Formal Functional Test Designs:
Bridging The Gap Between
Test Requirements and
Test Specifications

JPL

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Section 333

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Formal Functional Test Designs
Bridging The Gap Between
Test Requirements and Test Design

AGENDA

Testing Life Cycle
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Test Design Methods
Category–Partition Method
  Background
  Functional Decomposition
  Category Analysis
  Partition Value Analysis
  Partition Constraint Analysis
Example Application
Test Representation Language (TRL)
TRL Summary
Example Application With TRL
Block V Receiver Sample Test Requirement
Block V Receiver Sample Test Design
FORMAL FUNCTIONAL TEST DESIGNS
TESTING LIFECYCLE

TIP SMP → 'TEST PLANNING' → WPA/WIP

FRD FDD SRD → TEST REQUIREMENTS ANALYSIS → SSITP-1

SSD-1 SSD-2 PSOM → 'TEST DESIGN' → SSITP TEST DESIGNS

SOM → TEST SPECIFICATION → SSITP-2

RDD CODE → TEST EXECUTION → PFR/AR

SSITP TEST DESIGNS 'STP TEST DESIGNS

LEGEND: D-4000 INPUT D-4000 PHASE OR OUTPUT 'PHASE OR OUTPUT NOT DEFINED IN D-4000
FORMAL FUNCTIONAL TEST DESIGNS

PURPOSE OF TEST DESIGN PHASE

TO CONCEIVE AND SPECIFY THE ENVIRONMENTAL AND SYSTEMAttributes THAT VERIFY REQUIREMENTS AND MEET OBJECTIVES

SYSTEM UNDER TEST

TEST DESIGN SPEC #1

TEST DESIGN SPEC #2

TEST DESIGN SPEC #3

MAJOR TEST OBJECTIVES OR TEST REQUIREMENTS

TEST PROC SPEC #1

TEST PROC SPEC #2

TEST CASES
Formal Functional Test Designs
Test Design Methods

Most Common Methods of Test Design Specification

- Representative set of “normal” cases selected

  - Generate all permutations and then eliminate invalid cases

  - Generate test cases ad-hoc

Category Partition With Test Representation Language (TRL)

- Can generate all cases or just “normal” ones

- Allows rapid elimination of undesired test cases

- Confidence that all important test cases are generated

- Easy specification and review of test set designs
Formal Functional Test Designs
Category–Partition Method

● Background
  . Ostrand and Balcer, 1988
    Siemens Research Corporation
  ● Similar to other specification-based techniques
  ● Unique because it provides a systematic approach and a method for formal test specifications.

● Method
  ● Functional Decomposition
  ● Category Analysis
    . Partition Value Analysis
    . Partition Constraint Analysis
Formal Functional Test Designs

Category–Partition Method (cont.)

Functional Decomposition

- Decompose specification into functional units to be tested independently

- Identify parameters that affect the behavior of the system for each functional unit

- Types of parameters
  - user input
  - input form external interface
  - environmental input
  - output to program/user
  - output to environment
  - change in program or environment state
  - sequence of events

- Examples
  - sort integer array in either ascending or descending order
Formal Functional Test Designs
Category–Partition Method (cont.)
Category Analysis

- Properties or characteristics of a parameter
  Example: parameter ARRAY
  Properties: size, values, value arrangement

- Identify major categories for each parameter

- Note how the functional unit behaves with respect to the category

- Often exposes ambiguous, contradictory, or missing descriptions of behavior
Partition Value Analysis "

- Group of category values that have the same overall effect on functional behavior
- Partition each category into distinct choices
- Include all possible kinds of values
- Choose values to maximize error detection
  - boundary values (valid and invalid)
  - special cases (0, 1, -1, 2, ...)
  - special interactions (program to program, program to environment)
- Partitions are used to build each test case

Example
  - Category: Array Size
  - Partition Values:
    - 0
    - 1
    - 2 to Upper Bound minus 1
    - Upper Bound greater than Upper Bound
Constraints refine the test representation to a set that is technically effective and economically feasible.

- **Types of constraints on values**
  - **pre-conditions:** a condition or state that must co-occur for this partition to be used in a test case.
  - **post-condition:** a condition or state that is set when this partition value is used in a test case.
  - **limit:** limit the use of this partition value to a certain number of valid test cases.
  - **error:** this partition value represents an error that should be used in a test case only once.

