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DNP3 Self-Conformance Test L2

Conformance testing by:	Schweitzer Engineering Laboratories, Inc.
Product Tested:	SEL-3530 Real-Time Automation Controller

The DNP3 component listed herein displayed conformance to the following tests:

DNP3 Level 1, DNP3 Level 2 Self Conformances

Test results verified by DNP Users Group member from SEL Power Systems group.

The SEL Real-Time Automation Controller (RTAC) product family includes products of varying scale and capability to provide protocol conversion, remote terminal unit (RTU), communications, automation, and control in a variety of applications requiring utility-grade specifications for environmental and temperature conditions. The DNP3 firmware component is identical in each product in the RTAC family, which includes (as of December 2013), the following devices:

- SEL-3530 RTAC
- SEL-3530-4 RTAC
- SEL-3505 Automation Controller
- SEL-2240 Axion

This document describes L2 DNP3 conformance test results as performed on the SEL-3530 RTAC with the following software, firmware, and test versions:

Conformance Test Software	Triangle MicroWorks, Inc., Test Scripts Version 3.16.1.0
	IED Certification Procedure Subset Level 2 Version 2.6 rev1 28-October-2010
	R126
	1.14.5025.0945

This document certifies the RTAC DNP component displayed no nonconformance behavior for all DNP3 L2 conformance test procedures. Test results were verified by DNP Users Group member from SEL Power Systems group.

Test Engineer

16 JAN 2014

Rick Bryson, Research and Development, Automation, SEL — Date

DNP Users Group Verification Engineer

1/20/2014

Ed Cenzon, Research and Development, Power Systems, SEL — Date

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RESULTS SUMMARY

Details of test results are contained in log captures in PDF format showing actions taken by the test harness, the tester, and the RTAC, and are archived with original RTAC test projects and Triangle MicroWorks, Inc., test harness settings. The remainder of this document describes an overall summary of test results and the RTAC DNP3 Device Profile Document.

Table 1: Test Results

Test	Description	Result
6	Link Layer	Passed all tests
7	Transport Layer	Passed all tests
8	Application Layer	Passed all tests
8.1	Binary Output Status	Passed all tests
8.2	Binary Ouputs	Passed all tests
8.3	Analog Output Status	Passed all tests
8.4	Analog Output	Passed all tests
8.5	Class Data	Passed all tests
8.6	Internal Indications	Passed all tests
8.7	Time	Passed all tests
8.8	Cold Restart	Passed all tests
8.9	Application Layer Fragmentation	Passed all tests
8.10	Multi-Drop Support	Passed all tests[a]
8.11	Unsolicited Responses	Passed all tests
8.12	Collision Avoidance	Skipped[b]
8.13	Binary Inputs	Passed all tests
8.14	Binary Input Change	Passed all tests
8.15	Common Time of Occurrence	Passed all tests
8.16	Binary Counters	Passed all tests
8.17	Binary Counters, Event	Passed all tests
8.18	Analog Input	Passed all tests
8.19	Analog Change Event	Passed all tests
8.20	Multiple Read Requests	Passed all tests
8.21	Double-bit Inputs	Not supported
8.22	Double-bit Input Change	Not supported

[a] Test was executed on an EIA-485 network. All other tests were executed using DNP/IP on an Ethernet network.
[b] Not required for L2 conformance. Serial mode collision avoidance not configured during test.

DNP3 Device Profile Document

Table 2: Server (Outstation)

