

Unit Testing Framework

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1 Main Page

This package empowers a programmer to utilize unit testing for Igor Pro procedures and XOPs. For a quick start have a look at the [first example](#).

The basic building blocks of this package are [Assertions](#) (for checking if an entity fulfills specific properties), [Test Cases](#) (group of assertions) and [Test Suites](#) (group of test cases).

Interface design and naming is inspired by the [Boost Test Library](#).

1.1 Assertion Types

An assertion checks that a given condition is true. Or in more general terms that an entity fulfills specific properties. Test assertions are defined for strings, variables and waves and have ALL CAPS names. They usually come in triplets which differ only in how they react on a failed assertion. Comparing two variables for example can be done with [WARN_EQUAL_VAR](#), [CHECK_EQUAL_VAR](#) or [REQUIRE_EQUAL_VAR](#).

The following table summarizes the action on a failed assertion:

| Type | Create Log Message | Increment Error Count | Abort execution immediately |
|---------|--------------------|-----------------------|-----------------------------|
| WARN | YES | NO | NO |
| CHECK | YES | YES | NO |
| REQUIRE | YES | YES | YES |

If in doubt use the CHECK variant. For the sake of clarity only the CHECK variants are documented, as the interface for REQUIRE and WARN is equivalent. The assertions with only one variant are [PASS](#) and [FAIL](#), see also [example7-uncaught-aborts.ipf](#).

1.2 Test Case

A test case is one of the basic building blocks grouping assertions together. A function is considered a test case if it fulfills all of the following properties:

- takes no parameters
- its name does not end on `_IGNORE`
- is either non-static or static and part of a regular module

The second rule allows advanced users to add their own helper functions. It is advised to define all test cases as static functions and to create one regular module per procedure file.

A single test case from a test suite can be run using the optional `testCase` parameter of [RunTest](#).

1.3 Test Suite

A test suite is a group of test cases which should belong together and is equal to a procedure file. Therefore tests suites can not be nested, although multiple test suites can be run with once command using the parameter `procWinList` of [RunTest](#).

1.4 Test Hooks

To ensure proper test case execution and enable book keeping, specific hook functions are called before/after distinct events. These hook functions always come in pairs with their names ending on `_BEGIN` and `_END`. Before the first test case of the first test suite is executed, the hook [TEST_BEGIN](#) is called, therefore [TEST_END](#) marks the

last function being called immediately before `RunTest` returns. Similarly the hooks `TEST_SUITE_BEGIN` and `TEST_SUITE_END` are called before and after every test suite, `TEST_CASE_BEGIN` and `TEST_CASE_END` before and after every test case.

In case the default hook functions don't suite your needs, it is explicitly **not** advised to just adapt them. Instead use [test hook overrides](#) and override them on a global or per test suite level.

1.4.1 Override Test Hooks

The default test hooks can be overridden by defining your own version of the hooks suffixed with `_OVERRIDE`. The override hooks for `TEST_BEGIN` and `TEST_END` can only be overridden by functions in ProcGlobal. The override hooks for test suites/cases can be overridden globally if they reside in ProcGlobal context, or for a specific test suite only if they are defined in the same regular module as that test suite. Overriding here means that the default test hook is **not** executed. In case you still want to have the default test hook executed, you have to call it yourself in the override function as done in [example 5](#).

The override test hooks have to accept exactly one string parameter, which is the name of the test suite group, test suite name or test case name.

1.5 Automate Test Runs

To further simplify test execution it is possible to automate test runs from the command line.

Steps to do that include:

- Implement a function called `run` in ProcGlobal context taking no parameters. This function must perform all necessary steps for test execution, which is at least one call to [RunTest](#).
- Put the test experiment together with your test suites (procedure files) and the script helper/autorun-test.bat into its own folder
- Run the batch file autorun-test.bat
- Inspect the created log file

See also [example6-automatic-invocation.ipf](#).

2 Example Documentation

2.1 example1-plain.ipf

Test suite showing the basic working principles.

```
#pragma rtGlobals=3

#include "unit-testing"

// Execute the test suite, same named as this procedure file
// with RunTest("example1-plain.ipf")

Function TestModulo()

    CHECK_EQUAL_VAR(abs(1.5), 1.5)
    CHECK_EQUAL_VAR(abs(-1.5), 1.5)
    CHECK_EQUAL_VAR(abs(NaN), NaN)
    // remember that NaN is not equal to NaN
    // this check will generate a warning message but due
```

```

// to the usage of WARN instead of CHECK not increment the error count
WARN(abs(NaN) == NaN)
CHECK_EQUAL_VAR(abs(INF), INF)
CHECK_EQUAL_VAR(abs(-INF), INF)
End

