Underwriters Laboratories, Inc.
455 East Trimble Road. San Jose, CA 95131,
USA

TEST REPORT

ACCORDING TO: TIA-968-A and IC CS-03

FOR:

Ribbon
SBC 2000 Session Border Controller

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Report ID: 12CA45891DUS4 Rev V2
Date of Issue: 6/2/2018

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1 Client information

Client name:	Ribbon Communications Inc.
Address:	4 Technology Park Drive, Westford, MA 01886, USA.
E-mail:	aelshama@rbbn.com
Contact name:	Mr Adam Elshama

2 Equipment Under Test

Product name:	Session Border Controller
Model(s):	SBC 2000
Serial number:	01-88360
Software version	UX2000 release 1
Receipt date	6/2/2010
Sample Tag Number	841872
Modification status	As received
Parameters affecting compliance	The equipment may be configured for use as a T1 or E1 interface. Testing was performed with the equipment set for T1 operation.

3 Test project performance

Project ID:	10CA16493 T1
Location:	Underwriters Laboratories, Inc. 455 East Trimble Road. San Jose, CA 95131, USA
Test started:	6/3/2010 7:33:00 AM
Test completed:	6/16/2010
Test specification(s):	**TIA-968-A Telecommunications ,Telephone Terminal Equipment ,Technical Requirements for Connection of Terminal Equipment to the Telephone Network** Approved: October 29, 2002 TIA-968-A-1 (Addendum 1 to TIA-968-A) Approved: July 23, 2003) TIA-968-A-2 (Addendum 2 to TIA-968-A) Approved: January 29, 2004) TIA-968-A-3 (Addendum 3 to TIA-968-A) Approved: December 9, 2004) TIA-968-A-4 (Addendum 4 to TIA-968-A) Approved: November 3, 2006 TIA-968-A-5 (Addendum 5 to TIA-968-A) Approved: July 25, 2007 **CS-03 Issue 9, Amendment 1 July 2005** Issue 9, Amendment 1, July 2005 Issue 9, Amendment 2, March 2006 Issue 9, Amendment 3, October 2006, April 2007 Issue 9, Amendment 4, May 2009
Test suite:	TIA-968-A-3 1.544 Mbps TE (11/20/2007 5:55:34 PM, modified)

4 Test report summary

Testing was completed against all relevant requirements of the test standard. Results obtained indicate that the product under test complies in full with the requirements tested.

The test results relate only to the items tested.

A summary of the test status of the product under test with respect to each test requirement of the standard is provided in section 9.

Detailed test results are presented in section 10.

	Name and Title	**Date**	**Signature**
Tested by:	Dave Weaver	6/16/2010	
Reviewed by:	Tim Lee	6/16/2010	

Rev.	Date	Revisions	Revised By
-	6/16/2010	Original Issue	-
V1	9/21/2016	Updated model number and company name and address	Dave Weaver
V2	6/2/2018	Updated company name and product name. The report was previously issued under the Sonus brand name. The company name has now changed to Ribbon Communications Inc. Only cosmetic changes have occurred to reflect the rebranding.	Dave Weaver

5 EUT description

The Ribbon SBC 2000 is a 1U (1.75”) high and 19” wide Unified Communications Exchange with one single board computer, up to six digital signaling processors, five Ethernet ports for internet protocol devices and two 2-connector USB ports for data devices. It also has the option to provide one additional Stratum-3 Building Integrated Timing Source (BITS) card and one additional four-port Ethernet card.

There are 2 configurable card slots at the back of the Ribbon SBC 2000 chassis to provide connection for the following interface card –

1. 2 / 4 / 8-port T1/E1 PSTN cards for connection to public network 1544 kbit/s or 2048 kbit/s digital and ISDN primary rate access lines.
2. *8 / 16 / 24-port FXS cards for on-premises analog telephone equipment.
3. *8 / 16 / 24-port FXO cards for connection to PSTN analog trunk lines.
4. *T1/E1 WAN card with 2 x 8-port T1/E1 daughter-cards for WAN connectivity.
5. *Serial Data card with 2 x 8-port Serial Data daughter-cards for data communication or terminal equipment.

*****Note: cards listed in items 2, 3, 4 and 5 were not evaluated

SBC 2000 system submitted for testing

The configuration of Ribbon SBC 2000 Unified Communications Exchange for testing

is fully equipped with the following components.

1. Dual input 100-240Vac, 50/60Hz UL/cUL/CB certified PSU.
2. One single board computer with hard-drive.
3. Six digital signaling processors.
4. Two 8-port T1/E1 PSTN ISDN interface cards.
5. Five 10/100/1000 Base-T Ethernet ports and two 2-connector USB ports.

The 8-port T1/E1 PSTN ISDN interface card was the interface assessed.

6 Test laboratory description

Recognized under the National Voluntary Laboratory Accreditation Program (NVLAP) for Telecommunications Evaluation. NVLAP Lab Code: 200252-0. This assessment has been performed in accordance with the requirements of ISO 17025.

Testing has been performed in accordance with issued UL test procedures.

This report may contain data that are not covered by the NVLAP accreditation (LAB code 200252-0). Please refer to Section 9 "Results Summary Table " for further details.

This report shall not be used to claim, constitute or imply product certification, approval, or endorsement by NVLAP or any agency of the US government.

All tests were performed under the following environmental conditions:

Temperature range	:	19 – 25 ^{o}C
Humidity range	:	5 – 75 %
Pressure range	:	86 – 106 kPa
Power supply range	:	Within 10% of rated voltage.

7 Test equipment used

Description	Model	S/N	Hardware Rev.	Software Rev.	Last Calibration
Telecom Conformance Analyzer	Hermon Laboratories TCA 8200	8764	A4.05	2.3.10	1/3/2010 1:37:56 AM
Surge Generator*	CDI M5	1873	-	-	
Transient Coupler*	CDI STC-5	2641	-	-	*Used with calibrated instruments
Mains Coupling Network*	CDI 3CN	1874	-	-	
Leakage Tester*	CDI HVC-200	2800	-	-	
Transient Waveform Monitor	TWM-5	2640	-	-	07/20/2009
Multimeter	Fluke 87	2511	-	-	06/12/2009
Oscilloscope	Le Croy 9370M	2830	-	-	2/24/2010

8 Requirement conditions table

Condition	Applies
Is the EUT hand-held or table-top equipment with a weight less than 5 kg?	No
Is the EUT intended to have a connection to earth?	Yes
Is the EUT AC powered?	Yes
Does the EUT have an intentional dc conducting path from its telephone connection to earth ground at operational voltages?	No
Does the EUT have an intentional dc conducting path from its telephone connection to earth ground for protection purposes?	No
XD - Digital Equipment that is not designed for direct connection to the PSTN (i.e. must be connected through an NCTE) but provides billing protection and analog encoded content protection.	No
DE - Digital Equipment that is designed for direct connection to the PSTN and does not provide billing protection and analog encoded content protection (e.g. NCTE, CSU).	No
DD - Digital equipment that is designed for direct connection to the PSTN and provides billing protection and analog encoded content protection.	No
Does the EUT telephone interface go off-premises on common carrier facilities? (only for XD type)	No
Does the EUT include digital to digital through transmission path for analog encoded content towards the PSTN ?	No
Does the EUT include analog to digital through transmission path towards the PSTN ?	No
Is the EUT T1 interface (not ISDN PRI)?	No
Does the EUT have a handset?	No

9 Test results summary

TIA-968-A	CS 03	Test Description	Status	Result	Notes
4.2		**ENVIRONMENTAL SIMULATION**	**—**		
4.2.1	2.1.1 Pt I	Mechanical Shock	NA	—	
4.2.2.1	2.4.1 Pt I	Metallic Voltage Surge – Type A	A	PASS	
4.2.2.2	2.4.2 Pt I	Longitudinal Voltage Surge – Type A	A	PASS	
4.2.3.1	NER	Metallic Voltage Surge – Type B	A	PASS	
4.2.3.2	NER	Longitudinal Voltage Surge – Type B	A	PASS	
4.2.4	2.5.1 Pt I	Power Line Surge	A	PASS	
4.3		**LEAKAGE CURRENT LIMITATIONS**	**—**		
	2.2.1 Pt I	Leakage Current	A	PASS	
4.4		**HAZARDOUS VOLTAGE LIMITATIONS**	**—**		
4.4.1	2.3.1 Pt I	Hazardous Voltage – General	A	PASS	
4.4.1.1/2	2.3.2 Pt I	Type I E&M Leads	NA	—	
4.4.1.3	2.3.3 Pt I	Type II E&M Leads	NA	—	
4.4.1.4	2.3.4 Pt I	Off Premise Station (OPS) Voltage	NA	—	
4.4.1.5	2.3.4 Pt I	Direct Inward Dialing (DID) Voltage	NA	—	
4.4.1.6	2.3 Pt I	Local Area Data Channel Interfaces (LADC)	NA	—	
4.4.1.7	2.3.5 Pt I	Ringdown Voiceband Private Line & Metallic Channel I/F	NA	—	
4.4.2	2.3.6 Pt I	Non-registered Equipment	NA	—	
4.4.3	2.3.7 Pt I	Non-hazardous Voltage Source	NA	—	
4.4.4	2.3.8 Pt I	Ringing Source Limitations	NA	—	
4.4.5.1	2.3.9.1 Pt I	Intentional Operational Paths to Ground	NA	—	
4.4.5.2	2.3.9.2 Pt I	Intentional Protective Paths to Ground	NA	—	
4.5		**SIGNAL POWER LIMITATIONS**	**—**		
4.5.2.1	3.4.1 Pt I	Voiceband Metallic Signal Power (non-voice)	NA	—	
4.5.2.2	3.4.3 Pt I	Voiceband Metallic Signal Power (network control signaling)	NA	—	
4.5.2.3.1	3.4.5(2) Pt I	Through Transmission (DC conditions)	NA	—	
4.5.2.3.2	3.4.5(2) Pt I	Through Transmission (data jack requirements)	NA	—	
4.5.2.4	3.4.4 Pt I	Data circuit terminal equipment power levels	NA	—	
4.5.2.5	3.4.5 Pt I	Through Transmission Amplification and Loss	NA	—	
4.5.2.6.1	3.8 Pt I	Tie Trunk return loss	NA	—	
4.5.2.7	NER	DC Conditions for OPS Ports	NA	—	
4.5.3.1	3.4.6	Signal power 3995–4005 Hz (internally generated signals)	NA	—	
4.5.3.2	3.4.6	Signal power 3995–4005 Hz (through transmission)	NA	—	
4.5.4.1	3.3.3.1 Pt I	Longitudinal Voltage below 4 kHz	NA	—	
4.5.5.1	3.4.6 Pt I	Metallic Voltage 4 kHz – 30 MHz	NA	—	
4.5.5.2	3.3.3.2/3 Pt I	Longitudinal Voltage 4 kHz – 6 MHz	NA	—	
4.5.6	3.1.1	LADC Interface requirements (LDM)	NA	—	
4.5.8.1	3.2 Pt VII	Subrate Requirements	NA	—	
4.5.8.2	3.2 Pt II	1.544 Mbps interface requirements	A	PASS	
4.5.8.3	NER	PSDS Requirements	NA	—	
4.5.8.4	3.5.2 Pt VI	ISDN Encoded Analog Content (BRA only)	NA	—	
4.5.9	3.2-5 Pt VIII	DSL Requirements	NA	—	
4.6		**TRANSVERSE BALANCE LIMITATIONS**	**—**		

