

Set-Top Box Diagnostic Station

INTRODUCTION

Manufacturers and distributors of set-top boxes (STB) face with the issue of returned devices due to numerous problems occurring during exploitation. These malfunctions can be caused by various reasons, either in software (bugs in device's functionality) or hardware (damages caused by improper use or malfunction of the hardware). It is natural to expect that after a certain period of exploitation, some problems in devices can occur; unexpected and sudden failures due to improper or careless use of STB are also expected, all resulting in returning of device for repair, whether it's physical damage or software type error. When a device comes in for repair, it is necessary that it is put under a specific test to verify the nature of the defect and detect if there is a general breakdown of the software itself. Testing of the image and sound quality, menu functionality, measurements of the output voltage level on output interfaces, and signal decoding are some of the basic tests that needs to be pursued; additionally, every manufacturer in accordance with the specific characteristics of the device and own requirements adds more tests for more reliable diagnostic.

It is required that the diagnostic is fast and effective and to fully cover the set of features, in order to return the unit to user in due time. The devices are tested for the same or at least similar functionality (a list of tests being more or less similar), and there's a need for a tool which can execute the tests repeatedly on one device after another. These actions could be performed by a human tester, but automation of this segment is recommended in order to rationalize and save time, and also increase reliability excluding human factor. In theory, testing should be automated when a large number of predefined tests need to be performed repeatedly in the same fashion, to avoid the human factor caused by tester's actions and subjective decision making, which increases the potential for errors. In particular with set-top boxes, testing considers sending commands to the unit (via remote control emulator), bringing the STB into a desired state, analyzing output according to expected values, and decision making based on the implemented algorithms for video and audio analysis. Automated testing provides confidence in stability, reliability and performance of STB, which also increases user's confidence in the operator/manufacturer.

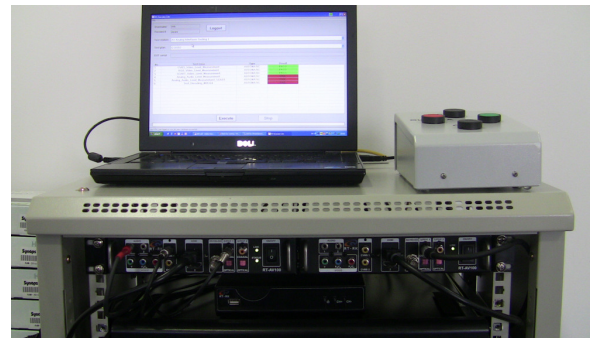
STB DIAGNOSTIC STATION

STB Diagnostic Station (STB DS) is a test environment for automated testing of STB based on black box testing concept. It performs rapid functional testing of STBs on the repair line, whether they are returned from service as malfunctioning, or there has been a cancellation of service.

STB DS is the most efficient and most economical way to test a device in a predefined scenario which provides the complete functionality verification. At the same time it allows testing of multiple devices simultaneously.

STB DS is an integrated hardware/software testing solution containing:

- PC application for simultaneous automatic control of DUT (Device Under Test), analysis and verification of the results
- Source of test signal (internal network, DekTec streamer, streaming card...)
- A device for capturing of audio and video in real time - RT-AV101 (1 - 6 devices).
- The device consists of two RT-AV100 devices integrated into a single RT-AV101 housing. Each DUT can be tested by a single unit, though one RT-AV100 allows testing of two DUTs at once.
- Housing with drawers to test multiple set-top boxes (1-12 units)
- LAN Switch providing Ethernet connection to RT-AV101 devices
- 1-12 remote control emulators associated with the RT-AV101 devices, controllable via the PC application
- 4-button keypad to run the test suites and interact with the test procedure.



STB DS for simultaneous testing of two devices.

The system is set up in the way that the outputs from the STB to be tested are fed to the RT-AV101 device's inputs. RC emulators are positioned in front of each of DUTs, enabling navigation through their menus. When the application is started on the PC workstation, it automatically loads the configuration, and controls the system and all connected devices.

