

Conformity Assessment Program Update

IEEE 1588

Terry Jones, ORNL
April 15, 2019

ORNL is managed by UT-Battelle, LLC for the US Department of Energy

IEEE 1588 Conformity Assessment Program

- A series of tests (test suite) to determine if a Power Industry device is conformant (can be downloaded)
 - <https://www.iol.unh.edu/1588PowerProfileConformance> <- available here
- Conformant: A well-defined criteria (tests) to establish compliance to the specification.
 - Follow-on topics being discussed include, but are not limited to, Interoperability, Cybersecurity, Redudancy, etc.
- University of New Hampshire Interoperability Laboratory & National Institute of Standards & Technology
- Currently version at 1.22
 - Divided into 13 groups of tests
 - Validates behavior (timeouts, protocol values, response behavior, ...)

IEEE Certificate and Registry

- Upon successfully passing all tests, applicants receive a certificate and are listed on an IEEE registry (shown for Synchrophasor program).



TSS preview testing at ISPCS Workshop



Sample testing offered at last 3 ISPCS Workshops

Need to transition to Pilot Program for more thorough test and feedback on TSS and to transition to active Certification

Test Suite Specification (TSS) for IEC 61850-9-3 / IEEE C37.238

UNH-IOL
IEEE 1588 Testing Service
1588 Power Profile Conformance
Test Suite Specification
Version 1.22
Technical Document



***NOTICE: This is a living document. All contents are subject to change.
Individual tests and/or test groups may be added/deleted/changed in forthcoming revisions.
General feedback and comments are welcome, please contact ptplab@iol.unh.edu.***

Last Updated: March 25, 2019

*University of New Hampshire's
InterOperability Laboratory
21 Madbury Drive, Suite 100
Durham NH, 03824*

*Tel: +1 603-862-0090
Fax: +1 603-862-4181
Email: ptplab@iol.unh.edu
Web: www.iol.unh.edu/1588*

1588 Power Profile Test Suite Specification

Contents

Revision Tracking	4
Acknowledgments	5
Summary of Test Pre-requisites and Certification Classifiers	6
SECTION PWR.c: 1588 Power Profile Conformance	15
Group 1: PTP Attribute Values	16
Test PWR.c.1.1 — logAnnounceInterval attribute value	17
Test PWR.c.1.2 — logSyncInterval attribute value	21
Test PWR.c.1.3 — announceReceiptTimeout attribute value	25
Test PWR.c.1.4 — logMinPdelayReq interval value	27
Test PWR.c.1.5 — priority1 and priority2 attribute values	29
Test PWR.c.1.6 — domainNumber attribute value	32
Test PWR.c.1.7 — Announce message flags: timeTraceable and frequencyTraceable	35
Test PWR.c.1.8 — Configured settings preserved following power cycle	37
Group 2: Peer Delay	39
Test PWR.c.2.1 — Use of Proper Path Delay Mechanism	40
Test PWR.c.2.2 — Peer Delay Message Field Values, Two-Step Clock	43
Test PWR.c.2.3 — Pdelay_Resp Message Field Values, One-Step Clock	46
Test PWR.c.2.4 — Behavior when no, or multiple, Pdelay_Resp received	48
Test PWR.c.2.5 — Mean Path Delay	56
Test PWR.c.2.6 — Independent Ports for Boundary Clocks	67
Test PWR.c.2.7 — Independent Ports for Transparent Clocks	76
Test PWR.c.2.8 — Pdelay messages from other domains	86
Test PWR.c.2.9 — Peer Delay Turnaround Timestamps, One-Step Clock	92
Test PWR.c.2.10 — Peer Delay Turnaround Timestamps, Two-Step Clock	94
Test PWR.c.2.11 — Impact of Pdelay Responses Received with High Turnaround Time	96
Group 3: Best Master Clock Algorithm	101
Test PWR.c.3.1 — Disqualified Announce Messages, by clockIdentity	102
Test PWR.c.3.2 — Disqualified Announce Messages, by Most Recent	104
Test PWR.c.3.3 — Qualifying Announce Messages, by Foreign Master Time Window	106
Test PWR.c.3.4 — Disqualified Announce Messages, by stepsRemoved	111
Test PWR.c.3.5 — Disqualified Announce Messages, by alternateMasterFlag	113
Test PWR.c.3.6 — Data Set Comparison for an Ordinary Clock (Single Port)	115
Test PWR.c.3.7 — Data Set Comparison for a Boundary Clock	117
Test PWR.c.3.8 — State Decision Algorithm	126
Test PWR.c.3.9 — Data Set Comparison: stepsRemoved & sourcePortIdentity fields	133
Test PWR.c.3.10 — Announce messages from other domains are ignored	142
Group 4: State Protocol	146
Test PWR.c.4.1 — ANNOUNCE_RECEIPT_TIMEOUT_EXPIRES event	147
Test PWR.c.4.2 — QUALIFICATION_TIMEOUT_EXPIRES event	150
Group 5: Transport Mechanism	152
Test PWR.c.5.1 — IEEE 802.3 Transport for Announce, Sync and Follow_Up Messages	153
Test PWR.c.5.2 — IEEE 802.3 Transport for Peer Delay Messages	155
Test PWR.c.5.3 — TransportSpecific Field Checking upon Receipt	158
Test PWR.c.5.4 — MAC Source Address usage with IEEE 802/Ethernet Transport	165
Group 6: Timescale	169
Test PWR.c.6.1 — PTP Timescale behavior upon loss & restoration of primary reference	170
Test PWR.c.6.2 — Current UTC Offset	173
Test PWR.c.6.3 — Grandmaster Clock Class when Locked	174