TIA-968-A	CS 03	Test Description	Status	Result	Notes
4.6.2	3.6.2 Pt I	Transverse Balance – Analog Voiceband Equipment	NA	—	
4.6.3	3.2.7 Pt VI	Transverse Balance – Digital Equipment	A	PASS	
4.6.4/5	3.4 Pt VIII	Transverse Balance – DSL Equipment	NA	—	
4.7		**ON-HOOK IMPEDANCE LIMITATIONS**	—		
4.7.2	3.7.3 Pt I	On-Hook DC Resistance – Loop-start equipment	NA	—	
4.7.3	3.7.3 Pt I	On-Hook DC Resistance – Ground-start equipment	NA	—	
4.7.4/5	1.8 Pt I	Ringer Equivalence	NA	—	
4.7.6	NER	OPS Ring Trip requirement	NA	—	
4.7.8	NER	Transition to off-hook state	NA	—	
4.8		**BILLING PROTECTION**	—		
4.8.1	3.5.1 Pt I	Call Duration	NA	—	
4.8.2	3.3.1	On-hook output power	NA	—	
4.8.3	3.5.1.1 Pt I	Loop current requirements	NA	—	
4.8.4	3.5.2.1 Pt I	Signaling Interference	NA	—	
4.8.5	3.6.2.1 Pt VII	1.544 Mbps on-hook power requirements	NA	—	
4.8.6	3.5.1 Pt VII	1.544 Mbps off-hook signal signaling requirements	NA	—	
4.8.7	3.5.3 Pt I	Direct inward dialing requirements	NA	—	
47 CFR part 68	**CS 03**	Test Description	**Status**	**Result**	**Notes**
68.317	Pt V	Hearing aid compatibility	NA	—	
68.318	3.9 Pt I	Additional limitations	NA	—	

10 Detailed test results

Test specification:	4.2.2.2 Metallic voltage surge - type A		
Test purpose:	Unit shall not cause harm to the network after two 800 V 100 A peak surges (one of each polarity) of a metallic voltage were applied		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	6/16/2010 10:38:55 AM		
Remarks: Post surge			

Test results

Test leads			
		Normal	Inverse
4-wire	Tip - Ring grounded	X	X
	Ring – Tip grounded	X	X
	Tip1 - Ring1 grounded	X	X
	Ring 1 – Tip 1	X	X

Failure modes resulting from application of Type A telephone line surges:

Regardless of operating state, equipment and circuitry are allowed to be in violation of the transverse balance requirements of section 5 and, for terminal equipment connected to local area data channels, the longitudinal voltage requirements of subclause 5.2.1.4.3, if:

a) Such failure results from an intentional, designed failure mode that has the effect of connecting telephone or auxiliary connections with earth ground; and,

b) If such a failure mode state is reached, the equipment is designed so that it would become substantially and noticeably unusable by the user, or an indication is given (e.g., an alarm), in order that such equipment can be immediately disconnected or repaired.

Failure modes resulting from application of Type B telephone line surges:

Approved terminal equipment and approved protective circuitry shall withstand the energy of Type B surge without causing permanent opening or shorting of the interface circuit and without sustaining damage that will affect compliance with the Standard.

Test specification:	4.2.2.2 Metallic voltage surge - type A		
Test purpose:	Unit shall not cause harm to the network after two 1500 V 200 A peak surges (one of each polarity) of a longitudinal voltage were applied		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	6/16/2010 10:31:55 AM		
Remarks: Post surge			

Test results

Test leads	On-hook	
	Normal	Inverse
Tip - Ring	X	X
Tip 1 - Ring 1	X	X

Failure modes resulting from application of Type A telephone line surges:

Regardless of operating state, equipment and circuitry are allowed to be in violation of the transverse balance requirements of section 5 and, for terminal equipment connected to local area data channels, the longitudinal voltage requirements of subclause 5.2.1.4.3, if:

a) Such failure results from an intentional, designed failure mode that has the effect of connecting telephone or auxiliary connections with earth ground; and,

b) If such a failure mode state is reached, the equipment is designed so that it would become substantially and noticeably unusable by the user, or an indication is given (e.g., an alarm), in order that such equipment can be immediately disconnected or repaired.

Failure modes resulting from application of Type B telephone line surges:

Approved terminal equipment and approved protective circuitry shall withstand the energy of Type B surge without causing permanent opening or shorting of the interface circuit and without sustaining damage that will affect compliance with the Standard.

Test specification:	4.2.3.1 Metallic voltage surge - type B		
Test purpose:	Unit shall withstand without causing permanent opening or shorting of the interface circuit and without damage affecting compliance with the rules after two 1000 V 25 A peak surges (one of each polarity) of a metallic voltage were applied		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	6/16/2010 10:32:14 AM		
Remarks: Post surge			

Test results

Test leads			
		Normal	Inverse
4-wire	Tip - Ring grounded	X	X
	Ring – Tip grounded	X	X
	Tip1 - Ring1 grounded	X	X
	Ring 1 – Tip 1	X	X

Failure modes resulting from application of Type A telephone line surges:

Regardless of operating state, equipment and circuitry are allowed to be in violation of the transverse balance requirements of section 5 and, for terminal equipment connected to local area data channels, the longitudinal voltage requirements of subclause 5.2.1.4.3, if:

a) Such failure results from an intentional, designed failure mode that has the effect of connecting telephone or auxiliary connections with earth ground; and,

b) If such a failure mode state is reached, the equipment is designed so that it would become substantially and noticeably unusable by the user, or an indication is given (e.g., an alarm), in order that such equipment can be immediately disconnected or repaired.

Failure modes resulting from application of Type B telephone line surges:

Approved terminal equipment and approved protective circuitry shall withstand the energy of Type B surge without causing permanent opening or shorting of the interface circuit and without sustaining damage that will affect compliance with the Standard.

Test specification:	4.2.3.2 Longitudinal voltage surge - type B		
Test purpose:	Unit shall not cause harm to the network after two 1500 V 37.5 A peak surges (one of each polarity) of a longitudinal voltage were applied		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	6/16/2010 10:32:37 AM		
Remarks: Post surge			

Test results

Test leads		
	Normal	Inverse
Tip - Ring	X	X
Tip 1 - Ring 1	X	X

Failure modes resulting from application of Type A telephone line surges:

Regardless of operating state, equipment and circuitry are allowed to be in violation of the transverse balance requirements of section 5 and, for terminal equipment connected to local area data channels, the longitudinal voltage requirements of subclause 5.2.1.4.3, if:

a) Such failure results from an intentional, designed failure mode that has the effect of connecting telephone or auxiliary connections with earth ground; and,

b) If such a failure mode state is reached, the equipment is designed so that it would become substantially and noticeably unusable by the user, or an indication is given (e.g., an alarm), in order that such equipment can be immediately disconnected or repaired.

Failure modes resulting from application of Type B telephone line surges:

Approved terminal equipment and approved protective circuitry shall withstand the energy of Type B surge without causing permanent opening or shorting of the interface circuit and without sustaining damage that will affect compliance with the Standard.

Test specification:	4.2.4 Power line surge		
Test purpose:	Unit shall withstand without damage affecting compliance with the rules after six 2500-volt peak surges (three of each polarity) applied between the phase and neutral terminals of the AC power line		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	6/16/2010 10:32:58 AM		
Remarks:			

Test results

Test leads	On-hook	
	Normal polarity	Inverse polarity
Phase - Neutral	X	X
Phase - Neutral	X	X
Phase - Neutral	X	X

Failure modes resulting from application of power line surge.

Approved terminal equipment and approved protective circuitry shall comply with all the criteria in this Standard, both prior to and after the application of the power line surge notwithstanding that this surge may result in partial or total destruction of the equipment under test.

Test specification:	4.3 Leakage current limitation		
Test purpose:	The leakage current shall not exceed 10 mA peak when voltage of 1000 or 1500 Vrms is applied to the various connections of the TE		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	6/16/2010 10:51:09 AM		
Remarks: Post surge			

Test results

Test leads	Test voltage	Leakage current	Verdict
T/R (1) to exposed conductive surfaces (3)	1000 V rms	<100uA	Pass
T/R (1) to non registered (4)	1000 V rms	<100uA	Pass
T/R (1) to auxiliary (6)	1000 V rms	NA	
T/R (1) to E&M (7)	1000 V rms	NA	
T/R (1) to PR, PC, CY1, CY2 (8)	1000 V rms	NA	
Auxiliary (6) to exposed conductive surfaces (3)	1000 V rms	NA	
E&M (7) to exposed conductive surfaces (3)	1000 V rms	NA	
E&M (7) to non registered (4)	1000 V rms	NA	
Auxiliary (6) to non registered (4)	1000 V rms	NA	
Auxiliary (6) to PR, PC, CY1, CY2 (8)	1000 V rms	NA	
AC (2) to T/R (1)	1500 V rms	<100uA	Pass
AC (2) to exposed conductive surfaces (3)	1500 V rms	<100uA (dc)*	Pass
AC (2) to non registered (4)	1500 V rms	700uA	Pass
AC (1) to points (5)	1500 V rms	NA	
AC (2) to PR, PC, CY1, CY2 (8)	1500 V rms	NA	

* The applied voltage used was 2121V dc because of the mains input filter.

Test specification:	4.4.1 General (T&R)		
Test purpose:	Under no condition of failure of registered terminal equipment or registered protective circuitry that can be conceived to occur in the handling, operation or repair of such equipment or circuitry shall the open circuit voltage on telephone connections exceed 70 volts peak after one second, except for voltages for network control signaling, alerting and supervision.		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	6/16/2010 10:30:39 AM		
Remarks: Post surge			

No condition could be conceived that would lead to non-compliance with this requirement.

Test specification:	4.4.2 Physical separation of leads		
Test purpose:	Leads or any elements having a conducting path to telephone connections shall be reasonably physically separated from power circuits and from circuits connected to non-approved equipment		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	6/16/2010 10:29:16 AM		
Remarks: Post surge			

Observations: There was ample separation

Test specification:	4.5.8.2.1 Pulse repetition rate		
Test purpose:	The transmit signal shall have a free running bit rate of 1544 kbit/s ± 32 ppm.		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	6/3/2010 11:34:46 AM		
Remarks:			

Measurement uncertainty

Expanded uncertainty, k=2 (95% confidence):

Measured bit rate ± 1 ppm

General parameters

Parameter	Value
Overall meas. time	60 s
Tx Clock source	Recovered Clk
Line coding	B8ZS
Frame format	ESF (193E)

Bit rate, Minimum bit rate offset, Maximum bit rate offset

Bit frequency	Minimum bit rate offset	Limit	Maximum bit rate offset	Limit	Verdict
					Pass
1543967 bit/s	-22.7 ppm	-32 ppm	-21.4 ppm	32 ppm	Pass

Test specification:	4.5.8.2.1 Pulse repetition rate		
Test purpose:	The transmit signal shall have a free running bit rate of 1544 kbit/s ± 32 ppm.		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	6/16/2010 9:53:42 AM		
Remarks: Post Surge			

Measurement uncertainty

Expanded uncertainty, k=2 (95% confidence):

Measured bit rate ± 1 ppm

General parameters

Parameter	Value
Overall meas. time	60 s
Tx Clock source	Recovered Clk
Line coding	B8ZS
Frame format	ESF (193E)

Bit rate, Minimum bit rate offset, Maximum bit rate offset

Bit frequency	Minimum bit rate offset	Limit	Maximum bit rate offset	Limit	Verdict
					Pass
1543967 bit/s	-22.7 ppm	-32 ppm	-21.4 ppm	32 ppm	Pass

Test specification:	4.5.8.2.2.1 Pulse shape A		
Test purpose:	The pulse shape of the digital signal applied to a 100 ohm resistor shall fall within the pulse template described in Figure 4.6 (TIA-968-A).		
Test mode:	Evaluation	Verdict:	PASS
Date & Time:	6/3/2010 12:17:14 PM		
Remarks:			