```

2.2 example2-plain.ipf

Test suite with run routine and module/static usage. See the section about [test cases](#) why the function `run_IGNORE()` is not considered a test case.

```

#pragma rtGlobals=3
#pragma ModuleName=Example2

#include "unit-testing"

// Command: run_IGNORE()
// Shows how to use ignore routines

Function run_IGNORE()
    // All of these commands run the test suite "example2-plain.ipf"

    // executes all test cases of this file
    RunTest("example2-plain.ipf")
    // execute only one test case at a time
    RunTest("example2-plain.ipf", testCase="VerifyDefaultStringBehaviour")
    // Give all test suites a descriptive name
    RunTest("example2-plain.ipf", name="My first test")
End

// Making the function static prevents name clashes with other
// procedure files. Using static functions requires also the
// line "#pragma ModuleName" from above.
static Function VerifyDefaultStringBehaviour()

    string nullString
    string emptyString = ""
    string strLow       = "1234a"
    string strUP        = "1234A"

    // by default string comparison is done case insensitive
    CHECK_EQUAL_STR(strLow, strUP)
    CHECK_EQUAL_STR(strLow, strUP, case_sensitive=0)
    // the next test fails
    WARN_EQUAL_STR(strLow, strUP, case_sensitive=1)

    CHECK_NEQ_STR(emptyString, nullString)
    CHECK_NEQ_STR(strLow, nullString)
    CHECK_EMPTY_STR(emptyString)
    CHECK_NULL_STR(nullString)
    CHECK_EQUAL_VAR(strlen(strLow), 5)
End

```

2.3 example3-plain.ipf

Test suite emphasising the difference between the [WARN\(\)](#), [CHECK\(\)](#) and [REQUIRE\(\)](#) assertion variants.

```
#pragma rtGlobals=3
#pragma ModuleName=Example3

#include "unit-testing"

// Command: RunTest("example3-plain.ipf")
// The error count of this test suite is 2

// WARN_* does not increment the error count
Function WarnTest()

    WARN_EQUAL_VAR(1.0,0.0)

End

// CHECK_* increments the error count
Function CheckTest()

    CHECK_EQUAL_VAR(1.0,0.0)

End

// REQUIRE_* increments the error count and will stop execution
// of the test case immediately.
// Nevertheless the test end hooks are still executed.
Function RequireTest()

    REQUIRE_EQUAL_VAR(1.0,0.0)
    print "I'm never reached :("

End
```

See also [Assertion Types](#).

2.4 example4-wavechecking.ipf

Test suite showing some test assertions Xfor waves.

```
#pragma rtGlobals=3
#pragma ModuleName=Example4

#include "unit-testing"

// Command: RunTest("example4-wavechecking.ipf")
// Helper functions to check wave types and compare with
// reference waves are also provided

static Function CheckMakeDouble()
    CHECK_EMPTY_FOLDER() // checks that the cdf is completely empty

    Make/D myWave
    CHECK_WAVE(myWave, NUMERIC_WAVE, minorType=DOUBLE_WAVE)
    CHECK_EQUAL_VAR(DimSize(myWave,0),128)
```

```

        // as this test case is always executed in a fresh datafolder
        // we don't have to use the overwrite /O option for Duplicate
        Duplicate myWave, myWaveCopy
        CHECK_EQUAL WAVES (myWave, myWaveCopy)

End

static Function CheckMakeText ()
    CHECK_EMPTY_FOLDER ()

    Make/T myWave
    CHECK_WAVE (myWave, TEXT_WAVE)
    CHECK_EQUAL_VAR (DimSize (myWave, 0), 128)

    Duplicate/T myWave, myWaveCopy
    CHECK_EQUAL WAVES (myWave, myWaveCopy)

End

```

2.5 example5-overridehooks.ipf

Two test suites showing how to use test hook overrides.

```

#pragma rtGlobals=3
#pragma ModuleName=Example5

#include "unit-testing"

// RunTest ("example5-overridehooks.ipf;example5-overridehooks-otherSuite.ipf")

static Function TEST_CASE_BEGIN_OVERRIDE (name)
    string name

    print "I'm for all test cases in *this* test suite"

End

static Function TEST_CASE_END_OVERRIDE (name)
    string name

    printf "I'm overriding test case end for (%s) in this test suite only\r", name
    TEST_CASE_END (name)

End

static Function CheckSquareRoot ()

    CHECK_EQUAL_VAR (sqrt (4.0), 2.0)
    CHECK_CLOSE_VAR (sqrt (2.0), 1.4142, tol=1e-4)

End

```

```

#pragma rtGlobals=3

#include "unit-testing"

// As this procedure file is in ProcGlobal context
// the test hook overrides are global.

