TYX CORPORATION

EADS NORTH AMERICA

TYX TestBase

Development of Diagnostics with DSI *eXpress* and TYX TestBase

For *eXpress* versions 5.10.x.

***DSI eXpress* User Group Meeting**
Sept 22, 2006
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DSI *eXpress*

- **Model-Based Diagnostics Engineering and System Governing tool**
  - □ Provides an object-oriented approach to full-system design
  - □ Supports analysis and optimization throughout all phases of development
- **Functionality**
  - □ Development of dependency models
  - □ Modeling of system test strategies
  - □ Diagnostic analysis (fault detection and fault isolation)
  - □ Failure Mode Effects and Criticality Assessment (FMECA)

TYX TestBase

Test Executive

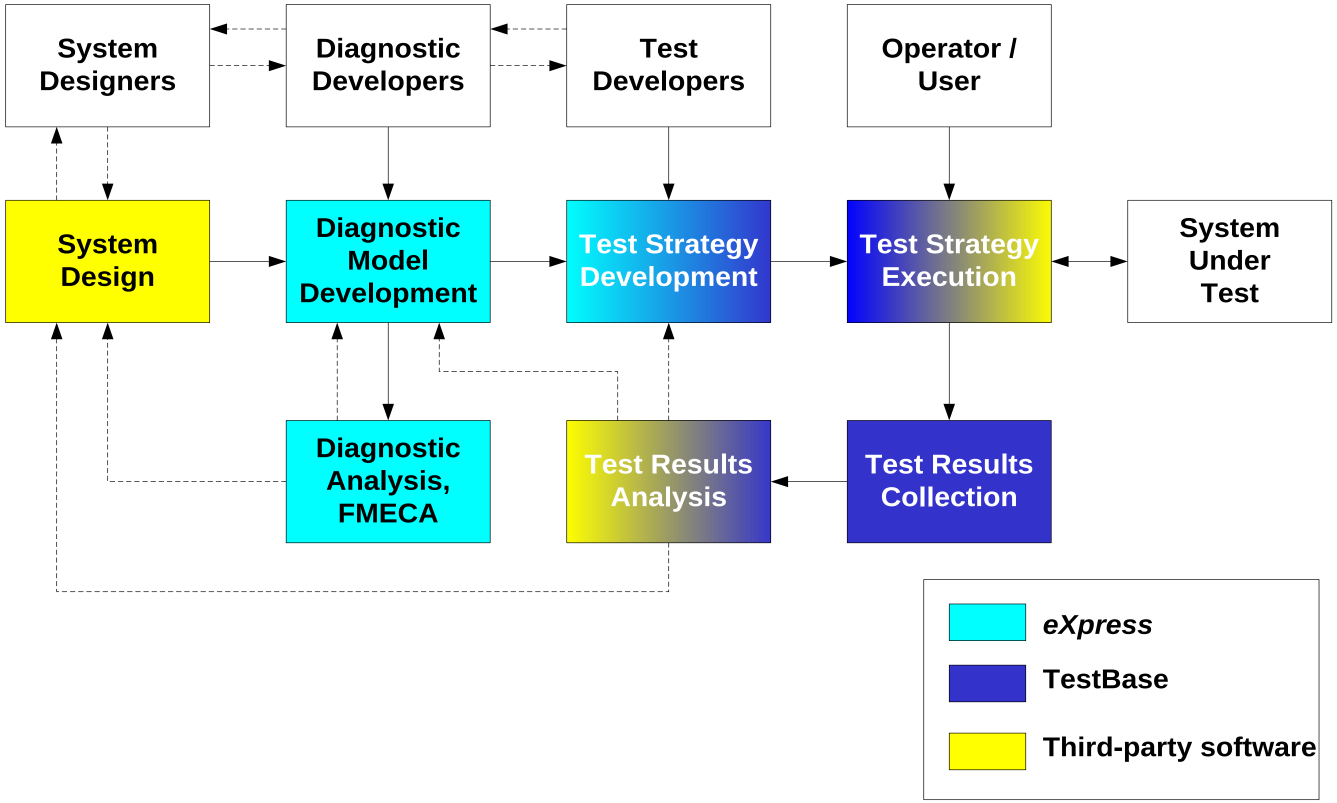
- Open architecture enables integration between
  - Diagnostic development tools
  - Test languages and environments
  - User interface modules
  - Storage of test results

Functionality

- Visual development of test strategies
- Import of test strategies from third-party tools
- Execution of test strategies using third-party test environments
- Collection of test results
- Statistical analysis of test results

