Declaration of Conformity
to the DeviceNet™ Specification

ODVA hereby issues this Declaration of Conformity to the DeviceNet™ Specification for the product(s) described below. The Vendor listed below (the "Vendor") has holds a valid the Terms of Usage Agreement for the DeviceNet Technology from ODVA, which is incorporated herein by reference, thereby agreeing that it is the Vendor's ultimate responsibility to assure that its DeviceNet Compliant Products conform to the DeviceNet Specifications and that the DeviceNet Specifications are provided by ODVA to the vendor on an AS IS basis without warranty. NO WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING WITHOUT LIMITATION ANY WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, ARE BEING PROVIDED BY ODVA.

In recognition of the below DeviceNet Compliant Product(s) having been DeviceNet Conformance Tested at ODVA-authorized Test Service Provider and having received a passing result from ODVA at the Composite Test Revision Level specified below, this Declaration of Conformity authorizes the Vendor to use the DeviceNet Certification Marks in conjunction with the specific DeviceNet Compliant Product(s) described below, for so long as the Vendor's Terms of Usage Agreement for the DeviceNet Technology remains valid.

DeviceNet CONFORMANCE TESTED ™

Certification Logo Mark *Certification Word Mark*

This Declaration of Conformity is issued on **24 JANUARY 2005** on behalf of ODVA by:

Katherine Voss
Executive Director

Vendor Information	
Vendor Name	**PULS**
Vendor Address	**2560 Foxfield Road, Suite 320** **St Charles, IL 60174** **USA**

Test Information	
Test Date	**24 January 2005**
Applicable Test	**Power Supply**
Composite Test Revision	**1.0**
ODVA File Number	**10218**

Product Information

Device(s) Under Test	Value
Vendor ID	**879**
Network Category	**Infrastructure**
Device Type	**Power Supply**
Device Profile Name	**N/A**
Product Revision	**N/A**

Products Covered Under This Declaration of Conformity

No.	Product Code (Identity Object Attribute 3)	Product Name (Identity Object Attribute 7)	SOC File Name
1	N/A	QS10.DNET	N/A

DeviceNet™ Power Supply Conformance Test Results

Test Information	
Test Date	**24 January 2005**
Composite Test Revision	**1.0**
ODVA File Number	**10218**
Test Type	_X_ Single device ___Product family* *The vendor-supplied list of product family members is attached to this report, if applicable. One instance of the remainder of this report shall be completed for each device tested.

Vendor Information	
Vendor ID	**879**
Vendor Name	**PULS, LP**
Vendor Address	**2560 Foxfield Road Suite 320** **St Charles, IL 60174**

Device Information	
Product Name	**QS10.DNET**

TSP **ODVA TTC**

Date **24 January, 2005**

Result** **Pass**

**All failing results are summarized and described in Table 1 at the end of the report.

Conformance Test Result Details (One report for each device tested)

Agency Approvals per Product Label

UL, CUL, CE

Data Sheet Specifications

		Pass	Fail
Temperature Range	-25 to +60 deg C without derating	**X**	

Isolation

		Pass	Fail
Chassis to V+		**X**	
Chassis to V-		**X**	

Initial Tolerance

				Pass	Fail
V_{Max}	240VAC	Measured Initial Tolerance:	24.216VDC	**X**	
V_{Min}	100VAC				
V_{Line}	170VAC				

Line Regulation

				Pass	Fail
I_{Max}	8A	Calculated Line Regulation:	0 %	**X**	
$V_{Initial}$	24.216V				
R_{Load}	3.0 O				
V_{err}	0.0 V				

Load Regulation

				Pass	Fail
$V_{Initial}$	24.216 V	Calculated Load Regulation:	0.05 %	**X**	
V_{err}	0.014 V	Measured Maximum Current:	7.98 A	**X**	

Output Ripple

	Value	Pass	Fail
Maximum peak-to-peak ripple, I = 0:	5.6 mV	X	
Maximum peak-to-peak ripple, I = maximum:	15 mV	X	

7000µF Load Test

	Value	Pass	Fail
Rise time, Part 1 (resistor & capacitor):	40 ms	X	
Rise time, Part 2 (resistor & capacitor):	47 ms	X	
Rise time, Part 1 repeated (capacitor only):	26 ms	X	
Rise time, Part 2 repeated (capacitor only):	40 ms	X	
DUT did not latch in an overload or shutdown condition		X	

Over Current Protection

				Pass	Fail
$I_{Measured}$	8.60 A	Calculated Over Current:	108 %	X	
I_{Max}	8.0 A				

Turn-on Overshoot (without Resistor)

				Pass	Fail
$V_{max\_overshoot}$	24.2 V	Calculated Overshoot:	0 %	X	
V_{steady_state}	24.2 V				

Turn-on Overshoot (with Resistor)

				Pass	Fail
$V_{max\_overshoot}$	24.2 V	Calculated Overshoot:	0 %	X	
V_{steady_state}	24.2 V				

Notes:

Table 1 Conformance Failures and Advisories

Test Item	Advisory or Failure	Explanation or Waiver
	None	

DeviceNet Network Power Supply
Conformance Test
Description and Procedure

Version 1.0

March 25, 2002

Revision History

Version	Date	Revision Description	Authors / Editors
1.0	3/25/02	Initial Release	B. Lounsbury, M. Kuzel, J. Korsakas, D. Stanton

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1. OVERVIEW

1.1 Introduction

This document provides a procedure for verifying that a DeviceNet network power supply adheres to the requirements set forth in the ODVA DeviceNet Specification**.** If the network power supply, herein called the Device Under Test (DUT), successfully passes all tests detailed in this document, the device manufacturer gains a high level of confidence that the device can be integrated into a DeviceNet network as intended by the specification.

