MultiTrace System

Technical Reference V 2.0

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Part 1: Basic information about the test system

Introduction

This manual is a comprehensive update of this same document Version 1.2 last updated in 1999. The procedures and details in this manual are written to match the Windows XP operating system. Some details and steps might be slightly different when using Windows 98SE or Windows Me. In most cases the procedures are the same excepting for how the shortcuts are configured to run the applications under Win XP. Variants of the procedures for other operating systems are given where practical.

Please consult with UTI directly if you have any questions.
Contact Support@ultratest.com or directly email your support engineer.

Please review these procedures carefully if you are an existing user. The recommended procedures and frequency of testing may have changed since the last version of this document or since your training. In many cases the procedures have been simplified and more concise advice about when and why to these procedures is given.

Installation procedures for the MultiTrace are given in appendix A2 and procedures for installing the software are outlined in Appendix A3. Detailed instructions for software installation will also be included with the software on the CDROM or at the web distribution site because software development necessarily causes frequent changes to this procedure. *Always look for a "MultiTrace Installation Readme.txt" file accompanying your files for more details*.

System Architecture

The MultiTrace essentially consists of 4 main parts.

A. The **Software and the PC** it runs on. All configurations have essentially the same software with some small adjustments to accommodate the actual hardware and fixture configuration. Only the Latch Up testing software is an option.

B. The **Switch Matrix** which can be as few as 2 channels and 54 pins up to 8 channels and 2160 pins. More common are systems with 6 channels and 432 or 625 pins. In our terminology we call the channels in the switch matrix "Busses" so a 6 bus system can connect up to 6 sources to any of its pins.

C. The **Curve Tracer** which can have 4 or 8 Source Measure Units (SMUs) built into it. The Drives (or SMUs) are 4 quadrant type capable of sourcing or sinking current or voltage. Detailed specifications are in the appendix A1.

D. The **Fixture** is connected to the Switch Matrix via cables. Depending on the model tester you bought, you may have one of several different fixture styles. This fixture is intended to interface with device adapters or devices directly. See the following section on Hardware Configurations for more description.

In general each **Drive** of the MultiTrace is connected to the input of each **Bus** through a normally closed relay. The programmed voltage and current travel through this bus to the inputs of the **Switch Matrix.** If the **Switch Program** calls for a **Switch** to be closed, the associated **Relay** or **FET** switch will make contact and the drive signal will be applied to that **Pin** under test. Finally the drive is powered to the programmed settings and **Measurements** are made. These measurements are saved in a file (StdTrace file) and immediately displayed on the graph in the **StdTrace Program** window.

For more specific details, here is a list of other documents where you can find information about the hardware and software architecture of the MultiTrace.

Getting Started Manual
App note: MultiTrace Architecture
App Note: Curve Trace vs. Parametric mode
App note: Sources of Error
MultiTrace Users Manual

Model Numbers

Model numbers are typically structured like this: A2R4-625 The A2 part refers to two busses of FET switches. The R4 part refers to four busses of Relays. Finally, the pin count is appended to the end, in this case 625. We call this example a “6 bus 625 pin” tester.

- 2 bus systems:
  A2-216 to A2-625 (standard fixture) and A2-1080 (for the big fixture)

- 4 Bus Systems
  A2R2-216 up to A2R2-625 (standard fixture) and A2R2-1080 (for the big fixture)
  Older systems may have all FET switches and be designated A4-216 up to A4-441

  Systems made in 2007 or later may also be A4 but the FET switches are lower series resistance. For these systems the serial number will have an “M” appended to the end.

- 6 Bus systems:
  A2R4-216 up to A2R4-625 (standard fixture) and A2R2-1080 (for the big fixture)
  6 bus systems are always configured with 4 Relay busses in the first 4 slots (bus 1 to 4) and 2 FET busses as bus 5,6. These may also be listed as R4A2.

  A convenient A2R4-54 pin system is available with a 48 pin DIP ZIF fixture integrated into the main tester chassis.

- 8 Bus Systems:
  R6A2- systems of any pin count are available only on the MegaTrace platform. This configuration uses larger 4 bus switch cards instead of the standard 2 bus 54 pin cards used in every other configuration of the tester. Troubleshooting of these cards is not discussed in detail in this manual however, testing from the software point of view is the same as for any bus.

Hardware Configurations

Several versions of the Curve Tracer hardware are available. In some cases specific versions of software must be paired with the hardware for correct operation.

AutoTrace: Simplified form of the MultiTrace where there are always 4 busses (2 FET and 2 Relay) and 4 SMUs of which 3 are connected to the switch matrix, the fourth bus is hard wired to ground and the high voltage drive is connected manually through the fixture. The AutoTrace fixture consists of a plug in edge connector type card. Two generic cards are supplied with the system and custom cards can be designed as required.

MultiTrace: Primary platform for the test system. This version supports from 2 busses and 54 pins up to 6 busses and 625 pins and all variants in between including 4 bus. The test fixture consists of a PGA 625 pin ZIF socket in a 25x25 pin configuration. Older models may have had a 441 pin, 21x21 array socket.

MultiTrace with Megatrace Fixture: This is a hybrid of MultiTrace chassis and a MegaTrace style fixture supporting up to 6 busses and 1080 pins. These systems can have many cables and chassis.

MegaTrace: This is the large cart based test system capable of up to 8 busses and from 625 to 2160 pins. This configuration generally starts where the MultiTrace leaves off but can be made smaller. It features a DUT board interface using elastomer (Zebra Stripe) connectors for a reliable no pin connection.

Part 2: Calibration and maintenance procedures

The following procedures detail regular maintenance and detailed calibration procedures.

Overview

Regular testing of the MultiTrace system must be performed to ensure that the accuracy of the tester is at its best and to ensure that no failures of the equipment have occurred. Testing of the system consists of two parts. First the Curve tracer portion of the hardware is tested and self calibrated then the switch matrix portion is completely tested for correct continuity.

Annual verification of the tester's drive output voltage and current should also be performed so that the conditions of ISO9000 are met. A complete procedure is printed in this manual, templates of the calibration certificate and verification results spreadsheet can be found on your CDROM and in the MultiTrace Literature folder on your tester's hard drive. Commands files to configure the tester for the tests are also preinstalled on the tester's hard drive.

1. **Curve Tracer Checkout:** Run the CTCAL program and verify that it passes. It is recommended that a typical checkout using CTCAL be done <u>weekly</u> by the user to ensure proper operation and the most accurate calibration. Depending on usage this procedure can be done daily , weekly, monthly or yearly with no negative effects. Testing too infrequently can allow failures to persist unknown and may cause unexpected results.

2. **Continuity Verification:** Curve trace each pin with and without a shorting jig in place and verify that the curve trace results are all open or shorted as appropriate. This method uses the Unpowered Curve trace capability of the MTForms program. This procedure should be done whenever the tester is installed, setup, moved or repaired or annually as part of a complete system re-verification.

3. **Accuracy Verification:** Verify the Output of the drives using the Drive Output Verification Procedure. This part is optional and required only for ISO9000 compliance. The procedure sets each drive to a constant voltage or current which can then be measured by a calibrated, traceable meter to verify that it is within operational limits. For the purposes of a formal calibration and re-verification, the procedure should be performed once a year.

Execution of the CTCAL and the Continuity Check takes between 10 minutes and 20 minutes depending on the pin count of the system.

If there are any discrepancies or failures that you cannot clear, call UltraTest for advise on how to proceed with fault isolation.

Calibration documentation

When you receive the new system you should also receive a calibration packet. This packet contains the original factory calibration certificate and a 2 page copy of the drive verification results. For customers observing ISO9000 calibration requirements, this calibration may be renewed on a yearly or semi annual basis (depending on your organizations requirements). Procedures for regular weekly maintenance and annual calibration renewal are given in Part 2, templates of the calibration and verification forms are supplied on your CDROM and in the MultiTrace Literature folder on your tester's hard drive.

MultiTrace Calibration Specification

The MultiTrace System is a digital sampling measurement system. The accuracy of the measurements is based on constants calculated from actual measured values of several calibration resistors and a precision voltage reference. This document will outline the use of the self diagnostic software and the procedures used verify continuity and drive accuracy. System maintenance concerns such as verifying correct continuity to the test fixture are also explained

Explanation of Calibration

The MultiTrace system relies on a variety of internal reference standards for self calibration. There is a 10V precision voltage reference and three precision resistors. When used along with the voltage reference, these resistors are used to create reference currents in three ranges. When the system is manufactured or recalibrated, these four values are accurately measured to high precision and their values are entered into the UTAPPS.INI file. When CTCAL is run according to the test procedure, these exact values are read out of the file and used during the test to calculate a set of factors that are written into the binary DEFAULT.CTC file. It is these factors that are used to convert the digital counts measured by the A/D converter into actual voltages and currents that are displayed on the graph. These resistors and voltage sources are the standards to which the rest of the system is calibrated.

CTCAL.EXE

CTCAL uses the values specified in the **UTAPPS.INI** file to perform a battery of calibration and verification tests on the curve trace cards. When this test is complete the program will create a binary calibration file called **DEFAULT.CTC** which will be located in the C:\WINDOWS\UTI\SYSTEM\DEFAULTS\ directory. If this file is missing there will be an error message stating **"Calibration file missing, Results may not be Accurate"** displayed when the MultiTrace Software boots up. To clear the error, run the CTCAL program before operating the tester. If the file is present and the error message is displayed, Check to see that the path pointing to this file is correct or call UltraTest for debugging methods. The path to this file is also specified in the C:\WINDOWS\UTI\UTIAPPS.INI file. The test procedure is as follows.

CTCAL Procedure

1. Power up the system and wait 1 hour for it to obtain normal operating temperature.

2. Close all MultiTrace software applications, particularly the Switch, StdTrace and ListMgr programs.

3. Make sure nothing is plugged into the test socket. (an empty device socket is OK)

4. Locate the CTCAL icon in the Start Menu, on the Desktop or on the Quick Launch toolbar. Click this icon to start the test program.

5. Press any key to begin the test sequence. The system will automatically step through a variety of tests. If successful, it will display a PASS message at the end. For 2 bus systems, One set of cards will be detected. For 4, 6 bus systems, it will detect two sets of cards and repeat the test of each set.

6. When the test is complete, it will instruct you to press any key to complete the calibration, you must do this, the space bar is sufficient. If you are using Win 98SE or Win ME, the program will exit now. If you are using Windows XP a block cursor will appear and the DOS screen will remain idling.

7. If you are using Windows XP, the program will not automatically Exit. You must press [ALT]-Spacebar to return to the windows desktop, then you must close the CTCAL program by left clicking on its icon in the taskbar and selecting Close.

    The results of the test will be saved in a file located at:
    C:\program Files\MultiTrace\Calibration Programs\CTERROR.TXT
    You may email this file to UltraTest if you have a failure. You will get advice on the severity of the failure and how to proceed with a repair.

CTCAL Command Line options:

CTCAL is normally invoked by clicking on its Shortcut. The shortcut supplied during installation will perform a normal calibration of the system. Other operational options are available for troubleshooting or burn in purposes.

The normal shortcut for Windows XP is specially formatted. The Target line in the shortcut should read like this:
"C:\Program Files\MultiTrace\Calibration Programs\AllowIo.exe" CTCAL.exe 0x300

For troubleshooting purposes, you can copy this shortcut and modify the Target information in the following ways:

CTCAL /? Help Mode: For information about available CTCAL options
"C:\Program Files\MultiTrace\Calibration Programs\AllowIo.exe" CTCAL.exe/? 0x300

CTCAL /B Burn In Mode: runs continuously in a loop until stopped
"C:\Program Files\MultiTrace\Calibration Programs\AllowIo.exe" CTCAL.exe/B 0x300

CTCAL /Y Force Mode: Forces calibration to update even in the event of a failure
"C:\Program Files\MultiTrace\Calibration Programs\AllowIo.exe" CTCAL.exe/Y 0x300

CTCAL /t=nnn Loop Mode: runs test for specified number of loops
"C:\Program Files\MultiTrace\Calibration Programs\AllowIo.exe" CTCAL.exe/t=10 0x300

CTCAL /V Verbose Mode: Outputs a detailed Calibration Report. Use this mode after detecting a failure
"C:\Program Files\MultiTrace\Calibration Programs\AllowIo.exe" CTCAL.exe/Y 0x300

Note: the calibration file is only updated in the normal and /Y modes. Any other mode will not result in updating the results.

For Windows 98, and Windows ME, the normal shortcut for CTCAL, the Target line in the shortcut should read like this:
"C:\Program Files\MultiTrace\Calibration Programs\ CTCAL.exe

CTCAL Notes:

1. A standard 4 or 6 bus configuration will have 2 cards detected with addresses at #20 hex and #A0 hex. A two bus system will only have a card at #20 hex.

2. If your system should fail try running CTCAL after the system has time to warm up. Some of the test tolerances are close and some boards may fail if tested cold right after start up. If the failure persists, call UltraTest for trouble shooting advice or warranty service. A print out of the failure screen or the CTERROR.TXT file will be helpful when you contact us.

3. If the line voltage supplying the MultiTrace is out of tolerance (typically 105V to 120V AC) CTCAL may fail with a failure code of "(-16) 10V reference" In this case check the voltage at the wall with a voltmeter and Contact UTI for advice on dealing with this problem. You may be instructed to run the CTHVtest.exe program to determine the actual raw High Voltage being measured by the system. This information is helpful in determining if the card is failed or if the supply voltage is out of spec. In most cases the problem can be fixed by plugging the system into a different AC mains circuit. If this is the only problem, the tester will appear to run normally with out of mains spec voltage

4. **If any drives should fail, CTCAL will not write the binary calibration file**. To force this file to be written type C:\UTSA\CTCAL /Y. This may be necessary if a less critical drive, such as a high voltage drive, fails and you elect to ignore it because the drive is usually not used. Check with your support engineer at UltraTest to decide if this is an appropriate failure to ignore.

5. Failure codes are numbered form low to high. Failures with low numbers are generally more severe than ones with high numbers. Failures with codes greater than (-80) the system may still be partially functional. Contact UltraTest for advice about the severity and course of action for failures.