eXpress – TestBase Integration

➢Integrated “Design-to-Test” Process



System Designers

Diagnostic Developers

Test Developers

Operator / User

System Design

Diagnostic Model Development

Test Strategy Development

Test Strategy Execution

System Under Test

Diagnostic Analysis, FMECA

Test Results Analysis

Test Results Collection

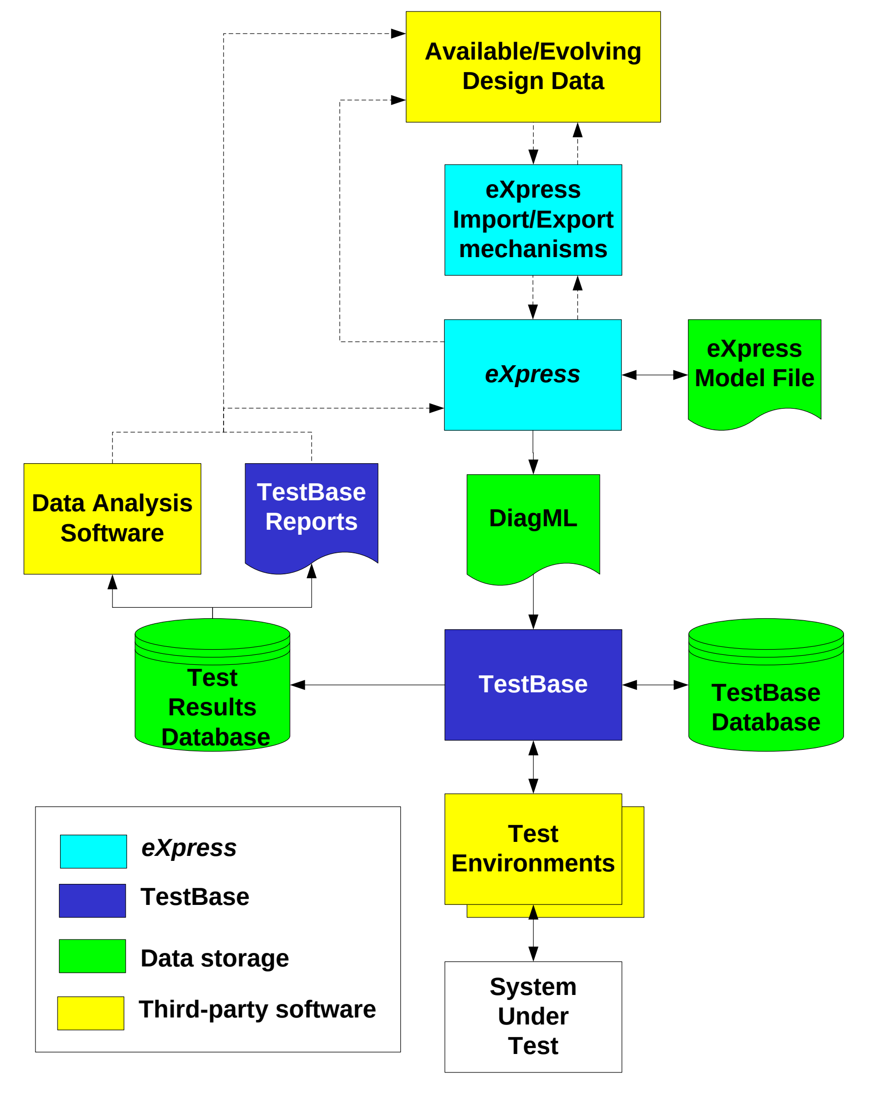
🟦 *eXpress*

🟦 TestBase

🟨 Third-party software

eXpress – TestBase Integration…

- Integration Architecture

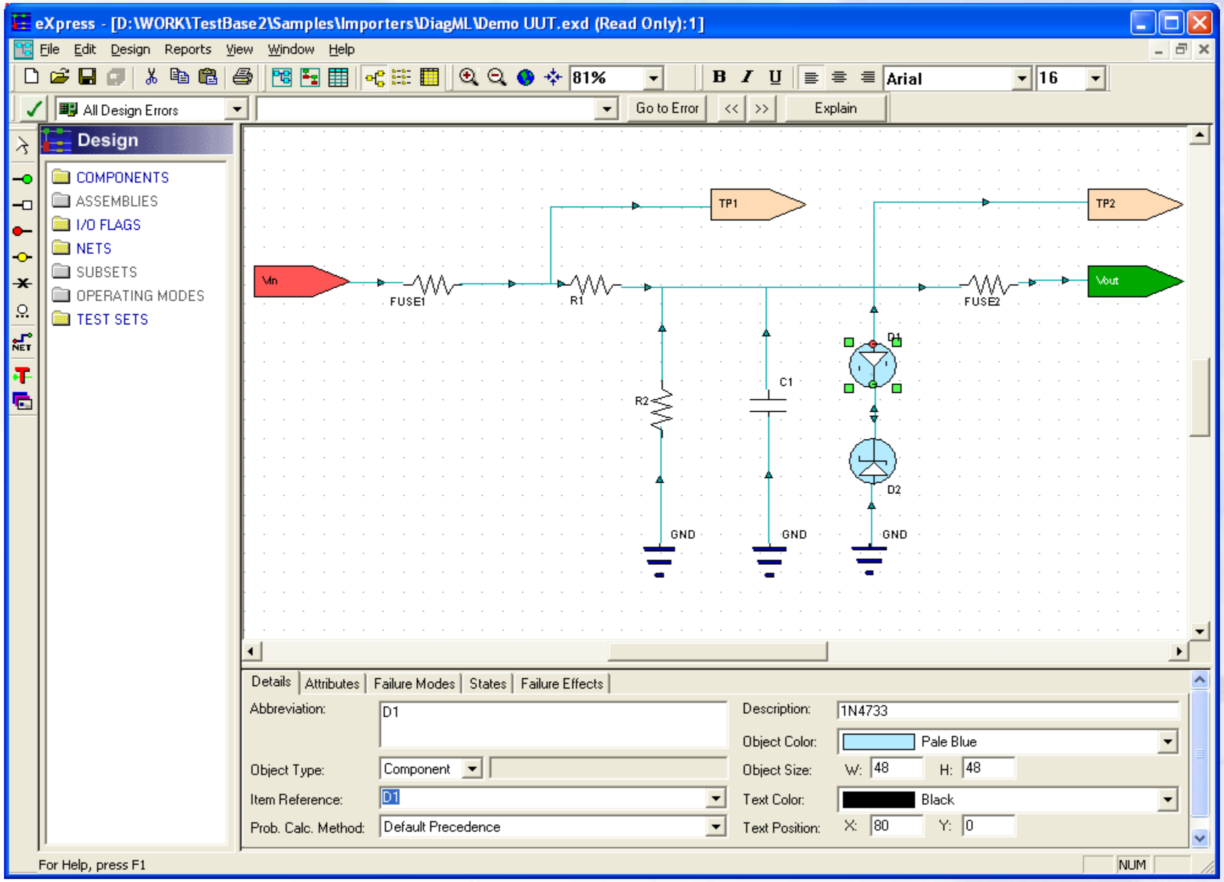


eXpress – TestBase Integration…

- **DiagML:**
  - ❑ “Diagnostic Modeling Language”
  - ❑ Based on XML
  - ❑ Developed by a consortium of companies as an open specification
  - ❑ After a trial period, open to membership by other companies
  - ❑ Benefits
    - Explicit extensibility
    - Parsability
    - Transformability
    - Wide industry acceptance
    - Human readable
  - ❑ Details at http://www.diag-ml.com

