

ProTE_x – The Efficient, Low Cost LabVIEW Based Test Executive for Production & Engineering Test

Key Features:

- Easy test sequences using Excel
- Unlimited number of tests can be integrated
- Conditional branching
- Branching based on specific VI result
- Loop selected test(s)
- Dynamically Load and execute VI's with/without front panel display
- Select and run single/multiple test on the menu for troubleshooting
- Summary/Detailed test report generation
- Retrieve detailed Test Info to understand the test methodologies for selected test
- Login access for administrator privileges
- CRC protected reports
- Calibration and system self-test alerts
- CRC Protected test VI's

ProTE_x takes test programs (VI's) and sequence scripts to automate test operation. ProTE_x test executive was developed by Porcyon experts having many years of experience in test system developments.

ProTE_x is an open architecture test sequencer for functional or stress testing. It is developed using National Instruments LabVIEW. It offers a single environment for sequencing of individual tests, including conditional branching to skip some tests based previous test results. It offers increased engineering productivity by reducing the test program development time.

The tool allows the user to develop and run highly efficient test sequences supporting optimal test execution and resulting in minimum costs of testing.

The Test Sequence files are developed using Excel application, it is very simple to add or modify the sequence files. The user no need to spend money to maintain the sequence files, the modifications can be done by him self easily, since it is an Excel based sequence file.

ProTE_x engine executes the test VI's by passing test variables as specified in the sequence file and checks the test results against the limit specified in the sequence file. Test VI's performs individual tests, by doing required stimulus and measurements. The current version of ProTE_x capable of validating three results for a specific test. Depending on the test limits specified in the sequence file, the report is generated with either one or two or three test results.

ProTE_x checks test VI's version by calculating file CRC, if the VI's are modified that need to be released and version information file need to be updated. ProTE_x pops-up a warning if there is a Test VI change,

the user can continue to do the test but the report becomes invalid.

ProTE_x also checks for calibration of the tester, it gives advance notification, if the calibration date is expired; the reports become invalid if the user continues to test with the expired calibration.

ProTE_x generated test report as text file with enough information about the test equipment and test software. The report is CRC protected; any manual change in text can be detected by validating the report file using ProTE_x check report CRC feature. There are two reports generated every time the user does testing, one gives detailed report and other one gives only the summary.

The screenshot shows the ProTE_x software interface. At the top, it displays 'DemoStn 1.0' and 'Product: DemoProduct, Sequence: DoubleResult.seq - Ver. 1.01, Operator: Administrator, UUT Serial #: 2121'. The interface is divided into several sections:

- Test Sequence:** A list of tests (S1.0 to S2.1) with their results (NONE, PASS, RUNNING).
- Test Execution:** Buttons for 'Run All Tests', 'Run Selected Tests', 'Loop Selected Tests', and 'Test Info'.
- Test Results:** Buttons for 'Test Report', 'Test Summary', and 'Clear Test Results'.
- Sub Panel:** A text area containing test details: 'This is a sample test VI for Double Integer Results. This VI parse the input data given in the test sequence and stimulates the required signal for UUT. This VI acquires the UUT signal and does required signal processing and gives final result in integers. This example Input Data sets Signal generator to given voltage and frequency and turn ON Mux Relay to route signals to UUT. Delay: delays measurement after applying stimulus. Measurement Mux relay No also given in the Input Data to route the signal to scope or DMM.' Below this is 'Input Data' (10;600;2;300) and 'Status' (Applying 10Volt 600HZ Via Mux2).
- Failures = 0, Status: RUNNING** with 'Continue' and 'Stop' buttons.
- Results Table:** A table with columns for Test #, Description, LoLmt, HiLmt, Actual, Unit, Result - 1, Result - 2, Result - 3, and Pass/Fail.
- Footer:** 'ProTE_x 1.0a' and '© 2007 Procyon TechSolutions Pvt. Ltd. All rights reserved.'