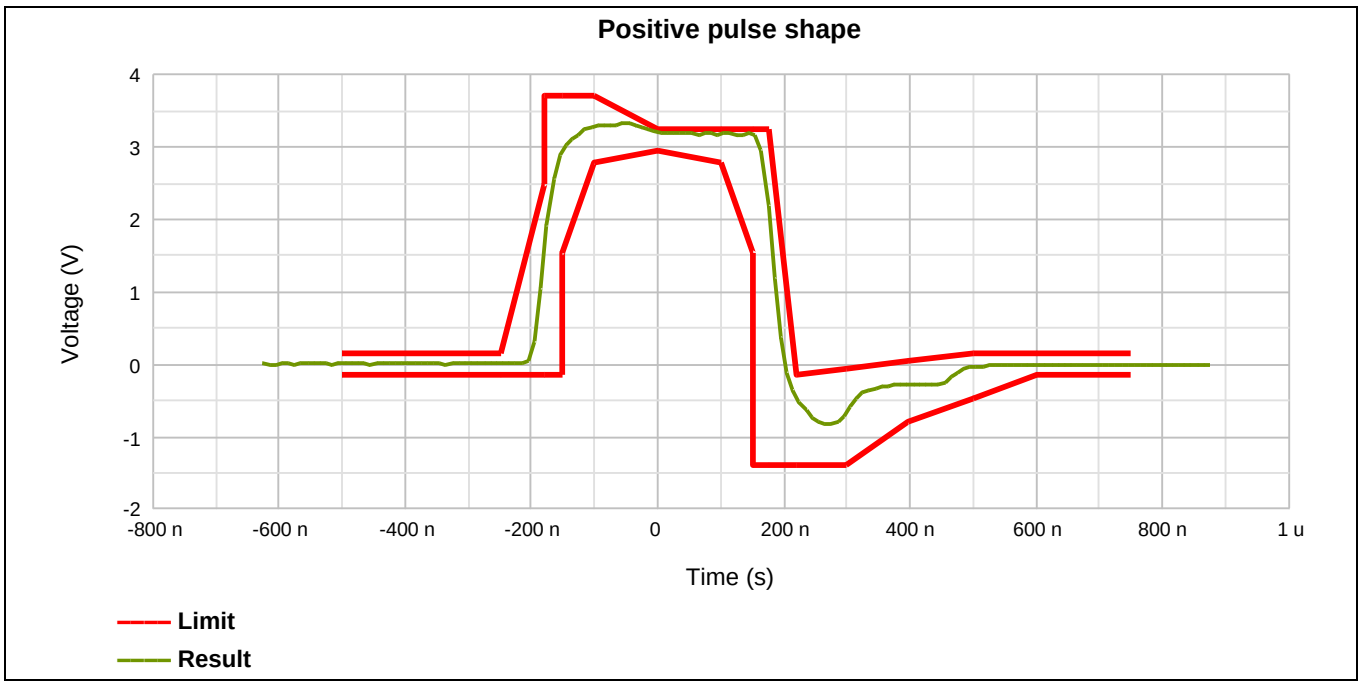
Measurement uncertainty

Expanded uncertainty, k=2 (95% confidence):

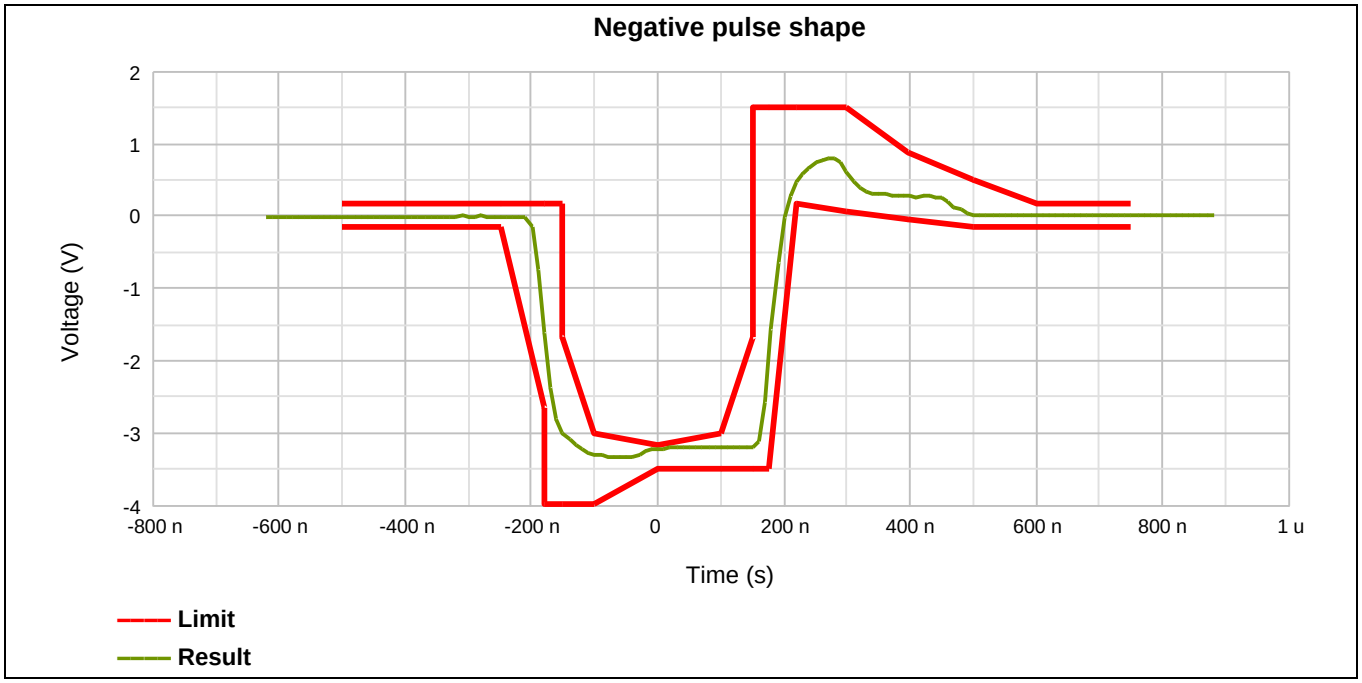
Pulse amplitude	±2.2%
Timing	±0.35%

General parameters

Parameter	Value
Overall meas. time	120 s
Amplitude auto-scaling	On (x 0.80 - x 1.20)
Frame format	ESF (193E)
Pattern	1:2



Test specification:	4.5.8.2.2.1 Pulse shape A		
Test purpose:	The pulse shape of the digital signal applied to a 100 ohm resistor shall fall within the pulse template described in Figure 4.6 (TIA-968-A).		
Test mode:	Evaluation	Verdict:	PASS
Date & Time:	6/3/2010 12:17:14 PM		
Remarks:			



Positive pulse shape fail ratio, Negative pulse shape fail ratio

Ratio	Ratio	Limit	Verdict
			Pass
0 %	0 %	0 %	Pass

Min pos pulse voltage, Max pos pulse voltage, Min neg pulse voltage, Max neg pulse voltage

Min pos peak	Max pos peak	Limit min	Limit max	Min neg peak	Max neg peak	Limit min	Limit max	Verdict
								Pass
3.28 V	3.39 V	2.4 V	3.6 V	-3.29 V	-3.37 V	-3.6 V	-2.4 V	Pass

Test specification:	4.5.8.2.2.1 Pulse shape A		
Test purpose:	The pulse shape of the digital signal applied to a 100 ohm resistor shall fall within the pulse template described in Figure 4.6 (TIA-968-A).		
Test mode:	Evaluation	Verdict:	PASS
Date & Time:	6/16/2010 10:08:49 AM		
Remarks: Post surge			

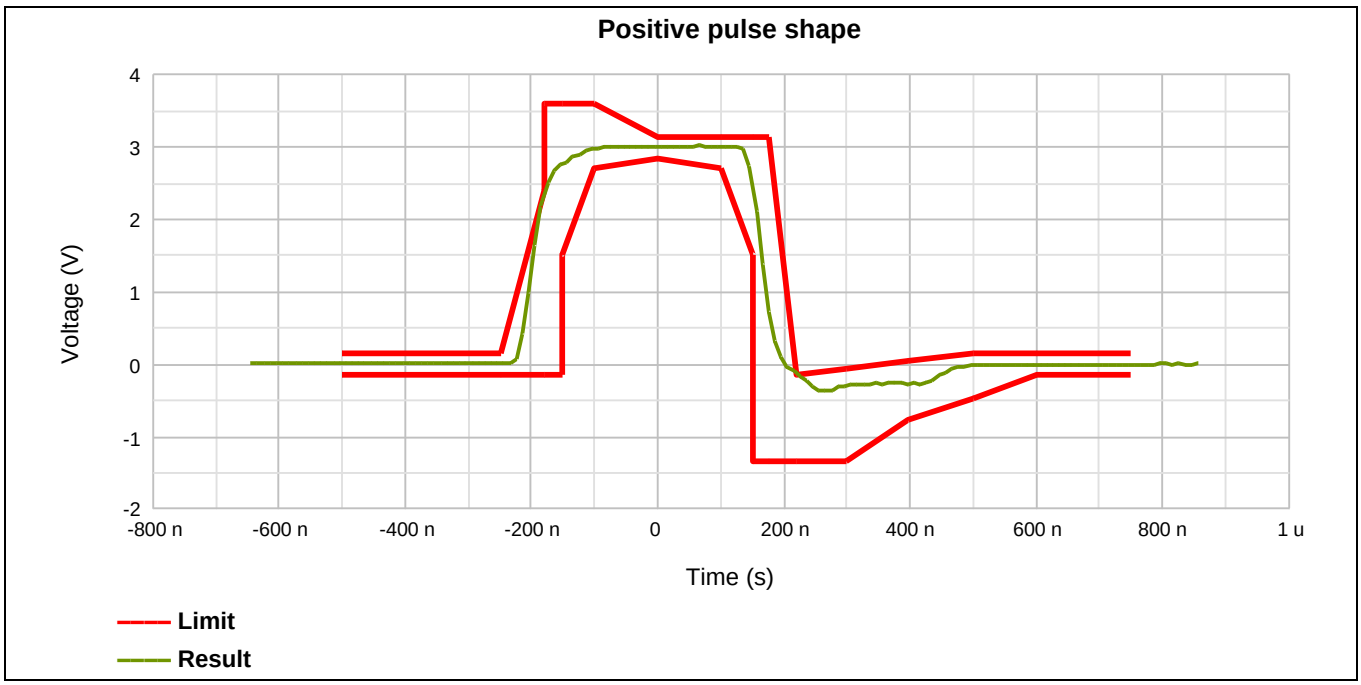
Measurement uncertainty

Expanded uncertainty, k=2 (95% confidence):

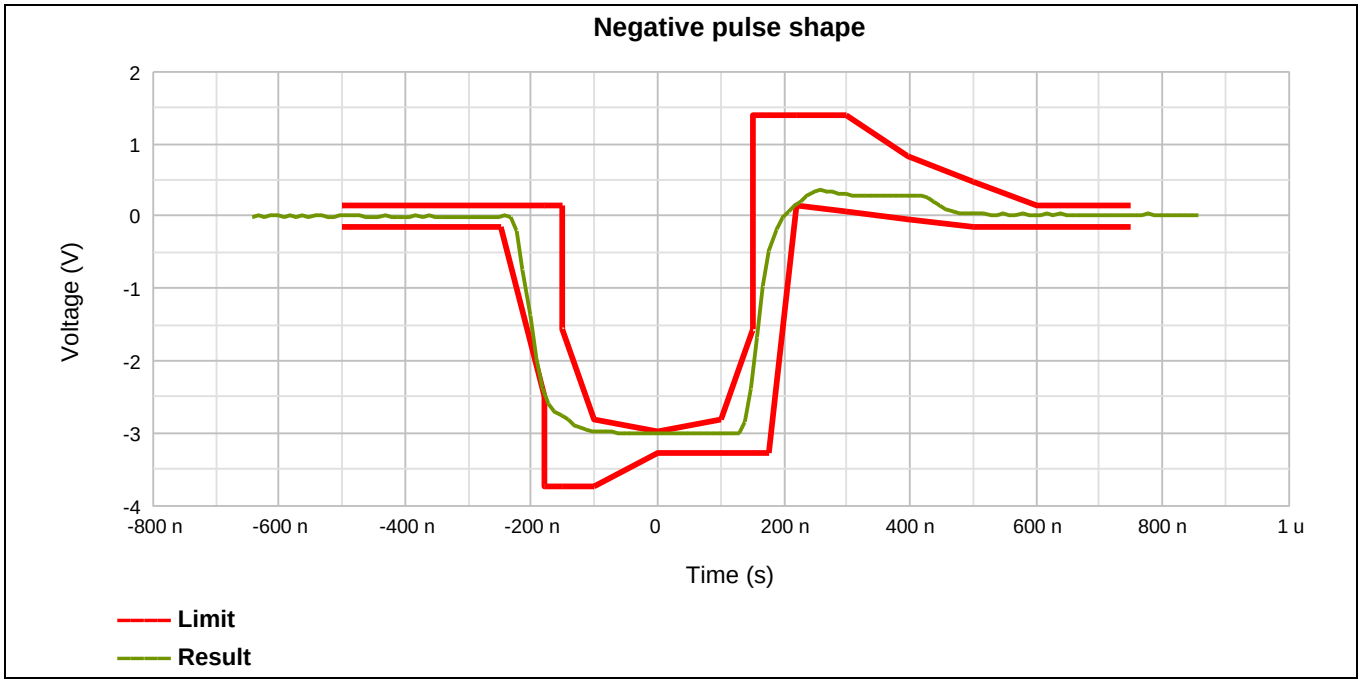
Pulse amplitude	±2.2%
Timing	±0.35%

General parameters

Parameter	Value
Overall meas. time	120 s
Amplitude auto-scaling	On (x 0.80 - x 1.20)
Frame format	ESF (193E)
Pattern	1:2