Integrated Diagnostic Development

➢1. Build Diagnostic Model



Abbreviation: D1

Description: 1N4733

Object Color: Pale Blue

Object Type: Component

Object Size: W: 48 H: 48

Item Reference: D1

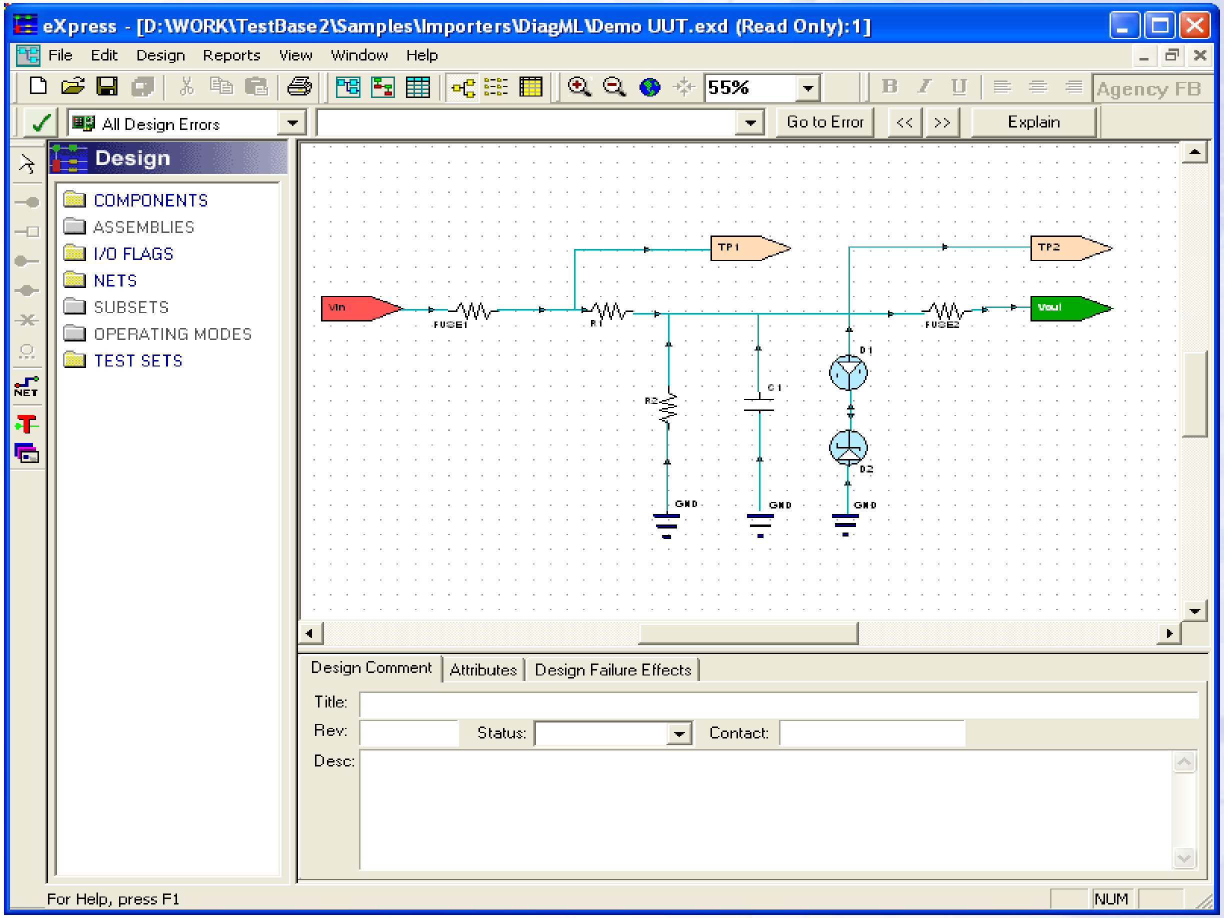
Text Color: Black

Prob. Calc. Method: Default Precedence

Text Position: X: 80 Y: 0

Integrated Diagnostic Development…

- 2. **Build Test Set**



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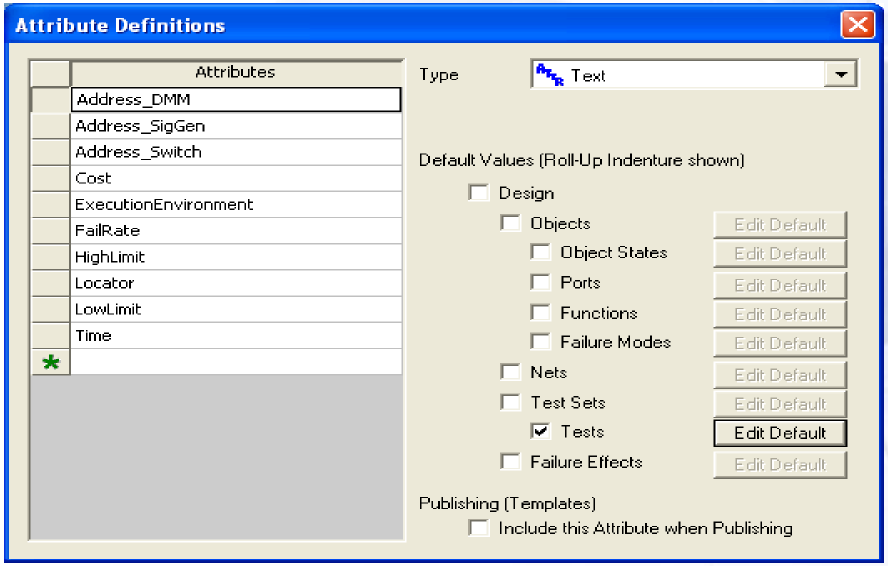
Integrated Diagnostic Development…