1.2 Scope

This document defines the official tests used by the ODVA Conformance Test Labs to test DeviceNet network power supplies. These tests are intended to be a complement to existing product developer tests. It is not the responsibility of these tests to verify electrical characteristics of I/O (e.g. the isolation voltage of an output relay, etc.) or the Electromagnetic Compatibility (EMC) of the DUT, nor is it meant to guarantee the conformance of the DUT. No warranty is expressed or implied.

The tests in this document focus on a DeviceNet network power supply's most critical parameters that directly affect the overall network operation. The tests are applicable only to the network power supply functionality of the DUT. If the DUT contains a DeviceNet communications port, the testing of the communications port is beyond the scope of this document, but is covered by ODVA Device Conformance Test Procedure.

1.3 ODVA Conformance Mark

A DUT must pass all of the tests in this procedure to warrant a passing verdict and be eligible to have the ODVA Conformance Mark. Failure of any part of this test will constitute a failure of the DUT. If the DUT contains a DeviceNet communications port, it must also pass the ODVA Device Conformance Test Procedure to be eligible for the ODVA Conformance Mark.

1.4 References

The following documents are referenced by this test specification:

1. ODVA DeviceNet Specification, Volume I, Release 2.0, Errata 4

1.5 Definitions

Initial Tolerance	Unloaded output voltage under normal conditions and temperatures.
Inrush Current Limit	The peak current that the power supply will require at startup.
Isolation	The voltage between any output line to earth ground and line voltage terminals.
Line Regulation	Voltage stability between the minimum and maximum input voltage under normal temperatures. Usually expressed as a percentage.
Load Capacitance Capability	The amount of total network capacitance that may be present in a system.
Load Regulation	Voltage stability between the minimum and maximum rated load under normal temperatures and input voltages.
Output Current	Rated output current availability of the power supply.
Output Ripple	Peak to peak noise from all sources riding on the output voltage.

Output Voltage	Steady state output voltage of the power supply.
Over Current Protection	Capability to disable output upon the occurrence of a short in the network.
Over Voltage Protection	Capability to disable output upon failure of internal regulation.
Stability	Long term output voltage variation due to input voltage, temperature, and output current variations.
Surge Current Capability	The available reserve current over the rated output current for short periods of time such as during network startup. Usually expressed as a percentage.
Temperature Coefficient	De-rating of output power due to ambient temperature.
Temperature Range	Maximum and minimum ambient temperature in which the power supply must exist.
Turn-on (Rise) Time	The time required for a power supply to reach its steady state output voltage under a full resistive and capacative load after the input voltage is applied.
Turn-on Overshoot	Initial overshoot past the steady state output voltage after the input voltage is applied.

2. TEST BED REQUIREMENTS

2.1 DUT Requirements

If the DUT requires field connections in order to perform the tests, the vendor is responsible for providing the appropriate equipment or simulators. For example, if the DUT is part of a larger assembly that cannot be delivered to the test lab (because of size or power requirements), then the vendor must provide a test bed to allow testing of the DUT. The vendor must also provide documentation that illustrates that the test bed is an accurate representation of the field application.

2.2 Equipment Component List

Table 1 lists the equipment that is required to perform the power supply testing. Equivalent equipment may be substituted.

CAUTION: Make sure that the ratings of all electrical components are sufficient for the current of the DUT. The components' ratings listed in Table 1 should be sufficient for most DUTs.

Qty	Description
2	Digital Volt Meter (DVM)
1	Digital Ohmmeter
1	Oscilloscope
1	Electronic Load or Variable Power Resistor (see Equation 1)
1	7000µF Electrolytic 30V Capacitor
1	Digital Current Meter (suitable for output current range of DUT)
1	Variable AC or DC Source (suitable to cover input voltage range of DUT)
1	20A Momentary Switch
	8 to 10 AWG wire

Table 1: Required Test Equipment

To calculate the minimum required rating for the Electronic Load, use Equation 1.

$$P_{Max} = V_{Max} * I_{Max}$$

$$R_{Max} = \frac{V_{Max}}{I_{Max}}$$

V_{max} = Maximum DUT output voltage (25 V)
I_{Max} = Maximum DUT output current from data sheet
P_{max} = Calculated load power dissipation rating (W)
R_{max} = Calculated maximum resistance of load (O)

Equation 1: Electronic Load Rating

A single variable power resistor may be difficult to obtain, so an electronic load or an equivalent group of parallel resistors is recommended. In the latter case, one of the resistors will need to be variable. This method will split the power amongst several resistors. The resistors should be mounted on an aluminum plate with a fan for cooling.