Test specification:	4.5.8.2.2.1 Pulse shape A		
Test purpose:	The pulse shape of the digital signal applied to a 100 ohm resistor shall fall within the pulse template described in Figure 4.6 (TIA-968-A).		
Test mode:	Evaluation	Verdict:	PASS
Date & Time:	6/16/2010 10:08:49 AM		
Remarks: Post surge			



Positive pulse shape fail ratio, Negative pulse shape fail ratio

Ratio	Ratio	Limit	Verdict
			Pass
0 %	0 %	0 %	Pass

Min pos pulse voltage, Max pos pulse voltage, Min neg pulse voltage, Max neg pulse voltage

Min pos peak	Max pos peak	Limit min	Limit max	Min neg peak	Max neg peak	Limit min	Limit max	Verdict
								Pass
2.99 V	3.07 V	2.4 V	3.6 V	-2.98 V	-3.06 V	-3.6 V	-2.4 V	Pass

Test specification:	4.5.8.2.2.2 Pulse shape B		
Test purpose:	The pulse shape of the digital signal applied to a 100 ohm resistor shall fall within the pulse template obtained by passing the bounding pulses described in Figure 4.6 through the transfer function described in paragraph 4.5.8.2.2.2 (TIA-968-A).		
Test mode:	Evaluation	Verdict:	PASS
Date & Time:	6/3/2010 12:20:19 PM		
Remarks:			

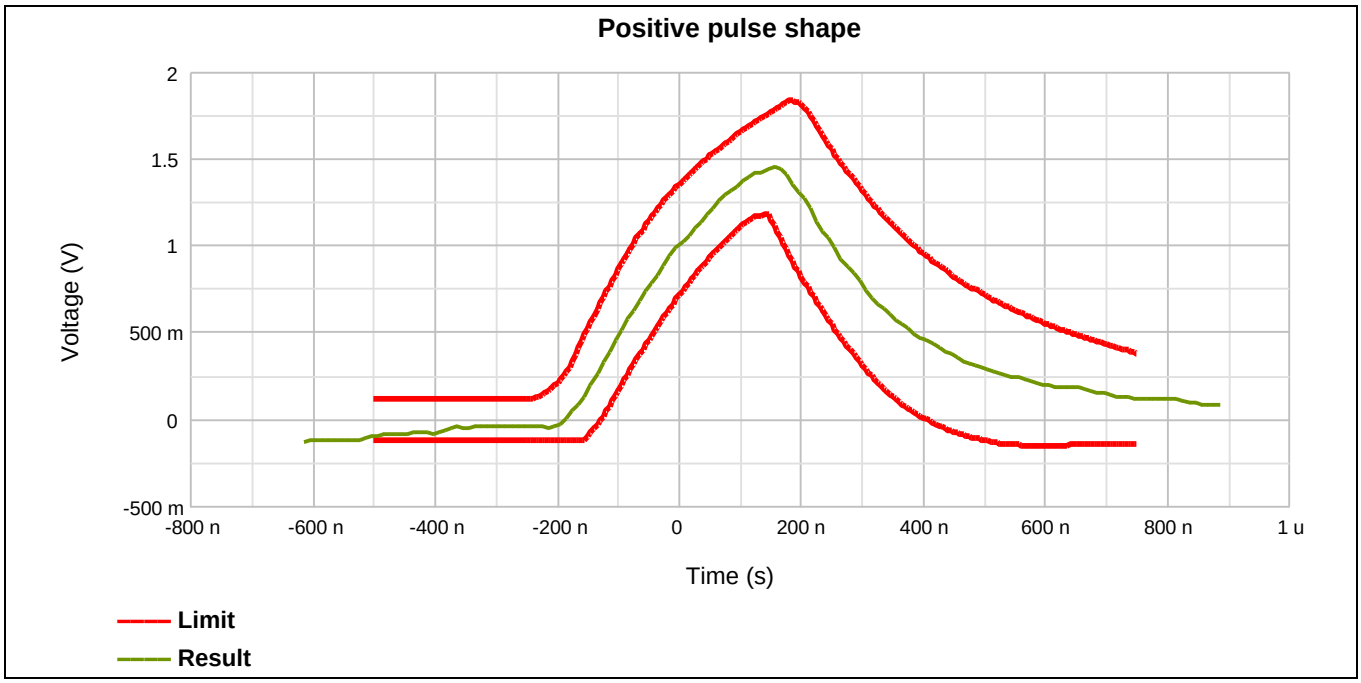
Measurement uncertainty

Expanded uncertainty, k=2 (95% confidence):

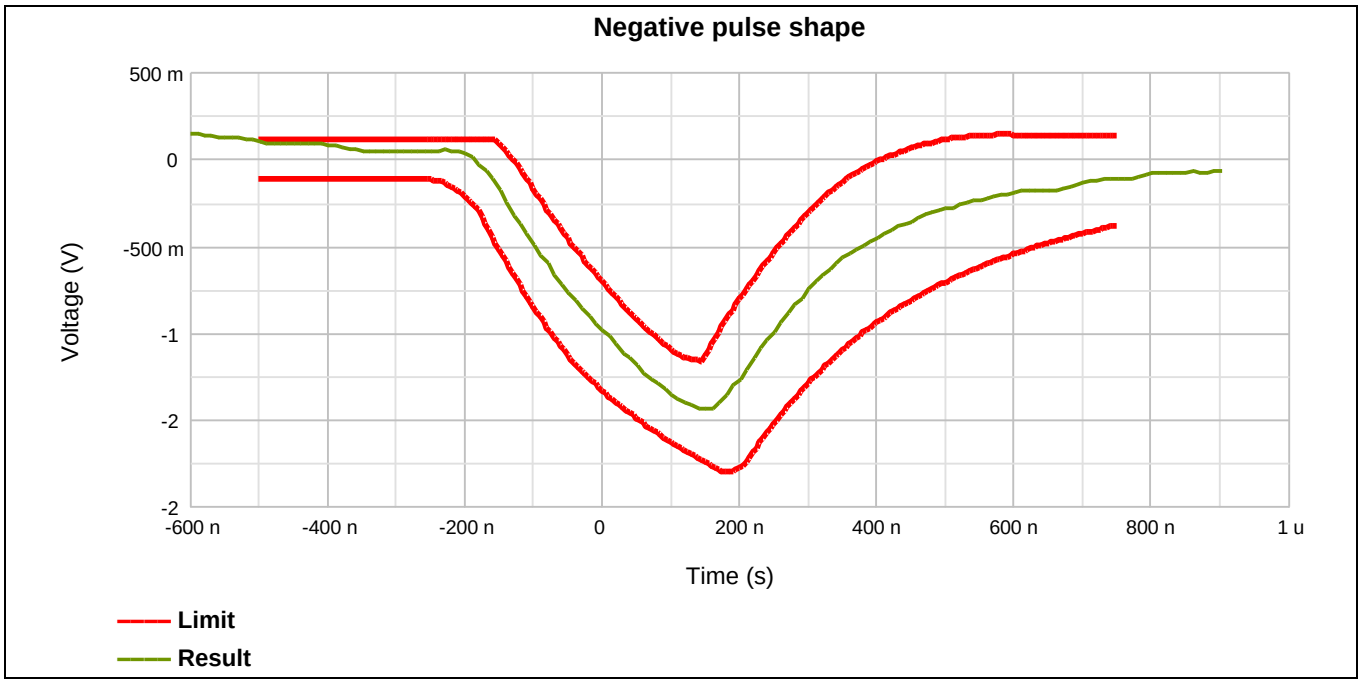
Pulse amplitude	±2.2%
Timing	±0.35%

General parameters

Parameter	Value
Overall meas. time	120 s
Amplitude auto-scaling	On (x 0.80 - x 1.20)
Frame format	ESF (193E)
Pattern	1:7



Test specification:	4.5.8.2.2.2 Pulse shape B		
Test purpose:	The pulse shape of the digital signal applied to a 100 ohm resistor shall fall within the pulse template obtained by passing the bounding pulses described in Figure 4.6 through the transfer function described in paragraph 4.5.8.2.2.2 (TIA-968-A).		
Test mode:	Evaluation	Verdict:	PASS
Date & Time:	6/3/2010 12:20:19 PM		
Remarks:			



Positive pulse shape fail ratio, Negative pulse shape fail ratio

Ratio	Ratio	Limit	Verdict
			Pass
0 %	0 %	0 %	Pass

Min pos pulse voltage, Max pos pulse voltage, Min neg pulse voltage, Max neg pulse voltage

Min pos peak	Max pos peak	Min neg peak	Max neg peak	Verdict
				-
1.454 V	1.474 V	-1.442 V	-1.442 V	-

Test specification:	**4.5.8.2.2.2 Pulse shape B**		
Test purpose:	The pulse shape of the digital signal applied to a 100 ohm resistor shall fall within the pulse template obtained by passing the bounding pulses described in Figure 4.6 through the transfer function described in paragraph 4.5.8.2.2.2 (TIA-968-A).		
Test mode:	Evaluation	**Verdict:**	PASS
Date & Time:	6/16/2010 10:17:49 AM		
Remarks: Post Surge			

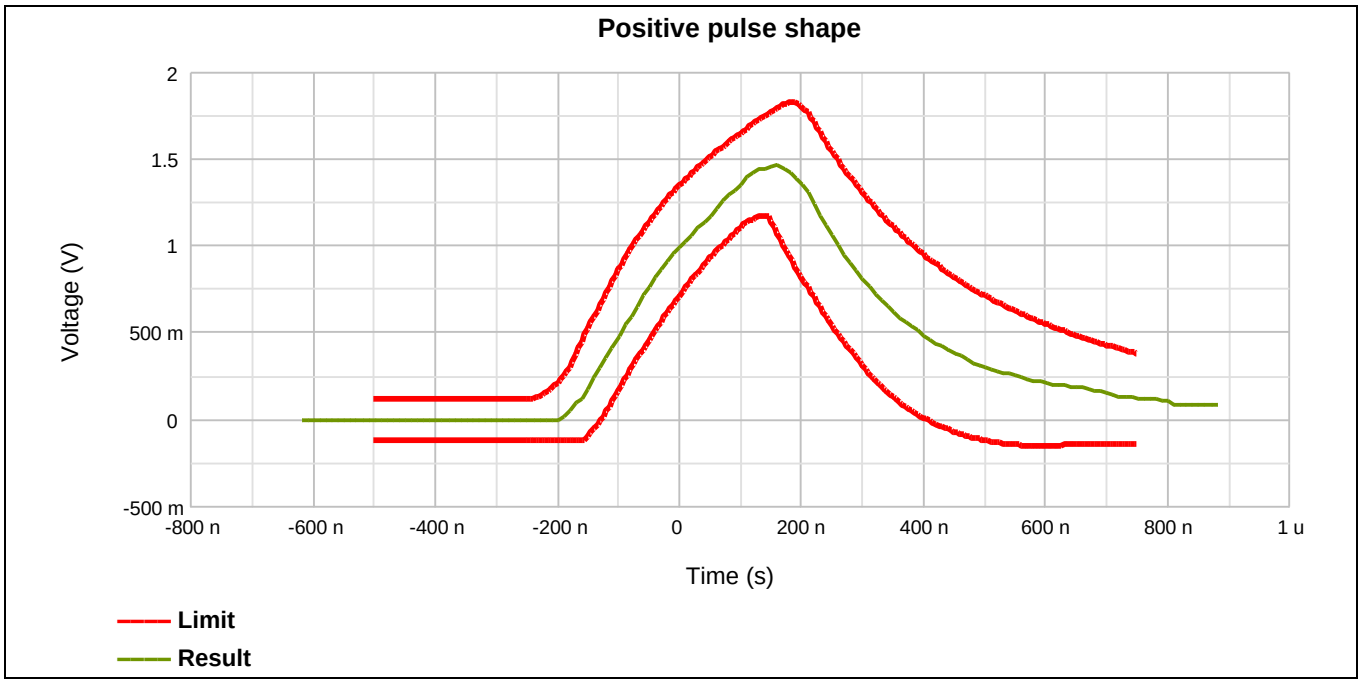
Measurement uncertainty

Expanded uncertainty, k=2 (95% confidence):