CTCAL Example Results

Testing Curve Trace cards at port 300
Scanning for Boards

2 boards detected

Curve Trace calibration in progress

Testing Curve Trace Board #20 (hex)
Using a value of 10.0000 for the 10 volt reference,
using a value of 31.600 for the 31.6 ohm resistor,
using a value of 3320.0 for the 3320 ohm resistor, and
using a value of 348000 for the 348K ohm resistor.
Curve Trace Board #20 PASSED

Testing Curve Trace Board #A0 (hex)
Using a value of 10.0000 for the 10 volt reference,
using a value of 31.600 for the 31.6 ohm resistor,
using a value of 3320.0 for the 3320 ohm resistor, and
using a value of 348000 for the 348K ohm resistor.
(-100)Calibrating drive D/A 0, max + current- Drive 2 1k Ohm FAILED
(-100)Calibrating drive D/A 0, max + current- Drive 2 1M Ohm FAILED
(-100)Calibrating drive D/A 0, max + current- Drive 2 10M Ohm FAILED
(-120)Calibrating drive D/A 0, max - current- Drive 2 10k Ohm FAILED
(-120)Calibrating drive D/A 0, max - current- Drive 2 100k Ohm FAILED
Curve Trace Board #A0 FAILED

Self Test Complete

Continuity using MTForms

The MultiTrace software itself is an excellent way to checkout continuity on the system directly. There are two specific tests that will quickly detect shorts and opens on any pin in the system.

In an Opens Test, when you short all pins together and curve trace, you expect to see all shorts. Any open pins are failures. An open pin is identified as a horizontal curve trace

In a Shorts Test you ground all the pins but do not attach anything to them (no shorting block) and curve trace. You should expect to see all opens, Any shorted pins are failures. A short is identified as a vertical line and leakage is anything that is not an open (horizontal line). A short can be thought of as very bad leakage (100%).

1. Start the MultiTrace System and choose Unpowered Curve Trace from the black MTForms main screen. Choose any job.
2. For the Pinmap, choose “SKT-625” from the Template. Pin numbers on this map correspond directly to the card and channel number in the system and on the pinmap in this document. If you do not have a 625 pin system, only the pins you do have will show.
3. Configure the drive settings.
    a. Opens Test: -5V to +5V, 20 Samples, 1Ω Series resistor.
    b. Shorts Test: -5V to +5V, 20 Samples, 100kΩ Series resistor.
4. Pins to Test: “All pins”
5. Pins to ground:
    a. Opens Test: Select “List of pins” but put no pin numbers in the box. This will ensure that all pins are open with respect to the switch matrix.
    b. Shorts Test: Select “All pins”
6. Attach test Fixture:
    a. Opens Test: Use the shorting plug supplied with the system to short all the pins of the ZIF socket together. Place a banana cable between the shorting plug and a black “ground” banana jack on the back of the system.
    b. Shorts Test: No fixture or device should be attached to the socket
7. Run the test by pressing the “Run Test” Button on the unpowered curve trace setup form.
8. Evaluate results:
    a. Opens Test: All the curves should be shorts. Any open (horizontal) curve indicates a pin which does not have continuity to the test head.
    b. Shorts Test: All the curves should be opens. Any shorted (vertical) curve indicates a pin that is shorted. A shorted pin may be shorted to an adjacent pin or may exist deeper within the system.

The above test procedure is adequate for a 2 bus system. It will test all of the switches on bus 1 and 2, the switch cables that connect the fixture and the fixture continuity all at one time.

9. If you have a 4 or 6 bus system, you need to repeat the above tests using the other busses. The easiest way to do this is select “Use bus 3&4” or Use Bus 5&6” on the settings tab of the Unpowered form of MTForms. When using busses 5&6, you will be forced to use the 1ohm series resistor. This is because this the only selection for the Power Drives.

10. Finally test the Measure bus. With any pair of busses selected, check the “Use Low Resistance Measurements” and “Display Low Resistance Measurements” checkboxes. Now run the opens test and the shorts test per steps 1-8 and verify normal opens and shorts results.

Tips for opens/shorts analysis:

- Select “Trace ID” from the Screen menu to activate the ID mode, the cursor should have “ID” attached to it. With this cursor, use the shift button and the primary (left) mouse button to drag a box around the pins you wish to identify. When you release the mouse button the system will tell you the pin numbers of the pins within the rubber band box up to a maximum of 32.

- By checking or unchecking the “Display all pins” checkbox on the Unpowered curve trace form you can choose to see all the pins or one at a time. When one pin is showing, you can select the pin number by clicking on the control panel at the right of the StdTrace window.

- Select “Calc. Slope” from the Screen menu and the cursor can now measure the resistive slope of a curve. Use the secondary (Right) mouse button to drag/draw a line on the screen on top of the curve of interest. The slope of this line is displayed at the right of the StdTrace window.

- If one or just a few pins fail, you can enter those pin numbers in MTForms under “pins to test” and focus your attention on only the failures while you debug the hardware fault. By selecting Continuous from the control menu, it will sample continuously until you select abort from the same menu. F9 will give you a single re-sampling without needing to use the mouse. (see procedure in next section)

- The pin numbers refer to the card and channel number of the actual switch location. The hundreds place signifies the card address and the tens and ones places indicate the channel number. Note that there are 54 channels or pins on each card so the pin numbers always jump from 54 to 101 or 154 to 201 etc.

See Debugging Continuity Failures in the next section for advice on how to fix problems.

625 Pin Mapping Key

The chart **<u>625 pin Mapping Key</u>** is used to determine the location of a pin on the 441 or 625 pin ZIF socket when you know the card and channel that failed (or vice versa). Check your CDROM or your system hard drive for similar documentation limited to your specific pin count (432, 441, 216)

0:01	1:01	1:15	0:41	1:29	1:42	0:40	2:01	3:01	3:15	2:41	3:29	3:42	2:40	4:25	4:40	5:37	6:17	6:36	7:22	7:43	8			
0:02	1:02	1:16	0:42	1:30	1:43	0:39	2:02	3:02	3:16	2:42	3:30	3:43	2:39	4:26	4:41	5:38	6:18	6:37	7:23	7:44	8			
0:03	1:03	1:17	0:43	1:31	1:44	0:38	2:03	3:03	3:17	2:43	3:31	3:44	2:38	4:27	4:42	5:39	6:19	6:38	7:24	7:45	8			
0:04	1:04	1:18	0:44	1:32	1:45	0:37	2:04	3:04	3:18	2:44	3:32	3:45	2:37	4:28	4:43	5:40	6:20	6:39	7:25	7:46	8			
0:05	1:05	1:19	0:45	1:33	1:46	0:36	2:05	3:05	3:19	2:45	3:33	3:46	2:36	4:29	4:44	5:41	6:21	6:40	7:26	7:47	8			
0:06	1:06	1:20	0:46	1:34	1:47	0:35	2:06	3:06	3:20	2:46	3:34	3:47	2:35	4:30	4:45	5:42	6:22	6:41	7:27	7:48	8			
0:07	107	1:21	0:47	1:35	1:48	0:34	2:07	3:07	3:21	2:47	3:35	3:48	2:34	4:31	4:46	5:43	6:23	6:42	7:28	7:49	8			
0:08	1:08	1:22	0:48	1:36	1:49	0:33	2:08	3:08	3:22	2:48	3:36	3:49	2:33	4:32	4:47	5:44	6:24	6:43	7:29	7:50	8			
0:09	1:09	1:23	0:49	1:37	1:50	0:32	2:09	3:09	3:23	2:49	3:37	3:50	2:32	4:33	4:48	5:45	6:25	6:44	7:30	7:51	8			
0:10	1:10	1:24	0:50	1:38	1:51	0:31	2:10	3:10	3:24	2:50	3:38	3:51	2:31	4:34	4:49	5:46	6:26	6:45	7:31	7:52	8			
0:11	1:11	1:25	0:51	1:39	1:52	0:30	2:11	3:11	3:25	2:51	3:39	3:52	2:30	4:35	4:50	5:47	6:27	6:46	7:32	7:53	8			
0:12	1:12	1:26	0:52	1:40	1:53	0:29	2:12	3:12	3:26	2:52	3:40	3:53	2:29	4:36	4:51	5:48	6:28	6:47	7:33	7:54	8			
0:13	1:13	1:27	0:53	1:41	1:54	0:28	2:13	3:13	3:27	2:53	3:41	3:54	2:28	4:37	4:52	5:49	6:29	6:48	7:34	8:01	8			
0:14	1:14	1:28	0:54	4:07	4:10	0:27	2:14	3:14	3:28	2:54	4:19	4:22	2:27	4:38	4:53	5:50	6:30	6:49	7:35	8:02	8			
0:15	4:01	4:03	4:05	4:08	4:11	0:26	2:15	4:13	4:15	4:17	4:20	4:23	2:26	4:39	4:54	5:51	6:31	6:50	7:36	8:03	8			
0:16	4:02	4:04	4:06	4:09	4:12	0:25	2:16	4:14	4:16	4:18	4:21	4:24	2:25	5:31	5:34	5:52	6:32	6:51	7:37	8:04	8			
0:17	5:01	5:05	5:09	5:13	5:17	0:24	2:17	5:21	5:23	5:25	5:27	5:29	2:24	5:32	5:35	5:53	6:33	6:52	7:38	8:05	8			
0:18	5:02	5:06	5:10	5:14	5:18	0:23	2:18	5:22	5:24	5:26	5:28	5:30	2:23	5:33	5:36	5:54	6:34	6:53	7:39	8:06	8			
0:19	5:03	5:07	5:11	5:15	5:19	0:22	2:19	6:01	6:03	6:05	6:07	6:09	2:22	6:11	6:13	6:15	6:35	6:54	7:40	8:07	8			
0:20	5:04	5:08	5:12	5:16	5:20	0:21	2:20	6:02	6:04	6:06	6:08	6:10	2:21	6:12	6:14	6:16	7:18	7:20	7:41	8:08	8			
7:01	7:02	7:03	7:04	7:05	7:06	7:07	7:08	7:09	7:10	7:11	7:12	7:13	7:14	7:15	7:16	7:17	7:19	7:21	7:42	8:09	8			
8:52	8:51	8:50	8:49	8:48	8:47	8:46	8:45	8:44	8:43	8:42	8:41	8:40	8:39	8:38	8:37	8:36	8:35	8:34	8:33	8:32	8			
8:53	8:54	9:01	9:02	9:03	9:04	9:05	9:06	9:07	9:08	9:09	9:10	9:11	9:12	9:13	9:14	9:15	9:16	9:17	9:18	9:19	9			
10:36	10:35	10:34	10:33	10:32	10:31	10:30	10:29	10:28	10:27	10:26	10:25	10:24	10:23	10:22	10:21	10:20	10:19	10:18	10:17	10:16	1(			
10:37	10:38	10:39	10:40	10:41	10:42	10:43	10:44	1045	10:46	10:47	10:48	10:49	10:50	10:51	10:52	10:53	10:54	11:01	11:02	11:03	1:			

Card Addresses for each slot on the fixture box

		0	1	2	3	4	5	6	7	8	9	10	
	Slot	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	
Card Address for Bus	**1,2**	0	1	2	3	4	5	6	7	8	9	10	
Card Address for Bus	**3,4**	128	129	130	131	132	133	134	135	136	137	13:	
Card Address for Bus	**5,6**	64	65	66	67	68	69	70	71	72	73	74	
	Cable	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E1	
	Fixture Box Connector	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F1:	

Notes:
This is the pin mapping for a 625 pin system. This pin map is numbered by card and channel.
The cards are numbered 0 through 11. Each card has 54 channels numbered 1 through 54.
The number before the colon ":" is the slot number and is the same as the card address for bus 1,2 cards

The number after the colon ":" is the channel number and corresponds to the switch on the card
Use this pin map when tracking down opens or shorts on the main interface cable or when trouble shooting at the card level.
This pin map can be found in the [SYSTEM] Template job and is called SKT-625

Accuracy Verification.

For the purposes of an official calibration and certification you must verify that the system is actually outputting the programmed values. In other words, you must measure the output of the system with a calibrated meter and compare that with the published accuracy.

[SYSTEM] Verify job

This method uses the MultiTrace windows software to set certain voltage and current values on the drive outputs so that they may be measured directly on the fixture box and verified. While this test does directly confirm setting accuracy, the measurement accuracy is also confirmed since much of the measurements circuitry is used to regulate the setting of the drives.

In the SYSTEM Category there is a job called “VERIFY”. This job contains files setup specifically to allow the user to verify the accuracy of the drive outputs. By loading the indicated commands files and measuring the drive outputs with a voltmeter or ammeter you can verify that the system is outputting correct values with independent test equipment. For ISO9000 compliance the meter should be NIST traceable.

To run the test:

1. Turn on the system while it is fully assembled. It should boot up the MultiTrace software.
2. Choose the “Filer” from the File menu on the StdTrace program.
3. Choose “Select Job” from the Job menu in filer
4. Select the “System” category at the right then “VERIFY” from the Job list at the left.
5. Choose “Load/Open” from the File menu on the Filer window.
6. Highlight “Commands” as the file type on the right side of the Filer window.
7. Select the desired commands file name from the list on the left. (See Worksheet)
8. Once the files have loaded, Exit Filer.
9. Choose “Step” from the Control menu to make the drives active.
10. Make the indicated measurements. (See Worksheet)
11. Enter Value on Calibration Worksheet
12. Repeat steps 2,5-11 for each commands file. (Total 6, See Worksheet)

To make a measurement use test leads terminated in banana plugs. Place the red lead of the voltmeter in the banana jack at the back of the fixture box corresponding to the drive you want to measure. Place the black lead in the banana jack labeled ground (4 choices). Alternatively you can use the Pins at the top row of the jumper matrix located on top of the fixture box to make these connections.

Each of the test files are setup in the following manner: X and R are stated in the Table on the next page.

- No particular pinmap is required, any pinmap may be loaded for this test
- Drive 1 is programmed to Sweep X to X with 1 step, with an R ohm series resistor and the Quiescent value (modes button) disabled
- Drives 2, 3 and 4 are programmed for a constant value of X, with an R ohm series resistor and the Quiescent value (modes button) disabled.
- Power Drives 1 and 2 are programmed for a constant value of X, with a 1 ohm series resistor and the Quiescent value (modes button) disabled.
- The relays that connect the Drives to the Busses are open. Unchecked boxes on the File Modes window (settings Menu)
- Power Down After Acquisition is Disabled. (Settings menu, Control Sequence)
- Any measurement can be made and displayed because you do not need on screen measurements. Typically V and I from Drive 1 are measured and displayed on the X and Y axis.

