AN AUTOMATED TEST STATION DESIGN USED TO VERIFY AIRCRAFT
COMMUNICATION PROTOCOLS

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by
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TITLE: AN AUTOMATED TEST STATION DESIGN USED
TO VERIFY AIRCRAFT COMMUNICATION
PROTOCOLS

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ABSTRACT

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Requirements verification is typically the costliest part of the systems engineering design process. In the commercial aircraft industry, as the software and hardware design evolves, it must be verified to conform to requirements. In addition, when new design releases are made, regression analysis must be performed which usually requires repeat testing. To streamline verification, a suite of automated verification tools is described in this document which can reduce the test effort. This test suite can be qualified to be used to verify systems at any DO-178B design assurance level. Some of the software tools are briefly described below.

There are major advantages of this automated verification effort. The tools can either be internally developed by a company or purchased “off the shelf”, depending upon budget and staff constraints. Every automated test case can be run with the click of a button and failures caused by human factors are reduced. The station can be qualified per DO-178B guidelines, and can also be expanded to support ARINC 429, AFDX, Ethernet, and MIL-STD-1553 interfaces. The expansion of these test programs would enable the creation of a universal avionics test suite with minimal cost and a reduction of the overall program verification effort.

The following is a presentation of an automated test station capable of reducing verification time and cost. The hardware and software aspects needed to create the test station are examined. Also, steps are provided to help guide a designer through the tool qualification process. Lastly, a full suite of test functions are included that can be implemented and customized to verify a wide range of avionics communication characteristics.

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CHAPTER 1: AVIONICS COMMUNICATION OVERVIEW

In order to facilitate information communication throughout an aircraft, several data transmission protocols can be employed. The following sections discuss the differences between the types of data signals.

1.1 ARINC-429 Communication Protocol

1.1.1 Avionics Usage

ARINC-429 is a data transmission protocol used throughout the commercial aircraft industry. An aircraft is comprised of many individual systems, ranging from fire detection to navigation. Commercial aircraft use ARINC-429 protocol as a means of communication between these systems in order to send system status, failure information, GPS, and other avionics data. For example, a navigation system can send heading, pitch, roll, etc. to the cockpit avionics displays using ARINC-429 data buses.

1.1.2 Protocol Description

The ARINC-429 protocol is defined as a 32-bit word that is structured as shown in Table 1.1. All ARINC-429 data is received in this format. The first 8 bits define the label number converted in octal. The label is organized with bit 7 as most significant bit (MSB), and bit 0 as least significant bit (LSB). The rest of the word is sent from LSB to MSB. Bit 8 is the ninth bit sent followed by bit 9 and so on until bit 31. So, the transmission is organized first as bits 7-0, then 8-31 follow.

TABLE 1.1 ARINC-429 WORD STRUCTURE

Bit Numbers.	31	30-29	28 – 10	9,8	7 - 0
Definition	Parity	SSM	Data (MSB-LSB)	SDI	Label (MSB-LSB)

The SSM stands for Sign/Status Matrix and is used to relay the validity of the data word. As the SSM is a 2-bit field, there are four states indicating validity: Normal Operation (NO), No Computed Data (NCD), Functional Test (FT), and Failure Warning (FW). A Normal Operation SSM indicates the data is valid with the origination system working as designed. An SSM of No Computed Data indicates the data may not be trustworthy due to a reason other than failure. For example, NCD could be indicated for inertial navigation data before the sensor package has fully aligned. Failure Warning is used for invalid data resulting from a failed software partition or entire system. Functional Test can be used when “canned” data is being streamed due to a known test setting.

1.1.3 Avionics Hardware Interface

Each ARINC data bus requires two wires (twisted pair) to facilitate data transmission between aircraft systems. Therefore, a main wiring harness may contain a bundle of hundreds of wires that are strung throughout the aircraft body. Specialized ARINC backplate connectors such as the ARINC-600 connector allow for organization of data bus connections with many pins.

FIGURE 1.1 ARINC-600 CONNECTOR WITH 600 PINS PLUS POWER PINS

1.1.4 Test Station Interface

The test station can be upgraded to accommodate all ARINC type connections. The wiring harness would be fitted to match that which would mount in the aircraft.

1.2 MIL-STD 1553 Communication Protocol

1.2.1 Avionics Usage

MIL-STD-1553 was developed to alleviate the growing wire harness weight of increasingly complex aircraft systems. This protocol offered a common data bus that could facilitate communication using a destination identifier. The receiving system can disseminate data that was intended for its destination terminal. MIL-STD-1553 is widely used in the military aviation field. Each

system on the aircraft can be configured to be a remote terminal, which can be reached by the bus controller.

1.2.2 Protocol Description

This standard uses words that are 20 bits long. 1 bit is used for parity, 3 bits are used for sync and the other 16 bits hold the data payload. Like Ethernet and AFDX protocols, 1553 messages are sent in packets or groups of up to 32 data words from the bus controller to a remote terminal.

1.3 AFDX Communication Protocol

1.3.1 Avionics Usage

Avionics Full Duplex Switched Ethernet (AFDX) was developed by Airbus Industries to provide an integrated high speed Ethernet network in aircraft. This network is defined by communication from end-systems to and from switches. Each line replaceable unit (LRU) on the aircraft could be defined as an end-system. These end-systems use IP addresses and MAC destination fields to route their data.

1.3.2 Avionics Hardware Interface

The figure shown below is a representation of an AFDX network connection which includes inherent redundancy. Transmissions are sent simultaneously across the TX+ and TX- wires while data is received across the RX+ and RX- wires. These channels are wired in a twisted pair configuration.

FIGURE 1.2 AFDX CONNECTOR REPRESENTATION

1.3.3 Test Station Interface

The ARINC 600 connector provides capability for AFDX connections. The test station wiring harness can be configured to support numerous AFDX networks.

1.4 Open/Ground Discretes

Input discretes on each I/O can be set to either the OPEN condition or to the ground (GND) condition. In the OPEN condition the corresponding register bit would read "1", and in GND would read "0".

1.4.1 Avionics Usage

Input discretes are generally used to set initial conditions upon system startup. They can be set to include mode control (normal operation, safe mode, maintenance, etc), aircraft type (Airbus, Boeing, etc.), power on/off, and various other avionics options. Output discretes are used to indicate states, settings, or modes of a system.

FIGURE 1.3 EXAMPLE OF AVIONICS SYSTEM OUTPUT DISCRETES

1.4.2 Avionics Hardware Interface

Each input and output discrete will be assigned to their own pin in the system connector. These can then be wired to the test station control panel

1.5 ANALOG I/O

Analog signals are used frequently in aircraft design. They are widely used to relay air data information. Examples include: Angle-of-Attack (AOA) resolver inputs, Barometric pressure resolver inputs, voltage reference inputs, and Total Air Temperature (TAT) inputs.

CHAPTER 2: AUTOMATED TEST STATION DESIGN

2.1 Purpose

The purpose of this project is to design a universal, system level, Automated Verification Station (AVS) for that can interface with general avionics data communication interfaces. System level testing refers to verification at the “black box” level. This level of testing includes simulating inputs and reading the resulting outputs of a unit under test (UUT). However, with the use of a memory inspector utility (MIU), data can be input or read directly from system memory. The basic design of this test station is to provide inputs to and measure outputs from the UUT.

2.1.1 DO-178B Guidelines

Software Considerations in Airborne Systems and Equipment Certification, or DO-178B, was published by RTCA, Incorporated. The Federal Aviation Administration (FAA) uses DO-178B as a guideline to verify that software for an airborne system will perform reliably. It is not part of the scope of this project to detail DO-178B usage, but to merely relay the possible constraints that it may place on an aircraft system in development.

2.2 Hardware Design

For an automated test station design, various computing packages can be used. National Instruments provides several options that can allow for test station growth and adaptation to different environments. The availability of future growth options is very important when designing for aircraft systems. These systems need to be maintainable and upgradeable as aircraft systems can be in usage for decades. As components become obsolete or end production, replacements can be very expensive or impossible to find, and testing can be a difficult process. Also, when dealing with DO-178B guidelines, it

may necessary to qualify every update to test station hardware and software. Clearly, it would be beneficial to only have to verify the test station once during a program lifespan.

2.2.1 Test Station Hardware and Cost

TABLE 2.1 AUTOMATED TEST STATION HARDWARE COST

Company	Description	Qty	Price	Total
Techmar Enclosures	Interface Chassis	1	\$ 240.00	\$ 240.00
Staco Energy Products	Motorized Variable Transformer	1	\$ 669.00	\$ 669.00
Pacific Design	Machine Front Panel Interface	1	\$ 285.00	\$ 285.00
Pacific Design	Machine Rear Panel Interface	1	\$ 365.00	\$ 365.00
National Instruments	SCXI-1310 96 Pin Connector	6	\$ 50.00	\$ 300.00
National Instruments	Cable, HV8-BAN4	1	\$ 40.00	\$ 40.00
National Instruments	PXI-1011 Rack	1	\$ 2,795.00	\$ 2,795.00
National Instruments	PCI to PXI Kit	1	\$ 1,495.00	\$ 1,495.00
National Instruments	SCXI-1181 Breadboard Module	1	\$ 195.00	\$ 195.00
National Instruments	SCXI-1160 16Ch Relay	5	\$ 895.00	\$ 4,475.00
National Instruments	SCXI-1127 HV Multiplexer	1	\$ 995.00	\$ 995.00
National Instruments	SCXI-1331 64 ch. Termin. Blk.	1	\$ 180.00	\$ 180.00
National Instruments	NI-4070 PXI Voltmeter	1	\$ 1,995.00	\$ 1,995.00
North Atlantic Instruments	4-Dig to Resolver CPCI Card	1	\$ 4,735.00	\$ 4,735.00
Mercury Interactive	DC Power Supplies	2	\$ 964.41	\$ 1,928.82
Mercury Interactive	Flange Kit	1	\$ 53.22	\$ 53.22
Mercury Interactive	Lock Link Kit	1	\$ 70.78	\$ 70.78
Amco Engineering Co.	Console -Blue	1	\$ 421.00	\$ 421.00
Amco Engineering Co.	Castors	4	\$ 18.00	\$ 72.00
Amco Engineering Co.	Panel 8.75"	2	\$ 20.00	\$ 40.00
Amco Engineering Co.	Chassis Guide	6	\$ 20.00	\$ 120.00
Condor Engineering	16 Channel ARINC PCI Board	1	\$ 6,000.00	\$ 6,000.00
Condor Engineering	8 Channel ARINC PCI Board	1	\$ 4,268.00	\$ 4,268.00
AIM	2 Ch. AFDX CPCI Interface	0	\$ 9,844.00	\$ 9,844.00
AIM	AFDX Analyzer Software	0	\$ 5,995.00	\$ 5,995.00
AIM	AFDX Traffic Generator	0	\$ 3,995.00	\$ 3,995.00
TECH SAT	Intelligent ARINC 429 PCI-Interface	1	\$ 2,840.50	\$ 2,840.50
TECH SAT	A330/340 CMC Simulation Software	1	\$ 2,840.50	\$ 2,840.50
Computer Cable Makers	68 Pin SCSI F to F	2	\$ 32.00	\$ 64.00
Newark Electronics	68 Pin SCSI M to M 6'	2	\$ 30.00	\$ 60.00
Newark Electronics	DB-37 Cable M to F 6'	4	\$ 17.61	\$ 70.44
Newark Electronics	DB-9 Cable F to F 6'	2	\$ 4.72	\$ 9.44
Newark Electronics	DB-37 Male Connector	3	\$ 10.76	\$ 32.28
Newark Electronics	DB-25 Male Connector	7	\$ 3.60	\$ 25.20
Newark Electronics	DB-25 Female Connector	7	\$ 4.63	\$ 32.41
Newark Electronics	DB-9 Female Connector	2	\$ 2.57	\$ 5.14
Newark Electronics	DB-9 Male Connector	2	\$ 1.85	\$ 3.70
Newark Electronics	RJ-45 Coupler (AFDX)	2	\$ 17.07	\$ 34.14
Newark Electronics	DB-25 Backshell Kit	7	\$ 1.49	\$ 10.43
Newark Electronics	DB-9 Backshell Kit	2	\$ 1.50	\$ 3.00
Newark Electronics	8PC4627 AC Panel mount Plug	1	\$ 0.68	\$ 0.68

Newark Electronics	2086 AC Aux Plug	1	\$ 2.54	\$ 2.54
Newark Electronics	5 Pin Box Mount Receptacle	1	\$ 17.36	\$ 17.36
Newark Electronics	5 Pin Box Mount Receptacle	1	\$ 14.40	\$ 14.40
Newark Electronics	5 Pin Straight Plugs	1	\$ 30.77	\$ 30.77
Newark Electronics	5 Pin Straight Plugs	1	\$ 33.23	\$ 33.23
Newark Electronics	Toggle Switch (Large)	2	\$ 13.35	\$ 26.70
Newark Electronics	115V 400Hz Flanged Inlet	1	\$ 13.92	\$ 13.92
Newark Electronics	115V 400Hz Plug	1	\$ 16.12	\$ 16.12
Quality Time Computers	2+GHz Computer	1	\$ 619.00	\$ 619.00
Quality Time Computers	18" Active Matrix Monitor	2	\$ 590.00	\$ 1,180.00
	TOTAL COST PER STATION			\$ 59,557.72

Figure 2.1 shows a block diagram of the test station hardware connections. Details of the hardware and how it is controlled are given in the following sub-sections.

FIGURE 2.1 BLOCK DIAGRAM OF TEST STATION HARDWARE

2.2.1.1 National Instruments computer rack (PXI-1011)

The PXI-1011 provides PCI-E slots that facilitate the connections between the UUT and test computer. The slot configurations are described in the following sections.

2.2.1.1.1 Input Discretes

FIGURE 2.2 SLOT 1 PCI-E CARD CONNECTED TO UUT INPUT DISCRETES

FIGURE 2.3 SLOT 2 PCI-E CARD CONNECTED TO UUT INPUT DISCRETES

2.2.1.1.2 Output Discretes and Analog Signals

FIGURE 2.4 SLOT 3 PCI-E CARD CONNECTED TO UUT ANALOG INPUT AND DISCRETE OUTPUT

2.2.1.1.3 Bus interface hardware – ARINC 429 and AFDX

FIGURE 2.5 SLOT 4 PCI-E CARD CONNECTED TO UUT ARINC 429 INPUT DATABUS

FIGURE 2.6 SLOT 5 PCI-E CARD CONNECTED TO UUT ARINC 429 OUTPUT DATABUS

2.2.1.1.4 Discrete Interface panel (power, control discrete, etc)

FIGURE 2.7 SLOT 6 PCI-E CARD CONNECTED TO UUT INPUT POWER

2.2.2 Digitally Controlled DC Power Supplies

Two Mercury Interactive DC power supplies are used to provide primary and backup battery power to the system. Controls from the test computer can set the input voltages to the desired level.

2.2.3 Motor Variac for AC Voltage Regulation

A motor variac is used to adjust a primary input voltage with alternating current. When the variac motor is rotated, one can adjust the voltage up or down. This control is handled by the Power Control Virtual Panel resident on the test computer, which is described in following sections.

CHAPTER 3: SOFTWARE APPLICATIONS FOR TEST STATION USE

3.1 Applications to Exercise Avionics Systems

3.1.1 ARINC Communication Organizer

ACO is a software application that simulates and transmits ARINC 429 inputs (labels) to and receives output channels from the UUT. Other programs are available off-the-shelf. For example, Mystic is available from Excaliber Systems.

3.1.2 AIM Paraview and fdXplorer

In usage, fdXplorer is analogous to the ACO except it is used for AFDX buses instead of ARINC 429. An AFDX input setup can be loaded into fdXplorer and it can capture the resulting output from the UUT. Paraview is a user-friendly GUI shell that organizes the ADFX packets into data words. Both fdXplorer and Paraview are available from AIM GmbH.

Wireshark (from the Wireshark Foundation) can also be used to record outputs from the UUT. It can “sniff” the data pertaining to specific IP addresses. However, Wireshark may only be used for data reception, not transmission.

3.1.3 Virtual Panel

The Virtual Panel is a representation of the direct connections between the test computer and the UUT. The routing is handled and controlled through the PXI-1011 National Instruments rack. AI signals are controlled by the Virtual Panel except for the ARINC 429 and AFDX data buses. The panels are shown in the following figures.

FIGURE 3.1 INPUT DISCRETE VIRTUAL PANEL

FIGURE 3.2 OUTPUT DISCRETE VIRTUAL PANEL

FIGURE 3.3 ANALOG CONTROLS VIRTUAL PANEL

FIGURE 3.4 POWER CONTROLS VIRTUAL PANEL

3.2 Applications for Software Verification

3.2.1 Mercury Interactive WinRunner

WinRunner from Mercury Interactive Corporation (WinRunner) is a software application that supports the generation of automated test cases either through the capture playback method or by utilization of the built-in Test Scripting Language (TSL) to construct test procedures. This is an off-the-shelf product. WinRunner allows for custom functions to be created that can record “pass” or “fail” test steps.

3.2.1.1 Customized Function Library

When constructing on automated test, it is desirable to use functions to avoid repetition of many lines of code. See the appendix for a detailed code description of the current useable functions created specifically for avionics testing. These functions can be customized to manipulate data on any windows-based GUI. They were written using TSL. The verification procedures would typically be structured as shown in Figure 3.5 (the functions are shown in bold).

FIGURE 3.5 AUTOMATED TEST FLOW

3.2.1.1.1 Test Station Startup Functions

The following list are functions used to start applications used for verification on the test station. The function “Startup_ALL” will open all the test applications and power on the UUT. The function “Add_to_Generator” will populate a custom function menu in WinRunner. This allows a user to insert a function and provides instructions. The other functions start an individual application in case not all of them are needed in a given test.

- Startup_ALL
- Startup_Virtual_Panels
- Startup_MIU
- Startup_ACO_Trans16
- Startup_ACO_Trans8
- Startup_ACO_Rec8
- Startup_ACO_Rec16
- Add_to_Generator

3.2.1.1.2 Verification Test User Functions

The functions listed in this section can be used to construct a test. A test will, in general, have one or more of these functions, which will report a pass or fail to the test results. The first two functions create or set an input label to a desired condition, while the other functions check the system output against expected results and report to the test results. The “Shutdown” function turns off the UUT and closes the test applications.

- Create_Label
- Set_Label_Info
- Check_Label_SSM
- Check_Label_Unit
- Check_Label_Rate
- Check_Label_Value_With_Mask
- Check_Label_Value_With_Tolerance
- Check_Label_Transmission
- Create_Data_Table
- Shutdown

3.2.1.1.3 ATP, EMI, and Environmental Test Functions

These functions were developed to assist in qualification tests that are required of many aircraft systems. The Acceptance Test Procedure (ATP) is used to verify the stability of the system hardware. This can be done by developing embedded software that is only designed to exercise the hardware. Chapter 6 discusses these tests in more detail.

- ATP_Check_Receivers
- ATP_Check_Input
- ATP_Check_Resolvers
- ATP_Check_Output_Discretes
- EMI_Check_Receivers
- EMI_Check_Input
- EMI_Check_Resolver
- EMI_Check_Output_Discretes

3.2.2 DOORS

DOORS is a requirements management tool from IBM/Telelogic that is widely used throughout the aerospace industry. Requirements should have a defined structure that is used throughout a program. Having this defined structure allows for database manipulation of the requirements and even automatic generation of test cases for the requirements. The requirement attributes can be extracted from DOORS based on defined rules that have been incorporated into a windows-based extraction tool. The extraction is then loaded into a SQL tool database, and into the requirements section of the WinRunner tool used for traceability, test generation, test execution and results comparison.

3.2.2.1 System Requirements Extraction and Synchronization

The extraction tool compares the previous extractions in the SQL database to the current extraction to determine requirements additions and deletions when synchronizing with WinRunner. If a requirement was deleted from DOORS, it would thus be deleted along with any traceability from WinRunner. If a requirement was added to DOORS since the last extraction and synchronization, the new requirement would be added to the WinRunner tool and traceability would be provided for each requirement. This qualification is performed on a preexisting SQL database such that additions and deletions are determined by a comparison from the last extraction and synchronization process.

3.2.2.2 WinRunner Verification Test Shell Creation

The synchronization between DOORS and WinRunner should only be performed on an as-needed basis. However, whenever changes are made to the requirements within DOORS that affect a test, another extraction and synchronization should be performed. When the synchronization is performed, all verification tests that were previously created by this process are deleted and new versions are created. A standard test description is loaded into each verification test created, and all the related requirement attributes are traced to this test based on rules within the extraction program. Finally, a test script is loaded into each test name created. This script consists of function calls that will create and execute the test based on the specific requirement ID. The script shell is standard for each verification test created but will differ based on the requirements for each specific test.

CHAPTER 4: VERIFICATION TEST RESULTS

4.1 WinRunner Verification Data Generation

Once the verification test shell creation phase is complete, the tests can be scheduled and executed as a batch run or “test set”. This enables many tests to be run with no operator effort or data entry. Therefore, tests can be run overnight, or throughout a weekend.

The tests can also be run individually. The WinRunner tool contains function scripts called from each created test shell. When the function calls are executed, the SQL database is queried for requirements associated with the requirement ID and the expected results for each test procedure.

4.2 WinRunner Verification Test Results

The automated test script is able to query the SQL tool database to return the requirements to be tested, along with the expected results for each verification test. Some requirements for each verification test may not be automatically testable. For those requirements, manual or other forms of verification tests are to be performed. Also, it is possible to have a hybrid test that is mostly automated, but will prompt a user for action. For example, the test may need to prompt a tester to change the pitch of a navigation system by a certain amount.