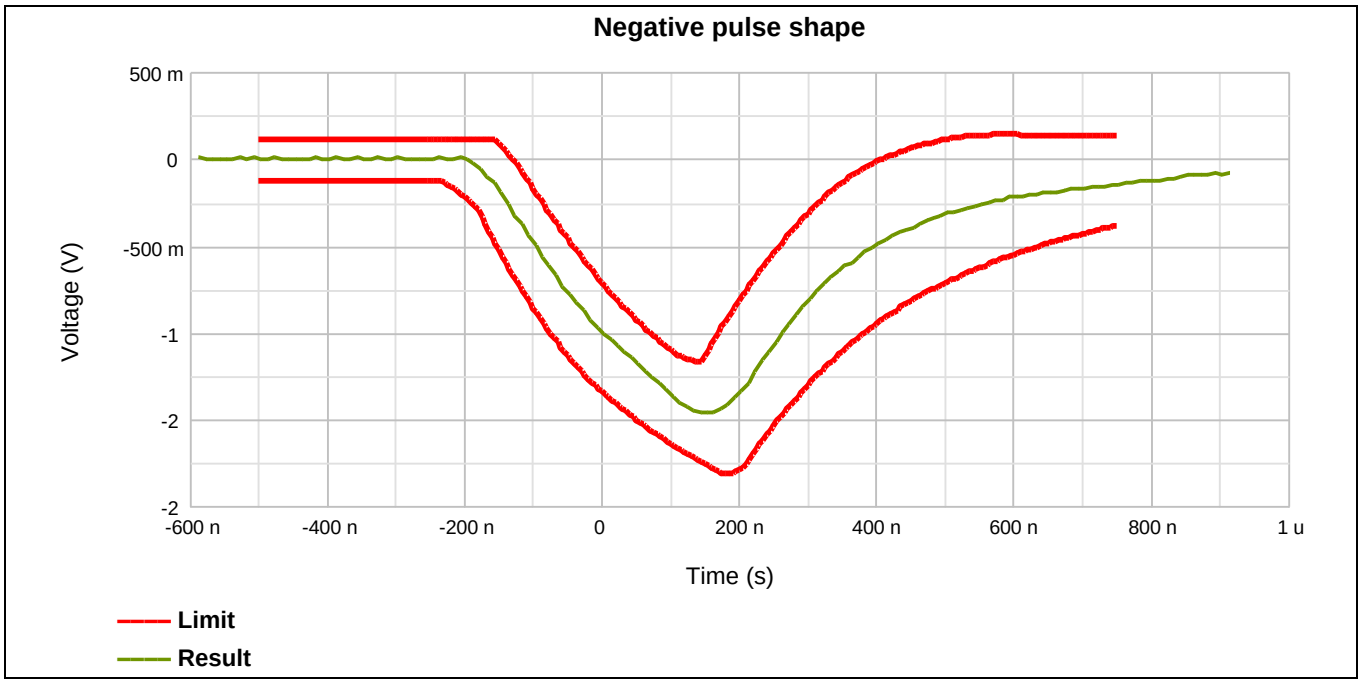
Pulse amplitude	±2.2%
Timing	±0.35%

General parameters

Parameter	Value
Overall meas. time	120 s
Amplitude auto-scaling	On (x 0.80 - x 1.20)
Frame format	ESF (193E)
Pattern	1:7



Test specification:	4.5.8.2.2.2 Pulse shape B		
Test purpose:	The pulse shape of the digital signal applied to a 100 ohm resistor shall fall within the pulse template obtained by passing the bounding pulses described in Figure 4.6 through the transfer function described in paragraph 4.5.8.2.2.2 (TIA-968-A).		
Test mode:	Evaluation	Verdict:	PASS
Date & Time:	6/16/2010 10:17:49 AM		
Remarks: Post Surge			



Positive pulse shape fail ratio, Negative pulse shape fail ratio

Ratio	Ratio	Limit	Verdict
			Pass
0 %	0 %	0 %	Pass

Min pos pulse voltage, Max pos pulse voltage, Min neg pulse voltage, Max neg pulse voltage

Min pos peak	Max pos peak	Min neg peak	Max neg peak	Verdict
				-
1.436 V	1.475 V	-1.437 V	-1.477 V	-

Test specification:	4.5.8.2.2.3 Pulse shape C		
Test purpose:	The pulse shape of the digital signal applied to a 100 ohm resistor shall fall within the pulse template obtained by passing the bounding pulses described in Figure 4.6 through the transfer function described in paragraph 4.5.8.2.2.2 twice (TIA-968-A)		
Test mode:	Evaluation	Verdict:	PASS
Date & Time:	6/3/2010 12:25:54 PM		
Remarks:			

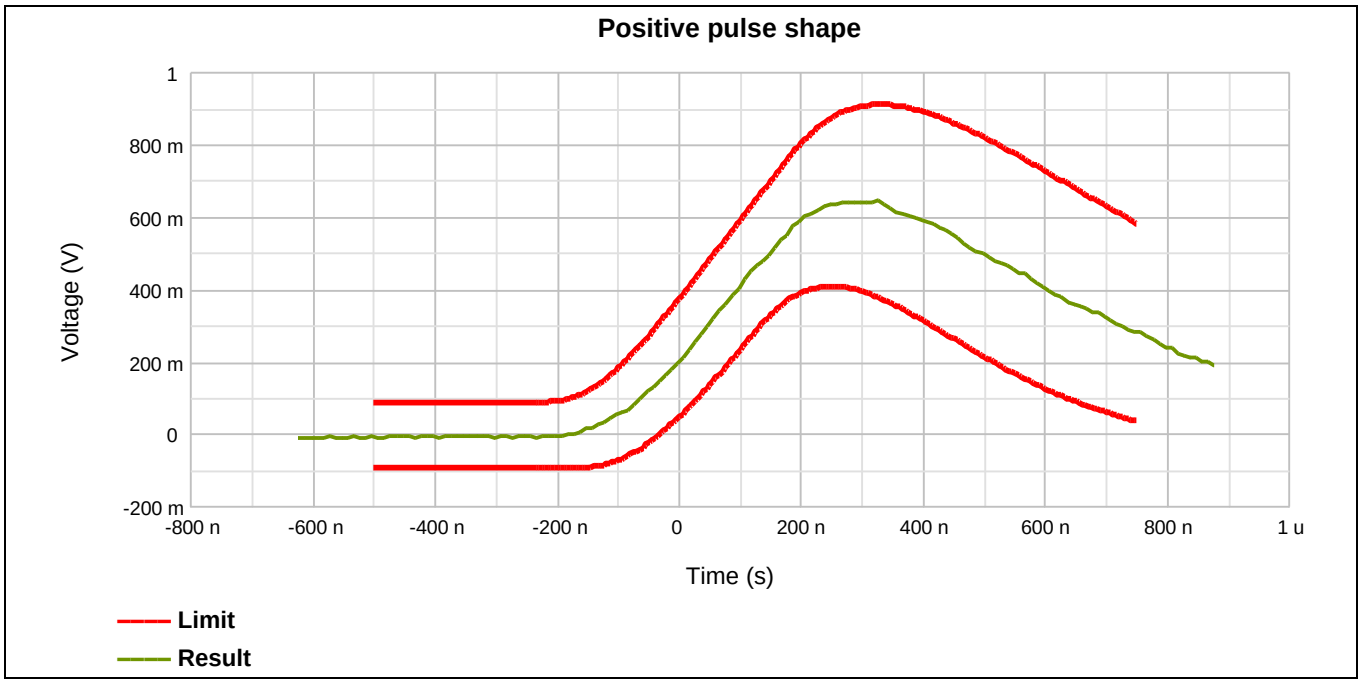
Measurement uncertainty

Expanded uncertainty, k=2 (95% confidence):

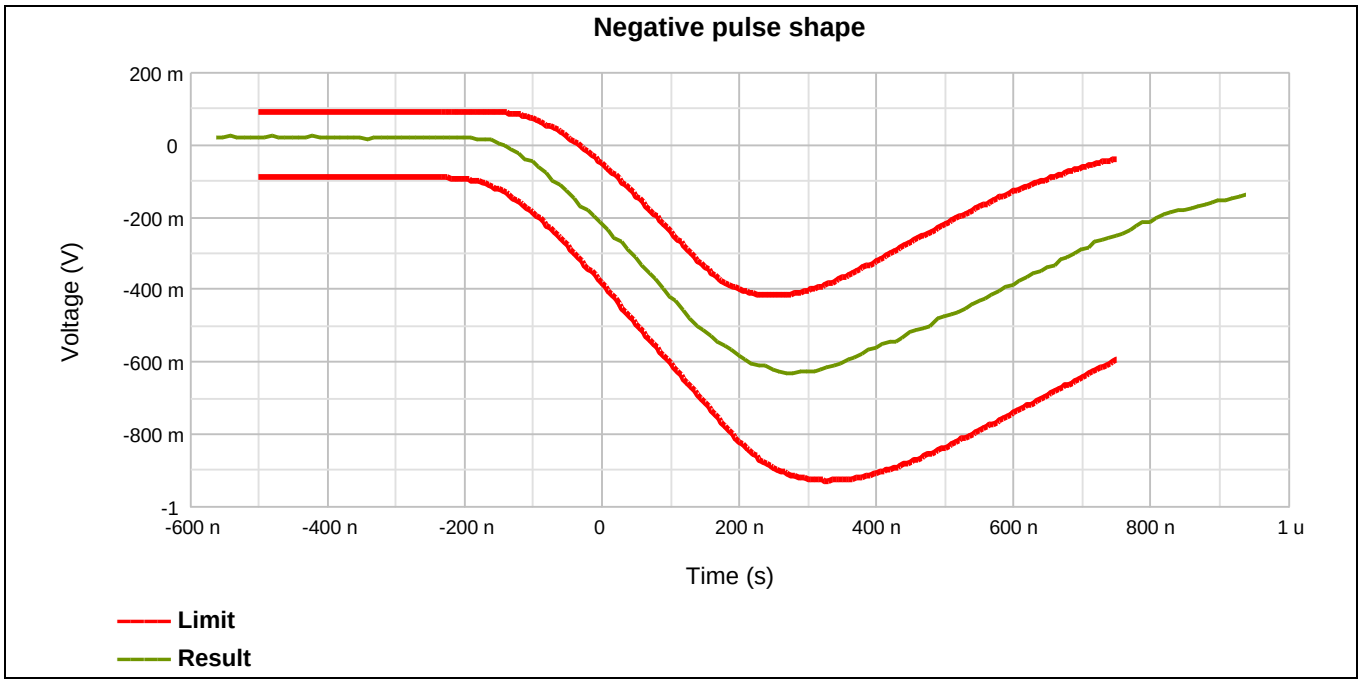
Pulse amplitude	±2.2%
Timing	±0.35%

General parameters

Parameter	Value
Overall meas. time	10 s
Amplitude auto-scaling	On (x 0.80 - x 1.20)
Frame format	ESF (193E)
Pattern	1:7



Test specification:	4.5.8.2.2.3 Pulse shape C		
Test purpose:	The pulse shape of the digital signal applied to a 100 ohm resistor shall fall within the pulse template obtained by passing the bounding pulses described in Figure 4.6 through the transfer function described in paragraph 4.5.8.2.2.2 twice (TIA-968-A)		
Test mode:	Evaluation	Verdict:	PASS
Date & Time:	6/3/2010 12:25:54 PM		
Remarks:			



Positive pulse shape fail ratio, Negative pulse shape fail ratio

Ratio	Ratio	Limit	Verdict
			Pass
0 %	0 %	0 %	Pass

Min pos pulse voltage, Max pos pulse voltage, Min neg pulse voltage, Max neg pulse voltage

Min pos peak	Max pos peak	Min neg peak	Max neg peak	Verdict
				-
508.29 mV	665.88 mV	-614.56 mV	-653.95 mV	-