Parameter	Value
Vendor name	Schweitzer Engineering Laboratories
Device name	SEL-5033
Highest DNP request level	Level 3
Highest DNP response level	Level 3
Device function	Outstation
Notable objects, functions, and/or qualifiers supported	Analog Dead-Band Objects (object 34)
Maximum data link frame size transmitted/received (octets)	292
Maximum data link retries	Configurable, range 0–15
Requires data link layer confirmation	Configurable by setting
Maximum application fragment size transmitted/received (octets)	2048
Maximum application layer retries	None
Requires application layer confirmation	When reporting event data
Data link confirm time-out	Configurable
Complete application fragment time-out	None
Application confirm time-out	Configurable
Complete application response time-out	None
Executes control WRITE binary outputs A	Always
Executes control SELECT/OPERATE	Always
Executes control DIRECT OPERATE	Always
Executes control DIRECT OPERATE-NO ACK	Always
Executes control count greater than 1	When pulse count > 1
Executes control Pulse On	Always
Executes control Pulse Off	Never
Executes control Latch Off	Always
Executes control Latch On	Always
Executes control Queue	Never
Executes control Clear Queue	Never
Reports binary input change events when no specific variation requested	Only timetagged
Reports time-tagged binary input change events when no specific variation requested	Binary input change with time
Sends unsolicited responses	Configurable with unsolicited message enable settings. Increases retry time (configurable) when a maximum retry setting is exceeded.
Sends static data in unsolicited responses	Never
Default counter object/variation	Object 20, Variation 6
Counter rollover	32 bits
Sends multifragment responses	Yes

Table 3: DNP Server (Slave) Object

Obj	Var (*default)	Description	REQUEST Func Codes (dec)	REQUEST Qual Codes (hex)	RESPONSE Func Codes (dec)	RESPONSE Qual Codes (hex)
1	0	Binary Input—All Variations	1,22	0,1,6,7,8,17,28		
1	1	Binary Input	1	0,1,6,7,8,17,28	129	0,1,17,28
1	2*	Binary Input With Status	1	0,1,6,7,8,17,28	129	0,1,17,28
2	0	Binary Input Change—All Variations	1	6,7,8		
2	1	Binary Input Change Without Time	1	6,7,8	129,130	17,28
2	2*	Binary Input Change With Time	1	6,7,8	129,130	17,28
2	3	Binary Input Change With Relative Time	1	6,7,8	129,130	17,28
10	0	Binary Output—All Variations	1	0,1,6,7,8		
10	2*	Binary Output Status	1	0,1,6,7,8	129	0,1
12	0	Control Block—All Variations				
12	1	Control Device Output Block	3,4,5,6	17,28	129	echo of request
12	2	Pattern Control Block	5,6	7		
12	3	Pattern Mask	5,6	0,1		
20	0	Binary Counter—All Variations	1,7,8,9,10,22	0,1,6,7,8,17,28		
20	1	32-Bit Binary Counter	1,7,8,9,10	0,1,6,7,8,17,28	129	0,1,17,28
20	2	16-Bit Binary Counter	1,7,8,9,10	0,1,6,7,8,17,28	129	0,1,17,28
20	5	32-Bit Binary Counter Without Flag	1,7,8,9,10	0,1,6,7,8,17,28	129	0,1,17,28
20	6*	16-Bit Binary Counter Without Flag	1,7,8,9,10	0,1,6,7,8,17,28	129	0,1,17,28
21	0	Frozen Counter—All Variations	1,22	0,1,6,7,8,17,28		
21	1	32-Bit Frozen Counter	1	0,1,6,7,8,17,28	129	0,1,17,28
21	2	16-Bit Frozen Counter	1	0,1,6,7,8,17,28	129	0,1,17,28
21	5	32-Bit Frozen Counter With Time of Freeze	1	0,1,6,7,8,17,28	129	0,1,17,28
21	6*	16-Bit Frozen Counter With Time of Freeze	1	0,1,6,7,8,17,28	129	0,1,17,28
21	9	32-Bit Frozen Counter Without Flag	1	0,1,6,7,8,17,28	129	0,1,17,28
21	10	16-Bit Frozen Counter Without Flag	1	0,1,6,7,8,17,28	129	0,1,17,28
22	0	Counter Change Event—All Variations	1	6,7,8		
22	1	32-Bit Counter Change Event Without Time	1	6,7,8	129,130	17,28
22	2*	16-Bit Counter Change Event Without Time	1	6,7,8	129,130	17,28
22	5	32-Bit Counter Change Event With Time	1	6,7,8	129,130	17,28
22	6	16-Bit Counter Change Event With Time	1	6,7,8	129,130	17,28
23	0	Frozen Counter Event—All Variations	1	6,7,8		