```

```

Function TEST_BEGIN_OVERRIDE (name)
    string name

    print "I can only be overridden globally"
End

Function TEST_END_OVERRIDE (name)
    string name

    print "I can only be overridden globally, too"
End

Function TEST_CASE_END_OVERRIDE (name)
    string name

    print "I'm for all test suites overriding the test case end"
    TEST_CASE_END (name)
End

Function TEST_SUITE_BEGIN_OVERRIDE (name)
    string name

    print "Global test suite begin override"
End

Function TEST_SUITE_END_OVERRIDE (name)
    string name

    print "Global test suite end override"
    TEST_SUITE_END (name)
End

Function CheckBasicMath()

    CHECK_EQUAL_VAR (1+2, 3)
End

```

2.6 example6-automatic-invocation.ipf

Test suite showing how to automate testing from the command line. See also [Automate Test Runs](#).

```

#pragma rtGlobals=3
#pragma ModuleName=Example6

#include "unit-testing"

// Command: Call "autorun-test.bat" without Igor Pro running

static Function CheckTrigonometricFunctions()
    CHECK_EQUAL_VAR (sin(0.0), 0.0)
    CHECK_EQUAL_VAR (cos(0.0), 1.0)
    CHECK_EQUAL_VAR (tan(0.0), 0.0)
End

```

```
#pragma rtGlobals=3

#include "unit-testing"

Function run()
    RunTest("example6-automatic-invocation.ipf")
End
```

2.7 example7-uncaught-aborts.ipf

Test suite showing how unhandled aborts in test cases are handled.

```
#pragma rtGlobals=3
#pragma ModuleName=Example7

#include "unit-testing"

// Command: RunTest("example7-uncaught-aborts.ipf")
// Showing the effect of uncaught aborts
// PASS() just increases the assertion counter
Function CheckNumber(a)
    variable a

    PASS()

    if(numType(a) == 2)
        Abort
    endif

    return 1
End

static Function CheckNumber_not_nan()

    CheckNumber(1.0)
End

static Function CheckNumber_nan()

    CheckNumber(NaN)
End
```

3 Module Documentation

3.1 Helper functions

Functions

- variable `DisableDebugOutput()`
- variable `EnableDebugOutput()`
- variable `RunTest` (string procWinList, string name=defaultValue, string testCase=defaultValue)

3.1.1 Detailed Description

Runner and helper functions.

3.1.2 Function Documentation

3.1.2.1 DisableDebugOutput()

```
variable DisableDebugOutput ( )
```

Turns debug output off.

3.1.2.2 EnableDebugOutput()

```
variable EnableDebugOutput ( )
```

Turns debug output on.

3.1.2.3 RunTest()

```
variable RunTest (
    string procWinList,
    string name = defaultValue,
    string testCase = defaultValue )
```

Main function to execute one or more test suites.

Parameters

| | |
|--------------------|---|
| <i>procWinList</i> | semicolon (";") separated list of procedure files |
| <i>name</i> | (optional) descriptive name for the executed test suites |
| <i>testCase</i> | (optional) function name, resembling one test case, which should be executed only |