3. TEST BED SETUP

The basic test bed setup is illustrated in Figure 1. Each test procedure illustrates its own test bed configuration with a similar figure.

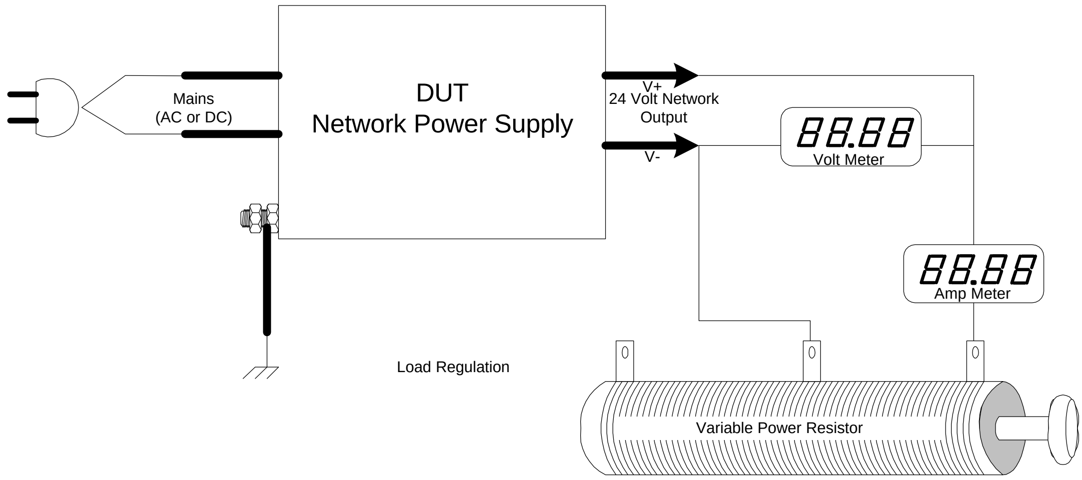

Figure 1: Basic Test Bed Setup

4. PARAMETERS TO BE TESTED

Table 2 lists the set of tests in this document to which a DUT will be subjected. A check mark in the last column indicates that the parameter is only to be visually checked on the vendor's data sheet, labeling, or documentation. A section number indicates the specific test procedure to be used to test that parameter. "No" indicates that a test is either beyond the scope of this document or is not necessary.

Specification	Reference Parameter Values [1]	Test?
Agency Approvals	(To be noted)	5.1 ✓
Humidity	5% to 95% non-condensing	5.2 ✓
Initial Tolerance	24V +/- 1% or adjustable to 0.2%	5.4
Inrush Current Limit	Less than 65A peak	No
Isolation	Output isolated from AC and Chassis ground	5.3
Line Regulation	0.3% maximum	5.5
Load Capacitance Capability	7000µF maximum	5.8
Load Regulation	0.3% maximum	5.6
Output Current	Up to 16A continuous	5.6
Output Ripple	250mV peak to peak	5.7
Output Voltage	24V +/- 1%	5.4
Over Current Protection	Yes (current limit 125% maximum)	5.9
Over Voltage Protection	Yes (no value specified)	No
Stability	0% to 100% load (all conditions)	No
Surge Current Capability	10% reserve capability	No
Temperature Coefficient	0.03% per °C maximum	No
Temperature Range	Operating*: 0 to 60° C Non-operating: -40 to 85° C *De-rating acceptable for 60° C operation	5.2 ✓
Turn-on (Rise) Time w/ Full Load	250ms maximum to 5% of final value	5.8
Turn-on Overshoot	2% maximum	5.10

Table 2: Power Supply Specifications

When measuring the parameters in Table 2, the tolerance and display resolution of the measurement equipment shall be taken into consideration when determining final conformance to the specification.

[1] The data in this table is taken from Table F.1, Appendix F, of the ODVA DeviceNet Specification Volume 1, Release 2.0, Errata 4.

5. TEST PROCEDURES

Caution!

Exposure to high voltage and high currents can occur during these tests. The user is required to be familiar with proper safe handling of exposed voltages and potential currents. It is strongly recommended that the operator wear protective safety glasses while performing these tests.

5.1 Agency Approvals

Verify that any other agency approvals awarded to the DUT are clearly displayed on the DUT's label and listed in the DUT's documentation. Note these agency approvals for listing on the ODVA Conformance Documentation.

5.2 Data Sheet Specifications

5.2.1 Humidity

Verify that the Humidity specification on the vendor data sheet is equal to or better than the parameter range specified in Table 2: Power Supply Specifications.

5.2.2 Temperature Range

Verify that the Temperature Range specification on the vendor data sheet is equal to or better than the parameter range specified in Table 2: Power Supply Specifications.

5.3 Isolation

The purpose of this test is to verify that the DUT does not have an internal connection from chassis ground to V+ or V-. Any connection from chassis ground to V- needs to be made only at the installation site.