Test #	Description	Result - 1				Result - 2				Result - 3				Pass/Fail
		LoLmt	HiLmt	Actual	Unit	LoLmt	HiLmt	Actual	Unit	LoLmt	HiLmt	Actual	Unit	
S1.0	SingleResultVIs													
S1.1	SingleResultInt													
S1.1.1	Result >=	30.000	42.000	30.085	Volts									PASS
S1.1.2	Result <=		60.000	40.469	Volts									PASS
S1.1.3	Result !=	NotEQ	60.000	50.120	Volts									PASS
S1.1.4	Result >= <=	35.000	45.000	36.223	Volts									PASS

Sequence Editor:

ProTEx needs only simple tab delimited sequence file, so for easy editing and maintenance the sequence file is created using Excel application. Though the sequence file is simple text file, it has CRC embedded in it; any direct change in text file will become invalid sequence file. The direct change may cause file format issue and also to avoid unauthorized personals to change the sequence file. It is not recommended to have the sequence editor in the tester, to avoid unauthorized access unless it is password protected to read.

ProTEx do not have any limitation for number of tests; as many as more than 60,000 tests can be sequenced using Excel. Refer the screenshot of the typical sequence file. The first eight rows of column C and E have power up, power down vi names, part number, Version information of tester hardware and software.

Before starting the test sequence file, the test VI's need to be written or VI's input variables and results should be defined. The Row 9 and 10 have header information to create the sequence file. The following briefs the details of sequence editor columns.

Each column in the sequence editor has a fixed maximum allowed text width, this is to avoid text wrap in the test report. The test report fit into A4 sheet.

Test #: This is a unique test identification number for each test.

Test Description: Short test name or test group name, the description will be printed on the test report as well it will show up on the screen while the test is executing.

VI Name: The file name of the VI that need to be executed for that particular Test. The VI name should be *Section.vi* when it is just a test group name. Basically it groups a set of tests under a section heading. *Section.vi* defines how many tests will be run in a test section.

The VI name should be *SpecialFunction.vi*, this performs branching, looping, loads vi dynamically and saves test report in binary format.

Input Data: This column contains parameters that must be passed to the VI to perform the test (Example: 30;500;31;500). The separator can be comma or semi colon depends on the Test VI development, but for special function it should be semi colon.

Limit Columns: – Define the PASS/FAIL criteria to determine whether the test is pass or fail. These limits are compared with the returned values from the test VI's.

Units: – The unit of the test measurement, if applicable (Examples: μ sec, Volts, etc.)

Comments: – Not required to run test sequence, just a place for comments about the test.

The Export button on Excel spreadsheet file creates the test sequences defined in the spreadsheet, it creates the *.seq test sequence files. When the Export button is pushed, a temporary file (temp.txt) is generated first, and then CRC is embedded into the file and renamed as user given file name. If the test sequence file already exists, it prompts error. The files created by the macro are stored in the C:\ProTEx\TestSequenceFiles. This file will appear in selection window when PtoTEx is opened. The Export macro uses CRC32.exe to generate 32bit CRC.

The test sequence file revision is maintained in the separate sheet named as Rev History. The current revision number should be updated in the cell C5, the version number is displayed on the main screen as well as it get printer on the test report.

Unlimited number of tests by using Excel based sequence editor. Easy to maintain and minimal effort to learn.

