



ESD Testing System Model 9910 PinPulse™/PinScan™ Operating Manual

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I. IMPORTANT SAFETY INFORMATION

WARNING: Equipment contains High Voltage.

The equipment described in this Manual is designed and manufactured to operate within defined design limits. Any misuse may result in electric shock, damage to equipment, or fire. To prevent these unwanted events, the following rules should be observed for installation, use and maintenance. Read the following safety instructions before operating the instrument. Retain these instructions in a safe place for future reference.

POWER

POWER CORD: Use only the power cord specified for this equipment and certified for the country of use. If the power (mains) plug is replaced, follow the wiring connections specified for the country of use. When installing or removing the power plug **hold the plug, not the cord.**

The power cord provided is equipped with a United States standard **3-prong grounded plug (a plug with a third grounding pin)**. This is both a safety feature to avoid electrical shock and a requirement for correct equipment operation. Do not disable or remove the grounding pin. If the outlet to be used does not accommodate the 3- prong plug, either change the outlet or use a grounding adapter.

FUSES: The system has no replaceable fuses. Internal circuitry protects from over current situations. Protection resets automatically when the units are powered off. If the situation recurs, contact the factory.

POWER LINE VOLTAGE (MAINS): PinScan operates directly on any voltage in the range 100-240 VAC. If the line (mains) voltage is changed or isolated by an autotransformer the common terminal **must** be connected to the ground (earth) terminal of the power source.

OPERATION

CAUTION:

All equipment designed to simulate a high voltage electrostatic discharge, including the PinScan and PinPulse systems, utilizes high voltage, high frequency pulses. The basic nature of an ESD event will result in electromagnetic radiation in addition to the high level, short duration current pulse. **Therefore, personnel with a heart pacemaker must not operate the instrument or be in the vicinity while it is being used.**

DO NOT OPERATE WITH COVERS OR PANELS REMOVED. Voltages inside the units can be as high as 8kV. In addition, equipment may contain capacitors up to 200pF charged to 8kV. Capacitors can retain a charge even if the equipment is turned off.

DO NOT OPERATE WITH SUSPECTED EQUIPMENT FAILURES. If any odor or smoke becomes apparent turn off the equipment and unplug it immediately. Failure to do so may result in electrical shock, fire or permanent damage to the equipment. Contact the factory for further instructions.

DO NOT OPERATE IN WET/DAMP CONDITIONS: If water or other liquid penetrates the equipment, unplug the power cord and contact the factory for further instructions. Continuous use in this case may result in electrical shock, fire or permanent damage to the equipment.

DO NOT OPERATE IN HIGH HUMIDITY: Operating the equipment in high humidity conditions will cause deterioration in performance, system failure, or present a shock or fire hazard. Contact the factory for further instructions.

DO NOT OPERATE IN AREAS WITH HEAVY DUST: Operating the equipment in high dust conditions will cause deterioration in performance, system failure, or present a shock or fire hazard. Contact the factory for further instructions.

DO NOT OPERATE IN AN EXPLOSIVE ATMOSPHERE: Operating the equipment in the presence of flammable gases, powders, or fumes **CONSTITUTES A DEFINITE SAFETY HAZARD**. For equipment designed to operate in such environments the proper safety devices must be used such as dry air or inert gas purge, intrinsically safe barriers and/or explosion-proof enclosures.




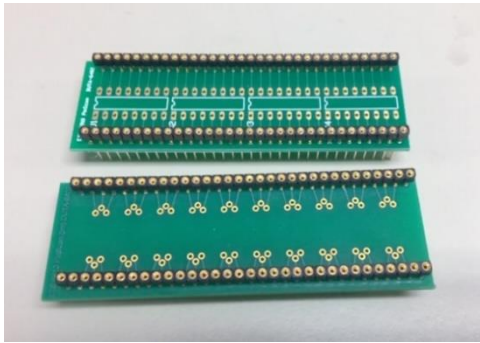
DO NOT USE IN ANY MANNER NOT SPECIFIED OR APPROVED BY THE MANUFACTURER: Unapproved use may result in damage to the equipment or present an electrical shock or fire hazard.

MAINTENANCE and SERVICE


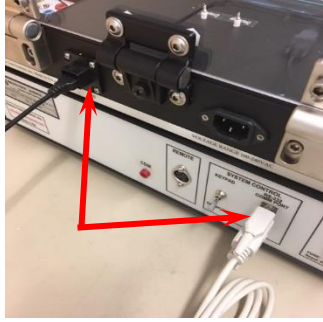


CLEANING: Keep surfaces clean and free from dust or other contaminants. Such contaminants can have an adverse effect on system performance or result in electrical shock or fire. To clean, use a damp cloth. Let dry thoroughly before use. Do not use detergent, alcohol or antistatic cleaner as these products may have an adverse effect on system performance.

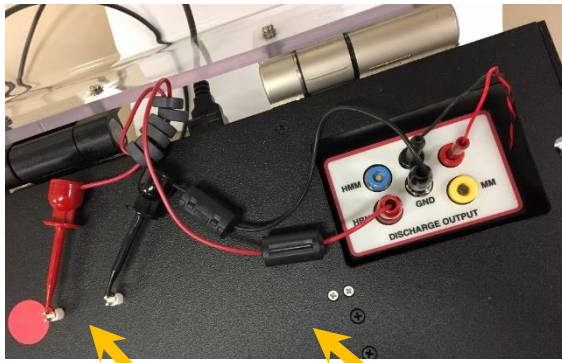
SERVICE: Do not attempt to repair or service the instrument yourself unless instructed by the factory to do so. Opening or removing the covers may expose you to high voltages, charged capacitors, electric shock and other hazards. Opening or removing the covers without authorization voids the warranty on the system. If service or repair is required, contact the factory.

II. DESCRIPTION OF CONTENTS

	<p>1. The ETS PinScan consists of an automation system mated with the ETS 9910 PinPulse discharge simulator. A testing deck at the top mounts devices to be tested and an acrylic safety cover encloses the test area.</p>
	<p>2. A laptop PC computer pre-loaded with windows-10 and the necessary PinScan Test Manager software loaded and operational. The PC has a standard AC (100-240 VAC) power supply with power cord.</p>
	<p>3. Cabling kit includes (1.) Two standard US power cables, (2.) a USB-A to USB-A cable to attach PinScan to the computer, (3.) a USB-A to DB-9 cable to attach the PinPulse 9910 to the computer, (4.) a set of HV jumper cables for HBM, HMM, and MM models (6 cables) with a cable data sheet.</p>
	<p>4. Adapter kit includes (1.) Adapter 6402, designed for up to four 16-pin DIP packages, (2.) Adapter 6403, designed to mount up to twenty 2- or 3-pin devices, (3.) Adapter data sheets.</p>

III. SETUP GUIDE

	<p>STEP 1:</p> <p>Set up the system on a clean well-illuminated work area.</p>
	<p>STEP 2:</p> <p>Plug in the 2 USB cables. One cable is a USB Type A –to- RS232 (DB9) cable which connects the 9910 (lower) electronics to the computer. The other cable is a USB Type A –to- USB Type A cable which connects the PinScan transport (upper) electronics to the computer. IMPORTANT: Switch the PinPulse rear panel switch to “COMPUTER”.</p>
	<p>STEP 3:</p> <p>Plug in the 2 AC power cords. Standard USA 110VAC cable is included. Plug into a grounded 110VAC receptacle.</p>
	<p>STEP 4:</p> <p>Switch on PinScan - red and green panel lights will illuminate.</p> <p>Switch on PinPulse - the display will illuminate.</p>

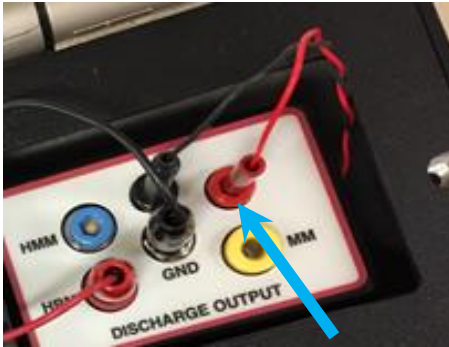


Discharge
Connections

PinScan Deck

STEP 5:

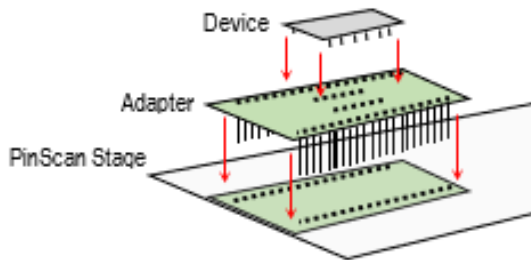
Attach the discharge cables. Choose the pair of cables for the discharge model you are using: HBM, HMM, or MM. Attach the ground cable from the GND (silver) banana jack on the PinPulse tower to the right-hand clip-on ground terminal on the PinScan Deck. Plug the positive cable into the labeled color-coded banana jack on the PinPulse tower, (HBM, HMM, or MM) and attach to the left hand clip-on discharge terminal (marked with a red dot) on the PinScan deck.