1588 Power Profile Test Suite Specification

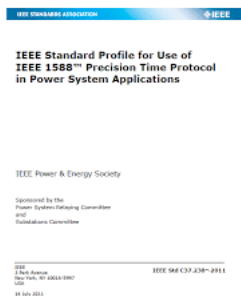
Test PWR.c.6.4 — Grandmaster Degradation of clockQuality	175
Test PWR.c.6.5 — Holdover Drift for Grandmasters	178
Group 7: TLVs	180
Test PWR.c.7.1 — Order of TLVs for C37.238	181
Test PWR.c.7.2 — Profile-Specific TLV Default Field Values	184
Test PWR.c.7.3 — Optional Grandmaster ID Configuration	187
Test PWR.c.7.4 — OrganizationId and OrganizationSubType Recognition	188
Test PWR.c.7.5 — Announce Messages without TLVs	192
Test PWR.c.7.6 — ATOI TLV Forwarding by BCs	199
Test PWR.c.7.7 — ATOI TLV with Local Time Offset	202
Group 8: Time Inaccuracy	205
Test PWR.c.8.1 — totalTimeInaccuracy from Grandmaster Clocks	206
Test PWR.c.8.2 — TimeInaccuracy for Boundary Clocks	210
Test PWR.c.8.3 — Time Inaccuracy for Transparent Clocks	213
Test PWR.c.8.4 — totalTimeInaccuracy Update	217
Group 9: VLAN Conformance	220
Test PWR.c.9.1 — VLAN Tag Transmission, DUT-generated PTP Messages	221
Test PWR.c.9.2 — VLAN Tag Reception – One Port Examination	223
Test PWR.c.9.3 — VLAN Tag Reception – Two-Port Examination (all ports tagged)	228
Test PWR.c.9.4 — TC: PTP Msg Relaying to/from Tagged & Untagged VLAN-Aware ports	232
Test PWR.c.9.5 — BC: PTP Msg Relaying to/from Tagged & Untagged VLAN-Aware ports	237
Group 10: One, Two & Mixed Step Event Message Validation	242
Test PWR.c.10.1 — Port Identity	243
Test PWR.c.10.2 — Peer Delay One-Step and Two-Step Ingress Ports	245
Test PWR.c.10.3 — Sync One-Step and Two-Step Ingress Ports	248
Test PWR.c.10.4 — One-Step or Two-Step Mode Egress Ports	250
Test PWR.c.10.5 — One-Step or Two-Step Flags	253
Group 11: PTP Time Transfer	257
Test PWR.c.11.1 — PTP time transfer from a Grandmaster device	258
Test PWR.c.11.2 — PTP time transfer across a Boundary Clock	261
Test PWR.c.11.3 — PTP time transfer across a Transparent Clock	266
Test PWR.c.11.4 — PTP time transfer to Slave OC with 1PPS	271
Test PWR.c.11.5 — Time transfer messages from other domains are ignored	273
Group 12: Asymmetry Corrections	276
Test PWR.c.12.1 — Asymmetry corrections for Sync Messages	277
Test PWR.c.12.2 — Asymmetry corrections for Pdelay_Req Messages	282
Test PWR.c.12.3 — Asymmetry corrections for Pdelay_Resp Messages	285
Group 13: Grandmaster External Reference Testing	288
Test PWR.c.13.1 — Grandmaster Response to DST changes	289
Test PWR.c.13.2 — GPS Signaled Leap Second Event	292
Test PWR.c.13.3 — Grandmaster Tolerance of GPS Week Rollover	296
Appendix A: DEFAULT TEST SETUP	299
Appendix B: Notes on Test Procedure	301
Appendix C: Discussion Tables	302
Appendix D: Calculations	307
Appendix E: Acronyms and Abbreviations	308
Appendix F: PICS Table Mapping to Tests	309
Group 1: IEEE C37.238 PICS Table Mapping to Tests	309
Group 2: IEC 61850-9-3 PICS Table Mapping to Tests	312
Group 3: IEEE 1588-2008 PICS Table Mapping to Tests	315

What it Covers: Two power profiles

- IEC / IEEE 61850-9-3 (Everyone has to conform to this standard)



- IEEE C37.238 (This is an optional extension)



Utilities interest in a Conformity Assessment Program for PTP Power Profile devices

- BPA & AltaLink will look to include certification into their procurement language in the future.
- Utilities viewed as end-users of these products and garnering their support in this effort is pivotal to this program's success.

What You Can Do – One of Three Ways

1. Consider Sending equipment to UNH Pilot Program for full evaluation report
 - \$6000
 - 3 months
 - Helps to advance Power Test Suite (still formative, but useful at this point)
 - Funds grad students in an area we want funded
 - <https://www.iol.unh.edu/1588/power>
2. Consider Participating in the IEEE-SA ICAP-CASC (small fee)
 - <https://standards.ieee.org/products-services/icap/ptp-power-profile/index.html>
3. Consider Hiring an Intern with NIST or UNH experience
 - contact: Bob Noseworthy <ren@iol.unh.edu>