Obj	Var (*default)	Description	REQUEST Func Codes (dec)	REQUEST Qual Codes (hex)	RESPONSE Func Codes (dec)	RESPONSE Qual Codes (hex)
23	1	32-Bit Frozen Counter Event Without Time	1	6,7,8	129,130	17,28
23	2	16-Bit Frozen Counter Event Without Time	1	6,7,8	129,130	17,28
23	5	32-Bit Frozen Counter Event With Time	1	6,7,8	129,130	17,28
23	6*	16-Bit Frozen Counter Event With Time	1	6,7,8	129,130	17,28
30	0	Analog Input—All Variations	1,22	0,1,6,7,8,17,18		
30	1	32-Bit Analog Input	1	0,1,6,7,8,17,28	129	0,1,17,28
30	2	16-Bit Analog Input	1	0,1,6,7,8,17,28	129	0,1,17,28
30	3	32-Bit Analog Input Without Flag	1	0,1,6,7,8,17,28	129	0,1,17,28
30	4*	16-Bit Analog Input Without Flag	1	0,1,6,7,8,17,28	129	0,1,17,28
30	5	Short Floating Point Analog Input (32 bit)	1	0,1,6,7,8,17,28	129	0,1,17,28
32	0	Analog Change Event—All Variations	1	6,7,8		
32	1*	32-Bit Analog Change Event Without Time	1	6,7,8	129,130	17,28
32	2	16-Bit Analog Change Event Without Time	1	6,7,8	129,130	17,28
32	3	32-Bit Analog Change Event With Time	1	6,7,8	129,130	17,28
32	4	16-Bit Analog Change Event With Time	1	6,7,8	129,130	17,28
32	5	Short Floating Point Analog Change Event	1	6,7,8	129,130	17,28
32	7	Short Floating Point Analog Change Event With Time	1	6,7,8	129,130	17,28
34	0	Analog Dead Band—All Variations	1	0,1,6,7,8,17,28		
34	1*	16-Bit Analog Dead Band	1,2	0,1,6,7,8,17,28	129	0,1,17,28
34	2	32-Bit Analog Dead Band	1,2	0,1,6,7,8,17,28	129	0,1,17,28
34	3	Short Floating Point Dead Band	1,2	0,1,6,7,8,17,28	129	0,1,17,28
40	0	Analog Output Status—All Variations	1	0,1,6,7,8		
40	1	32-Bit Analog Output Status	1	0,1,6,7,8	129	0,1,17,28
40	2*	16-Bit Analog Output Status	1	0,1,6,7,8	129	0,1,17,28
40	3	Short Floating Point Analog Output Status (32 bit)	1	0,1,6,7,8	129	0,1,17,28
41	0	Analog Output Block—All Variations				
41	1	32-Bit Analog Output Block	3,4,5,6	17,28	129	echo of request
41	2	16-Bit Analog Output Block	3,4,5,6	17,28	129	echo of request
41	3	Short Floating Point Analog Output Block (32 bit)	3,4,5,6	17,28	129	echo of request
50	0	Time and Date—All Variations				

Obj	Var (*default)	Description	REQUEST Func Codes (dec)	REQUEST Qual Codes (hex)	RESPONSE Func Codes (dec)	RESPONSE Qual Codes (hex)
50	1*	Time and Date	1,2	7,8 (index=0)	129	07 (quantity=1)
50	3	Time and Date (Last Recorded Time)	2	7 (quantity=1)	129	
51	1	Time and Date CTO			129	07 (quantity=1)
51	2*	Unsynchronized Time and Date CTO			129	07 (quantity=1)
52	1	Time Delay Coarse			129	07 (quantity=1)
52	2	Time Delay Fine			129	07 (quantity=1)
60	1	Class 0 Data	1,22	6,7,8		
60	2	Class 1 Data	1,20,21,22	6,7,8		
60	3	Class 2 Data	1,20,21,22	6,7,8		
60	4	Class 3 Data	1,20,21,22	6,7,8		
80	1	Internal Indications	1 2	0,1 1 (index 4,7)		
NA	NA	No Object	13,14,23,24			