Curve Trace
Connections

STEP 6:

Verify the attachment of the curve trace cables. The Red/Black twisted pair of cables with smaller pin-plugs connects to the small red and black jacks on the PinPulse connection panel. Attach the black wire to the black Ground pin-jack. Attach the red cable to the red CT pin-jack.



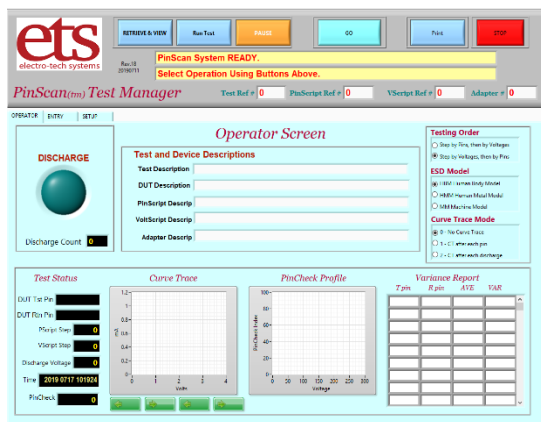
STEP 7:

Note the Adapter board's 4-digit number. Verify that it matches the Device to be tested. Plug the Device into the Adapter. Plug Device and Adapter Board into PinScan's 128-pin Stage. For the details of Adapters, see the section titled "The ADAPTER BOARD" below.



STEP 8:

Start the computer. Verify that the PC desktop has an icon named "PinScan Test Manager", and verify there is a folder on C:-drive named "ETS". These items are pre-installed on the computer shipped with the system.



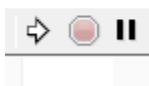
STEP 9:

Click on the PinScan Test Manager icon . The Operator Screen will open as shown with operating buttons across the top of the window. The yellow highlighted instruction fields are important – they display status updates and requests for operator action.

Program Running:



Program Stopped:



(Program Control):

The Test Manager will indicate the running condition by the appearance of a black arrow at the upper left.

The program may be stopped using the red button, or paused using the “||” icon. If the program is stopped it will show a white arrow as shown. It may be re-started by clicking on the arrow.



(Navigation):

The system has three front panel screens: Operator, Entry, and Setup. In most cases the screens are automatically switched, but if a different screen is needed, use the tabs above the DISCHARGE indicator.

IV. QUICK START GUIDE

After setting up the system as described above, PinScan is ready to operate. This section covers the steps necessary to create a quick no-frills test, without considering options or customization. The quick start process is as follows:

START PROCEDURE:

- After launching the PinScan Test Manager, the yellow banner will display “PinScan System READY” indicating that PinScan is in the “Ready Mode”.

ets
electro-tech systems

Rev:18
20190711

PinScan System READY.
Select Operation Using Buttons Above.

PinScan_(tm) Test Manager Test Ref # 1498 PinScript Ref # 7001 VScript Ref # 7001 Adapter # 6400

OPERATOR ENTRY SETUP

Operator Screen

DISCHARGE

Discharge Count 0

Test and Device Descriptions

Test Description
DUT Description
PinScript Descip Short PS 5-Pins for testing
VoltScript Descip 2 zaps 200-300v
Adapter Descip Direct 128-pin adapter

Testing Order

☐ Step by Pins, then by Voltages
☒ Step by Voltages, then by Pins

ESD Model

☒ HBM Human Body Model
☐ HMM Human Metal Model
☐ MM Machine Model

Curve Trace Mode

☐ 0 - No Curve Trace
☐ 1 - CT after each pin
☒ 2 - CT after each discharge

Test Status

DUT Tst Pin 128
DUT Rtn Pin 127
PScript Step 0
VScript Step 1
Discharge Voltage 0
Time 2019 0717 142543
PinCheck 39.789

Curve Trace

PinCheck Profile

Variance Report

T pin	R pin	AVE	VAR
1	2	40.04233	0.000856
63	64	39.96000	0.000012
128	127	39.79166	0.000005
98	97	39.78433	0.000005
31	32	39.40966	0.000001

- The system is controlled by the buttons across the top of the window. The first 2 buttons allow selection of viewing a previous test (“REVIEW & VIEW”) or creating and running a new test (“RUN TEST”). The “GO” button is the global control indicating that the operator approves, and the system will move ahead to the next step. The “Print” button sends an image of the entire operator screen to the current default printer. The “STOP” button halts the setup or testing process.

- The first time the system is run, a check of the COM ports is recommended. The PC is shipped with the COM ports properly configured, however this is not completely dependable in the windows environment. See Appendix B for COM Port Setup.
- Click on the **RUN TEST** button to create a new test. PinScan will create a new number for your test, a 4-digit sequential number.
- If this is the first time the system is run after a power up, it will do a brief electrical check. It will ask you to Click on GO to confirm that the Green light on the front Panel of PinScan is illuminated. If Green is not illuminated or Red is illuminated, see Appendix B for COM port setup, then return to this section to re-check for Green.
- Internal automation and alignment will then be checked. This will take several minutes.
- Once alignment is complete, PinScan will ask you to click on GO to start the test.

PinScan always loads the most recent test and its PinScript, Voltage Script, and PinMap as a starting point. For this quick start, use the scripts as loaded. Later when you are designing tests, you can make changes using the keyboard, load in different scripts from C:ETS, or create custom scripts. Details of all the scripts can be found in section V.

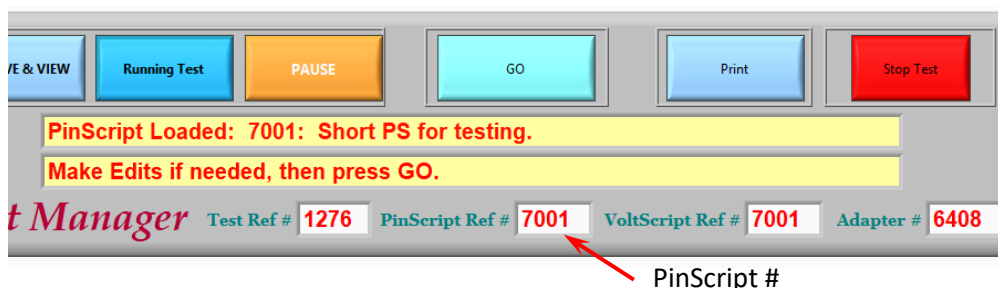
4.1. CONFIRM ADAPTER AND PINMAP FILE



Connection to the device to be tested is provided by the Adapter, a printed circuit board, and the PinMap, a file which lists the pin locations. An Adapter # will be shown on the screen identifying the Adapter and PinMap loaded. Click on GO to accept this adapter number.