1. Using an ohmmeter, check for continuity (zero resistance) between the chassis ground and the V+ output of the DUT.
2. Also check for continuity between the chassis ground and the V- output of the DUT.
3. Verify that the Ohmmeter did not detect a connection between chassis ground and V+ or V-.

5.4 Initial Tolerance

The purpose of this test is to verify that the DUT "out of the box" has the correct output voltage under normal, unloaded conditions. The test configuration is illustrated in Figure 2.

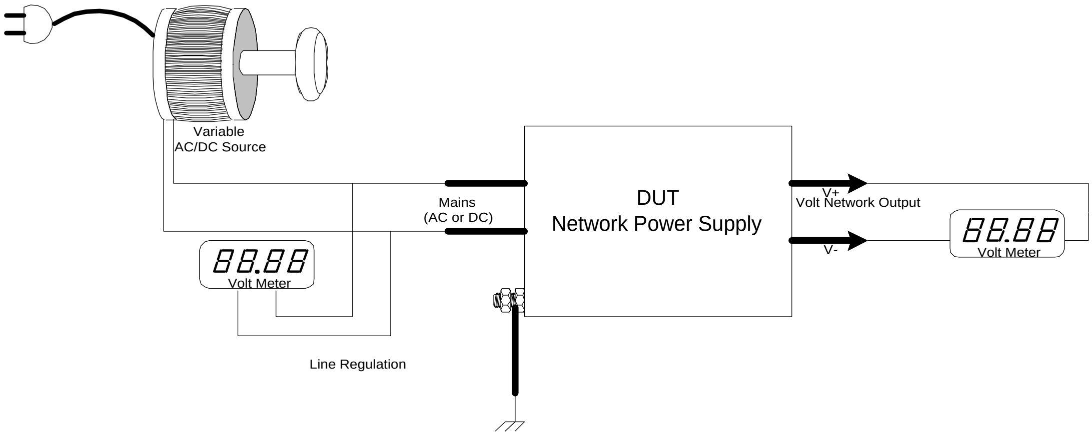

Figure 2: Initial Tolerance Test Configuration

1. Apply an input voltage that is in the middle of the range specified in the manufacturer's data sheet. Use Equation 2 to calculate the line input voltage.

$$V_{Line} = \frac{V_{Max} + V_{Min}}{2}$$

V_{Line} = Line input voltage
V_{Max} = Max input voltage from data sheet
V_{Min} = Min input voltage from data sheet

Equation 2: Line Input Voltage

2. Measure the output voltage (initial tolerance).
3. Verify that the initial tolerance is within the parameter range specified in Table 2: Power Supply Specifications.

5.5 Line Regulation

The purpose of this test is to verify that the DUT can maintain output regulation under the range of input voltages specified in the vendor documentation. The test configuration is illustrated in Figure 3.

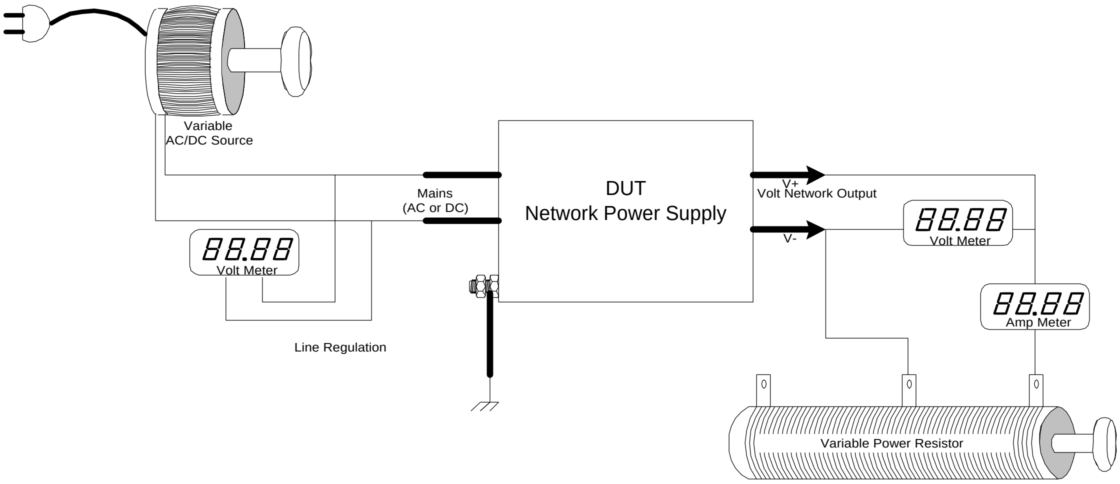

Figure 3: Line Regulation Test Configuration

1. Set the load resistor to the value calculated from Equation 3.

$$R_{Load} = \frac{V_{Initial}}{I_{Max}}$$

R_{Load} = Load resistor value
$V_{Initial}$ = Measured initial tolerance from Section 5.4
I_{Max} = Maximum current from data sheet

Equation 3: Load Resistance

2. Vary the input source (AC or DC) over the range specified on the vendor data sheet.
3. Record the worst-case voltage fluctuation from the initial tolerance from Section 5.4.
4. Calculate the line regulation using Equation 4.

$$\text{Line Regulation}(\%) = \left(\frac{|V_{err}|}{V_{Initial}}\right) \cdot 100$$

V_{err} = Measured worst-case voltage fluctuation
$V_{Initial}$ = Measured initial tolerance from Section 5.1.