Test specification:	4.5.8.2.2.3 Pulse shape C		
Test purpose:	The pulse shape of the digital signal applied to a 100 ohm resistor shall fall within the pulse template obtained by passing the bounding pulses described in Figure 4.6 through the transfer function described in paragraph 4.5.8.2.2.2 twice (TIA-968-A)		
Test mode:	Evaluation	Verdict:	PASS
Date & Time:	6/16/2010 10:21:38 AM		
Remarks: Post surge			

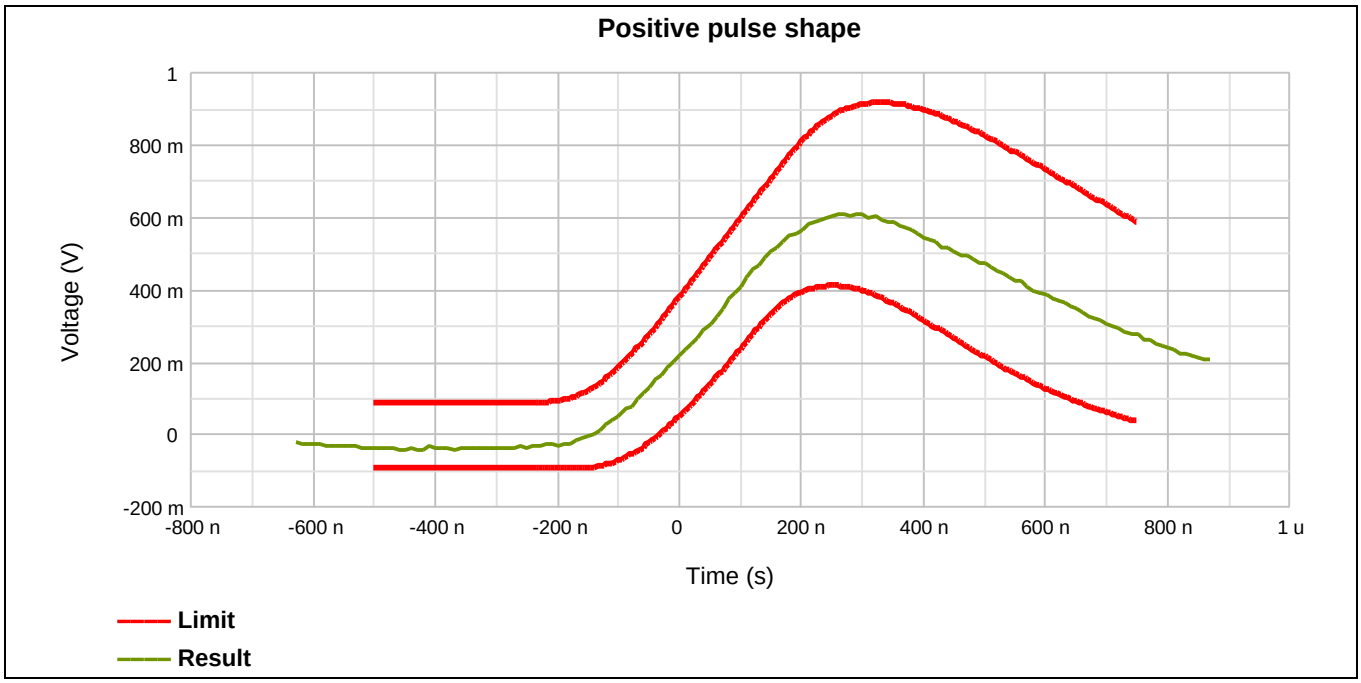
Measurement uncertainty

Expanded uncertainty, k=2 (95% confidence):

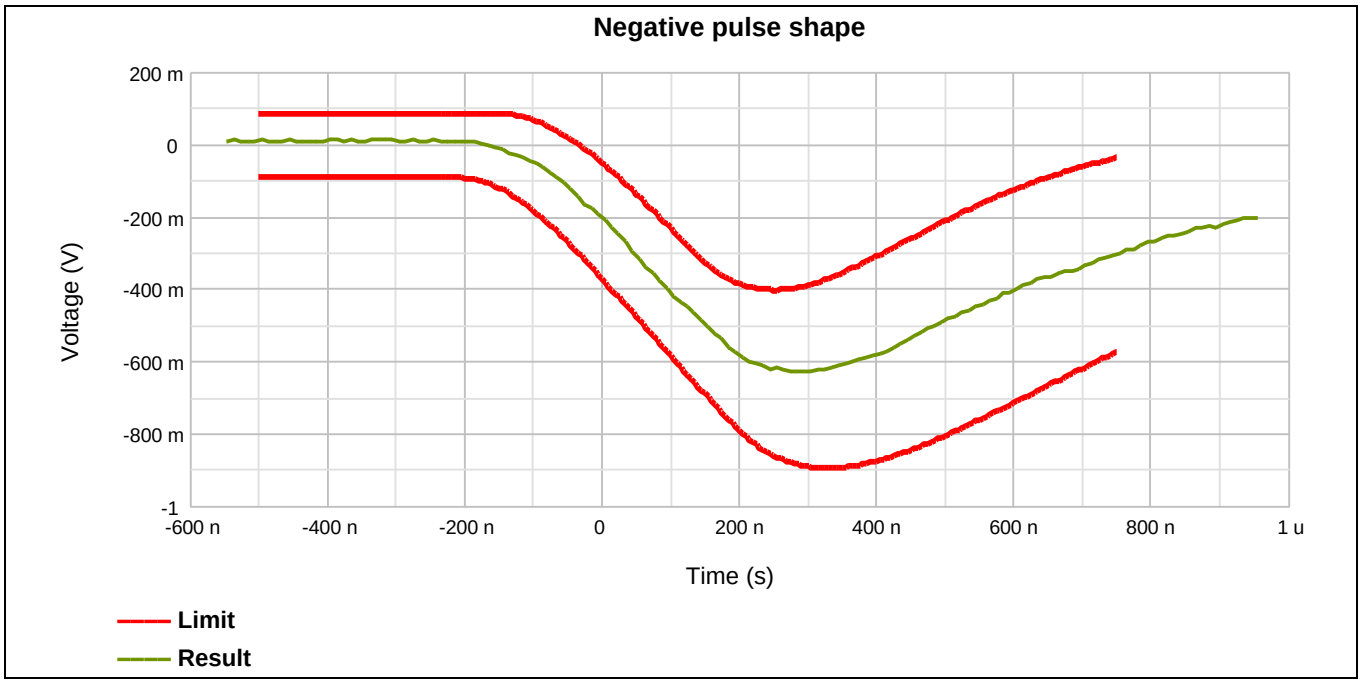
Pulse amplitude	±2.2%
Timing	±0.35%

General parameters

Parameter	Value
Overall meas. time	10 s
Amplitude auto-scaling	On (x 0.80 - x 1.20)
Frame format	ESF (193E)
Pattern	1:7



Test specification:	4.5.8.2.2.3 Pulse shape C		
Test purpose:	The pulse shape of the digital signal applied to a 100 ohm resistor shall fall within the pulse template obtained by passing the bounding pulses described in Figure 4.6 through the transfer function described in paragraph 4.5.8.2.2.2 twice (TIA-968-A)		
Test mode:	Evaluation	Verdict:	PASS
Date & Time:	6/16/2010 10:21:38 AM		
Remarks: Post surge			



Positive pulse shape fail ratio, Negative pulse shape fail ratio

Ratio	Ratio	Limit	Verdict
			Pass
0 %	0 %	0 %	Pass

Min pos pulse voltage, Max pos pulse voltage, Min neg pulse voltage, Max neg pulse voltage

Min pos peak	Max pos peak	Min neg peak	Max neg peak	Verdict
				-
484.51 mV	643.02 mV	-486.38 mV	-644.89 mV	-

Test specification:	4.5.8.2.4 Output power		
Test purpose:	The output power in a 3-kHz band about 772 kHz when an all ones signal sequence is being produced as measured across a 100 ohm terminating resistance shall not exceed +19 dBm. Second harmonic level shall be at least 25 dB below carrier.		
Test mode:	Evaluation	Verdict:	PASS
Date & Time:	6/3/2010 11:32:58 AM		
Remarks:			

Measurement uncertainty

Expanded uncertainty, k=2 (95% confidence):

Power and voltage in the -25 to +20 dBm range ±0.2dB

General parameters

Parameter	Value
Line coding	B8ZS
Frame format	Unframed
BER Pattern	All Ones
Reference frequency	772 kHz
Bandwidth	3 kHz
Overall meas. time	30 s

Average output power

Power	Limit	Verdict
		Pass
16.75 dBm	19 dBm	Pass

Average second harmonic level

2nd Harmonic level	Limit	Verdict
		Pass
69.85 dBc	25 dBc	Pass

Test specification:	4.5.8.2.4 Output power		
Test purpose:	The output power in a 3-kHz band about 772 kHz when an all ones signal sequence is being produced as measured across a 100 ohm terminating resistance shall not exceed +19 dBm. Second harmonic level shall be at least 25 dB below carrier.		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	6/16/2010 10:24:39 AM		
Remarks: Post surge			

Measurement uncertainty

Expanded uncertainty, k=2 (95% confidence):

Power and voltage in the -25 to +20 dBm range ±0.2dB

General parameters

Parameter	Value
Line coding	B8ZS
Frame format	Unframed
BER Pattern	All Ones
Reference frequency	772 kHz
Bandwidth	3 kHz
Overall meas. time	30 s

Average output power

Power	Limit	Verdict
		Pass
16.30 dBm	19 dBm	Pass

Average second harmonic level

2nd Harmonic level	Limit	Verdict
		Pass
69.21 dBc	25 dBc	Pass

Test specification:	4.6.3 Transverse balance for digital equipment		
Test purpose:	The transverse balance of TE in the frequency range of 12 - 1544 kHz shall be at least 35 dB.		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	6/3/2010 7:50:31 AM		
Remarks:			

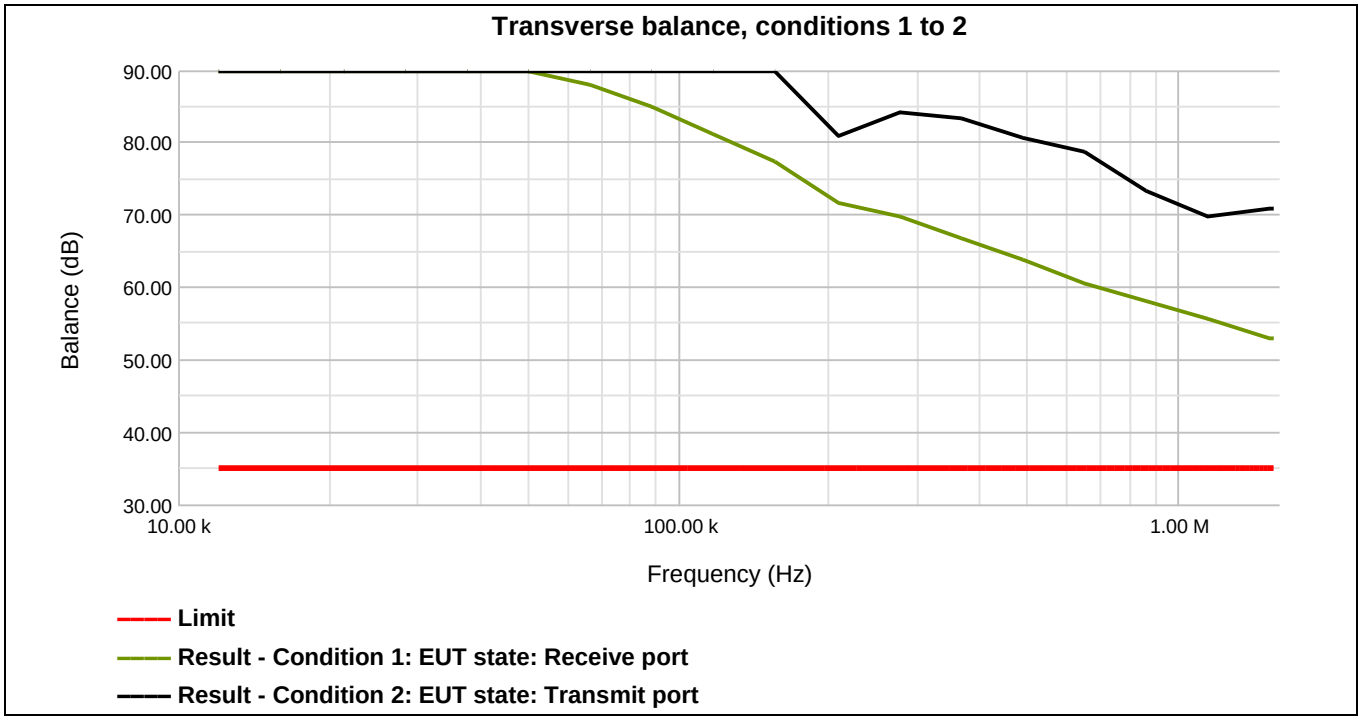
Measurement uncertainty

Expanded uncertainty, k=2 (95% confidence):