4.2. CONFIRM THE PINSCRIPT

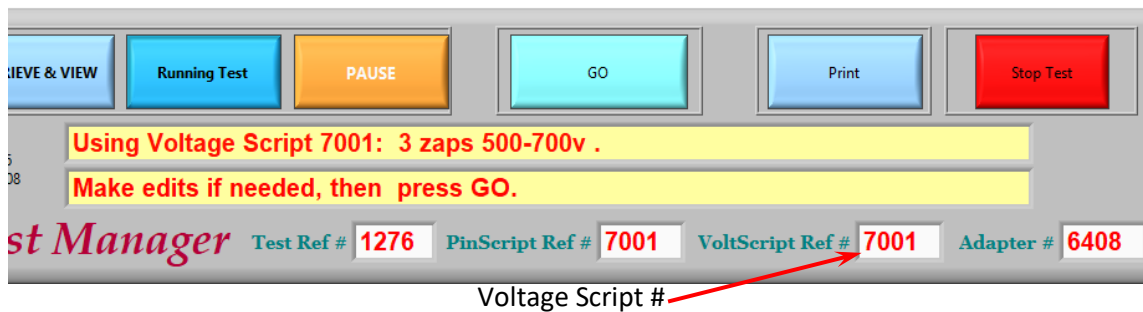
The PinScript is the main list of instructions to PinScan describing a test. It specifies the pin combinations to be tested.



The system will have a PinScript loaded and ready to run and its number will appear in the PinScript Ref# field. (7001 as shown in the example above). Click on GO to accept this PinScript.

4.3. CONFIRM THE VOLTAGE SCRIPT

For each pin pair in the PinScript, a sequence of discharge pulses will be applied, at specific voltages listed in the Voltage Script. (A.K.A. “VScript”)

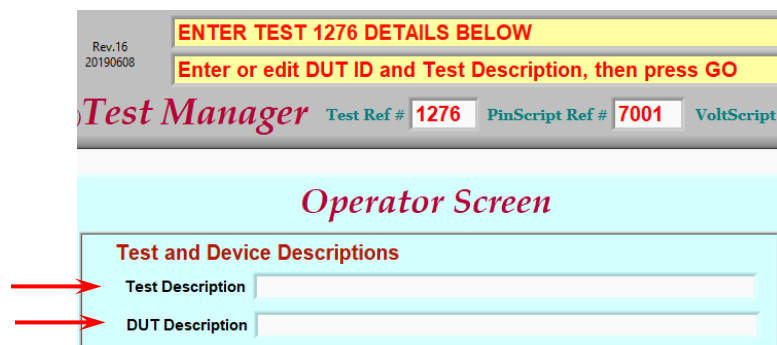


The screenshot shows the Test Manager interface. At the top, there are buttons: 'REVIEW & VIEW', 'Running Test', 'PAUSE', 'GO', 'Print', and 'Stop Test'. Below these buttons, there are two yellow instruction boxes: 'Using Voltage Script 7001: 3 zaps 500-700v .' and 'Make edits if needed, then press GO.'. Below the instructions, there are fields for 'Test Ref # 1276', 'PinScript Ref # 7001', 'VoltScript Ref # 7001', and 'Adapter # 6408'. A red arrow points to the 'VoltScript Ref # 7001' field, with the text 'Voltage Script #' written below it.

The system will have a Voltage Script loaded and ready to run and its number will appear in the VScript Ref# field. (7001 as shown in the example above). Click on GO to accept this Voltage script.

4.4. ENTER THE TEST AND DEVICE DESCRIPTIONS

The Test Description field and the Device Description field are free-form fields.



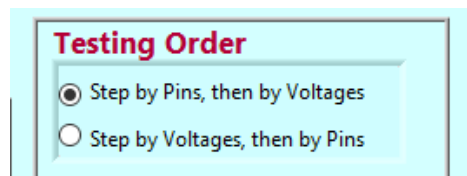
The screenshot shows the Test Manager interface. At the top, there are buttons: 'REVIEW & VIEW', 'Running Test', 'PAUSE', 'GO', 'Print', and 'Stop Test'. Below these buttons, there are two yellow instruction boxes: 'ENTER TEST 1276 DETAILS BELOW' and 'Enter or edit DUT ID and Test Description, then press GO'. Below the instructions, there are fields for 'Test Ref # 1276', 'PinScript Ref # 7001', and 'VoltScript Ref # 7001'. Below these fields, there is a section titled 'Operator Screen' with a sub-section titled 'Test and Device Descriptions'. This section contains two text input fields: 'Test Description' and 'DUT Description'. Two red arrows point to these fields.

For this quick-start run, leave these fields blank and click on GO to accept.

Next are the testing options shown at the right of the screen:

4.5. SELECT THE TESTING ORDER

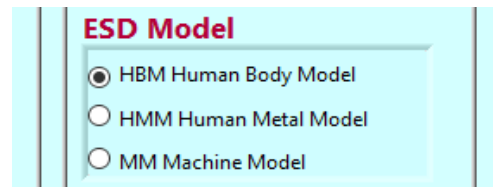
Leave this option as-is:



The screenshot shows the 'Testing Order' selection screen. It has two radio button options: 'Step by Pins, then by Voltages' (which is selected) and 'Step by Voltages, then by Pins'.

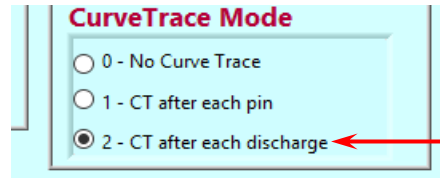
4.6. SELECT THE ESD MODEL

Leave this model as-is:



4.7. SELECT THE CURVE TRACE OPTION

Click on Option 2 – CT after each discharge:



Accept these 3 options by clicking GO.

4.8 RUN THE TEST.

The system is now ready to begin the test. Click GO

*** TESTING BEGINS ***

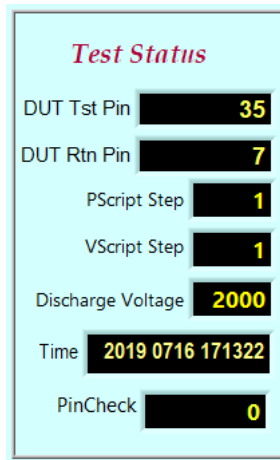
PinScan starts the following sequence of actions:

- The PinScan transport will move to the first pin pair specified by the PinScript.
- The first activity for each pin pair will be to perform an initial Curve Trace as the “before” or baseline trace for the pin pair. This will be displayed as a zero-voltage curve.
- PinPulse 9910 will display on its front panel the first Voltage in the Voltage Script, and the system will perform a discharge at this Voltage.
- The after-discharge Curve Trace will be performed.
- PinScan will step to the next pin-pair and voltage, as instructed by the scripts.
- Once all voltages and pin pairs have been completed, the PinScan Test Manager will return to READY status.

4.9 MONITORING THE TEST

As PinScan follows the sequence dictated by the scripts. The Test and Return Pin numbers can be viewed during the test at the lower left Test Status section of the screen, as shown below. The PinScript and Voltage Script step numbers are shown. Also displayed are the present discharge voltage, the time stamp, and the computed PinCheck number for the last Curve Trace. Consult the PinScan Operating Manual for a full description of PinCheck numbers.

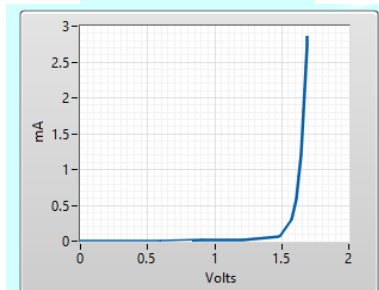
Live test status display:



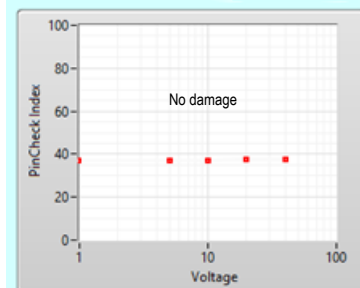
NOTE: The following Curve Trace and PinCheck displays only apply if Curve Tracing is active.