Equation 4: Line Regulation

5. Verify that the calculated Line Regulation percentage is less than or equal to the value specified in Table 2.

5.6 Load Regulation & Output Current

The purpose of this test is to verify that the DUT maintains adequate output regulation as the current demand changes. The test configuration is illustrated in Figure 4.

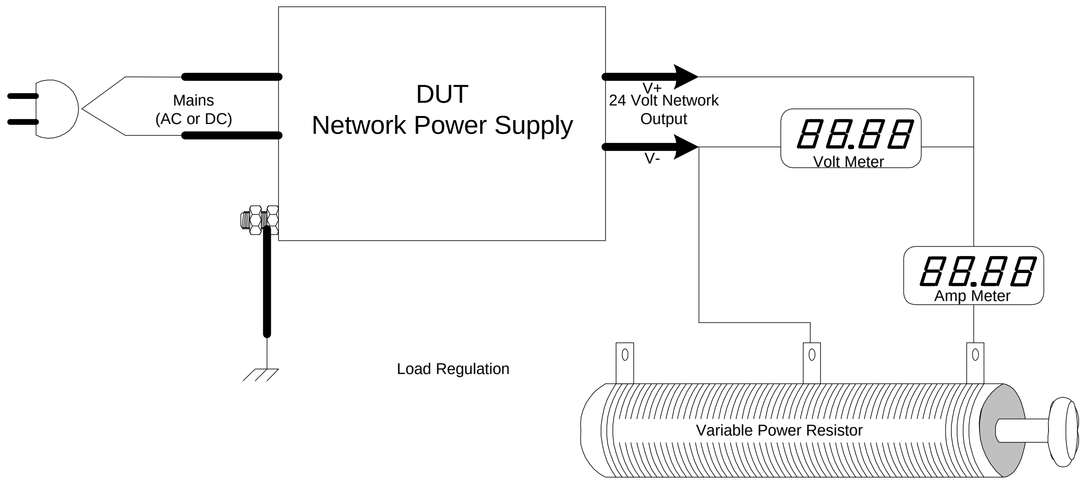

Figure 4: Load Regulation Test Configuration

1. Apply an input voltage that is in the middle of the range specified in the manufacturer's data sheet. Use Equation 2 to calculate the line input voltage.
2. Set the resistor to the value calculated with Equation 3 (minimum resistance, maximum current), re-connect it and measure the current and voltage.
3. Increase the resistance to the resistor's maximum value while monitoring the output voltage.
4. Record the worst-case voltage fluctuation from the initial tolerance from Section 5.4.
5. Calculate the load regulation using Equation 5.

$$\text{Load Regulation}(\%) = \left(\frac{|V_{err}|}{V_{Initial}}\right) \cdot 100$$

V_{err} = Measured worst-case voltage fluctuation
$V_{Initial}$ = Measured initial tolerance from Section 5.4

Equation 5: Load Regulation

6. Verify that the calculated Load Regulation percentage is less than or equal to the value specified in Table 2.
7. Verify that the maximum current measured matches the vendor data sheet and is less than the value specified in Table 2.

5.7 Output Ripple

The purpose of this test is to verify that the noise riding on the DC output of the DUT is at or below the limit specified in Table 2. The ripple bandwidth of interest is between 5Hz and 1 MHz. The test configuration is illustrated in Figure 5. A scope with a differential probe or a dual channel scope with two probes may be used to derive the differential output ripple voltage.

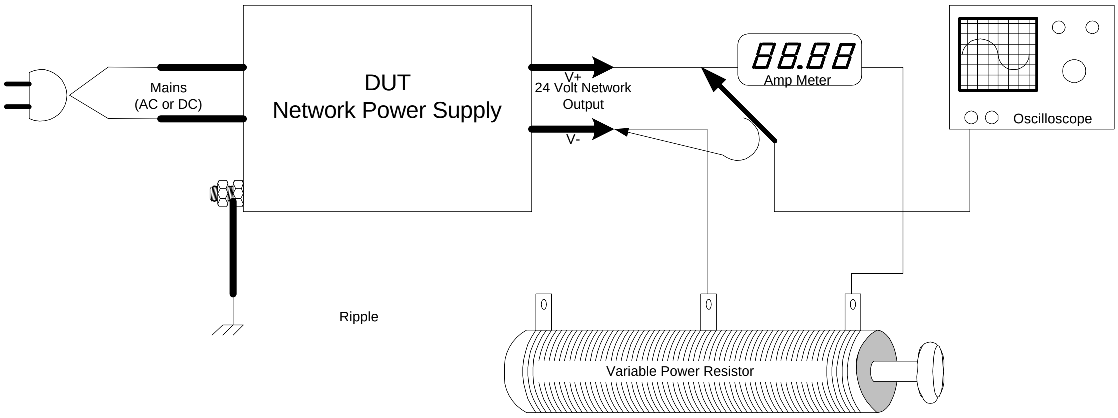

Figure 5: Output Ripple Test Configuration

1. Verify that the input voltage is within the range specified in the vendor data sheet.
2. Setup the oscilloscope to measure AC and connect to the output.
3. Measure the output ripple first with the variable power resistor disconnected (DUT at I = 0)
4. Measure the output ripple with the variable power resistor set to the value calculated with Equation 3 (I = maximum).
5. Verify that the peak-to-peak ripple of the DUT is less than or equal to the value specified in Table 2.