Test #	Test Description	VI Name	Input Data	Result - 1	Result - 2	Result - 3	Comments
1	Power Up VI:	DemoUUTInit.vi	Tester Part Number:	677-231			
2	Power Down VI:	DemoUUTShutdown.vi	Tester Serial Number:	965			
3	Seq. Description:	Demo	Tester Rev Status:	2			
4	Test Mode:	Final-Test	Test Specification Document PN:	011-2345			
5	Version:	1.01	Test Procedure Document PN:	022-3455			
6	Product Name:	DemoProduct	Signal Flow DWG PN	044-0112			
7	Product PN:	956-632	UUT Cable PN, Rev:	877-9876			
8	Sequence Name:	ThreeResult.seq	UUT Adapter PN, Rev:	809-9762			
11	Init	UUTInit	DemoUUTInit.vi				
12	S1.0	SingleResult	Section.vi	S1.0 - SingleResultVIs STOP 23			
13	S1.1	SingleResultInt	Section.vi	S1.1 - SingleResultInt STOP 17			
14	S1.1.1	Result >=	SingleResult.vi	30;500;31;500	>= 30	Volts	
15	S1.1.2	Result <=	SingleResult.vi	40;500;31;500	<= 42	Volts	
16	S1.1.3	Result !=	SingleResult.vi	50;500;31;500	!= 60	Volts	
17	S1.1.4	Result > <=	SingleResult.vi	38;500;31;500	>= 35	<= 45	Volts
18	S1.2	SingleResultHex	Section.vi	S1.2 - SingleResultHex STOP 23			
19	S1.2.1	Result =	SingleResultHex.vi	ReadVol:FE123456;300	= FE123456h		
20	S1.2.2	Result >=	SingleResultHex.vi	ReadVol:FE123456;300	>= FE123456h		
21	S1.2.3	Result <=	SingleResultHex.vi	ReadVol:FE123456;300	<= FE123458h		
22	S1.2.4	Result !=	SingleResultHex.vi	ReadVol:FE123456;300	!= FE123458h		
23	S1.2.5	Result > <=	SingleResultHex.vi	ReadVol:FE123456;300	>= FE123455h	<= FE123459h	
24	S1.3	SingleResultOct	Section.vi	S1.3 - SingleResultOct STOP 29			
25	S1.3.1	Result =	SingleResultOctal.vi	ReadDbl:55556644;300	= 55556644o		
26	S1.3.2	Result >=	SingleResultOctal.vi	ReadDbl:55556644;300	>= 55556642o		
27	S1.3.3	Result <=	SingleResultOctal.vi	ReadDbl:55556644;300	<= 55556647o		
28	S1.3.4	Result !=	SingleResultOctal.vi	ReadDbl:55556644;300	!= 55556647o		
29	S1.3.5	Result > <=	SingleResultOctal.vi	ReadDbl:55556644;300	>= 55556640o	<= 55556647o	
30	S2.0	DoubleResults	Section.vi	S2.0 - DoubleResultsVIs STOP 34			
31	S2.1	DoubleResultsInt	TwoResults.vi	10;600;2;300	>= 10	Volts	>= 600 HZ
32	S2.2	DoubleResultsInt	TwoResults.vi	12;700;2;300	<= 13	Volts	<= 750 HZ
33	S2.3	DoubleResultsInt	TwoResults.vi	13;800;2;300	!= 13	Volts	!= 800 HZ
34	S2.4	DoubleResultsInt	TwoResults.vi	18;900;2;300	>= 18	<= 19	Volts >= 900 <= 950 HZ
35	S3.0	ThreeResults	Section.vi	S3.0 - ThreeResultsVIs STOP 39			
36	S3.1	ThreeResultsInt	ThreeResults.vi	10;600;2;300;4	>= 10	Volts	>= 1 Volts >= 2 Volts
37	S3.2	ThreeResultsInt	ThreeResults.vi	12;700;2;300;4	<= 13	Volts	<= 10 Volts <= 20 Volts
38	S3.3	ThreeResultsInt	ThreeResults.vi	13;800;2;300;4	!= 13	Volts	!= 5 Volts != 15 Volts
39	S3.4	ThreeResultsInt	ThreeResults.vi	18;900;2;300;4	>= 18	<= 19	Volts >= 1 <= 10 Volts >= 2 <= 20 Volts
40	S4.0	ReadResult	Section.vi	S4.0 - ReadResult STOP 45			

Test Report:

At the end of the test; ProTEEx gives simple text report files, there are two files get generated every time the test performed. The summary test report and detailed test report. The detailed test report has the results for all the test that was executed, the summary has only the results for tests that are failed. If all tests are passed the summary report has test count showing the number of tests performed.