- Don’t care values may need to be added to some of the categories when all values are constrained.
Formal Functional Test Designs

Example Application of Method

Functional Specification
- Sort integer array in either ascending or descending order

Functional Decomposition
- Parameters: Array, indication of sort order, result

Category Analysis
- array size
  - array values
  - value arrangement
  - sort order
  - result
### Partition Value Analysis

<table>
<thead>
<tr>
<th>Category</th>
<th>Partitions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. array size</td>
<td>1. 0, 1, 2 to Upper Bound minus 1, Upper Bound, greater than Upper Bound</td>
</tr>
<tr>
<td>2. array values</td>
<td>2. all zero, all same but non-zero, all negative, all positive, mixed ±0</td>
</tr>
<tr>
<td>3. value arrangement</td>
<td>3. minimum before max, maximum before min</td>
</tr>
<tr>
<td>4. sort order</td>
<td>4. unspecified, ascending, descending</td>
</tr>
<tr>
<td>5. result</td>
<td>5. error notification, array unchanged, array in ascending order, array in descending order</td>
</tr>
</tbody>
</table>
Partition Constraint Analysis

<table>
<thead>
<tr>
<th>Partition Values</th>
<th>Constraints</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. array size</td>
<td>• error-occurs once</td>
</tr>
<tr>
<td>• 0, greater than upper bound</td>
<td></td>
</tr>
<tr>
<td>• 1, 2 to upper bound minus 1, upper bound</td>
<td></td>
</tr>
<tr>
<td>2. array values</td>
<td>• no constraints</td>
</tr>
<tr>
<td>• all zero, all same but non-zero</td>
<td></td>
</tr>
<tr>
<td>• all negative, all positive, mixed ±0</td>
<td></td>
</tr>
<tr>
<td>• don’t care</td>
<td></td>
</tr>
<tr>
<td>3. value arrangement</td>
<td>• $c = \text{size}\leq \text{upper bound}$</td>
</tr>
<tr>
<td>• minimum before max, maximum before min</td>
<td></td>
</tr>
<tr>
<td>• don’t care</td>
<td></td>
</tr>
<tr>
<td>4. sort order</td>
<td>• if error or size = 1</td>
</tr>
<tr>
<td>• unspecified</td>
<td>• 2 &lt; = size &lt; = upper bound, values are not all the same</td>
</tr>
<tr>
<td>• ascending, descending</td>
<td></td>
</tr>
<tr>
<td>• don’t care</td>
<td></td>
</tr>
<tr>
<td>5. result</td>
<td>• if error or size = 1 values are all the same</td>
</tr>
<tr>
<td>• error notification</td>
<td></td>
</tr>
<tr>
<td>• array unchanged</td>
<td></td>
</tr>
<tr>
<td>• array n ascending order</td>
<td></td>
</tr>
<tr>
<td>• array n descending order</td>
<td>• error--occurs once but only if no other errors occur</td>
</tr>
<tr>
<td>• sort order = ascending</td>
<td></td>
</tr>
<tr>
<td>• sort order = descending</td>
<td></td>
</tr>
</tbody>
</table>
Formal Functional Test Designs
Test Representation Language (TRL)

- Formal test specification language to be used with the Category-Partition Method

- Concise and uniform representation of test set design

- Produces individual test cases from a short test representation

- TRL processor reads the formal specification and creates test case descriptions based on the categories, sample values, and constraints. Available for DOS, SPARC, or in Generic “C”.

- Allows test representations to be easily created and subsequently analyzed

- Can be easily modified to adapt to changes in functional specification, or a desire for fewer or more test cases

- Can be used in test plans and procedures for systems, programs, and modules
**Character or Keyword**

<table>
<thead>
<tr>
<th>Purpose and/or Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>*</td>
</tr>
</tbody>
</table>

**DESCRIPTION**

Indicates the starting of a description block that will be included in test cases.

**PARAMETERS**

Indicates the beginning of parameter specifications.

**NAME**

Specifies the name of a parameter or category.

**TYPE**

Indicates the type of category.

**SAMPLES**

Indicates beginning of a samples block defining the partition values and constraints.

**IF**

Field identifier indicating that pre-condition constraints are listed in the current field. Comma (,) is used for logical AND, exclamation (!) for logical NOT.
Formal Functional Test Designs

TRL Summary (cont.)