- To the right of the Test Status area is the Curve Trace chart. If curve tracing is selected, a plot will appear here of current vs. voltage for the pin pair presently addressed. A typical diode characteristic is shown at the right.
- An index number which we call PinCheck is computed for each curve trace. PinCheck is a sensitive indicator of any change in the waveform. If the PinCheck number remains nearly constant during the discharges to a pin, then chances are no damage occurred.
- The PinCheck Profile chart shown at right shows this, plotting successive PinCheck numbers across the graph. If this plot is a straight line as shown in the first graph, no ESD damage is indicated. A change in the PinCheck numbers as shown in the second graph, indicates something changed in the circuit.

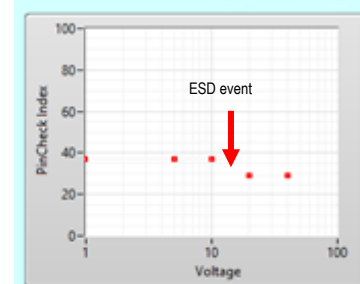
Curve Trace



PinCheck Profile



PinCheck Profile



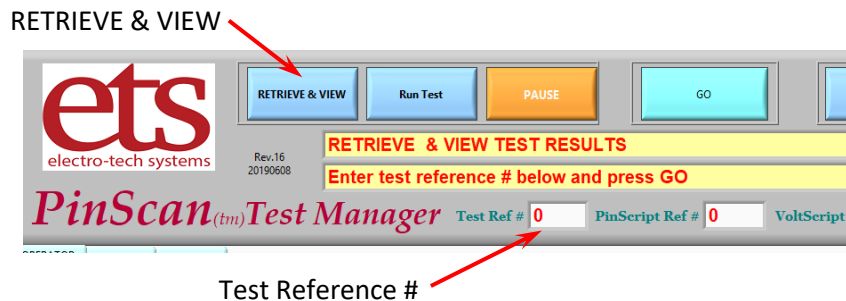
- PinScan computes the variance of the PinCheck numbers for each pin, for an indication of how constant the traces are across all the discharges. Then the results are shown in the Variance Report. This is sorted by variance, so any problem pins as indicated by a high variance show up at the start of the list. This chart is updated live when the testing order is Stepping by voltages. If the order is Stepping by pins, then this chart is completed at the end of the test.

Variance Report

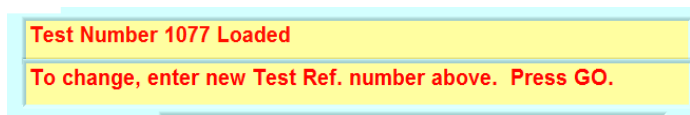
T pin	R pin	AVE	VAR
1	2	37.326	0.000555
1	2	37.318	0.000507
4	5	37.305	0.000468
4	5	37.296	0.000136
7	8	37.302	0.000105
7	8	37.308	9E-6
0	0	0	0

4.10 Viewing a Completed Test.

Click on the RETRIEVE & VIEW button. The following dialog will begin:

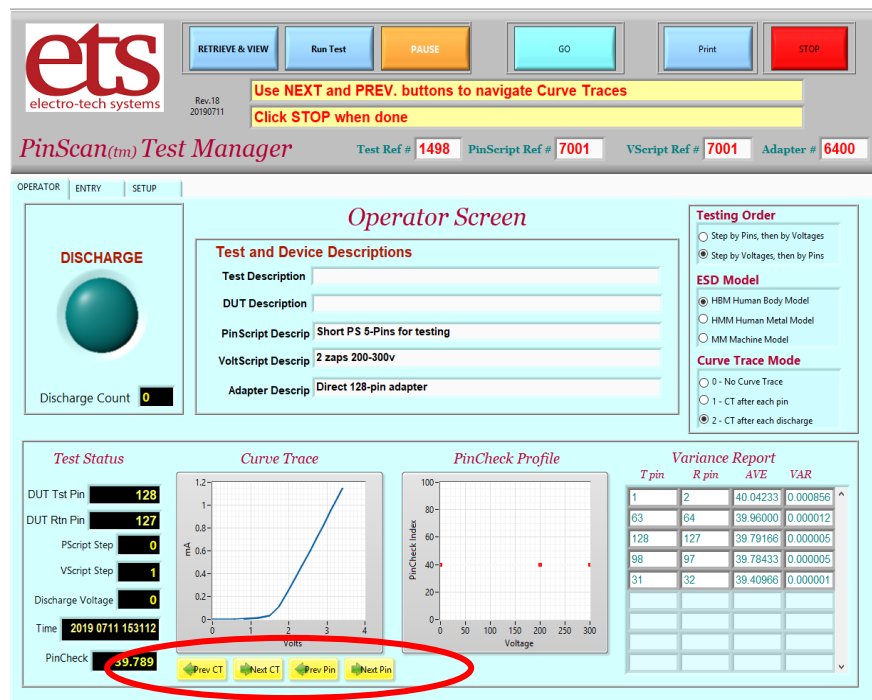


Enter the number in the Test Ref # field for the test you wish to view, and click on GO. If you just ran a test, the number will already be present – just click on GO:



Check to make sure this is the correct test number, and click on GO to confirm. The first step of the requested test will be displayed.

Four yellow buttons will be activated: Next CT and Prev CT for individual navigation among the curve traces, and Next Pin and Prev Pin for navigation by device pin.



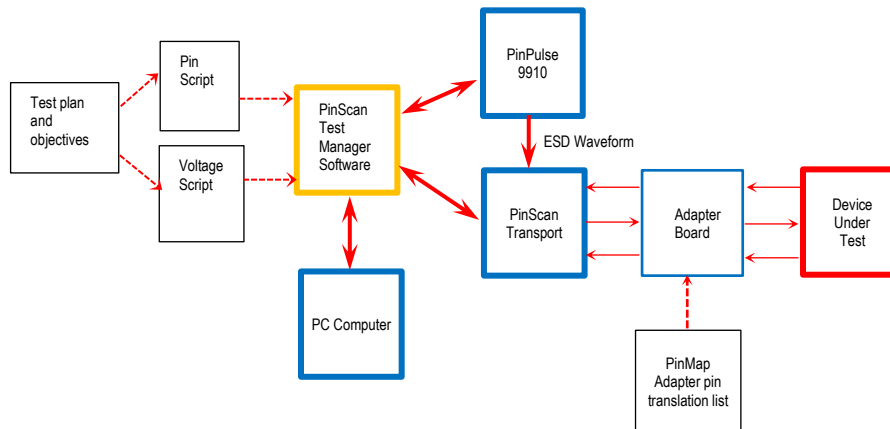
- Click on “Next CT” to step to the next curve trace,
- Click on “Prev CT” to step back to the previous curve trace.
- Click on “Next Pin” to step ahead to the following pin,
- Click on “Prev Pin” to step back to the previous pin.

Click on “STOP” to leave the View Test area, or “PRINT” to produce a copy of the present screen on your printer.

V. OPERATION GUIDE

5.1. Organization of the System

An organization block diagram of PinScan ESD testing is shown below.



The first step is to formulate a Test Plan and the objectives of the test, and this will dictate the Voltage ranges and pin combinations to be examined. The system can address any pair of pins on the device, and can apply discharge waveforms in the order desired.

5.2 PinPulse

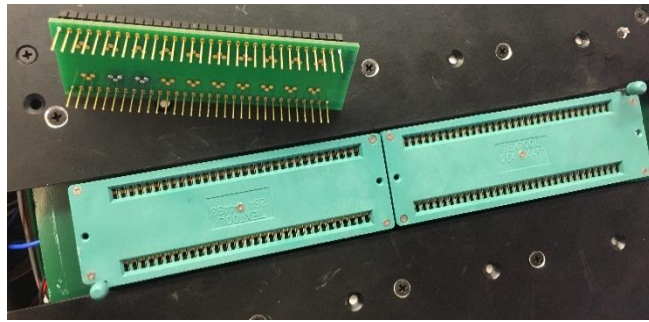
The 9910 PinPulse plays a crucial part in the operation of PinScan. It accepts commands from the Test Manager software and creates precision ESD discharges with the requested waveform and discharge Voltage. The PinPulse device can also be used independently as a manual tester (without PinScan automation) and full instructions are included in the PinPulse Operating Manual.