Returns

total number of errors

3.2 Test Assertions

Functions

- variable `CHECK` (variable var)
- variable `CHECK_CLOSE_CMPLX` (variable/c var1, variable/c var2, variable tol=defaultValue, variable strong_or_weak=defaultValue)
- variable `CHECK_CLOSE_VAR` (variable var1, variable var2, variable tol=defaultValue, variable strong_or_weak=defaultValue)
- variable `CHECK_EMPTY_FOLDER` ()
- variable `CHECK_EMPTY_STR` (string *str)
- variable `CHECK_EQUAL_STR` (string *str1, string *str2, variable case_sensitive=defaultValue)
- variable `CHECK_EQUAL_TEXTWAVES` (WaveText ww1, WaveText ww2, variable mode=defaultValue)
- variable `CHECK_EQUAL_VAR` (variable var1, variable var2)
- variable `CHECK_EQUAL_WAVES` (WaveOrNull ww1, WaveOrNull ww2, variable mode=defaultValue, variable tol=defaultValue)
- variable `CHECK_NEQ_STR` (string *str1, string *str2, variable case_sensitive=defaultValue)
- variable `CHECK_NEQ_VAR` (variable var1, variable var2)
- variable `CHECK_NON_EMPTY_STR` (string *str)
- variable `CHECK_NON_NULL_STR` (string *str)
- variable `CHECK_NULL_STR` (string *str)
- variable `CHECK_PROPER_STR` (string *str)
- variable `CHECK_SMALL_CMPLX` (variable/c var, variable tol=defaultValue)
- variable `CHECK_SMALL_VAR` (variable var, variable tol=defaultValue)
- variable `CHECK_WAVE` (WaveOrNull ww, variable majorType, variable minorType=defaultValue)
- variable `FAIL` ()
- variable `PASS` ()
- variable `REQUIRE` (variable var)
- variable `REQUIRE_CLOSE_CMPLX` (variable/c var1, variable/c var2, variable tol=defaultValue, variable strong_or_weak=defaultValue)
- variable `REQUIRE_CLOSE_VAR` (variable var1, variable var2, variable tol=defaultValue, variable strong_or_weak=defaultValue)
- variable `REQUIRE_EMPTY_FOLDER` ()
- variable `REQUIRE_EMPTY_STR` (string *str)
- variable `REQUIRE_EQUAL_STR` (string *str1, string *str2, variable case_sensitive=defaultValue)
- variable `REQUIRE_EQUAL_TEXTWAVES` (WaveText ww1, WaveText ww2, variable mode=defaultValue)
- variable `REQUIRE_EQUAL_VAR` (variable var1, variable var2)
- variable `REQUIRE_EQUAL_WAVES` (WaveOrNull ww1, WaveOrNull ww2, variable mode=defaultValue, variable tol=defaultValue)
- variable `REQUIRE_NEQ_STR` (string *str1, string *str2, variable case_sensitive=defaultValue)
- variable `REQUIRE_NEQ_VAR` (variable var1, variable var2)
- variable `REQUIRE_NON_EMPTY_STR` (string *str)
- variable `REQUIRE_NON_NULL_STR` (string *str)
- variable `REQUIRE_NULL_STR` (string *str)
- variable `REQUIRE_PROPER_STR` (string *str)
- variable `REQUIRE_SMALL_CMPLX` (variable/c var, variable tol=defaultValue)
- variable `REQUIRE_SMALL_VAR` (variable var, variable tol=defaultValue)
- variable `REQUIRE_WAVE` (WaveOrNull ww, variable majorType, variable minorType=defaultValue)
- variable `WARN` (variable var)
- variable `WARN_CLOSE_CMPLX` (variable/c var1, variable/c var2, variable tol=defaultValue, variable strong_or_weak=defaultValue)
- variable `WARN_CLOSE_VAR` (variable var1, variable var2, variable tol=defaultValue, variable strong_or_weak=defaultValue)
- variable `WARN_EMPTY_FOLDER` ()
- variable `WARN_EMPTY_STR` (string *str)

- variable `WARN_EQUAL_STR` (string *str1, string *str2, variable case_sensitive=defaultValue)
- variable `WARN_EQUAL_TEXTWAVES` (WaveText wv1, WaveText wv2, variable mode=defaultValue)
- variable `WARN_EQUAL_VAR` (variable var1, variable var2)
- variable `WARN_EQUAL_WAVES` (WaveOrNull wv1, WaveOrNull wv2, variable mode=defaultValue, variable tol=defaultValue)
- variable `WARN_NEQ_STR` (string *str1, string *str2, variable case_sensitive=defaultValue)
- variable `WARN_NEQ_VAR` (variable var1, variable var2)
- variable `WARN_NON_EMPTY_STR` (string *str)
- variable `WARN_NON_NULL_STR` (string *str)
- variable `WARN_NULL_STR` (string *str)
- variable `WARN_PROPER_STR` (string *str)
- variable `WARN_SMALL_CMPLX` (variable/c var, variable tol=defaultValue)
- variable `WARN_SMALL_VAR` (variable var, variable tol=defaultValue)
- variable `WARN_WAVE` (WaveOrNull wv, variable majorType, variable minorType=defaultValue)

3.2.1 Detailed Description

Test assertions for variables, strings, waves and helper functions.

3.2.2 Function Documentation

3.2.2.1 CHECK()

```
variable CHECK (
    variable var )
```

Tests if var is true (1).

Parameters

| | |
|------------|------------------|
| <i>var</i> | variable to test |
|------------|------------------|

3.2.2.2 CHECK_CLOSE_CMPLX()

```
variable CHECK_CLOSE_CMPLX (
    variable/c var1,
    variable/c var2,
    variable tol = defaultValue,
    variable strong_or_weak = defaultValue )
```

Compares two variables and determines if they are close.

Based on the implementation of "Floating-point comparison algorithms" in the C++ Boost unit testing framework.

Literature:

The art of computer programming (Vol II). Donald. E. Knuth. 0-201-89684-2. Addison-Wesley Professional; 3 edition, page 234 equation (34) and (35).

Parameters

| | |
|-----------------------|---|
| <i>var1</i> | first variable |
| <i>var2</i> | second variable |
| <i>tol</i> | (optional) tolerance, defaults to 1e-8 |
| <i>strong_or_weak</i> | (optional) type of condition, can be 0 for weak or 1 for strong (default) |

Variant for complex numbers.

3.2.2.3 CHECK_CLOSE_VAR()

```
variable CHECK_CLOSE_VAR (
    variable var1,
    variable var2,
    variable tol = defaultValue,
    variable strong_or_weak = defaultValue )
```

Compares two variables and determines if they are close.