The test report has the header information, providing the tester hardware and software part numbers and version information's. The test report has 'REPORT INVALID' warning sign embedded when the operator overrides the ProTEEx warnings, also for any test failures. At the end of report, 32 bit CRC is embedded into the file, with the CRC at anytime the credibility of the report can be verified using the ProTEEx check report feature.

Using the special function call ProTEEx creates binary report file, this file can be used to create a customer defined report format. The test reports file names formed by having serial number, date and time, this gives unique name to the test report file.

User Level Privileges:

There are two user levels in the ProTEEx login, Administrator and Operator. With the administrator level user can be added to the user group to perform the test.

Test VI's:

Test VI's must confirm to certain input and output parameter requirements to be used with the ProTEEx. The input parameters for a test VI is a string used as an Input Data. The output parameters are a Test Result cluster, which contains a Boolean for PASS/FAIL, three double precision numbers typically representing different measurements, and a

Comment string, and an Error Out cluster, which contains a Boolean indicating if an error occurred (TRUE = Error), a 32-bit integer indicating an error code, and a string indicating an error description. Not all test programs use all of these parameters; however, the test VI must be consistent with this format.

A template Sample.vi is installed by ProTEEx setup 'C:\ProTEEx\Help\' location, It is intended that test VI's to be designed top-down from the Sample.vi template. The results of the sub-VI can be converted (if necessary) into the format required by the ProTEEx. Simply disconnect the constants provided by the template and connect the test results as needed. The Input Data is determined by the sequence file. All results are processed by the ProTEEx in-accordance to the PASS/FAIL criteria set by the sequence file created from the Excel spreadsheet file.

```
Sum_w2qw_20070729192231.txt - Notepad
File Edit Format View Help
ProTEEx Test Summary.
-----
Product Name.....: DemoProduct
Product Part Number.....: 956-632
Serial Number.....: w2qw
Start Time.....: 29/07/2007 19:22:11
Operator Name.....: Administrator
Output File Name.....: Sum_w2qw_20070729192231.txt
Test Mode.....: Final-Test

===== Software Version Data =====
Test Executive.....: ProTEEx 1.0a
Test VIS Version.....: 1.0
Sequence File Name & Version.....: SingleResult.seq - Ver. 1.01

===== Test Platform Data =====
Tester Part Number.....: 677-231
Tester Serial Number.....: 965
Tester MOD Status.....: 2
Adapter Part Number, Rev.....: 809-8762.
UUT Interconnect Cable Part Number, Rev.....: 877-9876

===== Reference Documents =====
Test Specification Document PN.....: 011-2345
Test Procedure Document PN.....: 022-3455
Signal Flow DWG PN.....: 044-0112

===== Software Validity Check =====
Test VIs CRC Test.....: FAIL
Test Sequence File CRC Test.....: FAIL

===== Tester Calibration/Self-Test Verification =====
Self-Test Validity.....: FAIL, Due Date: NA
Calibration Validity.....: FAIL, Due Date: NA

!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!                REPORT INVALID                !
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!

Test #   Description           LoLmt   HiLmt   Actual   Unit   P/F
-----
S1.1.2  Result <=                   39.000  40.159  Volts    FAIL
S3.2    ThreeResultsInt              11.000  12.216  Volts    FAIL

Test Execution Time.....: 0:0:20 hours

*****
***      2 TESTS FAILED      ***
*****

29 Tests Analyzed

!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!                REPORT INVALID                !
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!

Operator.....: Administrator
Operator Signature or Stamp.....:

-----CRC:F4FB1746-----
```



Applications:

ProTE_x test executive can be configured to the most of the industry applications.

- Functional testing of PCB/CCA assemblies
- HASS/HALT testing for end products
- Test executive for any NI based Test systems
- Test executive for GPIB/USB COTS test systems
- Parametric testing for automotive electronic parts
- Engineering validation and verification tests

License Cost:

ProTE_x single user lincense cost is \$2500 (this does not include LabVIEW license cost)

Test VIs are developed upon customer request
(Based on the engineering complexity of the system the development cost is ~\$25 per hour)

Contact National Instruments (www.ni.com) to enquire about LabVIEW license cost.



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