Table 4: DNP Client (Master) Object

Obj	Var	Description	REQUEST Func Codes (dec)	REQUEST Qual Codes (hex)	RESPONSE Func Codes (dec)	RESPONSE Qual Codes (hex)
1	0	Binary Input—Any Variation	1	0,1,6,7,8,17,28		
1	1	Binary Input—Packed Format	1	0,1,6,7,8,17,28	129	0,1,17,28
1	2	Binary Input—With Flags	1	0,1,6,7,8,17,28	129	0,1,17,28
2	0	Binary Input Event—Any Variation	1	6,7,8		
2	1	Binary Input Event—Without Time	1	6,7,8	129,130	17,28
2	2	Binary Input Event—With Absolute Time	1	6,7,8	129,130	17,28
2	3	Binary Input Event—With Relative Time	1	6,7,8	129,130	17,28
10	0	Binary Output—Any Variation	1	0,1,6,7,8,17,28		
10	2	Binary Output—Output Status With Flags	1	0,1,6,7,8,17,28	129	0,1,17,28
11	1	Binary Output Event—Status Without Time			129, 130	17, 28
11	2	Binary Output Event—Status With Time			129, 130	17, 28
12	1	Binary Command—Control Relay Output Block (CROB)	3,4,5,6	17,28	129	echo of request
20	0	Counter—Any Variation	1,7,8,9,10	0,1,6,7,8,17,28		
20	1	Counter—32-bit With Flag	1	0,1,6,7,8,17,28	129	0,1,17,28
20	2	Counter—16-bit With Flag	1	0,1,6,7,8,17,28	129	0,1,17,28
20	5	Counter—32-bit Without Flag	1	0,1,6,7,8,17,28	129	0,1,17,28

Obj	Var	Description	REQUEST Func Codes (dec)	REQUEST Qual Codes (hex)	RESPONSE Func Codes (dec)	RESPONSE Qual Codes (hex)
20	6	Counter—16-bit Without Flag	1	0,1,6,7,8,17,28	129	0,1 17,28
21	0	Frozen Counter—Any Variation	1	0,1,6,7,8,17,28		
21	1	Frozen Counter—32-bit With Flag	1	0,1,6,7,8,17,28	129	0,1,17,28
21	2	Frozen Counter—16-bit With Flag	1	0,1,6,7,8,17,28	129	0,1,17,28
21	5	Frozen Counter—32-bit With Flag and Time of Freeze	1	0,1,6,7,8,17,28	129	0,1,17,28
21	6	Frozen Counter—16-bit With Flag and Time of Freeze	1	0,1,6,7,8,17,28	129	0,1,17,28
21	9	Frozen Counter—32-bit Without Flag	1	0,1,6,7,8,17,28	129	0,1,17,28
21	10	Frozen Counter—16-Bit Without Flag	1	0,1,6,7,8,17,28	129	0,1,17,28
22	0	Counter Event—Any Variation	1	6,7,8		
22	1	Counter Event—32-Bit With Flag	1	6,7,8	129,130	17,28
22	2	Counter Event—16-Bit With Flag	1	6,7,8	129,130	17,28
22	5	Counter Event—32-Bit With Flag and Time	1	6,7,8	129,130	17,28
22	6	Counter Event—16-Bit With Flag and Time	1	6,7,8	129,130	17,28
23	0	Frozen Counter Event—Any Variation	1	6,7,8		
23	1	Frozen Counter Event—32-Bit With Flag	1	6,7,8	129,130	17,28
23	2	Frozen Counter Event—16-Bit Without Flag	1	6,7,8	129,130	17,28
23	5	Frozen Counter Event—32-Bit With Flag and Time	1	6,7,8	129,130	17,28
23	6	Frozen Counter Event—16-Bit With Flag and Time	1	6,7,8	129,130	17,28
30	0	Analog Input—Any Variation	1	0,1,6,7,8,17,28		
30	1	Analog Input—32-Bit With Flag	1	0,1,6,7,8,17,28	129	0,1,17,28
30	2	Analog Input—16-Bit With Flag	1	0,1,6,7,8,17,28	129	0,1,17,28
30	3	Analog Input—32-Bit Without Flag	1	0,1,6,7,8,17,28	129	0,1,17,28
30	4	Analog Input—16-Bit Without Flag	1	0,1,6,7,8,17,28	129	0,1,17,28
30	5	Analog Input—Single-prec flt-pt With Flag	1	0,1,6,7,8,17,28	129	0,1,17,28
32	0	Analog Input Event—Any Variation	1	6,7,8		
32	1	Analog Input Event—32-Bit Without Time	1	6,7,8	129,130	17,28
32	2	Analog Input Event—16-Bit Without Time	1	6,7,8	129,130	17,28
32	3	Analog Input Event—32-Bit With Time	1	6,7,8	129,130	17,28
32	4	Analog Input Event—16-Bit With Time	1	6,7,8	129,130	17,28
32	5	Analog Input Event—Single-prec flt-pt Without Time	1	6,7,8	129,130	17,28
32	7	Analog Input Event—Single-prec flt-pt With Time	1	6,7,8	129,130	17,28
40	0	Analog Output Status—Any Variation	1	0,1,6,7,8,17,28		