When the Step command is invoked, all the drives will power up to the programmed levels and stay there until the StdTrace file is closed or the "Power Down" command is invoked (Command menu)

Enter the measured values in the indicated spaces on the calibration worksheet. Compare the entered values to the maximum and minimum values on the table. If the value is within max and min the drive has passed. If the measured value is greater than the max or less than the minimum the drive has failed. If any drives fail, contact UltraTest for advice.

For the lowest current range, if your meter is not accurate enough to make uA measurements, try shorting the drive output to ground through a resistor of known value (about 10kΩ will work well) and measure the voltage drop across the resistor. Use the resistance and voltage drop along with Ohm's Law (V=IR) to calculate the current. For test currents of 100uA you should get exactly 1.000V (1V = 100uA X 10kΩ) If you use a 100kΩ resistor you should measure 10.00V.

In Case of Failure

In general if the measured Voltage or Current values are very far off, you should also expect to fail the CTCAL program as well. If the values are close to ideal and are only marginally failed, this may be because the calibration experienced noise while running. Try running CTCAL again and retesting. Be sure that all UTI software is restarted after calibration so that the new calibration result is used. Note that this can particularly happen for Test # 5 and 6 on the Drives PS1 and PS2. Recalibrating and retesting usually works.

For very small errors you may elect to ignore a failure and proceed with normal use. As long as the CTCAL program is reliably passing, you should get consistent and repeatable results.

Error Messages when loading the Commands file

If you see an error when you load the commands files "Error loading commands file on line #12" you can either ignore this error or fix the commands file so that it does not happen again. To do this you need to select each commands file using the Filer and then select the Edit File command from the Utilities menu. Once the commands file is open in the Notepad, you can delete the last line "Select Tool (CT)" and close and save the file. Removing the last command should prevent the error, this command is not needed to configure these tests.

Calibration Verification Worksheet

The following two pages contain a copy of the Calibration Verification Worksheet. Use this form while completing the Drive Verification procedure to record your results. For your convenience a copy in PDF and XLS format can be found on your CDROM or the hard disk of your MultiTrace PC.

MultiTrace System Level Calibration Certificate

Following the verification worksheet is a template you may use for a Calibration Certificate or you may design your own taking your organization's requirements in mind.

Complete the form in the following manner:

Fill in the top section with your model, S/N, your name and today's date

Complete the CTCAL, MTForms Continuity and Drive Verification procedures and circle the appropriate result (Pass/Fail). Enter the name, model and cal info from the meter you used for the verification (any accurate traceable meter is acceptable).

When you receive a new system, you should receive a completed certificate containing the values for the internal calibration standards (three resistors and 10V reference). You should copy these values onto any renewed certificate unless the cards were replaced as part of a repair. If the cards were replaced, you will receive a new certificate for the replacement card, use those new values instead. Sign and date at the bottom

MultiTrace Calibration Verification Worksheet

System Serial Number ______________________________

Date Of testing ______________________________

Technician Name ______________________________

Result **Pass / Fail**

Signature ______________________________

	Test Conditions				Actual	Tolerance		
	Test	**Drive**	**X**	**Rs**	**Measured**	**Max**	**Min**	**Pass / Fail**
Nominal +V	1	1	5	1k		5.015 V	4.985 V	
	1	2	5	1k		5.015 V	4.985 V	
	1	3	5	1k		5.015 V	4.985 V	
	1	4	5	1k		5.015 V	4.985 V	
	1	HV1	5	10k		5.100 V	4.900 V	
	1	HV2	5	10k		5.100 V	4.900 V	
	1	PS1	5	1		5.015 V	4.985 V	
	1	PS2	5	1		5.015 V	4.985 V	
Nominal -V	2	1	-5	1k		-4.985 V	-5.015 V	
	2	2	-5	1k		-4.985 V	-5.015 V	
	2	3	-5	1k		-4.985 V	-5.015 V	
	2	4	-5	1k		-4.985 V	-5.015 V	
	2	HV1	-5	10k		-4.900 V	-5.100 V	
	2	HV2	-5	10k		-4.900 V	-5.100 V	
	2	PS1	-5	1		-4.985 V	-5.015 V	
	2	PS2	-5	1		-4.985 V	-5.015 V	
Full Scale +V	3	1	15	1k		15.015 V	14.985 V	
	3	2	15	1k		15.015 V	14.985 V	
	3	3	15	1k		15.015 V	14.985 V	
	3	4	15	1k		15.015 V	14.985 V	
	3	HV1	100	10k		100.100 V	99.900 V	
	3	HV2	100	10k		100.100 V	99.900 V	
	3	PS1	15	1		15.015 V	14.985 V	
	3	PS2	15	1		15.015 V	14.985 V	
Full Scale -V	4	1	-15	1k		-14.985 V	-15.015 V	
	4	2	-15	1k		-14.985 V	-15.015 V	
	4	3	-15	1k		-14.985 V	-15.015 V	
	4	4	-15	1k		-14.985 V	-15.015 V	
	4	HV1	-100	10k		-99.900 V	-100.100 V	
	4	HV2	-100	10k		-99.900 V	-100.100 V	
	4	PS1	-15	1		-14.985 V	-15.015 V	

	4	PS2	-15	1		-14.985 V	-15.015 V	

	Test Conditions				Actual	Tolerance		
	Test	Drive	X	Rs	Measured	Max	Min	Pass / F
High Range +I	5	1	900mA	10		912 mA	888 mA	
	5A	2	900mA	10		912 mA	888 mA	
	5	3	900mA	10		912 mA	888 mA	
	5A	4	900mA	10		912 mA	888 mA	
	5	HV1	100mA	332		102.41 mA	97.59 mA	
	5	HV2	100mA	332		102.41 mA	97.59 mA	
	5	PS1	900mA	1		912 mA	888 mA	
	5	PS2	900mA	1		912 mA	888 mA	
High Range -I	6	1	-900mA	10		-888 mA	-912 mA	
	6A	2	-900mA	10		-888 mA	-912 mA	
	6	3	-900mA	10		-888 mA	-912 mA	
	6A	4	-900mA	10		-888 mA	-912 mA	
	6	HV1	-100mA	332		-97.59 mA	-102.41 mA	
	6	HV2	-100mA	332		-97.59 mA	-102.41 mA	
	6	PS1	-900mA	1		-888 mA	-912 mA	
	6	PS2	-900mA	1		-888 mA	-912 mA	
Med. Range +I	7	1	10mA	1k		10.12 mA	9.88 mA	
	7	2	10mA	1k		10.12 mA	9.88 mA	
	7	3	10mA	1k		10.12 mA	9.88 mA	
	7	4	10mA	1k		10.12 mA	9.88 mA	
	7	HV1	10mA	10k		10.08 mA	9.92 mA	
	7	HV2	10mA	10k		10.08 mA	9.92 mA	
	7	PS1	100mA	1		112 mA	88 mA	
	7	PS2	100mA	1		112 mA	88 mA	
Med. Range -I	8	1	-10mA	1k		-9.88 mA	-10.12 mA	
	8	2	-10mA	1k		-9.88 mA	-10.12 mA	
	8	3	-10mA	1k		-9.88 mA	-10.12 mA	
	8	4	-10mA	1k		-9.88 mA	-10.12 mA	
	8	HV1	-10mA	10k		-9.92 mA	-10.08 mA	
	8	HV2	-10mA	10k		-9.92 mA	-10.08 mA	
	8	PS1	-100 mA	1		-88 mA	-112 mA	
	8	PS2	-100 mA	1		-88 mA	-112 mA	
Low Range +I	9	1	100uA	100k		101.20 uA	98.80 uA	
	9	2	100uA	100k		101.20 uA	98.80 uA	
	9	3	100uA	100k		101.20 uA	98.80 uA	
	9	4	100uA	100k		101.20 uA	98.80 uA	
	9	HV1	100uA	329k		102.43 uA	97.57 uA	
	9	HV2	100uA	329k		102.43 uA	97.57 uA	
Low Range -I	10	1	-100uA	100k		-98.80 uA	-101.20 uA	
	10	2	-100uA	100k		-98.80 uA	-101.20 uA	
	10	3	-100uA	100k		-98.80 uA	-101.20 uA	

10	4	-100uA	100k		-98.80 uA	-101.20 uA	
10	HV1	-100uA	329k		-97.57 uA	-102.43 uA	
10	HV2	-100uA	329k		-97.57 uA	-102.43 uA	

MultiTrace System Level Calibration Certificate

Date Tested: ______________________________

Customer: ______________________________

Model Number: ______________________________

System S/N ______________________________

User Calibration Procedures (not applicable to replacement cards)

Switch Matrix Diagnostics Pass / Fail / NA
Self Calibration Pass / Fail / NA
Drive Settings Verification Pass / Fail / NA

Equipment used for Drive Verification:
Model:____________ S/N:____________ Cal Date:______________

See the Technical Reference Manual for procedures.
Calibration re-verification is due 1 year from date on this certificate.

Record Internal Calibration Reference Standards

Original Factory Values	CT Card #20	CT Card #A0
10 V (9.990V to 10.010V)		
31.6Ω (31.57Ω to 31.63Ω)		
3320.0Ω (3317Ω to 3323Ω)		
348,000Ω (347.7kΩ to 348.3kΩ)		
Equipment Used in this step		Calibration Due Date: ______________

Statement of NIST Traceability
All test equipment used in the foregoing calibration is NIST traceable and was in calibration at the time as records on file indicate. Interested personnel may Audit at reasonable intervals. (per MIL-STD-45662A) Instruments are calibrated to NIST standards: 238583, 233638, 237840, 236930, WWVB, 232442, 809192.

Calibrated By:______________________________

Old Test Program versions

SMDiag.exe and **SKTDiag.exe** are obsolete self test programs. They are not compatible with Windows XP and may not be compatible with PCs faster than 1GHz. We now recommend that continuity be tested using the MTForms unpowered Curve Trace method and that detailed Switch card level diagnostics be done using the Switch Diagnostics program.

CTVERIFY.exe is no longer considered an accurate means to verify accuracy and may not have been shipped with your system.

Part 3: Basic Troubleshooting and Debugging Procedures

The procedures in this section are intended to help the user identify, debug and rectify the most common user correctable problems with the MultiTrace. The bulk of the faults that can be corrected by the user are continuity type faults. In some cases the problems are based on software configuration.

Troubleshooting

When debugging problems on the MultiTrace, they usually break down into major categories. By dividing the system into subunits, one can quickly determine the severity of a problem and decide if it is a user fixable problem of if the tester needs service

Software or hardware

The first determination is to decide if the problem is in the hardware or if it is a software configuration problem. The simplest test for this question can be done by running the CTCAL and Switch Diagnostics programs. If they detect the hardware and complete the tests with a passing result, the problem is surely in software. CTCAL and Switch Diagnostics are low level test programs that do not rely on the other software modules to operate.

If the problem is in software, it may be due to settings in the UTAPPS.INI file or Configuration files typically located in the System category. Reinstalling the S/W, restoring files and upgrading are all times when you are vulnerable to this. For that reason,. We recommend making a backup copy of any directory you modify directly

Minor calibration issues

If you observe any error in the curve trace results such as curves being offset in the current or voltage direction or feel that constant voltages like VDD set in the program are not accurate, you should run the CTCAL program, restart the software and try the measurement again. In most cases the problem will be resolved assuming there is no CTCAL failure.

If the problem persists and CTCAL always is passing, remove the device and try the drive verification procedure to check the accuracy of the drives under no load. If this procedure shows no obvious anomalies, then the problem may lie in the device or test conditions. See the applications manuals for tips of accurately curve tracing devices.

Continuity or major functional issue

Most problems will be simple opens or shorts problems. Most of these will be related to the cables or fixtures used. In many cases these can be repaired by checking the cables, other times the cable may need replacement. See the section of debugging continuity faults for more detail and how to determine if a failure is at card level.

If CTCAL fails or if you see major distortions of the curves in the StdTrace window, you may have a real failure requiring replacement of the CT card.

Curve trace or Switch matrix

In most cases a failure of the curve tracer will be easy to discern from one in the Switch Matrix. In most cases the two parts of the hardware can be considered separately. There are some failure modes involving either the power supply or a shorted card causing the power supply to shut down due to overcurrent which can be difficult to separate. Use the power supply test procedure and the card isolation procedures to find the bad module.

Explanation of 4 and 6 bus cables and numbering

On a 2 bus system, the switch cables have only one connector at each end, the pins in the fixture go directly to the FET switch card which supports bus 1,2

On a 4 or 6 bus system there are two or three switch cards paralleled for each set of 54 channels. This parallel link is made on the ribbon cables at the system chassis end. This connection, called a daisy chain, connects the switch outputs from one card supporting bus 1,2 to another card supporting the same pin numbers but bus 3,4 or bus 5,6

It is important to understand this when debugging continuity problems because it will allow you to determine which bus and connector to investigate when searching fort the fault.

Another important observation is that the cables are labeled F1, F2, F3 etc while the pins in the SKT-625 pinmap are numbered 001 to 054, 101 to 154, 201 to 254 etc. This means that pin 321 is located on card address #03 but is on cable F4 about half way down because cards start at 0 while cables start at 1.

The top pin on the cable indicated by the red strip on the ribbon cable is pin 1 for that cable and the remaining pins are numbered in order progressing down the cable. The last pin connected is 54, the remaining pins 55-60 on the ribbon cable are not connected.

Debugging Continuity failures

When you experience opens or shorts, the pattern of the pins effected is probably the most useful diagnostic clue you can observe. By correlating this pattern to the various connectors and interface points on the MultiTrace fixture and cabling array, one can predict with relative accuracy where the continuity fault is occurring.

When analyzing continuity problems, you need to be aware of the configuration of the tester. A 4 and 6 bus system have 2 or 3 connectors at one end of the cable connectors. These connectors go to the same pins but different busses.

Be sure to observe if an open or short is present on one pair of busses or all 3 pairs of busses. Do this using the "Use Bus 1&2" or "Use Bus 3&4" "Use Bus 5&6"checkbox on the unpowered form. Use the Pins to Curve Trace section and select List of Pins. Enter only the failed pin numbers in the list to quicken the test. You may want to include one passing pin for comparison. After running the test, select Continuous from the Control menu on StdTrace.

To debug opens

Leave the shorting plug on the fixture and inspect the following places:

1. Shorting plug pin to ZIF socket. Visually inspect the shorting plug for broken pin, rotate shorting plug in socket.
2. ZIF Socket pin: Visually inspect the pin by looking down into the ZIF socket holes. Move the lever to see if any look different.
3. Check the jumper matrix for missing jumpers
4. Check/replug the cable on the back of the fixture box
5. Check/replug the cable at the tester end.