➢ 2. Build Test Set (cont'd)



Attribute Definitions

	Attributes
	Address_DMM
	Address_SigGen
	Address_Switch
	Cost
	ExecutionEnvironment
	FailRate
	HighLimit
	Locator
	LowLimit
	Time
*	

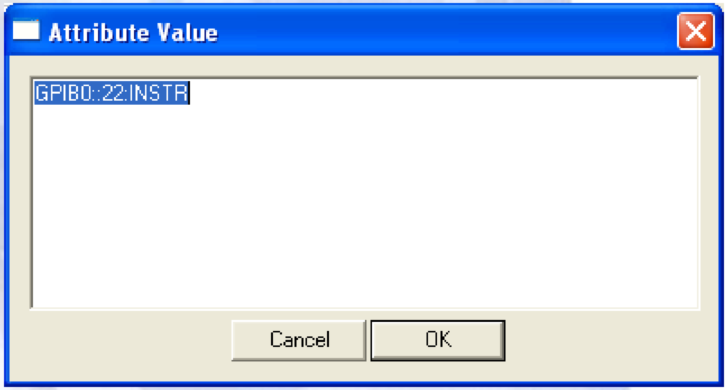
Type: Text

Default Values (Roll-Up Indenture shown)

- □ Design
  - □ Objects — Edit Default
    - □ Object States — Edit Default
    - □ Ports — Edit Default
    - □ Functions — Edit Default
    - □ Failure Modes — Edit Default
  - □ Nets — Edit Default
  - □ Test Sets — Edit Default
    - ☑ Tests — Edit Default
  - □ Failure Effects — Edit Default

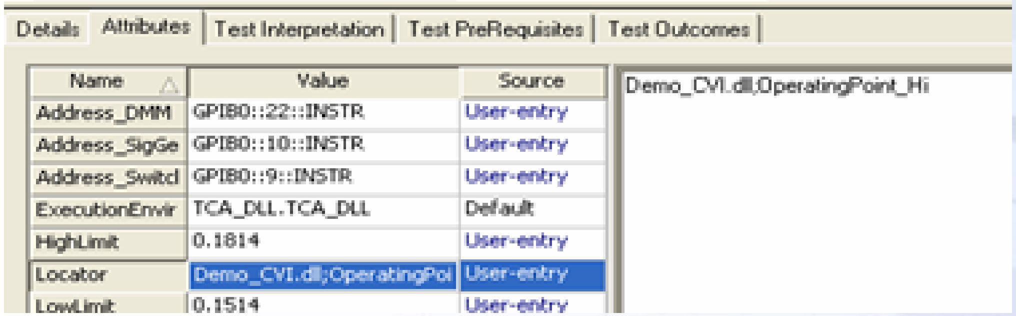
Publishing (Templates)

- □ Include this Attribute when Publishing



Attribute Value

GPIB0::22:INSTR

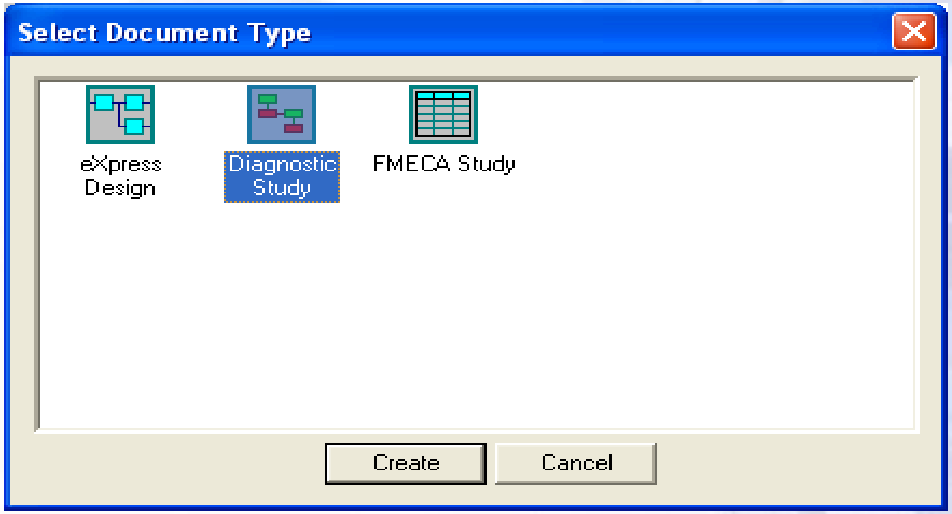


Name	Value	Source
Address_DMM	GPIB0::22::INSTR	User-entry
Address_SigGe	GPIB0::10::INSTR	User-entry
Address_Switcl	GPIB0::9::INSTR	User-entry
ExecutionEnvir	TCA_DLL.TCA_DLL	Default
HighLimit	0.1814	User-entry
Locator	Demo_CVI.dll;OperatingPoi	User-entry
LowLimit	0.1514	User-entry