The Test Manager instructs PinScan automation to make electrical connection to the two requested pins, then the Test Manager instructs PinPulse to create the required discharge.

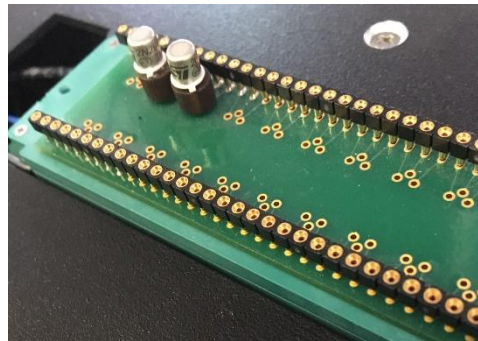
5.3 The Adapter Board

At the right of the diagram is the user's Device with its own unique package shape and pin designations. The device or devices have to connect to PinScan's 128 pins arranged in 2 rows of 64. In order to physically plug or connect to PinScan's testing stage, a PC board adapter is used. The adapter board has up to 128 pins and fits the zero-insertion-force sockets on the PinScan transport. Board traces route the device pins to the adapter pins.

Adapter boards are specific to the device to be tested, and are available from 3 sources: (1.) A catalog of basic adapters is available from ETS, (2.) New adapters may be designed by ETS to match the Device, and (3.) ETS provides PCB design artwork enabling a user to create a custom adapter. A 64-pin adapter is shown below, alongside the PinScan stage with its 128 pin connector.



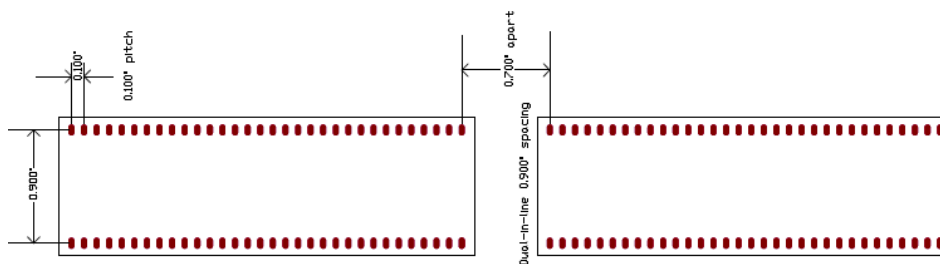
The Adapter board plugs into the PinScan Stage. This makes all of the Device pins accessible to PinScan for testing. The picture below shows an Adapter board mounted on the left half of the PinScan Stage. This is a 64 pin Adapter board and two simple 3-lead components are mounted on it.



Adapter boards can be configured to handle a single large device or multiple smaller components with a total of up to 128 leads.

ETS maintains a catalog of common adapter designs, and is happy to generate adapters for any new component for a reasonable cost. The Gerber files for the adapter board design are available to permit design of adapters by the user.

Dimensions of the connectors on the PinScan transport deck are as follows:



5.4 The PinMap

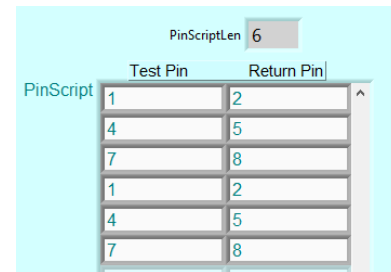
The pin designations assigned to the device by the user are the master set of designations used for all reporting and screen display, however PinScan internally uses pin numbers 1 through 128. This means a translation is necessary.

PinScan uses a list which associates the user's device pin numbers with the PinScan testing stage pin numbers. This list is known as the PinMap file and is kept in the C:\ETS\ folder with a name that includes the adapter number, for example ETS9910AS6408.txt for adapter # 6408. The operator should not have to work directly with this file – It is created along with the design of an adapter board. Details of the file may be found in Appendix A.

5.5 The PinScript

The PinScript is the main script which specifies the testing sequence. This is a list of the Test Pin / Ground Pin pairs for each step of the test.

The PinScript can be edited on screen. The Script Entry screen shows the present PinScript. Use the slider at the right of the list to navigate up and down:



The screenshot shows a software interface for editing a PinScript. At the top, there is a label 'PinScriptLen' followed by a value of '6' in a box. Below this is a table with two columns: 'Test Pin' and 'Return Pin'. The table contains six rows of data. To the left of the table is a vertical label 'PinScript'. To the right of the table is a vertical slider control with an upward-pointing arrow at the top.

Test Pin	Return Pin
1	2
4	5
7	8
1	2
4	5
7	8

To change the script, simply use the mouse cursor and keyboard to edit the pin numbers. New steps can be added to the test by adding the pin numbers at the end of the list. You will see the length of the list increase.

The script can be shortened by placing a 0 after the final desired location. This and subsequent steps will not be performed, and the length of the list will decrease accordingly.

The PinScript is identified by its 4-digit PinScript number, and saved in a file on C:\ETS with the name ETS9910PSxxxx.TXT ("xxxx" denotes the PinScript number.) This text file is easily ported into excel or edited directly using notepad, word, or a similar text editor.

CAUTION: When the PinScript is edited, take note of the PinScript number. If the PinScript file is saved without changing the PinScript Ref#, the file on disk will be replaced. To create a new script, change the PinScript Ref# to a new number before saving. It is recommended when editing an existing PinScript file using a text editor, open the original file and immediately SAVE AS to the new file name, in the format ETS9910PSxxxx.TXT .

Care must be taken to follow the file format as shown below. The delimiter is a TAB character which is easier to work with if you use a ¶ option in your editor to make tab characters visible.

The first record of this file is:

```
"ETS9910PS" <TAB> #-of-steps <TAB> description <RETN>
```

The following records each contain a pair of numbers representing a connection to device pins:

```
TestPin# <TAB> ReturnPin# <RETN>.
```

Example: ETS9910PS <TAB> 25 <TAB> Test#5 for modem 3324-hx <RETN>
 1 <TAB> 2 <RETN>
 3 <TAB> 2 <RETN>
 7 <TAB> 2 <RETN> etc. – 25 pairs.

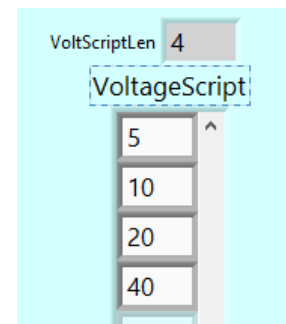
Remember to verify that the “#-of-steps” parameter in the first record agrees with the script length.

5.6 The Voltage Script

Each time PinScan connects to a pair of pins, it consults the Voltage Script (a.k.a. VScript) to determine the voltage necessary for discharges. The VScript is a list of the voltage levels to be applied to each pair of pins. PinScan will accept Voltage numbers up to 8000, however anything outside the stated range for the present model (MM: 1,000V and HMM: 5,000V) will be limited to the maximum for the range.

On the Script Entry screen, the present Voltage Script is displayed. Use the slider at the right of the list to navigate up and down.

To change the script, simply use the cursor and keyboard to edit the voltage numbers. New steps can be added to the test by adding the voltage numbers at the end of the list. You will see the length of the list increase.



The script can be shortened by placing a zero after the desired last entry. This and subsequent steps will not be performed, and the length of the list will decrease accordingly.

The Voltage Script is identified by a 4-digit VScript number, and saved in a file on C:\ETS with the name ETS9910VSxxxx.TXT (“xxxx” denotes the VScript number.) This text file is easily ported into excel or edited directly using notepad or a similar text editor.

CAUTION: When the VScript is edited, take note of the VScript number. If the VScript is saved without changing the VScript Ref#, the file on disk will be replaced. To create a new script, change the VScript Ref# to a new number before saving. It is recommended when editing an existing PinScript file using a text editor, open the original file and immediately SAVE AS to the new file name, in the format ETS9910VSxxxx.TXT.

Care must be taken to follow the file format as shown below. The delimiter is a TAB character which is easier to work with if you use a ¶ option in your editor to make tab characters visible.

