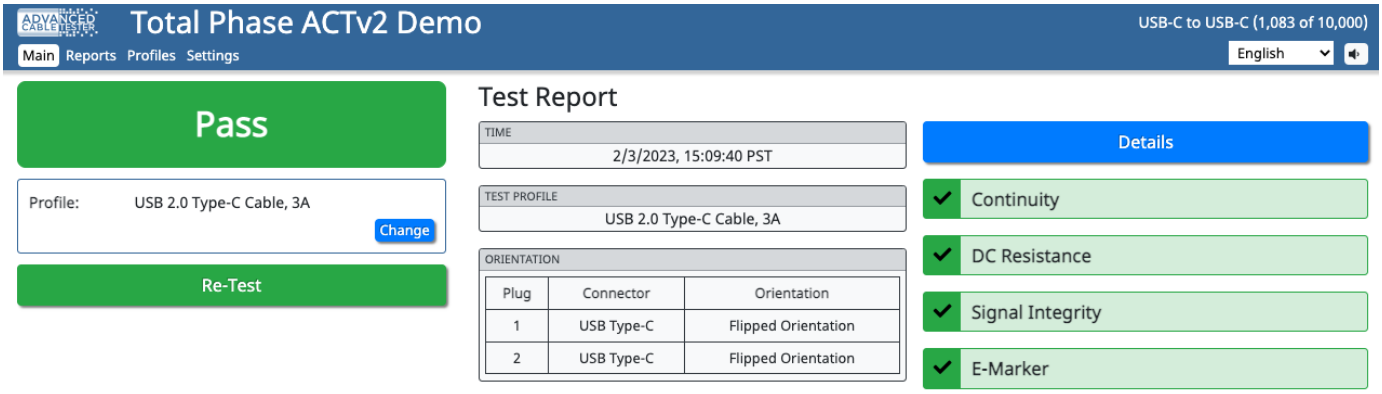
When used on the production line, this tool has provided an efficient way for their team to test individual cables on a mass scale. The cable tester's simplistic operation and reporting allows for users of varying skill sets to operate the machine and interpret the results, as opposed to utilizing tools such as an oscilloscope which often requires higher training and background knowledge. The simple PASS/FAIL result on the cable tester's LCD screen and web interface signifies whether or not the cable meets the specification or other specified criteria.

Users can also review the cable tester's web interface to find a summary report affirming which testing criteria passed or failed, including the checks for pin continuity, DC resistance, E-Marker, and signal integrity. These criteria are based on the default cable testing profile which compares against the cable specification values.

Users can also create custom cable testing profiles to assess against more or less stringent criteria as needed. This feature provided USBFireWire the flexibility to change certain test parameters, including the speed and dB at which a cable is tested.

For further details on each different test, users can review a comprehensive report that includes a comparison against the captured values to the expected values based on the testing profile. Any areas outside of the expected value or range are flagged.

USBFireWire's customers also find this reporting aspect favorable, as they are provided with detailed and accurate testing documentation that they can review and trust.





Technical Approach

The Advanced Cable Tester v2 extensively tests USB, HDMI, and DisplayPort cables for important quality and safety checks, including pin continuity, DC resistance, signal integrity, E-marker, and other cable-specific tests to ensure it meets the required cable specifications set by the respective cable organizations or criteria set by the tester.

Pin Continuity

The pin continuity test checks if pins from one connector are continuous with pins on the other connector. The report compares both ends of the plug to the expected plug values. If there are any deviations, a flag on the test will occur. This test helps detect shorts, opens, routings, and can help prevent dangerous occurrences like VBUS/GND reversals

Through this test, USBFireWire has been able to ensure that no outgoing cables contain any wiring issues or misconfigurations. This is particularly helpful when building USB Type-C connectors that are more prone to manufacturing inconsistencies due to their complexity.