<table>
<thead>
<tr>
<th>Character or Keyword</th>
<th>Purpose and/or Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>SET</td>
<td>Field identifier indicating that post-condition constraints are listed in the current field.</td>
</tr>
<tr>
<td>LIMIT m</td>
<td>Field identifier indicating that the number of test cases involving this partition value should be limited to m. If m is unspecified, the limit is one test case.</td>
</tr>
<tr>
<td>LABEL</td>
<td>Field identifier indicating that the specified label should be listed for this partition value.</td>
</tr>
<tr>
<td>ERROR n</td>
<td>Field identifier indicating that the sample value is an error exit. The error can be specified using the optional n.</td>
</tr>
<tr>
<td>MESSAGE n</td>
<td>Indicates that a message block follows corresponding to the errors in the partition values. The message number can be specified using the optional n.</td>
</tr>
</tbody>
</table>

Command Line Options

For performing “count only,” writing results into separate files, and for including pre/post conditions in output.
Formal Functional Test Designs
Example Application of Method With TRL

Functional Unit

- Sort integer array in either ascending or descending order

**Step 1. Apply Category–Partition Method to obtain Categories and Partition values**

Add in DESCRIPTION, PARAMETERS, NAME, TYPE, SAMPLES, and sample values for unconstrained representation.

Number of test cases = 1440

**Step 2. Determine which Partition values are errors and their corresponding messages**

Add in [ERROR] indication and MESSAGE lines

Number of test cases = 651
Step 3. Determine Pre and Post condition constraints or partition values.

Add in [IF] and [SET] fields

Number of test cases = 32

Step 4. Modify test representation as needed.

Add in [LIMIT] and [LABEL]

Number of test cases = 24
DESCRIPTION

Test Representation for SORT requirement.

File Name: SORT I-4. TRL
Version: 1.4 Errors/Messages/Conditions/Limits/Labels
Last Modified: 7/22/91
Modified By: J. Hops

PARAMETERS

TYPE Input-Categories for Parameter: Array

NAME array size
SAMPLES

* 5 partitions

0 (array unspecified) ' [ERROR 1]
  SET error, dont_care]
  LABEL error condition ]
  [ERROR 1]
  SET all_same, dont_care]
  LABEL valid]
  SET size__ok ]
  LABEL valid upper bound)

1 (degenerate array)]
  [ERROR 2]
  SET error, dont_care]
  LABEL invalid array size]

2 to Upper Bound minus 1
Upper Bound
greater than Upper Bound

MESSAGE 1
Array size of 0 is invalid or array size is unspecified.
Array size is greater than the Upper Bound of sizes

NAME array values
SAMPLES

* 5 partitions, dont care

all Os [IF size ok]
[SET all_same, dont_care]
[IF size ok]

all the same but not 0
[SET all_same, dont_care]

all negative [IF size ok] [SET min_max]
[LIMIT 4]

all positive [IF size ok] [SET min_max]
[LIMIT 4]

mixed +/-/0
[IF size ok] [SET min_max]

* dont care
[IF dont_care]
NAME    value arrangement
SAMPLES
*   2 partitions, 1 don't care
    minimum before max [IF size ok, min_max]
    maximum before min [IF size ok, min_max]
    don't care          [IF dont_care]
*

TYPE    Input-Parameter: Sort Order

NAME    sort order
SAMPLES
*   3 partitions, 1 don't care
    ascending         [IF size ok, min_max] [SET ascend]
    descending       [IF size ok, min_max] [SET descend]
    unspecified      [ERROR 3][IF size ok]
          [SET error, dont_care]
    don't care        [IF dont_care]

MESSAGE
*   Sort order is not specified

TYPE    Output to program or change in state

NAME    result
SAMPLES
*   4 partition values
    error notification    [IF error]
    array unchanged       [IF dont_care]
    array in ascending order [IF ascend, min_max]
    array in descending order [IF descend, min_max]
NAME:
1.4.2;5

TITLE:
Signal Path Routing-PVM B1

INPUT/OUTPUT:

BODY:

DESCRIPTION

PURPOSE:

Verify that all valid input and output signal path combinations can be configured. For Build 1, verify that RCP can select the IF input port, and that the correct signal is processed through the system.

PAST CRITERIA:

e. HVR provides IF distribution and switching [SNRD 3.7.9]
   [Build 1&2: IF switching at RCP; Build 3: IF distribution
   via IFD and cabling]

b. [Build 2] At least 7 RCP's are allowed on a given front-end simultaneously.[SNRD 3.7.10]

c. [Build 2] HVR provides graphical display to DMC of subsystem configuration.[SNRD 7.2.26]

d. An invalid request causes the routing to remain unchanged.[derived]

e. Displays [Build 1], and loops [Build 2] reflect signal routing as commanded.[derived]

f. [Build 2] the command is accepted in any link status mode from RMT and/or CMC.[derived]

g. [Build 2] HVR is designed for unattended operation (does not need to be operated from RMT).[SNRD 7.1.1]

h. [Build 2] HVR accepts operator directives from DMC.[SNRD 7.2.11]

i. HVR acknowledges, and executes operator directives (including multiple simultaneous functions).[SNRD 7.2.3]

j. [Build 2] The status of the execution of an operator directive is reported to DMC as per 810-133.[SNRD 7.2.7]

k. The HVR can be configured and operated according to a series of low-level directives.[SNRD 7.2.10]

l. HVR operation can be modified according to a series of low-level commands or directives.[SNRD 7.2.11]

m. [Build 2] The status of the execution of a directive includes the completion of a DMC directive.[SNRD 7.2.16]

n. [Build 2] The HVR can be controlled from the DMC for normal activities including pre-track and post track functions.[SNRD 9.1.1]