The first record of this file is:

```
“ETS9910VS” <TAB> #-of-steps <TAB> description <RETN>
```

The second record contains a list of numbers representing voltages to be applied during the test:

```
Voltage# <TAB> Voltage# <TAB> Voltage# <TAB> Voltage# ..... <TAB> Voltage#  
<RETN>.
```

Example: ETS9910VS <TAB> 5 <TAB> Low voltage sweep 50-90 <RETN>

```
50 <TAB> 60 <TAB> 70 <TAB> 80 <TAB> 90 <RETN>
```

Remember to verify that the “#-of-steps” parameter in the first record agrees with the script length.

5.7 Testing Order

The operator can choose one of two test methods, depending on the objective of the test:

(1.) Sequence by voltages, then by pins: Connects to a pin pair, then applies all scripted voltages, then step to the next pin, etc. This allows monitoring for ESD damage live during the test and enables identification of the exact discharge voltage which caused the problem.

(2.) Sequence by pins, then by voltages: PinScan selects a voltage, then sequences through the entire PinScript, then selects the next voltage, etc. This method supports verification of a device at a particular voltage, for example “HBM Class 1A” requires that all device pins can withstand a 500V discharge.

5.8 The ESD Model

PinScan utilizes the acclaimed versatility of the 9910 PinPulse to deliver a choice of the 3 major discharge simulation models in use in the industry: HBM (0 to 8kV), MM (0 to 1kV), and HMM (0 to 5kV). PinScan comes complete with 3 sets of color-coded HV discharge cables for these 3 models. When the ESD Model is selected at the start of the test, install the matching set of HV cables.

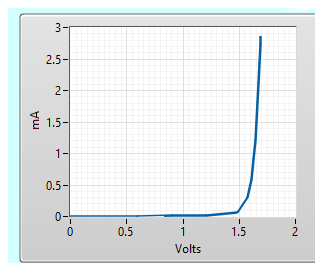
5.9 Curve Trace

Curve trace is an optional feature which provides a check for ESD damage during the test. A Current-vs-Voltage plot is created by sweeping the Voltage across the pin pair from 0.0V to 5.0V. The resulting current is measured and plotted against the applied voltage. Current is limited to 5 mA.

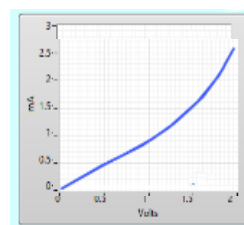
For a typical part such as a diode, a plot will be produced which is similar to the one at right. This is the characteristic curve trace of the circuit and it is a good predictor of condition of the circuit. Any damage to the part is likely to change the curve, as shown in the two smaller plots.

Curve trace can be disabled by selecting No Curve Trace, providing somewhat faster testing. This would be selected in the case that PinScan is utilized only to apply the discharges, then the device is tested by different equipment to verify functionality. If curve trace is active, PinScan interleaves discharges and I/V testing as follows.

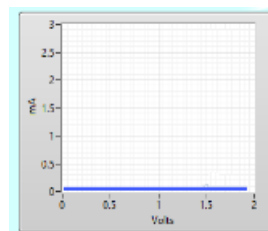
When Curve Trace is enabled, then for each pin pair, one initial curve trace is performed before testing to establish the starting condition of the circuit. Then depending on the Curve Trace Option selected, additional plots are done after each discharge, or after the series of discharges is complete for the pin pair. For example, in a test consisting of 3 discharges at each pin pair, the Curve Trace options select the following sequences:



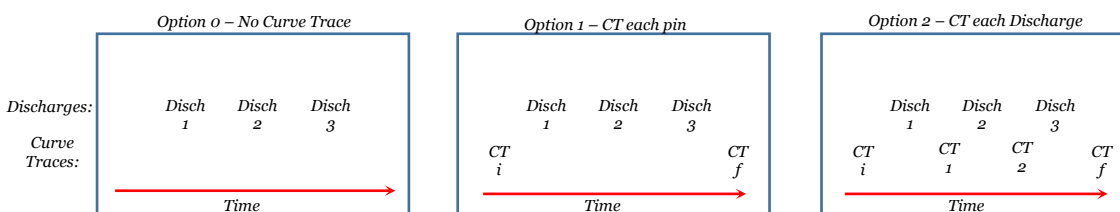
Diode Curve Trace



Increased leakage



Open Circuit



- Option 0 provides the fastest test time, and provides a time-stamped log of all discharges applied to the part.
- Option 1 gives the capability to determine if any of the discharges has caused damage to a pin pair.
- Option 2 will enable determination of which discharge caused the damage.

Each curve trace shows the condition of the device, and any change in the curve shape is likely to be an indication that damage has occurred. Historical practice is to visually compare the curve traces, looking for any change. The human eye is good at this, however the number of curves which must be viewed and evaluated gets very large with today's components, and it becomes an arduous and error-prone task to completely evaluate an IC. To address these points, ETS introduces PinCheck.

There may be modes of ESD damage which do not present as a change in the curve. PinScan cannot check functional operation of the device, so functional testing should be arranged in conjunction with PinScan testing.

5.10 PinCheck

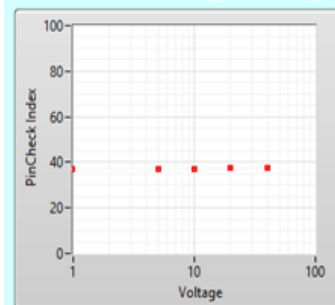
PinScan provides a special feature to streamline the evaluation process: **PinCheck**. This is an innovative feature which saves time by automating the comparison process. Each time a curve trace is performed, a characterization number, the PinCheck number, is generated based on the shape of the curve. As long as the circuit is unchanged, the PinCheck numbers will be very close. If after applying the requested sequence of Voltages to a pin, the PinCheck numbers for all discharges have remained constant, then a failure is unlikely.

After each curve trace, the PinCheck number is plotted as a point on the PinCheck Profile plot shown at right. The X coordinate indicates the discharge voltage applied. The Y coordinate indicates the computed PinCheck number. An initial curve trace is performed before any voltage is applied – this PinCheck number is plotted at the left edge of the graph.

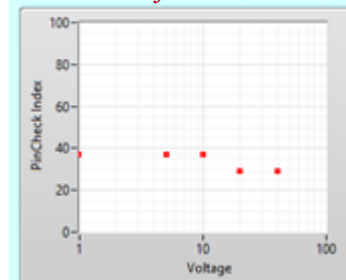
This is a quick visual check of the test sequence for the pin. If no ESD damage occurs, the PinCheck numbers will be very close, and a straight horizontal line plot will be created.

Any deviation of the curve trace during discharges to a pin pair indicates a likely ESD event. This will be visible as a shift in the computed PinCheck number, and a change in the value clearly denotes a change in the circuit. This shows up on the PinCheck profile plot as an increase or decrease as shown at right. This graph is denoting a circuit change after the 10V discharge.

PinChk Profile



PinChk Profile



5.11 The PinCheck Variance Report

When the discharges to a pin pair are completed, the mean and variance of the sequence of PinCheck numbers is computed. Variance is the customary method for measuring constancy and typically is 10^{-3} or less for PinCheck readings of an undamaged pin pair. If a change occurs during discharges to a pin pair, the variance will be much higher, clearly identifying the event.

The PinCheck Variance report shows the number of the Test pin and the Return pin, and the mean and variance computed for all of the discharges applied to the pin pair.

One line is present for each step of the PinScript. The results are sorted by variance to bring any high-variance pins to the top of the list. This avoids the necessity to visually scan through hundreds of graphs to identify an anomaly. Curve trace plots are still available for a detailed look at the results.

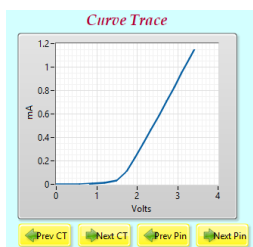
The Pin Report display includes a navigation bar at the right side to enable scanning up and down the report.

Variance Report			
<u>Tpin</u>	<u>Rpin</u>	<u>AVE</u>	<u>VAR</u>
1	2	37.326	0.000555
1	2	37.318	0.000507
4	5	37.305	0.000468
4	5	37.296	0.000136
7	8	37.302	0.000105
7	8	37.308	9E-6
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0

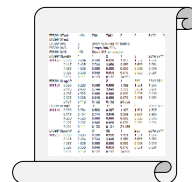
5.11 Viewing Test Results

When the test is complete, the results may be viewed in two ways:

1. On-screen view and plot - See section 4.10



2. Reports saved on C:ETS See below



Each test creates 4 new files in the folder C:\ETS\:. See Appendix A for the detailed file formats.

- Test detail file: “ETS9910Testxxxx.txt” (“xxxx” denotes the Test Reference number.)
- The Sequential PinCheck file: “ETS9910CKxxxx.txt” (“xxxx” denotes the Test Reference number.)
- The Sorted PinCheck file: “ETS9910CKSxxxx.txt” (“xxxx” denotes the Test Reference number.)
- The PinScript file if changed: “ETS9910PSxxxx.txt” (“xxxx” denotes the PinScript number.)
- The Voltage Script file if changed: “ETS9910VSxxxx.txt” (“xxxx” denotes the VScript number.)
- The PinScan Setup file: “ETS9910Setup.txt”. Each test run also updates the setup file.

When the test is complete, files are closed.

5.12 The Test Log file

As the test is conducted, a detailed test log is generated and saved as ETS9910Testxxxx.txt. This provides a complete listing of all discharges applied to the part, including a time stamp and voltage indication. This file will contain a record for each discharge showing the voltage and the time of the event, and curve trace data if selected.

The following is a sample test file with Curve Trace switched off:

ETS9910Test	1145	2145	3145	0	0	6408
ETS9910Test	Low V scan for diodes LED PN 7756-3243					
ETS9910PS	6	3 LEDs isolated				
ETS9910VS	4	Low V detail 5-40V 4 steps				
ETS9910AS	64	Direct 64-pin adapter				
ETS9910Log	1	1	2	1	5	2017 0708 120831
ETS9910Log	1	1	2	2	10	2017 0708 120836
ETS9910Log	1	1	2	3	20	2017 0708 120840
ETS9910Log	1	1	2	4	40	2017 0708 120846
ETS9910Log	2	4	5	1	5	2017 0708 120855
ETS9910Log	2	4	5	2	10	2017 0708 120900
ETS9910Log	2	4	5	3	20	2017 0708 120904
ETS9910Log	2	4	5	4	40	2017 0708 120910
ETS9910Log	3	7	8	1	5	2017 0708 120920
ETS9910Log	3	7	8	2	10	2017 0708 120924
ETS9910Log	3	7	8	3	20	2017 0708 120928
ETS9910Log	3	7	8	4	40	2017 0708 120934

The initial record contains the test reference number (1145), the PinScript reference number (2145), the Voltage script reference number (3145), the curve trace mode (0 indicates no curve trace), the ESD model (0 = HBM), and the adapter in use (6408). The second record contains the description entered for the test, and the description of the device under test. The third record identifies the PinScript file, showing length and description. The fourth record identifies the Voltage script in use, showing length and description.

Each Log entry includes:

1. Record identification "ETS9910Log"
2. The PinScript step number
3. The device test pin
4. The device return pin
5. The Voltage Script step number
6. The discharge voltage
7. Time stamp in the form YYYY MMDD HHMMSS
8. If Curve Trace is active, 32 data points
9. If Curve Trace is active, the Pin Check evaluation number

Log records containing curve trace information each contain 40 items separated by the <tab> character. Log records which do not contain curve trace information contain 7 items separated by the <tab> character.

The following is a sample test file with Curve Trace switched to 2 (Curve Trace at every discharge.) Notice that the first record for each pin is the curve trace before pulsing, recognizable by the voltage being 0.

```
ETS9910Test 1145 2145 3145 2 0 6408
ETS9910Test Low V scan for diodes LED PN 7756-3243
ETS9910PS 6 3 LEDs isolated
ETS9910VS 4 Low V detail 5-40V 4 steps
ETS9910AS 64 Direct 64-pin adapter
ETS9910Log 1 1 2 0 0 2017 0708 120826 0.000000 0.291000 0.596
0.907000 1.211000 1.497000 1.713000 1.920000 2.131000 2.331000 2.525
2.721000 2.913000 3.107000 3.300000 3.424000 0.000000 0.000000 0.000
0.009000 0.021000 0.056000 0.157000 0.273000 0.401000 0.524000 0.645
0.770000 0.892000 1.016000 1.140000 1.220000 37.313
ETS9910Log 1 1 2 1 5 2017 0708 120831 0.000000 0.291000 0.596
0.907000 1.211000 1.498000 1.712000 1.920000 2.131000 2.331000 2.525
2.722000 2.914000 3.108000 3.300000 3.423000 0.000000 0.000000 0.000
0.009000 0.021000 0.056000 0.156000 0.273000 0.400000 0.524000 0.645
0.769000 0.892000 1.016000 1.139000 1.219000 37.349
ETS9910Log 1 1 2 2 10 2017 0708 120836 0.000000 0.291000 0.596
0.906000 1.211000 1.497000 1.713000 1.920000 2.132000 2.331000 2.525
2.721000 2.913000 3.107000 3.300000 3.424000 0.000000 0.000000 0.000
0.009000 0.021000 0.056000 0.156000 0.273000 0.400000 0.524000 0.645
0.769000 0.892000 1.016000 1.139000 1.219000 37.349
ETS9910Log 1 1 2 3 20 2017 0708 120840 0.000000 0.291000 0.596
0.907000 1.211000 1.497000 1.713000 1.920000 2.133000 2.331000 2.525
2.722000 2.913000 3.107000 3.299000 3.424000 0.000000 0.000000 0.000
0.009000 0.020000 0.056000 0.157000 0.274000 0.400000 0.524000 0.645
0.769000 0.892000 1.016000 1.138000 1.219000 37.306
ETS9910Log 1 1 2 4 40 2017 0708 120846 0.000000 0.291000 0.596
0.907000 1.211000 1.497000 1.713000 1.920000 2.132000 2.331000 2.525
2.722000 2.914000 3.107000 3.300000 3.424000 0.000000 0.000000 0.000
0.009000 0.020000 0.056000 0.157000 0.273000 0.400000 0.524000 0.645
0.769000 0.892000 1.016000 1.139000 1.219000 37.306
```

5.13 Data Analysis and Anomaly detection

Typically, a sequence of discharges will be applied to each device pin-pair with increasing voltages, looking for the failure threshold. In order to accurately identify changes in the circuit which would indicate damage has occurred to the device, PinScan performs a Curve Trace showing the Current-vs.-Voltage characteristic at each pin-pair. Curve Trace can be scheduled before and after each pin of the device to identify the pin which was damaged, or before and after each discharge, identifying the pin and the voltage where damage occurred.

Each time a Curve Trace is performed, PinScan computes the Pin Check number. This is a characterization code number generated from the shape of the curve trace for the pin pair. As discharges are applied to a pin pair, if the PinCheck number remains constant, then a failure is unlikely. Statistics are computed, and when testing of a pin is complete, the variance of all PinCheck numbers is shown. This will typically be less than 10^{-4} for an undamaged circuit, and much higher if any change occurred. An chart of the PinCheck analysis for all pins is created during testing. Shown below is a sample PinCheck report.

ETS9910Ck PinChk Report for test # 1077. Pin Script # 2077. Voltage Script # 3077					
ETS9910Ck	Tst.Pin	Gnd.Pin	Mean	Variance	Readings.....
ETS9910Ck	1	2	44.256	0.000110	44.262,44.262,44.262,44.245,44.268,44.245
ETS9910Ck	4	5	44.258	0.000053	44.262,44.262,44.262,44.245,44.262,44.262
ETS9910Ck	7	8	44.306	0.000019	44.308,44.308,44.298,44.308,44.308,44.308
ETS9910Ck	1	2	44.253	0.000066	44.262,44.262,44.262,44.252,44.245,44.245
ETS9910Ck	4	5	44.261	0.000088	44.268,44.262,44.268,44.268,44.245,44.262
ETS9910Ck	7	8	44.298	0.000081	44.314,44.308,44.291,44.291,44.308,44.291

Once the PinCheck analysis has been applied to all the device pins, the PinCheck report is sorted by variance, to bring any high-variance pins to the top of the list. In this way, PinCheck avoids the necessity to visually scan through a long file to identify an ESD event. This Sorted PinCheck report is displayed on the screen during the test and is available as a final report as filename ETS9910CKSxxxx, (where xxxx is the test reference number).