Plug 1 : USB Type-C (Flipped Orientation)



Plug 2 : USB Type-C (Flipped Orientation)

Results

Continuity

Status	Wire	Plug 1	Expected Plug 1	Plug 2	Expected Plug 2
✓	CC	A5	A5	A5	A5
✓	DN1	A7	A7	A7	A7
✓	DN2			B7	B7
✓	DN2	B7	B7		
✓	DP1	A6	A6	A6	A6
✓	DP2			B6	B6
✓	DP2	B6	B6		
✓	GND, SHIELD	A1, A12, B1, B12, SHELL	A1, A12, B1, B12, SHELL	A1, A12, B1, B12, SHELL	A1, A12, B1, B12, SHELL
✓	RX1N, TX1N	B10	B10	A3	A3
✓	RX1P, TX1P	B11	B11	A2	A2
✓	RX2N, TX2N	A10	A10	B3	B3
✓	RX2P, TX2P	A11	A11	B2	B2
✓	SBU1, SBU2	A8	A8	B8	B8
✓	SBU2, SBU1	B8	B8	A8	A8
✓	TX1N, RX1N	A3	A3	B10	B10
✓	TX1P, RX1P	A2	A2	B11	B11
✓	TX2N, RX2N	B3	B3	A10	A10
✓	TX2P, RX2P	B2	B2	A11	A11
✓	VBUS	A4, A9, B4, B9	A4, A9, B4, B9	A4, A9, B4, B9	A4, A9, B4, B9
✓	VCONN			B5	B5
✓	VCONN	B5	B5		

E-Marker

On USB Type-C cables, the E-Marker test reads the data from any present E-Marker, then validates the advertised data and power capabilities against the actual measured parameters of the cable. Additionally, fields such as Vendor ID, Product ID, Test ID, firmware and hardware versions can be set by the operator, for easy pass/fail determination of cables through a QA process.

E-Marker

E-Marker Presence (PD Spec 2 Support)

Status	Plug	Packet Type	Expected	Measured
✓	1	SOP'	Present	Present
✓	1	SOP''	Absent	Absent
✓	2	SOP'	Present	Present
✓	2	SOP''	Absent	Absent

E-Marker Presence (PD Spec 3 Support)

Status	Plug	Packet Type	Expected	Measured
	1	SOP'		Present
✓	1	SOP''	Absent	Absent
	2	SOP'		Present
✓	2	SOP''	Absent	Absent

E-Marker VDOs

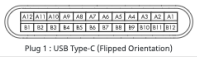
Status	Subtype	Expected	Measured
	USB Vendor ID		0x291A
	Decoded USB Vendor ID Lookup		Anker Innovations Limited
	Modal Operation Supported		true
✓	Product Type	Passive Cable (0b011)	Passive Cable (0b011)
	XID		3341
	USB Product ID		0x0D0C
	bcdDevice		0x0310
✓	SOP'' Controller Present?	false	false
✓	VBUS Through Cable	true	true
✓	VBUS Current Handling Capability	Five Amps (0b10)	Five Amps (0b10)
	SSRX2 Directionality		true
	SSRX1 Directionality		true
	SSTX2 Directionality		true
	SSTX1 Directionality		true
	Cable Termination		VCONN Not Required (0b00)
	Cable Latency		<10ns (0b0001)
✓	Plug Type	USB Type-C (0b10)	USB Type-C (0b10)
	FW Version		0x0
	HW Version		0x0
✓	USB SuperSpeed Signaling	USB 3.1 Gen 2 (0b010)	USB 3.1 Gen 2 (0b010)

E-Marker VDOs (PD Spec 3 Specific)

Status	Subtype	Expected	Measured
	PD3: EPR Mode Capable		false
	PD3: Max VBUS Voltage		20V
	PD3: VDO Version		0

DC Resistance

The DC resistance ("DCR") test confirms that each power pin (VBUS and GND) is capable of carrying the required current per the cable specification. For Type-C cables, each power pin is individually measured, then the cable as a whole is tested. Pass/fail criteria ensure that the cable will meet the specification requirements, such as Type-C IR Drop. If present, Type-C SBU and CC lines are also tested for DCR.