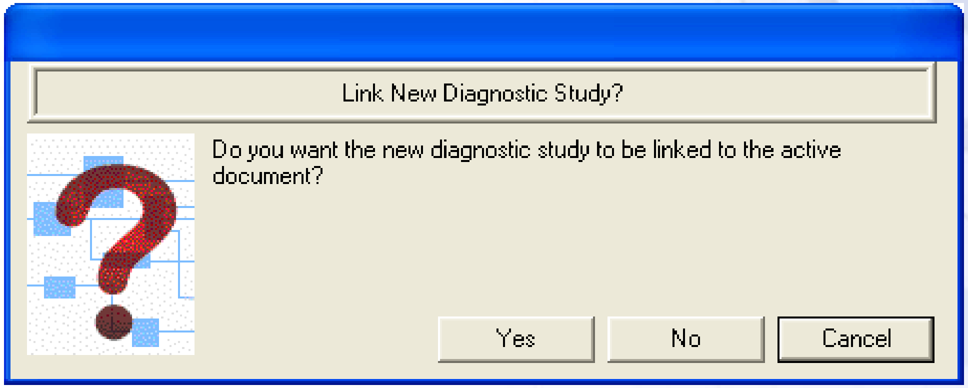
Demo_CVI.dll;OperatingPoint_Hi

Integrated Diagnostic Development…

3. Generate Diagnostic Strategy



Select Document Type



Link New Diagnostic Study?

Do you want the new diagnostic study to be linked to the active document?

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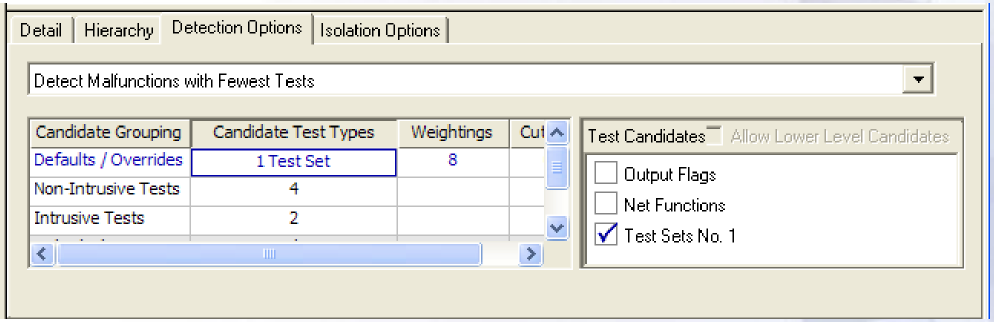
Integrated Diagnostic Development…

➢ 3. Generate Diagnostic Strategy (cont’d)



Detail | Hierarchy | Detection Options | Isolation Options

Detect Malfunctions with Fewest Tests

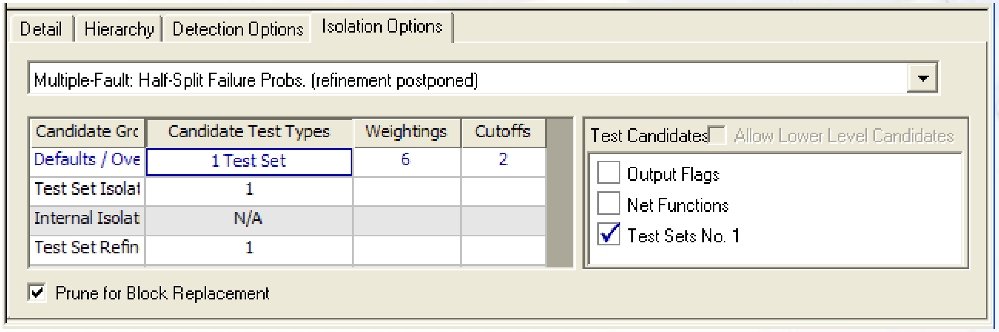
Candidate Grouping	Candidate Test Types	Weightings	Cut
Defaults / Overrides	1 Test Set	8	
Non-Intrusive Tests	4		
Intrusive Tests	2		

Test Candidates □ Allow Lower Level Candidates

□ Output Flags

□ Net Functions

☑ Test Sets No. 1



Detail | Hierarchy | Detection Options | Isolation Options

Multiple-Fault: Half-Split Failure Probs. (refinement postponed)

Candidate Grc	Candidate Test Types	Weightings	Cutoffs
Defaults / Ove	1 Test Set	6	2
Test Set Isolat	1		
Internal Isolat	N/A		
Test Set Refin	1		

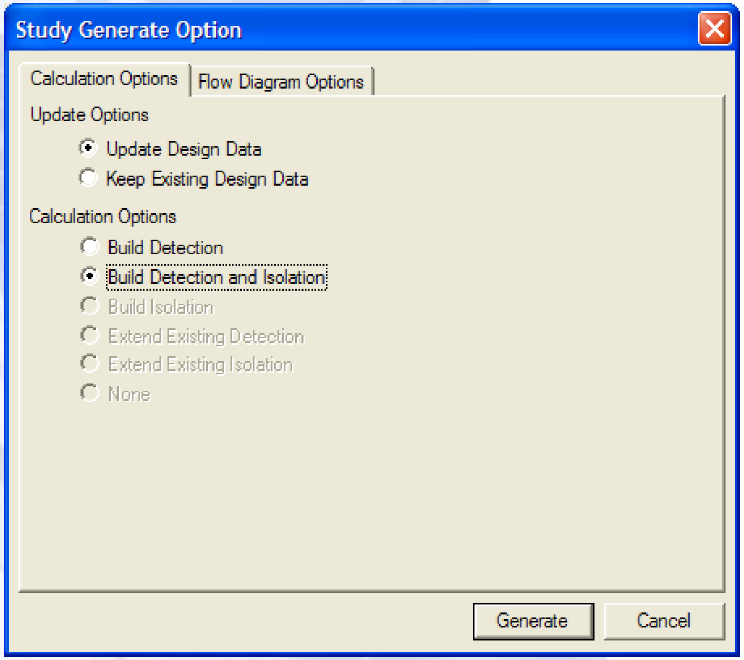
Test Candidates □ Allow Lower Level Candidates