To confirm if the failure is on the Switch card, plug a probe into the ground jack on the back of the tester. Use the tip of the probe to contact the connector on the end of switch card. Remove the cable and directly contact the faulty pin with the grounded probe, it should become shorted on the screen. If it is still open, the failure is on the Switch Card and not in the fixture or cables. You should be able to locate the pin based on its card, channel and bus. This should be apparent from the pin number if you are using the SKT-625 pinmap.

The grounded probe technique can be also used at these places

1. ZIF Socket pin under test. Poke the probe in the hole of the socket, use a wire if necessary to make good contact.
2. Jumper matrix: Probe both sides of the corresponding jumper for the pin under test.
3. Cable at back of fixture box (F end of cable). Poke a fine wire in the contact at the end of the cable for the pin under test, ground the wire with the probe.

The point at which continuity returns will in most cases indicate where the open circuit has occurred.

Open pins occur most often at the following places and for the following reasons.

- Damaged pin in the ZIF socket. This is replaceable (see appendix A4)
- Damaged ribbon cable. The top pin (Pin 1, 101, 201, 301 etc.) is particularly vulnerable to becoming open due to pulling on the cable. The wire is broken inside the insulation close to one of the IDC connector crimps and pulled apart by stretching of the insulation. Sometimes the cable can be massaged back to a working state, in this case, the open may have been due to incomplete contact to the IDC connector tooth. Replace cable if open or intermittent.
- Bent pin at the back of the Switch card. Unplug the cable and inspect the pins. Straighten any bent pins.

To debug Shorts

Make sure the shorting plug and any device test fixtures are removed from the Fixture Box. Open the following points until the short is cleared.

1. Exercise the ZIF socket handle by moving it open and closed. Verify any change in the curve trace.
2. Unplug the corresponding Jumper in the switch matrix. This decides if the short is in the fixture or in the cables or switch card.
3. Unplug the ribbon cable for that pin from the back of the fixture box.
4. Unplug the ribbon cable from the switch cards (one at a time if you have a 4 or 6 bus system)

Shorted pins occur most often at the following places and for the following reasons.

- Damaged pin in the ZIF socket. The pin gets bent and contacts a neighbor. This may happen with the lever up or down exclusively so test both ways.
- Damaged ribbon cable. Fringes of wire from the cut end can fold over and short adjacent wires.
- Damaged IDC connector: Certain types of mechanical damage can cause shorts. Replace cable.
- Bent pin at the back of the Switch card. A bent pin can contact a neighbor. Unplug the cable and inspect the pins. Straighten any bent pins.
- If the short persists even with the switch ribbon cable completely removed from all cards it leads to then the switch card is failed.

Common Continuity Failures

- **Single pin opens or shorts on all busses at once**
  When a pin is shorted, it will usually appear on all busses because they are all in parallel. The short may be located at any point from the fixture back to the switch card.

  Open pins are usually due to a damaged ribbon cable or damaged ZIF socket pin

- **Fails one bus but not the others**
  Check the ribbon cable at the tester end. One of the 2 or 3 connectors has come loose while the others are still plugged in. This can happen for a whole or partial cable (=54 pins or less in sequence)

- **Exactly 54 pins are open on all busses**
  One ribbon cable has become unplugged at the fixture box end or a switch card has failed.

- **Every pin is shorted**
  A short before a switch card has occurred on the bus. Detailed troubleshooting will be required to localize it to a switch card or curve trace card or interconnect.

- **Pins have opens in a series less than 54 pins**
  A cable is partially unplugged at the top or bottom. If all busses are effected, it is the F end of the cable near the fixture, if only 1 bus is effected it is at the tester end of the cable.

  For example pin 201-228 on bus 3,4. Look at cable E3 top half, middle connector on the tester end

- **Entire blocks of pins are missing from the Switch Window Display**
  One or more switch cards are absent from the configuration. This could indicate a failed switch card, a failed power supply or simply an unplugged TX/RX cable from one chassis. The number and distribution of the missing cards will decide what is most likely. If one card is missing, it may be a failed card. If a whole chassis of cards is missing, the power switch or TX/RX cable on the absent chassis is likely to blame. If all the cards are missing, see what to do about a dead system to narrow it down.

Debugging a dead system

If you have started the MultiTrace software and observe no pinmap in the Switch window or if when you load StdTrace files, the Control menu is disabled, the system may be dead.

To determine what is the cause and if this is serious or can be fixed by the user, check the following things.

- Power switch to all boxes are on, the LED is lit and the fans are running.
- TX/RX cable is firmly plugged into the PC and all MultiTrace system chassis
- The Transmitter card in the PC is sitting straight and has not slipped out of its slot
- Run the CTCAL program,
    - if it detects and passes the cards, the problem is probably software configuration.
    - If boards are detected but fail, this may be the cause, contact UTI
    - If "0 Boards Detected" is reported, check the above connections again. If all is normal, you may have a failure of the power supply or a shorted card in the chassis or a failed transmitter or receiver card.
- Run the Switch Diagnostics program
    - If it detects all the switch cards properly and displays the correct configuration, the problem is probably software configuration
    - If it detects some cards but not all check the above connections again. If all is normal, you may have a failure of the power supply or a shorted card in the chassis
    - If it detects no cards check the above connections again. If all is normal, you may have a failure of the power supply or a shorted card in the chassis or a failed transmitter or receiver card.
    - If it detects some cards but when you press reset it detects other cards and randomly changes you may have a failed switch card a failed TX/RX cable.

Verification of pin location

The following is a useful procedure for demonstrating that pins in the test fixture are actually physically where they are expected to be. This procedure can be done on an empty ZIF socket or on top of a user installed device adapter (subject of this example)

1. Place the adapter on the fixture in the expected orientation
2. Use MTForms to configure an unpowered curve trace
3. Select the pinmap appropriate for the DUT fixture
4. Select Pins to curve Trace "list of pins" and enter one pin number (pin 5 for example)
5. Run the test with any settings, the curve will be open
6. Select Continuous from the Control menu of StdTrace, the trace will redraw but remain open
7. Plug a probe into ground (or the drive set for ground) at the back of the fixture box.
8. Place the probe tip onto the pin you entered (pin 5 in this example). The curve should become short.
9. Repeat for selected other pins until you are convinced that the fixture is valid.

Switch Diagnostics Program

The Switch Diagnostics program is a windows replacement for what used to be called SMDiag. Its purpose is to detect and present a list of cards then to perform a detailed self diagnostic of the switch cards. The diagnostic is internal and does not check continuity of the cables or fixture.

Configuration Verification

To check the configuration of the hardware as it is attached at that time, simply run the Switch Diagnostic program. You can press the reset button anytime to refresh the display. If you are debugging cards and dipswitch addresses, you can leave the system powered, manipulate the dipswitches and then press reset to see the new configuration.

Detailed Switch Card Test

To test the switch cards you must first install the SMDiag jumper. This is a small IDC connector with all the pins shorted by solder. It is plugged onto the pins labeled Bus1, Bus 2, Bus 3, Bus 4 and Measure on the top of the jumper matrix on the MultiTrace fixture box. Alternatively you can short all the busses to the measure bus using banana cables and jacks on the back of the fixture box. The CRT1 and CRT2 cables must be attached to do this test. Without the jumper, all cards will fail.

Burn-in

A set of commands files is available for burning in the tester. These files are also useful in testing the continuity of each bus individually. This test is more complete than using MTForms because each of the 6 busses gets to be the curve trace bus wile current is returned to ground through a grounded shorting plug. With MTForms, only bus 1, 3, 5, are used to curve trace, when that happens, bus 2, 4, 6 is used as the corresponding ground. In most cases a Category called [FINALTST] and a job called "Burn In Programs" is already installed on the system hard drive. If not, you may contact UTI for a copy of these files.

1. Use Filer to Select the "[FINALTST] 5. Burn In Programs" job
2. Open the Commands file called "Procedure 5.2
    a. This will open 6 StdTrace files and the SKT-625 pinmap
    b. If you have a 4 bus system, close the StdTrace files "5.2 Burn In for Bus 5" and "5.2 Burn In for Bus 6"
    c. If you have a 2 bus system, close the StdTrace files "5.2 Burn In for Bus 3" and "5.2 Burn In for Bus 4", "5.2 Burn In for Bus 5", and "5.2 Burn In for Bus 6"
    d. The only StdTrace files remaining open should be busses you have in your system
3. On the Switch window, select the Open tool and press the All pins button to make sure they are not connected to any busses. The pinmap should be blank.
4. On the Switch window, select the Mark tool and press the "All pins" button mark all pins for testing. You may also mark just a subset of the pins
5. Insert the shorting plug into the ZIF socket, connect the plug to ground using a banana patch cable.
6. Select "Continuous" from the Control menu on StdTrace. The test will begin

This test will curve trace every pin on bus 1 to 150mA through the shorted fixture. The test will then proceed to test all pins on each other bus. When complete it will repeat. While this test exercises each switch multiple times, it also ramps the drive through -15V to +15V and 150mA thousands of times. This test adequately operates all the important functions of the tester in a repetitive mode. This test is normally done at the factory before shipping for 2-3 days. You may also want to use this procedure after a repair of a Switch or Curve Trace card to help ensure reliability. This test is designed to force the failure of weak, marginal and early life failure components.

CTHVTEST.exe

CTHVTest is used to measure and monitor the “Raw High Voltage” being sent to the curve trace cards from the power supply. It is one of the first things tested by CTCAL and if that test fails (-16) then you can use this test to see what might be wrong. Normally it is not necessary to run this program unless directed to do so by UTI service engineer or while troubleshooting this particular CTCAL failure.

No shortcut is normally supplied for this program, you will need to create it when you need it. For windows XP copy the CTCAL shortcut and modify it in this way

"C:\Program Files\MultiTrace\Calibration Programs\AllowIo.exe" CTHVTEST.exe 0x300

Run the test using the shortcut. The first screen will resemble CTCAL. After a few moments a time constant will be calculated and text “Press any Key to Continue” will appear. Press any key now. A graphical display will appear. There are two Red boundary lines drawn horizontally across the top and bottom 1/3 of the graph. There is also a test display of the numerical value currently measured at the top of the screen

When the test is run, a noisy line of data will be drawn horizontally across the screen. There will be one line for each set of curve trace cards (1 or 2). To pass, the lines must stay between the boundary lines at all times.

If the results are marginally low or high for both cards, CTCAL will fail and you must reduce or increase the supply voltage accordingly until it is in range. You can expect to see a small difference between each set of cards but it should still be within the limits.

If one or both curve trace cards draw no line or the line os so far off the graph it cannot be seen, this may indicate a failure of the curve trace cards or the power supply. CTCAL will also fail and give more information about what it bad.

Part 4: Advanced Repair Procedures

Hopefully you will never need to perform any of the procedures in this section. These sections describe detailed troubleshooting and fault isolation methods you may be asked to do in an effort to identify the failed module in the MultiTrace. You should do these procedures only under direction of an Ultratest support engineer. They are provided here as a convenience to the user in the event troubleshooting must take place. All troubleshooting on the MultiTrace is designed to locate a fault at the card level. There are no component level procedures and no schematic is supplied.

Most troubleshooting procedures are based on the tried and true method of "Divide and Conquer". IN other words, your basic goal will be to subdivide the tester into smaller units until only the failed module remains. The first level is Software or Hardware. The next level is Curve tracer or Switch Matrix. The final level is which board is failed.

The troubleshooting flow chart is complex and has many alternate pathways. Please contact the experts at UltraTest for advice on what procedures to follow based on the failure results you are experiencing.

Opening the tester for Service

<u>Do not Open the tester unless directed by an UltraTest Support Engineer. Failure to do so could void your warranty.</u>

Caution!*: ESD Sensitive components, technician should be grounded and work should be done at an ESD approved workstation.*

Warning!*: Working with the cover removed exposes user to potentially lethal voltages. Use extreme care when working around live circuits.*

To remove the cover, remove 4 screws from the right and left side of the box and two more screws from the back corners of the chassis. Save the lugs to use later to reconnect the ground straps. Next, slide the cover forward supporting the back edge with your fingernail so that it does not scrape the top of the cards. Finally pull the interlock switch to allow powering of the system. Once plugged in, you may use the power switch on the back or the interlock switch to activate the system.

With the cover removed, you may have any or all other cables attached or removed depending on the procedure you are doing. To allow the PC to access the hardware for testing, the TX/RX cable and power cord are needed at a minimum.

Note: When the cover is removed, an interlock switch will turn off power to the system. To reactivate power while the cover is removed, Pull out the white push-button switch located at the front, center, bottom, exterior of the chassis.

Isolating a single box for testing

Most MultiTrace systems have more than one chassis connected to the fixture. When a failure occurs, it may be useful to turn off all but the chassis with the failed card. Within limitations and depending on the failure, this will be possible.

In a multiple box system, only one of the chassis has the Curve Trace cards in it, We call that the Main chassis or Box 1. The other chassis have only switch matrix cards inside and we call these Expansion chassis or Box 2, 3, 4. Box 1 is easily identified as the only box having one otwo 37 pin D connector(s). This box will also have cables F1, F2, F3, F4 and maybe more but will always start with F1. When setting up the system, we recommend this box be set on top or accessible because the curve trace cards are the most likely module to fail if a problem does occur.

To isolate a box you need to unplug the CRT and TX/RX cables from the other boxes you are not testing. If you isolate box 2 or 3 alone, remember you will not have the curve trace cards to use for testing the switches within. This expansion chassis isolation is useful only for failures where one switch card is shorted across the supply and in preparation for the power supply test procedure.

Isolating a Curve Trace card failure

A curve trace card is actually comprised of three modules not counting some cables or the motherboard. There are two full sized edge connector type cards plus one smaller “Transistor Card” mounted on the heatsink. The card with the small heatsink and the DB-37 connector is called the CT-Analog card and the other card having more relays is called the CT-Digital board (actually both cards are mixed signal). The CT-A and CT-D boards are normally replaced as a set and should always be installed together in the two shared slots for the CT cards.

The transistor card interfaces to the curve trace card via a cable tat plugs into the motherboard on connector J21 or J22. J21 goes to the left two slots occupied by the curve trace cards and J22 goes to the right most slots. One transistor card is mounted on the top edge of the main heatsink and the other is mounted on the bottom and requires removal of the heatsink assembly to replace it. To remove the heatsink assembly, remove 4 screws on the back and two on the bottom. Unplug all cables leading from it to the main power supply board and the motherboard.