Based on the implementation of "Floating-point comparison algorithms" in the C++ Boost unit testing framework.

Literature:

The art of computer programming (Vol II). Donald. E. Knuth. 0-201-89684-2. Addison-Wesley Professional; 3 edition, page 234 equation (34) and (35).

Parameters

| | |
|-----------------------|---|
| <i>var1</i> | first variable |
| <i>var2</i> | second variable |
| <i>tol</i> | (optional) tolerance, defaults to 1e-8 |
| <i>strong_or_weak</i> | (optional) type of condition, can be 0 for weak or 1 for strong (default) |

3.2.2.4 CHECK_EMPTY_FOLDER()

```
variable CHECK_EMPTY_FOLDER ( )
```

Tests if the current data folder is empty.

Counted are objects with type waves, strings, variables and folders

3.2.2.5 CHECK_EMPTY_STR()

```
variable CHECK_EMPTY_STR (
    string * str )
```

Tests if str is empty.

A null string is never empty.

Parameters

| | |
|------------|----------------|
| <i>str</i> | string to test |
|------------|----------------|

3.2.2.6 CHECK_EQUAL_STR()

```
variable CHECK_EQUAL_STR (
    string * str1,
    string * str2,
    variable case_sensitive = defaultValue )
```

Compares two strings for equality.

Parameters

| | |
|-----------------------|--|
| <i>str1</i> | first string |
| <i>str2</i> | second string |
| <i>case_sensitive</i> | (optional) should the comparison be done case sensitive (1) or case insensitive (0, the default) |

3.2.2.7 CHECK_EQUAL_TEXTWAVES()

```
variable CHECK_EQUAL_TEXTWAVES (
    WaveText wv1,
    WaveText wv2,
    variable mode = defaultValue )
```

Tests two text waves for equality.

Parameters

| | |
|-------------|--|
| <i>wv1</i> | first text wave, can be invalid for Igor Pro 7 or later |
| <i>wv2</i> | second text wave, can be invalid for Igor Pro 7 or later |
| <i>mode</i> | (optional) features of the waves to compare, defaults to all modes, defined at Wave equality flags |

3.2.2.8 CHECK_EQUAL_VAR()

```
variable CHECK_EQUAL_VAR (
    variable var1,
    variable var2 )
```

Tests two variables for equality.

For variables holding floating point values it is often more desirable use CHECK_CLOSE_VAR instead. To fulfill semantic correctness this assertion treats two variables with both holding NaN as equal.

Parameters

| | |
|-------------|-----------------|
| <i>var1</i> | first variable |
| <i>var2</i> | second variable |

3.2.2.9 CHECK_EQUAL_WAVES()

```
variable CHECK_EQUAL_WAVES (
    WaveOrNull wv1,
    WaveOrNull wv2,
    variable mode = defaultValue,
    variable tol = defaultValue )
```

Tests two waves for equality.

Parameters

| | |
|-------------|---|
| <i>wv1</i> | first wave |
| <i>wv2</i> | second wave |
| <i>mode</i> | (optional) features of the waves to compare, defaults to all modes, defined at Wave equality flags |
| <i>tol</i> | (optional) tolerance for comparison, by default 0.0 which does byte-by-byte comparison (relevant only for mode=WAVE_DATA) |

3.2.2.10 CHECK_NEQ_STR()

```
variable CHECK_NEQ_STR (
    string * str1,
    string * str2,
    variable case_sensitive = defaultValue )
```

Compares two strings for unequality.

Parameters

| | |
|-----------------------|--|
| <i>str1</i> | first string |
| <i>str2</i> | second string |
| <i>case_sensitive</i> | (optional) should the comparison be done case sensitive (1) or case insensitive (0, the default) |

3.2.2.11 CHECK_NEQ_VAR()

```
variable CHECK_NEQ_VAR (
    variable var1,
    variable var2 )
```

Tests two variables for inequality.

Parameters

| | |
|-------------|-----------------|
| <i>var1</i> | first variable |
| <i>var2</i> | second variable |

3.2.2.12 CHECK_NON_EMPTY_STR()

```
variable CHECK_NON_EMPTY_STR (
    string * str )
```

Tests if str is not empty.

A null string is a non empty string too.

Parameters

| | |
|------------|----------------|
| <i>str</i> | string to test |
|------------|----------------|

3.2.2.13 CHECK_NON_NULL_STR()

```
variable CHECK_NON_NULL_STR (
    string * str )
```

Tests if str is not null.

An empty string is always non null.

Parameters

| | |
|------------|----------------|
| <i>str</i> | string to test |
|------------|----------------|

3.2.2.14 CHECK_NULL_STR()

```
variable CHECK_NULL_STR (
    string * str )
```

Tests if str is null.

An empty string is never null.