"Categories and Partitions"

PARAMETER R5

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TYPE: SETUP OF BVR H/W SUBASSEMBLIES AND TEST SIGNAL GENERATOR

NAME: RCP Operability Status (set via board installation)

SAMPLING

NORMAL - operational [SET normal]
[IF req valid]

DEGRADED - marginal [SET degraded, not normal]
[IF req valid]

FAILED - out of service [SET failed, not normal]
[IF req valid]

don't care [IF req valid] [SET normal]

NAME: Test Signal Output connected to RCP IF Port (stated below)

SAMPLING

IP1 [IF normal, req valid] [SET in a]

IP2 [IF normal, req valid] [SET in b]

IP3 [IF normal, req valid] [SET in c]
don't care [IF req valid]
don't care [IF not normal]

NAME: Test Signal Output Frequency Setting (stated below)

SAMPLING

SET Test Signal Frequency to 250001000 [IF normal, req valid, in a]

SET Test Signal Frequency to 250002000 [IF normal, req valid, in b]

SET Test Signal Frequency to 250003000 [IF normal, req valid, in c]
don't care [IF req valid]
don't care [IF not normal]

TYPE: T1 TRANSACTION ACTIVITY

NAME: Operator Directive validity

SAMPLING

request syntax is valid [SET req valid]

request syntax is invalid [IF normal] [ERROR]

MESSAGE: 1
Operator Directive Syntax is in error or undefined RCP/INPUT Port

NAME: Operator Directive History

SAMPLING

directive expected to change current setting [IF normal, req valid]

directive NOT expected to change current setting [IF normal, req valid]
don't care

NAME: Operator Directive Option: RCP

  SET unchanged
  SET unchanged
  IF not normal [SET unchanged]

SAMPLES

NAME: Operator Directive Option: RCP 1 input channels

  SET 1 F] IF normal, req valid SET want a]
  SET 1 1'2 IF normal, req valid SET want b]
  SET 1 1'3 IF normal, req valid SET want c]
  don't care [IF req valid]
  don't care [IF not normal]

1.151' ANALYSIS AND EXPECTED RESULTS

NAME: R.I. Response decor input display

  rejected directive, configuration unchanged [IF !req valid]
  cannot perform because RCP not normal [IF req valid, not normal]
  complete - configuration change reflects directive setup [IF normal, req valid, change]
  complete - configuration unchanged and reflects directive setup [IF normal, req valid, unchanged]

SAMPLES

NAME: Expected Frequency at all 4 BB Ports according to Spectrum Analyzer

  DC signal, 0 Hz  [IF in a, want a] [LIMIT?]
  DC signal, 0 Hz  [IF in b, want b] [LIMIT?]
  DC signal, 0 Hz; [IF in c, want c] [LIMIT?]
  1000 Hz  [IF in a, want a]
  7000 Hz  [IF in b, want b]
  3000 Hz  [IF in c, want c]
  unchanged - output derived from last valid configuration [IF !req valid]
  don't care [IF not normal]
TITLE:
TRT Test Cases for TS: 1.4.2 Signal Path Routing - (Build 1)

BODY:
Description:

PURPOSE:

Verify that all valid input and output signal path combinations can be configured. For Build 1: verify that RCP can select the IF input port, and that the correct signal is processed through the system.

PASS CRITERIA:
e. HWR provides IF distribution and switching [SFRD 3.7.9]
   [Build 1&2: IF switching at RCP; Build 3: IF distribution via IFD and cabling]

b. Build 2] At least 2 RCP's are allowed on a given front-end simultaneously.[SFRD 3.7.10]

c. [Build 2] HWR provides graphical display to DMC of subsystem configuration.[SFRD 7.2.76]

d. An invalid request causes the routing to remain unchanged. [derived]

e. Displays [Build 1], and logs [Build 2] reflect signal routing as commanded. [derived]

f. [Build 2] the command is accepted in any link status mode from RMT and/or CMC [derived]

q. [Build 2] HWR is designed for unattended operation (does not need to be operated from RMT).[SFRD 7.1.1]

u. [Build 2] HWR accepts operator directives from DMC.[SFRD 7.2.1]

i. HWR acknowledges, and executes operator directives [including multiple simultaneous functions]. [SFRD 7.2.1]

j. [Build 2] The status of the execution of an operator directive is reported to DMC as per 890-133.[SFRD 7.2.7]

k. The HWR can be configured and operated according to a series of low-level directives.[SFRD 7.2.10]