Plug 1 : USB Type-C (Flipped Orientation)



Plug 2 : USB Type-C (Flipped Orientation)

DC Resistance

Status	Group	Label	Sources	Sinks	Expected Min (Ω)	Expected Max (Ω)	Measured (Ω)
✓	GND / SHIELD	GND Cable	Plug 1: B1, A12, A1, B12	Plug 2: B1, A12, A1, B12	0.000	0.050	0.029
✓	GND / SHIELD	GND Cable with SHELLs	Plug 1: B1, A12, SHELL, A1, B12	Plug 2: B1, A12, SHELL, A1, B12	0.000	0.050	0.027
✓	GND / SHIELD	SHIELD Cable	Plug 1: SHELL	Plug 2: SHELL	0.000	15.000	0.159
✓	GND / SHIELD	Plug 1 Pin A1	Plug 1: A1	Plug 1: B1, A12, SHELL, B12 Plug 2: B1, A12, SHELL, A1, B12	0.000	0.040	0.020
✓	GND / SHIELD	Plug 1 Pin A12	Plug 1: A12	Plug 1: B1, SHELL, A1, B12 Plug 2: B1, A12, SHELL, A1, B12	0.000	0.040	0.019
✓	GND / SHIELD	Plug 1 Pin B1	Plug 1: B1	Plug 1: A12, SHELL, A1, B12 Plug 2: B1, A12, SHELL, A1, B12	0.000	0.040	0.021
✓	GND / SHIELD	Plug 1 Pin B12	Plug 1: B12	Plug 1: B1, A12, SHELL, A1 Plug 2: B1, A12, SHELL, A1, B12	0.000	0.040	0.020
✓	GND / SHIELD	Plug 2 Pin A1	Plug 2: A1	Plug 1: B1, A12, SHELL, A1, B12 Plug 2: B1, A12, SHELL, B12	0.000	0.040	0.021
✓	GND / SHIELD	Plug 2 Pin A12	Plug 2: A12	Plug 1: B1, A12, SHELL, A1, B12 Plug 2: B1, SHELL, A1, B12	0.000	0.040	0.020
✓	GND / SHIELD	Plug 2 Pin B1	Plug 2: B1	Plug 1: B1, A12, SHELL, A1, B12 Plug 2: A12, SHELL, A1, B12	0.000	0.040	0.020
✓	GND / SHIELD	Plug 2 Pin B12	Plug 2: B12	Plug 1: B1, A12, SHELL, A1, B12 Plug 2: B1, A12, SHELL, A1	0.000	0.040	0.020
✓	GND / SHIELD	Plug 1 SHELL to GND	Plug 1: SHELL	Plug 1: B1, A12, A1, B12 Plug 2: B1, A12, SHELL, A1, B12	0.000	1.500	0.115
✓	GND / SHIELD	Plug 2 SHELL to GND	Plug 2: SHELL	Plug 1: B1, A12, SHELL, A1, B12 Plug 2: B1, A12, A1, B12	0.000	1.500	0.027
✓	VBUS	VBUS Cable	Plug 1: B4, A9, B9, A4	Plug 2: B4, A9, B9, A4	0.000	0.100	0.058
✓	VBUS	Plug 1 Pin A4	Plug 1: A4	Plug 1: B4, A9, B9 Plug 2: B4, A9, B9, A4	0.000	0.040	0.020
✓	VBUS	Plug 1 Pin A9	Plug 1: A9	Plug 1: B4, B9, A4 Plug 2: B4, A9, B9, A4	0.000	0.040	0.020
✓	VBUS	Plug 1 Pin B4	Plug 1: B4	Plug 1: A9, B9, A4 Plug 2: B4, A9, B9, A4	0.000	0.040	0.022
✓	VBUS	Plug 1 Pin B9	Plug 1: B9	Plug 1: B4, A9, A4 Plug 2: B4, A9, B9, A4	0.000	0.040	0.022
✓	VBUS	Plug 2 Pin A4	Plug 2: A4	Plug 1: B4, A9, B9, A4 Plug 2: B4, A9, B9	0.000	0.040	0.020
✓	VBUS	Plug 2 Pin A9	Plug 2: A9	Plug 1: B4, A9, B9, A4 Plug 2: B4, B9, A4	0.000	0.040	0.022
✓	VBUS	Plug 2 Pin B4	Plug 2: B4	Plug 1: B4, A9, B9, A4 Plug 2: A9, B9, A4	0.000	0.040	0.023
✓	VBUS	Plug 2 Pin B9	Plug 2: B9	Plug 1: B4, A9, B9, A4 Plug 2: B4, A9, A4	0.000	0.040	0.022
✓	Resistors	B5 / Ra Resistor	Plug 1: B5	Plug 1: B1, A12, SHELL, A1, B12 Plug 2: B1, A12, SHELL, A1, B12	800	1.20k	1.01k
✓	Resistors	B5 / Ra Resistor	Plug 2: B5	Plug 1: B1, A12, SHELL, A1, B12 Plug 2: B1, A12, SHELL, A1, B12	800	1.20k	1.08k
✓	Wires	B5 Through	Plug 1: B5	Plug 2: B5	1.60k	∞	2.43k
✓	Wires	CC	Plug 1: A5	Plug 2: A5	0.000	15.000	2.465
✓	Wires	SBU	Plug 1: A8	Plug 2: B8	0.000	5.000	1.903
✓	Wires	SBU	Plug 1: B8	Plug 2: A8	0.000	5.000	1.776