Parameters

| | |
|------------|----------------|
| <i>str</i> | string to test |
|------------|----------------|

3.2.2.15 CHECK_PROPER_STR()

```
variable CHECK_PROPER_STR (
    string * str )
```

Tests if *str* is a "proper" string, i.e. a string with a length larger than zero.

Neither null strings nor empty strings are proper strings.

Parameters

| | |
|------------|----------------|
| <i>str</i> | string to test |
|------------|----------------|

3.2.2.16 CHECK_SMALL_CMPLX()

```
variable CHECK_SMALL_CMPLX (
    variable/c var,
    variable tol = defaultValue )
```

Tests if a variable is small using the inequality $|var| < |tol|$.

Parameters

| | |
|------------|--|
| <i>var</i> | variable |
| <i>tol</i> | (optional) tolerance, defaults to 1e-8 |

Variant for complex numbers

3.2.2.17 CHECK_SMALL_VAR()

```
variable CHECK_SMALL_VAR (
    variable var,
    variable tol = defaultValue )
```

Tests if a variable is small using the inequality $|var| < |tol|$.

Parameters

| | |
|------------|--|
| <i>var</i> | variable |
| <i>tol</i> | (optional) tolerance, defaults to 1e-8 |

3.2.2.18 CHECK_WAVE()

```
variable CHECK_WAVE (
    WaveOrNull wv,
    variable majorType,
    variable minorType = defaultValue )
```

Tests a wave for existence and its type.

Parameters

| | |
|------------------|----------------------------|
| <i>wv</i> | wave reference |
| <i>majorType</i> | major wave type |
| <i>minorType</i> | (optional) minor wave type |

See also

[Wave existence flags](#)

3.2.2.19 FAIL()

```
variable FAIL ( )
```

Force the test case to fail.

3.2.2.20 PASS()

```
variable PASS ( )
```

Increase the assertion counter only.

3.2.2.21 REQUIRE()

```
variable REQUIRE (
    variable var )
```

3.2.2.22 REQUIRE_CLOSE_CMPLX()

```
variable REQUIRE_CLOSE_CMPLX (
    variable/c var1,
    variable/c var2,
    variable tol = defaultValue,
    variable strong_or_weak = defaultValue )
```

3.2.2.23 REQUIRE_CLOSE_VAR()

```
variable REQUIRE_CLOSE_VAR (
    variable var1,
    variable var2,
    variable tol = defaultValue,
    variable strong_or_weak = defaultValue )
```

3.2.2.24 REQUIRE_EMPTY_FOLDER()

```
variable REQUIRE_EMPTY_FOLDER ( )
```

3.2.2.25 REQUIRE_EMPTY_STR()

```
variable REQUIRE_EMPTY_STR (
    string * str )
```

3.2.2.26 REQUIRE_EQUAL_STR()

```
variable REQUIRE_EQUAL_STR (
    string * str1,
    string * str2,
    variable case_sensitive = defaultValue )
```

3.2.2.27 REQUIRE_EQUAL_TEXTWAVES()

```
variable REQUIRE_EQUAL_TEXTWAVES (
    WaveText wv1,
    WaveText wv2,
    variable mode = defaultValue )
```

3.2.2.28 REQUIRE_EQUAL_VAR()

```
variable REQUIRE_EQUAL_VAR (
    variable var1,
    variable var2 )
```

3.2.2.29 REQUIRE_EQUAL_WAVES()

```
variable REQUIRE_EQUAL_WAVES (
    WaveOrNull wv1,
    WaveOrNull wv2,
    variable mode = defaultValue,
    variable tol = defaultValue )
```

3.2.2.30 REQUIRE_NEQ_STR()

```
variable REQUIRE_NEQ_STR (
    string * str1,
    string * str2,
    variable case_sensitive = defaultValue )
```

3.2.2.31 REQUIRE_NEQ_VAR()

```
variable REQUIRE_NEQ_VAR (
    variable var1,
    variable var2 )
```

3.2.2.32 REQUIRE_NON_EMPTY_STR()

```
variable REQUIRE_NON_EMPTY_STR (
    string * str )
```

3.2.2.33 REQUIRE_NON_NULL_STR()

```
variable REQUIRE_NON_NULL_STR (
    string * str )
```

3.2.2.34 REQUIRE_NULL_STR()

```
variable REQUIRE_NULL_STR (
    string * str )
```

3.2.2.35 REQUIRE_PROPER_STR()

```
variable REQUIRE_PROPER_STR (
    string * str )
```

3.2.2.36 REQUIRE_SMALL_CMPLX()

```
variable REQUIRE_SMALL_CMPLX (
    variable/c var,
    variable tol = defaultValue )
```