THE SET OF TESTS

A pre-defined set of tests running on STB DS cover following aspects:

- Reading the voltage levels on LNB and analog audio and video interfaces (CVBS and SCART)
- Decoding of compressed channels (MPEG4, MPEG2 ..) on the internal network (internal cable network)
- Testing of audio and video content for analog (CVBS, SCART, RGB) and digital (HDMI, S/PDIF Coax and Optical) interfaces with static or live video stream
- Testing in "loop through" conditions
- Testing of USB functionality
- Reading the serial number of STB
- Reading the bar code using bar code readers

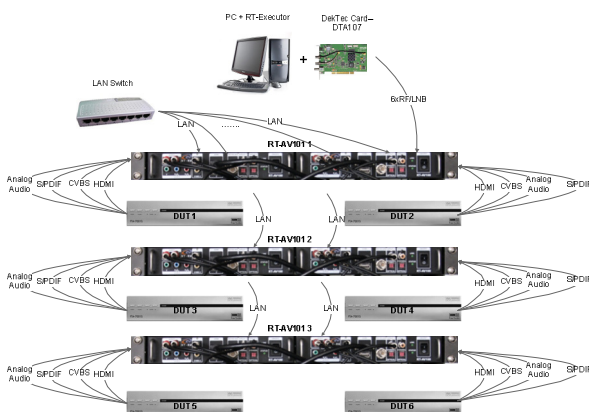
The set of tests can be expanded in accordance with requirements of testing.

PLUGGING A DEVICE AND TEST EXECUTION

A tester plugs in a device that needs to be tested into a free STB DS slot. Each of the slots facilitates testing of all STB interfaces available on a RT-AV100 device (2xCVBS, 2xAnalog audio, 1xComposite, 2xHDMI, 1xSDI, 2xS/PDIF Coax, 2xS/PDIF Optical) and feeds the unit with network signal, whether it's standard STB (RF, LNB interfaces) or IP STB (LAN). Upon connecting, a button on the application to test that particular slot is selected, and tests for that particular device in the slot are run. When the tests are executed, the device is removed from the station, another device may be placed in its slot and the same procedure repeated.

The test procedure enforces the application to carry out a scenario that verifies the functionality predefined by test requirements. Depending on what is being tested an RC emulator puts DUT into a predefined condition in which the functionality can be examined - e.g. if one wants to investigate the voltage level of CVBS signals, by navigation through the device's menu using the emulator, DUT's selected output is CVBS. When the DUT is brought into the required state, signal from the selected DUT output is grabbed by the RT-AV101 device and processed on the PC, using algorithms for image processing (PSNR, PBC), audio processing (FFT), and/or algorithms for optical character recognition (OCR), integrated into the control application. Based on the results obtained from the algorithms, and according to the predefined pass/fail criteria (algorithms developed by RT-RK) a decision on the test result is made.

Execution time on STB DS compared to manual testing is halved in the system in which there is absolutely no tester interaction during the test performance (except for connecting DUT) and totals of 25 seconds for a set of 6-8 tests (whereas for manual testing sums up to approximately 40 or more seconds). This ratio increases with the number of tests in the test suite. The system is featured by live DUT output preview without necessity to use additional monitors which supports cost cuts and space saving.



The schematic of testing of 6 set-top boxes on STB DS

REPORTING

Since the application itself is connected to a database from which it loads tests, all executed tests accompanied by their test results are stored in the database; by using

dedicated developed application it is possible to generate reports in various formats (HTML, PDF, Word, Excel...). The system is featured with automatic mechanisms for administering bug tracking systems like Bugzilla, ClearQuest and others.

AREA OF APPLICATION

STB DS is intended for rapid testing and verification of devices intended for repair and returned from exploitation, from the standpoint of functionality. Set of developed tests is optimized and fast to execute, covering the basic functionalities, and at the same time allowing simultaneous testing of multiple devices.

Thus STB DS finds its area of application at operators who deliver set-top-boxes, manufacturers, and service companies engaged in the repair.

FEATURES

The basic characteristics of STB DS are:

- The main application area - Cable and TV distributors and manufacturers of standard and IP STB
- Reduction of the execution time for a specific set of tests
- Testing of multiple units by golden reference and golden device methods
- Analysis of audio and video outputs of STB without the knowledge of the internal logic (BBT – black box testing)
- Running of test sequences without human interaction
- Automation which eliminates human factor
- DUT controlled by RC emulator
- Support for various signal generators
- Various integrated algorithms for image and audio analysis, optical character recognition (OCR), etc.
- Storage of results in a database
- Reporting in different formats - HTML, PDF, Word, Excel, etc.
- Easy integration into existing bug-tracking systems (Bugzilla, ClearQuest...)

PACKAGE

CD with:

- SW installation and documentation
- Test application

HASP key with SW licence

Hardware components:

- Housing with maximum 12 slots for STB testing
- Up to 6 RT-AV101 units
- Up to 12 RC emulators
- 4 button keyboard with mini USB cable
- PC work station*
- DekTec DTA-115/DTA-107 Card*

**optional*