Mercury TestDirector 7.6 SP3 - Microsoft Internet Explorer provided by Northrop Grumman Corporation

File Edit View Favorites Tools Help

Back Forward Stop Reload Search Favorites Print Copy Paste

Address http://rsec23engsrv1/tdbin/start_a.htm Go Links

Project: 101E [j. berrian] REQUIREMENTS TEST PLAN TEST LAB DEFECTS TOOLS HELP LOGOUT

Execution Test Sets View Hosts Analysis

Test Sets

Execution Grid Execution Flow Test Set Properties

Select Tests Run Run Test Set

Sorted By: Test Set[Asc]

Plan: Test Name	Plan: Type	Status	Results Review	Exec Date	Time	ICR / SCR #	Tester	Vc Version
[1]A_GPIR_006	WR-AUTOMATED	Passed		9/24/2008	12:25:36 PM		b. acuna	1.1.11
[1]A_ADR_057A	WR-AUTOMATED	Passed		9/24/2008	10:55:16 AM		j. blanpied	1.1.7
[1]A_ADR_059A	WR-AUTOMATED	Passed		9/17/2008	2:21:09 PM		j. blanpied	1.1.9
[1]A_ADR_059A2	WR-AUTOMATED	Passed		9/18/2008	9:57:37 AM		j. blanpied	1.1.7
[1]A_ADR_059A3	WR-AUTOMATED	Passed		9/23/2008	3:50:23 PM		j. blanpied	1.1.7
[1]A_ADR_093A	WR-AUTOMATED	Passed		9/24/2008	4:28:37 PM		j. blanpied	1.1.5
[1]A_ADR_094A	WR-AUTOMATED	Passed		9/25/2008	10:59:28 AM		j. blanpied	1.1.6
[1]A_IR_006	WR-AUTOMATED	Passed		9/26/2008	1:36:37 PM		j. anderson	1.1.10
[1]A_ADR_100	WR-AUTOMATED	Passed		6/9/2009	3:32:58 PM		j. blanpied	1.1.10
[1]A_IR_011	WR-AUTOMATED	Passed		9/29/2008	12:57:59 PM		am. supnet	1.1.13
[1]A_ADR_058A	WR-AUTOMATED	Passed		10/6/2008	11:48:37 AM		j. blanpied	1.1.9
[1]A_IR_033	WR-AUTOMATED	Passed		1/15/2009	4:06:57 PM		am. supnet	1.1.9
[1]A_IR_042	WR-AUTOMATED	Passed		10/9/2008	11:56:25 AM		am. supnet	1.1.11
[1]A_IR_037	WR-AUTOMATED	Passed		10/14/2008	12:59:48 PM		am. supnet	1.1.17
[1]A_ADR_017	WR-AUTOMATED	Passed		10/21/2008	5:42:54 PM		j. blanpied	1.1.14
[1]A_IR_140	WR-AUTOMATED	Passed		5/6/2009	10:43:40 AM		am. supnet	1.1.13
[1]A_IR_040	WR-AUTOMATED	Passed		12/16/2008	12:20:43 PM		am. supnet	1.1.13
[1]A_ADR_014A	WR-AUTOMATED	Passed		1/30/2009	1:37:41 PM		s. silver	1.1.9
[2]A_ADR_017	WR-AUTOMATED	Passed		1/30/2009	4:48:15 PM		s. silver	1.1.14
[1]A_IR_134	WR-AUTOMATED	Passed		2/4/2009	11:47:55 AM		am. supnet	1.1.20
[1]A_IR_133	WR-AUTOMATED	Passed		2/18/2009	3:06:59 PM		am. supnet	1.1.17
[1]A_POPC_038	WR-AUTOMATED	Passed		2/25/2009	3:35:48 PM		S. Silver	1.1.13
[1]A_POPC_041	WR-AUTOMATED	Passed		2/19/2009	7:24:52 PM		S. Silver	1.1.13
[1]A_IR_001	WR-AUTOMATED	Failed		2/19/2009	2:16:30 PM	984	am. supnet	1.1.24
[1]A_ADR_106	WR-AUTOMATED	Passed		3/4/2009	12:45:49 PM		j. berrian	1.1.4
[1]A_IR_136	WR-AUTOMATED	Passed		6/25/2009	1:23:40 PM		am. supnet	1.1.15
[1]A_ADR_018	WR-AUTOMATED	Passed		6/9/2009	4:10:53 PM		j. blanpied	1.1.17
[1]A_ADR_019	WR-AUTOMATED	Passed		6/9/2009	4:56:59 PM		j. blanpied	1.1.15
[1]A_ADR_020	WR-AUTOMATED	Passed		6/11/2009	9:27:55 AM		j. blanpied	1.1.17
[1]A_ADR_033	WR-AUTOMATED	Passed		6/10/2009	12:06:26 PM		j. blanpied	1.1.14
[1]A_ADR_034	WR-AUTOMATED	Passed		6/10/2009	1:20:03 PM		j. blanpied	1.1.14
[1]A_ADR_036	WR-AUTOMATED	Passed		6/10/2009	2:25:23 PM		j. blanpied	1.1.7
[1]A_ADR_038	WR-AUTOMATED	Failed		6/11/2009	11:32:39 AM	1632	j. blanpied	1.1.17

Test 24 of 34 Server Time: 12:50 PM 10/22/09

Done Local intranet

FIGURE 4.1 WINRUNNER VERIFICATION RESULTS IN A TEST SET

File Options Tools Window				
Run_5-27_14-53-18 (L3-2-1-FM Auto)				
<div> <div>Test Result: OK</div> <div> <div> <div>+</div> <div>✓</div> </div> <div>Total number of bitmap checkpoints: 0</div> </div> <div> <div>+</div> <div>✓</div> </div> <div>Total number of GUI checkpoints: 0</div> </div> <div> <div>!</div> <div>General Information</div> </div>				
Line	Event	Details	Result	Time
18	start run	CMC_Normal_Mode	run	00:00:00
111	tl_step	Step: Check Message Format with no faults., Status: Pass, Description: No Failures present and STX word Formatted correctly.	---	00:02:11
149	tl_step	Step: Check Message Format with no faults., Status: Pass, Description: No Failures present and STX word Formatted correctly.	---	00:02:55
208	tl_step	Step: Check Class 3 Internal Failure received when in Reporting Mode 1., Status: Pass, Description: Class 3 Internal Failure messages was present.	---	00:04:16
208	tl_step	Step: Check Class 2 Internal Failure received when in Reporting Mode 1., Status: Pass, Description: Class 2 Internal Failure messages was present.	---	00:04:17
245	tl_step	Step: Check Class 1 fault flag., Status: Pass, Description: Class 1 Fault Flag (Bit 21 of initial word) was set.	---	00:04:28
256	tl_step	Step: Check Class 3 fault flag for Class 3 fault set., Status: Pass, Description: Class 3 Fault Flag (Bit 20 of initial word) was set to 1.	---	00:04:29
300	tl_step	Step: Check Class 2 fault flag., Status: Pass, Description: Class 2 Fault Flag (Bit 21 of initial word) was set.	---	00:05:14
311	tl_step	Step: Check Class 3 fault flag for no Class 3 fault set., Status: Pass, Description: Class 3 Fault Flag (Bit 20 of initial word) was set to 0.	---	00:05:15
342	tl_step	Step: Check Normal Mode Failure Message Dump Formatting., Status: Pass, Description: The Actual Label 356 Record Number (12) matches the Expected (12).	---	00:05:49
363	tl_step	Step: Check Normal Mode DC1, Data Table Row 2., Status: Pass, Description: The time interval between consecutive Label 356 transmission was between 50 and 250 ms. Transmission Interval = 60 ms.	---	00:05:51
363	tl_step	Step: Check Normal Mode DC1, Data Table Row 3., Status: Pass, Description: The time interval between consecutive Label 356 transmission was between 50 and 250 ms. Transmission Interval = 60 ms.	---	00:05:51
363	tl_step	Step: Check Normal Mode DC1, Data Table Row 4., Status: Pass, Description: The time interval between consecutive Label 356 transmission was between 50 and 250 ms. Transmission Interval = 60 ms.	---	00:05:52
363	tl_step	Step: Check Normal Mode DC1, Data Table Row 5., Status: Pass, Description: The time interval between consecutive Label 356 transmission was between 50 and 250 ms. Transmission Interval = 60 ms.	---	00:05:54
363	tl_step	Step: Check Normal Mode DC1, Data Table Row 6., Status: Pass, Description: The time interval between consecutive Label 356 transmission was between 50 and 250 ms. Transmission Interval = 60 ms.	---	00:05:56
363	tl_step	Step: Check Normal Mode DC1, Data Table Row 7., Status: Pass, Description: The time interval between consecutive Label 356 transmission was between 50 and 250 ms. Transmission Interval = 60 ms.	---	00:05:57
363	tl_step	Step: Check Normal Mode DC1, Data Table Row 8., Status: Pass, Description: The time interval between consecutive Label 356 transmission was between 50 and 250 ms. Transmission Interval = 60 ms.	---	00:05:58
363	tl_step	Step: Check Normal Mode DC1, Data Table Row 9., Status: Pass, Description: The time interval between consecutive Label 356 transmission was between 50 and 250 ms. Transmission Interval = 60 ms.	---	00:05:59
363	tl_step	Step: Check Normal Mode DC1, Data Table Row 10., Status: Pass, Description: The time interval between consecutive Label 356 transmission was between 50 and 250 ms. Transmission Interval = 60 ms.	---	00:06:00
363	tl_step	Step: Check Normal Mode DC1, Data Table Row 11., Status: Pass, Description: The time interval between consecutive Label 356 transmission was between 50 and 250 ms. Transmission Interval = 60 ms.	---	00:06:01
363	tl_step	Step: Check Normal Mode DC1, Data Table Row 12., Status: Pass, Description: The time interval between consecutive Label 356 transmission was between 50 and 250 ms. Transmission Interval = 60 ms.	---	00:06:03
399	tl_step	Step: Check ATA test after STX and correct format., Status: Pass, Description: ATA (240000) First after STX and Correct Format.	---	00:06:05
424	tl_step	Step: Verify CMC Message Format., Status: Pass, Description: CMC From MCDU matches Data Table CMC Message.	---	00:06:07
448	tl_step	Step: Check EOT Word format., Status: Pass, Description: EOT Word in correct format after CMC Message.	---	00:06:09
460	stop run	CMC_Normal_Mode	pass	00:06:13

Ready

The test-log is filtered.

FIGURE 4.2 WINRUNNER VERIFICATION RESULTS FOR A SPECIFIC TEST

4.3 WinRunner Verification Test Execution

When the test(s) complete execution, the results from the test run(s) are sent to the WinRunner database. Either the tests passed, where all actual results matched all expected results for each step, or one or more actual results did not match expected results, which results in a test fail status.

CHAPTER 5: TEST STATION QUALIFICATION PLAN

The following sections discuss the steps to be performed in order to qualify the process and tools involved in the AVS. This is necessary for many Design Assurance Levels of DO-178B process guidelines.

5.1 AVS Operational Requirements

First, the operational requirements for the AVS need to be generated. This document should contain details on the process including the procedure, process diagrams and the function library listing used in the test process. The function library should be a large focus of this qualification plan.

5.2 Function Library Compliance / Test

The AVS Operational Requirements should document the function library scripts that are available to be used in any formal verification test procedure. Test cases will then be created to verify the function library scripts correctly test the requirements and correctly report pass and fail results. A matrix is generated that relates each function to the test case(s) that verify it and the result of the test case(s). It will be shown that a function will correctly verify the requirement it is intended to test. This is done by inserting two types of input data to each test function; one resulting in a pass, and the other in a fail result. One would expect that a function records a “pass” if the actual result matches the expected result. It will also be shown that if the expected and actual result do not match, a “fail” is reported for that step.

5.3 Test Coverage Compliance

It also must be verified that the verification process produces test cases for each requirement. This is necessary to show that the process did not generate too many or too

few test cases. This is to be done on a sample of the verification tests in the high level software requirements that are representative of various characteristics of the UUT.

5.4 Requirements Compliance

A comparison should be made that compares the DOORS requirements database to the WinRunner database to show that an equal amount of requirements were auto-generated by the tool. There should be the same amount of requirements in both databases and should match exactly.

5.5 Tool Qualification Summary

A report will be generated that contains all the listed output(s) from each step of the qualification process in summary form. The report will also contain the developer of the report, date of report generation, function library version, requirements version, and all appropriate versions of the tools used.

CHAPTER 6: TEST STATION SCOPE AND GENERAL USES

The hardware rack containing all the parts that comprise the test platform are designed to be mobile and universal. This presents a very significant enterprise advantage. A company could customize this standard platform to be compatible across many if not all programs. The test station software and hardware can be developed to communicate with any data bus, analog or digital resolvers, open/ground discretes, Ethernet protocols, etc.

6.1 General Software Verification

Automation is especially beneficial for required verification testing when it is applied to regression testing. Changes to software need to be tracked, controlled, and retested. As software is updated and released, these changes need to be analyzed to see which parts of the UUT need to be verified. This involves repeat testing, and automation reduces the time and cost of this effort.

6.2 Hardware Acceptance and Environmental Testing

At times in the design process, it is necessary to check the complete hardware configuration of the UUT. To this end, an Acceptance Test Procedure (ATP) can be performed. This is done to ensure all data pathways are in working order on a particular system. Generally, a comprehensive embedded software program can be written before the OFP is complete. This unique software program is designed to exercise all buses and paths of the hardware. For example, the UUT can be configured to send 0x5a5a5a on all buses and/or alternate open/ground discrete states. Once installed in the UUT, the automated test platform can be utilized to verify all hardware is responding appropriately.

The same software can be used for environmental testing of an aircraft system. Some tests induce Electromagnetic Interference (EMI) to try to “break” system hardware

(e.g. check for bit switching on data buses, or state switching of input/output discretes).

As system hardware is generally ready prior to system software, these tests can be run earlier in a program lifecycle than software verification.

6.3 Functional Maintenance Testing

Similar to the ATP, functional testing can be performed to check production units after maintenance has been on a system.

6.4 Mobile Testing

As the automated test platform is portable, it can be used to record data while in flight test or drive test. It can also be taken to specialized testing facilities that conduct environmental stress testing.

CHAPTER 7: CONCLUSIONS

The scope of this project was to propose a design for a portable, customizable, and maintainable automated test station. Without automation, software regression testing will require manual repetition of verification procedures. Furthermore, there is a learning curve involved with understanding manual test interfaces across different types of aircraft systems. With one upgradeable and customizable test station, a company can save time and money, and possibly win more contracts with lower bids.

Provided herein is such a test station design, along with test functions that allow for user-friendly verification test generation. The hardware and software design of the station can be upgraded or customized to interface with a number of aircraft systems that communicate using various protocols.

The implementation of an automated test station reduces human error associated with repeat testing. The function library can be qualified to perform the same with each test run and report passes and failures accordingly. Thousands of requirements can be exported into a SQL database and “fed” into the parameterized test script. Therefore, systems can be tested with deeper analysis in a shorter amount of time.

The test station described in this document is designed to be a “start-to-finish tester. It can be used for hardware verification (Acceptance Test Procedures), software/hardware integration, and system verification. The test station is portable and can be used in aircraft for flight testing, in vehicles for GPS and INS testing, and off-site environmental test laboratories. The AVS is a universal and customizable verification test suite.

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APPENDIX A: GLOSSARY

AC Alternating Current Voltage.

ACO ARINC Communication Organizer. Test computer software application that can simulate ARINC inputs and receive outputs from the UUT.

AFDX Avionics Full Duplex. Ethernet based approach for avionics data transmission.

ARINC Aeronautical Radio, Incorporated. A major provider of data communication systems (both protocol types and hardware).

ATP Acceptance Test Procedure. A test performed to exercise all system hardware connections.

Auto-Gen Test Procedure Auto-Generation. A process used to automatically generate verification tests directly from the software high level requirements data base.

AVS Automated Verification Station. This can be developed to perform system level testing. This station provides all hardware and software necessary for performing system level testing either automatically or manually.

BITE Built-In-Test-Equipment. Tests developed and embedded in the system software. Used for detection and reporting of system errors.

DC Direct Current Voltage.

DOORS IBM / Telelogic software application. A database tool used to develop and maintain requirements. This is an off-the-shelf product.

GPS Global Positioning System. Almost all aircraft contain at least one GPS receiver which uses time mark data from at least 4 satellite sources to calculate global location and velocity.

GUI Graphic User Interface. This is how the operator interfaces with applications in a Windows operating system. The automated testing utility “learns” a GUI map of every Windows application used for testing.

WinRunner WinRunner from Mercury Interactive Corporation. A tool integrated with the test station computer that supports the generation of automated test cases either through the capture playback method or by utilization of the built-in Test Scripting Language (TSL) to construct test procedures. This is an off-the-shelf product.

INS Inertial Navigation System. Consisting of gyros (body rate data) and accelerometers (lateral movement), the INS, coupled with Kalman filtering, can predict location based on previous movements.

I/O Input/Output. These are the signals going into and coming from the Unit Under Test (UUT). These signals can be analog or digital, discrete or status words, etc.

LRU Line Replaceable Unit. A sub-system of an aircraft. Examples include navigation systems, avionics displays, engine control systems.

MIU Memory Inspector Utility. A Windows-based application that can read and write UUT flash memory. Can be used to load operating software, control memory variables, record data, etc.

TSL Test Script Language. A coding language used to control test procedures and windows applications through the various GUIs.

UBC Universal Bus Communicator. A Windows-based application that can manage input and outputs (I/O) to and from the UUT.

UUT Unit Under Test. The system (black box) that has been designated for testing.

APPENDIX B: FUNCTION LIBRARY

```
#####
#####
#                                     !!!THIS AREA CONTAINS THE TEST FUNCTION LIBRARY!!!
#
# Author: Joshua Berrian
#####
# TEST STATION STARTUP FUNCTION LIST
#     Startup_Virtual_Panels(InputPanel)
#     Startup_MIU()
#     Startup_ACO_Trans16()
#     Startup_ACO_Trans8()
#     Startup_ACO_Rec8()
#     Startup_ACO_Rec16()
#     Startup_CMC(Function)
#     Startup_ALL(InputPanel, Function)
#     Add_to_Generator()
#
# USER FUNCTION LIST
#     Check_Label_SSM(step, Function, Label, Expected_SSM, Expected_SSM2)
#     Check_Label_Unit(step, Function, Label, Expected_Unit)
#     Check_Label_Rate(step, Label, Function, Expected_Rate)
#     Check_Label_Value_With_Mask(step, Function, Label, Expected_Value, Mask)
#     Check_Label_Value_With_Tolerance(step, Function, Label, Expected_Value, Min_Acceptable_Value, Max_Acceptable_Value)
#     Check_Label_Transmission(step, Function, Label, Expected_Transmission)
#     Set_Label_Info(Function, Port, Label, Value, SSM, Rate, Unit)
#     Shutdown(InputPanel)
#     Create_Data_Table(Table_Name, Folder_Path, num_columns, Column_Names)
#     Create_Label(Function, Port, Label, Name, Partition, SubFunction, Units, Value_Hex, Rate)
#
# STATIC FUNCTION LIST
#     Close_DOS_CMC()
#     Bit16_to_Hex4 (Bit, out Hex)
#     Bit4_to_Hex1 (Bit, out Hex)
```

```

#
# ATP HARDWARE CHECKOUT FUNCTION LIST
#     ATP_Check_Receivers(Function)
#     ATP_Check_Input(Function)
#     ATP_Check_Resolvers()
#     ATP_Check_Output_Discretes
#
# EMI HARDWARE CHECKOUT FUNCTION LIST
#     EMI_Check_Receivers(Function)
#     EMI_Check_Input(Function)
#     EMI_Check_Resolvers()
#     EMI_Check_Output_Discretes()
#
#####
#####
####!!!ADDING USER FUNCTIONS TO FUNCTION GENERATOR!!!####
public function Add_to_Generator()
{
    auto func_desc;
    #Add enhanced tl_step to Function Generator
    func_desc = ("This function divides test scripts into sections and inserts\r\n" &
        "a status message in the test results.\r\n" &
        "When WinRunner is connected to a TestDirector project,\r\n" &
        "the message is inserted to the TestDirector steps table\r\n" &
        "as well.\r\n" &
        " arg1 is the name of the test step.\r\n" &
        " arg2 sets whether the step passed(PASS) or failed(FAIL).\r\n" &
        " arg3 is a short explanation of the step.\r\n" &
        " arg4 is the expected result\r\n" &
        " arg5 is the actual result.");

    generator_add_function("tl_step",func_desc, 5,
        "Step Name", "type_edit","\\""",
        "Status", "select_list(PASS FAIL)","PASS",
        "Description", "type_edit","\\""",
        "Expected", "type_edit","\\""",
        "Actual", "type_edit","\\"");
}

```

#Add Check_Label_SSM to Function Generator

```
func_desc = ("This function checks the expected SSM message to the\r\n" &
            "actual and sends a PASS/FAIL message to the test results.\r\n" &
            " arg1 is the name of the test step.\r\n" &
            " arg2 sets which Function to look at (Air_Data or Navigation)\r\n" &
            " arg3 is the Port channel.\r\n" &
            " arg4 is the label to look at.\r\n" &
            " arg5 is the expected SSM message, choose from:\r\n" &
            "     Failure Warning\r\n" &
            "     No Computed Data\r\n" &
            "     Normal Operation\r\n" &
            " arg6 is a second SSM for test pass (optional).\r\n" &
            " arg7 is reserved BITE(leave blank).");

generator_add_function("Check_Label_SSM",func_desc, 7,
                    "step", "type_edit", "\"\"",
                    "Function", "select_list(\"Air_Data\" \"Navigation\")", "\"Air_Data\"",
                    "Port", "type_edit", "",
                    "Label", "type_edit", "",
                    "Expected_SSM", "select_list(\"Failure Warning\" \"No Computed Data\" \"Normal Operation\")", "\"Failure Warning\"",
                    "Expected_SSM2", "select_list(\"\" \"Failure Warning\" \"No Computed Data\" \"Normal Operation\")", "\"\"",
                    "BITE", "type_edit", "");
```

#Add Check_Label_Unit to Function Generator

```
func_desc = ("This function checks the expected Unit to the actual\r\n" &
            "and sends a PASS/FAIL message to the test results.\r\n" &
            " arg1 is the name of the test step.\r\n" &
            " arg2 sets which Function to look at (Air_Data or Navigation)\r\n" &
            " arg3 is the Port channel.\r\n" &
            " arg4 is the label to look at.\r\n" &
            " arg5 is the expected Unit, choose from:\r\n" &
            "     1\r\n" &
```



```

"      2\r\n" &
"      3");

generator_add_function("Check_Label_Unit",func_desc, 5,
    "step", "type_edit","\\""",
    "Function", "select_list(\"Air_Data\" \"Navigation\")","\\"Air_Data\"",
    "Port", "type_edit", "",
    "Label", "type_edit", "",
    "Expected_Unit", "select_list(1 2 3)", "1");

#Add Check_Label_Rate to Function Generator
func_desc = ("This function checks the expected Rate to the actual\r\n" &
    "and sends a PASS/FAIL message to the test results.\r\n" &
    " arg1 is the name of the test step.\r\n" &
    " arg2 sets which Function to look at (Air_Data or Navigation).\r\n" &
    " arg3 is the Port channel.\r\n" &
    " arg4 is the label to look at.\r\n" &
    " arg5 is the expected Rate");

generator_add_function("Check_Label_Rate",func_desc, 5,
    "step", "type_edit","\\""",
    "Function", "select_list(\"Air_Data\" \"Navigation\")","\\"Air_Data\"",
    "Port", "type_edit", "",
    "Label", "type_edit", "",
    "Expected_Rate", "type_edit", "");

#Add Check_Label_All_Ports to Function Generator
func_desc = ("This function checks that a label Value is the\r\n" &
    "same on all data buses within a certain tolerance.\r\n" &
    "(e.g +/- 0.1).\r\n" &
    " arg1 is the name of the test step.\r\n" &
    " arg2 sets which Function to look at (Air_Data or Navigation).\r\n" &
    " arg3 are the ports (comma delimited).\r\n" &
    " arg4 is the label to look at.\r\n" &
    " arg5 is the Lower Tolerance.\r\n" &
    " arg6 is the Upper Tolerance.");

```

```

generator_add_function("Check_Label_All_Ports",func_desc, 6,
    "step", "type_edit","\\""",
    "Function", "select_list(\"Air_Data\" \"Navigation\")","\\"Air_Data\"",
    "Ports", "type_edit", "\\", "",
    "Label", "type_edit", "",
    "Min_Tolerance", "type_edit", "",
    "Max_Tolerance", "type_edit", "");

```

#Add Check_Label_Value_With_Mask to Function Generator

```

func_desc = ("This function checks the expected label Value to the\r\n" &
    "actual and sends a PASS/FAIL message to the test results.\r\n" &
    " arg1 is the name of the test step.\r\n" &
    " arg2 sets which Function to look at (Air_Data or Navigation)\r\n" &
    " arg3 is the Port channel.\r\n" &
    " arg4 is the label to look at.\r\n" &
    " arg5 is the expected Value."
    " arg6 is the mask (only bits with 1's are compared.)");

```

```

generator_add_function("Check_Label_Value_With_Mask",func_desc, 6,
    "step", "type_edit","\\""",
    "Function", "select_list(\"Air_Data\" \"Navigation\")","\\"Air_Data\"",
    "Port", "type_edit", "",
    "Label", "type_edit", "",
    "Expected_Value", "type_edit", "\\", "",
    "Mask", "type_edit", "\\\");

```

#Add Check_Label_Time_With_Tolerance to Function Generator

```

func_desc = ("This function checks the expected label time value to the\r\n" &
    "actual and sends a PASS/FAIL message to the test results.\r\n" &
    " arg1 is the name of the test step.\r\n" &
    " arg2 sets which Function to look at (Air_Data or Navigation)\r\n" &
    " arg3 is the Port channel.\r\n" &
    " arg4 is the label to look at.\r\n" &
    " arg5 is the expected Time.\r\n" &

```

```

" arg6 is the Minimum Acceptable Time.\r\n" &
" arg7 is the Maximum Acceptable Time.");

generator_add_function("Check_Label_Time_With_Tolerance",func_desc, 7,
    "step", "type_edit","\"\"",
    "Function", "select_list(\"Air_Data\" \"Navigation\")\",\"Air_Data\"",
    "Port", "type_edit", "",
    "Label", "type_edit", "",
    "Expected_Time", "type_edit", "\"00:00:00\"",
    "Min_Time", "type_edit", "\"00:00:00\"",
    "Max_Time", "type_edit", "\"00:00:00\"");

#Add Check_Label_Date_With_Tolerance to Function Generator
func_desc = ("This function checks the expected label date value to the\r\n" &
    "actual and sends a PASS/FAIL message to the test results.\r\n" &
    " arg1 is the name of the test step.\r\n" &
    " arg5 is the expected Date.\r\n" &
    " arg6 is the Minimum Acceptable Date.\r\n" &
    " arg7 is the Maximum Acceptable Date.");

generator_add_function("Check_Label_Date_With_Tolerance",func_desc, 4,
    "step", "type_edit","\"\"",
    "Expected_Date", "type_edit", "\"MM\DD\YY\"",
    "Min_Date", "type_edit", "\"MM\DD\YY\"",
    "Max_Date", "type_edit", "\"MM\DD\YY\"");

#Add Check_Label_Value_With_Tolerance to Function Generator
func_desc = ("This function checks the expected label Value to the\r\n" &
    "actual and sends a PASS/FAIL message to the test results.\r\n" &
    " arg1 is the name of the test step.\r\n" &
    " arg2 sets which Function to look at (Air_Data or Navigation)\r\n" &
    " arg3 is the Port channel.\r\n" &
    " arg4 is the label to look at.\r\n" &
    " arg5 is the expected Value.\r\n" &
    " arg6 is the Minimum Acceptable Value.\r\n" &

```

```

" arg7 is the Maximum Acceptable Value.");

generator_add_function("Check_Label_Value_With_Tolerance",func_desc, 7,
    "step", "type_edit","\\""",
    "Function", "select_list(\"Air_Data\" \"Navigation\")","\\"Air_Data\"",
    "Port", "type_edit", "",
    "Label", "type_edit", "",
    "Expected_Value", "type_edit", "",
    "Min_AcceptableValue", "type_edit", "",
    "Max_Acceptable_Value", "type_edit", "");

#Add Check_Label_Transmission to Function Generator
func_desc = ("This function checks the expected Label Transmission to the\r\n" &
    "actual and sends a PASS/FAIL message to the test results.\r\n" &
    " arg1 is the name of the test step.\r\n" &
    " arg2 sets which Function to look at (Air_Data or Navigation)\r\n" &
    " arg3 is the Port channel.\r\n" &
    " arg4 is the label to look at.\r\n" &
    " arg5 is the expected Transmission Value.\r\n" &
    "     Not Transmitted\r\n" &
    "     Transmitted");

generator_add_function("Check_Label_Transmission",func_desc, 5,
    "step", "type_edit","\\""",
    "Function", "select_list(\"Air_Data\" \"Navigation\")","\\"Air_Data\"",
    "Port", "type_edit", "",
    "Label", "type_edit", "",
    "Expected_Transmission", "select_list(\"Not Transmitted\" \"Transmitted\")","\\"Not Transmitted\"");

#Add Check_Action_Code to Function Generator
func_desc = ("This function checks the expected Action Code to the\r\n" &
    "actual and sends a PASS/FAIL message to the test results.\r\n" &
    " arg1 is the name of the test step.\r\n" &
    " arg2 is the expected Action Code Number");

```

```
generator_add_function("Check_Action_Code",func_desc, 2,
    "step", "type_edit","\"\"",
    "ActionCode", "type_edit","\"\"");
```

#Add Set_Label_Info to Function Generator

```
func_desc = ("This function allows the user to update label \r\n" &
    "information on the ACO Transmitter pages. Leave\r\n" &
    "args 4, 5, 6, 7, or 8 blank if no new update.\r\n" &
    " arg1 is the function of the label.\r\n" &
    " arg2 is the ACO Port Number.\r\n" &
    " arg3 is the label to update.\r\n" &
    " arg4 is the new Value of the label if in Eng units.\r\n" &
    " arg5 is the new Value of the label if in Hex units.\r\n" &
    " arg6 is the new SSM value.\r\n" &
    " arg7 is the new transmission Rate.\r\n" &
    " arg8 is the new Unit");
```

```
generator_add_function("Set_Label_Info",func_desc, 8,
    "Function", "select_list(\"Air_Data\" \"Navigation\")\",\"Air_Data\"",
    "Port", "type_edit", "",
    "Label", "type_edit", "",
    "Value_Eng", "type_edit", "",
    "Value_Hex", "type_edit", "\"\"",
    "SSM", "select_list(\"Discrete\" \"Normal Operation\" \"No Computed Data\" \"Interface Test\" \"Failure\nWarning\" \"Minus\" \"Plus\" \"North\" \"South\" \"East\" \"West\")\",\"Normal Operation\"",
    "Rate", "type_edit", "",
    "Unit", "select_list(1 2 3)", "1");
```

#Add Shutdown to Function Generator

```
func_desc = ("This function will shut down system and close all Test_Station\r\n" &
    "applications.\r\n" &
    " arg1 is which Input Panel you are using.\r\n" &
    "     Input Discretes - System1 - Virtual Panel\r\n" &
    "     Input Discretes - System2 - Virtual Panel\r\n" &
    "     Input Discretes - System3 - Virtual Panel");
```

```

generator_add_function("Shutdown",func_desc, 1,
    "InputPanel", "select_list(\"Input Discretes - System1 - Virtual Panel\" \"Input Discretes - System2 - Virtual Panel\" \"Input Discretes - System3 - Virtual Panel\")", "\"Input Discretes - System2 - Virtual Panel\"");

#Add Startup_MIU to Function Generator
func_desc = ("This function will start the MIU application.\r\n" &
    "Leave the Build_Number variable blank if you want to default\r\n" &
    "to the previous build setting in MIU.\r\n" &
    "arg1 is the Build you are using.\r\n" &
    "arg2 is the RAM or ROM build choice.");

generator_add_function("Startup_MIU",func_desc, 2,
    "Build_Number", "type_edit", "\"\"",
    "RAM_ROM", "select_list(\"RAM_Program.map\" \"ROM_Program.map\")",
    "\"ROM_Program.map\"");

#Add MIU_Page to Function Generator
func_desc = ("This function will load a saved MIU page.\r\n" &
    "The page must be saved under Common.\r\n" &
    "arg1 is the User Name Directory.\r\n" &
    "arg2 is the Page Name.");

generator_add_function("MIU_Page",func_desc, 2,
    "Directory", "type_edit", "\"\"",
    "Page_Name", "type_edit", "\"");

#Add Create_Data_Table to Function Generator
func_desc = ("This function will create a new excel file to a\r\n" &
    "specified folder path.\r\n" &
    "arg1 new table name.\r\n" &
    "arg2 is the folder location path - USE DOUBLE SLASHES (\\\\\\\\).\r\n" &
    "arg3 is the number of columns to make.\r\n" &
    "arg4 is the list of the names of the columns - comma delimited.");

```

```
generator_add_function("Create_Data_Table",func_desc, 4,
    "Table_Name", "type_edit", "\"\\"",
    "Folder_Path", "type_edit", "\"\\"",
    "num_columns", "type_edit", "",
    "Column_Names", "type_edit", "\", , , , , ,\");
```

#Add Create_Label to Function Generator

```
func_desc = ("This function allows the user to create a label\r\n" &
    "in the standard Air_Data or Navigation ACO Pages. Leave last Three\r\n" &
    "args(8,9,10) alone if creating receiver label only.\r\n" &
    " arg1 is the Label Designation (Tx or Rx).\r\n" &
    " arg2 is the ACO Port Number.\r\n" &
    " arg3 is the label to create.\r\n" &
    " arg4 is the Name of the new label.\r\n" &
    " arg5 is the partition using the data.\r\n" &
    " arg6 is the subfunction of the label.\r\n" &
    " arg7 are the units.\r\n" &
    " arg8 is the hex value (bits 10-9 are the Unit).\r\n" &
    " arg9 is the rate.\r\n" &
    " arg10 is the Unit.");
```

```
generator_add_function("Create_Label",func_desc, 10,
    "Designation", "select_list(\"Air_Data Tx\" \"Air_Data Rx\" \"Air_Data Both\" \"Navigation Tx\" \"Navigation Rx\" \"Navigation Both\")\", \"Air_Data Rx\"",
    "Port", "type_edit", "",
    "Label", "type_edit", "",
    "Name", "type_edit", "\"\\"",
    "Partition", "select_list(\"LAB\" \"Navigation\" \"GPS\" \"FM\" \"Air_Data\")\", \"Air_Data\"",
    "SubFunction", "select_list(\"ADM 1\" \"ADM 2\" \"ADM 3\" \"BARO 1\" \"CDU\" \"Air_Data_1\" \"Air_Data_2\" \"Data Monitor\" \"FCU\" \"FMS 1\" \"FMS 2\" \"GPSSU 1\" \"GPSSU 2\" \"ISPP (Left)\" \"ISPP (Right)\" \"MFP\" \"N/A\" \"SSAP\")\", \"N/A\"",
    "Units", "select_list(\"° C\" \"°/Sec\" \"°/Sec^2\" \"D/M/Y\" \"Deg:Min\" \"Feet\" \"Ft/Min\" \"Ft/Sec\" \"Ft/Sec^2\" \"G\" \"H:M.x\" \"H:M:S\" \"In Hg\" \"Knots\" \"M/Sec\" \"Mach\" \"mB\" \"Meters\" \"N/A\" \"NM\" \"Sec\" \"Usec\")\", \"N/A\"",
    "Value_Hex", "type_edit", "\"\\"",
    "Rate", "type_edit", "",
```

```

        "Unit", "select_list(1 2 3)", "1");

#Add Add_Label to Function Generator
func_desc = ("This function allows the user to add a label\r\n" &
            "in the standard Air_Data or Navigation ACO Pages.\r\n" &
            " arg1 is the Label Designation (Tx or Rx).\r\n" &
            " arg2 is the ACO Port Number.\r\n" &
            " arg3 is the label to create.");

generator_add_function("Add_Label",func_desc, 3,
                    "Designation", "select_list(\"Air_Data Tx\" \"Air_Data Rx\" \"Air_Data Both\" \"Navigation Tx\" \"Navigation Rx\" \"Navigation Both\")", "\"Air_Data Rx\"",
                    "Port", "type_edit", "",
                    "Label", "type_edit", "");

#Add Round to Function Generator
func_desc = ("This function will return a Rounded Number for a given\r\n" &
            "number of decimal places.\r\n" &
            " arg1 is the Original Number.\r\n" &
            " arg2 is the Decimal Places.\r\n" &
            " arg3 is the Rounded Number returned.");

generator_add_function("Round",func_desc, 3,
                    "Number", "type_edit", "",
                    "Decimal_Places", "type_edit", "",
                    "Rounded_Number", "type_edit", "Rounded_Number");

#Add MIU shut down system and wait to Function Generator
func_desc = ("This function will shut down MIU.");
generator_add_function("MIU_Shutdown",func_desc, 0);

#Add Shut down system and wait to Function Generator
func_desc = ("This function will shut down the system and wait for power off.");
generator_add_function("Power_Off",func_desc, 0);

#Add MIU_Wait to Function Generator
func_desc = ("This function will wait for the screen to refresh.");

```



```

generator_add_function("MIU_Wait",func_desc, 0);

#Add StrToInt to Function Generator
func_desc = ("This function will convert a Hex string to an integer.");
generator_add_function("StrToInt",func_desc, 2,
                      "strIn", "type_edit", "",
                      "IntOut", "type_edit", "IntOut");

#ADD FUNCTION CATEGORY TO GENERATOR and ADD USER FUNCTIONS TO THAT CATEGORY
generator_add_category("Custom");
generator_add_function_to_category("Custom","Check_Label_SSM");
generator_add_function_to_category("Custom","Check_Label_Unit");
generator_add_function_to_category("Custom","Check_Label_Rate");
generator_add_function_to_category("Custom","Check_Label_All_Ports");
generator_add_function_to_category("Custom","Check_Label_Value_With_Mask");
generator_add_function_to_category("Custom","Check_Label_Time_With_Tolerance");
generator_add_function_to_category("Custom","Check_Label_Date_With_Tolerance");
generator_add_function_to_category("Custom","Check_Label_Value_With_Tolerance");
generator_add_function_to_category("Custom","Check_Label_Transmission");
generator_add_function_to_category("Custom","Check_Action_Code");
generator_add_function_to_category("Custom","Set_Label_Info");
generator_add_function_to_category("Custom","Shutdown");
generator_add_function_to_category("Custom","Startup_ALL");
generator_add_function_to_category("Custom","Create_Data_Table");
generator_add_function_to_category("Custom","Create_Label");
generator_add_function_to_category("Custom","Add_Label");
generator_add_function_to_category("Custom","Startup_MIU");
generator_add_function_to_category("Custom","MIU_Page");
generator_add_function_to_category("Custom","Round");
generator_add_function_to_category("Custom","MIU_Wait");
generator_add_function_to_category("Custom","Power_Off");
generator_add_function_to_category("Custom","MIU_Shutdown");
generator_add_function_to_category("Custom","StrToInt");
}
#####
#####
#####

```

```
####!!!STARTUP FUNCTIONS!!!####
```

```
#####
```

```
#This function will start all Applications necessary for Test_Station use
```

```
public function Startup_ALL(InputPanel, Function)
```

```
{
    Startup_Virtual_Panels (InputPanel);
    Startup_ACO_Trans16();
    Startup_ACO_Trans8();
    Startup_ACO_Receiver16();
    Startup_ACO_Receiver8();
    Startup_MIU("", "");
}
```

```
#####
```

```
#####
```

```
#This function will startup all virtual panels if not already invoked.
```

```
public function Startup_Virtual_Panels (InputPanel)
```

```
{
    auto value;
    auto i;
    switch(InputPanel)
    {
        case "Input Discretes - System1 - Virtual Panel":
            if (win_exists("Input Discretes - System2 - Virtual Panel",0)==E_OK)
                win_close("Input Discretes - System2 - Virtual Panel");
            if (win_exists("Input Discretes - System3 - Virtual Panel",0)==E_OK)
                win_close("Input Discretes - System3 - Virtual Panel");
            break;

        case "Input Discretes - System2 - Virtual Panel":
            if (win_exists("Input Discretes - System1 - Virtual Panel",0)==E_OK)
                win_close("Input Discretes - System1 - Virtual Panel");
            if (win_exists("Input Discretes - System3 - Virtual Panel",0)==E_OK)
                win_close("Input Discretes - System3 - Virtual Panel");
            break;

        case "Input Discretes - System3 - Virtual Panel":
            if (win_exists("Input Discretes - System2 - Virtual Panel",0)==E_OK)
```

```

        win_close("Input Discretes - System2 - Virtual Panel");
    if (win_exists("Input Discretes - System1 - Virtual Panel",0)==E_OK)
        win_close("Input Discretes - System1 - Virtual Panel");
    break;
}

#####
# Initialize Input Discretes
if (win_exists (InputPanel, 1)==E_OK) {}
else
{
    if(win_exists("Select a Panel...", 1)==E_OK) {}
    else
        invoke_application("Virtual Panel.exe","", "Virtual Panel",SW_SHOW);
    # Select a Panel...
    set_window ("Select a Panel...", 10);

    switch(InputPanel)
    {
        case "Input Discretes - System1 - Virtual Panel":
            list_select_item ("ListBox", "Input Discretes - System1");
            break;

        case "Input Discretes - System2 - Virtual Panel":
            list_select_item ("ListBox", "Input Discretes - System2");
            break;

        case "Input Discretes - System3 - Virtual Panel":
            list_select_item ("ListBox", "Input Discretes - System3");
            break;
    }

    button_press ("OK");
    set_window(InputPanel, 5);
    wait(2);
    obj_wait_info("Status Bar","value","Ready",60);
}

```

```

set_window(InputPanel, 2);
win_move (InputPanel, 1307, 159);
#####
# Initialize Output Discretes
if (win_exists("Output Discretes - Virtual Panel", 1)==E_OK) {}
else
{
    if(win_exists("Select a Panel...", 1)==E_OK) {}
    else
        invoke_application("Virtual Panel.exe","", "Virtual Panel",SW_SHOW);
    # Select a Panel...
    set_window ("Select a Panel...", 10);
    list_select_item ("ListBox", "Output Discretes"); # Item Number 8;
    button_press ("OK");
}

# Output Discretes - Virtual Panel
set_window ("Output Discretes - Virtual Panel", 7);
win_move ("Output Discretes - Virtual Panel", 1511, 1);
#####
# Initialize Analog Controls
if (win_exists("Analog Controls - Virtual Panel", 1)==E_OK) {}
else
{
    if(win_exists("Select a Panel...", 1)==E_OK) {}
    else
        invoke_application("Virtual Panel.exe","", "Virtual Panel",SW_SHOW);
    # Select a Panel...
    set_window ("Select a Panel...", 10);
    obj_mouse_dbl_click("ListBox",1,1,LEFT);
    wait(1);
}

for(i=0; i=1; i++)
{
    if(win_exists("Virtual Panel",2) == E_OK)

```

```

        {
            set_window ("Virtual Panel", 2);
            button_press ("OK");
            win_resize ("Analog Controls - Virtual Panel", 912, 192);
            win_move ("Analog Controls - Virtual Panel", 88, 88);
        }
        else
            break;
    }
    # Analog Controls - Virtual Panel
    set_window ("Analog Controls - Virtual Panel", 2);
    obj_wait_info("Status Bar", "value", "Ready", 40);
    win_move ("Analog Controls - Virtual Panel", 1335, 821);
    #####
    # Initialize Power Controls
    if (win_exists("Power Controls - Virtual Panel", 1)==E_OK) {}
    else
    {
        if(win_exists("Select a Panel...", 1)==E_OK) {}
        else
            invoke_application("Virtual Panel.exe", "", "Virtual Panel", SW_SHOW);
        # Select a Panel...
        set_window ("Select a Panel...", 10);
        list_select_item ("ListBox", "Power Controls"); # Item Number 9;
        button_press ("OK");
    }

    # Power Controls - Virtual Panel
    set_window ("Power Controls - Virtual Panel", 2);
    obj_wait_info("Status Bar", "value", "Ready", 40);
    win_move ("Power Controls - Virtual Panel", 1482, 617);
}
#####
#####
#This function will start MIU if not already invoked and will initialize application.
public function Startup_MIU (Build_Number, RAM_ROM)
{

```

```

auto computer;
auto board;
auto rx;
auto tx;
auto array[];
    if (win_exists("MIU",0)==E_OK)
        return;
    invoke_application("MIU.exe","", "MIU",SW_SHOW);

    if(win_exists("ARINC Setup", 5)!=E_OK)
    {
        # User Information
        set_window ("User Information", 3);
        button_press ("OK");
    }

    # ARINC Setup
    set_window ("ARINC Setup", 2);
    obj_get_text("Board Select", board);
    split(board, array, " ");
    board = array[1];
    obj_get_text("Rx Port Select", rx);
    split(rx, array, " ");
    rx = array[1];
    obj_get_text("Tx Port Select", tx);
    split(tx, array, " ");
    tx = array[1];

    if (board == 0)
        list_select_item ("Board Select", "1");
    if (rx != 1)
        list_select_item ("Rx Port Select", "#0");

    if(tx != 11)
        list_select_item ("Tx Port Select", "#10");

    button_press ("OK");

```

```

if(length(Build_Number) > 1)
{
    # Build Options
    set_window ("Build Options", 13);
    edit_set ("Link Map File", "");
    obj_type ("Link Map File", "\\Build_Number\\"RAM_ROM");
    button_press("OK");
}

else
{
    set_window ("Build Options", 13);
    button_press("OK");
}
}

#####
#####
#This function will start MIU if not already invoked and will initialize application.
public function Startup_fdXplorer ()
{
    if (win_exists("fdXplorer_0",0)==E_OK)
        return;

    invoke_application("fdxp.exe","", "fdXplorer V02.20",SW_SHOW);
    wait(10);

# fdXplorer_0
    set_window ("fdXplorer_0", 1);
    obj_mouse_click ("TToolBar", 250, 12, LEFT);
# Select ports for sending
    set_window ("Select ports for sending", 1);
    obj_mouse_click ("TListView", 142, 23, LEFT);
    obj_mouse_click ("Apply", 42, 17, LEFT);
    obj_mouse_click ("OK", 31, 11, LEFT);
# Send 1
    set_window ("Send 1", 6);

```

```

        obj_mouse_click ("TToolBar", 7, 11, LEFT);
# Import send setup file
    set_window ("Import send setup file", 2);
    obj_type ("File name:", "<kCtrl_L-v>");
    edit_set ("File name:", "");
    button_press ("Open");
    button_press ("Start");
}
#####
#####

public function MIU_Page(Directory, Page_Name)
{
    if (win_exists(Page_Name,0)==E_OK)
        return;

    # MIU
    set_window ("MIU", 2);
    toolbar_button_press ("ToolbarWindow32", "#1");

    # Load Page from Database
    set_window ("Load Page from Database", 5);
    wait(1);
    list_select_item ("User Name", Directory); # Item Number 6;
    list_select_item ("ListBox", Page_Name); # Item Number 0;
    button_press ("Open");
}
#####
#####
#These functions will start Universal Arinc Testor for the following:
#    16 Channel Transmitter (Navigation) - "Test_Station Transmitter"
#    8 Channel Transmitter (Air_Data) - "Air_Data Unit 1", "Air_Data Unit 2", "Air_Data Unit 3"
#    16 Channel Receiver (Navigation) - "Navigation Receiver"
#    8 Channel Receiver (Air_Data) - "Air_Data Receiver"
#####
#This function will start up 3 Air_Data Transmitter pages (1 Page per Unit)
public function Startup_ACO_Trans8 ()

```



```

{
auto i;
auto value;
auto computer;
    #Check and start 8 channel transmitter
    for(i=1; i<4; i++)
    {
        if (win_exists("ACO - Air_Data Unit " i, 1)==E_OK)
            return;
    }
    invoke_application("ACO.exe","", "",SW_SHOW);

    # Select an ARINC board
    set_window ("Select an ARINC board", 6);
    list_select_item ("SysListView32", "0"); # Item Number 0;
    button_press ("OK");
    # ACO_1
    set_window ("ACO_1", 2);
    button_press ("Yes");

    # Setup Page
    set_window ("Setup Page", 2);
    button_press ("Load");
    set_window ("Open", 7);
    edit_set ("File name:", "");
    edit_set ("File name:", "Setup.aco");
    button_press ("Open_2");
for (i = 1; i<=4; i++)
{
    if(win_exists("ACO_1",2)==E_OK)
    {
        # ACO_1
        set_window ("ACO_1", 2);
        button_press ("OK");
        # Setup Page
        set_window ("Setup Page", 2);
        button_press ("Load");
    }
}

```

```

        set_window ("Open", 7);
        edit_set ("File name:", "");
        edit_set ("File name:", ".aco");
        button_press ("Open_2");
    }
    else
        break;
}

# Setup Page
set_window ("Setup Page", 3);
button_press ("OK");

# ACO_2
set_window ("ACO", 1);
for (i=1; i < 4; i++)
{
    toolbar_button_press ("ToolbarWindow32", "#3");

    # Open Unit 1,2,3 Air_Data Transmitter Pages
    set_window ("Open", 2);
    edit_set ("File name:", "");
    edit_set ("File name:", "Air_Data Unit " i);
    button_press ("Open_2");
    set_window ("ACO - Air_Data Unit " i, 1);
}

# Air_Data Unit 1
set_window ("Air_Data Unit 1", 0);
button_set ("Start Transmitting", ON);
}

#Check and start 16 channel transmitter
#####
public function Startup_ACO_Trans16 ()
{
    auto value;
    auto computer;
    auto i;

```

```

if (win_exists("ACO - Test_Station Transmitter", 0)==E_OK)
    return;

invoke_application("\\ACO\\ACO.exe","", "",SW_SHOW);

# Select an ARINC board
set_window ("Select an ARINC board", 4);
list_select_item ("SysListView32", "1"); # Item Number 0;
button_press ("OK");
# ACO_1
set_window ("ACO_1", 2);
button_press ("Yes");

# Setup Page
set_window ("Setup Page", 2);
button_press ("Load");
# Open
set_window ("Open", 2);
edit_set ("File name:", "");
edit_set ("File name:", "Test_Station Transmitter.aco");
button_press ("Open_2");
for (i = 1; i<=4; i++)
{
    if(win_exists("ACO_1",2)==E_OK)
    {
        # ACO_1
        set_window ("ACO_1", 2);
        button_press ("OK");
        # Setup Page
        set_window ("Setup Page", 2);
        button_press ("Load");
        set_window ("Open", 7);
        edit_set ("File name:", "");
        edit_set ("File name:", "Test_Station Transmitter.aco");
        button_press ("Open_2");
    }
    else

```

```

        break;
    }

    # Setup Page
    set_window ("Setup Page", 1);
    button_press ("OK");

    # ACO_2
    set_window ("ACO", 1);
    toolbar_button_press ("ToolbarWindow32", "#3");

    # Open Navigation Transmitter Page
    set_window ("Open", 2);
    edit_set ("File name:", "");
    edit_set ("File name:", "Test_Station Transmitter");
    button_press ("Open_2");

    set_window ("ACO - Test_Station Transmitter", 1);
    set_window ("Test_Station Transmitter", 1);
    button_set ("Start Transmitting", ON);
}

# Check and Start 8 Channel Receiver Window
#####
public function Startup_ACO_Receiver8 ()
{
    auto value;
    auto computer;
    if (win_exists("ACO - Air_Data Receiver", 0)==E_OK)
        return;
    invoke_application("\\ACO\\ACO.exe", "", "", SW_SHOW);

    # Select an ARINC board
    set_window ("Select an ARINC board", 4);
    list_select_item ("SysListView32", "0"); # Item Number 0;
    button_press ("OK");
    # ACO_1
    set_window ("ACO_1", 2);

```

```

        button_press ("Yes");
        # Setup Page_1
        set_window ("Setup Page", 1);
        button_press ("Cancel");
        # ACO
        set_window ("ACO", 2);
        toolbar_button_press ("ToolbarWindow32", "#5");
        # Open
        set_window ("Open", 2);
        edit_set ("File name:", "");
        edit_set ("File name:", "Air_Data Receiver");
        button_press ("Open_2");
        # Air_Data Receiver
        set_window ("Air_Data Receiver", 4);
        button_set ("Start Receiving", ON);
        win_move ("Air_Data Receiver", 0, 0);
        set_window ("ACO - Air_Data Receiver", 2);
        menu_select_item ("Configuration;Update All Rx Labels");
    }
    # Check and Start 16 Channel Receiver Window
    #####
    public function Startup_ACO_Receiver16 ()
    {
        auto value;
        auto computer;
        if (win_exists("ACO - Navigation Receiver", 0)==E_OK)
            return;
        invoke_application("\\ACO\\ACO.exe", "", "", SW_SHOW);

        # Select an ARINC board
        set_window ("Select an ARINC board", 4);
        list_select_item ("SysListView32", "1");
        button_press ("OK");
        # ACO_1
        set_window ("ACO_1", 2);
        button_press ("Yes");
        # Setup Page

```

```

set_window ("Setup Page", 1);
button_press ("Cancel");
# ACO
set_window ("ACO", 2);
toolbar_button_press ("ToolbarWindow32", "#5");
# Open
set_window ("Open", 2);
edit_set ("File name:", "");
edit_set ("File name:", "Navigation Receiver");
button_press ("Open_2");
# Navigation Receiver
set_window ("Navigation Receiver", 4);
button_set ("Start Receiving", ON);
win_move ("Navigation Receiver", 0, 0);
set_window ("ACO - Navigation Receiver", 2);
menu_select_item ("Configuration;Update All Rx Labels");
}
#####
#####
#####!!USER FUNCTIONS!!#####
#####
# This function verifies that the correct SSM was attributed to the specified label.
# Choose which function you want to test. "Air_Data" for Air Data, etc.
public function Check_Label_SSM (step, Function, Port, Label, Expected_SSM, Expected_SSM2, BITE)
{
auto Actual_SSM;
auto rate;
auto ACO_window;
auto label_type;
auto Description;
auto i;

if(Function == "Air_Data")
    ACO_window = "Air_Data Receiver";
else
    ACO_window = "Navigation Receiver";
set_window (ACO_window, 5);

```

```

list_wait_info("SysListView32","displayed",1,10);
list_activate_item ("SysListView32", Port ";" Label);

if(win_exists("Label Data...", 1)== E_OK) { }
else
    list_activate_item ("SysListView32", Port ";" Label);

set_window("Label Data...", 1);
obj_get_text("SSM", Actual_SSM);
obj_get_text("Description", Description);
obj_get_text("Rate", rate);

if (BITE == "" && rate == 0)
{
    tl_step(step, FAIL, Function " Label " Label " (" Description ") could not be checked, it was not transmitted.", Function "
    Label " Label " (" Description ") should be transmitted" , Function " Label " Label " (" Description ") was not
    transmitted");
    win_close ("Label Data...");
    return;
}

if (BITE == "" && Actual_SSM == Expected_SSM)
{
    tl_step(step, PASS, Expected_SSM " Present On " Function " Label " Label " (" Description ").", "Expected SSM was "
    Expected_SSM, "Actual SSM was " Actual_SSM ".");
    win_close ("Label Data...");
    return;
}

obj_get_text("Type", label_type);

if (BITE == "Affected" && label_type == "BCD" && Expected_SSM == "Failure Warning")
{
    if (rate == 0)
        tl_step(step, PASS, Function " Label " Label " (" Description ") was not transmitted.", Function " Label " Label "
        (" Description ") should not be transmitted" , Function " Label " Label " (" Description ") was not transmitted");
    else

```

```

        tl_step(step, FAIL, Function " Label " Label " (" Description ") was transmitted.", Function " Label " Label " ("
        Description ") should not be transmitted" , Function " Label " Label " (" Description ") was transmitted");

    win_close ("Label Data...");
    return;
}

win_close ("Label Data...");

if(BITE == "Not Affected" && rate == 0)# Check again due to rate Fluctacoions
{
    for(i=0; i<=5; i++)
    {
        set_window (ACO_window, 5);
        list_wait_info("SysListView32","displayed",1,10);
        list_activate_item ("SysListView32", Port "," Label);

        if(win_exists("Label Data...", 0)!= E_OK)
            list_activate_item ("SysListView32", Port "," Label);

        set_window("Label Data...", 1);
        obj_get_text("Rate", rate);
        win_close ("Label Data...");

        if(rate>0)
            break;
    }
}

if (BITE == "Not Affected" && (Actual_SSM == "Failure Warning" || rate == 0))
{
    tl_step(step, FAIL, Function " Label " Label " (" Description ") was affected.", Function " Label " Label " (" Description
    ") should not be affected" , "Actual SSM: " Actual_SSM ", Transmission rate: " rate ".");
    return;
}

if (BITE == "Not Affected" && Actual_SSM != "Failure Warning" && rate > 0)

```



```

    {
        tl_step(step, PASS, Function " Label " Label " (" Description ") was not affected.", Function " Label " Label " ("
        Description ") should not be affected" , "Actual SSM: " Actual_SSM , Transmission rate: " rate ".");
        return;
    }

if(length(Expected_SSM2) > 0)
{
    if (Actual_SSM == Expected_SSM || Actual_SSM == Expected_SSM2)
        tl_step(step, PASS, Actual_SSM " Present On " Function " Label " Label ".", "Expected SSM was " Actual_SSM
        , "Actual SSM was " Actual_SSM ".");
    else
        tl_step(step, FAIL, Expected_SSM " or " Expected_SSM2 " Was NOT present On " Function " Label " Label " ("
        Description ").", "Expected SSM was " Expected_SSM " or " Expected_SSM2 , "Actual SSM was " Actual_SSM
        ".");
    return;
}

if (Actual_SSM == Expected_SSM)
{
    tl_step(step ,PASS, Expected_SSM " Present On " Function " Label " Label " (" Description ").", "Expected SSM was "
    Expected_SSM, "Actual SSM was " Actual_SSM ".");
    return;
}
else
    tl_step(step, FAIL, Expected_SSM " Was not present On " Function " Label " Label " (" Description "). SSM reported
    was " Actual_SSM ".", "Expected SSM was " Expected_SSM , "Actual SSM was " Actual_SSM ".");
}
#####
#####
# This function verifies that the correct Unit was attributed to the specified label.
# Choose which function you want to test. "Air_Data" for Air Data, etc.
public function Check_Label_Unit (step, Function, Port, Label, Expected_Unit)
{
    auto act_Unit;
    auto rate;
    auto i;

```

```

auto ACO_window;

# Receiver Window
if (Function == "Air_Data")
    ACO_window = "Air_Data Receiver";
else
    ACO_window = "Navigation Receiver";

set_window (ACO_window, 5);
obj_wait_info("SysListView32","displayed",1,10);
list_activate_item ("SysListView32", Port ";" Label);

if(win_exists("Label Data...", 1)!= E_OK)
    list_activate_item ("SysListView32", Port ";" Label);

set_window("Label Data...", 1);
obj_get_text("Unit", act_Unit);
obj_get_text("Rate", rate);
win_close ("Label Data...");
if (rate == 0)
{
    tl_step(step, FAIL, Function " Label " Label " Could not be checked, it was not transmitted.", Function " Label " Label "
    should be transmitted" , Function " Label " Label " Was not transmitted");
    return;
}

if (act_Unit == Expected_Unit)
    tl_step(step,PASS, "Unit " Expected_Unit " Present On " Function " Label " Label ". Unit Reported was " act_Unit ".",
    Expected_Unit, act_Unit);
else
    tl_step(step, FAIL, "Unit " Expected_Unit " Was not present On " Function " Label " Label ". Actual Unit was" act_Unit
    ".", Expected_Unit , act_Unit);
}
#####
#####
# This function verifies that the correct Label Value was attributed to the specified label.
# Choose which function you want to test. "Air_Data" for Air Data, etc.

```

```

public function Check_Label_All_Ports (step, Function, Ports, Label, Min_Tolerance, Max_Tolerance)
{
    auto act_Value;
    auto rate;
    auto i;
    auto ACO_window;
    auto num_channels;
    auto Channel[];
    auto n;
    auto Type;
    auto act_SSM;
    auto new_SSM;
    auto new_act_Value;
    auto fail_flag;

    # Receiver Window
    if (Function == "Air_Data")
        ACO_window = "Air_Data Receiver";
    else
        ACO_window = "Navigation Receiver";

    num_channels = split(Ports, Channel, ",");

    #Get Baseline Label Value to compare to the other Ports
    set_window (ACO_window, 5);
    obj_wait_info("SysListView32","displayed",1,10);
    list_activate_item ("SysListView32", Channel[1] ";" Label);

    if(win_exists("Label Data...", 1)!= E_OK)
        list_activate_item ("SysListView32", Channel[1] ";" Label);

    set_window("Label Data...", 1);
    obj_get_text("Value", act_Value);
    obj_get_text("Rate", rate);
    obj_get_text("SSM", act_SSM);
    win_close ("Label Data...");
    if (rate == 0)

```

```

{
    tl_step(step, FAIL, Function " Label " Label " on Port " Channel[1] " Could not be checked, it was not transmitted.",
    Function " Label " Label " should be transmitted" , Function " Label " Label " Was not transmitted");
    return;
}
fail_flag = 0;

#Compare baseline Label Value with other Port
for(n=2; n<=num_channels; n++)
{
    set_window (ACO_window, 5);
    obj_wait_info("SysListView32","displayed",1,10);
    list_activate_item ("SysListView32", Channel[n] ";" Label);

    if(win_exists("Label Data...", 1)!= E_OK)
        list_activate_item ("SysListView32", Channel[n] ";" Label);

    set_window("Label Data...", 1);
    obj_get_text("Value", new_act_Value);
    obj_get_text("Rate", rate);
    obj_get_text("Type", Type);
    obj_get_text("SSM", new_SSM);
    win_close ("Label Data...");
    if (rate == 0)
    {
        tl_step(step, FAIL, Function " Label " Label " on Port " Channel[n] " Could not be checked, it was not
        transmitted.", Function " Label " Label " should be transmitted" , Function " Label " Label " Was not
        transmitted");
        return;
    }

    if (Type == "BCD")
    {
        if(new_SSM == act_SSM && new_act_Value >= act_Value - Min_Tolerance && new_act_Value <= act_Value
        + Max_Tolerance)
            continue;
        else

```

```

        {
            tl_step(step, FAIL, "The expected BCD value (or its SSM) of " act_Value " was NOT present or Out-of-
Tolerance on " Function " Label " Label " on Port " Channel[n] ". Actual Value and its SSM were "
new_act_Value "and" new_SSM ".", act_Value " with tolerance: between " act_Value - Min_Tolerance "
and " act_Value + Max_Tolerance " and SSM of " act_SSM, new_act_Value "and SSM of " new_SSM);
            fail_flag = 1;
            continue;
        }
    }
}
if (Type == "SPL")
{
    if (new_act_Value == act_Value)
        continue;
    else
    {
        tl_step(step, FAIL, "The expected discrete value of " act_Value " was NOT present on " Function " Label
" Label " on Port " Channel[n] ". Actual Value was " new_act_Value ".", act_Value, new_act_Value);
        fail_flag = 1;
        continue;
    }
}
if (new_act_Value >= act_Value - Min_Tolerance && new_act_Value <= act_Value + Max_Tolerance)
    continue;
else
{
    tl_step(step, FAIL, "The expected value of " act_Value " was NOT present (or within tolerance) on " Function "
Label " Label " on Port " Channel[n] ". Actual Value was " new_act_Value ".", act_Value " with tolerance:
between " act_Value - Min_Tolerance " and " act_Value + Max_Tolerance, new_act_Value);
    fail_flag = 1;
}
}
if (fail_flag == 0)
    tl_step(step, PASS, "The values on " Function " Label " Label " on Ports " Ports " all match the value of " act_Value ".",
    "All Label values should match on each port.", "The label values match.");
else

```

```

        tl_step(step, FAIL, "The values on " Function " Label " Label " on Ports " Ports " do NOT all match the value of "
        act_Value ".", "All Label values should match on each port.", "The label values did NOT all match.");
    }
#####
#####
# This function verifies that the correct Label Value was attributed to the specified label.
# Choose which function you want to test. "Air_Data" for Air Data, etc.
public function Check_Label_Value_With_Mask (step, Function, Port, Label, Expected_Value, Mask)
{
    auto act_Value;
    auto rate;
    auto ReturnValue;
    auto i;
    auto ACO_window;
    auto func[];

    split(Function, func, " "); # Second element denotes possible Test type (EMI, ATP, etc)

    # Receiver Window
    if (func[1] == "Air_Data")
        ACO_window = "Air_Data Receiver";
    else
        ACO_window = "Navigation Receiver";

    if (func[2] == "ATP")
    {
        if (func[1] == "Air_Data")
            ACO_window = "Air_Data HW RX";
        else
            ACO_window = "GPS_Navigation HW RX";
    }

    if (func[2] == "EMI")
    {
        if (func[1] == "Air_Data")
            ACO_window = "EMI Air_Data RX";
        else

```

```

        ACO_window = "EMI GPS_Navigation RX";
    }

    set_window (ACO_window, 5);
    obj_wait_info("SysListView32","displayed",1,10);
    list_activate_item ("SysListView32", Port "," Label);

    if(win_exists("Label Data...", 1)!= E_OK)
        list_activate_item ("SysListView32", Port "," Label);

    set_window("Label Data...", 1);
    obj_get_text("Value", act_Value);
    obj_get_text("Rate", rate);
    win_close ("Label Data...");
    if (rate == 0)
    {
        tl_step(step, FAIL, func[1] " Label " Label " Could not be checked, it was not transmitted.", func[1] " Label " Label "
        should be transmitted" , func[1] " Label " Label " Was not transmitted");
        return;
    }
    WRU_MaskAndCompareBinString(Expected_Value, act_Value, Mask, ReturnValue);
    if (ReturnValue == 1)
        tl_step(step,PASS, "The expected value of " Expected_Value " was Present On " func[1] " Label " Label " with a Mask =
        " Mask ". Actual Value was " act_Value ".", Expected_Value " with Mask = " Mask, act_Value " with Mask = " Mask);
    else
        tl_step(step, FAIL, "The expected value of " Expected_Value " Was NOT present On " func[1] " Label " Label " with a
        Mask = " Mask ". Actual Value = " act_Value ".", Expected_Value " with Mask = " Mask, act_Value " with Mask = "
        Mask);
}
#####
#####
# This function verifies that the correct Label Value was attributed to the specified label.
# Choose which function you want to test. "Air_Data" for Air Data, etc.
public function Check_Label_Time_With_Tolerance (step, Function, Port, Label, Expected_Time, Min_Time, Max_Time)
{
    auto act_Value;
    auto act_Value1;

```

```

auto Min_Time1;
auto Max_Time1;
auto rate;
auto Type;
auto SSM;
auto i;
auto ACO_window;

# Receiver Window
if (Function == "Air_Data")
    ACO_window = "Air_Data Receiver";
else
    ACO_window = "Navigation Receiver";

set_window (ACO_window, 5);
obj_wait_info("SysListView32","displayed",1,10);
list_activate_item ("SysListView32", Port ";" Label);

if(win_exists("Label Data...", 1)!= E_OK)
    list_activate_item ("SysListView32", Port ";" Label);

set_window("Label Data...", 1);
obj_get_text("Value", act_Value);
obj_get_text("Rate", rate);
obj_get_text("Type", Type);
obj_get_text("SSM", SSM);
win_close ("Label Data...");
if (rate == 0)
{
    tl_step(step, FAIL, Function " Label " Label " Could not be checked, it was not transmitted.", Function " Label " Label "
    should be transmitted" , Function " Label " Label " Was not transmitted");
    return;
}
act_Value1 = repl_str(act_Value, ":", "");
Min_Time1 = repl_str(Min_Time, ":", "");
Max_Time1 = repl_str(Max_Time, ":", "");

```



```

        if (act_Value1 >= Min_Time1 && act_Value1 <= Max_Time1)
            tl_step(step,PASS, "The expected time of " Expected_Time " was Present (and within tolerance) On " Function " Label "
            Label ". The actual Time was " act_Value ".", Expected_Time " with tolerance: between " Min_Time "and" Max_Time,
            act_Value);
        else
            tl_step(step, FAIL, "The expected time of " Expected_Time " Was not present (or within tolerance) On " Function " Label
            " Label ". Actual Time was " act_Value ".", Expected_Time " with tolerance: between " Min_Time "and" Max_Time,
            act_Value);
    }
#####
#####
# This function verifies that the correct Date was attributed to Label 260.
# Choose which function you want to test. "Air_Data" for Air Data, etc.
public function Check_Label_Date_With_Tolerance (step, Expected_Date, Min_Date, Max_Date)
{
    auto act_Date;
    auto actDate;
    auto MaxDate;
    auto MinDate;
    auto Act[];
    auto Min[];
    auto Max[];
    auto rate;

    set_window ("Navigation Receiver", 1);
    list_activate_item ("SysListView32", "2;260");

    if(win_exists("Label Data...", 0.5)== E_OK)
    {
    }
    else
        list_activate_item ("SysListView32", "2;260");

    set_window("Label Data...", 1);
    obj_get_text("Value", act_Date);
    obj_get_text("Rate", rate);
    win_close ("Label Data...");

```

```

if (rate == 0)
{
    tl_step(step, FAIL, "Navigation Label 260 Could not be checked, it was not transmitted.", "Navigation Label 260 should
    be transmitted" , "Navigation Label 260 Was not transmitted");
    return;
}
split(act_Date, Act, "/");
split(Min_Date, Min, "/");
split(Max_Date, Max, "/");
actDate = Act[3] Act[1] Act[2];
MinDate = Min[3] Min[1] Min[2];
MaxDate = Max[3] Max[1] Max[2];

if (actDate >= MinDate && actDate <= MaxDate)
    tl_step(step, PASS, "The expected date of " Expected_Date " was Present (and within tolerance) On Navigation Label
    260. The actual date was " act_Date ".", Expected_Date " with tolerance: between " Min_Date " and " Max_Date,
    act_Date);
else
    tl_step(step, FAIL, "The expected date of " Expected_Date " Was not present (or within tolerance) On Navigation Label
    260. Actual date was " act_Date ".", Expected_Date " with tolerance: between " Min_Date " and " Max_Date, act_Date);
}
#####
#####
# This function verifies that the correct Label Value was not attributed to the specified label.
# Choose which function you want to test. "Air_Data" for Air Data, etc.
public function Check_Label_Not_Value (step, Function, Port, Label, Expected_Value)
{
    auto act_Value;
    auto rate;
    auto Type;
    auto SSM;

    set_window (Function " Receiver", 1);
    list_activate_item ("SysListView32", Port "; " Label);

    if(win_exists("Label Data...", 0.5)== E_OK) { }
    else
        list_activate_item ("SysListView32", Port "; " Label);

```

```

set_window("Label Data...", 1);
obj_get_text("Value", act_Value);
obj_get_text("Rate", rate);
obj_get_text("Type", Type);
obj_get_text("SSM", SSM);
win_close ("Label Data...");

if (rate == 0)
{
    tl_step(step, FAIL, Function " Label " Label " Could not be checked, it was not transmitted.", Function " Label " Label "
    should be transmitted" , Function " Label " Label " Was not transmitted");
    return;
}

if (Type == "BCD")
{
    if(SSM == "Minus" || SSM == "West" || SSM == "South")
        act_Value = -act_Value;
}
if (act_Value != Expected_Value)
    tl_step(step,PASS, "The value of " Expected_Value " was Not Present On " Function " Label " Label " as expected. ",
    Expected_Value " should not be present.", act_Value);
else
    tl_step(step, FAIL, "The value of " Expected_Value " was incorrectly present On " Function " Label " Label ". ",
    Expected_Value " should not be present.", act_Value);
}
#####
#####
# This function verifies that the correct Label Value was attributed to the specified label.
# Choose which function you want to test. "Air_Data" for Air Data, etc.
public function Check_Label_Value_With_Tolerance (step, Function, Port, Label, Expected_Value, Min_Acceptable_Value,
Max_Acceptable_Value)
{
    auto act_Value;
    auto rate;
    auto Type;

```

```

auto SSM;
auto i;

    set_window (Function " Receiver", 1);
    list_activate_item ("SysListView32", Port ";" Label);

    if(win_exists("Label Data...", 0.5)== E_OK) {}
    else
        list_activate_item ("SysListView32", Port ";" Label);

    set_window("Label Data...", 1);
    obj_get_text("Value", act_Value);
    obj_get_text("Rate", rate);
    obj_get_text("Type", Type);
    obj_get_text("SSM", SSM);
    win_close ("Label Data...");

    if (rate == 0)
    {
        tl_step(step, FAIL, Function " Label " Label " Could not be checked, it was not transmitted.", Function " Label " Label "
        should be transmitted" , Function " Label " Label " Was not transmitted");
        return;
    }

    if (Type == "BCD")
    {
        if(SSM == "Minus" || SSM == "West" || SSM == "South")
            act_Value = -act_Value;
    }
    if (act_Value >= Min_Acceptable_Value && act_Value <= Max_Acceptable_Value)
        tl_step(step, PASS, "The expected value of " Expected_Value " was Present (and within tolerance) On " Function " Label
        " Label ". The actual value was " act_Value ".", Expected_Value " with tolerance: between " Min_Acceptable_Value "
        and " Max_Acceptable_Value, act_Value);
    else
        tl_step(step, FAIL, "The expected value of " Expected_Value " Was not present (or within tolerance) On " Function "
        Label " Label ". Actual Value was " act_Value ".", Expected_Value " with tolerance: between " Min_Acceptable_Value "
        and " Max_Acceptable_Value, act_Value);
}

```

```
#####
#####
# This function verifies that the Label was either Transmitted or Not Transmitted per User Input.
# Choose which function you want to test. "Air_Data" for Air Data, etc.
public function Check_Label_Rate (step, Function, Port, Label, Expected_Rate)
{
    auto rate;
    auto i;
    auto ACO_window;

    # Receiver Window
    if (Function == "Air_Data")
        ACO_window = "Air_Data Receiver";
    else
        ACO_window = "Navigation Receiver";

    set_window (ACO_window, 5);
    obj_wait_info("SysListView32","displayed",1,10);
    list_activate_item ("SysListView32", Port ";" Label);

    if(win_exists("Label Data...", 1)!= E_OK)
        list_activate_item ("SysListView32", Port ";" Label);

    set_window("Label Data...", 1);
    obj_get_text("Rate", rate);
    win_close ("Label Data...");
    if (rate == 0 && Expected_Rate != 0)
    {
        tl_step(step, FAIL, Function " Label " Label " Could not be checked, it was not transmitted.", Function " Label " Label "
        should be transmitted" , Function " Label " Label " Was not transmitted");
        return;
    }
    if (rate >= Expected_Rate-(Expected_Rate * 0.1) && rate <= Expected_Rate+(Expected_Rate * 0.1))
        tl_step(step, PASS, Function " Label " Label " Was Transmitted at correct Rate of " Expected_Rate " Hz. The actual rate
        was " rate ".", Function " Label " Label " should be transmitted at " Expected_Rate " Hz." , Function " Label " Label "
        Was Transmitted at " rate " Hz.");
    else

```

```

        tl_step(step, FAIL, Function " Label " Label " Was NOT Transmitted at correct Rate of " Expected_Rate " Hz. Actual
        Rate was " rate " Hz.", Function " Label " Label " should be transmitted at " Expected_Rate " Hz." , Function " Label "
        Label " Was Transmitted at " rate " Hz.");
    }
#####
#####
# This function verifies that the Label was either Transmitted or Not Transmitted per User Input.
# Choose which function you want to test. "Air_Data" for Air Data, etc.
public function Check_Label_Transmission (step, Function, Port, Label, Expected_Transmission)
{
    auto rate;
    auto i;
    auto ACO_window;
        # Receiver Window
        if (Function == "Air_Data")
            ACO_window = "Air_Data Receiver";
        if (Function == "Navigation")
            ACO_window = "Navigation Receiver";
        if (Function == "ATP Air_Data")
            ACO_window = "Air_Data HW RX";
        if (Function == "ATP GPS_Navigation")
            ACO_window = "GPS_Navigation HW RX";

        set_window (ACO_window, 5);
        obj_wait_info("SysListView32","displayed",1,10);
        list_activate_item ("SysListView32", Port ";" Label);

        if(win_exists("Label Data...", 1)!= E_OK)
            list_activate_item ("SysListView32", Port ";" Label);

        set_window("Label Data...", 1);
        obj_get_text("Rate", rate);
        win_close ("Label Data...");

        if(Expected_Transmission=="Not Transmitted")
        {

```

```

        if (rate == 0)
        {
            tl_step(step, PASS, Function " Label " Label " was not transmitted.", Function " Label " Label " should not be
            transmitted" , Function " Label " Label " Was not transmitted");
            return;
        }
        else
        {
            tl_step(step, FAIL, Function " Label " Label " was transmitted.", Function " Label " Label " should not be
            transmitted" , Function " Label " Label " Was transmitted");
            return;
        }
    }

else
{
    if (rate > 0)
    {
        tl_step(step, PASS, Function " Label " Label " was transmitted.", Function " Label " Label " should be
        transmitted" , Function " Label " Label " Was transmitted");
        return;
    }
    else
    {
        tl_step(step, FAIL, Function " Label " Label " was not transmitted.", Function " Label " Label " should be
        transmitted" , Function " Label " Label " Was not transmitted");
        return;
    }
}

}

#####
#####
# This function allows the user the update label information on the transmitter pages.
# Choose which function you want to test. "Air_Data" for Air Data, etc.
public function Set_Label_Info (Function, Port, Label, Value_Eng, Value_Hex, SSM, Rate, Unit)
{
    auto text;

```

```

auto ACO_window;
    # Receiver Window
    if (Function == "Air_Data")
        ACO_window = "Air_Data Unit " Unit;
    else
        ACO_window = "Test_Station Transmitter";

    win_activate(ACO_window);
    set_window (ACO_window, 5);
    obj_wait_info("SysListView32","displayed",1,10);
    obj_mouse_click("SysListView32",1,1,LEFT);
    list_select_item ("SysListView32", Port ";" Label);
    obj_get_text("Description", text);

    if(length(Value_Eng) > 0)
    {
        button_press ("Eng_0");
        # 42 - Set Longitude
        set_window (Label " - " text, 11);
        if(length(Value_Eng) > 0)
            edit_set ("Value (Eng)_0", Value_Eng);

        if(length(SSM) > 0)
            list_select_item ("Value (Eng)_1", SSM);

        if(length(Unit) > 0)
            list_select_item ("ComboBox", Unit); # Item Number 1;

        button_press ("OK");

        set_window (ACO_window, 5);
        if (length(Rate) > 0)
            edit_set ("Rate (Hz)", Rate);

        button_press ("Update");
    }

```



```

else
{
    set_window (ACO_window, 4);

    if(length(Value_Hex) > 0)
        edit_set ("Data (Hex)", Value_Hex);

    if (length(Rate) > 0)
        edit_set ("Rate (Hz)", Rate);

    if(length(SSM) > 0)
        list_select_item ("SSM", SSM); # Item Number 0;

    if(length(Unit) > 0)
        list_select_item ("Unit", Unit); # Item Number 1;

    button_press ("Update");
}
}
#####
#####
#This function will shutdown Test_Station applications (Virtual Panel, CMC, ACO, MIU)
public function Shutdown (InputPanel)
{
    auto i;
    if (win_exists (InputPanel, 1)==E_OK)
    {
        set_window(InputPanel, 1);
        list_select_item ("Mode Command", "Power Off"); # Item Number 0;
        win_close(InputPanel);
    }

    if (win_exists ("Output Discretes - Virtual Panel", 1)==E_OK)
        win_close("Output Discretes - Virtual Panel");

    if (win_exists("Analog Controls - Virtual Panel", 1)==E_OK)
        win_close("Analog Controls - Virtual Panel");

```

```

if (win_exists("Power Controls - Virtual Panel", 1)==E_OK)
    win_close("Power Controls - Virtual Panel");

if (win_exists("ACO - Test_Station Transmitter", 1)==E_OK)
    win_close("ACO - Test_Station Transmitter");
if (win_exists("ACO - Navigation Receiver", 1)==E_OK)
    win_close("ACO - Navigation Receiver");
if (win_exists("ACO - Navigation Receiver", 1)==E_OK)
    win_close("ACO - Navigation Receiver");
if (win_exists("ACO - Air_Data Receiver", 1)==E_OK)
    win_close("ACO - Air_Data Receiver");
if (win_exists("ACO - Air_Data Receiver", 1)==E_OK)
    win_close("ACO - Air_Data Receiver");
if (win_exists("MIU", 1)==E_OK)
    win_close("MIU");
if(win_exists("ACO - Air_Data HW TX",1)==E_OK)
    win_close("ACO - Air_Data HW TX");
if(win_exists("ACO - Air_Data HW RX",1)==E_OK)
    win_close("ACO - Air_Data HW RX");
if(win_exists("ACO - GPS_Navigation HW TX",1)==E_OK)
    win_close("ACO - GPS_Navigation HW TX");
if(win_exists("ACO - GPS_Navigation HW RX",1)==E_OK)
    win_close("ACO - GPS_Navigation HW RX");
if(win_exists("Air_Data Unit 1", 1)==E_OK)
{
    set_window ("Air_Data Unit 1", 1);
    button_set ("Start Transmitting", OFF);
    win_close("Air_Data Unit 1");
    set_window ("Air_Data Unit 2", 1);
    button_set ("Start Transmitting", OFF);
    win_close("Air_Data Unit 2");
    set_window ("Air_Data Unit 3", 1);
    button_set ("Start Transmitting", OFF);
    win_close("Air_Data Unit 3");

    set_window("ACO",1);
    win_close("ACO");
}

```

```

    }
}
#####
#####
public function Create_Data_Table(Table_Name, Folder_Path, num_column, Column_Names)
{
    auto Table_Path;
    auto column[];
    auto i;
        invoke_application("C:\\Program Files\\Microsoft Office\\Office\\EXCEL.EXE","", "C:\\Program Files\\Microsoft
        Office\\Office\\",SW_SHOW);
        Table_Path = Folder_Path & Table_Name;
        Column_Names = repl_str(Column_Names, " ", "");
        split(Column_Names, column, ",");
        # Microsoft Excel - Blank
        set_window ("Microsoft Excel - Book1", 5);
        obj_mouse_click ("Book1", 42, 28, LEFT);
        for(i=1; i <= 100; i++)
        {
            if(column[i])
            {
                obj_mouse_dbl_click ("EXCEL<", 118, 9, LEFT);
                obj_type ("EXCEL<",column[i]);
                obj_type ("EXCEL<","<kTab>");
            }

            else
                break;
        }
        # Microsoft Excel - Figure
        win_close ("Microsoft Excel - Book1");
        # Microsoft Excel
        set_window ("Microsoft Excel", 2);
        button_press ("Yes")
        # Save As
        set_window ("Save As", 2);
        obj_type ("RichEdit20W", Table_Path);

```

```

obj_type ("RichEdit20W", "<kReturn>");

if(win_exists("Microsoft Excel", 1)==E_OK)
{
    set_window ("Microsoft Excel", 3);
    button_press ("Yes");
}
}
#####
#####
# This function allows a user to add labels in the standard Air_Data or Navigation ACO Pages
public function Add_Label(Designation, Port, Label)
{
    auto array[];
    auto Function;
    auto ACO_Window;
    split(Designation, array, " ");
    Function = array[1];
    if(Function == "Air_Data")
        ACO_Window = "Air_Data Receiver";
    else
        ACO_Window = "Navigation Receiver";
    set_window (ACO_Window, 4);
    list_select_item ("Port", Port); # Item Number 0;
    button_set ("By Label #", ON);
    list_select_item ("ComboBox", Label); # Item Number 82;
    button_press ("Lookup");
    if(win_exists("Select a Function\\SubFunction Pair", 1)==E_OK)
    {
        set_window ("Select a Function\\SubFunction Pair", 4);
        button_press ("OK");
    }
}
#####
#####
# This function allows a user to create new labels in the standard Air_Data or Navigation ACO Pages

```

```

public function Create_Label(Designation, Port, Label, Name, Partition, SubFunction, Units, Value_Hex, Rate, Unit)
{
    auto Transmitter;
    auto Receiver;
    auto Function;
    auto array[];
        split(Designation, array, " ");
        Function = array[1];
        Designation = array[2];

        if(Function == "Air_Data")
        {
            Transmitter = "Air_Data Unit " Unit;
            Receiver = "Air_Data Receiver";
        }
        else
        {
            Transmitter = "Test_Station Transmitter";
            Receiver = "Navigation Receiver";
        }

    if(Designation == "Tx" || Designation == "Both")
    {
        set_window (Transmitter, 2);
        button_press ("Define New");
        # Label Parameters (page)
        set_window ("Label Parameters (page)", 6);
        list_select_item ("Port", Port); # Item Number 0;
        edit_set ("Label", Label);
        edit_set ("Description", Name);
        list_select_item ("Function", Partition); # Item Number 4;
        list_select_item ("SubFunction", SubFunction); # Item Number 19;
        list_select_item ("Units", Units); # Item Number 1;

        # Custom Label Definition
        set_window ("Custom Label Definition", 3);
        tab_select_item ("tab", "Label Data"); # Item Number 1;
    }
}

```

```

    # Label Data (page)
    set_window ("Label Data (page)", 35);
    edit_set ("Value (Hex)", Value_Hex);
    edit_set ("Rate", Rate);
    # Custom Label Definition
    set_window ("Custom Label Definition", 1);
    button_press ("OK");

    set_window (Transmitter, 6);
    list_select_item ("SysListView32", Port ";" Label);
    list_select_item ("Unit", Unit);
    button_press ("Update");
}
if(Designation == "Rx" || Designation == "Both")
{
    set_window (Receiver, 1);
    button_press ("Add Custom Label");
    # Label Parameters (page)
    set_window ("Label Parameters (page)", 6);
    list_select_item ("Port", Port); # Item Number 0;
    edit_set ("Label", Label);
    edit_set ("Description", Name);
    list_select_item ("Function", Partition); # Item Number 4;
    list_select_item ("SubFunction", SubFunction); # Item Number 19;
    list_select_item ("Units", Units); # Item Number 1;
    # Custom Label Definition
    set_window ("Custom Label Definition", 1);
    button_press ("OK");
}
}
#####
#####
# This function will turn the system off and wait for power down
public function Power_Off()
{
    auto k;
    auto value;

```

```

auto start_time;

set_window ("Input Discretes - System3 - Virtual Panel", 1);
list_select_item ("Mode Command", "Power Off"); # Set M1 Off

start_time = get_time();
for (k=0;;k++)
{
    if (get_time() - start_time > 15) # Wait 15 seconds max
    {
        set_window ("Input Discretes - System3 - Virtual Panel", 5);
        list_select_item ("Mode Command", "Power Off"); # Try turning off again
        break;
    }
    set_window("Output Discretes - Virtual Panel", 1);
    obj_get_info("System On ODSC","enabled",value);
    if(value == 0)
    {
        break;
    }
}

#####
#####
# Shut down MIU
public function MIU_Shutdown()
{
    set_window ("MIU", 5);
    toolbar_button_press ("ToolbarWindow32", "#9");
    win_close ("MIU");
}

#####
#####
#This function will round a number to the desired decimal place
public function Round (Number, Decimal_Places, out Rounded_Number)
{
    auto Fractional;

```

```

auto Scale;
auto Scaled_Number;
auto ReverseSign;
    ReverseSign = 0;
    Scale = 10^Decimal_Places;
    Scaled_Number = Number * Scale;
    Rounded_Number = int(Scaled_Number);
    Fractional = (Scaled_Number) - Rounded_Number;

```

```

    if(Number <= 0.0)
    {
        Number = -Number;
        ReverseSign = 1;
    }
    if(Fractional >= 0.5)
    {
        Rounded_Number = (Rounded_Number + 1)/(Scale);
    }
    else
    {
        Rounded_Number = Rounded_Number/(Scale);
    }
    if(ReverseSign == 1) {Number = -Number;}
}

```

```

#####
#####

```

#This function will convert a Hex string to an integer

```

public function StrToInt (strIn, out intOut)

```

```

{
    auto Hex;
    auto Digit;
    auto i;
    for (i=1;i<length(strIn)+1;i++)
    {
        Hex = substr(strIn,length(strIn)-i+1,1);
        switch (Hex)
        {

```



```

        case "A":
            Digit = 10;
            break;
        case "B":
            Digit = 11;
            break;
        case "C":
            Digit = 12;
            break;
        case "D":
            Digit = 13;
            break;
        case "E":
            Digit = 14;
            break;
        case "F":
            Digit = 15;
            break;
        default:
            Digit = Hex;
    }
    intOut = intOut + Digit * 16^(i-1);
}

}

#####
#####
#This function will convert a Hex string to a Binary String (bit 32 to bit 1 left to right)
public function StrToBin (strIn, out BinOut)
{
    auto Hex;
    auto Bin;
    auto i;
    for (i=1;i<=length(strIn);i++)
    {
        Hex = substr(strIn,i,1);
        Hex_to_Bin (Hex, Bin)
        BinOut = BinOut Bin;
    }
}

```

```

    }
}
#####
#####
#This function will convert a Bin string to a Decimal Value (msb to lsb is binary digits left to right)
public function BinToDec (strIn, out DecOut)
{
    auto Dec;
    auto Bin;
    auto i;
        for (i=0;i<length(strIn);i++)
        {
            Bin = substr(strIn,length(strIn)-i,1);
            DecOut = DecOut + Bin*(2^i);
        }
}
#####
#####
#####
####!!!STATIC FUNCTIONS!!!####
#####
public function Hex_to_Bin (Hex, out Bin)
{
    if(Hex == "0")
        Bin = "0000";
    if(Hex == "1")
        Bin = "0001";
    if(Hex == "2")
        Bin = "0010";
    if(Hex == "3")
        Bin = "0011";
    if(Hex == "4")
        Bin = "0100";
    if(Hex == "5")
        Bin = "0101";
    if(Hex == "6")
        Bin = "0110";

```

```

    if(Hex == "7")
        Bin = "0111";
    if(Hex == "8")
        Bin = "1000";
    if(Hex == "9")
        Bin = "1001";
    if(Hex == "A" || Hex == "a")
        Bin = "1010";
    if(Hex == "B" || Hex == "b")
        Bin = "1011";
    if(Hex == "C" || Hex == "c")
        Bin = "1100";
    if(Hex == "D" || Hex == "d")
        Bin = "1011";
    if(Hex == "E" || Hex == "e")
        Bin = "1110";
    if(Hex == "F" || Hex == "f")
        Bin = "1111";
}
#####
#####
# This function converts a bit into its place in a 4 bit hex word
# Ex: bit 3 = 0000 0000 0000 1000 = 0008
static function Bit16_to_Hex4 (Bit, out Hex)
{
    switch (Bit)
    {
        case "0":
            Hex = "0001";
            break;

        case "1":
            Hex = "0002";
            break;

        case "2":
            Hex = "0004";

```

```
break;

case "3":
Hex = "0008";
break;

case "4":
Hex = "0010";
break;

case "5":
Hex = "0020";
break;

case "6":
Hex = "0040";
break;

case "7":
Hex = "0080";
break;

case "8":
Hex = "0100";
break;

case "9":
Hex = "0200";
break;

case "10":
Hex = "0400";
break;

case "11":
Hex = "0800";
break;
```

```

        case "12":
            Hex = "1000";
            break;

        case "13":
            Hex = "2000";
            break;

        case "14":
            Hex = "4000";
            break;

        case "15":
            Hex = "8000";
            break;
    }
}
#####
#####
# This function converts a 4 bit binary word into a hex value
# Used in checking the event status word as more than one bit could be set (0, 1, 2, 3)
# Ex: bits 0, 2, 3 = 1101 (binary) = D (hex)
static function Bit4_to_Hex1 (Bit, out Hex)
{
    auto Dec;
    auto bit[];
    auto i;
    for (i=0; i<length(Bit); i++)
    {
        bit[i] = substr(Bit, length(Bit)-i, 1);
        Dec += bit[i] * 2^i;
    }
    Hex = sprintf("%.2X", Dec);
}
#####
#####

```

```

#####!!!!HARDWARE CHECKOUT FUNCTIONS!!!!#####
public function ATP_Hardware_Check ()
{
    auto i;
    auto ODSC;
    auto DDT_MODE_READ;
    auto rc;
    auto ODSC_Row;
    auto value;
    auto Output;
        ddt_close_all_tables();

        if (win_exists("Input Discretes - System2 - Virtual Panel", 1)==E_OK)
            win_close("Input Discretes - System2 - Virtual Panel");
        Startup_Virtual_Panels("Input Discretes - System2 - Virtual Panel");
        # Power Controls - Virtual Panel
        set_window ("Power Controls - Virtual Panel", 2);
        menu_select_item ("Panel;Load Configuration Ctrl+L");
        # Load a Configuration...
        set_window ("Load a Configuration...", 1);
        list_select_item ("ListBox", "Power Default"); # Item Number 0;
        button_press ("Load");
        # Analog Controls - Virtual Panel
        set_window ("Analog Controls - Virtual Panel", 1);
        menu_select_item ("Panel;Load Configuration Ctrl+L");
        # Load a Configuration...
        set_window ("Load a Configuration...", 1);
        list_select_item ("ListBox", "Analog Default"); # Item Number 0;
        button_press ("Load");
        if (win_exists("Air_Data HW RX", 1)!=E_OK)
            ATP_Startup_ACO_Air_Data();

        if (win_exists("GPS_Navigation HW RX", 1)!=E_OK)
            ATP_Startup_ACO_GPS_Navigation();

        # Input Discretes - System2 - Virtual Panel
        set_window ("Input Discretes - System2 - Virtual Panel", 2);

```

```

list_select_item ("Mode Command", "Nav"); # Item Number 1
set_window ("Output Discretes - Virtual Panel", 2);
obj_wait_info("Align ODSC", "enabled", 1, 15);
set_window ("Input Discretes - System2 - Virtual Panel", 2);
list_select_item ("Mode Command", "Power Off");
#Check initial state of Output Discretes to be Lit
ODSC = "\\ATP output discretes.xls";
rc = ddt_open(ODSC, DDT_MODE_READ);
if (rc!= E_OK && rc != E_FILE_OPEN)
    pause("Cannot open table.");

for(ODSC_Row = 1; ODSC_Row <= 17; ODSC_Row ++)
{
    ddt_set_row(ODSC,ODSC_Row);

    Output = ddt_val(ODSC, "Output");
    set_window("Output Discretes - Virtual Panel", 1);
    obj_get_info(Output,"enabled",value);

    if (value == 1)
        tl_step("Check initial state of " Output ".", PASS, Output " was Lit.", Output " should be Lit.", Output " was
Lit.");
    else
        tl_step("Check initial state of " Output ".", FAIL, Output " was NOT Lit.", Output " should be Lit.", Output " was
NOT Lit.");
}

ddt_close(ODSC);
report_msg("Finished with Hardware Check Initialization.");
# Call Hardware Check Functions
set_window ("ACO - GPS_Navigation HW RX", 1);
menu_select_item ("Configuration;Update All Rx Labels");
set_window ("ACO - Air_Data HW RX", 1);
menu_select_item ("Configuration;Update All Rx Labels");
ATP_Check_Air_Data_Resolvers();
set_window ("ACO - GPS_Navigation HW RX", 1);
menu_select_item ("Configuration;Update All Rx Labels");

```

```

set_window ("ACO - Air_Data HW RX", 1);
menu_select_item ("Configuration;Update All Rx Labels");
ATP_Check_Receivers("GPS_Navigation");
ATP_Check_Receivers("Air_Data");
ATP_Check_Input("GPS_Navigation");
ATP_Check_Input("Air_Data");
#ATP_Check_Output_Discretes();
#ATP_Check_Sensor_Assembly();
}
#####
#####
public function ATP_Startup_ACO_Air_Data()
{
auto value;
#####
#Check and start 8 channel transmitter
if(win_exists("ACO - Air_Data HW TX",1)==E_OK)
{
    set_window("ACO - Air_Data HW TX",1);
    set_window ("Air_Data HW TX", 1);
    button_set ("Start Transmitting", OFF);
    win_close("ACO - Air_Data HW TX");
}

invoke_application("\\ACO\\ACO.exe","", "",SW_SHOW);

# Select an ARINC board
set_window ("Select an ARINC board", 4);
list_select_item ("SysListView32", "0"); # Item Number 0;
button_press ("OK");

# ACO_1
set_window ("ACO_1", 1);
button_press ("Yes");
# Setup Page
set_window ("Setup Page", 2);
button_press ("Load");

```



```

# Open
set_window ("Open", 2);
edit_set ("File name:", "");
edit_set ("File name:", "Air_Data HW Checkout.aco");
button_press ("Open_2");

# Setup Page
set_window ("Setup Page", 3);
button_press ("OK");

# ACO_2
set_window ("ACO", 1);
toolbar_button_press ("ToolbarWindow32", "#3");

# Open Unit 1,2,3 Air_Data Transmitter Pages
set_window ("Open", 1);
edit_set ("File name:", "");
edit_set ("File name:", "Air_Data HW TX");
button_press ("Open_2");

set_window ("ACO - Air_Data HW TX", 1);
set_window ("Air_Data HW TX", 1);
button_set ("Start Transmitting", ON);
#####
# Check and Start 8 Channel Receiver Window
if(win_exists("ACO - Air_Data HW RX",1)==E_OK)
{
    set_window("ACO - Air_Data HW RX",1);
    set_window ("Air_Data HW RX", 1);
    button_set ("Start Receiving", OFF);
    win_close("ACO - Air_Data HW RX");
}

invoke_application("\\ACO\\ACO.exe","", "",SW_SHOW);

# Select an ARINC board
set_window ("Select an ARINC board", 4);

```

```

list_select_item ("SysListView32", "0"); # Item Number 0;
button_press ("OK");

# ACO_1
set_window ("ACO_1", 1);
button_press ("Yes");
# Setup Page
set_window ("Setup Page", 3);
button_press ("Cancel");
# ACO
set_window ("ACO", 2);
toolbar_button_press ("ToolbarWindow32", "#5");
# Open
set_window ("Open", 3);
edit_set ("File name:", "");
edit_set ("File name:", "\\Air_Data HW RX")
button_press ("Open_2");
# Air_Data Receiver
set_window("ACO - Air_Data HW RX", 5);
set_window ("Air_Data HW RX", 4);
button_set ("Start Receiving", ON);

win_resize ("Air_Data HW RX", 861, 912);
win_move ("Air_Data HW RX", 0, 0);
set_window ("ACO - Air_Data HW RX", 1);
menu_select_item ("Configuration;Update All Rx Labels");
}
#####
#####
public function ATP_Startup_ACO_GPS_Navigation()
{
auto value;
#####
#Check and start 16 channel transmitter
if(win_exists("ACO - GPS_Navigation HW TX",1)==E_OK)
{
    set_window("ACO - GPS_Navigation HW TX",1);

```

```

        set_window ("GPS_Navigation HW TX", 1);
        button_set ("Start Transmitting", OFF);
        win_close("ACO - GPS_Navigation HW TX");
    }

    invoke_application("\\ACO\\ACO.exe","", "",SW_SHOW);

    # Select an ARINC board
    set_window ("Select an ARINC board", 4);
    list_select_item ("SysListView32", "1"); # Item Number 0;
    button_press ("OK");

    # ACO_1
    set_window ("ACO_1", 1);
    button_press ("Yes");
    # Setup Page
    set_window ("Setup Page", 2);
    button_press ("Load");
    # Open
    set_window ("Open", 2);
    edit_set ("File name:", "");
    edit_set ("File name:", "\\GPS_Navigation HW Checkout.aco");
    button_press ("Open_2");
    # Setup Page
    set_window ("Setup Page", 1);
    button_press ("OK");

    # ACO_2
    set_window ("ACO", 1);
    toolbar_button_press ("ToolbarWindow32", "#3");

    # Open Navigation Transmitter Page
    set_window ("Open", 1);
    edit_set ("File name:", "");
    edit_set ("File name:", "\\GPS_Navigation HW TX");
    button_press ("Open_2");

```

```

set_window ("ACO - GPS_Navigation HW TX", 1);
set_window ("GPS_Navigation HW TX", 1);
button_set ("Start Transmitting", ON);

#####
# Check and Start 16 Channel Receiver Window
if(win_exists("ACO - GPS_Navigation HW RX",1)==E_OK)
{
    set_window("ACO - GPS_Navigation HW RX",1);
    set_window ("GPS_Navigation HW RX", 1);
    button_set ("Start Receiving", OFF);
    win_close("ACO - GPS_Navigation HW RX");
}

invoke_application("\\ACO\\ACO.exe","", "",SW_SHOW);

# Select an ARINC board
set_window ("Select an ARINC board", 4);
list_select_item ("SysListView32", "1"); # Item Number 0;
button_press ("OK");

# ACO_1
set_window ("ACO_1", 1);
button_press ("Yes");
set_window ("Setup Page", 3);
button_press ("Cancel");
# ACO
set_window ("ACO", 2);
toolbar_button_press ("ToolbarWindow32", "#5");
# Open
set_window ("Open", 3);
edit_set ("File name:", "");
edit_set ("File name:", "\\GPS_Navigation HW RX");
button_press ("Open_2");
# Navigation Receiver
set_window("ACO - GPS_Navigation HW RX", 1);
set_window ("GPS_Navigation HW RX", 4);

```

```

button_set ("Start Receiving", ON);

win_resize ("GPS_Navigation HW RX", 861, 911);
win_move ("GPS_Navigation HW RX", 0, 0);
set_window ("ACO - GPS_Navigation HW RX", 1);
menu_select_item ("Configuration;Update All Rx Labels");
}
#####
#####
public function ATP_Check_Receivers(Function)
{
auto i;
auto Port;
auto Label;
auto RealValue;
auto ExpectedValue;
auto rate;
auto rc;
auto DDT_MODE_READ;
auto Transmitters;
auto Transmitters_Row;
auto Receiver;
auto Transmitters_RowCount;
    if (Function == "GPS_Navigation")
    {
        Transmitters_RowCount = 34;
        Transmitters = "ATP GPS_Navigation transmitter data.xls";
    }
    else
    {
        Transmitters_RowCount = 32;
        Transmitters = "ATP Air_Data transmitter data.xls";
    }

rc = ddt_open(Transmitters, DDT_MODE_READ);
if (rc!= E_OK && rc != E_FILE_OPEN)
    pause("Cannot open table.");

```

```

for(Transmitters_Row = 1; Transmitters_Row <= Transmitters_RowCount; Transmitters_Row ++)
{
    ddt_set_row(Transmitters,Transmitters_Row);

    Receiver = ddt_val(Transmitters, Function "_Receiver");
    Port = ddt_val(Transmitters, Function "_Port");
    Label = ddt_val(Transmitters, "Label");
    ExpectedValue = ddt_val(Transmitters, "Expected_Value");

    Check_Label_Value_With_Mask("Check " Receiver, Function " ATP", Port, Label,
ExpectedValue,"11111111111111111111111111111111");
}

report_msg("End of " Function " Transmitter/Receiver Test Function");
ddt_close(Transmitters);
}

#####
#####
public function ATP_Check_Input(Function)
{
    auto IDSC;
    auto rc;
    auto DDT_MODE_READ;
    auto IDSC_Row;
    auto Label;
    auto Discrete;
    auto ExpectedValue;
    auto Mask;
    auto Ground;
    auto Open;
    auto Bit;
    auto ActualBits;
    auto RealValue;
    auto i;
    auto Port;
    auto array[];

```

```

auto count[];
auto ReturnValue;
auto bits[];
auto Value;
auto Designation;
auto IDSC_RowCount;
auto tm1;
auto rate;
auto tm2;
auto TimeMark1;
auto TimeMark2;
auto TimeCount1;
auto TimeCount2;
auto Time1;
auto Time2;
auto bit[];
auto ATP_window;
    if (Function == "GPS_Navigation")
    {
        IDSC = "ATP GPS_Navigation input discretes.xls";
        IDSC_RowCount = 36;
        ATP_window = "GPS_Navigation HW RX";
    }
    else
    {
        IDSC_RowCount = 33;
        IDSC = "ATP Air_Data input discretes.xls";
        ATP_window = "Air_Data HW RX";
    }

rc = ddt_open(IDSC, DDT_MODE_READ);
if (rc!= E_OK && rc != E_FILE_OPEN)
    pause("Cannot open table.");
# Set Custom Values for Input Discretes
for(IDSC_Row = 1; IDSC_Row <= IDSC_RowCount; IDSC_Row ++)
{
    ddt_set_row(IDSC,IDSC_Row);

```

```

Label = ddt_val(IDSC, "Label");
Discrete = ddt_val(IDSC, "Signal_Reference");
ExpectedValue = ddt_val(IDSC, "Expected_with_Ground");
Designation = ddt_val(IDSC, "Designation");
Port = ddt_val(IDSC, "Port");
Mask = ddt_val(IDSC, "Mask");
Ground = ddt_val(IDSC, "Button_Ground");
Open = ddt_val(IDSC, "Button_Open");
Bit = ddt_val(IDSC, "Bit");

if (Discrete == "Aircraft Parity")
    wait(2);

split(Bit, count, ",");

# Input Discretes - Virtual Panel
set_window ("Input Discretes - System2 - Virtual Panel", 3);
list_select_item (Discrete, "*Custom");

# Program Write Enable : Custom Pin Setting
set_window ( Discrete " : Custom Pin Setting", 1);
button_set (Ground, ON);
button_press ("OK");

if (count[2])
{
    wait(2);
    set_window (ATP_window, 5);
    obj_wait_info("SysListView32","displayed",1,10);
    list_activate_item ("SysListView32", Port ";" Label);

    if(win_exists("Label Data...", 1)!= E_OK)
        list_activate_item ("SysListView32", Port ";" Label);

    set_window("Label Data...", 1);
    obj_get_text("Rate", rate);

```



```

obj_get_text("Value", RealValue);
win_close ("Label Data...");
if (rate == 0) #Label is not transmitted
{
    tl_step("Check " Function " Label " Label, FAIL, Function " Label " Label " Could not be checked, it was
not transmitted.", Function " Label " Label " should be transmitted" , Function " Label " Label " Was not
transmitted");
    continue;
}

if (rate >= 1) #Check Label Value to expected
{
    RealValue = repl_str(RealValue, " ", "");
    # Convert ACO Bits String to Actual Bits set
    for (i=0; i < length(RealValue); i++)
    {
        array[i+1] = substr(RealValue, i+1, 1);

        if(array[i+1]==0)
            array[i+1] = 32-i " ";
        else
            array[i+1] = "";
    }

    # Labels 100-103 are GPS_Navigation, Labels 110-112 are Air_Data
    if (Label == 100)
        ActualBits = "Bit(s) " array[21] array[20] array[19] array[18] array[14] array[13] array[12]
array[11] array [10] array[9];
    if (Label == 101)
        ActualBits = "Bit(s) " array[22] array[21] array[19] array[13] array[12] array[11] array[10]
array[9] array[8];
    if (Label == 102)
        ActualBits = "Bit(s) " array[22] array[21] array[20] array[19] array[13] array[12] array[11]
array[10] array[9];
    if (Label == 103)
        ActualBits = "Bit(s) " array[22] array[21] array[20] array[14] array[13] array[12] array[9];
    if (Label == 110)

```

```

        ActualBits = "Bit(s) " array[22] array[21] array[20] array[19] array[18] array[17] array[16]
        array[15] array[14] array[13] array[12] array[11] array[10] array[9] array[8] array[7];
    if (Label == 111)
        ActualBits = "Bit(s) " array[22] array[13] array[12] array[11] array[10] array[9] array[8]
array[7];

    if (Label == 112)
        ActualBits = "Bit(s) " array[19] array[14] array[13] array[12] array[11] array[10] array[9]
        array[8] array[7];

    WRU_MaskAndCompareBinString(ExpectedValue, RealValue, Mask, ReturnValue);

    if (ReturnValue == 1)
        tl_step("Check " Function " Label " Label, PASS, "All Input Discretes on " Function " Label "
        Label " were grounded correctly. Expected: Bit(s) " Bit " set on " Function " Label " Label ".
        Actual: " ActualBits, "Expected: Bit(s) " Bit " set on " Function " Label " Label, "Actual: "
        ActualBits);
    else
        tl_step("Check " Function " Label " Label, FAIL, "All Input Discretes on " Function " Label "
        Label " were NOT grounded correctly. Expected: Bit(s) " Bit " set on " Function " Label " Label
        ". Actual: " ActualBits, "Expected: Bit(s) " Bit " set on " Function " Label " Label, "Actual: "
        ActualBits);
    }
}

# END GPS_Navigation DISCRETE CHECK LOOP
# Check GPS Time Mark Count
if (Function == "GPS_Navigation")
{
    for (i=1; i<=100; i++)
    {
        set_window ("GPS_Navigation HW RX", 5);
        list_activate_item ("SysListView32", "6;106");

        if (win_exists("Label Data...", 1)!=E_OK)
            list_activate_item ("SysListView32", "6;106");

        set_window("Label Data...", 1);
    }
}

```

```

        obj_get_text("Value", RealValue);
        win_close("Label Data...");

        if (RealValue != "00011100 00000000 00000011")
            i = 101;
    }

    RealValue = repl_str(RealValue, " ", "");
    Time2 = substr(RealValue, 7, 7);
    Time1 = substr(RealValue, 15, 7);
    # Now Convert Binary to Decimal (GPS Time Mark Counts)
    for (i=0; i<length(Time1); i++)
    {
        bit[i] = substr(Time1, length(TimeMark1)-i, 1);
        TimeCount1 += bit[i] * 2^i;
    }

    for (i=0; i<length(Time2); i++)
    {
        bit[i] = substr(Time2, length(Time2)-i, 1);
        TimeCount2 += bit[i] * 2^i;
    }

    tl_step("GPS Time Mark #1", PASS, "GPS Time Mark #1 Count: " TimeCount1);
    tl_step("GPS Time Mark #2", PASS, "GPS Time Mark #2 Count: " TimeCount2);
}

report_msg("End of GPS_Navigation Input Discrete Test Function");
ddt_close(IDSC);
}
#####
#####
public function ATP_Check_Air_Data_Resolvers()
{
    auto Resolvers;
    auto DDT_MODE_READ;
    auto Control;

```

```

auto Value;
auto Label;
auto ExpectedValue;
auto Designation;
auto ResolverValue;
auto RealValue;
auto ResolverValueDec;
auto TwosComp;
auto RealVoltage;
auto SetValue;
auto rc;
auto i;
auto Resolvers_Row;
auto rate;
auto Angle;
auto bits[];
auto bit[];
auto twos[];
auto Units;
auto Port;
auto MaxVoltage = 10;
auto Tolerance;
auto ResRef;
auto Function;

# Input Discretes - System2 - Virtual Panel
set_window ("Input Discretes - System2 - Virtual Panel", 2);
list_select_item ("26 VAC Ref 1", "Reference On"); # Item Number 1;
list_select_item ("26 VAC Ref 2", "Reference On"); # Item Number 1;

# Analog Controls - Virtual Panel
set_window ("Analog Controls - Virtual Panel", 4);
menu_select_item ("Panel;Load Configuration Ctrl+L");
# Load a Configuration...
set_window ("Load a Configuration...", 0);
list_select_item ("ListBox", "ATP"); # Item Number 1;
button_press ("Load");

```

```

# Get Reference Voltage Reading
win_move ("Power Controls - Virtual Panel", 127, 33);
set_window ("Power Controls - Virtual Panel", 2);
list_select_item ("Volt Reader", "Resolver Ref"); # Item Number 7;
wait(8);
obj_get_text("Value:", ResRef);
win_move ("Power Controls - Virtual Panel", 1482, 617);

if (ResRef > 23 && ResRef < 28)
    tl_step("Check Resolver Reference.", PASS, "Resolver Reference is within operational range. Expected Range: 23-28 vac
    RMS. Actual Voltage: " ResRef " vac RMS.", "Expected Range: 23-28 vac RMS.", "Actual Voltage: " ResRef " vac
    RMS.");
else
    tl_step("Check Resolver Reference.", FAIL, "Resolver Reference is NOT within operational range. Expected Range: 23-
    28 vac RMS. Actual Voltage: " ResRef " vac RMS.", "Expected Range: 23-28 vac RMS.", "Actual Voltage: " ResRef "
    vac RMS.");
# Analog Controls - Virtual Panel
win_move ("Analog Controls - Virtual Panel", 1305, 819);
Resolvers = "ATP Air_Data resolvers.xls";
rc = ddt_open(Resolvers, DDT_MODE_READ);
if (rc!= E_OK && rc != E_FILE_OPEN)
    pause("Cannot open table.");
for(Resolvers_Row = 1; Resolvers_Row <= 20; Resolvers_Row ++)
{
    ddt_set_row(Resolvers,Resolvers_Row);

    Label = ddt_val(Resolvers, "Label");
    Designation = ddt_val(Resolvers, "Designation");
    ExpectedValue = ddt_val(Resolvers, "Expected_Value_Dec");
    Units = ddt_val(Resolvers, "Units");
    Angle = ddt_val(Resolvers, "Angle");
    Port = ddt_val(Resolvers, "Port");
    ResolverValue = "";
    TwosComp = "";
    Function = "Air_Data";
    for(i=1; i<=10; i++)

```

```

{
    set_window ("Air_Data HW RX", 5);
    obj_wait_info("SysListView32","displayed",1,10);
    list_activate_item ("SysListView32", Port ";" Label);

    if(win_exists("Label Data...", 1)!= E_OK)
        list_activate_item ("SysListView32", Port ";" Label);

    set_window("Label Data...", 1);
    obj_get_text("Rate", rate);
    obj_get_text("Value", RealValue);
    win_close ("Label Data...");

    if (rate < 1 && i<10) #Try again due to Update Delay in ACO
        continue;
    if (rate < 1 && i==10) #Label is not transmitted
        tl_step("Check " Function " Label " Label, FAIL, Function " Label " Label " Could not be checked, it was
        not transmitted.", Function " Label " Label " should be transmitted" , Function " Label " Label " Was not
        transmitted");

    # Check Resolver Values
    if (rate >= 1)
    {
        RealValue = repl_str(RealValue," ","");
        ResolverValue = substr(RealValue, 7, 16);

        # Need Twos Compliment if MSB is 1
        if (substr(RealValue, 7, 1) == 1)
        {
            for(i=2; i<=16; i++)
            {
                twos[i] = substr(ResolverValue, i, 1);

                if(twos[i]==1)
                    twos[i] = 0;
                else
                    twos[i] = 1;
            }
        }
    }
}

```

```

        TwosComp = TwosComp twos[i];
    }
    ResolverValue = TwosComp;
}

# Now Convert Binary to Decimal and Multiply by 305 uV
ResolverValueDec = 0;
for (i=0; i<length(ResolverValue); i++)
{
    bit[i] = substr(ResolverValue, length(ResolverValue)-i, 1);
    ResolverValueDec += bit[i] * 2^i;
}

RealVoltage = ResolverValueDec * .000305;

if (substr(RealValue, 7, 1) == 1)
    RealVoltage = (ResolverValueDec * -0.000305) - .000305;

if (Resolvers_Row <= 8)
{
    if (ExpectedValue-MaxVoltage*.1 < RealVoltage && RealVoltage <
        ExpectedValue+MaxVoltage*.1)
        tl_step("Check " Designation, PASS, Designation " was set to within 10% Tolerance at
            Angle " Angle "°on Air_Data ODB #" Port ". Actual voltage: " RealVoltage " " Units ".
            Expected Voltage: "ExpectedValue " " Units, "Expected Voltage: " ExpectedValue " "
            Units, "Actual Voltage: " RealVoltage " " Units);
    else
        tl_step("Check " Designation, FAIL, Designation " was NOT within 10% Tolerance at
            Angle " Angle "°on Air_Data ODB #" Port ". Actual voltage: " RealVoltage " " Units ".
            Expected Voltage: "ExpectedValue " " Units, "Expected Voltage: " ExpectedValue " "
            Units, "Actual Voltage: " RealVoltage " " Units);
}

if (Resolvers_Row > 8 && Resolvers_Row <= 18)
{
    if (ExpectedValue-MaxVoltage*.1 < RealVoltage && RealVoltage <
        ExpectedValue+MaxVoltage*.1)

```

```

        tl_step("Check " Designation, PASS, Designation " was set to within 10% Tolerance on
        Air_Data ODB #" Port ". Actual value: " RealVoltage " " Units ". Expected value:
        "ExpectedValue " " Units, "Expected value: " ExpectedValue " " Units, "Actual value: "
        RealVoltage " " Units);
    else
        tl_step("Check " Designation, FAIL, Designation " was NOT within 10% Tolerance on
        Air_Data ODB #" Port ". Actual value: " RealVoltage " " Units ". Expected value:
        "ExpectedValue " " Units, "Expected value: " ExpectedValue " " Units, "Actual value: "
        RealVoltage " " Units);
    }
}
}
}
report_msg("End of Air_Data Resolver Test Function");
ddt_close(Resolvers);
# Input Discretes - System2 - Virtual Panel
set_window ("Input Discretes - System2 - Virtual Panel", 14);
list_select_item ("26 VAC Ref 1", "Reference Off"); # Item Number 0;
list_select_item ("26 VAC Ref 2", "Reference Off"); # Item Number 0;
}
#####
#####
public function ATP_Check_Output_Discretes()
{
    auto ODSC;
    auto rc;
    auto DDT_MODE_READ;
    auto ODSC_Row;
    auto Label;
    auto Discrete;
    auto value;
    auto Output;
    auto Mask;
    auto text;
    auto Ground;
    auto Open;
    auto i;

```



```

auto Designation;
auto ODSC_RowCount = 12;
auto Batt;
auto DC;
auto Navigation;
auto Align;
auto Function;
auto Expected;
auto Port;
auto RealValue;
auto array[];
auto Bit[];
auto Setting;
auto rate;
    ODSC = "ATP output discretes.xls";
    rc = ddt_open(ODSC, DDT_MODE_READ);
    if (rc!= E_OK && rc != E_FILE_OPEN)
        pause("Cannot open table.");
    # Need to Ground A/C Discrete 1 to Test ODSC's affected by ANN Test Discrete
    set_window ("Input Discretes - System2 - Virtual Panel", 2);
    list_select_item ("Aircraft Identification", "*Custom"); # Item Number 20;
    set_window ("Aircraft Identification : Custom Pin Setting", 0);
    button_set ("Ground_6", ON);
    button_press ("OK");
    #Check Output Discretes with Input Enabled
    for(ODSC_Row = 1; ODSC_Row <= ODSC_RowCount; ODSC_Row ++)
    {
        ddt_set_row(ODSC,ODSC_Row);

        Discrete = ddt_val(ODSC, "Input");
        Output = ddt_val(ODSC, "Output");
        Ground = ddt_val(ODSC, "Button_Ground");
        Open = ddt_val(ODSC, "Button_Open");
        Designation = ddt_val(ODSC, "Designation");
        Function = ddt_val(ODSC, "Function");
        Label = ddt_val(ODSC, "Label");
        Expected = ddt_val(ODSC, "Expected_Bit");
    }

```

```

Port = ddt_val(ODSC, "Port");
Setting = ddt_val(ODSC, "Setting");

set_window("Output Discretes - Virtual Panel", 1);
obj_get_info(Output,"enabled",value);

if (value == 0)
    tl_step("Check " Discrete " " Designation " sets " Output, PASS, Output " was set correctly by Input Discrete "
    Discrete " " Designation, "Expected: " Output " set.", "Actual: " Output " set.");
else
    tl_step("Check " Discrete " " Designation " sets " Output, FAIL, Output " was NOT set correctly by Input
    Discrete " Discrete " " Designation, "Expected: " Output " set.", "Actual: " Output " NOT set.");

if (length(Function) > 1)
{
    set_window (Function " HW RX", 5);
    obj_wait_info("SysListView32","displayed",1,10);
    list_activate_item ("SysListView32", Port ";" Label);

    if(win_exists("Label Data...", 1)!= E_OK)
        list_activate_item ("SysListView32", Port ";" Label);

    set_window("Label Data...", 1);
    obj_get_text("Rate", rate);
    obj_get_text("Value", RealValue);
    win_close ("Label Data...");
    if (rate == 0) #Label is not transmitted
    {
        tl_step("Check " Function " Label " Label, FAIL, Function " Label " Label " Could not be checked, it was
        not transmitted.", Function " Label " Label " should be transmitted" , Function " Label " Label " Was not
        transmitted");
        continue;
    }

    if (rate > 0)
    {
        RealValue = repl_str(RealValue," ","");
    }
}

```

```

# Convert ACO Bits String to Actual Bits set
for (i=length(RealValue); i > 0; i--)
{
    array[33-i] = substr(RealValue, i, 1);
}

if (array[Expected] == Setting)
    tl_step("Check " Discrete " " Designation " sets " Output " W/A", PASS, Output " W/A was set
on " Function " Label " Label " as Bit " Expected ".");
else
    tl_step("Check " Discrete " " Designation " sets " Output " W/A", FAIL, Output " W/A was NOT
set on " Function " Label " Label " as Bit " Expected ".");
}
}
}

# Check ANN Test Discrete by Setting A/C ID 1 to Ground
# On Batt, Low DC, Navigation Warn, Align should be enabled with A/C ID 8, GPS Priority Select
# Input Discretes - System2 - Virtual Panel
set_window ("Input Discretes - System2 - Virtual Panel", 4);
list_select_item ("Aircraft Identification", "*Custom");
set_window ("Aircraft Identification : Custom Pin Setting", 0);
button_set ("Ground_3", ON);
button_press ("OK");
# Input Discretes - System2 - Virtual Panel
set_window ("Input Discretes - System2 - Virtual Panel", 8);
list_select_item ("GPS Priority Select", "*Custom");
set_window ("GPS Priority Select : Custom Pin Setting", 0);
button_set ("Ground", ON);
button_press ("OK");
wait(2);
set_window("Output Discretes - Virtual Panel", 1);
obj_get_info("On Batt ODSC","enabled",Batt);
obj_get_info("Low DC ODSC","enabled",DC);
obj_get_info("Navigation Warn ODSC","enabled",Navigation);
obj_get_info("Align ODSC","enabled",Align);

```

```

if (Batt == 0 && DC == 0 && Navigation == 0 && Align == 0)
    tl_step("Check A/C ID #1 sets ANN Test", PASS, "ANN Test was set correctly by A/C ID #1.");
else
    tl_step("Check A/C ID #1 sets ANN Test", FAIL, "ANN Test was NOT set correctly by A/C ID #1.");

# Power Controls - Virtual Panel
# Check Air_Data Warn with DC Present BR
set_window ("Power Controls - Virtual Panel", 5);
scroll_drag_from_min ("0.00_0", HSCROLL, 0);
wait(3);

set_window("Output Discretes - Virtual Panel", 1);
obj_get_info("Air_Data Warn ODSC","enabled",value);

if (value == 0)
    tl_step("Check DC Present BR sets Air_Data Warn", PASS, "Air_Data Warn was set correctly by DC Present BR.");
else
    tl_step("Check DC Present BR sets Air_Data Warn", FAIL, "Air_Data Warn was NOT set correctly by DC Present BR.");
set_window ("Air_Data HW RX", 5);
obj_wait_info("SysListView32","displayed",1,10);
list_activate_item ("SysListView32", "7;112" );

if(win_exists("Label Data...", 1)!= E_OK)
    list_activate_item ("SysListView32", "7;112");

set_window("Label Data...", 1);
obj_get_text("Rate", rate);
obj_get_text("Value", RealValue);
win_close ("Label Data...");
if (rate == 0) #Label is not transmitted
    tl_step("Check Air_Data Warn W/A on Air_Data Label", FAIL, "Air_Data Warn W/A Could not be checked, Air_Data
    Label was not transmitted.");
if (rate >= 1)
{
    RealValue = repl_str(RealValue," ","");
    # Convert ACO Bits String to Actual Bits set
    for (i=length(RealValue); i > 0; i--)

```

```

    {
        array[33-i] = substr(RealValue, i, 1);
    }

    if (array[11] == 1)
        tl_step("Check DC Present BR sets Air_Data Warn W/A", PASS, "Air_Data Warn W/A was set correctly by DC Present BR.");
    else
        tl_step("Check DC Present BR sets Air_Data Warn W/A", FAIL, "Air_Data Warn W/A was NOT set correctly by DC Present BR.");
    set_window ("Power Controls - Virtual Panel", 5);
    scroll_drag_from_min ("0.00_0", HSCROLL, 28);
}

# Power Controls - Virtual Panel
# Check Spare 4 with AC Present BR
set_window ("Power Controls - Virtual Panel", 5);
scroll_drag_from_min ("3.00", HSCROLL, 0);
wait(45);

set_window("Output Discretes - Virtual Panel", 1);
obj_get_info("Spare 4 ODSC","enabled",value);

if (value == 0)
    tl_step("Check AC Present BR sets Spare 4 ODSC", PASS, "Spare 4 ODSC was set correctly by AC Present BR.");
else
    tl_step("Check AC Present BR sets Spare 4 ODSC", FAIL, "Spare 4 ODSC was NOT set correctly by AC Present BR.");
set_window ("GPS_Navigation HW RX", 5);
obj_wait_info("SysListView32","displayed",1,10);
list_activate_item ("SysListView32", "6;103" );

if(win_exists("Label Data...", 1)!= E_OK)
    list_activate_item ("SysListView32", "6;103" );

set_window("Label Data...", 1);
obj_get_text("Rate", rate);
obj_get_text("Value", RealValue);

```

```

win_close ("Label Data...");
if (rate == 0) #Label is not transmitted
    tl_step("Check Spare 4 W/A on GPS_Navigation Label", FAIL, "Spare 4 W/A Could not be checked, GPS_Navigation
    Label was not transmitted.");
if (rate > 0)
{
    RealValue = repl_str(RealValue, " ", "");

    # Convert ACO Bits String to Actual Bits set
    for (i=length(RealValue); i > 0; i--)
    {
        array[33-i] = substr(RealValue, i, 1);
    }

    if (array[16] == 0)
        tl_step("Check AC Present BR sets Spare 4 ODSC W/A", PASS, "Spare 4 ODSC W/A was set correctly by AC
        Present BR.");
    else
        tl_step("Check AC Present BR sets Spare 4 ODSC W/A", FAIL, "Spare 4 ODSC W/A was NOT set correctly by
        AC Present BR.");

    set_window ("Power Controls - Virtual Panel", 5);
    scroll_drag_from_min ("3.00", HSCROLL, 112);
}

# Power Controls - Virtual Panel
# Check Spare 3 with Batt Present BR
set_window ("Power Controls - Virtual Panel", 5);
scroll_drag_from_min ("0.00_1", HSCROLL, 0);
wait(3);
    scroll_drag_from_min ("0.00_1", HSCROLL, 28);
}

report_msg("End of Output Discrete Test Function");
ddt_close(ODSC);

# Input Discretes - System2 - Virtual Panel
set_window ("Input Discretes - System2 - Virtual Panel", 2);

```

```

list_select_item ("Aircraft Identification", "*Custom"); # Item Number 20;
# Aircraft Identification : Custom Pin Setting
set_window ("Aircraft Identification : Custom Pin Setting", 0);
button_set ("Open_7", ON);
button_set ("Open_3", ON);
button_press ("OK");
}

####!!!!END ATP HARDWARE CHECKOUT FUNCTIONS!!!!####
#####
#####
####!!!!EMI HARDWARE CHECKOUT FUNCTIONS!!!!####
##### EMI Hardware Checkout Startup#####
public function EMI_Hardware_Check (runtimes)
{
auto i;
for (i=1; i<=runtimes; i++)
{
ddt_close_all_tables();
if (win_exists("EMI Air_Data TX", 1)!=E_OK)
EMI_Startup_ACO_Air_Data();
if (win_exists("EMI GPS_Navigation TX", 1)!=E_OK)
EMI_Startup_ACO_GPS_Navigation();
EMI_Check_Receivers("GPS_Navigation");
EMI_Check_Input("GPS_Navigation");
EMI_Check_Receivers("Air_Data");
EMI_Check_Input("Air_Data");
EMI_Check_Air_Data_Resolvers();
EMI_Check_Output_Discretes();
EMI_Check_Sensor_Assembly();

report_msg("Finished with Hardware Check (Run #" runtimes ").");
}
}
#####
#####
public function EMI_Startup_ACO_Air_Data()

```

```

{
auto value;
#Check and start 8 channel Air_Data transmitter
#####
    if(win_exists("ACO - EMI Air_Data TX",1)==E_OK)
    {
        set_window ("Air_Data HW TX", 1);
        button_set ("Start Transmitting", OFF);
        win_close("ACO - EMI Air_Data TX");
    }

    invoke_application("\\ACO\\ACO.exe","", "",SW_SHOW);
    # ACO_1
    set_window ("ACO_1", 5);
    button_press ("Yes")

    # Setup Page
    set_window ("Setup Page", 2);
    button_press ("Load");
    # Open
    set_window ("Open", 2);
    edit_set ("File name:", "");
    edit_set ("File name:", "EMI ACO Setup.aco");
    button_press ("Open_2");

    # Setup Page
    set_window ("Setup Page", 3);
    button_press ("OK");

    # ACO_2
    set_window ("ACO", 1);
    toolbar_button_press ("ToolbarWindow32", "#3");

    # Open Air_Data Transmitter Page
    set_window ("Open", 1);
    edit_set ("File name:", "");
    edit_set ("File name:", "EMI Air_Data TX");

```



```

        button_press ("Open_2");
        set_window ("EMI Air_Data TX", 1);
        button_set ("Start Transmitting", ON);
# Check and Start 8 Channel Air_Data Receiver Window
#####
        if(win_exists("ACO - EMI Air_Data RX",1)==E_OK)
        {
            set_window ("Air_Data HW RX", 1);
            button_set ("Start Receiving", OFF);
            win_close("ACO - EMI Air_Data RX");
        }

        invoke_application("\\ACO\\ACO.exe","", "",SW_SHOW);
# ACO_1
        set_window ("ACO_1", 0);
        button_press ("Yes");
# Setup Page
        set_window ("Setup Page", 3);
        button_press ("Cancel");
# ACO
        set_window ("ACO", 2);
        toolbar_button_press ("ToolbarWindow32", "#5");
# Open
        set_window ("Open", 3);
        edit_set ("File name:", "");
        edit_set ("File name:", "EMI Air_Data RX");
        button_press ("Open_2");
        set_window ("EMI Air_Data RX", 4);
        button_set ("Start Receiving", ON);
        win_resize ("EMI Air_Data RX", 924, 680);
        win_move ("EMI Air_Data RX", 0, 0);
        set_window ("ACO - EMI Air_Data RX", 2);
        menu_select_item ("Configuration;Update All Rx Labels");
    }
#####
#####
public function EMI_Startup_ACO_GPS_Navigation()

```

```

{
auto value;

#Check and start 8 channel GPS_Navigation transmitter
#####
    if(win_exists("ACO - EMI GPS_Navigation TX",1)==E_OK)
    {
        set_window ("GPS_Navigation HW TX", 1);
        button_set ("Start Transmitting", OFF);
        win_close("ACO - EMI GPS_Navigation TX");
    }

    invoke_application("\\ACO\\ACO.exe","", "",SW_SHOW);
    # ACO_1
    set_window ("ACO_1", 2);
    button_press ("Yes");

    # Setup Page
    set_window ("Setup Page", 2);
    button_press ("Cancel");

    # ACO_2
    set_window ("ACO", 1);
    toolbar_button_press ("ToolbarWindow32", "#3");

    # Open Unit 1,2,3 Air_Data Transmitter Pages
    set_window ("Open", 1);
    edit_set ("File name:", "");
    edit_set ("File name:", "EMI GPS_Navigation TX");
    button_press ("Open_2");
    set_window ("EMI GPS_Navigation TX", 1);
    button_set ("Start Transmitting", ON);
# Check and Start 16 Channel Receiver Window
#####
    if(win_exists("ACO - EMI GPS_Navigation RX",1)==E_OK)
    {
        set_window ("GPS_Navigation HW RX", 1);

```

```

        button_set ("Start Receiving", OFF);
        win_close("ACO - EMI GPS_Navigation RX");
    }

    invoke_application("\\ACO\\ACO.exe","", "",SW_SHOW);
    # ACO_1
    set_window ("ACO_1", 0);
    button_press ("Yes");

    # Setup Page
    set_window ("Setup Page", 3);
    button_press ("Cancel");
    # ACO
    set_window ("ACO", 2);
    toolbar_button_press ("ToolbarWindow32", "#5");
    # Open
    set_window ("Open", 3);
    edit_set ("File name:", "");
    edit_set ("File name:", "EMI GPS_Navigation RX");
    button_press ("Open_2");
    set_window ("EMI GPS_Navigation RX", 4);
    button_set ("Start Receiving", ON);
    win_resize ("EMI GPS_Navigation RX", 924, 680);
    win_move ("EMI GPS_Navigation RX", 0, 0);
    set_window ("ACO - EMI GPS_Navigation RX", 2);
    menu_select_item ("Configuration;Update All Rx Labels");
}
#####
#####
public function EMI_Check_Receivers(Function)
{
    auto Port;
    auto Label;
    auto RealValue;
    auto ExpectedValue;
    auto rate;
    auto rc;

```



```

public function EMI_Check_Input(Function)
{
    auto IDSC;
    auto rc;
    auto DDT_MODE_READ;
    auto IDSC_Row;
    auto Label;
    auto Discrete;
    auto ExpectedValue;
    auto Mask;
    auto Ground;
    auto Open;
    auto Bit;
    auto ActualBits;
    auto RealValue;
    auto i;
    auto array[];
    auto ReturnValue;
    auto bits[];
    auto Value;
    auto Designation;
    auto IDSC_RowCount;
    auto tm1;
    auto tm2;
    auto Port;
    auto TimeMark1;
    auto TimeMark2;
    auto TimeCount1;
    auto TimeCount2;
    auto Time1;
    auto Time2;
    auto bit[];
    auto EMI_window;
    auto rate;
    if (Function == "GPS_Navigation")
    {
        IDSC = "EMI GPS_Navigation input discretes.xls";
    }
}

```

```

        IDSC_RowCount = 4;
        EMI_window = "EMI GPS_Navigation RX";
    }
    else
    {
        IDSC_RowCount = 3;
        IDSC = "EMI Air_Data input discretes.xls";
        EMI_window = "EMI Air_Data RX";
    }

    IDSC = "EMI GPS_Navigation input discretes.xls";
    rc = ddt_open(IDSC, DDT_MODE_READ);
    if (rc!= E_OK && rc != E_FILE_OPEN)
        pause("Cannot open table.");
    for(IDSC_Row = 1; IDSC_Row <= IDSC_RowCount; IDSC_Row ++)
    {
        ddt_set_row(IDSC,IDSC_Row);

        Label = ddt_val(IDSC, "Label");
        ExpectedValue = ddt_val(IDSC, "Expected_with_Ground");
        Mask = ddt_val(IDSC, "Mask");
        Bit = ddt_val(IDSC, "Bit");
        Port = ddt_val(IDSC, "Port");

        for( i=1; i<=3; i++)
        {
            set_window (EMI_window, 5);
            obj_wait_info("SysListView32","displayed",1,10);
            list_activate_item ("SysListView32", Port ";" Label);

            if(win_exists("Label Data...", 1)!= E_OK)
                list_activate_item ("SysListView32", Port ";" Label);

            set_window("Label Data...", 1);
            obj_get_text("Rate", rate);
            obj_get_text("Value", RealValue);
            win_close ("Label Data...");
        }
    }

```

```

if (rate < 1 && i<3) #Try one more time due to Update Delay in ACO
    continue;
if (rate < 1 && i==3) #Label is not transmitted
    tl_step("Check " Function " Label " Label, FAIL, Function " Label " Label " Could not be checked, it was
    not transmitted.", Function " Label " Label " should be transmitted" , Function " Label " Label " Was not
    transmitted");

if (rate >= 1) #Check Label Value to expected
{
    RealValue = repl_str(RealValue, " ", "");
    # Convert ACO Bits String to Actual Bits set
    for (i=0; i < length(RealValue); i++)
    {
        array[i+1] = substr(RealValue, i+1, 1);

        if(array[i+1]==0)
            array[i+1] = "bit " 32-i " ";
        else
            array[i+1] = "";
    }
    #GPS_Navigation Labels are 100-103, Air_Data Labels are 110-112
    if (Label == 100)
        ActualBits = array[21] array[18] array[14] array[13] array[12] array[11] array[9];
    if (Label == 101)
        ActualBits = array[21] array[14] array[13] array[12] array[11] array[10] array[9] array[8];
    if (Label == 102)
        ActualBits = array[22] array[21] array[19] array[13] array[12] array[11] array[10] array[9];
    if (Label == 103)
        ActualBits = array[22] array[20] array[14] array[13] array[12] array[9];
    if (Label == 110)
        ActualBits = array[22] array[21] array[20] array[19] array[18] array[16] array[15] array[14]
        array[13] array[12] array[11] array[10] array[9] array[8] array[7];
    if (Label == 111)
        ActualBits = array[13] array[11] array[10] array[9] array[8] array[7];
    if (Label == 112)

```

```

        ActualBits = array[19] array[14] array[13] array[12] array[11] array[10] array[9] array[8]
        array[7];

        WRU_MaskAndCompareBinString(ExpectedValue, RealValue, Mask, ReturnValue);

        if (ReturnValue == 1)
            tl_step("Check " Function " Label " Label, PASS, "Discretes were set correctly on Label " Label
            " on " Function " ODB #" Port ". Expected Ground: Bit " Bit " set on " Function " Label " Label
            ". Actual: " ActualBits, "Expected: Bit " Bit " set on " Function " Label " Label, "Actual: "
            ActualBits);
        else
            tl_step("Check " Function " Label " Label, FAIL, "Discretes were NOT set correctly on Label "
            Label " on " Function " ODB #" Port ". Expected Ground: Bit " Bit " set on " Function " Label "
            Label ". Actual: " ActualBits, "Expected: Bit " Bit " set on " Function " Label " Label, "Actual: "
            ActualBits);
    }
    break;
}
}
# END GPS_Navigation DISCRETE CHECK LOOP
# Check GPS Time Mark Count
if (Function == "GPS_Navigation")
{
    for (i=1; i<=50; i++)
    {
        set_window ("GPS_Navigation HW RX", 5);
        obj_wait_info("SysListView32","displayed",1,10);
        list_activate_item ("SysListView32", "6;106");

        if (win_exists("Label Data...", 1)==E_OK)
        {
        }
        else
            list_activate_item ("SysListView32", "6;106");

        set_window("Label Data...", 1);
        obj_get_text("Value", RealValue);
    }
}

```



```

        win_close("Label Data...");

        if (RealValue != "00011100 00000000 00000011")
            i = 51;
    }

    RealValue = repl_str(RealValue, " ", "");
    Time2 = substr(RealValue, 7, 7);
    Time1 = substr(RealValue, 15, 7);
    # Now Convert Binary to Decimal (GPS Time Mark Counts)
    for (i=0; i<length(Time1); i++)
    {
        bit[i] = substr(Time1, length(TimeMark1)-i, 1);
        TimeCount1 += bit[i] * 2^i;
    }

    for (i=0; i<length(Time2); i++)
    {
        bit[i] = substr(Time2, length(Time2)-i, 1);
        TimeCount2 += bit[i] * 2^i;
    }

    tl_step("GPS Time Mark #1", PASS, "GPS Time Mark #1 Count: " TimeCount1);
    tl_step("GPS Time Mark #2", PASS, "GPS Time Mark #2 Count: " TimeCount2);
}

report_msg("End of " Function " Input Discrete Test Function");
ddt_close(IDSC);
}
#####
#####
public function EMI_Check_Resolvers()
{
    auto Resolvers;
    auto DDT_MODE_READ;
    auto Control;
    auto Value;
    auto Label;

```

```

auto ExpectedValue;
auto Designation;
auto ResolverValue;
auto RealValue;
auto ResolverValueDec;
auto TwosComp;
auto RealVoltage;
auto SetValue;
auto rc;
auto i;
auto Resolvers_Row;
auto rate;
auto Angle;
auto bits[];
auto bit[];
auto twos[];
auto Units;
auto Port;
auto Resolvers_RowCount = 20;
auto MaxVoltage = 9.0;
auto Tolerance;
auto ResRef;
auto Function;

Resolvers = "EMI Air_Data resolvers.xls";
rc = ddt_open(Resolvers, DDT_MODE_READ);
if (rc!= E_OK && rc != E_FILE_OPEN)
    pause("Cannot open table.");
for(Resolvers_Row = 1; Resolvers_Row <= 20; Resolvers_Row ++)
{
    ddt_set_row(Resolvers,Resolvers_Row);

    Label = ddt_val(Resolvers, "Label")
    Designation = ddt_val(Resolvers, "Designation");
    ExpectedValue = ddt_val(Resolvers, "Expected_Value_Dec");
    Units = ddt_val(Resolvers, "Units");
    Angle = ddt_val(Resolvers, "Angle");
}

```

```

Port = ddt_val(Resolvers, "Port");
ResolverValue = "";
TwosComp = "";
Function = "Air_Data";
for(i=1; i<=10; i++)
{
    set_window ("Air_Data HW RX", 5);
    obj_wait_info("SysListView32","displayed",1,10);
    list_activate_item ("SysListView32", Port ";" Label);

    if(win_exists("Label Data...", 1)!= E_OK)
        list_activate_item ("SysListView32", Port ";" Label);

    set_window("Label Data...", 1);
    obj_get_text("Rate", rate);
    obj_get_text("Value", RealValue);
    win_close ("Label Data...");

    if (rate < 1 && i<10) #Try again due to Update Delay in ACO
        continue;
    if (rate < 1 && i==10) #Label is not transmitted
        tl_step("Check " Function " Label " Label, FAIL, Function " Label " Label " Could not be checked, it was
        not transmitted.", Function " Label " Label " should be transmitted" , Function " Label " Label " Was not
        transmitted");

    # Check Resolver Values
    if (rate >= 1)
    {
        RealValue = repl_str(RealValue, " ", "");
        ResolverValue = substr(RealValue, 7, 16);

        # Need Twos Compliment if MSB is 1
        if (substr(ResolverValue, 1, 1) == 1)
        {
            for(i=2; i<=16; i++)
            {
                twos[i] = substr(ResolverValue, i, 1);
            }
        }
    }
}

```

```

        if(twos[i] == 1)
            twos[i] = 0;
        else
            twos[i] = 1;

        TwosComp = TwosComp twos[i];
    }
    ResolverValue = TwosComp;
}

# Now Convert Binary to Decimal and Multiply by 305 uV
ResolverValueDec = 0;
for (i=0; i<length(ResolverValue); i++)
{
    bit[i] = substr(ResolverValue, length(ResolverValue)-i, 1);
    ResolverValueDec += bit[i] * 2^i;
}

RealVoltage = ResolverValueDec * .000305;

if (substr(RealValue, 7, 1) == 1)
    RealVoltage = (ResolverValueDec * -0.000305) - .000305;

if (Resolvers_Row <= 8)
{
    if (ExpectedValue-MaxVoltage*.1 < RealVoltage && RealVoltage <
        ExpectedValue+MaxVoltage*.1)
        tl_step("Check " Designation, PASS, Designation " was set to within 10% Tolerance at
            Angle " Angle "°on Air_Data ODB #" Port ". Actual voltage: " RealVoltage " " Units ".
            Expected Voltage: "ExpectedValue " " Units, "Expected Voltage: " ExpectedValue " "
            Units, "Actual Voltage: " RealVoltage " " Units);
    else
        tl_step("Check " Designation, FAIL, Designation " was NOT within 10% Tolerance at
            Angle " Angle "°on Air_Data ODB #" Port ". Actual voltage: " RealVoltage " " Units ".
            Expected Voltage: "ExpectedValue " " Units, "Expected Voltage: " ExpectedValue " "
            Units, "Actual Voltage: " RealVoltage " " Units);
}

```

```

    }

    if (Resolvers_Row > 8 && Resolvers_Row <= 18)
    {
        if (ExpectedValue-MaxVoltage*.1 < RealVoltage && RealVoltage <
            ExpectedValue+MaxVoltage*.1)
            tl_step("Check " Designation, PASS, Designation " was set to within 10% Tolerance on
                Air_Data ODB #" Port ". Actual value: " RealVoltage " " Units ". Expected value:
                "ExpectedValue " " Units, "Expected value: " ExpectedValue " " Units, "Actual value: "
                RealVoltage " " Units);
        else
            tl_step("Check " Designation, FAIL, Designation " was NOT within 10% Tolerance on
                Air_Data ODB #" Port ". Actual value: " RealVoltage " " Units ". Expected value:
                "ExpectedValue " " Units, "Expected value: " ExpectedValue " " Units, "Actual value: "
                RealVoltage " " Units);
    }

    if (Resolvers_Row > 18 && Resolvers_Row <= 20)
    {
        RealVoltage = ResolverValueDec / .000305;
        if (ExpectedValue*.9 < RealVoltage && RealVoltage < ExpectedValue*1.1)
            tl_step("Check " Designation, PASS, Designation " was set to within 10% Tolerance on
                Air_Data ODB #" Port ". Actual value: " RealVoltage " " Units ". Expected value:
                "ExpectedValue " " Units, "Expected value: " ExpectedValue " " Units, "Actual value: "
                RealVoltage " " Units);
        else
            tl_step("Check " Designation, FAIL, Designation " was NOT within 10% Tolerance on
                Air_Data ODB #" Port ". Actual value: " RealVoltage " " Units ". Expected value:
                "ExpectedValue " " Units, "Expected value: " ExpectedValue " " Units, "Actual value: "
                RealVoltage " " Units);
    }
    }
    break;
}

}
report_msg("End of Air_Data Resolver Test Function");
ddt_close(Resolvers);

```

```

}
#####
#####
public function EMI_Check_Output_Discretes()
{
    auto ODSC;
    auto rc;
    auto DDT_MODE_READ;
    auto ODSC_Row;
    auto Label;
    auto Discrete;
    auto value;
    auto Output;
    auto Mask;
    auto Ground;
    auto Open;
    auto i;
    auto Designation;
    auto ODSC_RowCount = 6;
    auto Batt;
    auto DC;
    auto Navigation;
    auto Align;
    auto Function;
    auto Expected;
    auto Port;
    auto RealValue;
    auto array[];
    auto Bit[];
    auto Setting;
    auto rate;

    ODSC = "EMI output discretes.xls";
    rc = ddt_open(ODSC, DDT_MODE_READ);
    if (rc!= E_OK && rc != E_FILE_OPEN)
        pause("Cannot open table.");

    #Check Output Discretes with Input Enabled

```

```

for(ODSC_Row = 1; ODSC_Row <= ODSC_RowCount; ODSC_Row ++)
{
    ddt_set_row(ODSC,ODSC_Row);

    Discrete = ddt_val(ODSC, "Input");
    Output = ddt_val(ODSC, "Output");
    Designation = ddt_val(ODSC, "Designation");
    Function = ddt_val(ODSC, "Function");
    Label = ddt_val(ODSC, "Label");
    Expected = ddt_val(ODSC, "Expected_Bit");
    Port = ddt_val(ODSC, "Port");
    Setting = ddt_val(ODSC, "Setting");
    for( i=1; i<=3; i++)
    {
        set_window ("EMI " Function " RX", 5);
        obj_wait_info("SysListView32","displayed",1,10);
        list_activate_item ("SysListView32", Port ";" Label);

        if(win_exists("Label Data...", 1)!= E_OK)
            list_activate_item ("SysListView32", Port ";" Label);

        set_window("Label Data...", 1);
        obj_get_text("Rate", rate);
        obj_get_text("Value", RealValue);
        win_close ("Label Data...");

        if (rate < 1 && i<3) #Try one more time due to Update Delay in ACO
            continue;
        if (rate < 1 && i==3) #Label is not transmitted
            tl_step("Check " Function " Label " Label, FAIL, Function " Label " Label " Could not be checked, it was
not transmitted.", Function " Label " Label " should be transmitted" , Function " Label " Label " Was not
transmitted");

        if (rate >= 1)
        {
            RealValue = repl_str(RealValue, " ", "");
            # Convert ACO Bits String to Actual Bits set

```

```

        for (i=length(RealValue); i > 0; i--)
        {
            array[33-i] = substr(RealValue, i, 1);
        }

        if (array[Expected] == Setting)
            tl_step("Check " Discrete " " Designation " sets " Output " W/A", PASS, Output " W/A was set
            on " Function " Label " Label " as Bit " Expected ".");
        else
            tl_step("Check " Discrete " " Designation " sets " Output " W/A", FAIL, Output " W/A was NOT
            set on " Function " Label " Label " as Bit " Expected ".");
    }
    break;
}

}

report_msg("End of Output Discrete W/A Test Function");
ddt_close(ODSC);
}
#####
#####
public function EMI_Check_Sensor_Assembly()
{
    auto SA;
    auto Expected;
    auto Mask;
    auto Label;
    auto Transmitter;
    auto Description;
    auto Port;
    auto rate;
    auto rc;
    auto RealValue;
    auto i;
    auto n;
    auto Count;
    auto array[];
    auto ActualBits;

```



```

auto ReturnValue;
auto MessageCount1;
auto MessageCount2;
auto RealValueMSH;
auto RealValueLSH;
auto MessageCount[];
auto ECC_ErrorCount;
auto ECC[];
auto bit[];
auto SA_TableRow;
auto CountValue;
auto Message[];
auto ErrorMessageCount;
auto Error[];
auto ErrorCount;
    SA = "EMI sensor assembly data.xls";
    rc = ddt_open(SA, DDT_MODE_READ);
    if (rc!= E_OK && rc != E_FILE_OPEN)
        pause("Cannot open table.");

    # Check Processor Control Registers for Errors
    for (SA_TableRow = 1; SA_TableRow < 1; SA_TableRow++)
    {
        ddt_set_row(SA, SA_TableRow);
        Label = ddt_val(SA, "Label");
        Description = ddt_val(SA, "Description");
        Port = ddt_val(SA, "Port");
        Expected = ddt_val(SA, "Expected");
        Mask = ddt_val(SA, "Mask");

        for( i=1; i<=3; i++)
        {
            set_window ("EMI Air_Data RX", 5);
            obj_wait_info("SysListView32","displayed",1,10);
            list_activate_item ("SysListView32", Port "," Label);

            if(win_exists("Label Data...", 1)!= E_OK)

```

```

list_activate_item ("SysListView32", Port ";" Label);

set_window("Label Data...", 1);
obj_get_text("Rate", rate);
obj_get_text("Value", RealValue);
win_close ("Label Data...");

if (rate < 1 && i<3) #Try one more time due to Update Delay in ACO
    continue;
if (rate < 1 && i==3) #Label is not transmitted
    tl_step("Check Air_Data Label " Label, FAIL, "Air_Data Label " Label " Could not be checked, it was
    not transmitted.", "Air_Data Label " Label " should be transmitted" , "Air_Data Label " Label " Was not
    transmitted");

if (rate >= 1)
{
    RealValue = repl_str(RealValue, " ", "");

    if (Label == 151)
    {
        CountValue = substr(RealValue, 15, 8);

        # Now Convert Binary to Decimal (Error Count)
        for (i=0; i<length(CountValue); i++)
        {
            ECC[i] = substr(CountValue, length(CountValue)-i, 1);
            ECC_ErrorCount += ECC[i] * 2^i;
        }

        if (ECC_ErrorCount > 0)
            tl_step("Check TESCR1 Single ECC Error Count", FAIL, ECC_ErrorCount " Single
            ECC Error(s) Present on Air_Data Label " Label, "No ECC Error(s) Present.",
            ECC_ErrorCount " Single ECC Error(s) Present.");
        else
            tl_step("Check TESCR1 Single ECC Error Count", PASS, "No ECC Error(s) Present.",
            "No ECC Error(s) Present on Air_Data Label " Label, "No Single ECC Error(s)
            Present.");
    }
}

```

```

}

else
{
    # Convert ACO Bits String to Actual Bits set
    for (i=0; i < length(RealValue); i++)
    {
        array[i+1] = substr(RealValue, i+1, 1);

        if(array[i+1]==1)
            array[i+1] = 32-i " ";
        else
            array[i+1] = "";
    }

    switch(Label)
    {
        case 150:
            ActualBits = "Bit(s) " array[13] array[12] array[11] array[10] array[9] array[8];
            break;

        case 152:
            ActualBits = "Bit(s) " array[22] array[21] array[20] array[19] array[18] array[17]
            array[16] array[15] array[9] array[8];
            break;

        case 153:
            ActualBits = "Bit(s) " array[18] array[17] array[16] array[15] array[14] array[13]
            array[12] array[11] array[10] array[9] array[8] array[7];
            break;
    }

    WRU_MaskAndCompareBinString(Expected, RealValue, Mask, ReturnValue);

    if (ReturnValue == 1)
        tl_step("Check " Description, PASS, "No " Description " Found on Label " Label, "No "
        Description " Found.", "No " Description " Found.");
}

```

```

else
    tl_step("Check " Description, FAIL, Description " Found on Label " Label ". Check Error
Corresponding to " ActualBits " of Label " Label "., "No " Description " Found.", "Error
Corresponding to " ActualBits " of Label " Label ".");
    }
    }
    break;
}
}

# Check AFDX Message Count and Errors
for (SA_TableRow=5; SA_TableRow<=12; SA_TableRow++)
{
    # Check First Label Value
    ddt_set_row(SA, SA_TableRow);
    Label = ddt_val(SA, "Label");
    Description = ddt_val(SA, "Description");
    Port = ddt_val(SA, "Port");
    Expected = ddt_val(SA, "Expected");
    Mask = ddt_val(SA, "Mask");

    if(Label==154 || Label==156 || Label==164 || Label==170)
    {
        for (n=1; n<=2; n++)
        {
            # Check First Label Value
            ddt_set_row(SA, SA_TableRow);
            Label = ddt_val(SA, "Label");
            Description = ddt_val(SA, "Description");
            Port = ddt_val(SA, "Port");
            Expected = ddt_val(SA, "Expected");
            Mask = ddt_val(SA, "Mask");

            for( i=1; i<=3; i++)
            {
                set_window ("EMI Air_Data RX", 5);
                obj_wait_info("SysListView32","displayed",1,10);
            }
        }
    }
}

```

```

list_activate_item ("SysListView32", Port ";" Label);

if(win_exists("Label Data...", 1)!= E_OK)
    list_activate_item ("SysListView32", Port ";" Label);

set_window("Label Data...", 1);
obj_get_text("Rate", rate);
obj_get_text("Value", RealValue);
win_close ("Label Data...");

if (rate < 1 && i<3) #Try one more time due to Update Delay in ACO
    continue;
if (rate < 1 && i==3) #Label is not transmitted
    tl_step("Check Air_Data Label " Label, FAIL, "Air_Data Label " Label " Could not be
        checked, it was not transmitted.", "Air_Data Label " Label " should be transmitted" ,
        "Air_Data Label " Label " Was not transmitted");

if (rate >= 1)
{
    RealValue = repl_str(RealValue, " ", "");
    RealValueMSH = substr(RealValue, 7, 16);

    #Check Next Label Value
    SA_TableRow = SA_TableRow+1;
    ddt_set_row(SA, SA_TableRow);
    Label = ddt_val(SA, "Label");
    Description = ddt_val(SA, "Description");
    Port = ddt_val(SA, "Port");
    Expected = ddt_val(SA, "Expected");
    Mask = ddt_val(SA, "Mask");

    for( i=1; i<=3; i++)
    {
        set_window ("EMI Air_Data RX", 5);
        obj_wait_info("SysListView32","displayed",1,10);
        list_activate_item ("SysListView32", Port ";" Label);
    }
}

```

```

if(win_exists("Label Data...", 1)!= E_OK)
    list_activate_item ("SysListView32", Port ";" Label);

set_window("Label Data...", 1);
obj_get_text("Rate", rate);
obj_get_text("Value", RealValue);
win_close ("Label Data...");

if (rate < 1 && i<3) #Try one more time due to Update Delay in ACO
    continue;
if (rate < 1 && i==3) #Label is not transmitted
    tl_step("Check Air_Data Label " Label, FAIL, "Air_Data Label " Label "
    Could not be checked, it was not transmitted.", "Air_Data Label " Label
    " should be transmitted" , "Air_Data Label " Label " Was not
    transmitted");

if (rate >= 1)
{
    RealValue = repl_str(RealValue, " ", "");
    RealValueLSH = substr(RealValue, 7, 16);

    Count = RealValueMSH RealValueLSH;
    MessageCount[n] = 0;

    # Now Convert Binary to Decimal
    for (i=0; i<length(Count); i++)
    {
        Message[i] = substr(Count, length(Count)-i, 1);
        MessageCount[n] += Message[i] * 2^i;
    }

    if (n==1)
        SA_TableRow = SA_TableRow-1;
    }
break;
}
}

```

```

        break;
    }
}
else
{
    for( i=1; i<=3; i++)
    {
        set_window ("EMI Air_Data RX", 5);
        obj_wait_info("SysListView32","displayed",1,10);
        list_activate_item ("SysListView32", Port ";" Label);

        if(win_exists("Label Data...", 1)!= E_OK)
            list_activate_item ("SysListView32", Port ";" Label);

        set_window("Label Data...", 1);
        obj_get_text("Rate", rate);
        obj_get_text("Value", RealValue);
        win_close ("Label Data...");

        if (rate < 1 && i<3) #Try one more time due to Update Delay in ACO
            continue;
        if (rate < 1 && i==3) #Label is not transmitted
            tl_step("Check Air_Data Label " Label, FAIL, "Air_Data Label " Label " Could not be checked,
            it was not transmitted.", "Air_Data Label " Label " should be transmitted" , "Air_Data Label "
            Label " Was not transmitted");

        if (rate >= 1)
        {
            RealValue = repl_str(RealValue, " ", "");
            RealValueMSH = substr(RealValue, 7, 16);

            #Check Next Label Value
            SA_TableRow = SA_TableRow+1;
            ddt_set_row(SA, SA_TableRow);
            Label = ddt_val(SA, "Label");

```

```

Description = ddt_val(SA, "Description");
Port = ddt_val(SA, "Port");
Expected = ddt_val(SA, "Expected");
Mask = ddt_val(SA, "Mask");

for( i=1; i<=3; i++)
{
    set_window ("EMI Air_Data RX", 5);
    obj_wait_info("SysListView32","displayed",1,10);
    list_activate_item ("SysListView32", Port ";" Label);

    if(win_exists("Label Data...", 1)!= E_OK)
        list_activate_item ("SysListView32", Port ";" Label);

    set_window("Label Data...", 1);
    obj_get_text("Rate", rate);
    obj_get_text("Value", RealValue);
    win_close ("Label Data...");

    if (rate < 1 && i<3) #Try one more time due to Update Delay in ACO
        continue;
    if (rate < 1 && i==3) #Label is not transmitted
        tl_step("Check Air_Data Label " Label, FAIL, "Air_Data Label " Label " Could
        not be checked, it was not transmitted.", "Air_Data Label " Label " should be
        transmitted" , "Air_Data Label " Label " Was not transmitted");

    if (rate >= 1)
    {
        RealValue = repl_str(RealValue, " ", "");
        RealValueLSH = substr(RealValue, 7, 16);

        ErrorCount = RealValueMSH RealValueLSH;
        ErrorMessageCount = 0;

        # Now Convert Binary to Decimal
        for (i=0; i<length(ErrorCount); i++)
        {

```



```

Error[i] = substr(ErrorCount, length(ErrorCount)-i, 1);
ErrorMessageCount += Error[i] * 2^i;
    }
    }
    break;
}
}
break;
}
}
if(SA_TableRow==6 || SA_TableRow==8 || SA_TableRow==14 || SA_TableRow==18)
{
    if (MessageCount[2] > MessageCount[1])
        tl_step("Check " Description " is incrementing.", PASS, Description " is incrementing. Message Count 1
        = " MessageCount[1] ". Message Count 2 = " MessageCount[2], Description " is incrementing.",
        Description " is incrementing.");
    else
        tl_step("Check " Description " is incrementing.", FAIL, Description " is NOT incrementing. Message
        Count 1 = " MessageCount[1] ". Message Count 2 = " MessageCount[2], Description " is incrementing.",
        Description " is NOT incrementing.");
}
else
{
    if(ErrorMessageCount > 0)
        tl_step("Check " Description, FAIL, Description " is greater than zero. Error Count = "
        ErrorMessageCount ".", Description " should be zero.", Description " is greater than zero.");
    else
        tl_step("Check " Description, PASS, Description " is zero.", Description " should be zero.", Description "
        is zero.");
}
}
}
Check_Label_Transmission("Check IMU Transmission","Air_Data_HW",164,"Transmitted");
Check_Label_Transmission("Check IMU Transmission","Air_Data_HW",165,"Transmitted");
Check_Label_Transmission("Check IMU Transmission","Air_Data_HW",166,"Transmitted");
Check_Label_Transmission("Check IMU Transmission","Air_Data_HW",167,"Transmitted");
Check_Label_Transmission("Check IMU Transmission","Air_Data_HW",170,"Transmitted");

```

```

        Check_Label_Transmission("Check IMU Transmission","Air_Data_HW",171,"Transmitted");
        Check_Label_Transmission("Check IMU Transmission","Air_Data_HW",172,"Transmitted");
        Check_Label_Transmission("Check IMU Transmission","Air_Data_HW",173,"Transmitted");
report_msg("End of AFDX/SA Message and Error Count Check.");
ddt_close(SA);
}
#####
#####
public function EMI_Recorded_Labels(Label_Table)
{
    auto Record;
    auto array[];
    auto Label;
    auto Label_Row;
    auto rc;
    auto i;
    auto Expected;
    auto Label_Number;
    auto Data;
    auto Event;
    auto Function;
        split(Label_Table, array, " ");
        Function = array[1];
        if (Function == "Air_Data")
            Label = "Air_Data Expected Data.xls";
        else
            Label = "GPS_Navigation Expected Data.xls";
        rc = ddt_open(Label, DDT_MODE_READ);
        if (rc!= E_OK && rc != E_FILE_OPEN)
            pause("Cannot open expected data table.");

        Record = "" Label_Table ".xls";
        rc = ddt_open(Record, DDT_MODE_READ);
        if (rc!= E_OK && rc != E_FILE_OPEN)
            pause("Cannot open record data table.");
        for (Label_Row = 1; Label_Row < 500; Label_Row++)
        {

```

```

ddt_set_row(Label, Label_Row);
Expected = ddt_val(Label, "Expected_Data");
Label_Number = ddt_val(Label, "Label");

if (Expected == "#")
    break;

report_msg("Beginning " Function " Label " Label_Number " Record Check from " Label_Table ".xls. Assume Pass if no
failures reported.");
for(i=1; i<10000; i++)
{
    ddt_set_row(Record, i);
    Data = ddt_val(Record, "Label_ " Label_Number);
    Event = ddt_val(Record, "Event_Marker");

    if(Event == "#")
        i=10001;

    if (Data != "" && Data != Expected)
        tl_step("Check Label " Label_Number " Recorded Data.", FAIL, "The Actual Recorded Label "
Label_Number " data (" Data ") did not match the Expected (" Expected ").", "The Data on Label "
Label_Number " should be equal to " Expected ".", "The actual data on Label " Label_Number " was "
Data ".");
}
}
report_msg("Finished Checking " Label_Table ".xls");
ddt_close_all_tables();
}
####!!!!END EMI HARDWARE CHECKOUT FUNCTIONS!!!!####

```