When certain CTCAL failures occur, it is important to discern if the failure is on the curve trace cards or on the transistor card that goes with that set. The most straightforward method involves swapping J21 and J22 and observing if the failure code moves to the other curve trace card address. If it changes the failure is likely on the transistor card, if it remains unchanged, the failure is likely on the curve trace card. If the failure code changes to something else, that is inconclusive and other testing must be done or the failure may be distributed on both modules.

Another useful method is to remove one set of curve trace cards (the one that passes) and move the failed cards to the other slot on the motherboard. This has a similar effect to moving J21,J22 but it also swaps another cable that is more difficult to remove. This method also verifies function of the physical slot on the motherboard.

Some curve trace card failures can be induced by faults on the power supply or other shorted cards affecting the current limit on the main power supply. In this case, use the power supply test procedure to isolate that fault.

Ultimately the failure code from CTCAL will determine the best course of action.

Use the card replacement procedure to see the dipswitch and jumper configurations
Use CTCAL or CTCAL/V to test the cards
Test the cards one at a time or together
2 bus systems only have one set of cards
Follow the cables from J21, J22 to see if the top or the bottom transistor card is attached.

Isolating a Switch Card failure

Switch cards are much simpler than curve trace cards. There are only 2 kinds in the system. Relay Switch cards and FET switch cards. The measure bus circuitry is also physically located on the FET switch card. Each switch card supports exactly 2 busses and 54 pins. Which bus it is configured for is determined by the jumpers near the edge connector and the pin numbers it represents is determined by the dipswitch setting.

In most cases, continuity testing using MTForms or Switch Diagnostics will have already identified which pins are bad and the basic troubleshooting method will have excluded the cables as being the cause. In those cases, all you need to do is translate the pin number to the card address and locate the card by its dipswitch setting.

- Always use the SKT-625 pinmap when testing or debugging the tester so you can easily correlate to the cable and switch card.
- See the Card replacement procedure for dipswitch and jumper settings.
- See the 625 mapping key to correlate pin location with card and channel address.
- The physical address of a pin can be determined by looking at the Fixture Program
- Use the pin verification method to test individual pins anywhere along its conduction path.
- Use the Switch Diagnostics program to detect what cards are installed and to do a detailed test on one or all of them.

Power Supply Test Procedure

When a large group of switch cards, both curve trace cards or any other systematic failure of many modules occurs the fault may be a failed power supply or a card powered by that supply is shorted causing the supply to current limit and appear to be failed.

In this situation it is important to determine if it is the supply itself or a card in that same chassis. The procedure below will direct you on how to make that determination with minimal disassembly. The procedure then goes on to describe how to identify which card in the chassis is the shorted one (assuming it is not the supply).

In most cases the indication that something has gone wrong is either a failure of CTCAL where “0 Boards are detected” or some or all switch cards are missing from the list when you run Switch Diagnostics. In these cases, you will want to have the box open, powered up and the TX/RX cable attached. Other cables are optional.

You will only need a voltmeter to do this procedure. Refer to the silkscreen of the Power supply PCB for connector locations.

Loaded Measurements, Leave all connectors attached

On J403 or J406 (they are in parallel) measure with respect to ground (center pin or large screw on C402 indicated in picture)

Pin 1	+20V
Pin 3	-20V
Pin 2	ground

On J402 measure with respect to ground.

Pin 7	-20V
Pin 8	-15.3V
Pin 12	+15.3V
Pin 13	+20V
Pins 9, 11	Ground
Pins 1, 3	High Voltage (~130VDC) CAUTION

On the Mother Board find connector J18.

It is a Molex and is near the power supply and has 2 red and 2 black wires running into it. Using DMM probes push into the top of the connector to make the measurements. You should get 5V steady between either if the two pairs (red and black. The black wires (ground) are common and each red wire comes from a separate regulated 5V supply.

Results from Loaded measurements

If all the voltages on these test points are in spec, there is no power supply fault and no card is shorted across the supply. Stop here and use a different method to isolate the failure.

If one or more voltages are Too high, there is a power supply failure, stop here and contact UTI. If one or more of the voltages are too low, there may be a power supply or shorted card failure. Proceed to the unloaded measurements to determine which is failed.

No Load Measurement, Remove output connectors

Remove connectors J402, J406, J403 and J18 only. Do not remove any other connectors. This will test the supply only with no load. These connectors are the outputs to the supply, removing them will leave all cards and the motherboard unbiased.

Repeat the measurements with the J402, J406, J403 and J18 connectors removed.

On J403 or J406 (they are in parallel) measure with respect to ground

Pin 1	+20V
Pin 3	-20V
Pin 2	ground

On J402 measure with respect to ground.

Pin 7	-20V
Pin 8	-15.3V
Pin 12	+15.3V
Pin 13	+20V
Pins 9, 11	Ground
Pins 1, 3	High Voltage (~130VDC) CAUTION

On the Mother Board find connector J18.

It is a Molex and is near the power supply and has 2 red and 2 black wires running into it. Using DMM probes push into the top of the connector to make the measurements. You should get 5V steady between either if the two pairs (red and black. The black wires (ground) are common and each red wire comes from a separate regulated 5V supply.

Results from unloaded measurements

If the voltage is failed for both test conditions (loaded and no load) then the power supply itself has failed. You need to replace the P/S module or the Heatsink module to fix it. The 5V regulator is located on the heatsink, all other voltages are derived from the PS board and transformer. Consult UTI to further isolate or repair the failure.

If the voltage is failed only when the connectors are in place (loaded) then there is a short on the motherboard or one of the cards plugged into it. Proceed to the Shorted card isolation procedure.

Shorted Card Isolation procedure:

To isolate the failed card, start by removing all of the boards from the system. Be sure to keep them in order for reinstallation and observe ESD handling precautions. Replace connectors J402, J406, J403 and J18 and re-measure the voltages in the table above to verify they are now correct. If the fault reappears now, there may be a short on the motherboard itself.

Assuming the voltage returned to normal, begin replacing the cards one by one until the failure comes back. When the failure returns, you will know which board to replace. Use CTCAL, Switch Diagnostics or direct Voltage measurements to monitor your progress.

Be sure to turn off the power whenever you remove or replace a card in the system.
Do not hot plug the cards.

Replace all other cards after removing the bad one to be sure there are not multiple failures. If the failure is a switch card, decide if this is critical to your testing needs (is it supporting pins you need to test parts. In most cases, another less used card may be moved to the failed location providing the jumpers and dipswitch are changed to match the removed card.

MultiTrace System Card Replacement Procedure

Replacing Cards in the system

If any of the tests should fail, you may be directed by UltraTest personnel to replace one or more cards within the system to effect the repair. Normally the replacement cards will already be configured to the proper settings. This section outlines the replacement procedure and illustrates the settings on the cards.

Caution!*: ESD Sensitive components, technician should be grounded and work should be done at an ESD approved workstation.*

Warning*!: Working with the cover removed exposes user to potentially lethal voltages. Use extreme care when working around live circuits*

Note*: When the cover is removed, an interlock switch will turn off power to the system. To reactivate power while the cover is removed, Pull out the white push-button switch located at the front, center, bottom, exterior of the chassis.*

Replacing Curve Trace Cards

The curve trace cards are always replaced as a matched calibrated pair. They are located at the right side of the chassis nearest to the power supply (actually a short card is in the first slot, this is the receiver card). Typically the first two (nearest the supply) are the #A0 card set and the next two (nearest to the switch cards) is the #20 card set. The cards could actually be in either position. To verify the addressing, refer to the next section.

If you have more than 324 pins or have a 6 bus system, you will have more than one system box (Expansion chassis). Only one box contains the curve trace cards, it is the box with 32 pin D-sub connectors, all other boxes only have 25 pin D-sub and 60 pin Ribbon cable connectors. The is box will also have switch cards with the lowest numbers (E1, E2, E3…)

Remove the Two curve trace cards. You will need to remove the short retaining bar along the front by loosening the two screws first, you will also need to remove the cable from the back of the cards and the retaining screw on the back of the card. Set the cards aside and unwrap the new cards. Confirm that the dipswitch and jumper settings are the same as the old cards and agree with the settings printed here.

In order for you to verify the addressing, you will need to look at the dipswitch mounted on each card. In the following tables The Binary address is set on the dipswitch. In all cases the switch on the dipswitch is set to “off” for a “1” all other switches are “on” for “0”.

After replacing the new cards into the same locations as the failed cards, replace all the cables and retaining hardware. It is OK to power up the box and test the cards before replacing the cover. Simply follow the instructions for CTCAL.

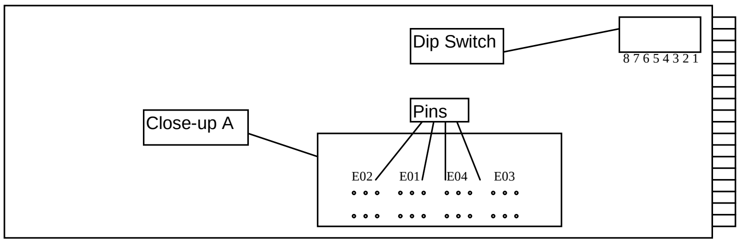
The final step involves updating the UTAPPS.INI file with the new calibration information. The new values for the calibration standards are written on the calibration certificate included with the new cards. A procedure for updating the file is included at the end of Part 1: Hardware calibration. It is important that you run the CTCAL program one last time after updating the file since the binary calibration file will not be updated with the new information until you run it. Make sure the system is completely warmed up (power on for 30 minutes) when you run the final calibration, this will ensure the best possible calibration, this can be done after the system is fully reassembled and returned to the working location.

Configured for #20

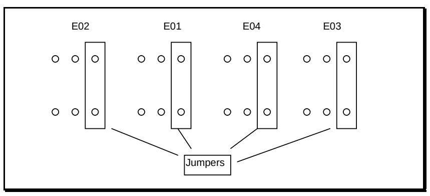
The #20 cards serve Drives 1,2, PS1, HV1

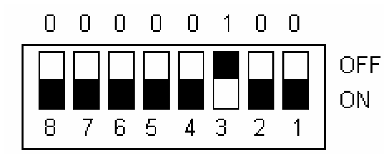
Dipswitch: 00000100

The Dip Switch for the digital board has dip switches # 1, 2, 4, , 6, 7, 8 as ON. Dip switch # 3 is OFF.

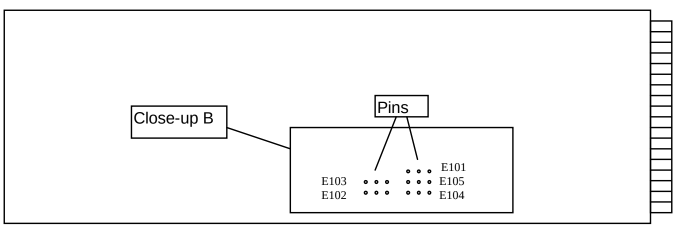


Digital Curve Trace Card

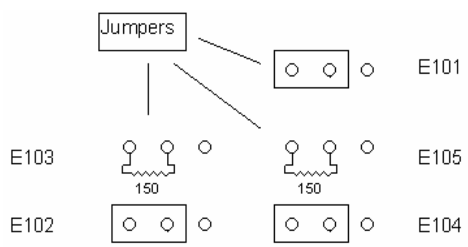




Close Up A



Analog Curve Trace Card



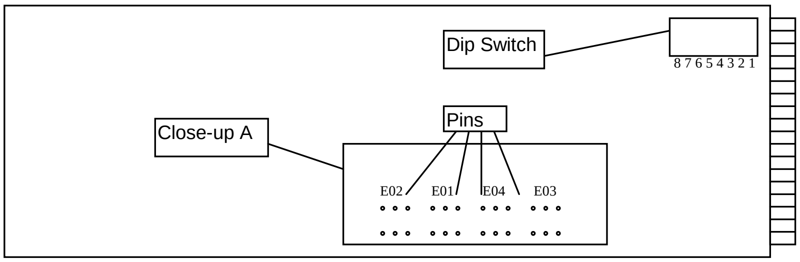
Close Up B

Configured for #A0

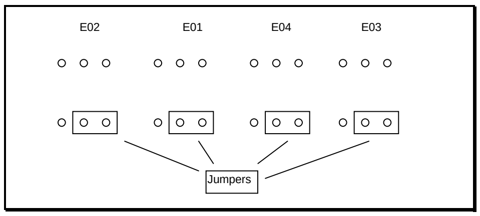
The #A0 cards serve Drives 3,4, PS2, HV2

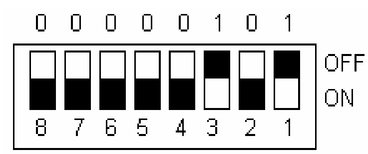
Dipswitch: 00000101

The Dip Switch for the digital board has dip switches # 2, 4, , 6, 7, 8 as ON. Dip switch # 1, 3 is OFF.

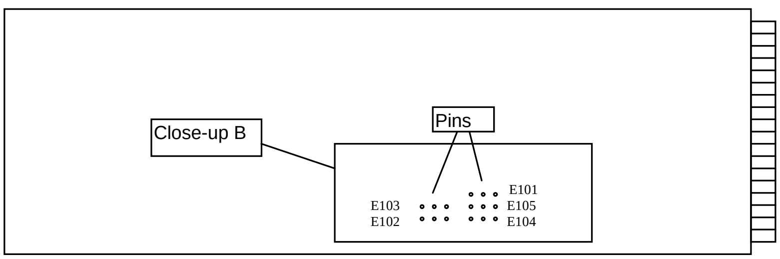


Digital Curve Trace Card

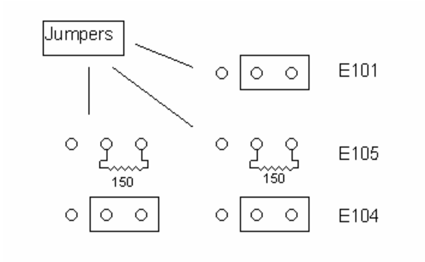




Close Up A



Analog Curve Trace Card



Close Up B

Replacing a Transistor Card

Transistor cards are mounted on the left side of the main heatsink assembly. One is mounted on the top and is easily visible and serviceable. Another card (4 and 6 bus only) is mounted on the bottom of the heatsink. To access the bottom card, you will need to remove the heatsink assembly from the chassis. TO do this, remove 4 screws from the back and 2 more from the bottom. Gently lift the assembly out and unplug all cables leading to it.

