5233 Broida Hall
Santa Barbara,CA 93106

UCSB HEP

BaBar SVT HDI Cable Tester

Operating and Service Manual for model HEP1298

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General Information

Description

The BaBar SVT HDI Cable Tester functions to make electrical resistance measurements on the set of cables, which connect, between the HDI Matching card and the HDI Link card. The cable connectors consist of the D-Sub 25 pin male matching card signal connector and the D-SUB 37 pin male matching card/HDI detector module power cable connector. The system is designed to carry out measurements on the cables and associated electronics in the power-down state. The purpose of carrying out the measurements is to access that the system is safe to be powered up.

The test system consists of; a PowerPC Computer, a National Instruments DAQ500 Interface board, a 26-conductor ribbon interface cable and the HEP1298 Cable Tester board. The PowerPC executes the National Instruments LabVIEW program, which communicates between the virtual instrument program and the interface board. The system functions by loading the program Cabletest.vi and making note of any out of tolerance resistance readings on the cabled system under test. The program makes use of the reference file "cable_tester_connections.txt" as a basis for the interconnection resistance of a know good cabled HDI system.

Specifications and Characteristics

INPUTS:

P2: SVT HDI Signal Cable DS37M from matching card

P3: SVT HDI Power Cable HD20-37M from matching card

P1: PR27-30F flat cable from DAQ500 card mounted in PCMCIA slot in PC carrying power along with Digital inputs. WARNING: Insure that the DAQ500 PCMCIA card is installed in the bottom slot on the PC.

OUTPUTS:

P1: PR27-30F flat cable from DAQ500 card carrying Digital and Analog Inputs

TP1: High output (HI) connection from multiplexer switches U2 - U8, connected to resistive loads R5-R12 and DAQ500 A/D Input channels.

TP2: Low output (LO) connection from multiplexer switches U9-U15, connected to 0.5-volt reference voltage source.

POWER:

Power for the test board is taken from the DAQ500 board which is capable of supplying currents up to 60 mA in the operating mode and 20 mA in the power-down mode of the Mac. Power Book PC. Load = 5.0 volts DC @ 10 Ma. Fused at 1/4 Amp.

RESOLUTION:

The measured unknown resistance R=((Vo-V)*560/V)-Rs, where Vo is the reference test voltage equal to 0.500 volts which is applied to the series combination of the unknown and the 560 ohm current limit resistor, V is the measured voltage across the 560 ohm resistor and Rs is the analog switch resistance times two. Rs was measured at 272.3 + - 2.3 ohms on the measurement channels where 50 ohms is expected and where accuracy is important. Since the DAQ500 A/D Converter is fixed at 12 bits with a + - 5.000 volt range, the resolution in resistance is 1 ohm at 50 ohms, 1.75 ohms at 500 and based on the (8x 0.0024) volt quantizing level.

ACCURACY:

The accuracy of the resistance measurement is within the 6% range from 10 ohms to 150 k ohms, however at lower and higher resistance ranges the results degrade,

1 - 10 ohms	10ohms - 250 kohms	250k - 1Meg
+ - 30 % typical, lower on some channels per absolute calibration	+ - 6 %	+ - 30 % or greater

TIMING:

The test execution time was measured at 30 seconds based on 215 separate path measurements as defined in the text file "cable_tester_connections.txt".

The input clock signal rate is a function of the LabVIEW execution time. This rate is on the order of 800 Hz with the program version 1.13 with 70 samples for each measurement. It is important to sample for greater than 14 samples so that samples span at least one period of the 60 hz line frequency.

Actual timing is also a function of the time delay and the repeat-on-change input settings. During tests conducted on version 1.29, using the test file "cable_tester_fast_connections.txt" the execution time was measured at 45 seconds on an actual HDI Cable assembly.

Time Delay (ms)	Maximum Repeats	Samples	Repeat Delay (ms) where N=number of repeat
200	2	70	100*N

OVERVOLTAGE PROTECTION:

Across the test terminals of the test board are a pair of 2N4117A JFET's Q1 and Q2, which are connected in a diode connection back to back to limit the applied voltage to 0.5 volts. The JFET's were selected because of the very low leakage below the turn-on point.

GROUND CONNECTIONS:

A pair of binding posts serve as ground connection points for the test system.

SHIELD BOX: The green binding post is connected to the aluminum instrument case, this is normally connected to building ground to prevent static buildup of the case.

PC CARD: The black binding post is connected to the shield plane on each side of the cable tester printed circuit board. The board board shield is connected to the DAQ500 power ground through a 110 ohm resistor. A jumper (JP7) connects the power ground of the DAQ500 to analog ground (see schematic).

The pair of grounding posts were connected together during preliminary testing at LBL in an attempt at reducing noise pickup.

HDI Shield and Power Supply Common board-ground jumpers are provided as an optional grounding scheme if required to reduce noise pickup, however they should not be used since shorting of the reference voltage or load resistor will result.

ENVIRONMENT:

Operating Temperature: The system has only been tested at room temperature

DIMENSIONS

The 5x12 inch double sided PC board is mounted within a 3 x 7 x 14 inch aluminum case.

Installation

Interface to PowerBook Computer

Before powering up the computer, install the DAQ500 PCMCIA card in the lower slot of the Mac PowerBook located on the left rear side of the PC. Connect the ribbon cable between the DAQ500 card and the HEP1298 Cable Tester board. The system is now ready to power up. A test connector with shorted terminals has been included to verify system operation, see service information section for details.

