A Generic Recipe Driven Functional Tester for PCBA

Introduction

This project profile describes a functional tester for a serial of DSP controlled PCBA (Printed Circuit Board Assembly). Because the software is fully recipe driven, the general system design can be applied to almost any type of PCBA with little or no modification.

A client asked us to develop a "universal" functional tester for a serial of PCBA for several lines of their active optical devices. The PCBA is rather typical for active optical devices, with voltage and current drivers, pre-amplifies, analog-to-digital converters (ADC), thermistor and TEC (thermal-electric cooler) drivers. An on-board DSP controls the inputs and outputs.

System Design

Because outputs include several high voltage DC (~200 V) drivers for MEMS (micro-electric-mechanical system), we decided that a digital multi-meter (DMM) interfaced with a switching box would be more suitable than a multi-channel data acquisition (DAQ) card. Using a DAQ card would need some *custom* interface to lower the output voltages to the typical 10 V range for DAQ cards, thus make the tester subject to the design change and revision. In addition, the switching approach is more scalable when high output channels are needed.

There are two multimeter-switching systems available in the market, 34970A from Agilent and 2700/2750 from Keithley. After comparing the functionalities, size, and price, the half-rack size Agilent system with 3 expansion slots was chosen. The Keithley 2700 has only 2 expansion slots while the 5-slot 2750 system is twice the size of the Agilent system and more expensive. Besides the switching card, the Agilent 34970A can also host a multi-function card with analog and digital outputs. They were used to simulate the inputs for the PCB boards.

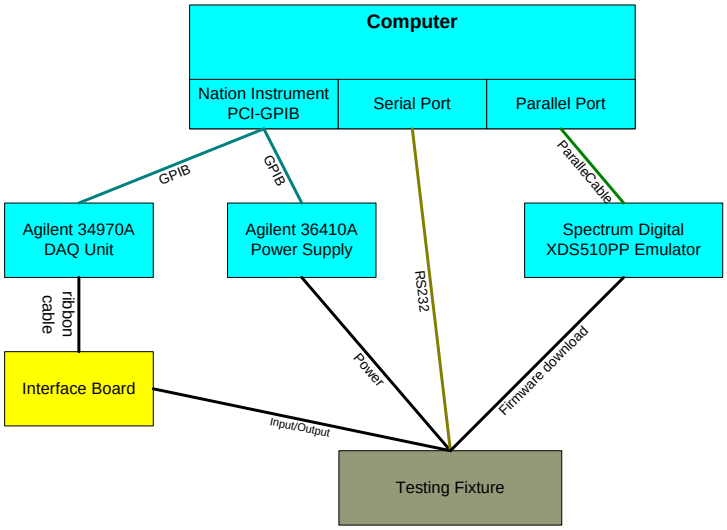
On the software side, we decided to let the PCBA driven by its product firmware. The firmware would be loaded onto the PCBA first during the test. The testing software, however, would not handle the firmware command sets directly. Instead, it reads the command sets from the recipe file. This decouples the tester from the firmware specification.

Hardware Setup

The tester hardware (Fig. 1) is rather simple. The PCB board is powered by a programmable power supply. Firmware is downloaded to the PCB board using a DSP emulator. The functional test is done with the DAQ unit and PCB board itself. A configurable interface board is built for signal routing, load simulation, thermistor simulation, and converting voltage signals to currents.

Not included in Figure 1 is an optional switching matrix between testing fixture and the rest of the electronics. It is used for multi-device testing fixtures.