At the Discretion of UTI and depending on the situation, you may be directed to replace the entire heatsink assembly or just one of the transistor cards. Replacement of the module is just the reverse procedure as removal. Swapping of J21 and J22 is allowed.

To remove the transistor card, remove the 5 screws holding the transistors to the heatsink. Remove the card from the heatsink. When reattaching the new transistor card use a small amount of heatsink grease and a mica or polymer insulator pad. After tightening the screws use an ohmmeter to verify that the metal tabs of the transistors are electrically isolated from the metal heatsink. Verify the tabs are not shorted together. Reinstall the heatsink assembly and repeat CTCAL testing to see if the repair was successful.

After repairing any transistor card or curve trace card you should run CTCAL at least 10 times without failing and repeat 2-5 more times throughout the next 2 days to verify the repair is stable. To run CTCAL 10 times copy the CTCAL shortcut and modify the target line this way:

"C:\Program Files\MultiTrace\Calibration Programs\AllowIo.exe" CTCAL.exe/t=10 0x300

Or for overnight burn in

"C:\Program Files\MultiTrace\Calibration Programs\AllowIo.exe" CTCAL.exe/b 0x300

Replacing Switch Matrix Cards

There are two types of switch cards FET and Relay, the cards are easily distinguishable because the relay cards have many relays on them and the FET cards have many DIP IC devices on them. The switch cards can be located in any of the expansion chassis. Each card supports 2 busses and 54 pins (channels). A four bus system parallels 2 cards together and a six bus system parallels 3 cards together. Paralleling is accomplished on the cables at the expansion chassis end (not the fixture box). Notice that the cable has two or three connectors on one end spaced about two inches apart.

Address Numbering System

When running SMDIAG, the switch cards are numbered with Hexadecimal digits. Therefore the bus 1,2, cards have addresses #00, #01, #02 etc., the bus 3,4 cards have addresses #80, #81, #82…. And busses 5,6 cards are addressed as #40, #41, #42….

When running SKTDIAG the cards are numbered with Decimal numbers. Therefore the bus 1,2, cards have addresses 0, 1, 2…, the bus 3,4 cards have addresses 128, 129, 130…. And busses 5,6 cards are addressed as 64, 65, 66….

When looking at the back of the box you will see the cards labeled E1, E2, E3…. And are labeled in pairs or triplets.

When looking for a failed card in the hardware after seeing a failure on the screen Be careful to note that most of the software starts counting the cards at 0 while the hardware starts counting the cards at 1. Therefore, for example, the card labeled E4 actually has an address of 05

In order for you to verify the addressing, you will need to look at the dipswitch mounted on each card. In the following tables The Binary address is set on the dipswitch. In all cases the switch on the dipswitch is set to “off” for a “1” all other switches are “on” for “0”.

Addresses for bus 1,2 cards

Decimal	HEX	Dipswitch (Binary)
0	00	0000 0000
1	01	0000 0001
2	02	0000 0010
3	03	0000 0011
4	04	0000 0100
5	05	0000 0101
6	06	0000 0110
7	07	0000 0111
8	08	0000 1000
9	09	0000 1001
10	0A	0000 1010
11	0B	0000 1011

Addresses for bus 3,4 Cards
In addition to the addresses used for the 2 bus systems

Decimal	Hex	Dipswitch (Binary)
128	80	1000 0000
129	81	1000 0001
130	82	1000 0010
131	83	1000 0011
132	84	1000 0100
133	85	1000 0101
134	86	1000 0110
135	87	1000 0111
136	88	1000 1000
137	89	1000 1001
138	8A	1000 1010
139	8B	1000 1011

Addresses for bus 5,6
In addition to the addresses used for the 2 bus and 4 bus systems

Decimal	Hex	Dipswitch
64	40	0100 0000 (Binary)
65	41	0100 0001
66	42	0100 0010
67	43	0100 0011
68	44	0100 0100
69	45	0100 0101
70	46	0100 0110
71	47	0100 0111
72	48	0100 1000
73	49	0100 1001
74	4A	0100 1010
75	4B	0100 1011

The cards for busses 3,4 and 5,6 are mixed in with the bus 1,2 cards. Typically the cards will be arranged in the box in the following way #0, #128, #64, #1, #129, #65, #2, #129, #66 etc.……
(ignore the bus 5,6 or bus 3,4 cards if you have a 4 bus or 2 bus system respectively)

After Locating the failed card, remove it by removing the long retaining bar at the front of the chassis by loosening the two screws. You will also need to remove the cable from the card and the retaining screw at the back of the chassis. Confirm that the dipswitch and jumpers on the new card are exactly the same as the failed one. Replace the card and cable and retest using SMDIAG and SKTDIAG. At the beginning of the SMDIAG test you will see a listing of all boards detected. Check to see that the total number of boards, their type and address are all correct.

Replacing The Receiver or Transmitter Cards

Diagnosing Problems:

The Transmitter card which is located in the computer, the receiver card which is located in each of the expansion chassis and the interconnecting TX/RX cable are responsible for providing a digital communications link between all the components of the MultiTrace system. If a problem should occur with one of these components you will experience it as one of the following symptoms.

- No pinmap displayed on the Switch window
- Incomplete pinmap displayed
- Settings, Display and Control menus are disabled even when a StdTrace file is loaded.

The most common reason for this problem is a loose or unplugged TX/RX cable. This cable is the 60 pin cable that goes from the computer to each of the chassis (1 to 3 in quantity). Check the connections at each point. You may need to remove the cable and inspect the pins.

To see if the fix worked, reboot the computer so that the MultiTrace software is completely reloaded. Check to see if a complete pinmap is displayed. You may want to load the pinmap SKT-625 which will display all active pins in your system. Use the “Physical” display (choose “View” from the Options menu) to inspect your pinmap, it is more informative for this purpose.

If after consultation with UTI and possibly trying a new cable, there still is a communications problem, the cause may be the actual transmitter or receiver card in the system. It is often impossible to determine which card is at fault without substituting with at least one known good card.

If you have recently installed a network card or another add in card, this may be responsible for the problem. A memory conflict will occur if any hardware is installed that uses the address #300 hex as it’s base address. While it is possible to change the base address of the MultiTrace, it is preferable and in most cases easier to change the address on the new hardware. Follow the instructions that come with the new hardware and avoid the base address #300 hex. The MultiTrace does not use an interrupt and is not subject to interrupt conflicts.

Replacing the Receiver Card

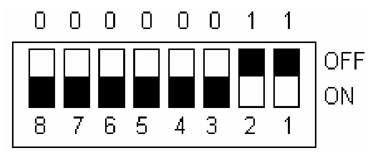
This card has no dipswitch and no jumper to be set. The card is located in each of the system boxes (large heavy box not the fixture box) and is the smallest card closest to the heatsink assembly. To replace, simply remove the cable and retaining screw, pull out the old card and store in a static safe area. Insert the new card in its place replace the cable and retaining screw, and power up the system for retest (see above instructions).

Replacing the Transmitter Card

This card is located in the PC computer. To access it, remove the cover from the PC. To remove the card, remove the cable and retaining screw. Insert the new card and reconnect the cable and retaining screw.

The card comes with a dipswitch. The default settings program the system base address port to #300hex (768 decimal). This value will only be different if the system has been reconfigured to avoid address conflicts with other hardware. Make sure that the dipswitch on the new card is set the same as on the old card. If for some reason you need to change the setting, then the base address also needs to be changed in the UTAPPS.INI file. Note that the dipswitch is read in hexadecimal units but the file is updated with the decimal equivalent of the setting. You can use a scientific calculator to make the conversion.

The dipswitch settings for #300 have switches 1,2 off and all others are on.



The card also comes with a Jumper which can be placed in any of 24 positions labeled 1 through 24. These settings correspond with a communications delay. For Pentium computers set this to the highest value and for other computers set it to mid range. If you are replacing a failed card it is best to use the same settings. Some older cards may only have 12 delay states.

Hardware Calibration.

Hardware Calibration is done at the factory and should not be necessary under normal circumstances. The procedures outlined here can be used if calibration is found to be necessary through troubleshooting. Do not use this procedure unless directed by UltraTest Personnel. Failure to do so could void your warranty.

Caution!*: ESD Sensitive components, technician should be grounded and work should be done at an ESD approved workstation.*

Warning!: Working with the cover removed exposes user to potentially lethal voltages. Use extreme care when working around live circuits

Note: When the cover is removed, an interlock switch will turn off power to the system. To reactivate power while the cover is removed, Pull out the white push-button switch located at the front, center, bottom, exterior of the chassis.

1. Remove power cord from Chassis.
2. Open the Expansion Chassis and remove the CT Analog cards.

The curve trace electronics are located on a pair of cards plugged into a mother board inside the Expansion Chassis. There will be one pair for a 2 bus system and two pairs on a 4 or 6 bus system. The cards are referred to as the CT analog and CT Digital cards. The calibration resistors are located on the CT digital card. This card can be identified as the one with the dip switch on the upper corner. It will be plugged into one of the first five slots nearest to the power supply (left). Remove both CT digital cards and place them flat on an ESD protected surface, you will have to remove the small cable connected to this card. Make note of which board came from which slot.

3. Measure the three calibration resistors for each set of cards.

Locate the three calibration resistors located at the bottom center of the card, they are designated as R63, R64, R65. The specified values of the resistors are:

R63 = 3320Ω, 0.1%
R64 = 348kΩ, 0.1%
R65 = 31.6Ω, 0.1%

Measure the actual resistance of the 31.6Ω resistor using the Kelvin four point method. (see the instructions included with your meter if you are unfamiliar with this method.) The two larger resistors can be measured using a two wire method. The leads of these resistors may have a conformal coating, it may be necessary to scrape the leads to expose bare metal.(It is not necessary to re-coat these leads when finished) Record the results for each board for later entry into the calibration file. Re-install the two cards into their original slots.

4. Measure the voltage of the precision 10V reference.

***Caution!**: This test is done under power, if the cover has been removed use caution, potentially lethal voltages are present.*

With all boards in place power up the system. If the cover is off you may need to pull out the white interlock switch located on the front of the chassis. On the back of the CT Analog card is a 36 pin D connector. This card can be identified by the black heat sink mounted on the component side. Measure the voltage of the 10V reference at pin 34 with respect to ground at pins 13-16. Record the voltage on each board for later entry into the calibration file.

5. Enter the measured values into the UTAPPS.INI file.

Start the computer and use a text editor to edit the C:\WINDOWS\UTI\UTAPPS.INI file. Windows Notepad or DOS Edit will work well for this.

Each pair of cards is identified by the address set on the DIP switch on the CT digital card. The two addresses used are #20 hex and #A0 hex. The DIP switches are all set to on (1) except switch 3 for card set #20 and switched 1 and 3 for card set #A0. Enter the measured values into the UTAPPS.INI file as illustrated below. These lines are located at the end of the file.

;Default settings of Curve Trace Card internal measurements
[0x20 calibrate]
TenVolt=10
31=31
3320=3320
348K=348000

;Default settings of Curve Trace Card internal measurements
[0xa0 calibrate]
TenVolt=10
31=31
3320=3320
348K=348000

When complete, close and save the UTAPPS.INI file, also close all cases and reconnect any cables. When finished power up the system and quit windows so that you are at a DOS prompt. Calibration is not complete until CTCAL generates the final calibration file. See the following section.

Reference Value	**Minimum Allowed**	**Maximum Allowed**
10.0000V	9.99V	10.01
31.600Ω	31.568Ω	31.663Ω
3320Ω	3316.7Ω	3323.3Ω
348000Ω	347650Ω	348350Ω

Appendices:

A1: MultiTrace System Technical Specifications

Architecture

The MultiTrace system consists of four integrated subsystems. The source/measurement unit (SMU) provides up to eight drivers for use in curve trace and parametric testing. The switch matrix unit provides up to six analog busses which allow connection of drivers to any combination of device pins. The fixture unit provides for connection of the MultiTrace system to a variety of device types. The computer unit controls the MultiTrace system, supporting a sophisticated interactive software package for easy,
yet flexible operation.

Available Configurations

MultiTrace systems vary in the number of analog busses supported (2, 4 or6 bus), and number of pins available. Contact ULTRATEST for information on custom configurations. The following standard models are available:

2, 4, or 6 bus with 324, 432, 441, or 625 pins.

Systems are available with either analog or relay switch matrix systems. Combinations of both (for example: Busses 1 & 2 connected through analog switches, Busses 3 & 4 through relay switches) are also available.

Curve Trace Unit Specifications

Drive Description

4 or 6 Bus System	2 Bus System
4 Standard Drives	2 Standard Drives
2 Power Drives	1 Power Drive
2 High Voltage Drives	1 High Voltage Drive

Each drive is capable of operating in three modes.

- In Curve Trace mode, the drive behaves as a curve tracer - the voltage specified is delivered to the device through a user specified series resistor (the voltage at the pin will generally not match the specified voltage due to voltage drop across the resistor).
- In DC Parametric Voltage mode the specified voltage is delivered to the device (i.e. the sense feedback is after the series resistor).
- In DC Parametric Current mode the specified current is delivered to the device. Drives are configured individually, thus it is possible to combine drives operating in different modes during a single test.

In all cases, drives are capable of both sinking and sourcing current automatically. All drives support full hardware current limiting in curve trace and DC parametric voltage mode. In DC parametric current mode, drives support voltage limiting. (Voltage limits in this mode prevent imposition of excessive voltages from the drive onto the device. They will not compensate for excessive voltages imposed externally onto the device).