□ Output Flags

□ Net Functions

☑ Test Sets No. 1

☑ Prune for Block Replacement



Study Generate Option

Calculation Options | Flow Diagram Options

Update Options

● Update Design Data

○ Keep Existing Design Data

Calculation Options

○ Build Detection

● Build Detection and Isolation

○ Build Isolation

○ Extend Existing Detection

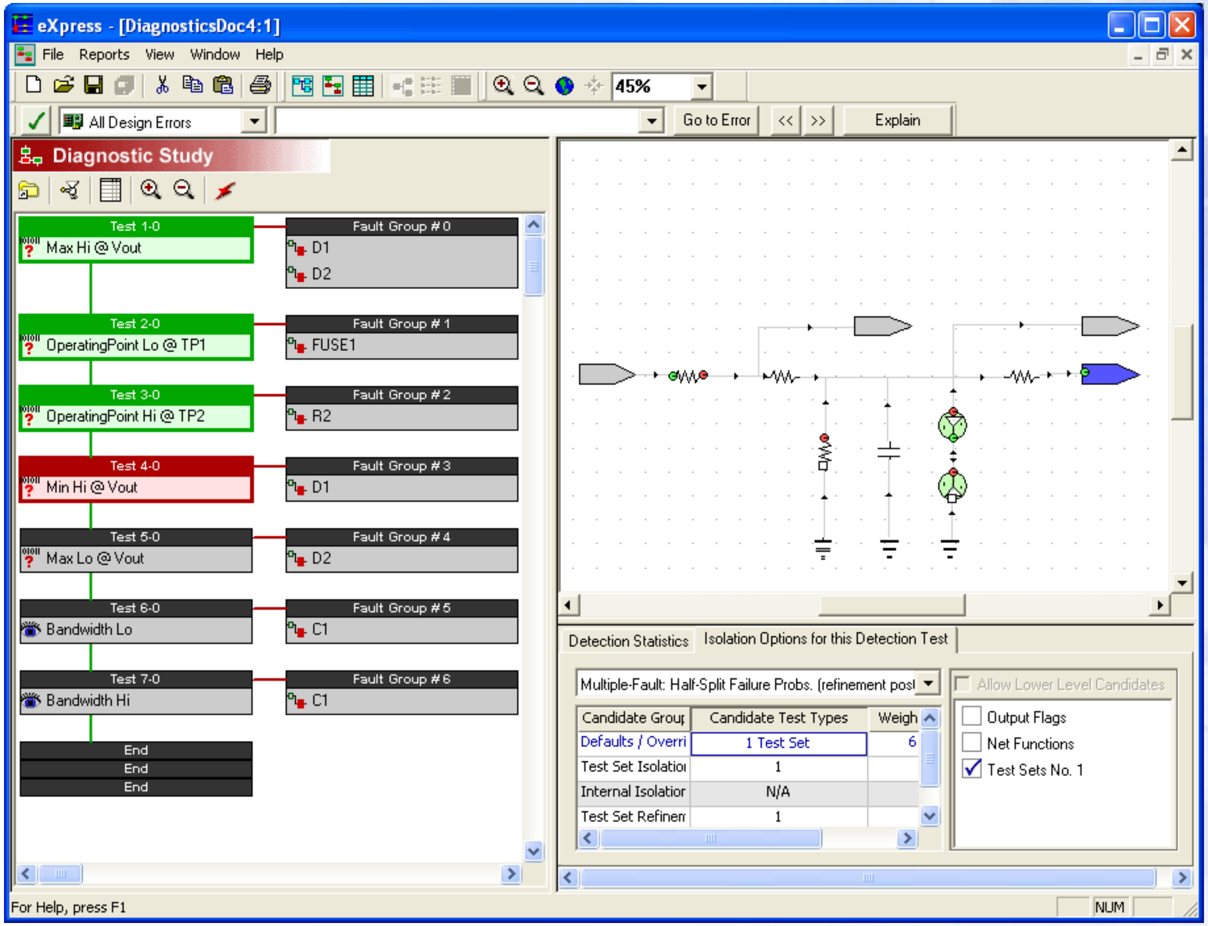
○ Extend Existing Isolation

○ None

Generate | Cancel

Integrated Diagnostic Development…

➢3. Generate Diagnostic Strategy (cont’d)

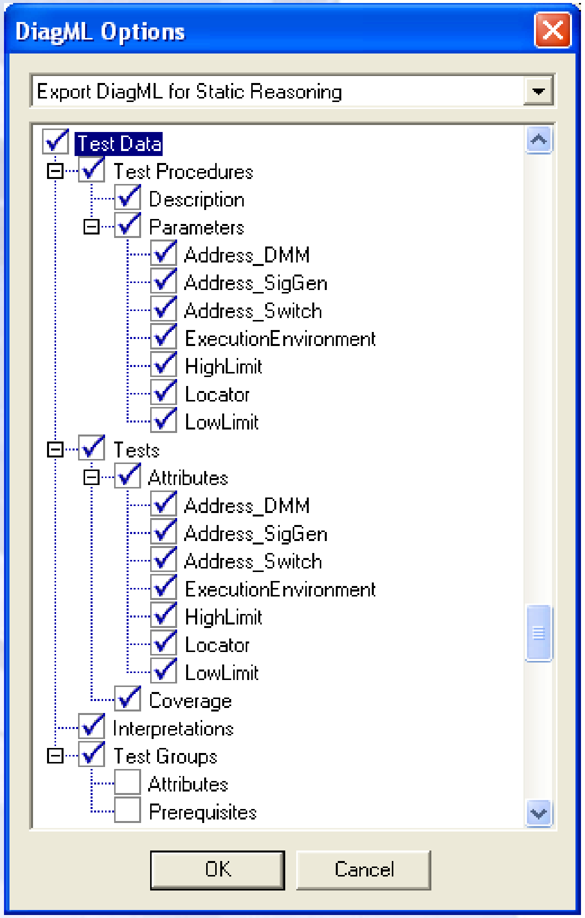


Multiple-Fault: Half-Split Failure Probs. (refinement posl

Candidate Grouţ	Candidate Test Types	Weigh
Defaults / Overri	1 Test Set	6
Test Set Isolatioı	1	
Internal Isolatior	N/A	
Test Set Refinerr	1	