Figure 1. PCB Board Tester Hardware Setup

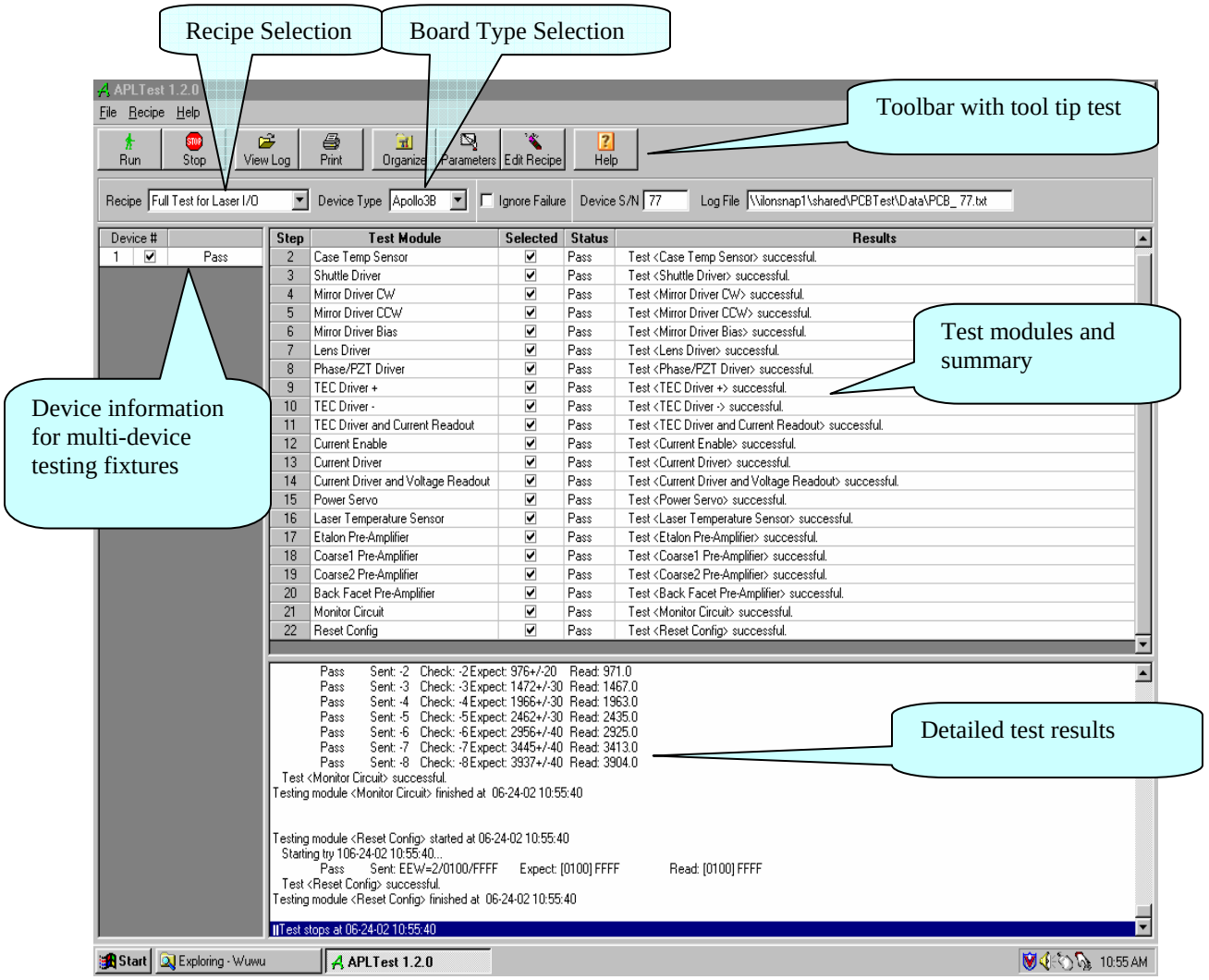


Software

Testing software is designed as a generic functional test program such that tests are performed according to the instructions specified in the test recipe files. Firmware instructions and pin assignments are passed into the program through the recipe file. This decouples software from the firmware and PCBA details. Each testing module (recipe item) can be constructed using six parameters defining test type, switch channel, firmware or shell command sets, DAQ unit outputs, and expected test results (nominal and tolerance). By carefully constructing the test modules, one can test a specific part of the PCBA circuit.

The testing program's user interface is shown in Figure 2 and 3. For a typical test operation, operator selects a board type and a test recipe, enters serial number, and clicks the "Run" button to start the test. The testing results are automatically logged into a text file.

Figure 2. Testing Program Main User Interface



Results

The tester was put into operation November 2001. During the past two years, the client has expended the business into different product lines with more than six types of PCB boards. Because the tester was designed to be decoupled from the product detail and firmware command sets, we have been able to accommodate these testing needs by only adding new testing fixture. The rest is simple test recipe generation which is managed by its internal engineers.

Figure 3. Test Recipe Manager and Builder