Input Power Requirements

Power for the test system is taken from the 5-volt supply line on the DAQ500 interface board. The interface is capable of supplying 60 mA of current in the PC operate mode and 20 mA in the PC power-down mode. The load is fused with a 1/4 amp solder in fuse. The measured load for the cable test board is 10 mA.

Operation

Turn-On Checkout Procedure

The PC may be powered up following installation of the DAQ500 card and interconnect cable to the HEP1298 Cable Tester. To insure that the cable test routine executes fast enough, insure the PC is on external AC power. For details on the internal checkout procedure, see Performance Test.

Connecting Test Cables

HDI test cables may be connected when the application program is not running. **Warning: Insure that the cable tester case is grounded to building ground and that the testing is conducted in a static free work station before connecting HDI test cables.** A *green binding post* provides for a connection to the aluminum case. A *black binding post* is connected to the PC card ground foil which is isolated from the box. These posts were interconnected during initial HDI Cable testing, this provided for a lower noise measurement.

Running LabVIEW Program

The LabVIEW program to run is"cable_test.vi" located in the "HDI Cable Tester "folder which is stored in the "project" folder under "LabVIEW" which is in turn in the "Applications" folder. After setting the time delay (200ms) and maximum repeats (2) desired, it is necessary to click on the upper left right_arrow icon at the top of the cable_test.vi front panel. The progress of the test sequence can be monitored on the front panel of the vi.

A listing of the current operating LabVIEW sub-programs associated with the Cabletest.vi appear below;

Cabletest.vi	5 Feb 99	82k	(updated 9 Feb)
Claudioread.vi	5 Feb 99	113k	
Newaddress.vi	5 Feb 99	71k	

Cabltest3.vi	5 Feb 99	158k	(updated 9 Feb)
Test1.vi	5 Feb 99	39k	(updated 9 Feb)
Serial1.vi	5 Feb 99	125k	

The 5 Feb versions of the executable programs currently reside at ftp://hep.ucsb.edu/pub/put/ along with the text files that are used as a basis for the testing.

Service Information

Principles of Operation

The cable tester operates by applying a reference voltage to selected input terminals at the test connectors P2 and P3. The selected terminals form a simple voltage divider with a 560 ohm resistor as the low output. The voltage across the 560 ohm resistor is amplified by a low offset DC amplifier with a gain of 8 and then sent off the a 12 bit A/D converter covering the range from + 5.000 to -5.000 volts.

The MAX395 interface can be thought of as an 8-bit shift register controlled by a chip select CS\. While CS\ is low, input data appearing at the DIN pin is clocked into the shift register synchronously with SCLK's rising edge. The data is an 8-bit word, each bit controlling one of eight switches in the MAX395. DOUT is the shift register's output, with data appearing synchronously with SCLK's falling edge. Date at DOUT is simply the input data delayed by eight clock cycles. When shifting the input data, D7 is the first bit in and out of the shift register. While shifting data, the switches remain in their previous configuration. When the eight bits of data have been shifted in, CS\ is driven high. This updates the new switch configuration and inhibits further data from entering the shift register.

Performance Test

The cable tester may be tested for normal operation by carrying out the short_test, the open_test and measurements on an HDI Cable simulator board.

Short Test: Insert the shorted cable connectors into P2 and P3 and run the tester using the reference file "cable_test_shorts.txt" and note the resulting error list. An error list will appear for the 30-kohm-thermistor simulator resistor and associated opens between the thermistor and Shield1, Shield2 and Power_Supply_Common lines. No other errors should appear.

Open Test: Remove all connections from the test cable connectors P2 and P3 and run the tester using the reference file "cable_test.opens.txt" and note the resulting error list, none should occur.

HDI Cable Simulator Test: Connect the simulator board to the test set connectors P2 and P3 and run the tester using the test file " cable_test_fast_test.txt". No faults should occur. The simulator is made up with resistors and capacitor networks corresponding to that of a typical cabled HDI / Terminator_board system.

Calibration

The cable tester calibration is carried out by using the shoring plug at P2 and P3 and running the tester reference file"cable_test_fast_test.txt" and noting the resistance readings for the 16 channels associated with the 40 to 60 ohm values. These channels should read at 0 + - 2.4 ohms. If the results are out of tolerance (i.e. ΔRavg>2.4 ohms) then the constant Rs should be undated in the R_Measure vi, the initial Rs=272 ohms.

Parts List

U1-U15	Serially controlled 8-Channel SPST Switch	Maxim	MAX395CNG	24 Pin DIP
U16	Operational Amplifier	AD	AD845JN	8 Pin DIP
U17	Single Supply, Operational Amplifier	BB	OPA340	8 Pin DIP
Q1-Q2	P Channel JFET	IS	2N4117	TO-72
F1	Fuse, fast blow	LF	1/4 Amp	solder-in
C1	Capacitor, electrolytic		47 mfd 10v	
C2-C15	Capacitor, ceramic, decoupling		0.1 mfd 10v	
R1-R16	Resistor, carbon composition		assorted, 1/8 watt 5%	

Schematic

The schematic of the cable tester is attached as an A size drawing, for details refer to the larger C size available separately. The current version is E dated 11 February 1999.