[Build 2] HWR operation can be modified according to a series of low-level commands or directives.[SFRD 7.2.11]

m. [Build 2] The status of the execution of a directive includes the completion of a DMC directive.[SFRD 7.2.16]

n. [Build 2] The HWR can be controlled from the DMC for normal activities including pre-track and post track functions.[SFRD 9.1.1]

******************************************************************************
Case # 1
Label: 1.1.1.1.1.1.1.3.4

PARAMETERS:

SETUP OF HWR H/W SUBASSEMBLIES AND TEST SIGNAL GENERATOR

RCP Operability Status (set via board installation) - >
   - > NORMAL - operational

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Test Signal Output connected to RCP F Port (stated below) ➔ 1F

Test Signal Output Frequency Setting (stated below) ➔ SET Test Signal Frequency to 25000000

TEST EXECUTION ACTION

Operator Directive validity ➔ request syntax is valid

Operator Directive History ➔ directive expected to change current setting

Operator Direct ve Option: RCP d. ➔ 1

Operator Direct ve Option: RCP E input channel s ➔ SET IF

TEST ANALYSIS AND EXPECTED RESULTS

HW/ Response according to Display ➔ complete configuration change reflects directive setup

Expected Frequency at all 4 HB Ports according to Spectrum Analyzer ➔ 1000 Hz

No error conditions exist.

**********************************************************************

Case # ➔
Label: 1.1.1.1.1.2.3.1

PARAMETERS:

SETUP OF HW/HW SUBASSEMBLY IF'S AND '115' SIGNAL OF INTEGRATOR

RCP Operability Status (set via board installation) ➔ NORMAL - operational

Test Signal Output connected to RCP F Port (stated below) ➔ 1F

Test Signal Output Frequency Setting (stated below) ➔ SET Test Signal Frequency to 25000000

TEST EXECUTION ACTION

Operator Direct ve validity ➔ request syntax is valid

Operator Direct ve History ➔ directive expected to change current setting
Operator Directive Option: RCP Id. --> 1

Operator Directive Option: RCP IF input channels --> SET IF2

TEST ANALYSIS AND EXPECTED RESULTS

RMT Response according to Display --> complete - configuration change reflects directive setup

Expected Frequency at all 4 IF Ports according to Spectrum Analyzer --> DC signal, 0 Hz

No error conditions exist.

******************************
Case #: 3
Label: 1.1.1.1.1.1.3.3.1

PARAMETERS:

SETUP OF BVR H/W SUBASSEMBLIES AND TEST SIGNAL GENERATOR

RCP Operability Status (set via board installation) --> NORMAL - operational

Test Signal Output connected to RCP IF Port (stated below) --> IF1

Test Signal Output Frequency Setting (stated below) --> SET Test Signal Frequency to 25000000

TEST EXECUTION ACTION

Operator Directive validity --> request syntax is valid

Operator Directive History --> directive expected to change current setting

Operator Directive Option: RCP Id. --> 1

Operator Directive Option: RCP IF input channels --> SET IF3

TEST ANALYSIS AND EXPECTED RESULTS

RMT Response according to Display --> complete - configuration change reflects directive setup

Expected Frequency at all 4 IF Ports according to Spectrum Analyzer --> DC signal, 0 Hz

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No error conditions exist.

CASE # 4
label: 1.1.1.7, 1.1.4.4

PARAMETERS:

SETUP OF H/W H/W SUBASSEMBLIES AN) TEST SIGNAL GENERATOR

RCP Operability Status (set via board installation) > NORMAL - operational

Test Signal Output connected to RCP IF Port (stated below) -> IF1

Test Signal Output Frequency Setting (stated below) -> SET Test Signal Frequency to 750000000

TEST EXECUTION ACTION

Operator Directive validity -> request syntax is valid

Operator Directive History -> directive NOT expected to change current setting

Operator Directive Option: RCP ID. -> 1

Operator Directive Option: RCP IF Input channels. -> SET IF1

TEST ANALYSIS AND EXPECTED RESULTS

HMF Response according to Display -> complete - configuration unchanged and reflects directive setup

Expected Frequency at all 4 IF Ports according to Spectrum Analyzer -> 1000 Hz

No error conditions exist.