Balance (0 to 40 dB)	±0.21dB
Balance (40 to 60 dB)	±0.42dB

General parameters

Parameter	Value
Stimulus level	-10.00 dBV



Transverse balance

Frequency	Balance	Limit	Verdict
Condition 1: EUT state: Receive port			**Pass**
12.00 kHz	90.00dB	35 dB	Pass
15.96 kHz	90.00dB	35 dB	Pass
21.23 kHz	90.00dB	35 dB	Pass
28.23 kHz	90.00dB	35 dB	Pass
37.55 kHz	90.00dB	35 dB	Pass

Test specification:	4.6.3 Transverse balance for digital equipment		
Test purpose:	The transverse balance of TE in the frequency range of 12 - 1544 kHz shall be at least 35 dB.		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	6/3/2010 7:50:31 AM		
Remarks:			

Frequency	Balance	Limit	Verdict
49.94 kHz	90.00dB	35 dB	Pass
66.42 kHz	88.04dB	35 dB	Pass
88.34 kHz	84.89dB	35 dB	Pass
117.49 kHz	81.16dB	35 dB	Pass
156.26 kHz	77.35dB	35 dB	Pass
207.83 kHz	71.73dB	35 dB	Pass
276.41 kHz	69.87dB	35 dB	Pass
367.62 kHz	66.67dB	35 dB	Pass
488.94 kHz	63.74dB	35 dB	Pass
650.29 kHz	60.54dB	35 dB	Pass
864.88 kHz	58.03dB	35 dB	Pass
1.15 MHz	55.68dB	35 dB	Pass
1.53 MHz	52.86dB	35 dB	Pass
1.54 MHz	52.83dB	35 dB	Pass
Condition 2: EUT state: Transmit port			**Pass**
12.00 kHz	90.00dB	35 dB	Pass
15.96 kHz	90.00dB	35 dB	Pass
21.23 kHz	90.00dB	35 dB	Pass
28.23 kHz	90.00dB	35 dB	Pass
37.55 kHz	90.00dB	35 dB	Pass
49.94 kHz	90.00dB	35 dB	Pass
66.42 kHz	90.00dB	35 dB	Pass
88.34 kHz	90.00dB	35 dB	Pass
117.49 kHz	90.00dB	35 dB	Pass
156.26 kHz	90.00dB	35 dB	Pass
207.83 kHz	80.89dB	35 dB	Pass
276.41 kHz	84.14dB	35 dB	Pass
367.62 kHz	83.48dB	35 dB	Pass
488.94 kHz	80.71dB	35 dB	Pass
650.29 kHz	78.84dB	35 dB	Pass
864.88 kHz	73.17dB	35 dB	Pass
1.15 MHz	69.66dB	35 dB	Pass
1.53 MHz	70.83dB	35 dB	Pass
1.54 MHz	70.79dB	35 dB	Pass

Test specification:	4.6.3 Transverse balance for digital equipment		
Test purpose:	The transverse balance of TE in the frequency range of 12 - 1544 kHz shall be at least 35 dB.		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	6/16/2010 9:57:41 AM		
Remarks: Post Surge			

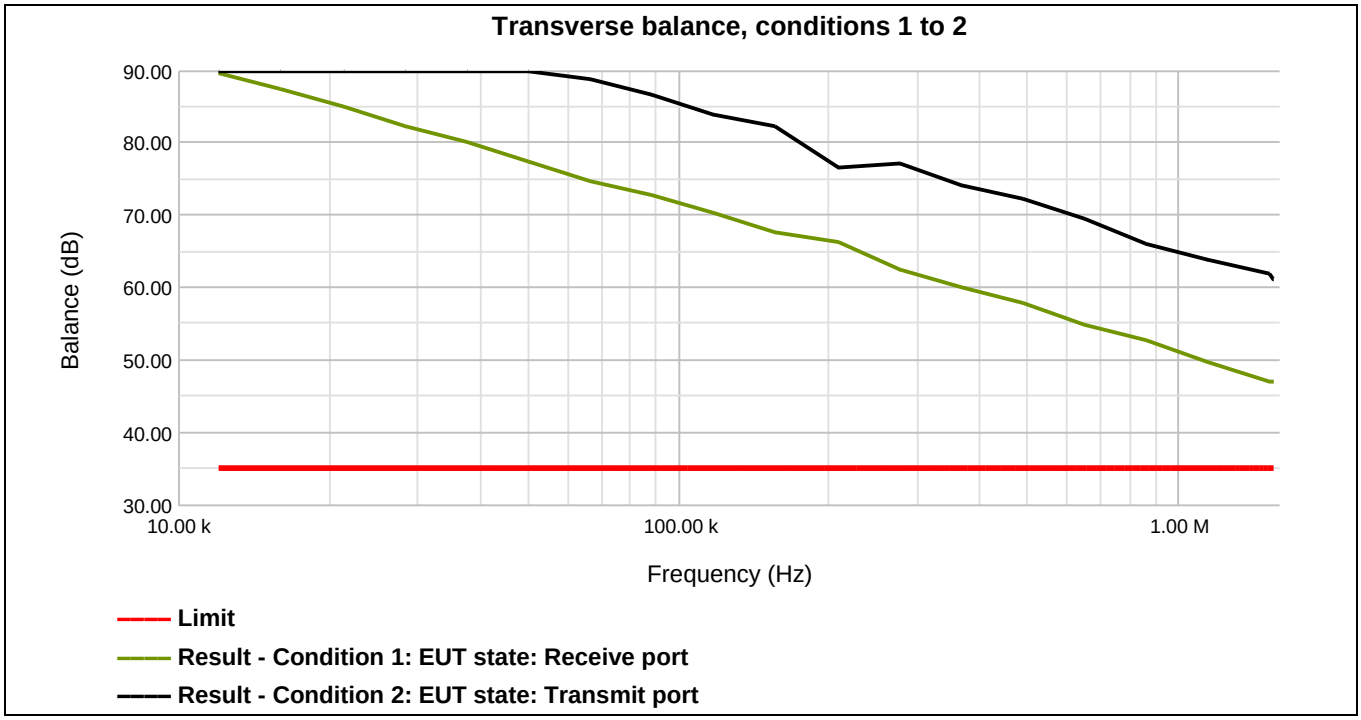
Measurement uncertainty

Expanded uncertainty, k=2 (95% confidence):

Balance (0 to 40 dB)	±0.21dB
Balance (40 to 60 dB)	±0.42dB

General parameters

Parameter	Value
Stimulus level	-10.00 dBV



Transverse balance

Frequency	Balance	Limit	Verdict
Condition 1: EUT state: Receive port			**Pass**
12.00 kHz	89.54dB	35 dB	Pass
15.96 kHz	87.41dB	35 dB	Pass
21.23 kHz	84.92dB	35 dB	Pass
28.23 kHz	82.30dB	35 dB	Pass
37.55 kHz	80.01dB	35 dB	Pass

Test specification:	4.6.3 Transverse balance for digital equipment		
Test purpose:	The transverse balance of TE in the frequency range of 12 - 1544 kHz shall be at least 35 dB.		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	6/16/2010 9:57:41 AM		
Remarks: Post Surge			

Frequency	Balance	Limit	Verdict
49.94 kHz	77.43dB	35 dB	Pass
66.42 kHz	74.66dB	35 dB	Pass
88.34 kHz	72.68dB	35 dB	Pass
117.49 kHz	70.18dB	35 dB	Pass
156.26 kHz	67.54dB	35 dB	Pass
207.83 kHz	66.17dB	35 dB	Pass
276.41 kHz	62.48dB	35 dB	Pass
367.62 kHz	59.95dB	35 dB	Pass
488.94 kHz	57.72dB	35 dB	Pass
650.29 kHz	54.93dB	35 dB	Pass
864.88 kHz	52.57dB	35 dB	Pass
1.15 MHz	49.55dB	35 dB	Pass
1.53 MHz	46.92dB	35 dB	Pass
1.54 MHz	46.84dB	35 dB	Pass
Condition 2: EUT state: Transmit port			**Pass**
12.00 kHz	90.00dB	35 dB	Pass
15.96 kHz	90.00dB	35 dB	Pass
21.23 kHz	90.00dB	35 dB	Pass
28.23 kHz	90.00dB	35 dB	Pass
37.55 kHz	90.00dB	35 dB	Pass
49.94 kHz	90.00dB	35 dB	Pass
66.42 kHz	88.82dB	35 dB	Pass
88.34 kHz	86.71dB	35 dB	Pass
117.49 kHz	84.03dB	35 dB	Pass
156.26 kHz	82.17dB	35 dB	Pass
207.83 kHz	76.47dB	35 dB	Pass
276.41 kHz	77.04dB	35 dB	Pass
367.62 kHz	74.15dB	35 dB	Pass
488.94 kHz	72.14dB	35 dB	Pass
650.29 kHz	69.47dB	35 dB	Pass
864.88 kHz	65.90dB	35 dB	Pass
1.15 MHz	63.91dB	35 dB	Pass
1.53 MHz	61.84dB	35 dB	Pass
1.54 MHz	61.17dB	35 dB	Pass

Test specification:	4.8.4.2 Signaling interference of 1.544 Mbps digital TE		
Test purpose:	TE shall not deliver digital signals to the telephone network with encoded analog content energy in the 2450 to 2750 Hz band unless at least an equal amount of encoded analog energy is present in the 800 to 2450 Hz band for the first two seconds after going to the off-hook state.		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	6/16/2010 10:28:12 AM		
Remarks: Post surge			

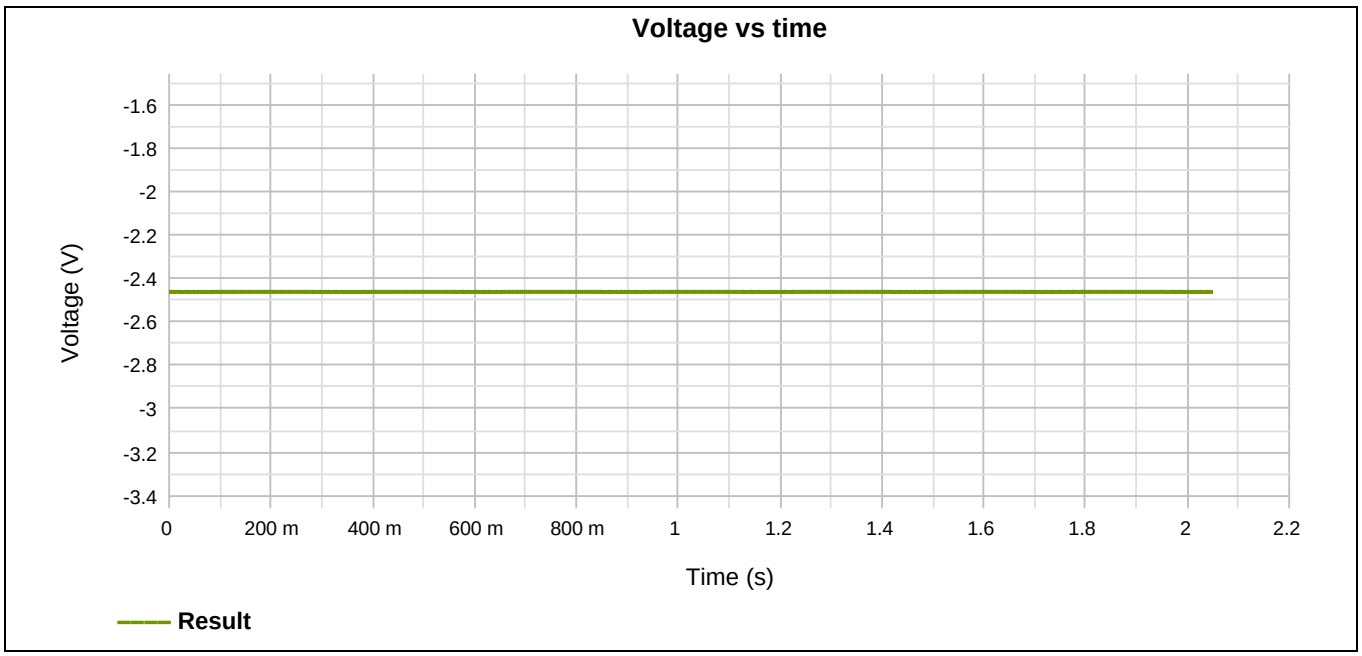
Measurement uncertainty

Expanded uncertainty, k=2 (95% confidence):