Standard Drive Specification

- Voltage: ±15 V
- Current: ±1 Amp (source or sink) @ 14 V, ±.75 Amp @ 15 V.
- Series resistors: User selectable 1Ω, 10Ω, 100Ω, 1KΩ, 10KΩ, 100KΩ, 1MΩ, 10MΩ. Auto resistor selectable in DC parametric modes.
- Voltage Setting Resolution: 16 bit DAC provides < 1 mV/step resolution. Accuracy at 18-28 °C ±0.05% full scale range.
- Voltage Measurement Resolution: 16 bit ADC provides < 1mV resolution. Accuracy at 18-28 °C ±0.03% full scale range.
- Current Setting and Measurement Resolution: Depends on series resistor (Rs) as follows:

Rs	Setting	Accuracy♠	Measurement♣	Accuracy♠
1Ω	< 400µA	±0.2%	< 50µA	±0.1%
10Ω	< 800µA	±0.2%	< 5µA	±0.1%
100Ω	< 80µA	±0.2%	< 500nA	±0.1%
1kΩ	< 8µA	±0.2%	< 50nA	±0.1%
10kΩ	< 800nA	±0.2%	< 5nA	±0.1%
100kΩ	< 80nA	±0.2%	< 500pA	±0.1%
1MΩ	< 8nA	±0.2%	< 50pA	±0.1%
10MΩ	< 800pA	±0.2%	< 5pA	±0.1%

♠Full scale range at 18-28 °C.
♣These are typical values for normal operation. For all drives, accuracies will be slightly worse for low value resistors dissipating high power for extended periods of time.

There are two measurement scales for each series resistor. The above chart shows resolution for the high gain measurement scale. The low gain resolution can be determined by multiplying these numbers by 20. Scales are selected automatically by the system on most series resistors. When the voltage across the resistor is between -1.5 V and +1.5 V, the high gain measurement scale is used by the system.

- Current Limits: Resolution is identical to current setting resolution for each series resistor.
- Software supported operating modes:
    - ⇒ Each drive can be Swept, Constant or Disabled.
    - ⇒ Configure each drive for Curve Trace, DC Parametric Voltage or DC Parametric current.

  - ⇒ High speed pulse mode available.
  - ⇒ Sweep direction up, down, both (with optional averaging).
  - ⇒ Optional Quiescent value (return to value when not sampling).
- Software supported measurement modes:
  - ⇒ Measure Voltage or Current.
  - ⇒ Average 2N samples (N user specified).
  - ⇒ Line frequency correction (50Hz or 60Hz)

⇒ Measure during, before or after high speed pulse.

High Voltage Drive Specification

- Voltage: ±100 V
- Current: ±100mA (source or sink)
- Series resistors: User selectable 10Ω, 332Ω, 10KΩ, 329KΩ, 10MΩ. Auto resistor selectable in DC parametric modes.
- Voltage Setting Resolution: 16 bit DAC provides < 4 mV/step resolution. Accuracy @ 18-28 °C ±.05% full scale range.
- Voltage Measurement Resolution: 16 bit ADC provides < 4 mV resolution. Accuracy @ 18-28 °C ±.03% full scale range.
- Current Setting and Measurement Resolution: Depends on series resistor (Rs) as follows.

Rs	Setting	Accuracy♠	Measurement♣	Accuracy♠
10Ω	< 120µA	±0.5%	< 30µA	±0.5%
332Ω	< 150µA	±0.2%	< 950nA	±0.2%
10kΩ	< 5µA	±0.2%	< 30nA	±0.2%
329kΩ	< 150nA	±0.2%	< 950pA	±0.2%
10MΩ	< 5nA	±0.2%	< 30pA	±0.2%

♠Full scale range at 18-28 °C.
♣These are typical values for normal operation. For all drives, accuracies will be slightly worse for low value resistors dissipating high power for extended periods of time.

- Current Limits: Resolution is identical to current setting resolution for each series resistor.
- Software supported operating modes:
  - ⇒ Each drive can be Swept, Constant or Disabled.
  - ⇒ Configure each drive for Curve Trace, DC Parametric Voltage or DC Parametric Current.
  - ⇒ High speed pulse mode available.
  - ⇒ Sweep direction up, down, both (with optional averaging).
  - ⇒ Optional Quiescent value (return to value when not sampling).
- Software supported measurement modes:
  - ⇒ Measure Voltage or Current.

⇒ Average 2N samples (N user specified).
⇒ Line frequency correction (50Hz or 60Hz)
⇒ Measure during, before or after high speed pulse.

Power Drive Specification

- Voltage: ±15 V
- Current: ±1 Amp (source or sink)
- Voltage Setting Resolution: 16 bit DAC provides < 1 mV/step resolution. Accuracy @ 18-28 °C ±.05% full scale range.
- Voltage Measurement Resolution: 16 bit ADC provides < 1mV resolution. Accuracy @ 18-28 °C ±.03% full scale range.
- Current Setting and Measurement Resolution:
  ⇒ Setting: < 500µA
  ⇒ Measurement: < 5µA
- Current Limits: Same as current setting resolution.
- Overall accuracy: Setting < .2% or measurement < 0.2%. These are typical values for normal operations. Accuracies will be slightly worse for low value resistors dissipating high power for extended periods of time. Calibration via internal software.
- Series resistor fixed at 1Ω
- Software supported operating modes:
  ⇒ Each drive can be Swept, Constant or Disabled.
  ⇒ Configure each drive for Curve Trace, DC Parametric Voltage or DC Parametric current.
  ⇒ High speed pulse mode available.
  ⇒ Sweep direction up, down, both (with optional averaging).
  ⇒ Optional Quiescent value (return to value when not sampling).
- Software supported measurement modes:
  ⇒ Measure Voltage or Current.
  ⇒ Average 2N samples (N user specified).
  ⇒ 60 Hz correction (3 filter types).
  ⇒ Measure during, before or after high speed pulse.

Calibration

The MicroLabs MultiTrace System is calibrated based on precision internal voltage and resistor references using calibration software provided by ULTRATEST. References include a precision 10.000V references and precision 348KΩ, 3320Ω and 32.4Ω ±.01% resistors.

Switch Matrix Specifications

The MicroLabs MultiTrace System uses either analog switches or relay switches to provide a low cost, extremely reliable switch matrix system to support testing of very high pin count devices. Each pin on a device can be connected to any analog bus. Each analog bus is typically connected (under software control) to one of the Standard Drives in the curve trace unit.

The switch matrix unit is configured for 2, 4 or 6 analog busses depending on the specific MultiTrace model. In addition, the Analog Switch Matrix has a high impedance measurement line that is used for voltage measurement of any pin.

The Analog Switch Matrix unit has a special option which allows it to be used as a logic pattern or test vector generator. This option is usually used in combination with a four buss Relay Switch Matrix. This combination combines the high reliability of analog switches for logic toggling with the low resistance of relays for accurate measurements.

RELAY Switch Matrix Unit Specifications

RELAY Switch Matrix Applications

- Connect any or all pins on a device to specified voltage or logic level.
- Curve trace any pin on a device to any or all other pins.
- Power device up to 2 amps (unswitched), 1 amp when switched (usually the relays will be switched unpowered)
- Relay switches have minimum resistance.
- Measurements on large numbers of pins or other sources.

RELAY Switch Specifications

- Voltage range: ±15V
- ESD protection > ±2000V
- Typical switch resistance: < 1Ω
- Maximum switch resistance: 1Ω (includes wiring)
- Maximum pin leakage current: < 1nA
- Typical bus leakage current per pin: 50pA
- Max bus leakage current per pin: 100pA
- Expected life: > 10^8 operations

ANALOG Switch Matrix Unit Specifications

ANALOG Switch Matrix Applications

- Connect any or all pins on a device to specified voltage or logic level.
- Curve trace any pin on a device to any or all other pins.
- Power device up to 100 mA. Less than 100% duty cycles make even greater currents possible.
- Analog switch's lack of relay bounce problems allows use in functional test applications (application of vector).
- Special measurement bus allows voltage measurements after switches.

ANALOG Switch Specifications

- Voltage range: ±15V
- ESD protection > ±4000V
- Typical switch resistance: < 15 Ω
- Maximum switch resistance: 20Ω
- Maximum pin leakage current: < 5nA
- Typical bus leakage current per pin: 100pA
- Max bus leakage current per pin: 250pA
- Reliable, solid state operation.

General Switch Matrix Specifications

- High impedance measurement bus impedance: > 100MΩ
  (Analog Switch Matrix only)
- Maximum number of pins in standard configuration: 625
- Maximum number of pins in custom configuration (4 bus system): 6858*
  *Software limits the practical maximum to 2047 when testing a single device.

Connection to Fixture unit (or user provided fixture) is via industry standard mass terminated ribbon cable. This is often used to connect the switch matrix unit to a probe station or oven.

Fixture Unit Specifications

The MicroLabs MultiTrace system provides a standard fixture unit for connecting a variety of devices to the system.

- 21 x 21 or 25 x 25 (for 625 pin systems) zero insertion force Pin Grid Array (0.1" centers) provides direct plug-in for PGA's and most DIP's.
- A wide variety of industry standard socket adapters are available for connecting LCC, PLCC, SOIC, PQFP, BGA and other devices.
- Provides direct access to all analog busses, the high impedance measurement line, all drives, and four extra user definable probes.

- Separate jumper area provides external access to all pins on a device. This can be used to connect pins directly to supplies or to each other, or to connect external test equipment to any pin(s).
- Jumper area allows isolation of pin from switch matrix for situations where switch matrix leakage or capacitance needs to be eliminated. Also useful when connecting voltages beyond ±15V to pins.
- Jumper area allows direct connection of pin to any drive for situations where switch matrix resistance is unacceptable, or to connect external or internal source to a pin or analog bus (for example: the high voltage or power drives).

Computer Specifications

Note: Since the computers available in the market are changing so rapidly, the following specifications are likely to change at any time. These specifications are as of January 1997.

Minimum Specifications

- 32 bit 80386 CPU at 33 MHz. 80386 systems include floating point coprocessor.
- At least 4 MB 32 bit memory.
- At least 80 MB hard disk drive @ <18ms average access time. 10 Mbit/s transfer.
- Fully compatible with MS-DOS and MS-Windows.
- VGA screen for 640x480 resolution in 16 colors.
- 1.44MB 3 1/2" floppy disk

Typical specifications for new systems

- Pentium 133MHz Processor
- 2.0GB Hard Disk Drive
- 1.44 MB 3.5” Floppy Disk Drive
- 16 MB RAM Memory (expandable)
- 4X CDROM Drive
- 101 Key Keyboard
- 15” SVGA Color Monitor and driver
- Mouse Pointing Device

Hardware Options Available (typical)

- High resolution color ink jet printer.
- Tape backup system.
- RAM Memory Upgrade
- Larger Hard Disk Drive
- Network Card

Included Software

- MS Windows 95
- MS Office 95
- MultiTrace Operating Software (see description to follow)

Software Specifications

Software Environment

- MicroLabs MultiTrace system software runs under the MS-Windows operating environment. It is fully compatible with other Windows applications.
- Context sensitive online help at the touch of a key.
- Multitasking allows multiple programs to run at the same time.

Files and Jobs

- Virtually all system settings, status, environment information and data can be saved to files on disk. Number of files is limited only by the size of the disk.
- Work is divided into Categories and Jobs. This allows work for different users, customers, jobs, etc. to be kept separate.
- File and Job names are up to 32 characters long. Each file and job may have an additional 1 line description.
- Password protection on Jobs (write only).
- Built in Job backup and restore utility for archival storage of data files.
- Support of template jobs and files for extremely rapid system setup.
- Command files allow saving and restoring the complete environment of any number of MultiTrace sessions.

Fixturing

The MicroLabs MultiTrace system provides complete software fixturing capabilities in which each physical channel (or location on the 21x21 pin socket) can be assigned a set number (or IC number), a pin number and a pin name.

Fixturing can be accomplished manually (by typing in the channel assignments and pin numbers), semi-automatically (by touching a probe to the pins in numerical order), or visually (refer to the section on "DataTrace"). No physical jumpering is required for most curve trace applications.

Pin mappings (or software fixtures) and names can be saved for future reference.
- Maximum number of sets (IC's) per pinmap: 31
- Maximum number of pins in each set: 2047

Switch

- Connect any pin to any bus (true break before make switching).
- Connect any pin to the high impedance measurement bus.
- Mark pins for automatic curve tracing.
- Lock pins into a particular state.
- Enable and disable individual switches in the switch matrix.
- Physical display shows image of IC on the computer screen.
- Switch matrix and software states can be saved for future reference.

Standard Trace Features

The StdTrace application is the main control program for the curve trace unit. The following is a partial list of its features:

- Support of hierarchical data acquisition. Here is an example of a 3-level trace:
  Do a curve trace,
  for every marked pin,
  for several different supply voltages.
- Specify multiple measurements to take at each sample point. Measurements include drive voltages and currents, analog bus voltages, measure bus voltages, voltage at any pin or pins, probe voltages, etc.
- Complete control of settings for each drive.
- Allow sequencing through marked pins or a list of pins. Curve Trace a set of pins to any pin or user defined set of pins.
- Overlay traces of known good devices with test devices. Display all traces for a device or a subset. Each device can be displayed in a different color (up to 16 colors).
- Rapid trace identification when many traces are being displayed.
- Link device files together to rapidly compare the same pin number on multiple devices.
- Plot current/voltage (traditional curve trace) or voltage/voltage, voltage/current or current/current.
- Full featured zooming, panning, and automatic scaling of display allows user to quickly focus on desired part of the trace.
- Cursor and slope calculation.
- Storage" mode for examination of trace change over time or temperature variation.
- Store and retrieve multiple display and screen formats for obtaining different perspectives on a set of data.
- Automatic comparison of traces based on user specified criteria.
- Report generator prints summary of system state and high resolution monochrome or color printout of trace screen (requires optional printer).
- Report generator prints summary of system state and Trace Display to a Bitmap file (.BMP)
- Multitasking system allows viewing of multiple trace screens at once.
- Clip trace and screen information to clipboard for incorporation into documents. Word processor included supports text and graphics.

Standard Trace Specifications

- Maximum number of samples per trace: 8000
- Maximum number of traces per trace file: 32000
- Maximum number of trace files open at one time: 64
- Maximum number of trace files that can be saved: Unlimited
- Maximum number of levels in trace hierarchy: 32
- Maximum number of measurements for each sample point: 64

- Theoretical maximum number of samples that can be taken automatically if you had a large enough hard disk: >16,384,000,000. (That is, not counting the DataTrace package, whose ATE type capabilities extend this already outrageous number beyond any reasonable application).
- Theoretical maximum number of samples that can be displayed at one time if you had a large enough hard disk: >16,384,000,000. (The point of these being, there are few theoretical limits on the ability of the MultiTrace system to acquire and display data, the practical limits being the amount of disk space you have, and the amount of patience you have. By our estimates, acquiring and displaying 16 x 109 traces would take over 2 years and require more than 100 gigabytes of hard disk space).