CASE # 5
label: 1.2.2.1.1.1.3.2

PARAMETERS:

SETUP OF H/W H/W SUBASSEMBLIES AND TEST SIGNAL GENERATOR

RCP Operability Status (set via board installation) > NORMAL - operational

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Test Signal Output connected to RCP 1F Port (stated below)  

> 1F7

Test Signal Output Frequency Setting (stated below)  

> Sky Test Signal Frequency to 250000000

TEST EXECUTION ON ACTION

Operator Directive validity  

> request syntax is valid

Operator Directive History  

> directive expected to change current setting

Operator Directive option: RCP 1d.  

> 1

Operator Directive Option: RCP 1F input channels  

> SET 1F1

TEST ANALYSIS AN) EXPECTED RESULTS

RMT Response according to Display  

> complete - configuration change reflects directive setup

Expected Frequency at all 4 BB Ports according to Spectrum Analyzer  

> DC signal, 0 Hz

No error conditions exist!

***************************************************************

Case # 6
Label: 1.2.1.1.2.3.5

PARAMETERS:

SETUP OF BMR H/W SUBASSEMBLIES AND TEST SIGNAL GENERATOR

RCP Operability Status (set via board installation)  

> NORMAL - operational

Test Signal Output connected to RCP 1F Port (stated below)  

> 1F7

Test Signal Output Frequency Setting (stated below)  

> SET Test Signal Frequency to 250000000

TEST EXECUTION ACTION

Operator Directive validity  

> request syntax is valid

Operator Directive History  

> directive expected to change current setting
Operator Directive Option: RCP Id. >
  ---- > 1

Operator Directive Option: RCP If' input channels >
  ---- > SET IF2

TEST ANALYSIS (S AN) EXPECTED 1(151111'S

RMT Response according to Display >
  ---- > complete - configuration change reflects directive setup

Expected Frequency at all 4 IF Ports according to Spectrum Analyzer >
  ---- > 2000 Hz

No error conditions exist

*******************************
Case # 7
Label: 1.2.1.1.1.3.3.7
PARAMETERS :

SETUP OF MV' S UBASSEMBLIES AND TEST SIGNAL GENERATOR

RCP Operability Status (set via board installation) >
  ---- > NORMAL - operational

Test Signal Output connected to RCP IF Port (stated below) >
  ---- > IF2

Test Signal Output Frequency Setting (stated below) >
  ---- > SET Test Signal Frequency to 250000000

TEST EXECUTION ACTION

Operator Directive validity >
  ---- > request syntax is valid

Operator Directive History >
  ---- > directive expected to change current setting

Operator Directive Option: RCP Id. >
  ---- > 1

Operator Directive Option: RCP If' input channels >
  ---- > SET IF3

TEST ANALYSIS (S AN) EXPECTED RESULTS

RMT Response according to Display >
  ---- > complete - configuration change reflects directive setup

Expected Frequency at all 4 IF Ports according to Spectrum Analyzer >
  ---- > No signal, 0 Hz

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No error conditions exist.

**********************************************

Case # 8
Label: 1.2.1.2.1.2.4.5

PARAMETERS:

SETUP OF HWR H/W SUBASSEMBLIES AND TEST SIGNAL GENERATOR

RCP Operability Status (set via board installation) : ->
        -> NORMAL - operational

Test Signal Output connected to RCP IF Port (stated below) : ->
        -> IF2

Test Signal Output Frequency Setting (stated below) : ->
        -> SET Test Signal Frequency to 7000 Hz

TEST EXECUTION ACTION

Operator Directive validity : ->
        -> request syntax is valid

Operator Directive History : ->
        -> directive NOT expected to change current setting

Operator Directive Option: RCP id. : ->
        -> 1

Operator Directive Option: RCP IF input channels : ->
        -> IF2

TEST RESULTS AND EXPECTED 1's

RMT Response according to Display : ->
        -> complete configuration unchanged and reflects directive setup

Expected Frequency at all 4 RMT Ports according to Spectrum Analyzer : ->
        -> 7000 Hz

No error conditions exist.

**********************************************

Case # 9
Label: 1.3.3.1.1.1.3.3

PARAMETERS:

SETUP OF HWR H/W SUBASSEMBLIES AND TEST SIGNAL GENERATOR

RCP Operability Status (set via board installation) : ->
        -> NORMAL - operational
Test Signal Output connected to RCP IF Port (stated below)  

> 1F3

Test Signal Output Frequency Setting (stated below)  

> SET Test Signal Frequency to 75000000

**TEST EXECUTION ACTION**

Operator Directive validity  

> request syntax is valid

Operator Directive History  

> directive expected to change current setting

Operator Directive Option: RCP Id.  