5.8 7000µF Load Test

The purpose of this test is to verify that the DUT will meet the startup requirements under a resistive and capacative load that represents a fully loaded, worst-case network. Devices may have bulk filter capacitors across their 24V inputs. Therefore, addition of all the devices' capacitance on a network and the capacitance of the power bus (cable) can be as high as 7000µF. The DUT must be able to startup a system beginning with the capacitance is totally discharged and meet the rise time requirement.

The test configuration is illustrated in Figure 6.

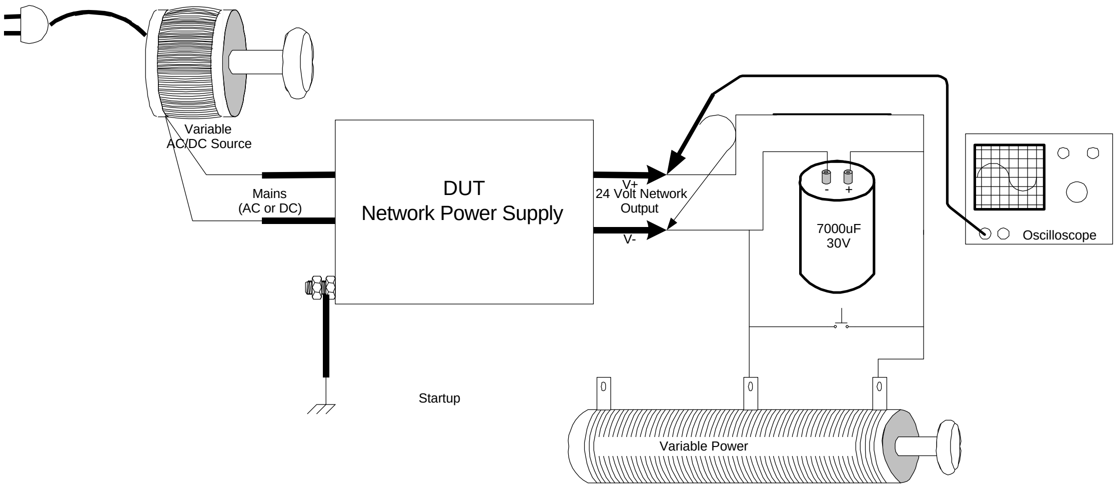

Figure 6: Network Startup Test Configuration

This test has three parts. Part 1 verifies that the DUT has the ability to start up when the input power is applied. Part 2 verifies that the DUT has the ability to recover from a short circuit. Part 3 repeats the steps of Part 1 and 2 with only the capacitor. In all three parts, the DUT must meet the rise time and output voltage as specified in Table 2. An example of a rise time measurement is shown in Figure 7.

1. Verify that the input voltage is within range as specified in the vendor data sheet.
2. Set the variable power resistor to the value calculated with Equation 3 (I = maximum).
3. Set the oscilloscope to trigger on the lowest positive DC voltage possible for the scope (trigger level < 0.25V). Set the oscilloscope for single trigger.
4. Set the oscilloscope to display 24V from top of the screen to the bottom.

In all three of the following parts, verify that the DUT is able to start-up without "latching" in an overload or shutdown condition.

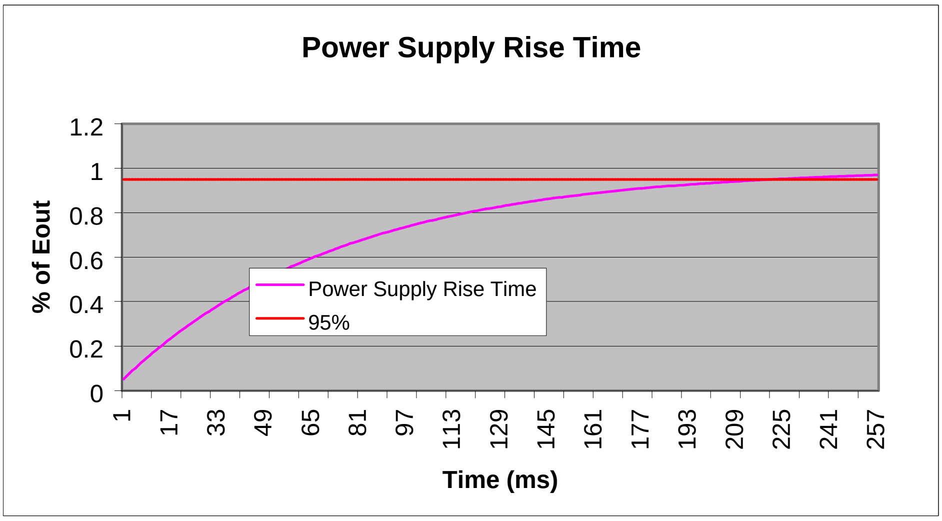

Figure 7: Power Supply Rise Time Example

5.8.1 Part 1

1. Turn off the DUT.
2. Short the output using the momentary switch to completely discharge the capacitor.
3. Turn on the DUT.
4. Measure the time for the output voltage to rise to within 5% of its final value.
5. Verify that the rise time is less than or equal to the value specified in Table 2.