DataTrace Specifications

DataTrace is an optional data analysis package. It consists of a macro package and communications package to integrate the MS-Excel spreadsheet into the MultiTrace system. The following is a partial list of its features.

- On screen fixturing. Type number directly onto image of a socket, or point at positions (and groups of positions) to rapidly enter sequential numbers.
- Extract raw trace data from the trace application. Data can be displayed, printed, graphed, etc.
- Customized trace comparison control (beyond the comparison features of StdTrace).
- Extract and graph data with axis types other than voltage or current. For example: A bar chart of CMOS latch-up current for each of a set of pins.

A2: MultiTrace System Installation Instructions

Hardware Assembly Procedure

This is the Hardware Assembly Procedure for the UTI MultiTrace Curve Trace System. The instructions are given for a 6-bus, 625-pin system. For other systems, the number of Expansion Chassis' and cables differ.

Contents

You should receive the following equipment the quantities of each will vary depending on your configuration:

- Personal computer
  - Monitor, Keyboard, Mouse
  - CDROM: Windows , MS-Office, MultiTrace Software
- Fixture Box with 441 or 625 pins
- MultiTrace Chassis with power cord (may be more than one)
- Cables:
  - Switch Matrix Cables: Multiple 60 pin ribbon cables wrapped with black jacket - **CAUTION! Do not remove the protective jacket**.
  - 25-pin Curve Trace Cables. CRT1 and CRT2
  - 60-pin Transmitter/Receiver Ribbon Cable.

Assembly Procedure:

1. Open all boxes and carefully remove the contents.

2. On table or workbench, position the equipment as follows (this is only the recommended placements. It can be placed anywhere you wish):
   a. Viewing all chassis from the front, place the computer on the right side of the workbench.
   b. Place Monitor to the left of the computer.
   c. Place Expansion Chassis #1 (this chassis has slots, that fit the 60-pin ribbon connectors, numbered starting from E1 on the back) to the left of the computer.
   d. If applicable, place Expansion Chassis #2 (this chassis has slots with the next set of "E" numbers on the back) on top of Expansion Chassis #1.
   e. If applicable, place Expansion Chassis #3 (this chassis has slots with the last set of "E" numbers on the back) on top of Expansion Chassis #2.
   f. Place the Test Fixture Chassis to the left of the Expansion Chassis.

3. Connect the System as follows:

   A. Computer and monitor connections.

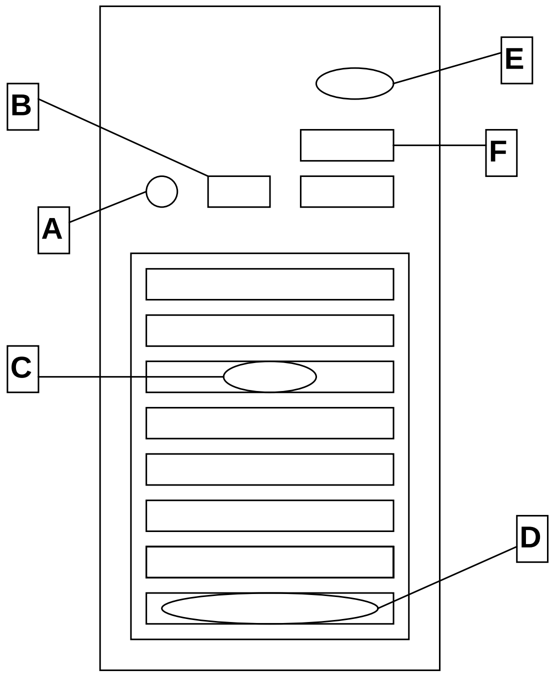


Figure 1. Computer

1. Connect Keyboard cable into location **A** (**Figure 1**) on back of computer.
2. Connect Mouse cable into location **B**.
3. Connect Monitor cable into location **C**.
4. Connect the 60-pin Transmitter/Receiver ribbon cable (the side labeled “TX/RX”) into location **D**.
5. Connect computer power cord into location **E** (do not plug cord into power outlet until all assembly is completed).
6. Connect monitor power cord into monitor (do not plug cord into power outlet until all assembly is completed).
7. Connect Printer Cable into location **F** (if equipped).

B. Test Fixture Chassis Connections

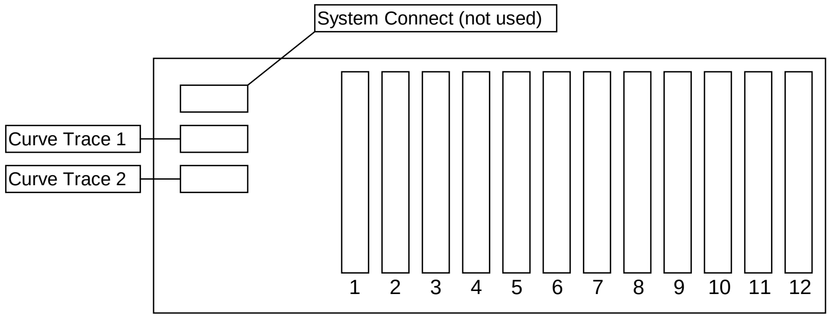


Figure 2. Fixture Chassis (for 625-pin system only)

1. Lay the Switch Matrix cables (the bundles of 60-pin ribbon cables wrapped in black) on the workbench at the rear of the Expansion and Test Fixture Chassis with the red edge up and with one end of the Switch Matrix cables towards the Fixture Chassis and the other end of the Switch Matrix cables towards the Expansion Chassis. The top of the connectors have the red edge along the cable length and also have the "arrow" on the connectors itself. Switch Matrix cable #1 (the cable that has 60-pin ribbon connectors marked starting from "F1" on one end) has four to six 60-pin ribbon cables and one ground line on each end. Channel Cable #2 (the cable with 60-pin ribbon connectors marked with the next group of "F" numbering on one end) and Channel Cable #3 (the same except with 60-pin connectors labeled with the last group of "F" numbering) are the same. For the 441-pin, 4-bus system, there are only two Switch Matrix cables and for the 324-pin 2-bus systems, there is only one.

2. Find the 60-pin ribbon connector, from Switch Matrix #1, with the side marked "F1". Carefully insert the connector into the leftmost slot (slot #1) on the Fixture Chassis. Make sure that the red edge of the Channel Cable is facing up and connect first from the bottom to the top of the ribbon cable (this is in case some of the bottom pins are bent or broken, since the bottom 6 pins are not used). Insert "F2" into slot #2, "F3" into slot #3, and continue this process until all the connectors have been inserted into the Fixture Chassis. Connect Channel Cable #2 and Channel Cable #3 in the same manner as Channel Cable #1 (e.g. "F7 goes in slot #7), making sure that the red edge of the Cable is facing up. When finished, squeeze the retainer clips (located on the top and bottom of the slots) onto each connector to secure the Channel Cable. Note: Don't force the connector in if it won't go in all the way; check first to see whether any of the pins in the Fixture Chassis slot were bent (most notably the top or bottom pins) during the process. The 441-pin, 4-bus system will only have nine connectors and the 324-pin, 2-bus system will only have six connectors.

3. Insert the 25-pin male cable (there are four 25-pin connectors labeled “CRT1”, connected in series, on the same cable, but use the one on the very end of the cable most isolated from the other ones) into the slot marked “Curve Trace 1” on the Fixture Chassis. Insert the other 25-pin cable (marked “CRT2”) in the same manner into the “Curve Trace 2” slot.

4. Plug the ground receptacles (the thin aluminum lines with the plastic heads) from all the Switch Matrix cables into the spade terminals found on the corners of the Fixture Chassis.

C. Expansion Chassis Connections

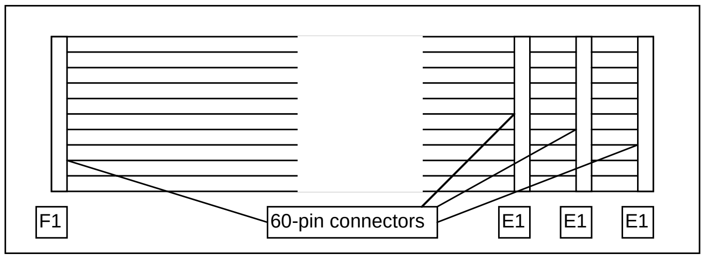
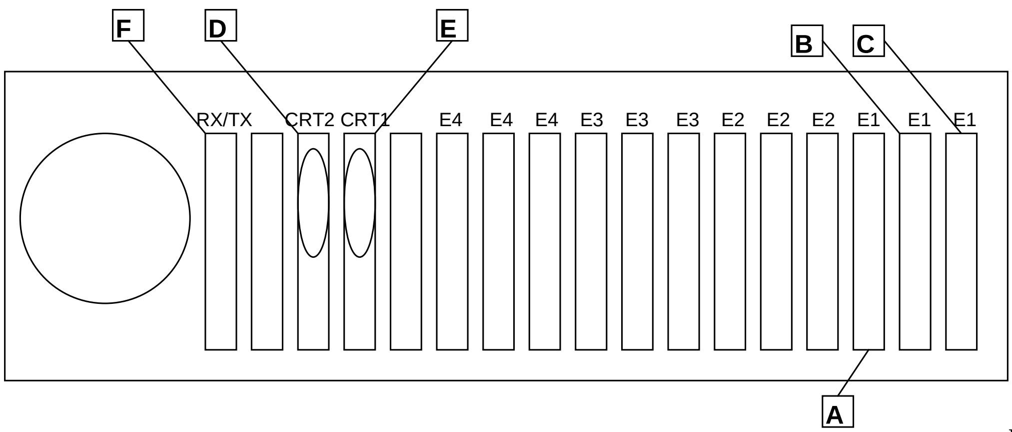


Figure 3. 60-pin Ribbon Cable for 6 bus system only
A 4 bus cable only has two connectors at the E end and
a 2 bus system has cables with only one connector at each end



Fi
gure 4. Expansion Chassis for 6 bus has the connectors grouped in three's
A 4 bus system has them grouped in pairs and a two bus system has one of each

1. At the end of the Switch Matrix Cable #1 that is not connected yet, find the 60-pin ribbon connector marked "E1". There should be one to three 60-pin connections labeled "E", depending on the number of busses in the system, on that side of the ribbon cable (Refer to **Figure 3**). There should also be the same number of slots marked "E1" on Expansion Chassis #1. Refer to **Figure 4** to determine the location of the slots. Insert the end-most 60-pin connector into the rightmost "E1" slot on Expansion Chassis #1 (location **C** in **Figure 4**). Insert the middle 60-pin connector into the middle "E1" slot (location **B** in **Figure 4**). Insert the inner 60-pin connector into the leftmost "E1" slot (location **A** in **Figure 4**). Make sure that the red edge of

Comment [-1]:

the Switch Matrix cable is facing up. Follow the same instructions for “E2”, “E3”, and so forth. Do the same for Switch Matrix cable #2 and Switch Matrix cable #3, if applicable, but insert the connectors, marked “E5” to “E8” and “E9” to “E12”, into the corresponding slots on Expansion Chassis #2 and Expansion Chassis #3. For a 4-bus system, there are only two 60-pin “E” connectors and for a 2-bus system, there is only one 60-pin “E” connector.

NOTE: The number of connectors on each cable equal the number of expansion boxes.

2. Insert the end-most 25-pin connector labeled “CRT1” (there should be three remaining 25-pin connectors on that cable for a 625-pin, 6-bus system, two connectors remaining for a 441-pin, 4-bus system, and one connector remaining for a 324-pin, 2-bus system) into the “CRT1” slot on Expansion Chassis #3 (location **E** in **Figure 4**). Insert the middle 25-pin connector labeled “CRT1” into the slot labeled “CRT1” on Expansion Chassis #2. Next insert the inner-most 25-pin connector into the slot labeled “CRT1” on Expansion Chassis #1. In the same way, insert the other 25-pin cable (with 25-pin connectors labeled “CRT2”), but into the slots labeled “CRT2” (location **D** in **Figure 4**) on each Expansion Chassis.

3. Plug the ground receptacle from each Channel Cable and 25-pin connector cable into the spade terminals found in the corners of the Expansion Chassis’ (the three ground receptacles left unconnected for each 25-pin cable should be connected to a corner in each expansion chassis).

4. Find the connectors on the Transmitter/Receiver Ribbon Cable (one side is already connected to the computer) marked “RX/TX”. There should be one to three connectors marked “RX/TX” (one for each MT chassis), left unconnected, on the same Cable. Insert the end-most “RX/TX” connector into the slot on Expansion Chassis #1 marked “RX/TX” (location **F** in **Figure 4**). Insert the middle “RX/TX” connector into the slot on Expansion Chassis #2 marked “RX/TX”. Do the same with the inner-most “RX/TX” connector, but into Expansion Chassis #3. Make sure that the red edge of the Transmitter/Receiver Ribbon Cable is facing up.

Your Hardware installation is complete.

CAUTION: TO PREVENT ELECTRICAL SHOCK, DO NOT REMOVE THE COVER OF ANY CHASSIS UNLESS AUTHORIZED BY UTI PERSONNEL.

WARNING: NO USER SERVICABLE PARTS INSIDE.
REFER ALL SERVICING TO ULTRATEST QUALIFIED PERSONNEL.

IN THE CASE THAT THE OPENING OF THE CHASSIS IS AUTHORIZED, AN INTER-LOCKING SWITCH, LOCATED IN THE FRONT-CENTER OF THE CHASSIS, WILL AUTOMATICALLY DISCONNECT POWER TO THE SWITCH MATRIX UPON REMOVAL OF THE COVER AND WILL NEED TO BE PULLED INTO ITS "ON" OR SERVICABLE POSITION TO RESTORE POWER TO THE DEVICE.

A3: Software Installation Instructions

Software installation

Your system should come with the MultiTrace System Software and all Options already installed. In the event that you need to reinstall the software, all necessary files are contained on a CDROM also included with the system. Depending on the version of your software, the installation procedure may vary. Please look for a MultiTrace installation ReadMe.txt file on your disk for more specific instructions.

There is no installation program. Installation is accomplished using drag and drop methods in the windows Explorer program. All files contained on the Basic System backup diskettes are uncompressed and are located in directories on the diskette that have the same names as the ones on your hard disk. For example if files are located in A:\WINDOWS\UTI then the files should be copied into C:\WINDOWS\UTI. After reinstalling the system you may need to run the "Verify File System" command from the Utilities Menu in Filer (from File menu in StdTrace). This will scan for jobs and categories and update the file database so that all the files can be displayed in the Filer program.