□ Allow Lower Level Candidates

□ Output Flags
□ Net Functions
☑ Test Sets No. 1

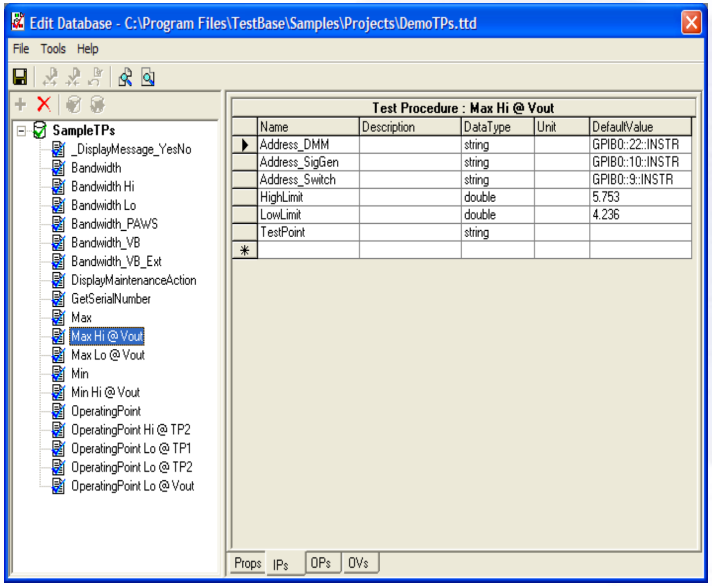


Export DiagML for Static Reasoning

- ☑ Test Data
  - ☑ Test Procedures
    - ☑ Description
    - ☑ Parameters
      - ☑ Address_DMM
      - ☑ Address_SigGen
      - ☑ Address_Switch
      - ☑ ExecutionEnvironment
      - ☑ HighLimit
      - ☑ Locator
      - ☑ LowLimit
  - ☑ Tests
    - ☑ Attributes
      - ☑ Address_DMM
      - ☑ Address_SigGen
      - ☑ Address_Switch
      - ☑ ExecutionEnvironment
      - ☑ HighLimit
      - ☑ Locator
      - ☑ LowLimit
    - ☑ Coverage
  - ☑ Interpretations
  - ☑ Test Groups
    - □ Attributes
    - □ Prerequisites

Integrated Diagnostic Development…

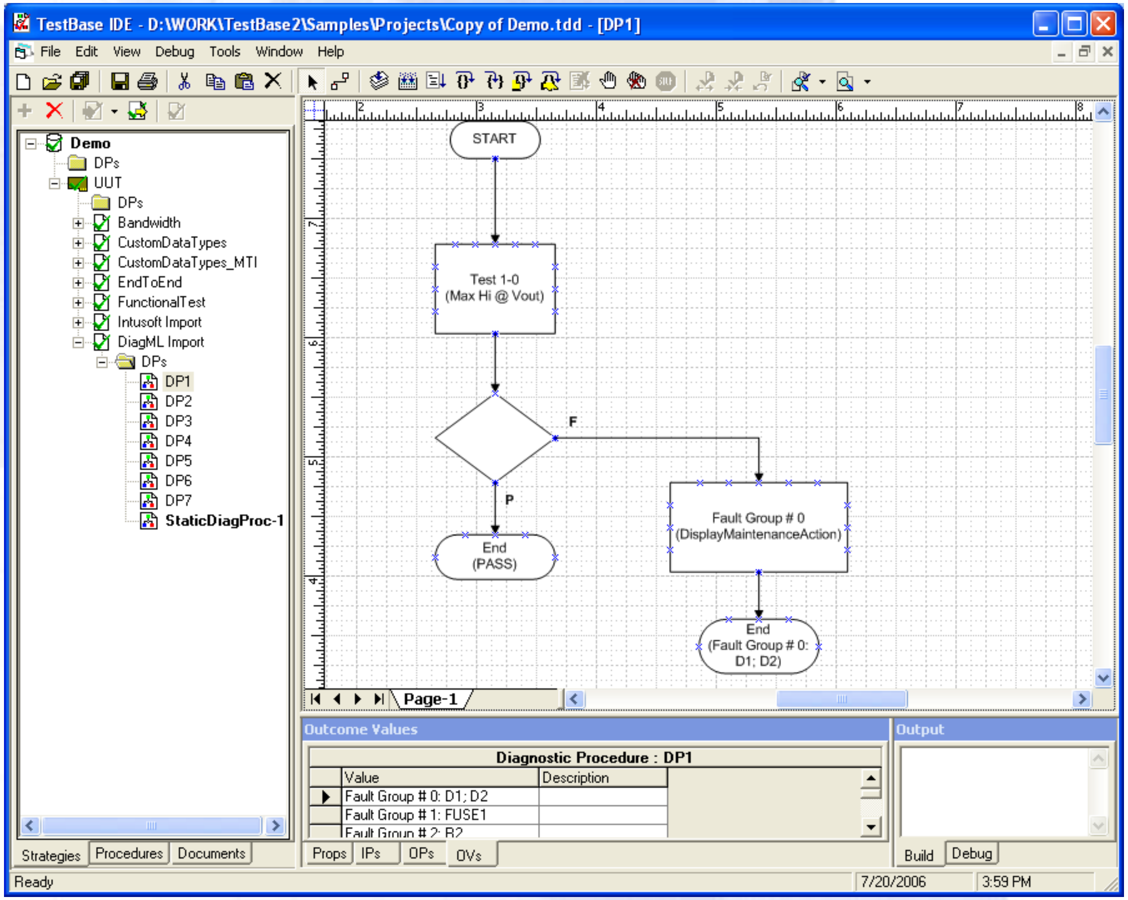
➤4. Import Diagnostic Strategy in TestBase