5.8.2 Part 2

1. With the DUT on, close the momentary switch for at least 2 seconds.
2. Measure the time for the output voltage to rise to within 5% of its final value.
3. Verify that the rise time is less than or equal to the value specified in Table 2.

5.8.3 Part 3

1. Remove the variable power resistor.
2. Repeat Parts 1 and 2 of this section (capacitor only).

5.9 Over Current Protection

The purpose of this test is to verify that the DUT will limit current in accordance with the DeviceNet Specification. The test configuration is illustrated in Figure 8.

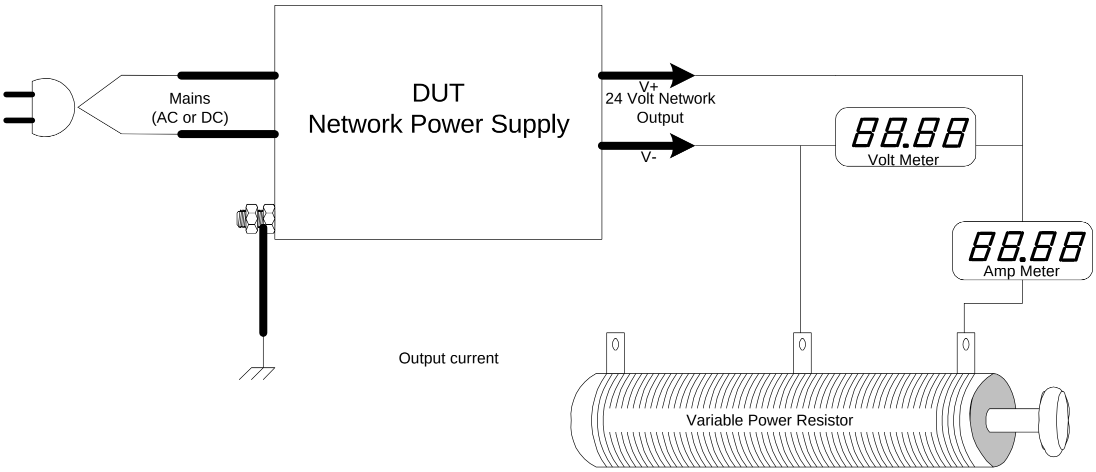

Figure 8: Over Current Test Configuration

1. Verify that the input voltage is within range as specified in the vendor data sheet.
2. Set the variable power resistor to 90% of the value calculated with Equation 3. This load value will draw a current from the DUT that is 10% less than its maximum.
3. Monitor the output current while decreasing the resistance.
4. Record the point (current) at which the DUT disables its output or limits its current. This point will be where the output voltage of the DUT exceeds the maximum line regulation voltage as defined in Table 2.
5. Verify that the DUT disables or limits its output current and gradually decreases its output voltage. The point at which the output must disable or limit is defined in Table 2.
6. Use Equation 6 to calculate the Over Current percentage.

$$\text{Over Current}\,(\%) = \left(\frac{I_{Measured}}{I_{Max}}\right)\cdot 100$$

$I_{Measured}$ = Point at which DUT limits output
I_{Max} = Maximum current from data sheet

Equation 6: Over Current

7. Verify that the Over Current percentage is less than or equal to the value specified in Table 2.

5.10 Turn-on Overshoot

The purpose of this test is to verify that the output voltage of the DUT does not exceed the maximum allowed bus voltage by more than allowed in Table 2. The test configuration is illustrated in Figure 9.