3.2.2.37 REQUIRE_SMALL_VAR()

```
variable REQUIRE_SMALL_VAR (
    variable var,
    variable tol = defaultValue )
```

3.2.2.38 REQUIRE_WAVE()

```
variable REQUIRE_WAVE (
    WaveOrNull wv,
    variable majorType,
    variable minorType = defaultValue )
```

3.2.2.39 WARN()

```
variable WARN (
    variable var )
```

3.2.2.40 WARN_CLOSE_CMPLX()

```
variable WARN_CLOSE_CMPLX (
    variable/c var1,
    variable/c var2,
    variable tol = defaultValue,
    variable strong_or_weak = defaultValue )
```

3.2.2.41 WARN_CLOSE_VAR()

```
variable WARN_CLOSE_VAR (
    variable var1,
    variable var2,
    variable tol = defaultValue,
    variable strong_or_weak = defaultValue )
```

3.2.2.42 WARN_EMPTY_FOLDER()

```
variable WARN_EMPTY_FOLDER ( )
```

3.2.2.43 WARN_EMPTY_STR()

```
variable WARN_EMPTY_STR (
    string * str )
```

3.2.2.44 WARN_EQUAL_STR()

```
variable WARN_EQUAL_STR (
    string * str1,
    string * str2,
    variable case_sensitive = defaultValue )
```

3.2.2.45 WARN_EQUAL_TEXTWAVES()

```
variable WARN_EQUAL_TEXTWAVES (
    WaveText wv1,
    WaveText wv2,
    variable mode = defaultValue )
```

3.2.2.46 WARN_EQUAL_VAR()

```
variable WARN_EQUAL_VAR (
    variable var1,
    variable var2 )
```

3.2.2.47 WARN_EQUAL_WAVES()

```
variable WARN_EQUAL_WAVES (
    WaveOrNull wv1,
```

```
WaveOrNull wv2,  
variable mode = defaultValue,  
variable tol = defaultValue )
```

3.2.2.48 WARN_NEQ_STR()

```
variable WARN_NEQ_STR (   
    string * str1,  
    string * str2,  
    variable case_sensitive = defaultValue )
```

3.2.2.49 WARN_NEQ_VAR()

```
variable WARN_NEQ_VAR (   
    variable var1,  
    variable var2 )
```

3.2.2.50 WARN_NON_EMPTY_STR()

```
variable WARN_NON_EMPTY_STR (   
    string * str )
```

3.2.2.51 WARN_NON_NULL_STR()

```
variable WARN_NON_NULL_STR (   
    string * str )
```

3.2.2.52 WARN_NULL_STR()

```
variable WARN_NULL_STR (   
    string * str )
```

3.2.2.53 WARN_PROPER_STR()

```
variable WARN_PROPER_STR (   
    string * str )
```

3.2.2.54 WARN_SMALL_CMPLX()

```
variable WARN_SMALL_CMPLX (   
    variable/c var,  
    variable tol = defaultValue )
```

3.2.2.55 WARN_SMALL_VAR()

```
variable WARN_SMALL_VAR (   
    variable var,  
    variable tol = defaultValue )
```

3.2.2.56 WARN_WAVE()

```
variable WARN_WAVE (   
    WaveOrNull wv,  
    variable majorType,  
    variable minorType = defaultValue )
```

3.3 Assertions flags

Modules

- [Wave existence flags](#)
- [Wave equality flags](#)

3.3.1 Detailed Description

Constants for assertion test tuning.

3.4 Wave existence flags

Variables

- const variable `COMPLEX_WAVE` = 0x01
- const variable `DATAFOLDER_WAVE` = 0x100
- const variable `DOUBLE_WAVE` = 0x04
- const variable `FLOAT_WAVE` = 0x02
- const variable `INT16_WAVE` = 0x10
- const variable `INT32_WAVE` = 0x20
- const variable `INT64_WAVE` = 0x80
- const variable `INT8_WAVE` = 0x08
- const variable `NUMERIC_WAVE` = 1
- const variable `TEXT_WAVE` = 2
- const variable `UNSIGNED_WAVE` = 0x40
- const variable `WAVE_WAVE` = 0x4000

3.4.1 Detailed Description

Values for `majorType` / `minorType` of `WARN_WAVE`, `CHECK_WAVE` and `REQUIRE_WAVE`.