Edit Database - C:\Program Files\TestBase\Samples\Projects\DemoTPs.ttd

Test Procedure : Max Hi @ Vout

Name	Description	DataType	Unit	DefaultValue
Address_DMM		string		GPIB0::22::INSTR
Address_SigGen		string		GPIB0::10::INSTR
Address_Switch		string		GPIB0::9::INSTR
HighLimit		double		5.753
LowLimit		double		4.236
TestPoint		string		



TestBase IDE - D:\WORK\TestBase2\Samples\Projects\Copy of Demo.tdd - [DP1]

Outcome Values

Diagnostic Procedure : DP1

Value	Description
Fault Group # 0: D1; D2	
Fault Group # 1: FUSE1	
Fault Group # 2: B2	

Integrated Diagnostic Development…

5. Develop TestBase Test Procedures

- ❑ One TestBase test procedure for each Test defined in *eXpress*
  - Implementation must be consistent with the characterization of the test procedure, in the Test Database where DiagML was imported.
    - Property “Adapter ProgID” indicates the test language/environment to be used
    - Property “Locator” indicates the location of the test procedure code (ex. DLL name and function name)
    - Input parameter “TestPoint” indicates the location of the measurement; use for switching (if applicable)
    - All other input parameters originate from *eXpress* Test attributes; implement as designed
  - Recommended: for test procedures that have identical functionality but different parameter values and/or test point, delegate to a unique underlying function
- ❑ The special test procedure “DisplayMaintenanceAction”
  - Displays or implements the required maintenance action

Integrated Diagnostic Development…

6. Execute Test Strategy

- ❑ Move TestBase databases to production or embedded environment
- ❑ Configure run-time options
  - Assign MTI database, for collection of test results
- ❑ Execute test strategy
  - Execution reports/remediates “diagnosed faults”; to enable statistical assessment of diagnostic performance, enter the “actual faults” in the MTI Database (ex. via the MTI Database GUI)
- ❑ Evaluate diagnostic performance
  - Performed off-line, after a sufficient amount of test results was accumulated
  - Generate statistic reports from MTI Database GUI (new feature in TestBase 2.6)
  - Use third-party software to retrieve and process test results from the MTI database

Integrated Diagnostic Development…

➢Mapping of Design Entities

eXpress	TestBase
Diagnostic strategy	**➢Set of test procedures, in a Test Database** **➢Test strategy with one/more diagnostic procedures, in a Diagnostic Database**
Test node	**➢Test procedure** **➢"Test" block in the diagnostic procedure**
Test Location	**➢Test procedure input parameter "TestPoint"** **➢Test input parameter value**
Test attribute "ExecutionEnvironment"	**➢Test procedure property "Execution Environment" (i.e., Adapter ProgID)**
Test attribute "Locator"	**➢Test procedure property "Locator" (ex. DLL name, function name)**
Other test attributes	**➢Test procedure input parameter** **➢Test input parameter value**
Fault Group node	**➢Test procedure "DisplayMaintenanceAction"** **➢"Test" block** **➢"End" block**
Fault Group objects	**➢Value of input parameter "MaintenanceAction" of "Test" block** **➢Diagnostic procedure outcome assigned to "End" block**

Integrated Diagnostic Development…

- ***eXpress* Design Rules**
  - ❑ Tests shall have only one Location
  - ❑ Each test shall have the following attributes:
    - “ExecutionEnvironment” – indicates the test language/environment to be used for execution
    - “Locator” – indicates the location of the test procedure code
  - ❑ Tests shall not have attributes named “TestPoint”

Integrated Diagnostic Development…

TestBase Design Rules

- Test procedures implementing *eXpress* Tests
  - All test procedures shall support the input parameter “TestPoint” and use it to determine the location of the measurement
  - All test procedures shall support input parameters corresponding to the Test attributes defined in *eXpress* (excepting attributes “ExecutionEnvironment” and “Locator”)
  - All test procedures shall support the Outcome values “PASS” and “FAIL”
- Special test procedure “DisplayMaintenanceAction”
  - Shall support the input parameter “MaintenanceAction”, of type string
  - May display the string to the user, or may implement a remediation action (if applicable)
  - Is not required to return an Outcome value
  - A default implementation is available in <TestBase installation directory>\Samples\TPs\CVI\Demo_CVI\Demo_CVI.prj

Example

Fault Isolation

- *eXpress* model: <TestBase installation directory>\Samples\Importers\DiagML\Demo UUT.exd
- Test strategy in DiagML format: <TestBase installation directory>\Samples\Importers\DiagML\Demo UUT.xml
- Test strategy imported in TestBase:
  - Test Database: <TestBase installation directory>\Samples\Projects\DemoTPs.ttd
  - Diagnostic Database: <TestBase installation directory>\Samples\Projects\Demo.tdd
    - UUT Model: “UUT”
    - Test Strategy: “DiagML import”
- Test procedures (LabWindows/CVI): <TestBase installation directory>\Samples\TPs\CVI\Demo_CVI\Demo_CVI.prj

Future enhancements

- **Optimization of Export and Import, to Reduce:**
  - ❑ The number of test procedures
  - ❑ The size of test strategies
  - ❑ The duration of import