> 1

Operator Directive Option: RCP IF input channels  

> SET IF1

**15'1 ANALYSIS RESULT**

RMT Response according to Display  

> complete - configuration change reflects directive setup

Expected Frequency at all 4 IF Ports according to Spectrum Analyzer  

> DC signal, 0 Hz;

No error conditions exist.

***************************************

Case #: 10
Label: 1.3.3.1.1.1.2.3.3

**PARAMETERS:**

**SETUP Of HW R n/ W SUBASSEMBLY (ES AN) TEST SIGNAL GENERATOR**

RCP Operability Status (set via board installation)  

> NORMAL - operational

Test Signal Output connected to RCP IF Port (stated below)  

> 1F3

Test Signal Output Frequency Setting (stated below)  

> SET Test Signal Frequency to 75000000

**TEST EXECUTION ACTION**

Operator Directive validity  

> request syntax is valid

Operator Directive History  

> directive expected to change current setting
Operator Directive Option: RCP Id. ==> 1

Operator Directive Option: RCP IF input channels  
==> SET IF3

'II', 5'1 ANALYSIS AN) EXPECTED RESULTS

RMF Response according to Display ==> complete - configuration change reflects directive setup

Expected Frequency at all 4 IF Ports according to Spectrum Analyzer ==> DC signal, 0 Hz.

No error conditions exist

***************
Case 1: 11
Label: 1.3.3.1.1.3.3.6

PARAMETERS:

SETUP on VR n/W SUBASSEMBLIES AN) TEST SIGNAL GENERATOR

RCP Operability Status [set via board installation]  
==> NORMAL - operational

Test Signal Output connected to RCP IF Port (stated below)  
==> IF3

Test Signal Output Frequency Setting (stated below)  
==> SET Test Signal Frequency to 25000000

TEST EXECUTION ACTION

Operator Directive validity ==>
==> request syntax is valid

Operator Directive History ==>
==> directive expected to change current setting

Operator Directive Option: RCP Id.  
==> 1

Operator Directive Option: RCP IF input channels  
==> SET IF3

TEST ANALYSIS AN) EXPECTED RESULTS

RMF Response according to Display ==>
==> complete - configuration change reflects directive setup

Expected Frequency at all 4 IF Ports according to Spectrum Analyzer  
==> 3000 Hz
DEd Propulsion Laboratory Section

SHELL OF A/V E: MINIMUMS AND FIRST SIGNAL GENERATION

PARAMETERS:

- Index: 1.3.12
- Case 1

**---------------------------------------------**

No errorcond, go to HL

Expected frequency of all 3 H列车s except on 3 甲 signal and c-set direct set setup

RAW ANALYSIS AND EXPECTED RESULTS

- Syst 12
- Operation directive (Order: CCP 14)
- Operation directive (Order: CCP 14)
- Operation directive (Order: CCP 14)
- Operation directive (Order: CCP 14)
- Operation directive (Order: CCP 14)

TEST EXACT SIGNAL ACTION

- Set test signal frequency to 250003000
- Set test signal frequency setting (selected below)
- Set test signal frequency setting (selected below)
- Set test signal frequency setting (selected below)
- Set test signal frequency setting (selected below)
- Set test signal frequency setting (selected below)

ERROR OPERATIONAL STATION (Select the board as action)

SHELL OF A/V E: MINIMUMS AND FIRST SIGNAL GENERATION

PARAMETERS:

- Index: 1.3.12
- Case 1

**---------------------------------------------**

No error cond, go to HL
Test Signal Output connected to RCP IF Port (stated below) ... >
   ... > don’t care

Test Signal Output Frequency Setting (stated below) ... >
   ... > don’t care

'* TEST: XDU10 AN ACTION

Operator Directive validity
   > request syntax is valid

operator DirectiveHistory
   > don’t Care

Operator Directive Option: RCP Id. ... >
   ... >

Operator Directive Option: RCP IF input channels ... >
   ... > don’t care

TEST ANALYSIS ANI) EXPECTED/RESULTS

RMT Response according to Display ... >
   ... > cannot perform because RCP not normal

Expected Frequency at all 4 HW Ports according to Spectrum Analyzer ... >
   ... > don’t care

No error conditions exist

************************************************************
Case # 14
Label: 3.5.3.14.1.5.2.8

PARAMETERS:

SETUP OF H/W M/W SUBASSEMBLIES AND TEST SIGNAL GENERATOR

RCP Operability Status (not via board installation) ... >
   ... > FAILED - out of service

Test Signal Output connected to RCP IF Port (stated below) ... >
   ... > don’t care

Test Signal Output Frequency Setting (stated below) ... >
   ... > don’t care

TEST EXECUTION ACTION

Operator Directive validity ... >
   ... > request syntax is valid

Operator Directive History ... >
   ... > don’t Care

Jet Propulsion Laboratory, Section 333
Operator Directive Option: RCP lid. > 1

Operator Directive Option: RCP IF input channels >

TEST ANALYSIS AND EXPECTED RESULTS

RMT Response according to Display >

--> cannot perform because RCP not normal

Expected Frequency at all 4 Hz Ports according to Spectrum Analyzer >

--> don’t care

No error conditions exist.

PARAMETERS:

SETUP OF RMR H/W SUBASSEMBLIES AND TEST SIGNAL GENERATOR

RCP Operability Status (set via board installation) >

--> don’t care

Test Signal Output connected to RCP IF Port (stated below) >

--> don’t care

Test Signal Output Frequency Setting (stated below) >

--> don’t care

'1' IS' EXECUTION ACTION

Operator Directive validity >

--> request syntax is invalid

Operator Directive History >

--> don’t care


--> 1

Operator Directive Option: RCP IF input channels >

--> don’t care

'1' IS' ANALYSIS AND EXPECTED RESULTS

RMT Response according to Display >

--> rejected directive, configuration unchanged

Expected Frequency at all 4 Hz Ports according to Spectrum Analyzer >

--> unchanged - output derived from last valid configuration
Error #1: Operator Directive Syntax is in error or undefined RCP/Input Port
So ftTest

**Release Level:** 3.1 **Release Date:** 5/91

SoftTest is a PC based tool that provides automated support for requirements based testing for any application, language, or hardware environment. SoftTest aids the testing process in four major areas. It aids in validating system requirements by identifying all of the system's elementary functions and logical inconsistencies in the requirements specification. SoftTest will then determine the necessary tests that will ensure that 100% of system's functionality is tested. The tool also aids in project management by providing functional coverage analysis and archiving of both new and existing test libraries. SoftTest provides quantitative measurements of the testing process allowing quantifiable completion criteria for the testing process.

SoftTest is the only test tool currently available that utilizes a mathematically rigorous technique for designing and evaluating functional test cases. This technique, called Cause-Effect graphing, is on the same time tested algorithms that engineers use to test hardware logic circuits. The success of these algorithms can be seen in the consistently high quality that we see in the integrated circuit industry.

---

**Information Date:** 4/91

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<th><strong>Vendor:</strong> Bender &amp; Associates</th>
<th><strong>Date First Sold:</strong> 1987</th>
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<tbody>
<tr>
<td>484 Magnolia Avenue</td>
<td><strong>Current Users:</strong> 100+</td>
</tr>
<tr>
<td>P.O.Box 849</td>
<td><strong>Price:</strong> $2,500</td>
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<tr>
<td>Larkspur, CA 94939</td>
<td><strong>Annual Maintenance:</strong> 20%</td>
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<tr>
<td>415<em>927</em>5863</td>
<td><strong>Training Supplied:</strong> No</td>
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<td><strong>Trial Available:</strong> No</td>
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<td><strong>Documentation Supplied:</strong> Yes</td>
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<td><strong>Demo Available:</strong> Yes</td>
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<table>
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<th><strong>Class</strong></th>
<th><strong>Descriptors</strong></th>
<th><strong>Test Activity Supported</strong></th>
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<tr>
<td>Test Management</td>
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<td>Test Design</td>
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<td><strong>Case Generator</strong></td>
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<td><strong>Language Supported</strong></td>
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<td>Language Independent</td>
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**Hardware Supported:** IBM PC
T is a tool that automatically generates test case input data from requirements information. T verifies the testability of requirements, generates test cases, documents test cases, traces between requirements and test cases, and reports metrics for requirements coverage (Passed requirements/Total requirements).

T is a specification based test case generator. It uses cause effect graphing, equivalence class partitioning, boundary value analysis, function testing, error guessing, and fault directed test design techniques.

**Information** Date: 8/91

| Vendor: Programming Environments, Inc. 4043 State Hwy.33 Tinton Falls, NJ 07753 908-918-0110 |
|---|---|---|
| Date First Sold: 1987 | Current Users: 280+ | Price $7,000 |
| Annual Maintenance: 15% | Training Supplied: Yes |
| Trial Available: No | Documentation Supplied: Yes |
| Demo Available: Yes |

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<td>Requirements Coverage Analyzer Requirements Verifier Test Data Generator</td>
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