Power level	±0.23 dB
Timing	±4ms

General parameters

Parameter	Value
Overall meas. time	500 ms
Digital interface	1544 kbit/s
Digital Termination	100 ohm
Tx Timeslot	1
Rx Timeslot	1



Power in band 1, Power in band 2, Power in band 1 - Power in band 2

Power	Power	Difference	Limit	Verdict
				Pass
-305.694 dBm	-313.141 dBm	7.45 dB	0 dB	Pass

11 Photographs of test Samples

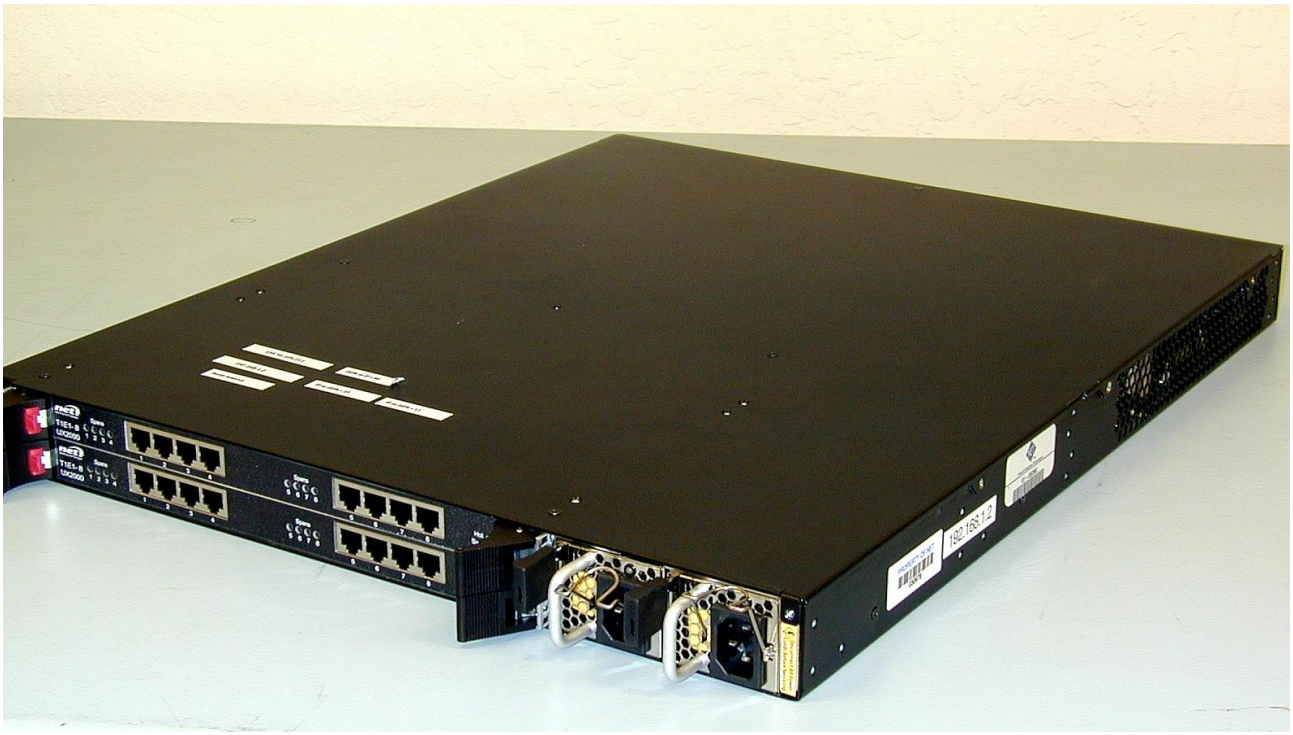
Photograph of the test samples during assessment. The photographs depict the samples as originally supplied.



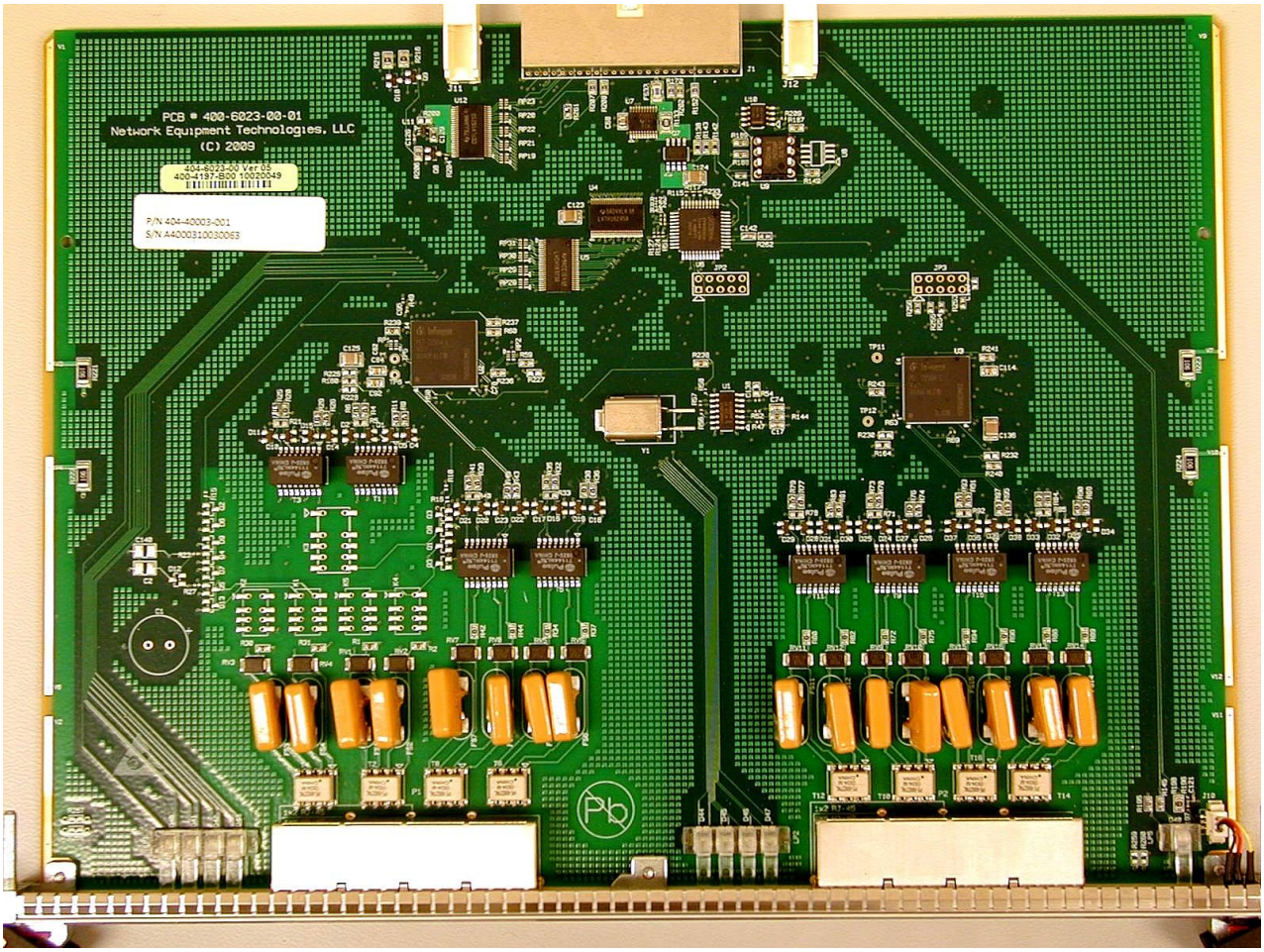
11.1 General view – Sonus branding



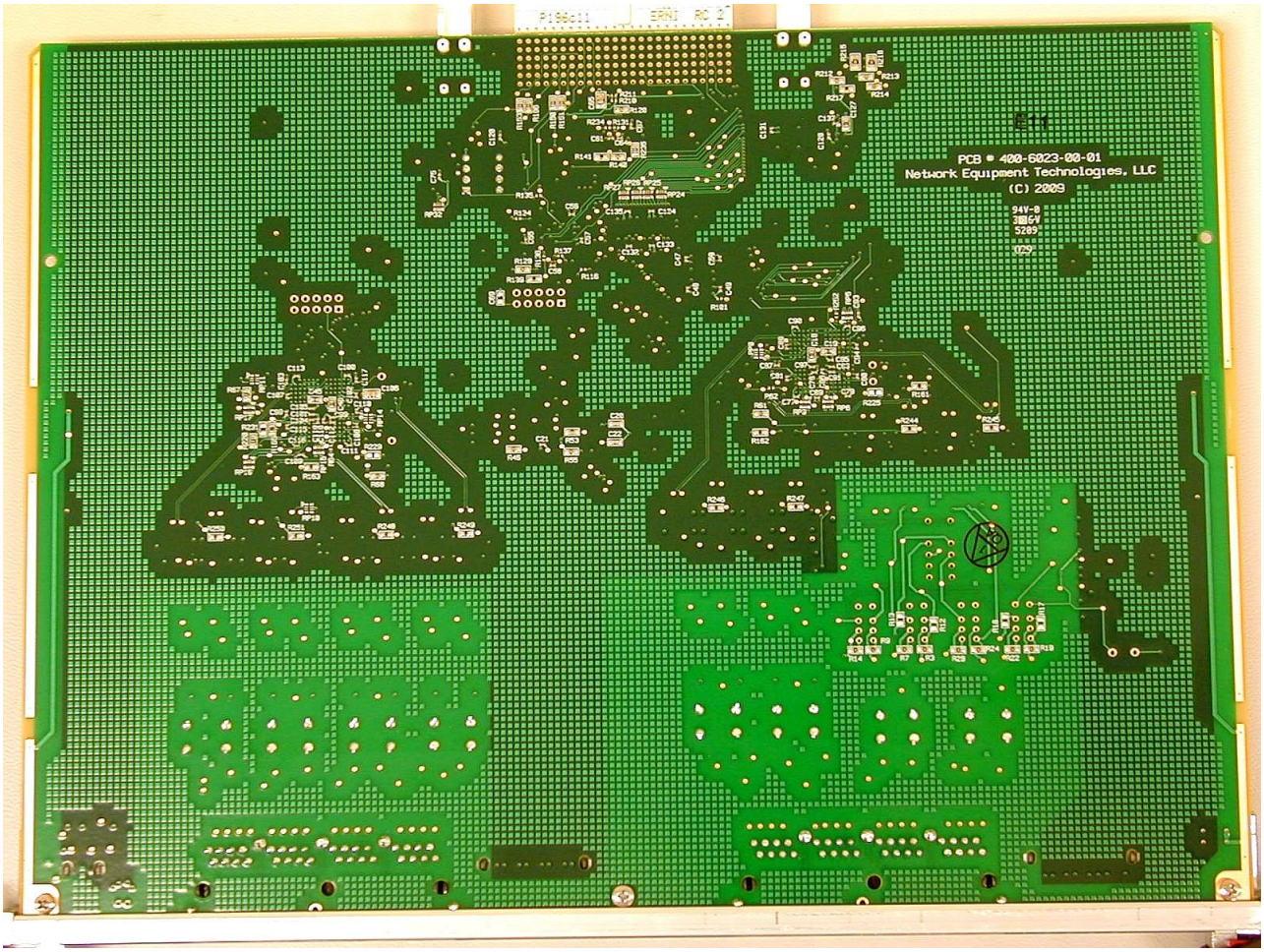
11.1 General view – Ribbon branding



11.3 Rear view



11.4 Interface card – top view



11.5 Interface card – bottom view