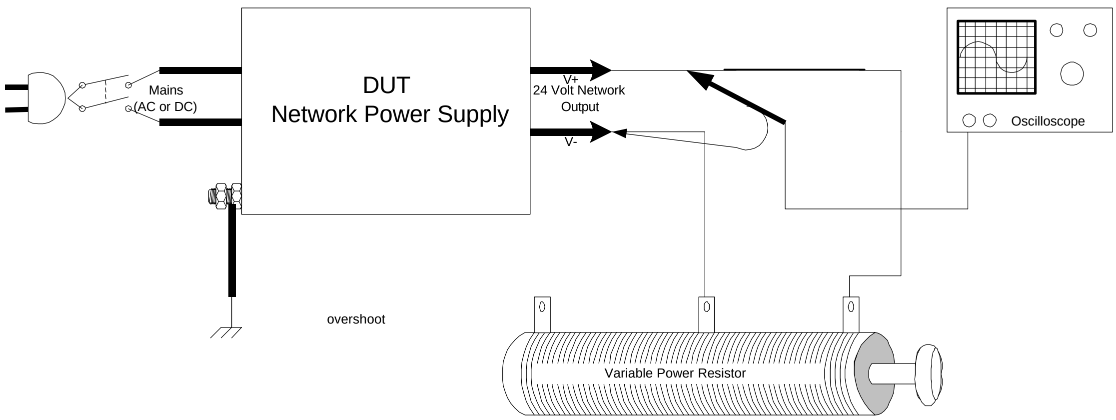

Figure 9: Turn-on Overshoot Test Configuration

1. Verify that the input voltage is within range as specified in the vendor data sheet.
2. Set the oscilloscope to trigger on the lowest positive DC voltage possible for the scope (trigger level < 0.25V). Set the oscilloscope for single trigger.
3. Set the oscilloscope to vertically display the range 23 – 25 V.
4. Initially, remove the variable power resistor so that the DUT's output is open.
5. Turn on the DUT and capture the start-up waveform. The output waveform will rise and then settle to a steady state voltage. An example waveform is shown in Figure 10.
6. Calculate the Overshoot using Equation 7.

$$\text{Overshoot (\%)} = \left(\frac{V_{max\_overshoot} - V_{steady\_state}}{V_{steady\_state}} \right) \cdot 100$$

$V_{max\_overshoot}$ = Measured maximum overshoot
V_{steady_state} = Measured steady-state voltage

Equation 7: Overshoot

7. Verify that the Overshoot of the DUT does not exceed the maximum value specified in Table 2.
8. Repeat the steps 4-6 with the variable power resistor set to the value calculated with Equation 3.

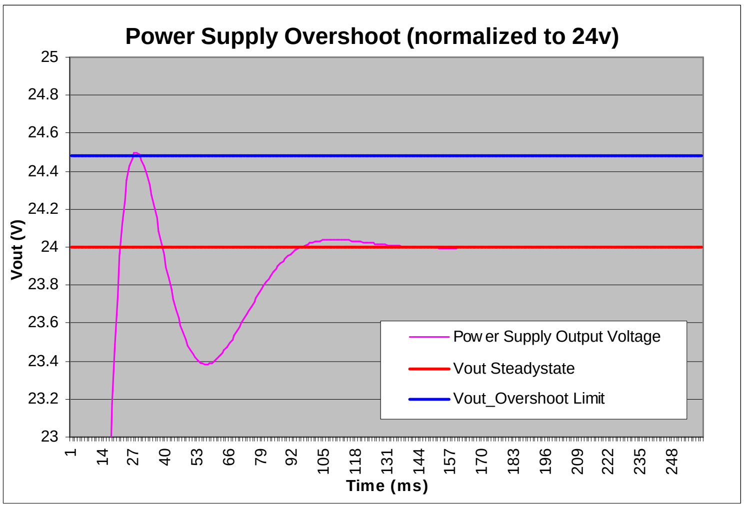

Figure 10: Example Overshoot Waveform

APPENDIX A: CONFORMANCE TEST DATA

Date	2004-11-17
Vendor ID	PULS
Vendor Name	PULS Elektronische Stromversorgungen GmbH
Product Name	QS10.DNET Ser.Nb.

Agency Approvals

Data Sheet Specifications

	Pass	Fail
Humidity	X	
Temperature Range	X	

Isolation

	Pass	Fail
Chassis to V+	X	
Chassis to V-	X	

Initial Tolerance

				Pass	Fail
V_{Max}	240V	Measured Initial Tolerance:	24,111V	X	
V_{Min}	100V				
V_{Line}	170V				

Line Regulation

				Pass	Fail
I_{Max}	8A	Calculated Line Regulation:	0%	X	
$V_{Initial}$	24,111V				
R_{Load}	3O				
V_{err}	0V				

Load Regulation

				Pass	Fail
$V_{Initial}$	24,111V	Calculated Load Regulation:	0,075%	X	
V_{err}	18mV	Measured Maximum Current:	8A	X	

Output Ripple

		Pass	Fail
Maximum peak-to-peak ripple, I = 0:	4mV	X	
Maximum peak-to-peak ripple, I = maximum:	15mV	X	

7000µF Load Test

	Value	Pass	Fail
Rise time, Part 1 (resistor & capacitor):	47ms	X	
Rise time, Part 2 (resistor & capacitor):	53ms	X	
Rise time, Part 1 repeated (capacitor only):	31ms	X	
Rise time, Part 2 repeated (capacitor only):	45ms	X	
DUT did not latch in an overload or shutdown condition		X	

Over Current Protection

$I_{Measured}$ 8,6A
I_{Max} 8A

	Value	Pass	Fail
Calculated Over Current:	107,5%	X	

Turn-on Overshoot (without Resistor)

$V_{max\_overshoot}$ 24,11V
V_{steady_state} 24,11V

	Value	Pass	Fail
Calculated Overshoot:	0%	X	

Turn-on Overshoot (with Resistor)

$V_{max\_overshoot}$ 24,091V
V_{steady_state} 24,091V

	Value	Pass	Fail
Calculated Overshoot:	0%	X	

Notes: