GCI E84 Emulator Application Users Manual

Version 2.6a

Get Control, Inc.
Embedded Solutions

Table of Contents

List of Figures

List of Tables

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Overview

Due to the migration to large wafer sizes, semiconductor factories are moving toward highly automated material handling systems (AMHS) to transfer wafer carriers of increasing weight. The parallel input / output (PI/O) control signals between the production equipment and the AMHS must be better defined for more reliable and efficient carrier hand-offs (load/unload) at production equipment Load Ports.

To accomplish this, a new communications specification was created (SEMI® E84) to enhance the capabilities of the parallel I/O interface defined in SEMI® E84. SEMI® E84 supports the improvements in reliability and efficiency of carrier transfer required. The enhanced capabilities include continuous handoff, simultaneous handoff, and the capabilities of error detection on the interface.

The **E84 Emulator** provides an automated method to test the active and passive E84 interfaces on semiconductor processing equipment. The emulator utilizes a software based platform that runs on a PC using the Windows XP, 7, or 10 operating system. This software provides the graphical user interface (GUI) and the control algorithms. The **E84 Emulator** provides the hardware required to interface with the active or passive process equipment. The **E84 Emulator** interfaces with the PCs USB port.

The **E84 Emulator** performs automated E84 interface testing following pre-defined industry standard test plans. These test plans provide a means of verifying the E84 compliance of both active and passive process equipment. All defined handoff sequences are supported, including Single, Simultaneous and Continuous modes.

The **E84 Emulator** GUI was developed in Corel ® Paradox, an object-oriented database package. The GUI provides a menu driven system consisting of configuration and test screens. The database capabilities of Paradox provide for the storage and retrieval of test configuration and results by the operator.

The pre-defined test plans are implemented both in Paradox database tables and as a Windows dynamic link library (DLL) that was developed in C++. The DLL interfaces with the GUI using DLL function calls from the Paradox application. The DLL interfaces with the **E84 Emulator** through the USB port. The DLL provides the algorithms that perform the signal handshaking of active (or passive) signals to match the E84 interface specification. The **E84 Emulator** also provides algorithms and hardware required to perform the +24V tests defined by the E84 interface specification. It includes additional hardware to implement an accurate hardware timer circuit for timing the E84 handshaking signals.

E84 Emulator Application Version 2.6a requires a USB Interface E84 Emulator whose hardware has been updated to version 1.3. Older versions of the E84 Emulator, both USB and Parallel Port versions, are not compatible. Contact GCI Support (support@getcontrol.com) for hardware upgrade pricing.

Getting Started

Minimum System Requirements

The **E84 Emulator Application** requires the following minimum system configuration:

- Windows XP, 7, or 10 operating system.
- One USB port for the USB Interface version.
- 40 MB of available hard disk space.

E84 Emulator Package Contents

The **E84 Emulator** package includes the following:

- The **E84 Emulator Application** installation CD-ROM.
- The **E84 Emulator.**
- 1 - 15', male-to-female, 25-pin, straight-through interface cable (connects the **E84 Emulator** to the process equipment under test).
- 1 - 6' power cable.
- 1 - USB Cable (for the USB Interface version).
- Printed *Getting Started* manual.

E84 Emulator Power Requirements

- 110 to 220 VAC 50 - 60 Hz (see rear panel).

Typographical Conventions

Throughout this manual, various type is used in describing the **E84 Emulator's** GUI. The styles defined here are used for:

Italics -	Used for screen names.
Underlined -	Used for option button names.
SMALL CAPS -	Used for data entry fields.

Installation

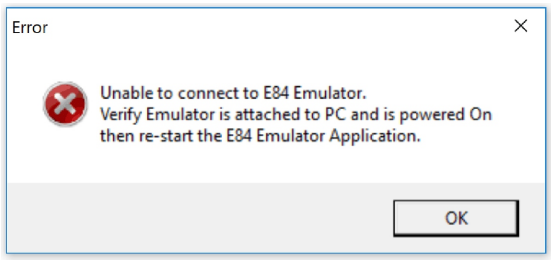
To install the **E84 Emulator Application**, run the GCI_E84EmulatorSetup.exe program from the E84 Emulator Installation CD.

Follow the on-screen instructions, selecting the destination directory. GCI recommends accepting the default directory. Selecting a directory within the C:\Program Files or C:\Program Files (x86) directory structure is not recommended and may cause unexpected application behavior.

When installation is complete, a dialog box is displayed indicating the completion of the installation. You must re-boot your system before using the **E84 Emulator Application**.

The setup program will add a shortcut to the **E84 Emulator Application** to your Start Menu. Use this shortcut to start the **E84 Emulator Application**.

If, when starting the E84 Emulator GUI, you receive an error message of the form:



Connection Error Message

the E84 Emulator Application has failed to connect to the E84 Emulator hardware.

Check that the USB cable is properly connected and the Emulator has power.

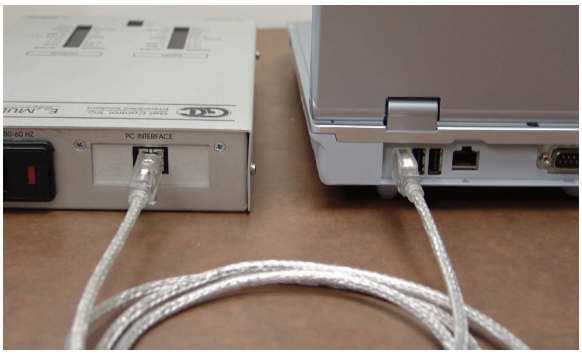
Uninstalling the E84 Emulator Application

The **E84 Emulator** Installation program adds a shortcut to an uninstall program that will completely remove the **E84 Emulator Application** from your system. If it becomes necessary to remove the Application, simply click on the Uninstall shortcut and follow the on-screen instructions.

PC to E84 Emulator Connection

Connect the **E84 Emulator** to a PC USB Port and turn the Emulator on before running the **E84 Emulator Application**.

Connect the provided USB cable into a USB Port on the PC and to the USB Port on the **E84 Emulator** as shown. The USB Port is located on the back panel next to the AC power input module. It is labeled PC INTERFACE.



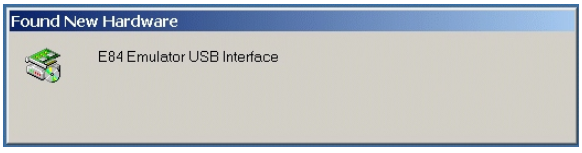
USB Cable Connection

Powering Up the E84 Emulator

Plug the provided standard power cord into the **E84 Emulator** and into a 100V - 240V AC wall outlet. Turn the power switch on. The power switch is located on the power input module.

The top of the **E84 Emulator** has cut-outs showing a series of status LEDs. Make sure the two green power LEDs are both illuminated (+24V and +5V). If either of these LEDs are not illuminated when the **E84 Emulator** is connected to a known good AC power source (and the power switch is in the ON position), there may be a problem with the power supply in the unit.

The first time the USB Interface is turned on, Windows will display a brief message indicating that it has found new hardware. The **E84 Emulator** USB interface utilizes the Human Interface Device (HID) Class of USB drivers. Windows XP, 7, and 10 all provide a default HID Class Driver. It is not necessary to install any additional drivers. Note, this message only appears the first time you start up the **E84 Emulator**.,

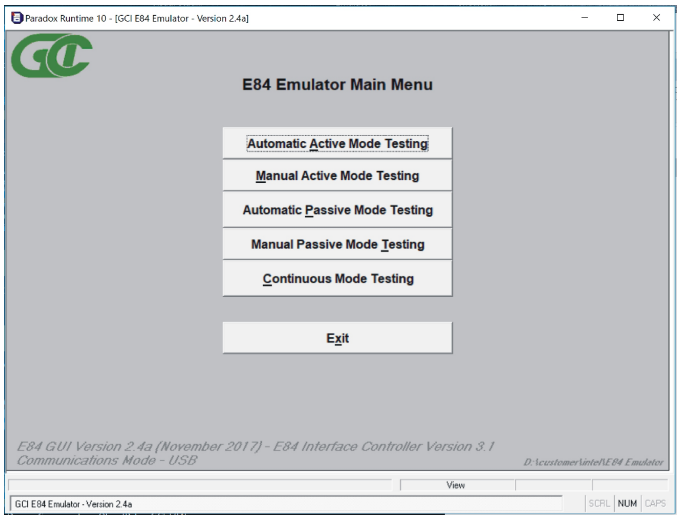


Found New Hardware Message

Connection Status Indicator

Launch the **E84 Emulator Application** from the Windows desktop. The Communications status is displayed in the lower left of the *Main Menu*. It will display *Communications Mode - USB* (for USB connection) when the **E84 Emulator Application** is properly communicating with the **E84 Emulator** USB Interface.

When the user attempts to use any of the four test buttons, the **E84 Emulator Application** attempts to communicate with the E84 Emulator. With communication established, testing continues normally. If the **E84 Emulator Application** cannot communicate with the **E84 Emulator**, a Communication Error Message will be displayed, and testing will be disabled.



E84 Emulator Main Menu

Using Optical Transceivers

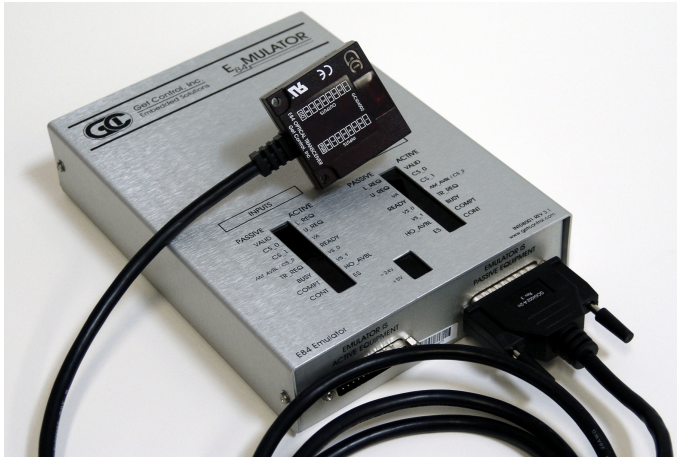
The Get Control **E84 Emulator** is shipped with a 15' connecting cable used for hardwired E84 emulation. The **E84 Emulator** is compatible with all E84 compatible Optical Transceivers. GCI produces several optical transceivers that can be used with the **E84 Emulator**.

P/N GCI04002 - **GCI E84 Optical Transceiver** (available in 2 and 5 meter cable lengths)
P/N GCI04100 - **GCI RJ-11 E84 Optical Transceiver** (with data logging)

Optical transceivers from GCI are compatible as shipped. Other optical transceivers must first be properly terminated with a male DB-25 connector, according to the E84 specification.

Plug an E84 compatible optical transceiver into the female DB-25 port on the **E84 Emulator** labeled **Emulator as Passive Equipment** as shown. With an optical transceiver connected in this way, the E84 Emulator Application can run both Active and Passive mode tests.

Do not attempt to install a gender changer between the optical transceiver and the **E84 Emulator**. Connecting the optical transceiver to the male DB-25 port labeled **Emulator as Active Equipment** using a gender changer will not work.



*Optical Transceiver connects to the **Emulator as Passive Equipment** female DB-25 connector*

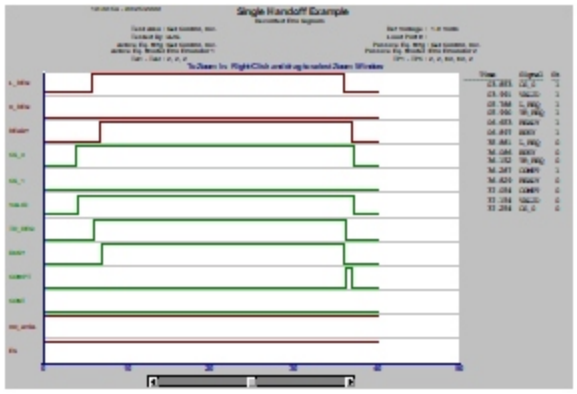
E84 Handoff Modes

The SEMI® E84 Specification defines three types of handoff modes, Single, Simultaneous, and Continuous. The **E84 Emulator** supports all three handoff modes. This section briefly describes each mode, and explains the associated testing capabilities of the **E84 Emulator**.

Single Handoff Mode

Single Handoff Mode is used to transfer a single carrier to or from a Load Port. The AMHS equipment defines the target Load Port at the beginning of the handoff sequence, using one of the Load Port select signals (CS_0, CS_1). Only one of the two signals is activated during the handoff sequence.

The figure at right shows E84 interface signals recorded during a typical Single Handoff Mode transfer. The timing diagram shows the CS_0 signal turning ON to indicate a Single Handoff Mode transfer.



Example Single Handoff Mode Transfer

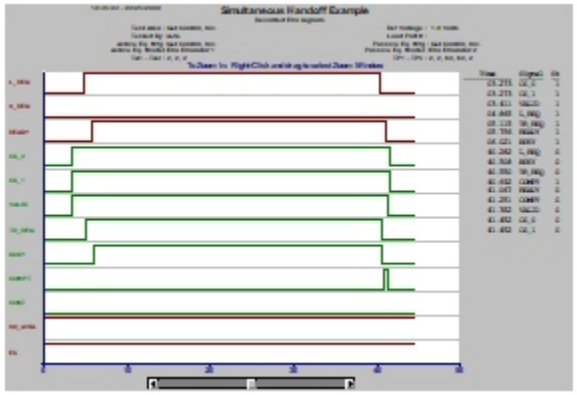
The **E84 Emulator Application** provides 17 active mode tests (Emulator acts as the active equipment) that can be run using Single Handoff Mode. These tests are selectable from the *Active Mode Test Setup Screen*, which can be reached from the *Main Menu* using the Automatic Active Mode Testing button. To configure a Single Handoff Mode test, simply select either the CS_0 or CS_1 button from the LOAD PORT NUMBER field on the *Active Mode Test Setup Screen*.

The **E84 Emulator Application** provides 15 passive mode tests (Emulator acts as the passive equipment) that can be run using Single Handoff Mode. These tests are selectable from the *Passive Mode Test Setup Screen*, which can be reached from the *Main Menu* using the Automatic Passive Mode Testing button. The active equipment sets the Load Port select signals. Therefor, in passive mode testing there are no Load Port select options. The Emulator simply provides the proper transfer handshaking, while monitoring and verifying the Load Port select signals detected at the beginning of the transfer.

Simultaneous Handoff Mode

Simultaneous Handoff Mode is used to transfer two carriers concurrently to or from two separate Load Ports. The AMHS equipment indicates a Simultaneous Handoff by setting **both** Load Port select signals (CS_0 and CS_1). Both signals remain activated during the handoff sequence.

The figure at right shows E84 interface signals recorded during a typical Simultaneous Handoff Mode transfer. The timing diagram shows the CS_0 and CS_1 signals turning ON, indicating a Simultaneous Handoff Mode transfer.



Example Simultaneous Handoff Mode Transfer

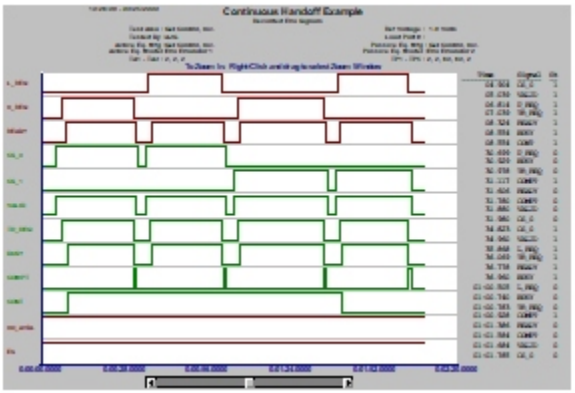
The 17 active mode tests provided by the **E84 Emulator Application** can be run in Simultaneous Handoff Mode as well as Single Handoff Mode. The only difference between Single and Simultaneous Handoff Modes is the use of the two Load Port select signals. This allows the **E84 Emulator Application** to use the same pre-defined tests to verify both Single and Simultaneous Handoff sequences. To configure a Simultaneous Handoff Mode test, simply select the Simultaneous button from the LOAD PORT NUMBER field on the *Active Mode Test Setup Screen*.

The 15 passive mode tests provided by the **E84 Emulator Application** can be also run in Simultaneous Handoff Mode as well as Single Handoff Mode.

Continuous Handoff Mode

Continuous Handoff Mode is used to transfer multiple carriers sequentially to or from a specific Load Port. The AMHS equipment indicates a Continuous Handoff by setting the CONT signal during the first carrier handoff, at the time the BUSY signal is turned ON. The AMHS keeps the CONT signal ON through subsequent carrier handoff's, turning it OFF during the last carrier handoff.

The figure at right shows E84 interface signals recorded during a typical Continuous Handoff Mode transfer. The timing diagram shows a four carrier, Continuous Handoff sequence: Unload CS_0, Load CS_0, Unload CS_1, Load CS_1. Note how the CONT signal turns ON during the first carrier handoff, and remains ON until the last carrier handoff.



Example Continuous Handoff Mode Transfer

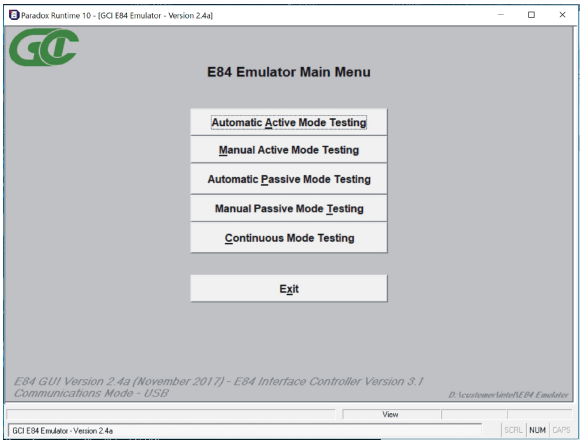
The **E84 Emulator Application** provides three Continuous Handoff Mode tests; two active mode, and one passive mode. These tests are selectable from the *Continuous Mode Test Setup Screen*, which can be reached from the *Main Menu* using the Continuous Mode Testing button.

Using the E84 Emulator GUI

The user interface is broken down into a series of menu, configuration, and test screens. The user navigates through these screens by selecting option buttons (with mouse clicks, or keystrokes) provided on each screen.

Main Menu

At startup, the **E84 Emulator** *Main Menu* is displayed. The *Main Menu* provides the user with options for Automatic and Manual testing for both Active and Passive equipment.



Main Menu

At the lower left corner of the *Main Menu*, version number information is displayed for both the GUI and the **E84 Emulator** firmware. The communications mode in use between the GUI and the **E84 Emulator** is also shown.

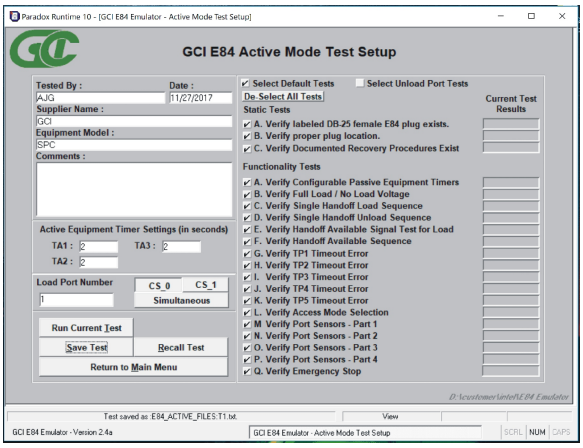
Each menu option is associated with a button on the *Main Menu*. The desired menu option is selected by clicking the button with the mouse, or using the keyboard to activate the associated hot key. An underlined character in the text of the button designates the buttons hot key. Generally, the first unique character in the buttons text is used for the hot key.

Six option buttons are available on the *Main Menu*.

Automated Active Mode Testing	Provides automated testing of passive equipment using pre-defined test plans. In this mode, the **E84 Emulator** acts as the active equipment. This option allows the user to run test plans in either Single or Simultaneous Handoff Modes.
Manual Active Mode Testing	Allows the user to manipulate each of the 7 Active mode signals, while monitoring the 5 Passive mode signals.
Automated Passive Mode Testing	Provides automated testing of active equipment using pre-defined test plans. In this mode, the **E84 Emulator** acts as the passive equipment. This option allows the user to run test plans in either Single or Simultaneous Handoff Modes.
Manual Passive Mode Testing	Allows the user to manipulate each of the 5 Passive mode signals, while monitoring the 7 Active mode signals.
Continuous Mode Testing	This option provides automated testing of either active or passive equipment using the Continuous Handoff Mode. Options on the *Continuous Mode Test Setup Screen* configure the **E84 Emulator** to act as either the active or passive equipment.
Exit	Closes the **E84 Emulator Application**.

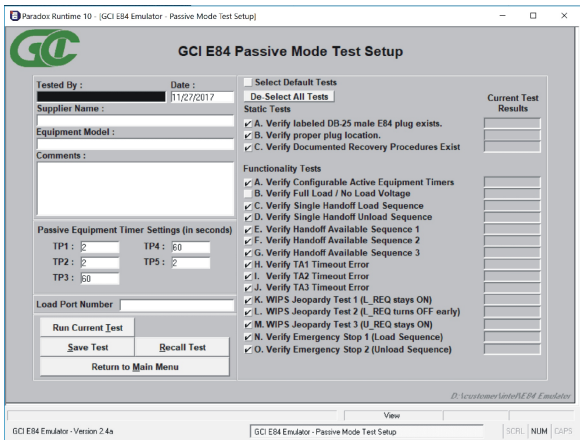
Automated Active Test Setup Screen
Automated Passive Test Setup Screen

The *Automated Active Mode* and *Automated Passive Mode* Test Setup screens are very similar. They are both described here with their differences noted where applicable. The *Automated Test Setup Screens* are displayed when the user selects the Automated Active Mode Testing or Automated Passive Mode Testing buttons from the *Main Menu*.



Automated Active Mode Test Setup Screen

The *Automated Test Setup Screen* is used to configure an Automated Test. When running Active Mode tests, the **E84 Emulator** is testing as the Active entity. Attach the female end of a straight through, 25-pin, male-to-female cable (provided) to the DB-25 connector labeled EMULATOR IS ACTIVE EQUIPMENT on the **E84 Emulator**. Attach the male end of the cable to the DB-25 E84 plug on the passive equipment being tested.



Automated Passive Mode Test Setup Screen

When running Passive Mode tests, the **E84 Emulator** is testing as the Passive entity. Attach the male end of a straight through, 25-pin, male-to-female cable (provided) to the DB-25 connector labeled EMULATOR IS PASSIVE EQUIPMENT on the **E84 Emulator**. Attach the female end of the cable to the DB-25 E84 plug on the active equipment being tested.

The *Automated Test Setup Screen* is divided into two main sections. The left side of the screen provides data fields for entering details about the equipment being tested. Data fields provided include the TESTER'S NAME, the TEST DATE (defaulted to today's date), the equipment SUPPLIER NAME and EQUIPMENT MODEL.

For Active Mode Tests, the desired Active Mode timeouts can be entered in the three ACTIVE EQUIPMENT TIMER SETTINGS box fields (TA1, TA2, TA3). The Load Port being tested is defined using the LOAD PORT NUMBER buttons and field. For Simultaneous Handoff Mode testing, select the Simultaneous button. For Single Handoff Mode testing, select either the CS_0 or CS_1 button.

For Passive Mode Tests, the desired Passive Mode timeouts can be entered in the five PASSIVE EQUIPMENT TIMER SETTINGS box fields (TP1, TP2, TP3, TP4, TP5). The Load Port being tested is defined using the LOAD PORT NUMBER field. Passive Mode testing does not require the definition of a specific Load Port select signal (CS_0, CS_1). The **E84 Emulator** notes which signal is activated at the beginning of the handoff sequence. This allows for passive mode testing of both Single and Simultaneous Handoff Modes.

A COMMENTS field is also provided to allow the user to enter test specific comments. All fields (with the exception of the COMMENTS field) must be entered before automated testing can begin.

The right side of the screen lists check-off boxes to select pre-defined Automated Tests provided by the **E84 Emulator**. The user simply checks off the desired tests. Next to each test definition on the right side of the screen is a field that shows the current test results for each test. Initially, the fields are empty since no tests have been run. Once each test is executed, the individual test results (Pass, Fail, Untested) are displayed in these fields. For details on the available active and passive mode tests, see the **Test Plans** section towards the end of this manual.

Select Default Tests Button

The Select Default Tests button selects default load cycle testing, and marks all tests to run. This provides a quick method of selecting all tests. For Passive Mode testing, this is the only function of the Select Default Tests button. For Active Mode testing, this button has one additional function.

The **E84 Emulator** can test certain Active Mode tests using either the Load or Unload Cycle sequences. The default testing method uses the Load Cycle. This button sets the **E84 Emulator** to use the Load Cycle tests.

Select Unload Port Tests Button

The Select Unload Port Tests button selects only those tests that can be tested using the Unload Cycle sequence. The tests included during Unload Port Testing are the five TP Timer tests, a handoff available test, Access Mode Selection, two Port Sensor tests, and the Emergency Stop test.

When the Select Unload Port Tests button is selected, a note is added to the text report.

Note that the test steps described in the **Active Mode Test Plan** section change to match the Unload Cycle when testing with the Select Unload Port Tests button selected.

De-Select All Tests Button

The De-Select All Tests button un-checks all tests, allowing the user to quickly remove all tests from the test plan. This is useful when the user wishes to run only one or two tests. Instead of having to un-click each unwanted test individually, the user can un-click all tests, then add only those tests desired.

Test Setup Option Buttons

A series of option buttons are provided at the lower left of the screen. These buttons allow the user to:

Run Selected Tests -	Initiates the selected Automated Tests.
New Test -	Clears all test information fields and selects all tests.
Save Test -	Saves current test setup details and test results to disk.
Recall Test -	Recalls previously saved test setup details and results from disk.
Return to Main Menu -	Closes the *Automated Test Setup Screen* and returns the user to the *Main Menu*.

Run Selected Tests Button

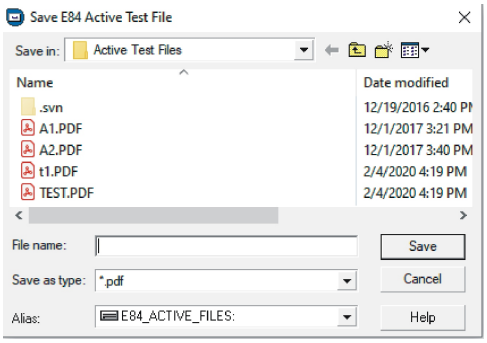
Selecting the Run Selected Tests button displays the *Automated Test Screen*, and starts the first selected test. The *Automated Test Screen* displays detailed information about the current Automated Test being executed. The same *Automated Test Screen* is used for both Active and Passive mode testing. Test titles and details are used to define the type of tests being run.

New Test Button

Selecting the New Test button clears all test information fields, clears all individual test comments, and selects all tests. If the current test setup has not been saved yet, the system will prompt the user for verification.

***Save Test* Button**

Selecting the Save Test button allows the user to save the current test setup and test results from completed tests to a file on the hard disk. The user is prompted for a file name through a standard Windows Save As dialog box. The user can enter a new file name, or select an existing one to overwrite. If an existing file is selected, the user will be warned before overwriting the file. The Save Test option saves the test information, setup and results in three separate files. The default location for saving Active Mode test files is a sub-directory named "Active Test Files" under the destination directory chosen during installation. The default location for saving Passive Mode test files is a sub-directory named "Passive Test Files" under the destination directory chosen during installation.



Save Test Setup Screen

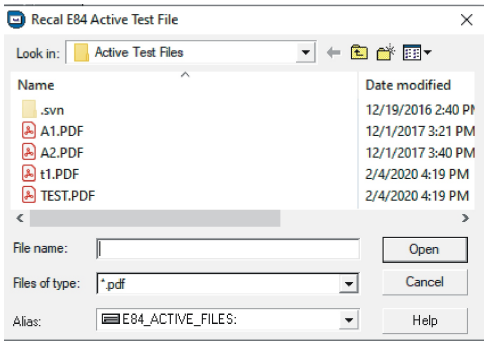
The main file saved is a PDF file formatted for printing. This PDF file contains all of the equipment information entered by the user, along with information about each Automated Test provided by the E84 Emulator. Test details include test title, results, and any comments entered by the user during testing.

Two additional database formatted files are saved to allow the **E84 Application** to easily recall saved test details. These two files are associated with the main ASCII text file, and are only accessed when the user chooses to recall the saved test. The user should take care in not deleting any of the three files. If any of the three files are removed from the system, the **E84 Application** cannot recall the test.

***Recall Test* Button**

Selecting the Recall Test button allows the user to restore test details that were previously saved to the hard disk. The user is prompted for a file name through a standard Windows **Select File** dialog box. When the user selects a previously saved test file, the **E84 Application** loads the test information and setup details from the two database formatted files associated with the recalled text file.

After reading the test details, all test screens are updated with the recalled information. The test results of any completed tests are displayed in the results fields next to the test definitions, and all Failed or Untested tests are selected.



Recall Test Setup Screen

***Return to Main Menu* Button**

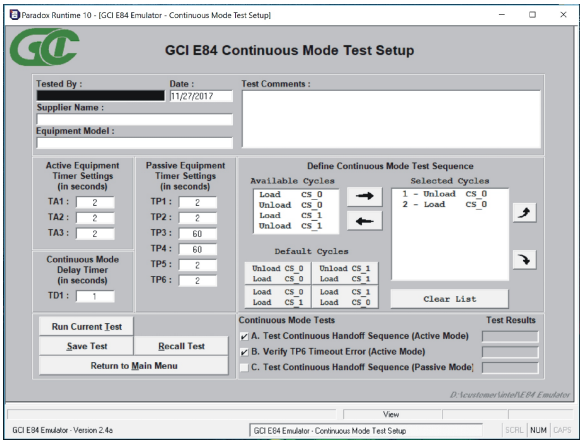
Pressing this button will close the *Automated Test Setup Screen* and return the user to the *Main Menu*. If the current test setup has not been saved, the user is first prompted to save the test.

Continuous Handoff Test Setup Screen

The *Continuous Mode Test Setup* screen is displayed when the user selects the Continuous Mode Testing button from the *Main Menu*.

The *Continuous Mode Test Setup Screen* is used to configure Continuous Handoff Mode tests. The *Continuous Mode Test Setup Screen* is divided into several sections.

Data entry fields allow the user to enter details about the equipment being tested. Data fields provided include the TESTER'S NAME, the TEST DATE (defaulted to today's date), the equipment SUPPLIER NAME and EQUIPMENT MODEL.



Continuous Mode Test Setup Screen

Active Mode timeouts can be entered in the three ACTIVE EQUIPMENT TIMER SETTINGS box fields (TA1, TA2, TA3). Passive Mode timeouts can be entered in the six PASSIVE EQUIPMENT TIMER SETTINGS box fields (TP1, TP2, TP3, TP4, TP5, TP6). Delay timer settings can be entered in the CONTINUOUS MODE DELAY TIMER box field (TD1).

A COMMENTS field is also provided to allow the user to enter test specific comments.

All fields (with the exception of the COMMENTS field) must be entered before automated testing can begin.

The bottom right side of the screen lists check-off boxes to select pre-defined Continuous Mode Tests provided by the **E84 Emulator**. The user simply checks off the desired tests. Next to each test definition on the right side of the screen is a field that shows the current test results for each test. Initially, the fields are empty since no tests have been run. Once each test is executed, the individual test results (Pass, Fail, Untested) are displayed in these fields. For details on the available Continuous Mode tests, see the **Test Plans** section towards the end of this manual.

Defining the Continuous Mode Test Sequence List

A DEFINE CONTINUOUS MODE TEST SEQUENCE box allows the user to define the specific order of handoff's to run during Continuous Handoff Mode testing. This box contains an AVAILABLE CYCLES list, a set of DEFAULT CYCLE buttons, the current set of selected handoff's (SELECTED CYCLES list), a Clear List button, an Add Cycle button, a Remove Cycle button, and two sorting buttons (Move Up, Move Down) displayed as arrows.

SELECTED CYCLES List

This field shows the list of currently selected handoff's. When running test A (active mode), this list defines the sequence of handoff's requested by the **E84 Emulator** acting as the active equipment. When running test C (passive mode), this list defines the sequence of handoff's the **E84 Emulator** expects to see when acting as the passive equipment. When running test B (TP6 Timeout Error), the first handoff in the list is requested by the **E84 Emulator**, after which the TP6 timeout error is verified.

At least one handoff must be placed in this list before testing can begin.

AVAILABLE CYCLES List

There are four available handoff's: Load CS_0, Unload CS_0, Load CS_1, Unload CS_1. Double-clicking one of these cycles will add that cycle to the SELECTED CYCLES list.

Add / Remove Buttons

The Add and Remove buttons are located between the AVAILABLE CYCLES list and the SELECTED CYCLES list, and take the shape of right and left arrows respectively. To Add a cycle, single click the desired cycle in the AVAILABLE CYCLES list (the selected cycle will be highlighted in blue) and click the Add (right arrow) button. The selected cycle will be added to the SELECTED CYCLES list.

To remove a cycle, single click the desired cycle in the SELECTED CYCLES list, and click the Remove (left arrow) button. The selected cycle will be removed from the SELECTED CYCLES list.

Clear List Button

This button clears the SELECTED CYCLES list.

Cycle Sorting Buttons

Two cycle sorting buttons positioned to the right of the SELECTED CYCLES list. The top button (displayed as an upward pointing arrow) moves the selected cycle up one step in the SELECTED CYCLES list. The bottom button (displayed as a downward pointing arrow) moves the selected cycle down one step in the SELECTED CYCLES list.

Default Cycles Buttons

A set of Default Cycle buttons are provided that allow the user to quickly define one of four standard Continuous Handoff sequences. These standard sequences include:

- Unload CS_0 - Load CS_0
- Unload CS_1 - Load CS_1
- Load CS_0 - Load CS_1
- Load CS_1 - Load CS_0

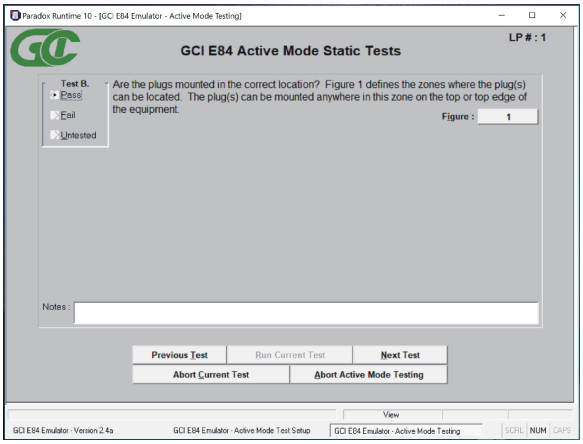
Test Setup Option Buttons

A series of option buttons are provided at the lower left of the screen. These buttons are identical to those found on the *Automated Active Mode* and *Automated Passive Mode* Test Setup screens, and allow the user to:

Run Selected Tests -	Initiates the selected Automated Tests.
New Test -	Clears all test information fields.
Save Test -	Saves current test setup details and test results to disk.
Recall Test -	Recalls previously saved test setup details and results from disk.
Return to Main Menu -	Closes the *Continuous Test Setup Screen* and returns the user to the *Main Menu*.

Automated Test Screens

An *Automated Test Screen* is used to display test status information during automated testing. The *Automated Test Screen* is displayed when the user selects the Run Selected Tests button from any of the three *Test Setup Screens*.

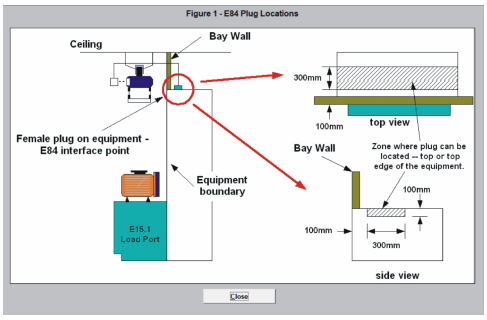


Automated Active Mode Test Screen

Details for the current test are displayed, including the test title, any test specific information, the test status (Passed, Failed, Untested), along with a user comment field and a series of option buttons.

The **E84 Test Plan** for Single and Simultaneous Handoff mode testing includes two types of Automated Tests, Static and Functionality. Static mode tests require the user to mark the test results manually. Typical Static tests include verification of proper E84 plug location. The user can mark the test results by clicking with the mouse, or using the hot-key combination from the keyboard. Hot keys for the three available test results are: Alt-P (Pass), Alt-F (Fail), Alt-U (Untested).

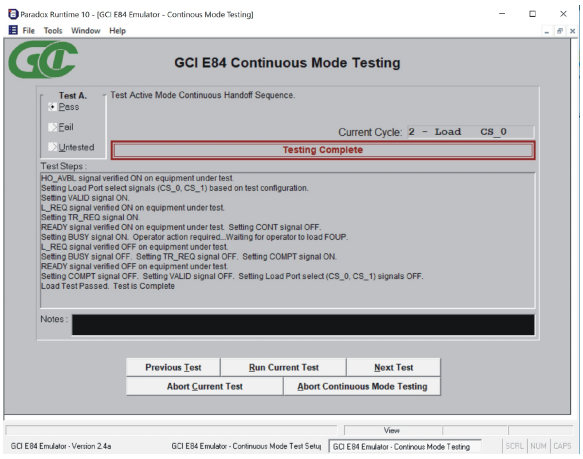
For static tests, the test title will instruct the user to mark the test results. If additional test instructions are required, a large window will be displayed in the center of the screen, containing detailed information for the user to complete the static test.



E84 Plug Locations

Additional information is available for some Single and Simultaneous Handoff mode tests in the form of graphic representations of E84 Specification details (for example, proper plug locations, and various timing diagrams). When an additional figure is available for the current test, an option button (labeled Figure: #) is displayed at the right side of the screen, just below the test title. Information in the test title will indicate to the user what details are available through this option button. This option button is enable throughout the current test, and can be selected at any time.

The second type of Automated Tests defined by the **E84 Test Plan** is Functionality tests. These tests are automated by the **E84 Emulator**, and include several individual steps to complete. During Functionality testing, a flashing "Please Wait - Testing" message is displayed directly below the test title. As each step of the current Functionality test is completed, a test step message is displayed in the large, center window of the *Automated Test Screen*. This window gives a detailed history of the steps completed for the given test. If the test fails, the test step that the failure occurred is displayed in this window, along with a failure message.



Continuous Mode Test Step Details

Continuous Handoff Mode testing involves running several separate handoff's sequentially. An typical Continuous Handoff Mode test might first Unload the carrier on Load Port CS_0, then load a new carrier to the same Load Port. For Continuous Handoff Mode testing, the test step details for each individual handoff is displayed during the handoff. At the end of each individual handoff, the message is displayed indicating that the **E84 Emulator** is processing the TD1 delay timer. This timer (defined by the SEMI® E84

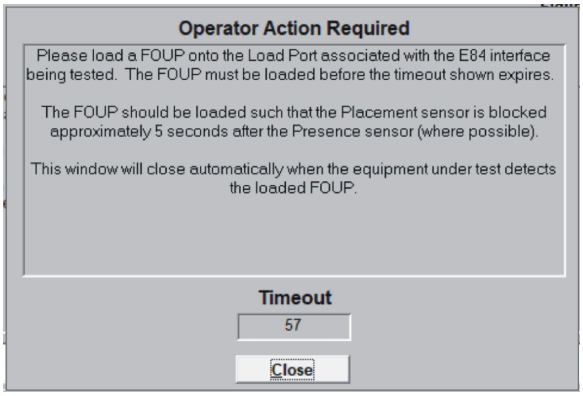
Specification as a delay time between the VALID signals of two successive handoff's) is used to separate two handoff's.

When the TD1 timer has expired, the center window on the *Automated Test Screen* is cleared, and the test steps for the next handoff are displayed.

During Continuous Handoff Mode testing, a CURRENT CYCLE field is displayed above the test step detail window, indicating the current handoff being tested.

Operator Action Required Screen

Most Functionality tests include at least one test step that requires the user to perform some action. A typical action would be loading a FOUP onto the Load Port during a Load Cycle test. When one of these test steps is processed, an *Operator Action Required Screen* is displayed, detailing the specific action required by the user.

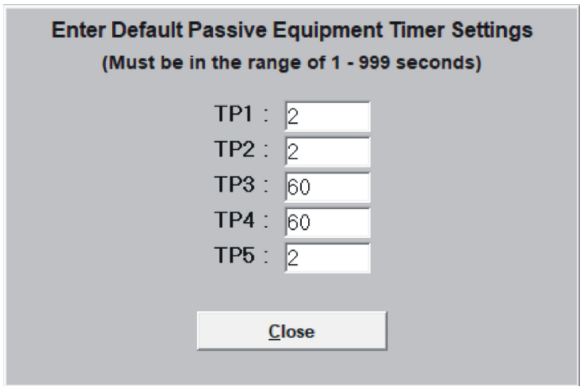


Operator Action Required Screen

Some of these required actions must be completed within a certain time frame. Continuing the example started above, during a Load cycle test, the **E84 Emulator** follows the proper handshaking with the process equipment until the point where the process equipment expects to see the FOUP loaded into its Load Port. The process equipment places a timeout (TP3) on seeing the FOUP loaded. If the FOUP is not positioned properly on the Load Port before the timeout expires, the process equipment will report an error.

Default Timer Settings Screen

The **E84 Emulator** uses timer information entered by the user during Active and Passive mode Functionality Test A to inform the user of the time available to complete the required action. If the user does not run Functionality Test A, the **E84 Emulator** uses the default timer values defined by the E84 specification. It is therefor very important that the user select the Functionality Test A during test setup.

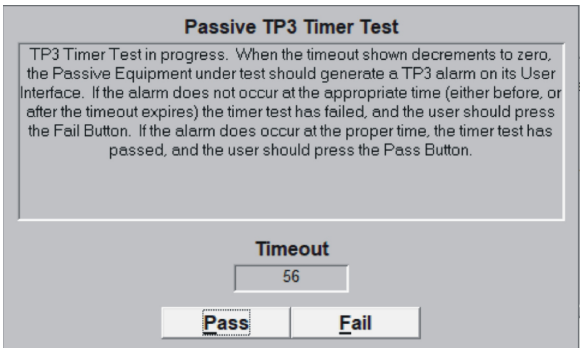


Default Timer Settings Screen

For Continuous Handoff Mode testing, all timer values are entered in the *Test Setup Screen*, therefor the *Default Timer Settings Screen* is not seen while running Continuous Handoff Mode tests.

When the *Operator Action Required Screen* is displayed, the value entered for the applicable timer setting is displayed on the *Operator Action Required Screen*. The display will decrement that timer value each second, showing the user the remaining time available to complete the required action.

Operator Prompted Pass / Fail Screen



Timer Test Pass/Fail Screen

Some Functionality tests (specifically the Timer tests) require the user to mark the final Pass/Fail status of the test based on feedback (unavailable to the **E84 Emulator**) from the equipment being tested. For example, when testing passive equipment timeout settings, the **E84 Emulator** will force a timeout error by not following the specified handshaking signals. The passive equipment being tested is required to issue a timeout alarm on its user interface. The details of this timeout alarm are not reported through the handshaking interface. The user is required to make the final Pass/Fail determination. The user is prompted for the Pass/Fail status of the test through a special *Timer Test Screen*. This screen provides the user with details on how to determine the Pass/Fail status of the test, along with two option buttons (Pass and Fail) to mark the actual test results.

Test NOTES Field

A NOTES entry field is provided for each Static and Functionality test. The notes field is a free format field (maximum of 32,768 characters) where the user can make notes concerning the current test. These notes are stored along with the rest of the test details when the user saves the test from the associated *Test Setup Screen*.

Five option buttons are displayed at the bottom of the *Automated Test Screen*. These buttons allow the user to:

Previous Test -	Moves back to the previous automated Test, and makes it the current test.
Run Current Test -	Runs the current test.
Next Test -	Advances to the next selected automated test, and makes it the current test.
Abort Current Test -	Aborts operation of the current automated test.
Abort Active Mode Testing -	Aborts all automated testing.

Previous Test Button

This option button moves back one test in the list of selected automated tests, and makes it the current test. If the current test is the first selected automated test, this button has no affect. The new current test is marked as “Untested”. The user can then start the test using the *Run Current Test* button.

This button is not enabled while the **E84 Emulator** is processing a test.

Run Current Test Button

This option button starts the current test. The current test can be re-run as often as desired. This is useful for trouble-shooting tests that fail. The test results is reset to “Untested”, and the test is initiated.

This button is not enabled while the **E84 Emulator** is processing a test.

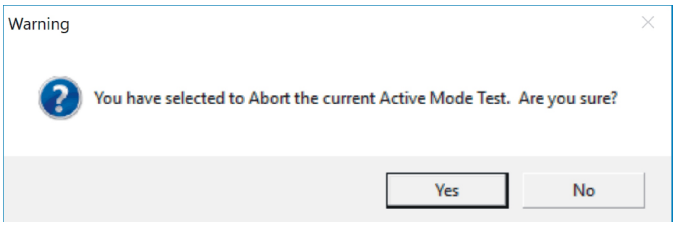
Next Test Button

This option button moves forward one test in the list of selected automated tests, and makes it the current test. If the current test is the last selected automated test, this button advances to the *Testing Completed Screen*.

This button is not enabled while the **E84 Emulator** is processing a test.

Abort Current Test Button

This option button Aborts operation of the current automated Test. It marks the test results "Untested". If an automated Test seems to lock up for any reason, this option button allows the operator to terminate it. All E84 output signals controlled by the **E84 Emulator** are dropped, and the **E84 Emulator** is reset. The user is first prompted for verification before the current test is aborted.

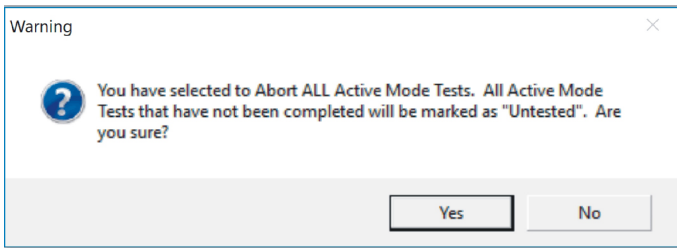


Abort Current Test Verification

Abort Automated Testing Button

This option button aborts all automated testing. The current, and all remaining test results are marked as "Untested".

If the current test has completed prior selecting the Abort Automated Testing button, its test results are not set to "Untested".



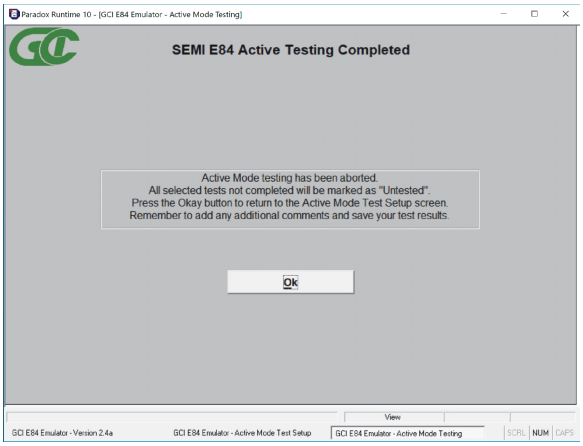
Abort Active (Passive) Mode Testing Verification

All E84 output signals controlled by the **E84 Emulator** are dropped, and the **E84 Emulator** is reset. The user is first prompted for verification before the current test is aborted.

Automated Testing Completed Screen

When all selected tests have completed (or when the user has aborted the test sequence) the *Automated Tests Completed Screen* is displayed. All automated testing terminates with this screen to inform the user that Automated Testing has ended.

This screen acts as a finishing point for Automated Testing. One of two messages is displayed on the screen, depending on whether the Automated Tests were aborted or not. This example shows the aborted message.



Active Testing Completed Screen

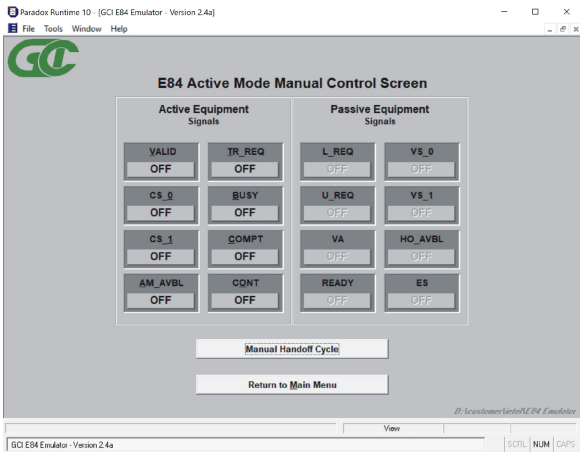
One option button is displayed that takes the user back to the associated *Test Setup Screen*. The *Test Setup Screen* will then display the current test results, along with the *New Test* button. The *Comments* field is still active for the current test. This allows the user to add any additional comments about the test results, or action items for the equipment supplier.

It is important to remember that the test information and results are not automatically saved. The operator must select the *Save Test* button to save the current test setup and results. If the user selects either the *New Test* or *Return to Main Menu* buttons before saving the current test, the system warns the user that the current test results will be lost without saving.

Manual Control Screens

Active Mode Manual Control Screen

When the user selects the Manual Active Mode Testing, the *Active Mode Manual Control Screen* is displayed. This screen is used to manually toggle E84 output signals that are under Active Mode control. Toggle buttons are provided for each signal, allowing the user to switch each signal's state ON and OFF.



Active Mode Manual Control Screen

Along with the E84 output signals under Active Mode control, the screen displays the live status of the Passive equipment's output signals.

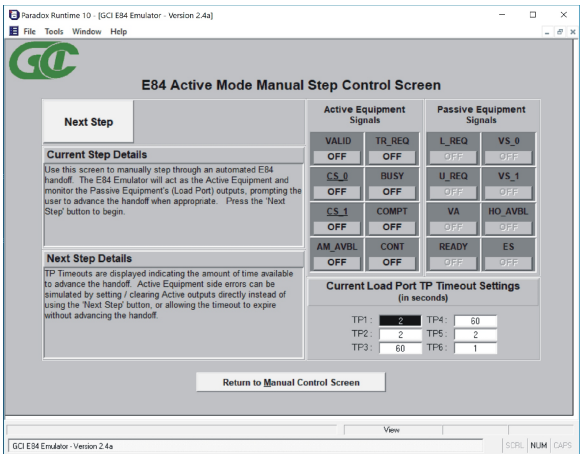
New in Rev. 2.1.1 are toggle buttons for Interbay Active Mode Output signals, and live status for Interbay Active Mode Input signals.

No automated timing sequences are followed on the *Active Mode Manual Control Screen*. The E84 Tester simply sets the Active Mode signals based on the state of the toggle buttons, and displays the Passive equipment's output signals based on their current state.

To close the *Active Mode Manual Control Screen* and return to the *Main Menu*, the user selects the Return to Main Menu button.

Active Mode Manual Step Control Screen

The *Active Mode Manual Step Control Screen* is accessed using the Manual Handoff Cycle button on the *Active Mode Manual Control Screen*. It provides a method of stepping through an E84 handoff, with the Next Step button advancing one step at a time. At each step, the **Current Step Details** describes what is happening during the current step, along with any error conditions detected by the Emulator.



Active Mode Manual Step Control Screen

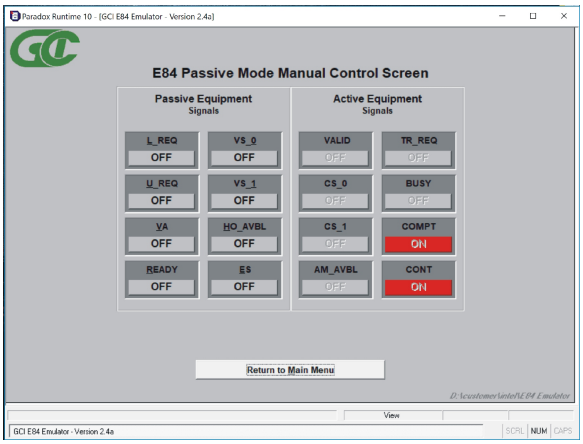
The **Current Load Port TP Timeout Settings** section can be used to set the current values. It is recommended that these values be configured on the Load Port to higher than normal settings to allow the operator time to advance between steps. The typical settings of 2 seconds for TP1 and TP2 will likely result in timeout errors.

The current state of both Active and Passive signals is maintained to the right of the screen.

This test screen is a good training tool for those who want a more in depth understanding of the E84 handoff cycles.

Passive Mode Manual Control Screen

When the user selects the Manual Passive Mode Testing, the *Passive Mode Manual Control Screen* is displayed. This screen is used to manually toggle E84 output signals that are under Passive Mode control. Toggle buttons are provided for each signal, allowing the user to switch each signal's state ON and OFF.



Passive Mode Manual Control Screen

Along with the E84 output signals under Passive Mode control, the screen displays the live status of the Active equipment's output signals.

New in Rev. 2.1.1 are toggle buttons for Interbay Passive Mode Output signals, and live status for Interbay Passive Mode Input signals.

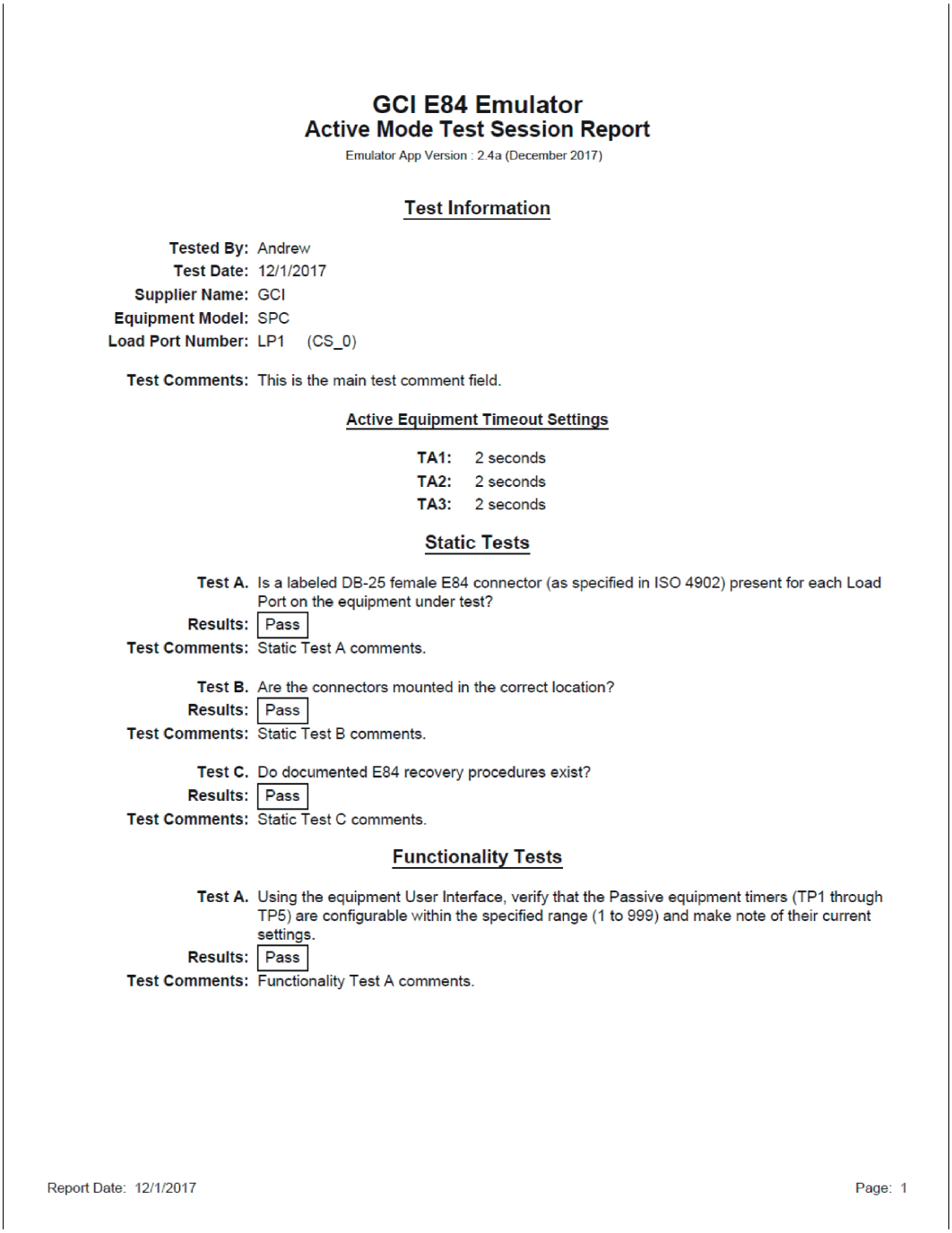
No automated timing sequences are followed on the *Passive Mode Manual Control Screen*. The E84 Tester simply sets the Passive Mode signals based on the state of the toggle buttons, and displays the Active equipment's output signals based on their current state.

To close the *Passive Mode Manual Control Screen* and return to the *Main Menu*, the user selects the Return to Main Menu button.

Saved Test Information

This section details the format of saved test information. When the user elects to save the current test information during Active, Passive, or Continuous Mode testing, the **E84 Emulator** writes an ASCII text file that is formatted for printing. Examples of saved test results for each testing mode are included below.

Active Mode Test Report



GCI E84 Emulator
Active Mode Test Session Report

Emulator App Version : 2.4a (December 2017)

Test Information

Tested By: Andrew
Test Date: 12/1/2017
Supplier Name: GCI
Equipment Model: SPC
Load Port Number: LP1 (CS_0)

Test Comments: This is the main test comment field.

Active Equipment Timeout Settings

TA1: 2 seconds
TA2: 2 seconds
TA3: 2 seconds

Static Tests

Test A. Is a labeled DB-25 female E84 connector (as specified in ISO 4902) present for each Load Port on the equipment under test?
Results: Pass
Test Comments: Static Test A comments.

Test B. Are the connectors mounted in the correct location?
Results: Pass
Test Comments: Static Test B comments.

Test C. Do documented E84 recovery procedures exist?
Results: Pass
Test Comments: Static Test C comments.

Functionality Tests

Test A. Using the equipment User Interface, verify that the Passive equipment timers (TP1 through TP5) are configurable within the specified range (1 to 999) and make note of their current settings.
Results: Pass
Test Comments: Functionality Test A comments.

Report Date: 12/1/2017 Page: 1

Active Mode Test Report

Passive Equipment Timeout Settings

TP1: 2 seconds
TP2: 2 seconds
TP3: 60 seconds
TP4: 60 seconds
TP5: 2 seconds

Test B. Verify for hard wired implementation the voltage provided by the unit under test (UUT) is within the range specified in E84 under Full Load [100mA] and No Load [<2mA]. Both measurements must be within the published range to pass.
Results: Pass
Test Comments: Functionality Test B comments.

Test C1. Verify single handoff sequence for Loading.
Results: Pass
Test Comments: Functionality Test C comments.

Test C2. Verify single handoff sequence for Loading (signal order independency verification).
Results: Pass
Test Comments: Functionality Test C2 (2nd run) comments.

Test D1. Verify single handoff sequence for Unloading.
Results: Pass
Test Comments: Functionality Test D comments.

Test D2. Verify single handoff sequence for Unloading (signal order independency verification).
Results: Pass
Test Comments: Functionality Test D2 (2nd run) comments.

Test E. Handoff available signal test for load.
Results: Pass
Test Comments: Functionality Test E comments.

Test F. Handoff available sequence.
Results: Pass
Test Comments: Functionality Test F comments.

Test G. TP1 timeout error.
Results: Fail
Test Comments: Functionality Test G comments.

Failed during Test Step 8.
Failure: Failure - TP1 timeout error did not occur at appropriate time (or did not occur at all).

Test H. TP2 timeout error.
Results: Pass
Test Comments: Functionality Test H comments.

Report Date: 12/1/2017 Page: 2

Test I. TP3 timeout error.
Results: Pass
Test Comments: Functionality Test I comments.

Test J. TP4 timeout error.
Results: Pass
Test Comments: Functionality Test J comments.

Test K. TP5 timeout error.
Results: Pass
Test Comments: Functionality Test K comments.

Test L. Access mode test
Results: Pass
Test Comments: Functionality Test L comments.

Test M. Verify Port sensors tied into E84 signals - Part 1 (Placement sensor(s)activated during Load, but presence sensor(s) is not).
Results: Pass
Test Comments: Functionality Test M comments.

Test N. Verify Port sensors tied into E84 signals - Part 2 (Presence sensor(s) activated during Load, but placement sensor(s) is not).
Results: Pass
Test Comments: Functionality Test N comments.

Test O. Verify Port sensors tied into E84 signals - Part 3 (Placement sensor(s) deactivated during Unload, but presence sensor(s) is not).
Results: Pass
Test Comments: Functionality Test O comments.

Test P. Verify Port sensors tied into E84 signals - Part 4 (Presence sensor(s) deactivated during Unload, but placement sensor(s) is not).
Results: Pass
Test Comments: Functionality Test P comments.

Test Q. Verify Emergency Stop operation.
Results: Pass
Test Comments: Functionality Test Q comments.

Report Date: 12/1/2017 Page: 3

GCI E84 Emulator
Active Mode Test Session Summary

Tested By: Andrew
Test Date: 12/1/2017
Supplier Name: GCI
Equipment Model: SPC
Load Port Number: LP1 (CS_0)

Test Comments: This is the main test comment field.

Active Equipment Timeout Settings

TA1: 2 seconds
TA2: 2 seconds
TA3: 2 seconds

Passive Equipment Timeout Settings

TP1: 2 seconds
TP2: 2 seconds
TP3: 60 seconds
TP4: 60 seconds
TP5: 2 seconds

Static Tests

A	B	C
P	P	P

Functionality Tests

A	B	C1	C2	D1	D2	E	F	G	H	I	J	K	L	M	N	O	P	Q
P	P	P	P	P	P	P	P	F	P	P	P	P	P	P	P	P	P	P

P - Passed / F - Failed / U - Untested

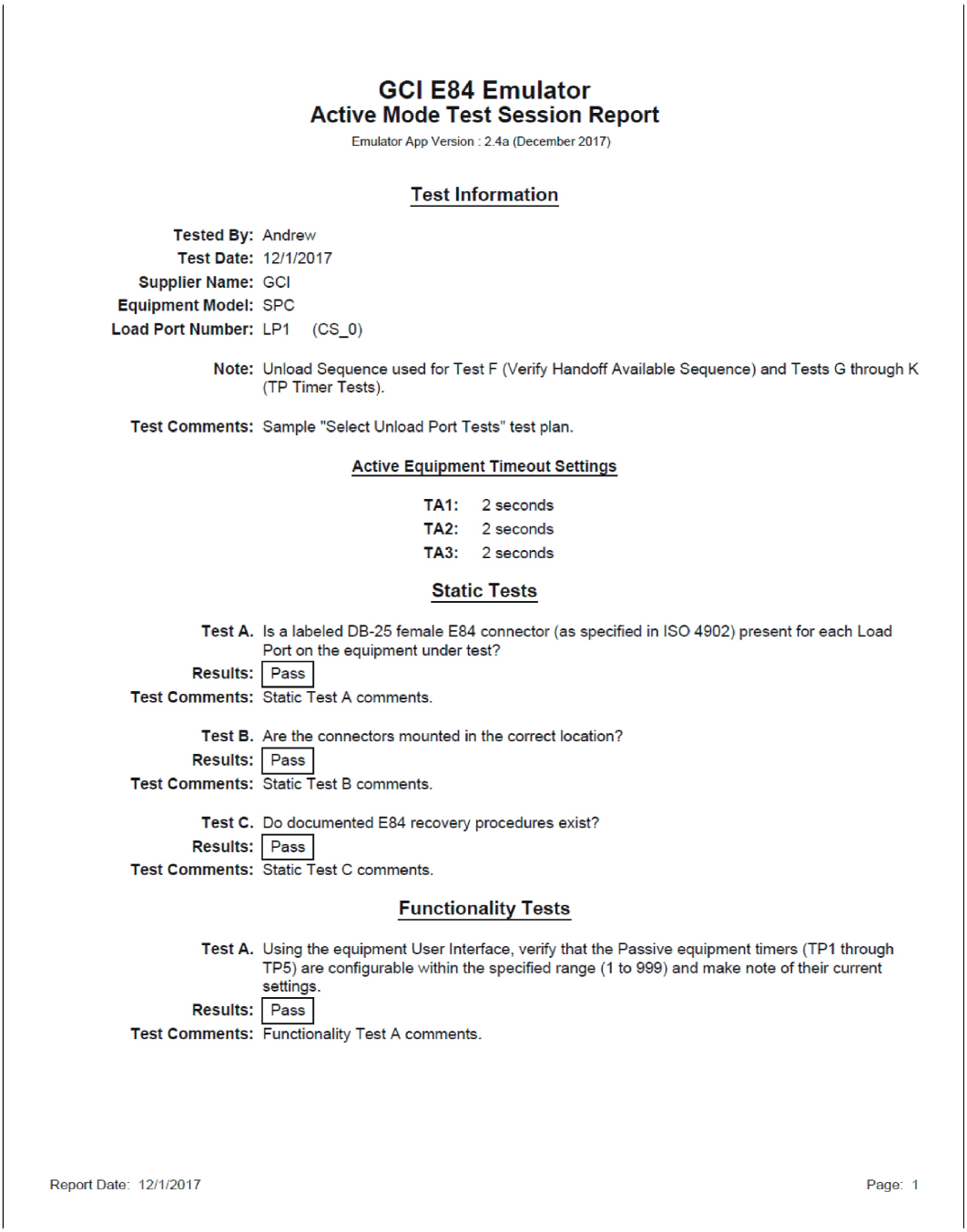
Final Test Results

FAILED

All Test were completed, but at least one Failed.

Report Date: 12/1/2017 Page: 4

Active Mode Test Report - Unload Port Test



GCI E84 Emulator
Active Mode Test Session Report

Emulator App Version : 2.4a (December 2017)

Test Information

Tested By: Andrew
Test Date: 12/1/2017
Supplier Name: GCI
Equipment Model: SPC
Load Port Number: LP1 (CS_0)

Note: Unload Sequence used for Test F (Verify Handoff Available Sequence) and Tests G through K (TP Timer Tests).

Test Comments: Sample "Select Unload Port Tests" test plan.

Active Equipment Timeout Settings

TA1: 2 seconds
TA2: 2 seconds
TA3: 2 seconds

Static Tests

Test A. Is a labeled DB-25 female E84 connector (as specified in ISO 4902) present for each Load Port on the equipment under test?
Results: Pass
Test Comments: Static Test A comments.

Test B. Are the connectors mounted in the correct location?
Results: Pass
Test Comments: Static Test B comments.

Test C. Do documented E84 recovery procedures exist?
Results: Pass
Test Comments: Static Test C comments.

Functionality Tests

Test A. Using the equipment User Interface, verify that the Passive equipment timers (TP1 through TP5) are configurable within the specified range (1 to 999) and make note of their current settings.
Results: Pass
Test Comments: Functionality Test A comments.

Report Date: 12/1/2017 Page: 1

Active Mode Test Report - Unload Port Test

Passive Equipment Timeout Settings

TP1: 2 seconds
TP2: 2 seconds
TP3: 60 seconds
TP4: 60 seconds
TP5: 2 seconds

Test B. Verify for hard wired implementation the voltage provided by the unit under test (UUT) is within the range specified in E84 under Full Load [100mA] and No Load [<2mA]. Both measurements must be within the published range to pass.
Results: Pass
Test Comments: Functionality Test B comments.

Test C1. Verify single handoff sequence for Loading.
Results: Untested
Test Comments: Functionality Test C comments.

Test C2. Verify single handoff sequence for Loading (signal order independency verification).
Results: Untested
Test Comments: Functionality Test C2 (2nd run) comments.

Test D1. Verify single handoff sequence for Unloading.
Results: Pass
Test Comments: Functionality Test D comments.

Test D2. Verify single handoff sequence for Unloading (signal order independency verification).
Results: Pass
Test Comments: Functionality Test D2 (2nd run) comments.

Test E. Handoff available signal test for load.
Results: Untested
Test Comments: Functionality Test E comments.

Test F. Handoff available sequence.
NOTE: Unload Sequence used for Handoff Available Test.
Results: Pass
Test Comments: Functionality Test F comments.

Test G. TP1 timeout error.
NOTE: Unload Sequence used for TP Timer Test.
Results: Pass
Test Comments: Functionality Test G comments.

Test H. TP2 timeout error.
NOTE: Unload Sequence used for TP Timer Test.
Results: Pass
Test Comments: Functionality Test H comments.

Report Date: 12/1/2017 Page: 2

Test I. TP3 timeout error.
NOTE: Unload Sequence used for TP Timer Test.
Results: Pass
Test Comments: Functionality Test I comments.

Test J. TP4 timeout error.
NOTE: Unload Sequence used for TP Timer Test.
Results: Pass
Test Comments: Functionality Test J comments.

Test K. TP5 timeout error.
NOTE: Unload Sequence used for TP Timer Test.
Results: Pass
Test Comments: Functionality Test K comments.

Test L. Access mode test
Results: Pass
Test Comments: Functionality Test L comments.

Test M. Verify Port sensors tied into E84 signals - Part 1 (Placement sensor(s)activated during Load, but presence sensor(s) is not).
Results: Untested
Test Comments: Functionality Test M comments.

Test N. Verify Port sensors tied into E84 signals - Part 2 (Presence sensor(s) activated during Load, but placement sensor(s) is not).
Results: Untested
Test Comments: Functionality Test N comments.

Test O. Verify Port sensors tied into E84 signals - Part 3 (Placement sensor(s) deactivated during Unload, but presence sensor(s) is not).
Results: Pass
Test Comments: Functionality Test O comments.

Test P. Verify Port sensors tied into E84 signals - Part 4 (Presence sensor(s) deactivated during Unload, but placement sensor(s) is not).
Results: Pass
Test Comments: Functionality Test P comments.

Test Q. Verify Emergency Stop operation.
Results: Pass
Test Comments: Functionality Test Q comments.

Report Date: 12/1/2017 Page: 3

GCI E84 Emulator
Active Mode Test Session Summary

Tested By: Andrew
Test Date: 12/1/2017
Supplier Name: GCI
Equipment Model: SPC
Load Port Number: LP1 (CS_0)

Note: Unload Sequence used for Test F (Verify Handoff Available Sequence) and Tests G through K (TP Timer Tests).

Test Comments: Sample "Select Unload Port Tests" test plan.

Active Equipment Timeout Settings

TA1: 2 seconds
TA2: 2 seconds
TA3: 2 seconds

Passive Equipment Timeout Settings

TP1: 2 seconds
TP2: 2 seconds
TP3: 60 seconds
TP4: 60 seconds
TP5: 2 seconds

Static Tests

A	B	C
P	P	P

Functionality Tests

A	B	C1	C2	D1	D2	E	F	G	H	I	J	K	L	M	N	O	P	Q
P	P	U	U	P	P	U	P	P	P	P	P	P	P	U	U	P	P	P

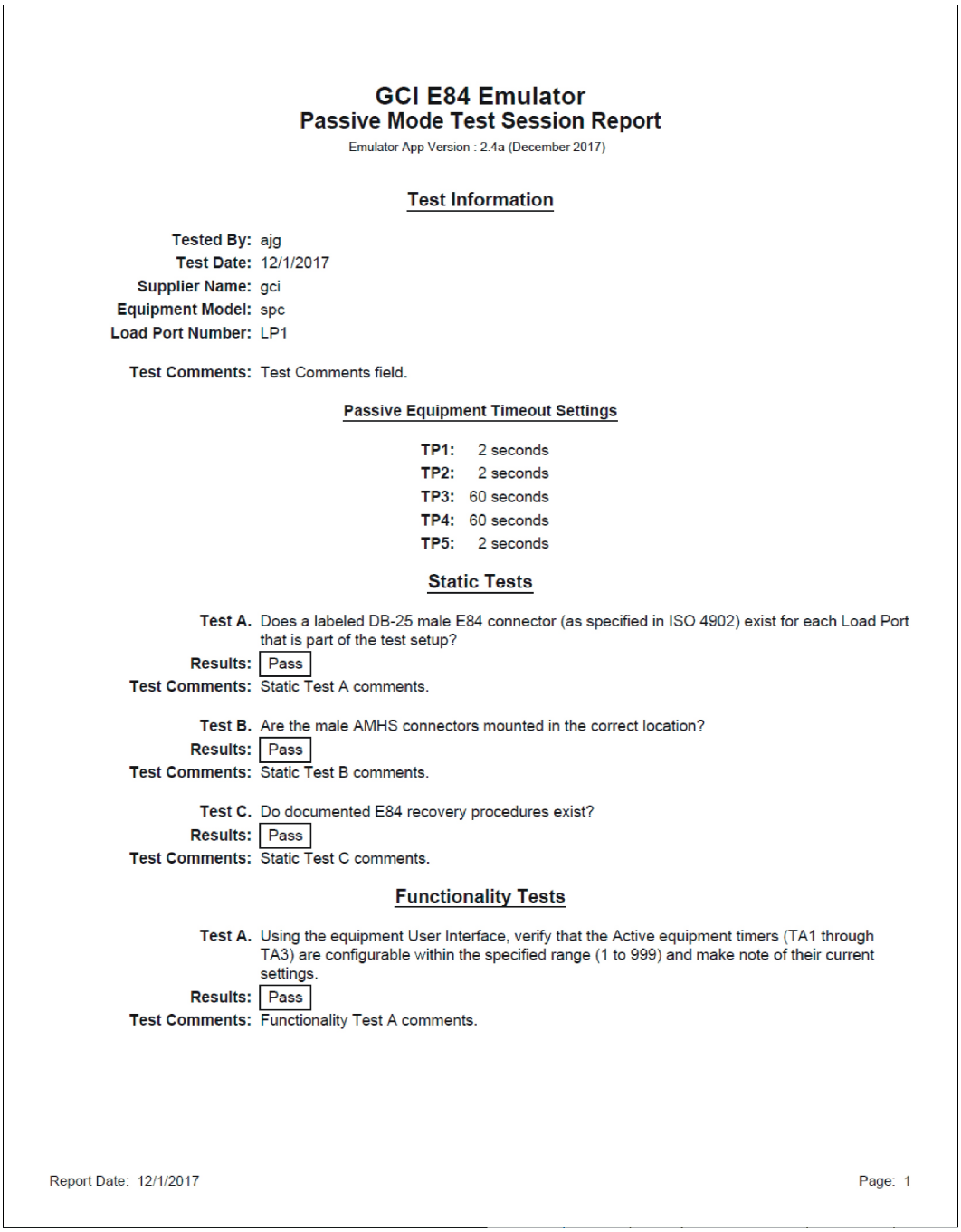
P - Passed / F - Failed / U - Untested

Final Test Results

PASSED (with Untested)
Not all Tests were completed, those that were, Passed.

Report Date: 12/1/2017 Page: 4

Passive Mode Test Report



GCI E84 Emulator
Passive Mode Test Session Report

Emulator App Version : 2.4a (December 2017)

Test Information

Tested By: ajg
Test Date: 12/1/2017
Supplier Name: gci
Equipment Model: spc
Load Port Number: LP1

Test Comments: Test Comments field.

Passive Equipment Timeout Settings

TP1: 2 seconds
TP2: 2 seconds
TP3: 60 seconds
TP4: 60 seconds
TP5: 2 seconds

Static Tests

Test A. Does a labeled DB-25 male E84 connector (as specified in ISO 4902) exist for each Load Port that is part of the test setup?
Results: Pass
Test Comments: Static Test A comments.

Test B. Are the male AMHS connectors mounted in the correct location?
Results: Pass
Test Comments: Static Test B comments.

Test C. Do documented E84 recovery procedures exist?
Results: Pass
Test Comments: Static Test C comments.

Functionality Tests

Test A. Using the equipment User Interface, verify that the Active equipment timers (TA1 through TA3) are configurable within the specified range (1 to 999) and make note of their current settings.
Results: Pass
Test Comments: Functionality Test A comments.

Report Date: 12/1/2017 Page: 1

Passive Mode Test Report

Active Equipment Timeout Settings

TA1: 2 seconds
TA2: 2 seconds
TA3: 2 seconds

Test B. Verify for hard wired implementation the voltage provided by the unit under test (UUT) is within the range specified in E84 under Full Load [100mA] and No Load [<2mA]. Both measurements must be within the published range to pass.
Results: Pass
Test Comments: Functionality Test B comments.

Test C. Verify single handoff sequence for Loading.
Results: Pass
Test Comments: Functionality Test C comments.

Test D. Verify single handoff sequence for Unloading.
Results: Pass
Test Comments: Functionality Test D comments.

Test E. Verify Handoff available sequence - Test 1.
Results: Pass
Test Comments: Functionality Test E comments.

Test F. Verify Handoff available sequence - Test 2.
Results: Pass
Test Comments: Functionality Test F comments.

Test G. Verify Handoff available sequence - Test 3.
Results: Pass
Test Comments: Functionality Test G comments.

Test H. TA1 timeout error.
Results: Pass
Test Comments: Functionality Test H comments.

Test I. TA2 timeout error.
Results: Pass
Test Comments: Functionality Test I comments.

Test J. TA3 timeout error.
Results: Pass
Test Comments: Functionality Test J comments.

Test K. WIPS Jeopardy Test 1 (L_REQ stays ON).
Results: Pass
Test Comments: Functionality Test K comments.

Report Date: 12/1/2017 Page: 2

Test L. WIPS Jeopardy Test 2 (L_REQ turns OFF early).
Results: Pass
Test Comments: Functionality Test L comments.

Test M. WIPS Jeopardy Test 3 (U_REQ stays ON).
Results: Pass
Test Comments: Functionality Test M comments.

Test N. Verify Emergency Stop operation - Test 1 (Load Sequence).
Results: Pass
Test Comments: Functionality Test N comments.

Test O. Verify Emergency Stop operation - Test 1 (Unload Sequence).
Results: Pass
Test Comments: Functionality Test O comments.

Report Date: 12/1/2017 Page: 3

GCI E84 Emulator
Passive Mode Test Session Summary

Tested By: ajg
Test Date: 12/1/2017
Supplier Name: gci
Equipment Model: spc
Load Port Number: LP1

Test Comments: Test Comments field.

Passive Equipment Timeout Settings

TP1: 2 seconds
TP2: 2 seconds
TP3: 60 seconds
TP4: 60 seconds
TP5: 2 seconds

Active Equipment Timeout Settings

TA1: 2 seconds
TA2: 2 seconds
TA3: 2 seconds

Static Tests

A	B	C
P	P	P

Functionality Tests

A	B	C	A	B	C	D	E	F	G	H	I	J	K	L
P	P	P	P	P	P	P	P	P	P	P	P	P	P	P

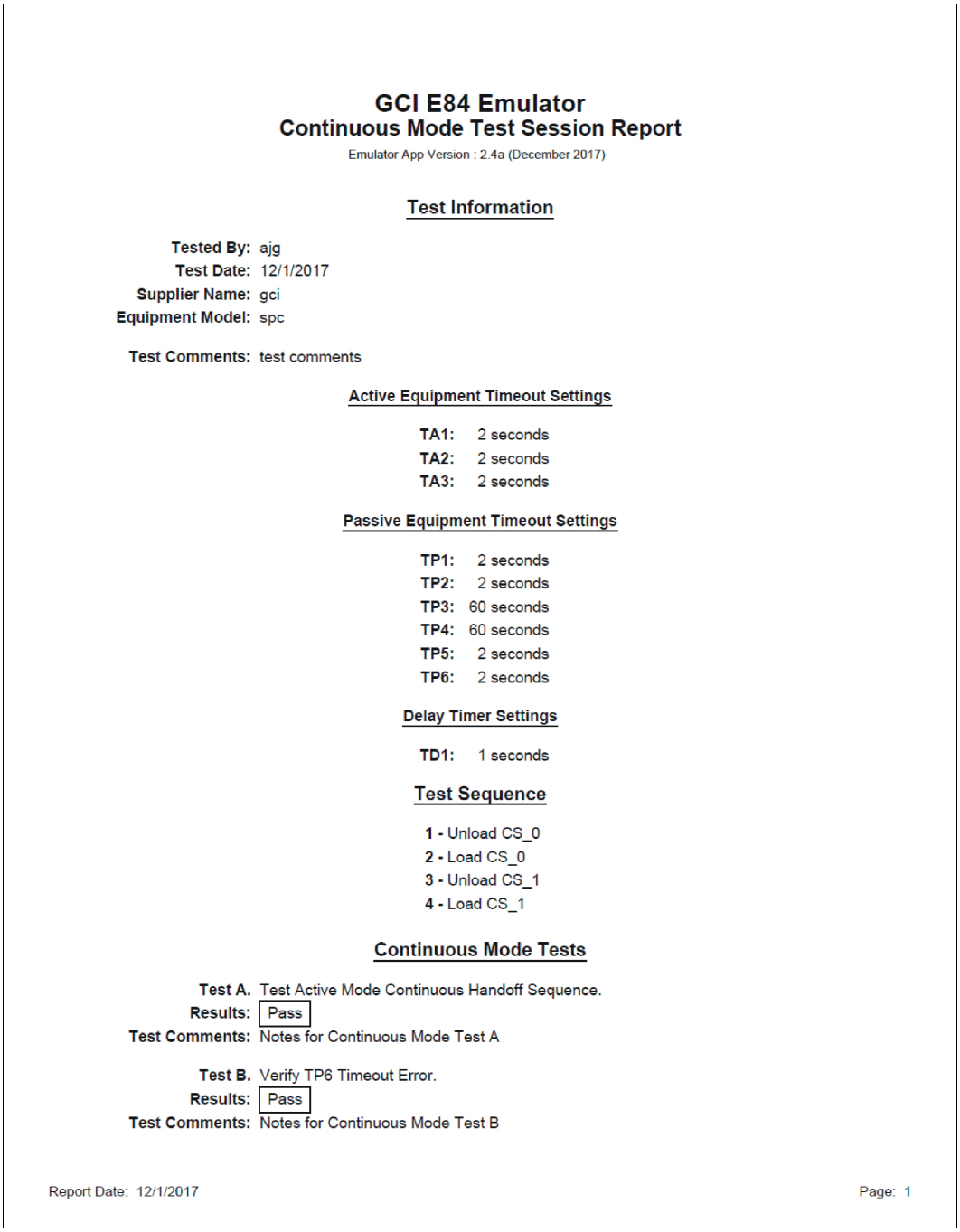
P - Passed / F - Failed / U - Untested

Final Test Results

PASSED
All Test were completed and all Passed.

Report Date: 12/1/2017 Page: 4

Continuous Mode Test Report



GCI E84 Emulator
Continuous Mode Test Session Report

Emulator App Version : 2.4a (December 2017)

Test Information

Tested By: ajg
Test Date: 12/1/2017
Supplier Name: gci
Equipment Model: spc

Test Comments: test comments

Active Equipment Timeout Settings

TA1: 2 seconds
TA2: 2 seconds
TA3: 2 seconds

Passive Equipment Timeout Settings

TP1: 2 seconds
TP2: 2 seconds
TP3: 60 seconds
TP4: 60 seconds
TP5: 2 seconds
TP6: 2 seconds

Delay Timer Settings

TD1: 1 seconds

Test Sequence

1 - Unload CS_0
2 - Load CS_0
3 - Unload CS_1
4 - Load CS_1

Continuous Mode Tests

Test A. Test Active Mode Continuous Handoff Sequence.
Results: Pass
Test Comments: Notes for Continuous Mode Test A

Test B. Verify TP6 Timeout Error.
Results: Pass
Test Comments: Notes for Continuous Mode Test B

Report Date: 12/1/2017 Page: 1

Continuous Mode Test Report

Test C. Test Passive Mode Continuous Handoff Sequence.
Results: Untested

Report Date: 12/1/2017 Page: 2

GCI E84 Emulator
Continuous Mode Test Session Summary

Tested By: ajg
Test Date: 12/1/2017
Supplier Name: gci
Equipment Model: spc

Test Comments: test comments

Passive Equipment Timeout Settings

TP1: 2 seconds
TP2: 2 seconds
TP3: 60 seconds
TP4: 60 seconds
TP5: 2 seconds
TP6: 2 seconds

Active Equipment Timeout Settings

TA1: 2 seconds
TA2: 2 seconds
TA3: 2 seconds

Delay Timer Settings

TD1: 1 seconds

Test Sequence

1 - Unload CS_0
2 - Load CS_0
3 - Unload CS_1
4 - Load CS_1

Continuous Mode Tests

A	B	C
P	P	U

P - Passed / F - Failed / U - Untested

The Continuous Test Form provides both Active Mode and Passive Mode tests. Only one type is typically tested during one test session.
This report covers a test session where the Emulator acted as the Active Equipment

Final Test Results

PASSED
All Test were completed and all Passed.

Report Date: 12/1/2017 Page: 3

Test Plans

The **E84 Emulator Application** has two built-in test plans, one for Active Mode Testing and one for Passive Mode Testing. Additionally, the **E84 Emulator Application** allows for customized Continuous Mode testing, using the Load and Unload tests defined in the standard test plans.

This section details both the Active and Passive Mode test plans, along with the three available Continuous Mode tests. Functional tests are broken down into a series of numbered test steps. Each test step is described using the text that is displayed by the **E84 Emulator** during automated testing. When a failure occurs during a Functional test, a failure message is displayed in place of the test step text. Failure messages appear in the lists below using a **bold** typeface, and are noted by the step number on screen and in generated reports.

Not all tests begin with step 1. Some tests require setup sequences that do not involve any user prompts. Also, some tests skip step numbers. This is required to simulate certain tested error conditions. The numbered steps described in this section match step numbers reported during actual testing.

Signal Status Verification Errors

The E84 Specification defines the state of all E84 signals during sequence handshaking. The **E84 Emulator** verifies all signal states against the E84 Specification during every Functionality test. If the **E84 Emulator** detects an invalid signal state (OFF when it should be ON, or ON when it should be OFF), a verification error is displayed, and the test is terminated with a failure. Verification error messages take one of the following forms:

> [signal name] signal is OFF when it should be ON
> [signal name] signal is ON when it should be OFF

Active Mode Test Plan

Active Mode testing includes both Static and Functionality tests. Static tests verify interface plug location and labeling, along with documentation issues. Functionality tests verify that the equipment under test adheres to the E84 handshaking specification. This section describes the pre-defined tests supplied by the **E84 Emulator**.

Static tests are described by the tests title. Functionality tests are described by the tests title, along with detailed information about the steps required to complete the test.

TP Timer Settings

During Active Mode Functionality testing, the **E84 Emulator** uses TP timer settings to verify timing critical sections of the load/unload sequences. Active Mode Functionality Test A allows the user to enter the TP settings of the equipment under test. If Active Mode Functionality Test A is not selected to run, the **E84 Emulator** reverts the TP timer values to the defaults defined by the E84 Specification.

It is critical that the TP timer values used by the E84 Emulator match those in use by the equipment under test. If the values differ, false test failures may occur. If Active Mode Functionality Test A is not selected, the following warning message is displayed before automated testing begins.

> You have not selected Functionality Test A, which allows you to enter the current TP timer values for the equipment under test. These values are used for timing various steps during Active Mode testing. If the timer settings don't match, test results may be invalid.
>
> If you do not enter the current values, the TP settings will revert to the defaults listed in the E84 Specification:

TP1 = 2 Seconds
TP2 = 2 Seconds
TP3 = 60 Seconds
TP4 = 60 Seconds
TP5 = 2 Seconds

Press "Yes" to run Functionality Test A.
Press "No" to test using the E84 default settings.
Press "Cancel" to abort testing.

Load / Unload Cycle Test

Starting with **E84 Emulator Application, Rev 2.0**, two new test sequences were added to Active Mode testing.

The Load Cycle contains two places where several signals are changing states concurrently.

Case 1: The first of these occurs just after the FOUP is detected on the Load Port. The AMHS (Active Equipment) turns the TR_REQ and BUSY signals OFF, and the COMPT signal ON.

Case 2: The second concurrent change occurs at the end of the Load Cycle, where the AMHS turns the CS_0, VALID and COMPT signals OFF.

In Case 1, the Passive Equipment responds to the signal changes by turning it's READY signal OFF. In Case 2, the Passive Equipment uses the signal changes to determine the end of the handoff sequence.

The SEMI® E84 Specification *implies* an order for these signal changes, but does not define one explicitly. This can cause confusion between different equipment manufacturers, and may result in different implementations of the E84 communication protocol.

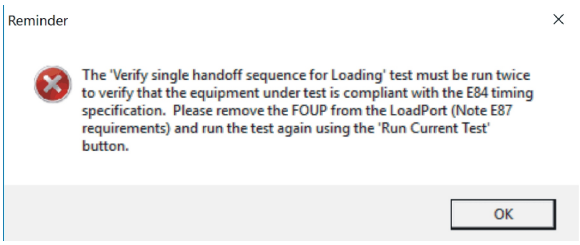
To resolve this, industry leaders have defined a standard trigger signal that can be used by the Passive Equipment to determine the completion of each sequence.

In Case 1, the Passive Equipment uses the COMPT signal turning ON to determine when to turn the READY signal OFF. The Passive Equipment should ignore the state of the TR_REQ and BUSY signals.

In Case 2, the Passive Equipment uses the COMPT signal turning OFF to determine the end of the handoff sequence. The Passive Equipment should ignore the state of the VALID and CS_0 signals.

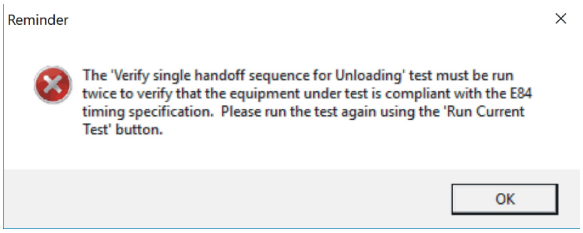
To test adherence of Passive Equipment to this standard, the **E84 Emulator** now runs the Load and Unload Cycle tests twice, using a different sequence of signal state changes for each test. This verifies that the Passive Equipment under test is not dependant on a specific sequence of signal state changes.

Following Active Mode, Functional Test C (Load Cycle Test), the user is prompted to run the test a second time. The second time the test is run, the sequence of signal state changes is modified. The first Load Cycle test uses the sequence: BUSY, TR_REQ, COMPT followed by COMPT, VALID, CS_0. The second Load Cycle test uses the sequence: TR_REQ, BUSY, COMPT followed by VALID, COMPT, CS_0.



Run Load Cycle Test Warning

Similarly, following Active Mode, Functional Test D (Unload Cycle Test), the user is prompted to run the test a second time. The second time the test is run, the sequence of signal state changes is modified. The first Unload Cycle test uses the sequence: BUSY, TR_REQ, COMPT followed by COMPT, VALID, CS_0. The second Unload Cycle test uses the sequence: TR_REQ, BUSY, COMPT followed by COMPT, CS_0, VALID.



Run Unload Cycle Test Warning

If the equipment under test fails the Load (or Unload) Cycle test when the **E84 Emulator** changes the signal state change order, a special error message is added to the saved test report.

If the failure occurs when the E84 Emulator is turning the TR_REQ and BUSY signals OFF, and the COMPT signal ON, the error message takes the form:

```
***** Failure at this step may indicate that the Passive
      Equipment expects a specific order of the signals
      TR_REQ, BUSY and COMPT.
      Please consult an E84 Standards expert.
```

If the failure occurs when the E84 Emulator is turning the VALID, CS_0 and COMPT signals OFF, the error message takes the form:

```
***** Failure at this step may indicate that the Passive
      Equipment expects a specific order of the signals
      CS_0 and VALID.
      Please consult an E84 Standards expert.
```

If one of the two Load (or Unload) Cycle tests passes, and the other fails, an additional error message is added to the saved test report.

```
***** When one Load test fails, and one passes, it may indicate that the
      Passive Equipment expects a specific order of the signals
      BUSY, TR_REQ, COMPLT or COMPT, VALID, CS_0.
      Please consult an E84 Standards expert.
```

SEMI® E87 Requirements Note

During several Active Mode Automatic tests, the operator is prompted to place a FOUP onto the Load Port whose E84 interface is being tested. It is important to note that the SEMI® E87 specification requires that Load Ports be placed in Manual Access Mode before allowing manual loading or unloading of FOUPs.

To avoid possible SEMI® E87 related alarms, the Load Port being tested must be placed in Manual Access Mode whenever a FOUP is manually loaded or unloaded.

When prompted by the software to manually place a FOUP onto the Load Port, first switch the Load Port to Manual Access Mode, then load the FOUP, then switch the Load Port back to Automatic Access Mode.

E84 Specification References

All references to E84 Specification sections or figures in the description of Active Mode tests are taken from E84-0304.

Active Mode Static Tests

There are three Active Mode, Static tests. These tests verify the following:

- Proper **labeling** of DB-25 female E84 plug.
- Proper **location** of DB-25 female E84 plug.
- Existence of documented E84 recovery procedures.

Active Mode Static Test A

Verify labeled DB-25 female E84 plug exists.

Is a labeled DB-25 female E84 plug (as specified in ISO 4902) present for each Load Port on the equipment?

Why we run this test

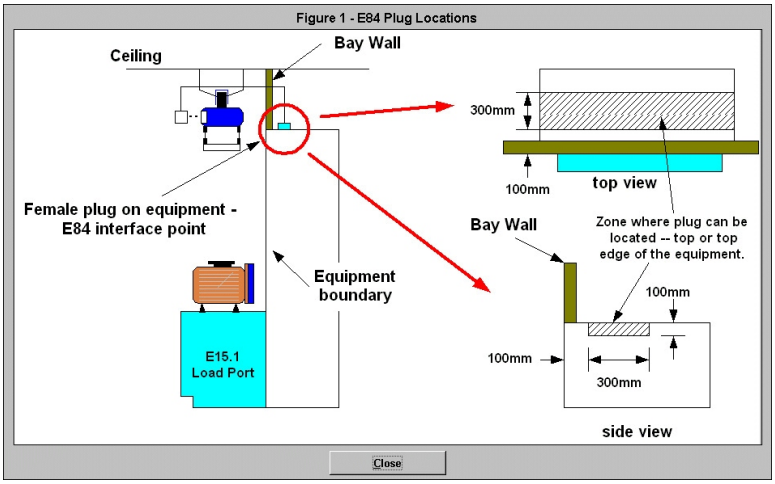
Section 6.4 of the E84 Specification requires that the passive equipment supply a female DB-25 connector for the E84 interface. This connector must also comply with all electrical and pin assignments defined by the Specification. The Emulator verifies I/O pin assignments during each test in the functional test suite. Functional test B verifies the pin assignment for supply voltage. The Emulator does not verify I/O electrical specifications. Signals are considered OFF if their voltage level is greater than 1.8 VDC. Signals are considered ON if their voltage level drops below 1.8 VDC. Use the GCI Handheld Tester for thorough electrical specification testing.

This test is a visual examination by the operator to verify that the equipment provides the required female DB-25 connector. The operator is required to manually pass or fail this test.

Active Mode Static Test B

Verify proper plug location.

Are the plugs mounted in the correct location? Figure 1 defines the zone where the plug(s) can be located. The plug(s) can be mounted anywhere in this zone on the top or top edge of the equipment.



E84 Plug Locations

Why we run this test

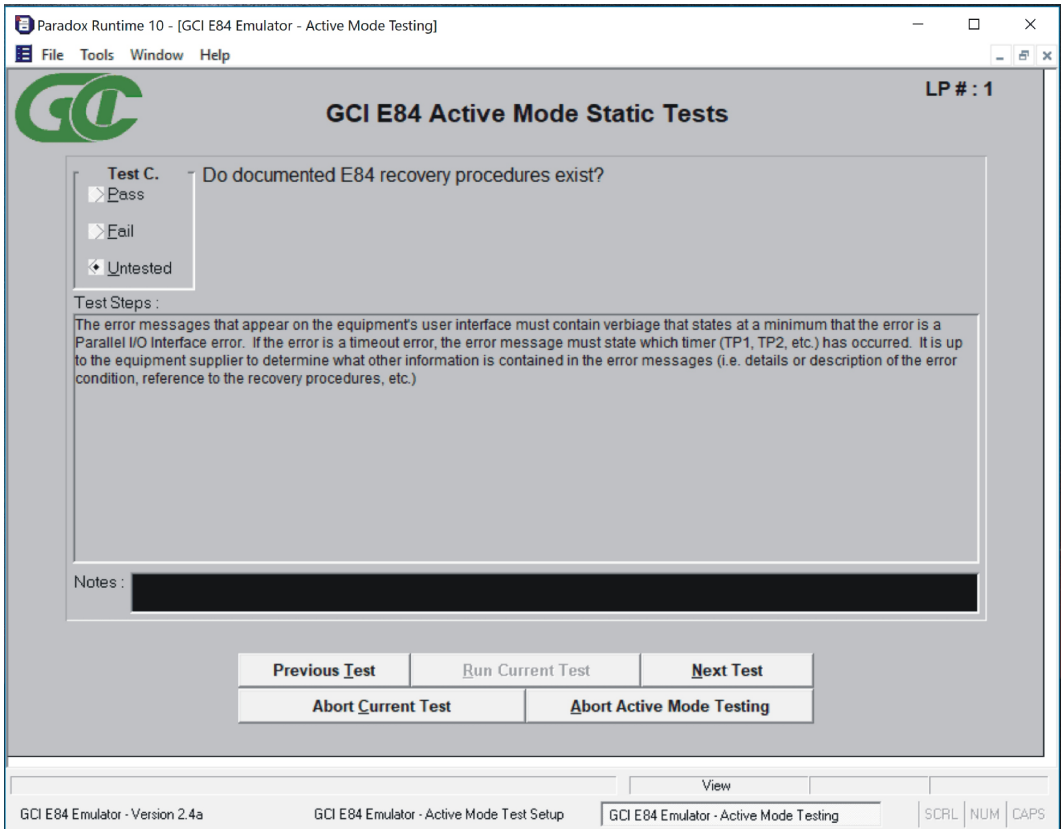
Application note A1 of the E84 Specification (section A1-1.1) defines a zone on the process equipment where the E84 interface connector should be placed.

This test is a visual examination by the operator to verify that the E84 interface connector is located in the correct zone. The operator is required to manually pass or fail this test.

Active Mode Static Test C

Verify Documented Recovery Procedures Exist.

Do documented E84 recovery procedures exist?



E84 Recovery Procedures Description

Why we run this test

The E84 Specification recommends (in section 6.3.3.1) that recovery procedures be provided on the passive equipment. The Specification also requires (6.3.1.1) that the passive equipment display error messages on it's user interface. These error messages must (according to section A1-4.7) include the timer name, timer description and current timer setting.

This test is a visual examination by the operator to verify that proper recovery procedures exist, and that the tool properly displays error messages on it's user interface.

Active Mode Functionality Tests

There are 17 Active Mode, Functionality tests. These tests verify that the equipment under test adheres to the E84 interface specification under the following conditions:

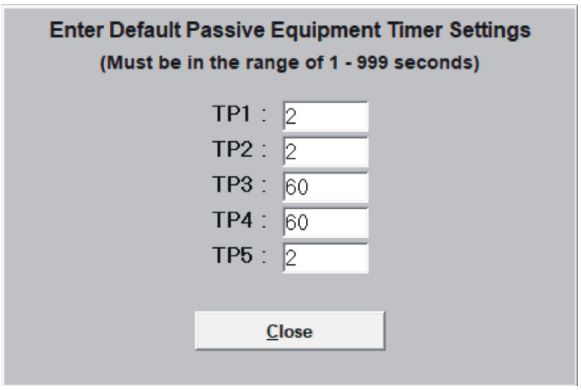
- User configurable passive equipment timers.
- +24 Volts Full Load and No Load voltage level.
- Load, and Unload Sequences.
- Handoff available 1, and 2.
- TP1 - TP5 Timeouts.
- Access Mode Change.
- Port Sensor Tests 1 - 4.
- Emergency Stop operation.

Active Mode Functionality Test A

Verify Configurable Passive Equipment Timers

Using the equipment user interface, verify that the passive equipment timers (TP1 through TP5) are configurable within the range specified in E84 (1 to 999) and make note of the default settings:

1. Operator action required...
2. Waiting for operator to enter default TP timer settings.
3. This test Passes if all TP timers can be configured at the equipment User Interface. Timers must be configurable between 1 and 999 Seconds. Please mark test results before continuing.



Default TP Timer Entry Screen

Why we run this test

Section 6.3.2.1 of the E84 Specification requires that interlock timeout values be user programmable. The Load Port uses five different timeout (TP1 - TP5) values for normal E84 hand-offs. A sixth timeout (TP6) is used during continuous mode hand-offs.

The Emulator uses the values of the Load Port's interlock timeouts during functional testing. The operator is asked to verify that the timeout settings are user programmable through the tools user interface. The current settings are entered into a dialog box so the Emulator can reference them in other functional tests.

After entering the five timeout values, the Emulator will automatically set the test results to 'Pass'. If the tool does not properly allow the timeouts to be modified, or if the allowable range for each timeout is not valid, the operator should manually fail the test.

Active Mode Functionality Test B

Verify Full Load / No Load Voltage

Verify for hard wired implementation the voltage provided by the equipment under test is within the range specified in E84 under Full Load [100mA] and No Load [<2mA].

1. No Load Voltage Pre-Check
2. No Load Voltage Pre-Check Verified. Testing Full Load Voltage.
   Failure - Voltage not detected, or is below 18Vdc. Verify cable connection.
3. Full Load Voltage verified greater than or equal to 18Vdc.
   Failure - Full Load Voltage is less than 18Vdc.
4. Full Load Voltage verified less than or equal to 30Vdc.
   Failure - Full Load Voltage is greater than 30Vdc.
5. Testing No Load Voltage.
6. No Load Voltage verified greater than or equal to 18Vdc.
   Failure - No Load Voltage is less than 18Vdc.
7. No Load Voltage verified less than or equal to 30Vdc.
   Failure - No Load Voltage is greater than 30Vdc.
8. Voltage Test Passed.

Why we run this test

Figure 35 of the E84 Specification defines the pin assignment for Power and Power COM on the passive equipment's E84 interface connector be on pins 23 and 24 respectively. Additionally, in section 6.4.2.1 the Specification defines that the power supply voltage be +24 VDC Nominal, with a minimum of +18 VDC and a maximum of +30 VDC (for both no load and full load of 100 mA).

This test verifies that the Load Port is supplying +24 VDC on pin 23, referenced to pin 24. No operator interaction is required for this test.

This test is only valid for hardwired applications. When testing with an attached Optical Transceiver, this test will always pass, but will not actually test the tools power supply pins.

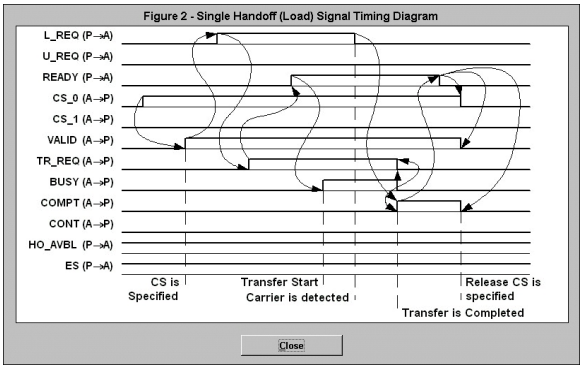
The Optical Transceiver connects to the Emulators female DB-25 connector, which is it's passive emulation port. This is required because of the pin assignments for the Optical Transceiver. The Emulator supplies +24 VDC to the attached Optical Transceiver through pin 23 of this female connector. The E84 Specification defines (Figure 32) that the Optical Transceiver tie pins 22 and 23 together. This brings the Emulator supplied +24 VDC back on pin 22 of the female connector, which is the pin that the active equipment normally supplies voltage on.

When running the voltage test through an attached Optical Transceiver, the Emulator will end up verifying it's own +24 VDC supply voltage.

Active Mode Functionality Test C

Verify Single Handoff Load Sequence

Verify single handoff sequence for Loading.
See Figure 2 for example signal timing diagram.



Single Handoff (Load) Signal Timing Diagram

3. HO_AVBL signal verified ON on equipment under test.
   Failure - HO_AVBL signal is OFF on equipment under test.
4. Setting Load Port select signals (CS_0, CS_1) based on test configuration.
5. Setting VALID signal ON.
6. L_REQ signal verified ON on equipment under test.
   Failure - L_REQ signal failed to turn ON within timeout specified (TA1).
7. Setting TR_REQ signal ON.
8. READY signal verified ON on equipment under test.
   Failure - READY signal failed to turn ON within timeout specified (TA2).
9. Setting BUSY signal ON. Operator action required…

Please load a FOUP onto the Load Port associated with the E84 interface being tested. The FOUP must be loaded before the timeout shown expires. This window will close automatically when the equipment under test detects the loaded FOUP.

10. Waiting for operator to load FOUP.
11. L_REQ signal verified OFF on equipment under test.
    Failure - L_REQ signal failed to turn OFF after FOUP loaded onto Load Port.

12-14. Setting BUSY signal OFF, TR_REQ signal OFF, and COMPT signal ON.

15. READY signal verified OFF on equipment under test.
    Failure - READY signal failed to turn OFF within timeout specified (TA3).

16-18. Setting COMPT, VALID and Load Port select (CS_0, CS_1) signals OFF.

19. Load Test Passed.

Why we run this test

The E84 Specification defines (in section 6.2.4) a specific sequence of signal state changes that must be followed to process an automatic E84 load cycle. This test runs the Active side of that defined sequence, and verifies that the Load Port being tested properly follows the Passive side. This test requires the operator to load a FOUP onto the Load Port at the correct time in the handoff sequence.

Active Mode Functionality Test C - 2nd Run

Verify Single Handoff Load Sequence 2

Verify single handoff sequence for Loading (signal order independency verification). See Figure 2 for example signal timing diagram.

3. HO_AVBL signal verified ON on equipment under test.
   Failure - HO_AVBL signal is OFF on equipment under test.
4. Setting Load Port select signals (CS_0, CS_1) based on test configuration.
5. Setting VALID signal ON.
6. L_REQ signal verified ON on equipment under test.
   Failure - L_REQ signal failed to turn ON within timeout specified (TA1).
7. Setting TR_REQ signal ON.
8. READY signal verified ON on equipment under test.
   Failure - READY signal failed to turn ON within timeout specified (TA2).
9. Setting BUSY signal ON. Operator action required...

Please load an FOUP onto the Load Port associated with the E84 interface being tested. The FOUP must be loaded before the timeout shown expires. This window will close automatically when the equipment under test detects the loaded FOUP.

10. Waiting for operator to load FOUP.
11. L_REQ signal verified OFF on equipment under test.
    Failure - L_REQ signal failed to turn OFF after FOUP loaded onto Load Port.

12-14. Setting TR_REQ signal OFF, BUSY signal OFF, and COMPT signal ON.

15. READY signal verified OFF on equipment under test.
    Failure - READY signal failed to turn OFF within timeout specified (TA3).

16-18. Setting VALID, COMPT and Load Port select (CS_0, CS_1) signals OFF.

19. Load Test Passed.

Why we run this test

Early versions of the E84 Specification did not clearly define the order of two key sequences of signal state changes. The first sequence is when the FOUP has been loaded / unloaded, and the Active equipment turns BUSY and TR_REQ off, and COMPT on. The second sequence is when the Active equipment turns COMPT, VALID and CS_0 / CS_1 off to complete the handoff.

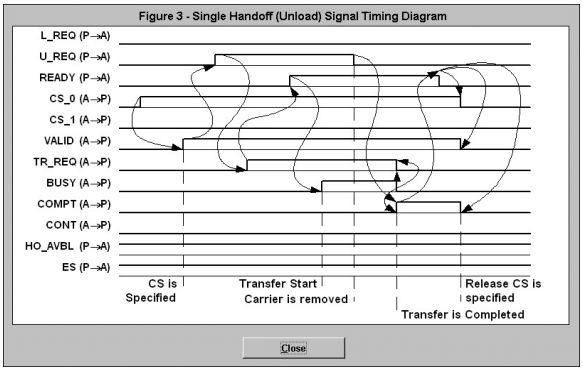
It was found in early testing that some process equipment vendors were depending on a specific order of signal state changes. Because of the ambiguity in the early E84 Specifications, it was decided to test for that dependancy by running the Load and Unload cycle tests twice, altering the order of signals state changes with each test. This verifies that the Load Port being tested does not depend on any specific signal order sequence.

The current E84 Specification has clarified the order of these signal state changes, but adds a note that indicates the Load Port should not be dependant on it (Note 3 in section 6.2.4.1).

Active Mode Functionality Test D

Verify Single Handoff Unload Sequence

Verify single handoff sequence for Unloading. See Figure 3 for example signal timing diagram.



Single Handoff (Unload) Signal Timing Diagram

1. Operator action required...

Please load a FOUP onto the Load Port associated with the E84 interface being tested. There is no specified time limit for this action, but testing cannot continue until the FOUP is loaded. Please press the Close button when finished.

Note: SEMI® E87 requires that the Load Port be placed in Manual Access Mode before loading or unloading a FOUP by hand. To avoid possible E87 related alarms, please place the Load Port in Manual Access Mode. Then load a FOUP. Place the Load Port back in Automatic Access Mode before continuing with the Unload Test.

2. Waiting for operator to load FOUP.
3. HO_AVBL signal verified ON on equipment under test.
   Failure - HO_AVBL signal is OFF on equipment under test.
4. Setting Load Port select signals (CS_0, CS_1) based on test configuration.
5. Setting VALID signal ON.
6. U_REQ signal verified ON on equipment under test.
   Failure - U_REQ signal failed to turn ON within timeout specified (TA1).
7. Setting TR_REQ signal ON.
8. READY signal verified ON on equipment under test.
   Failure - READY signal failed to turn ON within timeout specified (TA2).
9. Setting BUSY signal ON. Operator action required...

Please unload the FOUP from the Load Port associated with the E84 interface being tested. The FOUP must be removed before the timeout shown expires. This window will close automatically when the equipment under test detects the removal of the FOUP.

10. Waiting for operator to unload FOUP.
11. U_REQ signal verified OFF on equipment under test.
    Failure - U_REQ signal failed to turn OFF after FOUP unloaded from Load Port.

12-14. Setting BUSY signal OFF, TR_REQ signal OFF, and COMPT signal ON.

15. READY signal verified OFF on equipment under test.
    Failure - READY signal failed to turn OFF within timeout specified (TA3).

16-18. Setting COMPT, VALID and Load Port select (CS_0, CS_1) signals OFF.

19. Unload Test Passed.

Why we run this test

The E84 Specification defines (in section 6.2.4) a specific sequence of signal state changes that must be followed to process an automatic E84 unload cycle. This test runs the Active side of that defined sequence, and verifies that the Load Port being tested properly follows the Passive side. This test requires the operator to unload a FOUP onto the Load Port at the correct time in the handoff sequence.

Active Mode Functionality Test D - 2nd Run

Verify Single Handoff Unload Sequence - 2

Verify single handoff sequence for Unloading (signal order independency verification). See Figure 3 for example signal timing diagram.

1. Operator action required...

Please load a FOUP onto the Load Port associated with the E84 interface being tested. There is no specified time limit for this action, but testing cannot continue until the FOUP is loaded. Please press the Close button when finished.

Note: SEMI® E87 requires that the Load Port be placed in Manual Access Mode before loading or unloading a FOUP by hand. To avoid possible E87 related alarms, please place the Load Port in Manual Access Mode. Then load a FOUP. Place the Load Port back in Automatic Access Mode before continuing with the Unload Test.

2. Waiting for operator to load FOUP.
3. HO_AVBL signal verified ON on equipment under test.
   Failure - HO_AVBL signal is OFF on equipment under test.
4. Setting Load Port select signals (CS_0, CS_1) based on test configuration.
5. Setting VALID signal ON.
6. U_REQ signal verified ON on equipment under test.
   Failure - U_REQ signal failed to turn ON within timeout specified (TA1).
7. Setting TR_REQ signal ON.
8. READY signal verified ON on equipment under test.
   Failure - READY signal failed to turn ON within timeout specified (TA2).
9. Setting BUSY signal ON. Operator action required...

Please unload the FOUP from the Load Port associated with the E84 interface being tested. The FOUP must be removed before the timeout shown expires. This window will close automatically when the equipment under test detects the removal of the FOUP.

10. Waiting for operator to unload FOUP.
11. U_REQ signal verified OFF on equipment under test.
    Failure - U_REQ signal failed to turn OFF after FOUP unloaded from Load Port.

12-14. Setting TR_REQ signal OFF, BUSY signal OFF, and COMPT signal ON.

15. READY signal verified OFF on equipment under test.
    Failure - READY signal failed to turn OFF within timeout specified (TA3).

16-18. Setting COMPT, Load Port select (CS_0, CS_1) and VALID signals OFF.

19. Unload Test Passed.

Why we run this test

See note on Test C - 2nd Run.

Active Mode Functionality Test E

Verify Handoff Available Signal Test for Load

Handoff available signal test for load:

1. HO_AVBL signal verified ON on equipment under test.

This test verifies that the equipment does not allow for the delivery of a FOUP when the presence sensor(s) are activated. There are three acceptable communication scenarios:

1 - HO_AVBL signal is turned OFF immediately following activation of the presence sensor(s).
2 - L_REQ signal is not turned ON after the VALID signal is turned ON.
3 - READY signal is not turned ON after the TR_REQ signal is turned ON.

Activate the presence sensor(s) on the Load Port associated with the E84 interface being tested.

2. Setting Load Port select signals (CS_0, CS_1) based on test configuration.
3. Waiting for operator to activate placement sensor(s).
4. Setting VALID signal ON.
5. L_REQ signal verified ON on equipment under test.
6. Setting TR_REQ signal ON.
7. Verified - equipment does not allow for the delivery of a FOUP.
   Failure - READY signal turned ON on equipment under test when presence sensor(s) activated.
8. Handoff available signal test for load Passed.

Why we run this test

The E84 Specification states that the HO_AVBL signal should turn OFF if the Presence Sensor is ON, but the Placement Sensor is OFF (Table A1-6). If only one sensor is ON, then the FOUP is not properly positioned on the Load Port.

This test verifies that, if the Presence sensor is blocked before a load cycle is started, the tool does not allow a load cycle to proceed. If only the Presence sensor is blocked, then a potential collision situation is present on the Load Port, and the tool should not allow a load or an unload to occur.

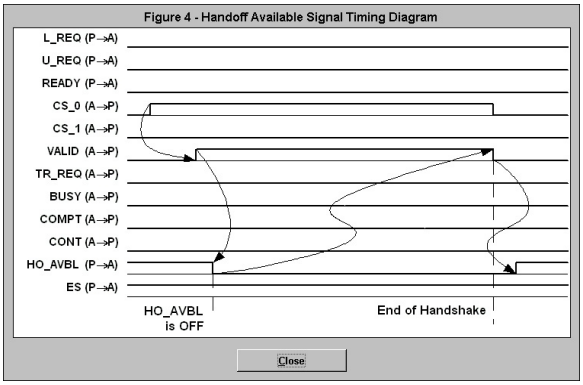
If the tool allows the load cycle to proceed past the point where the delivery vehicle would start moving the FOUP onto the Load Port, then the test fails.

Active Mode Functionality Test F

Verify Handoff Available Sequence

Note: This test uses a standard load cycle to verify the Handoff Available sequence. The Load Port under test must be empty prior to initiating the test.

Verify handoff available sequence. See Figure 4 for example signal timing diagram.



Handoff Available Signal Timing Diagram

1. Operator action required...

For this test only, set the passive equipments TP1 timeout to 15 seconds. Please press the Close button when ready to continue.

2. Waiting for operator to configure the TP1 setting.
3. HO_AVBL signal verified ON on equipment under test.
   Failure - HO_AVBL signal is OFF on equipment under test.
4. Setting Load Port select signals (CS_0, CS_1) based on test configuration.
5. Setting VALID signal ON. Operator action required...

Manually induce a condition on the equipment (switch the equipment to manual mode) that causes the HO_AVBL signal to go OFF. The operator must switch the equipment to manual mode before the timeout shown below expires.

6. Waiting for operator to cause error condition on equipment under test.
7. HO_AVBL signal verified OFF on equipment under test.
   Failure - HO_AVBL signal did not turn OFF following operator induced error.
8. Setting VALID and Load Port select (CS_0, CS_1) signals OFF. Operator action required...

Clear the condition on the equipment (switch the equipment back to automatic mode) that caused the HO_AVBL signal to go OFF. There is no specified time limit for this action.

9. Waiting for operator to clear error condition on equipment under test.
10. HO_AVBL signal verified ON on equipment under test. Operator action required...

Change the passive equipments TP1 timer setting back to the original default setting. Press the Close button when ready to continue.

Failure - HO_AVBL did not turn ON.

11. Waiting for operator to re-configure the TP1 setting.
12. Handoff Available Test Passed.

Why we run this test

The HO_AVBL signal should turn OFF when the Load Port is not available for an automatic handoff. This test verifies that the Load Port turns the HO_AVBL signal OFF when entering manual mode after a handoff has started.

Active Mode Functionality Test G

Verify TP1 Timeout Error

Verify TP1 timeout error.

3. HO_AVBL signal verified ON on equipment under test.
   Failure - HO_AVBL signal is OFF on equipment under test.
4. Setting Load Port select signals (CS_0, CS_1) based on test configuration.
5. Setting VALID signal ON.
6. L_REQ signal verified ON on equipment under test.
   Failure - L_REQ signal failed to turn ON within timeout specified (TA1).
7. Testing TP1 Timeout. Waiting for TP1 timeout period to expire.

TP1 Timer Test in progress. When the timeout shown decrements to zero, the Passive Equipment under test should generate a TP1 alarm on its User Interface. If the alarm does not occur at the appropriate time (either before, or after the timeout expires) the timer test has failed, and the user should press the Fail Button. If the alarm does occur at the proper time, the timer test has passed, and the user should press the Pass Button.

8. TP1 timeout error verified on equipment under test User Interface.
   Failure - TP1 timeout error did not occur at appropriate time (or did not occur at all).
20. Setting VALID and Load Port select (CS_0, CS_1) signals OFF.
21. TP1 Timeout Test Passed.

Passive Equipment must be reset before continuing to next test. Please verify that the Passive Equipment is ready before proceeding.

Why we run this test

The E84 Specification defines TP1 as the maximum time between L_REQ / U_REQ ON and TR_REQ ON (Table 8). Section 6.3 specifies that equipment should inform the operator about handoff timeout errors. Additionally, in section A1-4.71 requires that the equipment display details about the timeout error including: “Timer name, Timer Description and current Timer setting.”

This test will force a TP1 timeout error by advancing the handoff up to the point where the equipment is expecting the TR_REQ signal to turn ON. At this point, the Emulator locks it’s outputs and displays a timeout dialog box. This timeout box counts down from the TP1 value set during Test A. When the counter reaches zero, the timeout should have expired on the equipment.

The Emulator requires the operator to visually inspect the equipments GUI to verify that an appropriate timeout error message has been displayed. After the operator passes, or fails the test based on the visual display of an error message, the Emulator checks the HO_AVBL signal. When the timeout occurs, the the HO_AVBL signal should turn OFF. If the operator passes the test based on the display of an error message, but the equipment fails to turn OFF the HO_AVBL signal, the Emulator will fail the test. Note, this applies to E84 Emulator Application 2.2 or greater.

Active Mode Functionality Test H

Verify TP2 Timeout Error

Verify TP2 timeout error.

3. HO_AVBL signal verified ON on equipment under test.
   Failure - HO_AVBL signal is OFF on equipment under test.
4. Setting Load Port select signals (CS_0, CS_1) based on test configuration.
5. Setting VALID signal ON.
6. L_REQ signal verified ON on equipment under test.
   Failure - L_REQ signal failed to turn ON within timeout specified (TA1).
7. Setting TR_REQ signal ON.
8. READY signal verified ON on equipment under test.
   Failure - READY signal failed to turn ON within timeout specified (TA2).
9. Testing TP2 Timeout. Waiting for TP2 timeout period to expire.

TP2 Timer Test in progress. When the timeout shown decrements to zero, the Passive Equipment under test should generate a TP2 alarm on its User Interface. If the alarm does not occur at the appropriate time (either before, or after the timeout expires) the timer test has failed, and the user should press the Fail Button. If the alarm does occur at the proper time, the timer test has passed, and the user should press the Pass Button.

10. TP2 timeout error verified on equipment under test User Interface.
    Failure - TP2 timeout error did not occur at appropriate time (or did not occur at all).
20. Setting VALID, TR_REQ and Load Port select (CS_0, CS_1) signals OFF.
21. TP2 Timeout Test Passed.

Passive Equipment must be reset before continuing to next test. Please verify that the Passive Equipment is ready before proceeding.

Why we run this test

The E84 Specification defines TP2 as the maximum time between READY ON and BUSY ON (Table 8). Section 6.3 specifies that equipment should inform the operator about handoff timeout errors. Additionally, in section A1-4.71 requires that the equipment display details about the timeout error including: “Timer name, Timer Description and current Timer setting.”

This test will force a TP2 timeout error by advancing the handoff up to the point where the equipment is expecting the BUSY signal to turn ON. At this point, the Emulator locks it’s outputs and displays a timeout dialog box. This timeout box counts down from the TP2 value set during Test A. When the counter reaches zero, the timeout should have expired on the equipment.

The Emulator requires the operator to visually inspect the equipments GUI to verify that an appropriate timeout error message has been displayed. After the operator passes, or fails the test based on the visual display of an error message, the Emulator checks the HO_AVBL signal. When the timeout occurs, the the HO_AVBL signal should turn OFF. If the operator passes the test based on the display of an error message, but the equipment fails to turn OFF the HO_AVBL signal, the Emulator will fail the test. Note, this applies to E84 Emulator Application 2.2 or greater.

Active Mode Functionality Test I

Verify TP3 Timeout Error

Verify TP3 timeout error.

3. HO_AVBL signal verified ON on equipment under test.
   Failure - HO_AVBL signal is OFF on equipment under test.
4. Setting Load Port select signals (CS_0, CS_1) based on test configuration.
5. Setting VALID signal ON.
6. L_REQ signal verified ON on equipment under test.
   Failure - L_REQ signal failed to turn ON within timeout specified (TA1).
7. Setting TR_REQ signal ON.
8. READY signal verified ON on equipment under test.
   Failure - READY signal failed to turn ON within timeout specified (TA2).
9. Setting BUSY signal ON.
10. Testing TP3 Timeout. Waiting for TP3 timeout period to expire.

TP3 Timer Test in progress. When the timeout shown decrements to zero, the Passive Equipment under test should generate a TP3 alarm on its User Interface. If the alarm does not occur at the appropriate time (either before, or after the timeout expires) the timer test has failed, and the user should press the Fail Button. If the alarm does occur at the proper time, the timer test has passed, and the user should press the Pass Button.

11. TP3 timeout error verified on equipment under test User Interface.
    Failure - TP3 timeout error did not occur at appropriate time (or did not occur at all).
20. Setting BUSY, TR_REQ, VALID and Load Port select (CS_0, CS_1) signals OFF.
21. TP3 Timeout Test Passed.

Passive Equipment must be reset before continuing to next test. Please verify that the Passive Equipment is ready before proceeding.

Why we run this test

The E84 Specification defines TP3 as the maximum time between BUSY ON and carrier detect / removal (Table 8). Section 6.3 specifies that equipment should inform the operator about handoff timeout errors. Additionally, in section A1-4.71 requires that the equipment display details about the timeout error including: “Timer name, Timer Description and current Timer setting.”

This test will force a TP3 timeout error by advancing the handoff up to the point where the equipment is expecting the arrival of a FOUP. At this point, the Emulator locks it’s outputs and displays a timeout dialog box. This timeout box counts down from the TP3 value set during Test A. When the counter reaches zero, the timeout should have expired on the equipment.

The Emulator requires the operator to visually inspect the equipments GUI to verify that an appropriate timeout error message has been displayed. After the operator passes, or fails the test based on the visual display of an error message, the Emulator checks the HO_AVBL signal. When the timeout occurs, the the HO_AVBL signal should turn OFF. If the operator passes the test based on the display of an error message, but the equipment fails to turn OFF the HO_AVBL signal, the Emulator will fail the test. Note, this applies to E84 Emulator Application 2.2 or greater.

Active Mode Functionality Test J

Verify TP4 Timeout Error

Verify TP4 timeout error.

3. HO_AVBL signal verified ON on equipment under test.
   Failure - HO_AVBL signal is OFF on equipment under test.
4. Setting Load Port select signals (CS_0, CS_1) based on test configuration.
5. Setting VALID signal ON.
6. L_REQ signal verified ON on equipment under test.
   Failure - L_REQ signal failed to turn ON within timeout specified (TA1).
7. Setting TR_REQ signal ON.
8. READY signal verified ON on equipment under test.
   Failure - READY signal failed to turn ON within timeout specified (TA2).
9. Setting BUSY signal ON. Operator action required...

Please load an FOUP onto the Load Port associated with the E84 interface being tested. The FOUP must be loaded before the timeout shown expires.

10. Waiting for operator to load FOUP.
11. L_REQ signal verified OFF on equipment under test.
    Failure - L_REQ signal failed to turn OFF after FOUP loaded onto Load Port.
12. Testing TP4 Timeout. Waiting for TP4 timeout period to expire.

TP4 Timer Test in progress. When the timeout shown decrements to zero, the Passive Equipment under test should generate a TP4 alarm on its User Interface. If the alarm does not occur at the appropriate time (either before, or after the timeout expires) the timer test has failed, and the user should press the Fail Button. If the alarm does occur at the proper time, the timer test has passed, and the user should press the Pass Button.

13. TP4 timeout error verified on equipment under test User Interface.
    Failure - TP4 timeout error did not occur at appropriate time (or did not occur at all).
20. Setting BUSY, TR_REQ, VALID and Load Port select (CS_0, CS_1) signals OFF.
21. TP4 Timeout Test Passed.

Passive Equipment must be reset before continuing to next test. Please verify that the Passive Equipment is ready before proceeding.

Why we run this test

The E84 Specification defines TP4 as the maximum time between L_REQ / U_REQ OFF and BUSY OFF (Table 8). Section 6.3 specifies that equipment should inform the operator about handoff timeout errors. Additionally, in section A1-4.71 requires that the equipment display details about the timeout error including: “Timer name, Timer Description and current Timer setting.”

This test will force a TP4 timeout error by advancing the handoff up to the point where the equipment is expecting the BUSY signal to turn OFF. At this point, the Emulator locks it’s outputs and displays a timeout dialog box. This timeout box counts down from the TP4 value set during Test A. When the counter reaches zero, the timeout should have expired on the equipment. Note: the operator must load a FOUP onto the Load Port within the TP3 timeout period.

The Emulator requires the operator to visually inspect the equipments GUI to verify that an appropriate timeout error message has been displayed. After the operator passes, or fails the test based on the visual display of an error message, the Emulator checks the HO_AVBL signal. When the timeout occurs, the the HO_AVBL signal should turn OFF. If the operator passes the test based on the display of an error message, but the equipment fails to turn OFF the HO_AVBL signal, the Emulator will fail the test. Note, this applies to E84 Emulator Application 2.2 or greater.

Active Mode Functionality Test K

Verify TP5 Timeout Error

Verify TP5 timeout error.

3. HO_AVBL signal verified ON on equipment under test.
   Failure - HO_AVBL signal is OFF on equipment under test.
4. Setting Load Port select signals (CS_0, CS_1) based on test configuration.
5. Setting VALID signal ON.
6. L_REQ signal verified ON on equipment under test.
   Failure - L_REQ signal failed to turn ON within timeout specified (TA1).
7. Setting TR_REQ signal ON.
8. READY signal verified ON on equipment under test.
   Failure - READY signal failed to turn ON within timeout specified (TA2).
9. Setting BUSY signal ON. Operator action required...

Please load an FOUP onto the Load Port associated with the E84 interface being tested. The FOUP must be loaded before the timeout shown expires.

10. Waiting for operator to load FOUP.
11. L_REQ signal verified OFF on equipment under test.
    Failure - L_REQ signal failed to turn OFF after FOUP loaded onto Load Port.

12-14. Setting BUSY signal OFF, TR_REQ signal OFF, and COMPT signal ON.

15. READY signal verified OFF on equipment under test.
    Failure - READY signal failed to turn OFF within timeout specified (TA3).
16. Testing TP5 Timeout. Waiting for TP5 timeout period to expire.

TP5 Timer Test in progress. When the timeout shown decrements to zero, the Passive Equipment under test should generate a TP5 alarm on its User Interface. If the alarm does not occur at the appropriate time (either before, or after the timeout expires) the timer test has failed, and the user should press the Fail Button. If the alarm does occur at the proper time, the timer test has passed, and the user should press the Pass Button.

17. TP5 timeout error verified on equipment under test User Interface.
    Failure - TP5 timeout error did not occur at appropriate time (or did not occur at all).
20. Setting COMPT, VALID and Load Port select (CS_0, CS_1) signals OFF.
21. TP5 Timeout Test Passed.

Passive Equipment must be reset before continuing to next test. Please verify that the Passive Equipment is ready before proceeding.

Why we run this test

The E84 Specification defines TP5 as the maximum time between READY OFF and VALID OFF (Table 8). Section 6.3 specifies that equipment should inform the operator about handoff timeout errors. Additionally, in section A1-4.71 requires that the equipment display details about the timeout error including: “Timer name, Timer Description and current Timer setting.”

This test will force a TP5 timeout error by advancing the handoff up to the point where the equipment is expecting the VALID signal to turn OFF. At this point, the Emulator locks it’s outputs and displays a timeout dialog box. This timeout box counts down from the TP5 value set during Test A. When the counter reaches zero, the timeout should have expired on the equipment. Note: the operator must load a FOUP onto the Load Port within the TP3 timeout period.

The Emulator requires the operator to visually inspect the equipments GUI to verify that an appropriate timeout error message has been displayed. After the operator passes, or fails the test based on the visual display of an error message, the Emulator checks the HO_AVBL signal. When the timeout occurs, the the HO_AVBL signal should turn OFF. If the operator passes the test based on the display of an error message, but the equipment fails to turn OFF the HO_AVBL signal, the Emulator will fail the test. Note, this applies to E84 Emulator Application 2.2 or greater.

Active Mode Functionality Test L

Verify Access Mode Selection

Verify access mode selection.

1. HO_AVBL signal verified ON on equipment under test. Operator action required...

   Please place the equipment being tested into Manual Access Mode. This should cause the HO_AVBL signal to turn OFF. There is no specified time limit for this action. This window will close automatically when the E84 tester detects the HO_AVBL signal has turned OFF.

   Failure - HO_AVBL signal is OFF on equipment under test.
2. Waiting for Manual Access Mode.
3. 1HO_AVBL signal verified OFF on equipment under test. Operator action required...

   Please place the equipment being tested into Automated Access Mode. This should cause the HO_AVBL signal to turn ON. There is no specified time limit for this action. This window will close automatically when the E84 tester detects the HO_AVBL signal has turned ON.

   Failure - HO_AVBL signal did not turn OFF following operator switch to manual access mode.
4. Waiting for automated access mode.
5. HO_AVBL signal verified ON on equipment under test.
   Failure - HO_AVBL signal did not turn ON following operator switch to automated access mode.
6. Access Mode Test Passed.

Why we run this test

The E84 Specification requires the HO_AVBL signal be turned OFF when the equipment is in Manual Access Mode (Table A1-6). This test requests the operator to switch the equipment into Manual Access Mode, and monitors the HO_AVBL signal to verify that it turns OFF. After verification, the operator is instructed to switch the equipment back to Automatic Access Mode. The HO_AVBL signal should turn back ON.

Active Mode Functionality Test M

Verify Port Sensors - Part 1

Verify Port Sensors tied to E84 signals - Part 1 (Placement sensor(s) activated during Load, but Presence sensor(s) is not).

1. HO_AVBL signal verified ON on equipment under test.
   Failure - HO_AVBL signal is OFF on equipment under test.
2. Setting Load Port select signals (CS_0, CS_1) based on test configuration.
3. Setting VALID signal ON.
4. L_REQ signal verified ON on equipment under test.
   Failure - L_REQ signal failed to turn ON within timeout specified (TA1).
5. Setting TR_REQ signal ON.
6. READY signal verified ON on equipment under test.
   Failure - READY signal failed to turn ON within timeout specified (TA2).
7. Setting BUSY signal ON. Operator action required...

Please activate the Placement sensor(s) ONLY on the Load Port associated with the E84 interface being tested before the timeout shown expires. Operator must activate ALL Placement sensor(s). Please press the Close button when finished.

8. Waiting for operator to activate placement sensor(s) only.
9. L_REQ signal verified remained ON following placement sensor(s) activation. TP3 timeout expired. Verifying that HO_AVBL is OFF with timeout error.
   Failure - L_REQ signal signal turned OFF following placement sensor(s) activation. Note: False failures may occur if entered TP timer values do not match equipment under test.
10. **Failure - HO_AVBL signal did not turn OFF following the TP3 timeout error. The equipment under test properly kept L_REQ ON throughout timeout period, but should have dropped HO_AVBL when the timeout expired. Test has Failed**
11. Setting BUSY, TR_REQ, VALID and Load Port select (CS_0, CS_1) signals OFF.
12. Port Sensors Test (Part 1) Passed

Why we run this test

The E84 Specification states that the HO_AVBL signal should turn OFF if the Placement Sensor is ON, but the Presence Sensor is OFF (Table A1-6). If only one sensor is ON, then the FOUP is not properly positioned on the Load Port.

This test simulates an improperly positioned FOUP during a load cycle. The operator is asked to block ONLY the Placement Sensor during the load cycle. The equipment should continue to monitor it's TP3 timeout, and fail the handoff when that timeout expires.

The test fails if the equipment turns L_REQ OFF. L_REQ should not turn OFF until both Placement AND Presence sensors have turned ON. The test will also fail if the equipment does not turn the HO_AVBL signal OFF at the end of the timeout period.

The test passes if the equipment's TP3 timeout expires, and the HO_AVBL signal turns OFF. This indicates that the equipment requires both Placement AND Presence sensor activation on a load cycle.

Active Mode Functionality Test N

Verify Port Sensors - Part 2

Verify Port Sensors tied to E84 signals - Part 2 (Presence sensor(s) activated during Load, but Placement sensor(s) is not).

1. HO_AVBL signal verified ON on equipment under test.
   Failure - HO_AVBL signal is OFF on equipment under test.
2. Setting Load Port select signals (CS_0, CS_1) based on test configuration.
3. Setting VALID signal ON.
4. L_REQ signal verified ON on equipment under test.
   Failure - L_REQ signal failed to turn ON within timeout specified (TA1).
5. Setting TR_REQ signal ON.
6. READY signal verified ON on equipment under test.
   Failure - READY signal failed to turn ON within timeout specified (TA2).
7. Setting BUSY signal ON. Operator action required...

Please activate the Presence sensor(s) ONLY on the Load Port associated with the E84 interface being tested before the timeout shown expires. Operator must activate ALL Presence sensor(s). Please press the Close button when finished.

8. Waiting for operator to activate presence sensor(s) only.
9. L_REQ signal verified remained ON following presence sensor(s) activation. TP3 timeout expired. Verifying that HO_AVBL is OFF with timeout error.
   Failure - L_REQ signal turned OFF following presence sensor(s) activation. Note: False failures may occur if entered TP timer values do not match equipment under test.
10. Setting BUSY, TR_REQ, VALID and Load Port select (CS_0, CS_1) signals OFF.
    Failure - HO_AVBL signal did not turn OFF following the TP3 timeout error. The equipment under test properly kept L_REQ ON throughout timeout period, but should have dropped HO_AVBL when the timeout expired. Test has Failed
11. Port Sensors Test (Part 2) Passed

Why we run this test

The E84 Specification states that the HO_AVBL signal should turn OFF if the Presence Sensor is ON, but the Placement Sensor is OFF (Table A1-6). If only one sensor is ON, then the FOUP is not properly positioned on the Load Port.

This test simulates an improperly positioned FOUP during a load cycle. The operator is asked to block ONLY the Presence Sensor during the load cycle. The equipment should continue to monitor it's TP3 timeout, and fail the handoff when that timeout expires.

The test fails if the equipment turns L_REQ OFF. L_REQ should not turn OFF until both Placement AND Presence sensors have turned ON. The test will also fail if the equipment does not turn the HO_AVBL signal OFF at the end of the timeout period.

The test passes if the equipment's TP3 timeout expires, and the HO_AVBL signal turns OFF. This indicates that the equipment requires both Placement AND Presence sensor activation on a load cycle.

Active Mode Functionality Test O

Verify Port Sensors - Part 3

Verify Port Sensors tied to E84 signals - Part 3 (Placement sensor(s) deactivated during Unload, but Presence sensor(s) is not).

1. Operator action required...

Please activate ALL Placement sensor(s) and ALL Presence sensor(s) on the Load Port associated with the E84 interface being tested. This simulates the proper placement of a FOUP on the Load Port. There is no specified time limit for this action, but testing cannot continue until ALL sensor(s) are activated. Please press the Close button when finished.

Note: SEMI® E87 requires that the Load Port be placed in Manual Access Mode before loading or unloading a FOUP by hand. The Load Port being tested may issue an E87 related alarm when the Placement and Presence Sensor(s) are activated while in Automatic Access Mode. To avoid possible E87 related alarms, please place the Load Port in Manual Access Mode. Then activate the sensor(s). Place the Load Port back in Automatic Access Mode before continuing with the Test.

2. Waiting for operator to activate both placement and presence sensor(s) on Load Port under test.
3. HO_AVBL signal verified ON on equipment under test.
   Failure - HO_AVBL signal is OFF on equipment under test.
4. Setting Load Port select signals (CS_0, CS_1) based on test configuration.
5. Setting VALID signal ON.
6. U_REQ signal verified ON on equipment under test.
   Failure - U_REQ signal failed to turn ON within timeout specified (TA1).
7. Setting TR_REQ signal ON.
8. READY signal verified ON on equipment under test.
   Failure - READY signal failed to turn ON within timeout specified (TA2).
9. Setting BUSY signal ON. Operator action required.

Please de-activate the Placement sensor(s) ONLY on the Load Port associated with the E84 interface being tested before the timeout shown expires. Operator must de-activate ALL Placement sensor(s). Please press the Close button when finished.

10. Waiting for operator to de-activate placement sensor(s) only.
11. U_REQ signal verified remained ON following placement sensor(s) de-activation. TP3 timeout expired. Verifying that the HO_AVBL is OFF with timeout error.
    Failure - U_REQ signal turned OFF following placement sensor(s) de-activation. Note: False failures may occur if entered TP timer values do not match equipment under test.
12. Setting BUSY, TR_REQ, VALID and Load Port select (CS_0, CS_1) signals OFF.
    Failure - HO_AVBL signal did not turn OFF following the TP3 timeout error. The equipment under test properly kept U_REQ ON throughout timeout period, but should have dropped HO_AVBL when the timeout expired.
13. Port Sensors Test (Part 3) Passed

Why we run this test

The E84 Specification states that the HO_AVBL signal should turn OFF if the Presence Sensor is ON, but the Placement Sensor is OFF (Table A1-6). If only one sensor is ON, then the FOUP is not properly positioned on the Load Port.

This test simulates a failed unload cycle, where the FOUP is not fully removed from the Load Port. The operator is asked to de-activate ONLY the Placement Sensor during the unload cycle. The equipment should continue to monitor it's TP3 timeout, and fail the handoff when that timeout expires.

The test fails if the equipment turns U_REQ OFF. U_REQ should not turn OFF until both Placement AND Presence sensors have turned OFF. The test will also fail if the equipment does not turn the HO_AVBL signal OFF at the end of the timeout period.

The test passes if the equipment's TP3 timeout expires, and the HO_AVBL signal turns OFF. This indicates that the equipment requires both Placement AND Presence sensor clear during an unload cycle.

Active Mode Functionality Test P

Verify Port Sensors - Part 4

Verify Port Sensors tied to E84 signals - Part 4 (Presence sensor(s) deactivated during Unload, but placement sensor(s) is not).

1. Operator action required...

Please activate ALL Placement sensor(s) and ALL Presence sensor(s) on the Load Port associated with the E84 interface being tested. This simulates the proper placement of a FOUP on the Load Port. There is no specified time limit for this action, but testing cannot continue until ALL sensor(s) are activated. Please press the Close button when finished.

Note: SEMI® E87 requires that the Load Port be placed in Manual Access Mode before loading or unloading a FOUP by hand. The Load Port being tested may issue an E87 related alarm when the Placement and Presence Sensor(s) are activated while in Automatic Access Mode. To avoid possible E87 related alarms, please place the Load Port in Manual Access Mode. Then activate the sensor(s). Place the Load Port back in Automatic Access Mode before continuing with the Test.

2. Waiting for operator to activate both placement and presence sensor(s) on Load Port under test.
3. HO_AVBL signal verified ON on equipment under test.
   Failure - U_REQ signal turned OFF following placement sensor(s) de-activation.
4. Setting Load Port select signals (CS_0, CS_1) based on test configuration.
5. Setting VALID signal ON.
6. U_REQ signal verified ON on equipment under test.
   Failure - U_REQ signal failed to turn ON within timeout specified (TA1).
7. Setting TR_REQ signal ON.
8. READY signal verified ON on equipment under test.
   Failure - READY signal failed to turn ON within timeout specified (TA2).
9. Setting BUSY signal ON. Operator action required.

Please de-activate the Presence sensor(s) ONLY on the Load Port associated with the E84 interface being tested before the timeout shown expires. Operator must de-activate ALL Presence sensor(s). Please press the Close button when finished.

10. Waiting for operator to de-activate presence sensor(s) only.
11. U_REQ signal verified remained ON following presence sensor(s) de-activation. TP3 timeout expired. Verifying that the HO_AVBL is OFF with timeout error.
    Failure - U_REQ signal turned OFF following presence sensor(s) de-activation. Note: False failures may occur if entered TP timer values do not match equipment under test.
12. Setting BUSY, TR_REQ, VALID and Load Port select (CS_0, CS_1) signals OFF.
    Failure - HO_AVBL signal did not turn OFF following the TP3 timeout error. The equipment under test properly kept U_REQ ON throughout timeout period, but should have dropped HO_AVBL when the timeout expired.
13. Port Sensors Test (Part 3) Passed

Why we run this test

The E84 Specification states that the HO_AVBL signal should turn OFF if the Placement Sensor is ON, but the Presence Sensor is OFF (Table A1-6). If only one sensor is ON, then the FOUP is not properly positioned on the Load Port.

This test simulates a failed unload cycle, where the FOUP is not fully removed from the Load Port. The operator is asked to de-activate ONLY the Placement Sensor during the unload cycle. The equipment should continue to monitor it's TP3 timeout, and fail the handoff when that timeout expires.

The test fails if the equipment turns U_REQ OFF. U_REQ should not turn OFF until both Placement AND Presence sensors have turned OFF. The test will also fail if the equipment does not turn the HO_AVBL signal OFF at the end of the timeout period.

The test passes if the equipment's TP3 timeout expires, and the HO_AVBL signal turns OFF. This indicates that the equipment requires both Placement AND Presence sensor clear during an unload cycle.

Active Mode Functionality Test Q

Verify Emergency Stop

Verify Emergency Stop operation.

1. Operator action required...

Please load an FOUP onto the Load Port associated with the E84 Interface being tested. There is no specified time limit for this action, but testing cannot continue until FOUP is loaded. Please press the Close button when finished.

Note: SEMI® E87 requires that the Load Port be placed in Manual Access Mode before loading or unloading a FOUP by hand. To avoid possible E87 related alarms, please place the Load Port in Manual Access Mode. Then load a FOUP. Place the Load Port back in Automatic Access Mode before continuing with the Test.

2. Waiting for operator to load FOUP.
3. HO_AVBL signal verified ON on equipment under test.
   Failure - HO_AVBL signal is OFF on equipment under test.
4. Setting Load Port select signals (CS_0, CS_1) based on test configuration.
5. Setting VALID signal ON.
6. U_REQ signal verified ON on equipment under test.
   Failure - U_REQ signal failed to turn ON within timeout specified (TA1).
7. Setting TR_REQ signal ON.
8. READY signal verified ON on equipment under test.
   Failure - READY signal failed to turn ON within timeout specified (TA2).
9. Setting BUSY signal ON. Operator action required...

Please press the equipments Emergency Stop (E-Stop) button before the timeout shown expires. This should turn the ES signal OFF.

10. Waiting for operator to press E-Stop button.
11. ES signal verified OFF on equipment under test.
    Failure - ES signal failed to turn OFF within timeout specified (TP3).
12. Setting BUSY, TR_REQ, VALID and Load Port select (CS_0, CS_1) signals OFF.
    Failure - ES signal failed to stay OFF following 500 mSec debounce period.
13. E-Stop condition must be cleared on equipment under test. Operator action required...

Please clear the E-Stop condition on the equipment being tested. This should turn the ES signal ON. There is no specified time limit for this action.

14. Waiting for operator to clear the E-Stop condition.
15. ES signal verified ON on equipment under test.
    Failure - ES signal failed to turn ON after E-Stop condition cleared by operator.
16. E-Stop Test Passed.

Why we run this test

The E84 Specification states that the ES signal should turn OFF when the equipment detects a hazardous situation (Table 1). It can also turn OFF when the equipments EMO button is pressed.

This test verifies that the equipment properly turns the ES signal OFF when the EMO is pressed. The operator is asked to press the EMO button during an unload cycle. The equipment should turn the ES signal OFF. The operator is then asked to release the EMO. The ES signal should turn back ON.

Passive Mode Test Plan

Passive Mode testing includes both Static and Functionality tests. Static tests verify interface plug location and labeling, along with documentation issues. Functionality tests verify that the equipment under test adheres to the E84 handshaking specification. This section describes the pre-defined, Passive Mode tests supplied by the **E84 Emulator**.

Static tests are described by the tests title. Functionality tests are described by the tests title, along with detailed information about the steps required to complete the test.

During Passive Mode Functionality testing, the **E84 Emulator** uses TA timer settings to verify timing critical sections of the load/unload sequences. Passive Mode Functionality Test A allows the user to enter the TA settings of the equipment under test. If Passive Mode Functionality Test A is not selected to run, the **E84 Emulator** reverts the TA timer values to the defaults defined by the E84 Specification.

It is critical that the TA timer values used by the E84 Emulator match those in use by the equipment under test. If the values differ, false test failures may occur. If Passive Mode Functionality Test A is not selected, the following warning message is displayed before automated testing begins.

> You have not selected Functionality Test A, which allows you to enter the current TA timer values for the equipment under test. These values are used for timing various steps during Passive Mode testing. If the timer settings don't match, test results may be invalid.
>
> If you do not enter the current values, the TA settings will revert to the defaults listed in the E84 Specification:
>
> TA1 = 2 Seconds
> TA2 = 2 Seconds
> TA3 = 2 Seconds
>
> Press "Yes" to run Functionality Test A.
> Press "No" to test using the E84 default settings.
> Press "Cancel" to abort testing.

Passive Mode Static Tests

There are three Passive Mode Static tests. These tests verify the following:

- Proper **labeling** of DB-25 male E84 plug.
- Proper **location** of DB-25 male E84 plug.
- Existence of documented E84 recovery procedures.

Passive Mode Static Test A

Verify labeled DB-25 male E84 plug exists

Is a labeled DB-25 male E84 plug (as specified in ISO 2110:1989) present for each Load Port that is part of the test set-up? Note: this test applies to hardwired applications only.

Why we run this test

This test applies to hardwired applications only. For applications using optical transceivers, the AMHS connector is not covered by the E84 Specification.

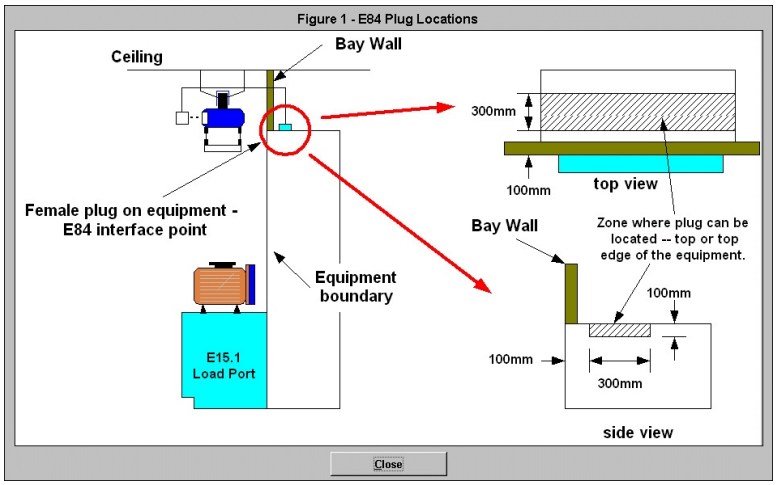
Section 6.4 of the E84 Specification requires that the passive equipment supply a female DB-25 connector for the E84 interface. The specification does not define the type of connector supplied by the active equipment. It is industry standard to use a male DB-25 connector. This connector must also comply with all electrical and pin assignments defined by the Specification. The Emulator verifies I/O pin assignments during each test in the functional test suite. Functional test B verifies the pin assignment for supply voltage. The Emulator does not verify I/O electrical specifications. Signals are considered OFF if their voltage level is greater than 1.8 VDC. Signals are considered ON if their voltage level drops below 1.8 VDC. Use the GCI Handheld Tester for thorough electrical specification testing.

This test is a visual examination by the operator to verify that the AMHS provides a male DB-25 connector. The operator is required to manually pass or fail this test.

Passive Mode Static Test B

Verify proper plug location

Are the male AMHS plug ends located so they can easily connect to a female equipment plug interface within the zones defined in Figure 1? Note: this test applies to hardwired applications only.



E84 Plug Locations

Why we run this test

Application note A1 of the E84 Specification (section A1-1.1) defines a zone on the process equipment where the E84 interface connector should be placed. It also indicates that for hardwired applications, the AMHS should provide a male connector that is easily reached from this zone.

This test is a visual examination by the operator to verify that the E84 interface connector is located near the correct zone. The operator is required to manually pass or fail this test.

Passive Mode Static Test C

Verify Documented Recovery Procedures Exist

Do documented E84 recovery procedures exist?

Why we run this test

The E84 Specification recommends (in section 6.3.3.1) that recovery procedures be provided on the active equipment.

This test is a visual examination by the operator to verify that proper recovery procedures exist.

Passive Mode Functionality Tests

There are 15 Passive Mode, Functionality tests. These tests verify that the equipment under test adheres to the E84 interface specification under the following conditions:

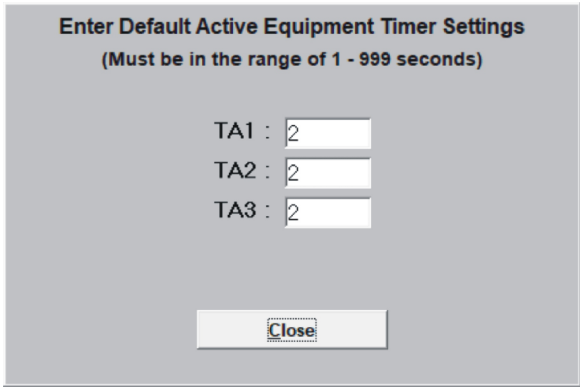
- User configurable active equipment timers.
- +24 Volts Full Load and No Load voltage test.
- Load Sequence.
- Unload Sequence.
- Handoff available 1.
- Handoff available 2.
- Handoff available 3.
- Emergency Stop operation (Load).
- Emergency Stop operation (Unload).
- TA1 - TA3 Timeout.
- WIPS Jeopardy Test 1 - 3.

Passive Mode Functionality Test A

Verify Configurable Active Equipment Timers

Verify that the Active Equipment timers (TA1 - TA3) are configurable within specified range (between 1 and 999 seconds). Note Default Settings.

1. Operator action required...
2. Waiting for operator to enter TA timer settings.
3. This test Passes if all TA timers can be configured between 1 and 999 seconds. Please mark test Results before continuing.



Default TA Timer Entry Screen

Why we run this test

Section 6.3.2.1 of the E84 Specification requires that interlock timeout values be user programmable. The active equipment uses three different timeout (TA1 - TA3) values for normal E84 hand-offs.

The Emulator uses the values of the active equipments interlock timeouts during functional testing. The operator is asked to verify that the timeout settings are user programmable through the equipments user interface. The current settings are entered into a dialog box so the Emulator can reference them in other functional tests.

After entering the three timeout values, the Emulator will automatically set the test results to 'Pass'. If the AMHS does not properly allow the timeouts to be modified, or if the allowable range for each timeout is not valid, the operator should manually fail the test.

Passive Mode Functionality Test B

Verify Full Load / No Load Voltage

Verify for hard wired implementation the voltage provided by the equipment under test is within the range specified in E84 under Full Load [100mA] and No Load [<2mA].

1. No Load Voltage Pre-Check
2. No Load Voltage Pre-Check Verified. Testing Full Load Voltage.
   Failure - Voltage not detected, or is below 18Vdc. Verify cable connection.
3. Full Load Voltage verified greater than or equal to 18Vdc.
   Failure - Full Load Voltage is less than 18Vdc.
4. Full Load Voltage verified less than or equal to 30Vdc.
   Failure - Full Load Voltage is greater than 30Vdc.
5. Testing No Load Voltage.
6. No Load Voltage verified greater than or equal to 18Vdc.
   Failure - No Load Voltage is less than 18Vdc.
7. No Load Voltage verified less than or equal to 30Vdc.
   Failure - No Load Voltage is greater than 30Vdc.
8. Voltage Test Passed.

Why we run this test

Figure 36 of the E84 Specification defines the pin assignment for Power and Power COM on the active equipment's E84 interface connector be on pins 22 and 25 respectively. Additionally, in section 6.4.2.1 the Specification defines that the power supply voltage be +24 VDC Nominal, with a minimum of +18 VDC and a maximum of +30 VDC (for both no load and full load of 100 mA).

This test verifies that the Load Port is supplying +24 VDC on pin 22, referenced to pin 25. No operator interaction is required for this test.

This test is only valid for hardwired applications. When testing with an attached Optical Transceiver, this test will always pass, but will not actually test the active equipment power supply pins.

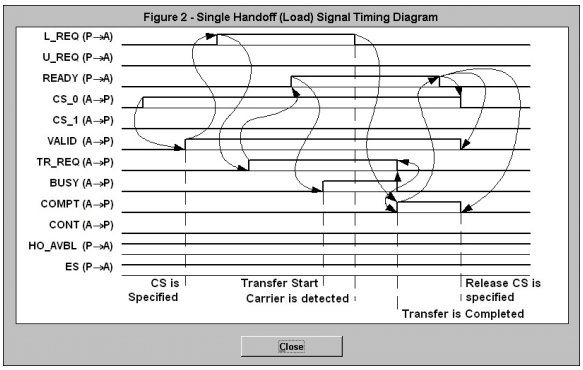
The Optical Transceiver connects to the Emulators female DB-25 connector. The Emulator supplies +24 VDC to the attached Optical Transceiver through pin 23 of this female connector. The E84 Specification defines (Figure 32) that the Optical Transceiver tie pins 22 and 23 together. This brings the Emulator supplied +24 VDC back on pin 22 of the female connector, which is the pin that the active equipment normally supplies voltage on.

When running the voltage test through an attached Optical Transceiver, the Emulator will end up verifying it's own +24 VDC supply voltage.

Passive Mode Functionality Test C

Verify Single Handoff Load Sequence

Verify single handoff sequence for Loading.
See Figure 2 for example signal timing diagram.



Single Handoff (Load) Signal Timing Diagram

1. Setting HO_AVBL and ES signals ON.

   Issue an E84 based AMHS move command (load).

2. Waiting for Load Port select signals (CS_0, CS_1) from AMHS equipment under test.
   Failure - VALID signal turned ON before Load Port select signals (CS_0, CS_1) were configured.
3. Waiting for VALID signal ON from AMHS equipment under test.
4. Setting L_REQ signal ON.
5. TR_REQ signal verified ON on AMHS equipment under test.
   Failure - TR_REQ signal failed to turn ON within timeout specified (TP1).
6. Setting READY signal ON.
7. BUSY signal verified ON on AMHS equipment under test.
   Failure - BUSY signal failed to turn ON within timeout specified (TP2).
8. Waiting for AMHS equipment to deliver the FOUP...

   Waiting for FOUP to be loaded. The AMHS equipment should be delivering the FOUP. The AMHS equipment should place the FOUP onto the "Load Port" before the timeout shown below expires. Please press the PASS button if the FOUP is loaded within the timeout period. Press the FAIL button if the FOUP is not loaded successfully.

10. FOUP load successful. Setting L_REQ signal OFF.
    Failure - Operator indicated that the AMHS failed to load the FOUP properly within timeout specified (TP3).
12. BUSY signal verified OFF,
    Failure - BUSY signal failed to turn OFF within timeout specified (TP4).
13. TR_REQ signal verified OFF,
    Failure - TR_REQ signal failed to turn OFF within timeout specified (TP4).
14. COMPT signal verified ON on AMHS equipment under test.
    Failure - COMPT signal failed to turn ON within timeout specified (TP4).
15. Setting READY signal OFF.
16. COMPT signal verified OFF,
    Failure - COMPT signal failed to turn OFF within timeout specified (TP5).
17. VALID signal verified OFF on AMHS equipment under test.
    Failure - VALID signal failed to turn OFF within timeout specified (TP5).
18. Load Port select signals (CS_0, CS_1) verified OFF on AMHS equipment under test.
    Failure - Load Port select signals (CS_0, CS_1) failed to turn OFF within timeout specified (TP5).
19. Load Test Passed.

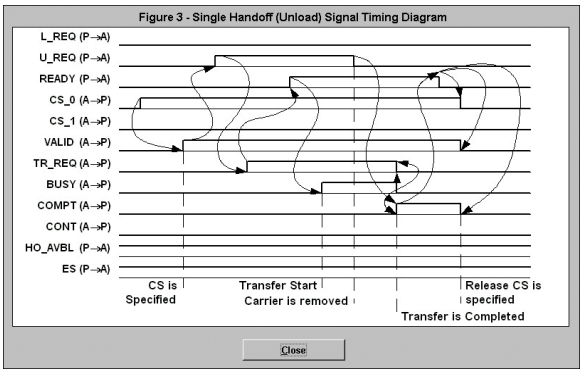
Why we run this test

The E84 Specification defines (in section 6.2.4) a specific sequence of signal state changes that must be followed to process an automatic E84 load cycle. This test runs the Passive side of that defined sequence, and verifies that the AMHS being tested properly follows the Active side. This test requires the operator to indicate when the AMHS has loaded the FOUP onto the dummy Load Port.

Passive Mode Functionality Test D

Verify Single Handoff Unload Sequence

Verify single handoff sequence for Unloading.



Single Handoff (Unload) Signal Timing Diagram

1. Setting HO_AVBL and ES signals ON.

   Issue an E84 based AMHS move command (unload).

2. Waiting for Load Port select signals (CS_0, CS_1) from AMHS equipment under test.
   Failure - VALID signal turned ON before Load Port select signals (CS_0, CS_1) were configured.
3. Waiting for VALID signal ON from AMHS equipment under test.
4. Setting U_REQ signal ON.
5. TR_REQ signal verified ON on AMHS equipment under test.
   Failure - TR_REQ signal failed to turn ON within timeout specified (TP1).
6. Setting READY signal ON.
7. BUSY signal verified ON on AMHS equipment under test.
   Failure - BUSY signal failed to turn ON within timeout specified (TP2).
8. Waiting for AMHS equipment to unload the FOUP...

Waiting for FOUP to be unloaded. The AMHS equipment should be unloading the FOUP. The AMHS equipment should remove the FOUP from the "Load Port" before the timeout shown below expires. Please press the PASS button if the FOUP is unloaded within the timeout period. Press the FAIL button if the FOUP is not unloaded successfully.

10. FOUP unloaded successfully. Setting U_REQ signal OFF.
    Failure - Operator indicated that the AMHS failed to unload the FOUP properly within timeout specified (TP3).
12. BUSY signal verified OFF,
    Failure - BUSY signal failed to turn OFF within timeout specified (TP4).
13. TR_REQ signal verified OFF,
    Failure - TR_REQ signal failed to turn OFF within timeout specified (TP4).
14. COMPT signal verified ON on AMHS equipment under test.
    Failure - COMPT signal failed to turn ON within timeout specified (TP4).
15. Setting READY signal OFF.
16. COMPT signal verified OFF,
    Failure - COMPT signal failed to turn OFF within timeout specified (TP5).
17. VALID signal verified OFF on AMHS equipment under test.
    Failure - VALID signal failed to turn OFF within timeout specified (TP5).
18. Load Port select signals (CS_0, CS_1) verified OFF on AMHS equipment under test.
    Failure - Load Port select signals (CS_0, CS_1) failed to turn OFF within timeout specified (TP5).
19. Unload Test Passed.

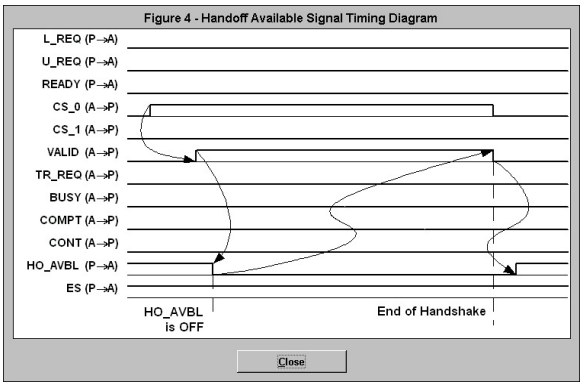
Why we run this test

The E84 Specification defines (in section 6.2.4) a specific sequence of signal state changes that must be followed to process an automatic E84 unload cycle. This test runs the Passive side of that defined sequence, and verifies that the AMHS being tested properly follows the Active side. This test requires the operator indicate when the AMHS has removed the FOUP from the dummy Load Port.

Passive Mode Functionality Test E

Verify Handoff Available Sequence 1

Verify handoff available sequence 1.



Handoff Available Signal Timing Diagram

1. Setting HO_AVBL and ES signals ON.

   Issue an E84 based AMHS move command (load or unload).

2. Waiting for Load Port select signals (CS_0, CS_1) from AMHS equipment under test.
   Failure - VALID signal turned ON before Load Port select signals (CS_0, CS_1) were configured.
3. Waiting for VALID signal ON from AMHS equipment under test.
4. Setting HO_AVBL signal OFF.
5. VALID signal verified OFF on AMHS equipment under test.
   Failure - VALID signal did not turn OFF following drop of HO_AVBL signal.
6. Load Port select signals (CS_0, CS_1) verified OFF on AMHS equipment under test.
   Failure - Load Port select signals (CS_0, CS_1) did not turn OFF following drop of HO_AVBL signal.
7. Setting HO_AVBL signal ON.
8. Handoff Available 1 Test Passed.

Why we run this test

The E84 Specification states that the active equipment must monitor the HO_AVBL signal (in section 6.2.7.1). When the HO_AVBL signal turns OFF, the active equipment should terminate the handoff, and drop it's VALID signal.

This test simulates an error condition on the Load Port by dropping the HO_AVBL signal after the AMHS has turned the VALID signal ON (Figure 21). The AMHS should detect HO_AVBL is OFF, and terminate the handoff.

Passive Mode Functionality Test F

Verify Handoff Available Sequence 2

Verify handoff available sequence 2.

1. Setting HO_AVBL signal OFF, ES signal ON.

   Issue an E84 based AMHS move command (load or unload).

   Verify that the AMHS equipment arrives at the Load Port and errors out.

   Press PASS if the AMHS equipment arrives at the Load Port and displays an error. Press FAIL if the AMHS equipment does not arrive, or does not error out.

2. Waiting for AMHS...
3. AMHS arrival and error display verified.
   Failure - Operator indicates AMHS did not arrive at Load Port, or did not issue an error.
4. Setting HO_AVBL signal ON.
5. Handoff Available 2 Test Passed.

Why we run this test

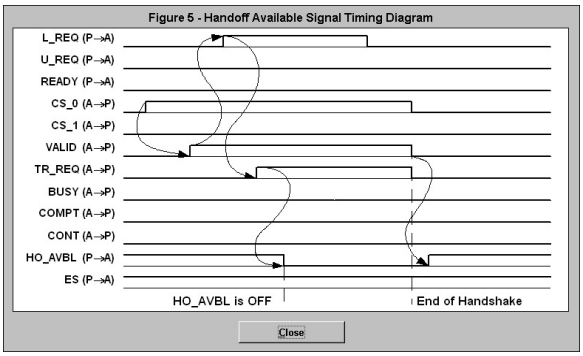
The E84 Specification states that the active equipment must monitor the HO_AVBL signal (in section 6.2.7.1). When the HO_AVBL signal turns OFF, the active equipment should terminate the handoff, and drop it's VALID signal.

This test simulates an error condition on the Load Port prior to the arrival of the AMHS (Figure 22). When the AMHS arrives, it should detect HO_AVBL is OFF, and not initiate a handoff.

Passive Mode Functionality Test G

Verify Handoff Available Sequence 3

Verify handoff available sequence 3.



Handoff Available Signal Timing Diagram

1. Setting HO_AVBL and ES signals ON.

   Issue an E84 based AMHS move command (load)

2. Waiting for Load Port select signals (CS_0, CS_1) from AMHS equipment under test.
   Failure - VALID signal turned ON before Load Port select signals (CS_0, CS_1) were configured.
3. Waiting for VALID signal ON from AMHS equipment under test.
4. Setting L_REQ signal ON.
5. TR_REQ signal verified ON on AMHS equipment under test.
   Failure - TR_REQ signal failed to turn ON within timeout specified (TP1).
6. Setting HO_AVBL signal OFF.
7. VALID signal verified OFF,
   Failure - VALID signal did not turn OFF following drop of HO_AVBL signal.
8. TR_REQ signal verified OFF on AMHS equipment under test.
   Failure - TR_REQ signal did not turn OFF following drop of HO_AVBL signal.
9. Load Port select signals (CS_0, CS_1) verified OFF on AMHS equipment under test.
   Failure - Load Port select signals (CS_0, CS_1) did not turn OFF following drop of HO_AVBL signal.
10. Setting L_REQ signal OFF.
11. Setting HO_AVBL signal ON.
12. Handoff Available 3 Test Passed.

Why we run this test

The E84 Specification states that the active equipment must monitor the HO_AVBL signal (in section 6.2.7.1). When the HO_AVBL signal turns OFF, the active equipment should terminate the handoff, and drop it's VALID signal.

This test simulates an error condition on the Load Port by dropping the HO_AVBL signal after the AMHS has turned the TR_REQ signal ON (Figure 24). The AMHS should detect HO_AVBL is OFF, and terminate the handoff.

Passive Mode Functionality Test H

Verify TA1 Timeout Error

Verify TA1 timeout error.

1. Setting HO_AVBL and ES signals ON.

Issue an E84 based AMHS move command (load)

2. Waiting for Load Port select signals (CS_0, CS_1) from AMHS equipment under test.
   Failure - VALID signal turned ON before Load Port select signals (CS_0, CS_1) were configured.
3. Waiting for VALID signal ON from AMHS equipment under test.
4. Testing TA1 Timeout. Waiting for TA1 timeout period to expire.

TA1 Timer Test in progress. When the timeout shown decrements to zero, the AMHS equipment under test should generate a TA1 alarm on its User Interface. If the alarm does not occur at the appropriate time (either before, or after the timeout expires) the timer test has failed, and the user should press the Fail Button. If the alarm does occur at the proper time, the timer test has passed, and the user should press the Pass Button.

5. TA1 timeout error verified on AMHS equipment under test User Interface.
   Failure - TA1 timeout error did not occur at appropriate time (or did not occur at all).
7. TA1 Timeout Test Passed.

AMHS Equipment must be reset before continuing to next test. Please verify that the AMHS Equipment is ready before proceeding.

Why we run this test

The E84 Specification defines TA1 as the maximum time between VALD ON and L_REQ / U_REQ ON (Table 7).

This test will force a TA1 timeout error by advancing the handoff up to the point where the AMHS is expecting the L_REQ signal to turn ON. At this point, the Emulator locks it's outputs and displays a timeout dialog box. This timeout box counts down from the TA1 value set during Test A. When the counter reaches zero, the AMHS should timeout, and terminate the handoff.

The Emulator requires the operator to visually inspect the AMHS GUI to verify that an appropriate timeout error has occurred.

Passive Mode Functionality Test I

Verify TA2 Timeout Error

Verify TA2 timeout error.

1. Setting HO_AVBL and ES signals ON.

Issue an E84 based AMHS move command (load)

2. Waiting for Load Port select signals (CS_0, CS_1) from AMHS equipment under test.
   Failure - VALID signal turned ON before Load Port select signals (CS_0, CS_1) were configured.
3. Waiting for VALID signal ON from AMHS equipment under test.
4. Setting L_REQ signal ON.
5. TR_REQ signal verified ON on AMHS equipment under test.
   Failure - TR_REQ signal failed to turn ON within timeout specified (TP1).
6. Testing TA2 Timeout. Waiting for TA2 timeout period to expire.

TA2 Timer Test in progress. When the timeout shown decrements to zero, the AMHS equipment under test should generate a TA2 alarm on its User Interface. If the alarm does not occur at the appropriate time (either before, or after the timeout expires) the timer test has failed, and the user should press the Fail Button. If the alarm does occur at the proper time, the timer test has passed, and the user should press the Pass Button.

7. TA2 timeout error verified on AMHS equipment under test User Interface.
   Failure - TA2 timeout error did not occur at appropriate time (or did not occur at all).
8. Setting L_REQ signal OFF.
9. TA2 Timeout Test Passed.

AMHS Equipment must be reset before continuing to next test. Please verify that the AMHS Equipment is ready before proceeding.

Why we run this test

The E84 Specification defines TA2 as the maximum time between TR_REQ ON and READY ON (Table 7).

This test will force a TA2 timeout error by advancing the handoff up to the point where the AMHS is expecting the READY signal to turn ON. At this point, the Emulator locks it's outputs and displays a timeout dialog box. This timeout box counts down from the TA2 value set during Test A. When the counter reaches zero, the AMHS should timeout, and terminate the handoff.

The Emulator requires the operator to visually inspect the AMHS GUI to verify that an appropriate timeout error has occurred.

Passive Mode Functionality Test J

Verify TA3 Timeout Error

Verify TA3 timeout error.

1. Setting HO_AVBL and ES signals ON.

Issue an E84 based AMHS move command (load)

2. Waiting for Load Port select signals (CS_0, CS_1) from AMHS equipment under test.
   Failure - VALID signal turned ON before Load Port select signals (CS_0, CS_1) were configured.
3. Waiting for VALID signal ON from AMHS equipment under test.
4. Setting L_REQ signal ON.
5. TR_REQ signal verified ON on AMHS equipment under test.
   Failure - TR_REQ signal failed to turn ON within timeout specified (TP1).
6. Setting READY signal ON.
7. BUSY signal verified ON on the AMHS equipment under test.
   Failure - BUSY signal failed to turn ON within timeout specified (TP2).
8. Waiting for AMHS equipment to deliver the FOUP…

Waiting for FOUP to be loaded. The AMHS equipment should be delivering the FOUP. The AMHS equipment should place the FOUP onto the "Load Port" before the timeout shown below expires. Please press the PASS button if the FOUP is loaded within the timeout period. Press the FAIL button if the FOUP is not loaded successfully.

10. FOUP load successful. Setting L_REQ signal OFF.
    Failure - Operator indicated that the AMHS failed to load the FOUP properly within timeout specified (TP3).
12. BUSY signal verified OFF,
    Failure - BUSY signal failed to turn OFF within timeout specified (TP4).
13. TR_REQ signal verified OFF,
    Failure - TR_REQ signal failed to turn OFF within timeout specified (TP4).
14. COMPT signal verified ON on AMHS equipment under test.
    Failure - COMPT signal failed to turn ON within timeout specified (TP4).
15. Testing TA3 Timeout.
16. Waiting for TA3 timeout period to expire.

TA3 Timer Test in progress. When the timeout shown decrements to zero, the AMHS equipment under test should generate a TA3 alarm on its User Interface. If the alarm does not occur at the appropriate time (either before, or after the timeout expires) the timer test has failed, and the user should press the Fail Button. If the alarm does occur at the proper time, the timer test has passed, and the user should press the Pass Button.

17. TA3 timeout error verified on AMHS equipment under test User Interface.
    Failure - TA3 timeout error did not occur at appropriate time (or did not occur at all).
18. Setting READY signal OFF.
19. TA3 Timeout Test Passed.

AMHS Equipment must be reset before continuing to next test. Please verify that the AMHS Equipment is ready before proceeding.

Why we run this test

The E84 Specification defines TA3 as the maximum time between COMPT ON and READY OFF (Table 7).

This test will force a TA3 timeout error by advancing the handoff up to the point where the AMHS is expecting the READY signal to turn OFF. At this point, the Emulator locks it's outputs and

displays a timeout dialog box. This timeout box counts down from the TA3 value set during Test A. When the counter reaches zero, the AMHS should timeout, and terminate the handoff.

The Emulator requires the operator to visually inspect the AMHS GUI to verify that an appropriate timeout error has occurred.

Passive Mode Functionality Test K

WIPS Jeopardy Test 1 (L_REQ stays ON)

WIPS Jeopardy Test 1 - L_REQ stays ON.

1. Setting HO_AVBL and ES signals ON.

   Issue an E84 based AMHS move command (load)

2. Waiting for Load Port select signals (CS_0, CS_1) from AMHS equipment under test.
   Failure - VALID signal turned ON before Load Port select signals (CS_0, CS_1) were configured.
3. Waiting for VALID signal ON from AMHS equipment under test.
4. Setting L_REQ signal ON.
5. TR_REQ signal verified ON on AMHS equipment under test.
   Failure - TR_REQ signal failed to turn ON within timeout specified (TP1).
6. Setting READY signal ON.
7. BUSY signal verified ON on the AMHS equipment under test.
   Failure - BUSY signal failed to turn ON within timeout specified (TP2).
8. Waiting for AMHS OHV to lower the FOUP onto the Load Port.

Waiting for FOUP to be loaded. The AMHS OHV should be lowering the FOUP. The AMHS should place the FOUP onto the "Load Port" before the timeout shown below expires. The AMHS should not release the FOUP, because the E84 Emulator has not turned the L_REQ signal OFF. This simulates a misplaced FOUP on the Load Port. Please press the PASS button if the AMHS OHV grippers fully support the FOUP. Press the FAIL button if the AMHS OHV releases the FOUP onto the "Load Port".

10. AMHS OHV properly supporting FOUP.
    Failure - Operator indicated that the AMHS OHV released the FOUP before the L_REQ signal is turned OFF.
11. WIP Jeopardy Test Passed.

Why we run this test

The E84 Specification defines the relationship between the L_REQ signal and the release of the FOUP by the AMHS during a load cycle (A1-4.6.1.1). The L_REQ signal turns OFF to indicate that the FOUP has been properly loaded onto the Load Port. The AMHS should not release the FOUP until the L_REQ signal turns OFF.

This test simulates a misplaced FOUP delivery by holding L_REQ ON throughout the TP3 timeout period. The operator is asked to verify that the AMHS fully supports the FOUP throughout this timeout period.

Passive Mode Functionality Test L

WIPS Jeopardy Test 2 (L_REQ turns OFF early)

WIPS Jeopardy Test 2 - L_REQ turns OFF early.

1. Setting HO_AVBL and ES signals ON.

Issue an E84 based AMHS move command (load)

2. Waiting for Load Port select signals (CS_0, CS_1) from AMHS equipment under test.
   Failure - VALID signal turned ON before Load Port select signals (CS_0, CS_1) were configured.
3. Waiting for VALID signal ON from AMHS equipment under test.
4. Setting L_REQ signal ON.
5. TR_REQ signal verified ON on AMHS equipment under test.
   Failure - TR_REQ signal failed to turn ON within timeout specified (TP1).
6. Setting READY signal ON.
7. BUSY signal verified ON on the AMHS equipment under test.
   Failure - BUSY signal failed to turn ON within timeout specified (TP2).
8. Setting L_REQ signal OFF to simulate loadport obstruction.

Waiting for FOUP to be loaded. The AMHS OHV should be lowering the FOUP. Before the FOUP is placed onto the "Load Port" the E84 Emulator has turned the L_REQ signal OFF early. This simulates an obstruction on the Load Port during the load. The AMHS OHV should not release the FOUP.

Please press the PASS button if the AMHS OHV grippers fully support the FOUP. Press the FAIL button if the AMHS OHV releases the FOUP onto the "Load Port".

10. AMHS OHV properly supporting FOUP.
    Failure - Operator indicated that the AMHS OHV released the FOUP before the L_REQ signal is turned OFF.
11. WIP Jeopardy Test 2 Passed.

Why we run this test

The E84 Specification defines does not address the situation where the Load Port determines that an obstruction occurs during the physical handoff portion of a load cycle. Typically, the Load Port would drop HO_AVBL when it determines a problem with the load cycle. The E84 Specification does not require the AMHS to monitor HO_AVBL during the physical handoff. The AMHS must verify HO_AVBL up to the point where READY turns ON. Once the physical handoff begins (with BUSY turning ON) the AMHS is not required to monitor HO_AVBL.

To handle this situation, some Load Port manufacturers have chosen to drop the L_REQ signal as soon as the obstruction is detected, before the FOUP approaches the Presence and Placement sensors. Many AMHS manufacturers treat L_REQ turning OFF prematurely as an error condition.

This test simulates this situation by dropping L_REQ as soon as BUSY turns ON. The AMHS should abort the handoff, without releasing the FOUP.

Passive Mode Functionality Test M

WIPS Jeopardy Test 3 (U_REQ stays ON)

WIPS Jeopardy Test 3 - U_REQ stays ON.

1. Setting HO_AVBL and ES signals ON.

   Issue an E84 based AMHS move command (unload)

2. Waiting for Load Port select signals (CS_0, CS_1) from AMHS equipment under test.
   Failure - VALID signal turned ON before Load Port select signals (CS_0, CS_1) were configured.
3. Waiting for VALID signal ON from AMHS equipment under test.
4. Setting U_REQ signal ON.
5. TR_REQ signal verified ON on AMHS equipment under test.
   Failure - TR_REQ signal failed to turn ON within timeout specified (TP1).
6. Setting READY signal ON.
7. BUSY signal verified ON on the AMHS equipment under test.
   Failure - BUSY signal failed to turn ON within timeout specified (TP2).
8. Waiting for AMHS OHV to lower to the Load Port.

Waiting for AMHS OHV to lower the gripper and pick up the FOUP. The AMHS equipment should lower the gripper and unload the FOUP before the timeout shown below expires. The AMHS OHV should grip the FOUP, but abort the handoff when the unload movement completes with the U_REQ signal still ON.

Please press the PASS button if the AMHS OHV grippers fully support the FOUP. Press the FAIL button if the AMHS OHV releases the FOUP onto the "Load Port".

10. AMHS OHV properly supporting FOUP.
    Failure - Operator indicated that the AMHS OHV released the FOUP before the U_REQ signal is turned OFF.
11. WIP Jeopardy Test 3 Passed.

Why we run this test

This test simulates the condition where the Load Port does not see the FOUP being properly removed during an unload cycle. If the AMHS sensors indicate that the unload was successful, but the Load Port does not drop it's U_REQ signal, the handoff must be aborted.

The E84 Specification indicates (A1-4.6.1.1) that the AMHS should ensure that the carrier is safely and securely contained aboard the vehicle, and if possible, continue to it's destination. Typically the OHT will not stop part way up, waiting for the U_REQ to turn OFF. Instead, the AMHS should verify that U_REQ is OFF after the unload movement is complete, and continue or abort the handoff at that time.

This test simulates this situation, and asks the operator to verify that the AMHS fully supports the FOUP following the unload attempt.

Passive Mode Functionality Test N

Verify Emergency Stop 1 (Load Sequence)

Verify Emergency Stop Test 1 - Load Sequence.

1. Setting HO_AVBL and ES signals ON.

Issue an E84 based AMHS move command (load).

2. Waiting for Load Port select signals (CS_0, CS_1) from AMHS equipment under test.
   Failure - VALID signal turned ON before Load Port select signals (CS_0, CS_1) were configured.
3. Waiting for VALID signal ON from AMHS equipment under test.
4. Setting L_REQ signal ON.
5. TR_REQ signal verified ON on AMHS equipment under test.
   Failure - TR_REQ signal failed to turn ON within timeout specified (TP1).
6. Setting READY signal ON.
7. BUSY signal verified ON on the AMHS equipment under test.
   Failure - BUSY signal failed to turn ON within timeout specified (TP2).
8. Turning ES and HO_AVBL signals OFF to simulate E-Stop button press.

E-Stop condition simulated. The AMHS equipment should immediately stop all motion.

Press the PASS button if the AMHS has stopped all motion. Press the FAIL button if the AMHS continued with the load cycle.

9. Waiting for operator input...
10. Verified that all AMHS equipment motion has stopped.
    Failure - AMHS equipment continued with load cycle following ES signal OFF.
11. Setting HO_AVBL and ES signals ON.
12. E-Stop Test 1 Passed.

Why we run this test

The E84 Specification defines the ES signal (Table 1) as a request to stop active equpment activity immediately. The Load Port uses this signal to inform the active equipment of a hazardous situation, where harm may be caused to material, product, or operation.

This test simulates a hazardous situation by dropping the ES signal in the middle of a load cycle.

Passive Mode Functionality Test O

Verify Emergency Stop 2 (Unload Sequence)

Verify Emergency Stop Test 2 - Unload Sequence

1. Setting HO_AVBL and ES signals ON.

Issue an E84 based AMHS move command (unload).

2. Waiting for Load Port select signals (CS_0, CS_1) from AMHS equipment under test.
   Failure - VALID signal turned ON before Load Port select signals (CS_0, CS_1) were configured.
3. Waiting for VALID signal ON from AMHS equipment under test.
4. Setting U_REQ signal ON.
5. TR_REQ signal verified ON on AMHS equipment under test.
   Failure - TR_REQ signal failed to turn ON within timeout specified (TP1).
6. Setting READY signal ON.
7. BUSY signal verified ON on the AMHS equipment under test.
   Failure - BUSY signal failed to turn ON within timeout specified (TP2).
8. Turning ES and HO_AVBL signals OFF to simulate E-Stop button press.

E-Stop condition simulated. The AMHS equipment should immediately stop all motion.

Press the PASS button if the AMHS has stopped all motion. Press the FAIL button if the AMHS continued with the load cycle.

9. Waiting for operator input...
10. Verified that all AMHS equipment motion has stopped.
    Failure - AMHS equipment continued with load cycle following ES signal OFF.
11. Setting HO_AVBL and ES signals ON.
12. E-Stop Test 2 Passed.

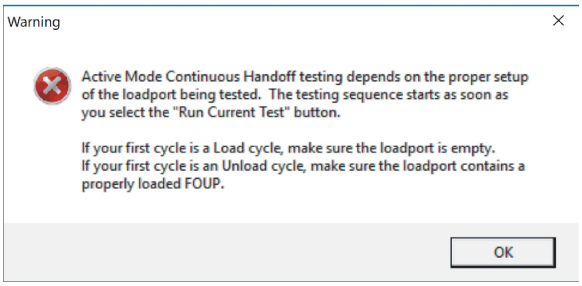
Why we run this test

The E84 Specification defines the ES signal (Table 1) as a request to stop active equpment activity immediately. The Load Port uses this signal to inform the active equipment of a hazardous situation, where harm may be caused to material, product, or operation.

This test simulates a hazardous situation by dropping the ES signal in the middle of an unload cycle.

Continuous Mode Test Plan

Continuous Mode testing involves running a customized sequence of handoff's. The user can string together a list of handoff's that are processed in a sequential manner, using the Continuous Handoff Mode defined by the SEMI® specification. The list is comprised of a sequence of Load and Unload cycles using either Load Port.



Continuous Mode Setup Warning

Continuous Mode testing uses the standard Load and Unload cycles defined above (for Active and Passive Modes) to test each individual handoff in the list. The CONT signal is also monitored and verified throughout the Continuous Mode test.

Continuous Mode Tests

Continuous Mode testing allows for three separate tests. These include:

- Test Continuous Handoff Sequence (Active Mode)
- Test TP6 Timeout Error (Active Mode)
- Test Continuous Handoff Sequence (Passive Mode)

Continuous Mode Test A

Test Continuous Handoff Sequence (Active Mode)

Continuous Mode Test A runs the selected sequence of handoff's, with the **E84 Emulator** acting as the active equipment. The **E84 Emulator** runs each handoff in order, setting the CONT signal to indicate Continuous Mode operation.

Why we run this test

The E84 Specification defines the proper sequence for continuous mode handoffs (6.2.6).

This test runs the Active equipment's side of the continuous handoff sequence, and verifies that the Load Port being tested properly processes the Passive side.

Continuous Mode Test B

Test TP6 Timeout Error (Active Mode)

Continuous Mode Test B runs the first selected handoff, then forces a delay greater than the entered TP6 Timer value. This should force the passive equipment being tested to respond with a TP6 timer error. The operator is asked to verify the TP6 Timeout error on the passive equipment.

Why we run this test

The E84 Specification defines TP6 as the maximum time between VALID OFF and VALID ON during a continuous mode handoff (Table 8).

This test will force a TP6 timeout error by advancing the handoff up to the point where the Load Port is expecting the VALID signal to turn ON again, after the initial handoff completes. At this point, the Emulator locks it's outputs and displays a timeout dialog box. This timeout box counts down from the TP6 value set in the Continuous Test Setup screen. When the counter reaches zero, the Load Port should timeout, and display a TP6 timeout message on it's GUI.

Continuous Mode Test C

Test Continuous Handoff Sequence (Passive Mode)

Continuous Mode Test C causes the **E84 Emulator** to act as the passive equipment. The **E84 Emulator** waits for the sequence of tests defined by the user, while monitors the active equipments CONT signal for proper adherence to the SEMI® specification.

Why we run this test

The E84 Specification defines the proper sequence for continuous mode handoffs (6.2.6).

This test runs the Passive equipment's side of the continuous handoff sequence, and verifies that the AMHS being tested properly processes the Active side.

Appendix

E84 Emulator Connector Pinout

The **E84 Emulator** provides two DB-25 connectors (labeled EMULATOR AS ACTIVE EQUIPMENT and EMULATOR AS PASSIVE EQUIPMENT). The following table provides pinouts for the two connectors.

Table 1 - E84 Emulator Pin Out

Pin #	Female DB-25 Emulator as Passive Equipment	Male DB-25 Emulator as Active Equipment	Symbol	Direction	Remarks
1	OUT 1	IN 1	L_REQ	P -> A	
2	OUT 2	IN 2	U_REQ	P -> A	
3	OUT 3	IN 3	VA	P -> A	Interbay AMHS (used with passive OHS, stockers)
4	OUT 4	IN 4	READY	P -> A	
5	OUT 5	IN 5	VS_0	P -> A	Interbay AMHS (used with passive OHS, stockers)
6	OUT 6	IN 6	VS_1	P -> A	Interbay AMHS (used with passive OHS, stockers)
7	OUT 7	IN 7	HO_AVBL	P -> A	
8	OUT 8	IN 8	ES	P -> A	
9	NC *	NC *	NC *		
10	NC *	NC *			Reserved per SEMI® Standard
11	NC *	NC *			Reserved per SEMI® Standard
12	NC *	NC *			Reserved per SEMI® Standard
13	NC *	NC *	NC *		
14	IN 1	OUT 1	VALID	A -> P	
15	IN 2	OUT 2	CS_0	A -> P	
16	IN 3	OUT 3	CS_1	A -> P	
17	IN 4	OUT 4	AM_AVBL	A -> P	Interbay AMHS (used with passive OHS, stockers)
18	IN 5	OUT 5	TR_REQ	A -> P	
19	IN 6	OUT 6	BUSY	A -> P	
20	IN 7	OUT 7	COMPT	A -> P	
21	IN 8	OUT 8	CONT	A -> P	
22	NC *	Power	not applicable		for wire based communication, power is isolated
23	Power	NC*	not applicable		for wire based communication, power is isolated
24	Power COM	Signal COM	not applicable		for wire base communication, Power com is routed to signal com
25	Signal COM	Power COM	not applicable		for wire base communication, Power com is routed to signal com

* NC = Not Connected

Version History

Version 2.6a

- Corrected description of file save process for Continuous Mode Testing..

Version 2.5a

- Corrected description of file save process.

Version 2.4a

- Supports Windows 7 & 10 when connected to a USB Interface E84 Emulator that has been updated for Windows 10 compatibility.

- Added Active Mode Manual Step Control Screen.

- Added PDF report generation.

Version 2.3

- Previous version would issue a system error if communications with the USB Emulator were interrupted. This version captures that error condition, displays an error message, and provides a retry option to the operator.

- The working directory is now displayed on the Main Menu. The Load Port Number entered during Active Mode Test Setup is now displayed on the Active Mode Test screens. These two changes help in distinguishing which Application instance is controlling each USB Emulator.

Version 2.2a

- Modifications to allow multiple instances of the Application to be running on the same PC at the same time. Multiple USB E84 Emulators can be controlled on the same PC by running multiple instances of the Application.

Version 2.2

- The ES signal is now monitored during all Active Mode tests. Previous versions did not monitor the ES signal during timeout and port sensor tests. This falsely passed load ports that dropped ES along with HO_AVBL on timeout errors. This change properly implements testing the ES signal as defined in section A1-4.5 of the E84 standard.

- HO_AVBL is now checked following completion of timeout tests (in Active Mode). The software asks the operator to pass / fail the test based on the load ports display of the timeout error on its GUI. When the operator passes the test, the Emulator now checks the HO_AVBL signal to make sure it has turned OFF. The load port should turn HO_AVBL OFF with the timeout error. If the load port properly displays the timeout message, but fails to drop HO_AVBL, the test is failed.

Version 2.1.1

- The Active Mode E-Stop test reported false failures on certain LoadPorts. The 500 mSecond debounce window incorrectly monitored the L_REQ signal. All signals are now allowed to fluctuate during the 500 mSecond window.

- A fix was added to correct for a database lock-up condition reported by some users.

- Interbay signals are now supported in Manual Mode Testing.

Technical Support

If you encounter problems using your **E84 Emulator**, Get Control technical support can be reached the following ways.

By email at **support@getcontrol.com**.

Please include GUI and **E84 Emulator** version numbers in your email, along with the following details:

- The Test Mode (Active, Passive or Continuous) you are running.
- The Test Number and State where the problem is occurring.
- Any Error messages displayed.

By phone at 1-480-539-0478 (9 - 5, Mountain Standard Time).

Please have the same information available when calling.

Also, see our web site at www.getcontrol.com for additional information about Get Control, Inc.. Software upgrades (when released) can also be found at www.getcontrol.com/products/e84emulator.html.