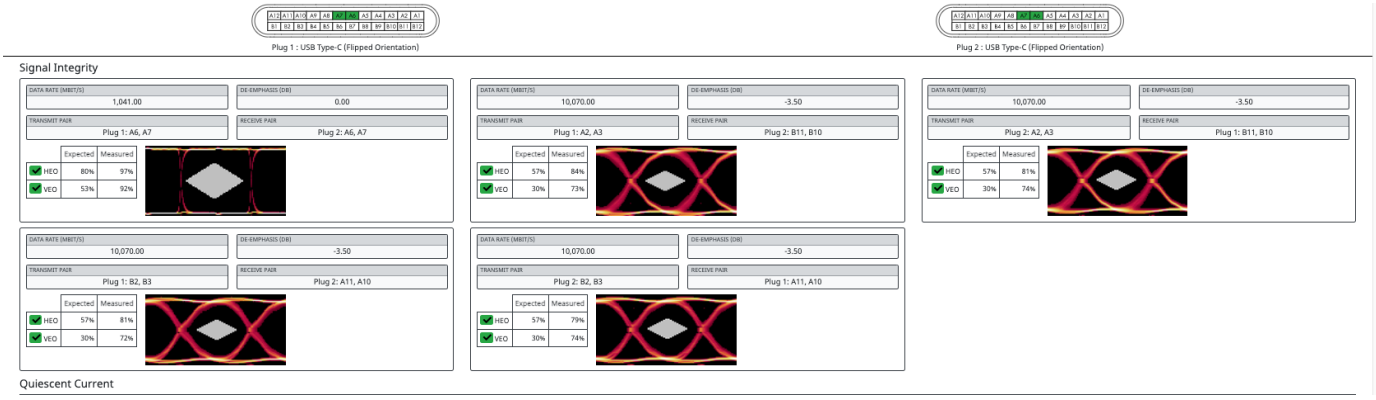
"We at USBFireWire are very happy with the Advanced Cable Tester v2. It's stable, functional, easy to use, and tough to misuse. This unit has given us and our customers the confidence that we are making well-built, reliable products that work day in and day out, as well as peace of mind to know that our processes are the best available and are being implemented properly."

— Rick Wessley, Operations Manager

Signal Integrity

The signal integrity test measures the quality of the differentially paired wires through the cable and is configurable from 518 Mbps up to 12.8 Gbps on up to 5 differential pairs. This test performs a speed test of the cable and is accompanied by eye diagrams that provide a visualization of the quality of signal, including a mask to provide a reference for the HEO and VEO values. If the test achieves lock on the indicated differential pair, the eye diagram image will be displayed on the test. If no lock was achieved, a no-lock image will be displayed.

This test allows USBFireWire to assess how the signal is affected and whether the cable satisfies the cable specification when testing cables under different circumstances, such when cables are angled or moved in different ways, or are at different bending radiuses.



Conclusion:

USBFireWire's product development and manufacturing teams have greatly benefited from using the Advanced Cable Tester v2. By incorporating this unit into their lab development and production line processes, they are now able to quickly and easily test hundreds of cables to ensure each cable meets their quality standards and to ensure they are providing their customers with a specialized product they can trust for their critical cable applications.

Product Brief:

The Advanced Cable Tester v2 combines blazing fast performance with a low cost per test and a rugged design, enabling rapid spot-checking of cables, easy-to-understand reports, with 100% test coverage for lab and production environments at a fraction of the price, time, and labor versus other solutions. Supporting a variety of cable types including USB, HDMI, and DisplayPort, this cable tester comprehensively tests each cable for criteria including pin continuity, DC resistance, signal integrity, E-marker, and other tests to ensure it meets the required cable specification.



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