3.4.2 Variable Documentation

3.4.2.1 COMPLEX_WAVE

```
const variable COMPLEX_WAVE = 0x01
```

3.4.2.2 DATAFOLDER_WAVE

```
const variable DATAFOLDER_WAVE = 0x100
```

3.4.2.3 DOUBLE_WAVE

```
const variable DOUBLE_WAVE = 0x04
```

3.4.2.4 FLOAT_WAVE

```
const variable FLOAT_WAVE = 0x02
```

3.4.2.5 INT16_WAVE

```
const variable INT16_WAVE = 0x10
```

3.4.2.6 INT32_WAVE

```
const variable INT32_WAVE = 0x20
```

3.4.2.7 INT64_WAVE

```
const variable INT64_WAVE = 0x80
```

3.4.2.8 INT8_WAVE

```
const variable INT8_WAVE = 0x08
```

3.4.2.9 NUMERIC_WAVE

```
const variable NUMERIC_WAVE = 1
```

3.4.2.10 TEXT_WAVE

```
const variable TEXT_WAVE = 2
```

3.4.2.11 UNSIGNED_WAVE

```
const variable UNSIGNED_WAVE = 0x40
```

3.4.2.12 WAVE_WAVE

```
const variable WAVE_WAVE = 0x4000
```

3.5 Wave equality flags

Variables

- const variable `DATA_FULL_SCALE` = 256
- const variable `DATA_UNITS` = 8
- const variable `DIMENSION_LABELS` = 32
- const variable `DIMENSION_SIZES` = 512
- const variable `DIMENSION_UNITS` = 16
- const variable `WAVE_DATA` = 1
- const variable `WAVE_DATA_TYPE` = 2
- const variable `WAVE_LOCK_STATE` = 128
- const variable `WAVE_NOTE` = 64
- const variable `WAVE_SCALING` = 4

3.5.1 Detailed Description

Values for `mode` in `WARN_EQUAL_WAVES`, `CHECK_EQUAL_WAVES` and `REQUIRE_EQUAL_WAVES`.

3.5.2 Variable Documentation

3.5.2.1 `DATA_FULL_SCALE`

```
const variable DATA_FULL_SCALE = 256
```

3.5.2.2 `DATA_UNITS`

```
const variable DATA_UNITS = 8
```

3.5.2.3 `DIMENSION_LABELS`

```
const variable DIMENSION_LABELS = 32
```

3.5.2.4 `DIMENSION_SIZES`

```
const variable DIMENSION_SIZES = 512
```

3.5.2.5 `DIMENSION_UNITS`

```
const variable DIMENSION_UNITS = 16
```

3.5.2.6 `WAVE_DATA`

```
const variable WAVE_DATA = 1
```

3.5.2.7 `WAVE_DATA_TYPE`

```
const variable WAVE_DATA_TYPE = 2
```

3.5.2.8 `WAVE_LOCK_STATE`

```
const variable WAVE_LOCK_STATE = 128
```

3.5.2.9 `WAVE_NOTE`

```
const variable WAVE_NOTE = 64
```


3.5.2.10 WAVE_SCALING

```
const variable WAVE_SCALING = 4
```

3.6 Default hook functions

Functions

- variable `TEST_BEGIN` (string name)
- variable `TEST_CASE_BEGIN` (string testCase)
- variable `TEST_CASE_END` (string testCase)
- variable `TEST_END` (string name)
- variable `TEST_SUITE_BEGIN` (string testSuite)
- variable `TEST_SUITE_END` (string testSuite)

3.6.1 Detailed Description

Default implementation of test hook functions.

3.6.2 Function Documentation

3.6.2.1 TEST_BEGIN()

```
variable TEST_BEGIN (  
    string name )
```

Default test begin hook.

The hook is immediately called after RunTest starts.

Parameters

| | |
|-------------|------------------------------|
| <i>name</i> | name of the test suite group |
|-------------|------------------------------|

3.6.2.2 TEST_CASE_BEGIN()

```
variable TEST_CASE_BEGIN (  
    string testCase )
```

Default hook for test case begin.

The hook is called before executing the test case.

Parameters

| | |
|-----------------|-----------------------|
| <i>testCase</i> | name of the test case |
|-----------------|-----------------------|

3.6.2.3 TEST_CASE_END()

```
variable TEST_CASE_END (  
    string testCase )
```

Default hook for test case end.

The hook is called after executing the test case.

Parameters

| | |
|-----------------|-----------------------|
| <i>testCase</i> | name of the test case |
|-----------------|-----------------------|

3.6.2.4 TEST_END()

```
variable TEST_END (
    string name )
```

Default test end hook.

The hook is called after all tests suites.

Parameters

| | |
|-------------|------------------------------|
| <i>name</i> | name of the test suite group |
|-------------|------------------------------|

3.6.2.5 TEST_SUITE_BEGIN()

```
variable TEST_SUITE_BEGIN (
    string testSuite )
```

Default hook for test suite begin.

The hook is called before executing the first test case of every test suite.

Parameters

| | |
|------------------|------------------------|
| <i>testSuite</i> | name of the test suite |
|------------------|------------------------|

3.6.2.6 TEST_SUITE_END()

```
variable TEST_SUITE_END (
    string testSuite )
```

Default hook for test suite end.

The hook is called after executing the last test case of every test suite.

Parameters

| | |
|------------------|------------------------|
| <i>testSuite</i> | name of the test suite |
|------------------|------------------------|

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