Obj	Var	Description	REQUEST Func Codes (dec)	REQUEST Qual Codes (hex)	RESPONSE Func Codes (dec)	RESPONSE Qual Codes (hex)
40	1	Analog Output Status—32-Bit With Flag	1	0,1,6,7,8,17,28	129	0,1,17,28
40	2	Analog Output Status—16-Bit With Flag	1	0,1,6,7,8,17,28	129	0,1,17,28
40	3	Analog Output Status—Single-prec flt-pt With Flag	1	0,1,6,7,8,17,28	129	0,1,17,28
41	1	Analog Output—32-Bit	3,4,5,6	17,28	129	echo of request
41	2	Analog Output—16-Bit	3,4,5,6	17,28	129	echo of request
41	3	Analog Output—Single-prec flt-pt	3,4,5,6	17,28	129	echo of request
42	1	Analog Output Event—32-bit Without Time			129,130	17,28
42	2	Analog Output Event—16-bit Without Time			129,130	17,28
42	3	Analog Output Event—32-bit With Time			129,130	17,28
42	4	Analog Output Event—16-bit With Time			129,130	17,28
42	5	Analog Output Event—Single-prec flt-pt Without Time			129,130	17,28
42	7	Analog Output Event—Single-prec flt-pt With Time			129,130	17,28
50	1	Time and Date—Absolute Time	1,2	7 (Qty = 1)	129	7 (Qty = 1)
50	3	Time and Date—Absolute Time at Last Recorded Time	2	7 (Qty = 1)	129	7 (Qty = 1)
51	1	Time and Date CTO—Absolute Time, synchronized			129,130	7 (Qty = 1)
51	2	Time and Date CTO—Absolute Time, unsynchronized			129,130	7 (Qty = 1)
52	1	Time Delay—Coarse			129	7 (Qty = 1)
52	2	Time Delay—Fine			129	7 (Qty = 1)
60	1	Class Objects—Class 0 Data	1	6		
60	2	Class Objects—Class 1 Data	1 20,21	6,7,8 6		
60	3	Class Objects—Class 2 Data	1 20,21	6,7,8 6		
60	4	Class Objects—Class 3 Data	1 20,21	6,7,8 6		
80	1	Internal Indications—Packed Format	1 2	0,1 1 (index 4,7)	129	0,1
NA	NA	No Object (function code only)	13,23 14,24			