ETS9910CKS PinChk Sorted Report for test # 1145 Pin Script # 2145 Voltage Script # 3145					
ETS9910CKS	Tst.Pin	Rtn.Pin	Mean	Variance	Readings.....
ETS9910CKS	1	2	37.325	0.000509	,37.313,37.349,37.349,37.306,37.306
ETS9910CKS	4	5	37.287	0.000357	,37.260,37.313,37.290,37.283,37.290
ETS9910CKS	1	2	37.316	0.000351	,37.306,37.313,37.306,37.349,37.306
ETS9910CKS	7	8	37.308	0.000105	,37.313,37.313,37.313,37.313,37.290
ETS9910CKS	7	8	37.308	0.000105	,37.313,37.313,37.313,37.290,37.313
ETS9910CKS	4	5	37.286	0.000013	,37.290,37.290,37.283,37.283,37.283

Once an event has been noted using this report, PinScan Test Manager can retrieve curve trace plots to reexamine the testing for the pin in question.

VI. Maintenance, Calibration, and Troubleshooting

6.1 Mechanical Verification

- The system does a self-test and verification after each power-up. This ensures accurate pin connections and low resistance paths to all pins.

6.2 Waveform Verification

- Waveform verification involves a high frequency current measurement of the discharge. The system includes a precision current probe (the universally approved CT-1 sensor). Viewing the discharge waveform requires a 1GHz (or higher) oscilloscope provided by the user which will display the verification waveforms and store them or send them from the scope to the user's computer for inclusion in reports.
- PinScan utilizes the 9910 PinPulse as a waveform source, and the procedures outlined in the 9910 manual also offer verification of the source waveform.
- Shown below are waveform verification reports for a 9910 discharge.



VII. Troubleshooting

- Make sure the Computer/Keypad on the rear panel of PinPulse is switched to Computer. PinPulse must be power cycled in order for the switch setting to take effect.
- When the system is powered up, PinPulse should display status and PinScan should illuminate both the red and the green LEDs on its front panel as shown below. If any deviation from this, power down and re-start. If the problem persists, contact ETS.



- If the PinScan Test Manager software reports an error, this most likely involves communication between PinScan, PinPulse, and the computer. Re-check the cables to verify that the USB cables are in place. Repeat the COM port setup sequence, making sure to click on “Refresh” at the end.

VIII. WARRANTY

Limited Warranties. Seller warrants that all goods manufactured and delivered hereunder shall (a) conform to any samples, drawings, specifications or other written documents provided to Seller by Buyer, or approved by Buyer to Seller and (b) be free from all defects in workmanship and material. Buyer's sole remedy against Seller for breach of either of the specifically mentioned warranty shall be the repair or replacement, at Seller's sole option, of the defective workmanship or material. Seller expressly disclaims all other warranties, express and/or implied, including but not limited to those of merchantability and fitness for a particular purpose. In no event shall Seller be liable, under either warranty or otherwise, to Buyer in excess of the purchase price of the products paid to Seller by Buyer. In no event shall Seller be liable for any loss or damage arising directly or indirectly from the use of the product or for consequential or incidental damages. Seller's specified warranties will expire and lapse (i) for renewable items (such as gloves, iris ports and desiccants), sixty (60) days from date of shipment and (ii) for all standard equipment and otherwise nonrenewable items, one year from date of shipment.

APPENDIX A – PinScan Files

PinScan™ File structure. 2019-06-14.

NOTE: __ indicates a TAB character, • indicates an example record.

A.1 SYSTEM SETUP FILES

Setup file: C:\ETS\ETS9910Setup.txt

Single record: System ID_ Test Ref#_ P.Script Ref#_ VScript Ref#_ CT Mode _ESD Model_Adapter#_Order

- ETS PinScan™ 9910 System_V16.0__1000__2000__3000__2__1__6408__1

A.2 TEST SETUP FILES

PinScript File C:\ETS\ETS9910PS2000.txt

PinScript 1st record: ETS9910PS__#Steps__Description

PinScript 2nd record: (List of [TestPin# : ReturnPin#])

- ETS9910PS_10_Low voltage 16-pin LT1091
- 2__1
- 7__1etc.

Voltage Script File C:\ETS\ETS9910VS3000.txt

VScript 1st record: ETS9910VS__#Steps__Description

VScript 2nd record: (List of voltages)

- ETS9910VS__8__LV: 20-500, minus 100
- 20__50__100__200__500__-20__-50__-100

Adapter PinMap Description File C:\ETS\ETS9910AS6408.txt

PinMap 1st record: ETS9910AS__#Steps__Description

PinMap 2nd record: (List of [DUT pin# : Adapter pin#])

- ETS9910AS_20_Description
- 1__2
- 2__4 ...etc.

A.3 TEST RESULT FILES

Test Log file: **C:\ETS\ETS9910TEST1000.txt**

Test File 1st record: Test#_Pscript#_Vscript#_CTmode_ESDmodel_Adapter#_Order

- ETS9910Test__1000__2000__3000__2__2__6408_1

Test file 2nd record: Test Descrip __Device Descrip

- ETS9910Test__500V Full Qual__Buffer I 27XQ3345 PNV

Test File 3rd record: #Pins_Description of PinScript

- ETS9910PS__18__20 pin package, DIP20

Test file 4th record: #Voltages_Description of Voltage Script

- ETS9910VS__7__50V to 500V 7 steps

Test file 5th record: # pins Description of Adapter

- ETS9910AS__20__20-pin DIP single unit test

Records 6.....N: PStep__TstPin__GndPin__VStep__Volts__Time__CT data (32)__PinCheck

- ETS9910Log_1_12_24_3_2000_20170201122303__0.00__0.11__0.13__.....__40.3
- ETS9910Log_2_13_24_3_2000_20170201122305__0.00__0.10__0.14__.....__40.2

PinCheck File **C:\ETS\ETS9910CK1000.txt**

PinCheck File 1st record: Test#_Pscript#_Vscript#

- ETS9910CK PinCheck Report for Test# 1000__PScript#_2081__VScript#_3081
- ETS9910CK Tst.Pin / Gnd.Pin / Mean / Variance / Readings...
- ETS9910CK 1 2 44.32 0.00002

PinCheck Sorted File **C:\ETS\ETS9910CKS1000.txt**

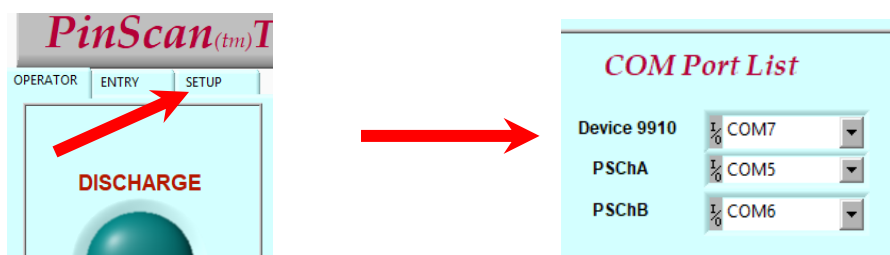
PinCheck Sorted File 1st record: Test#_Pscript#_Vscript#

- ETS9910CKS PinCheck Report for Test# 1000__PScript#_2081__VScript#_3081
- ETS9910CKS Tst.Pin / Gnd.Pin / Mean / Variance / Readings...
- ETS9910CKS 1 2 44.32 0.00002 ← NOTE: Highest variance appears 1st.

APPENDIX B – COM Port Setup

The PinScan system uses three USB/COM ports to control the electronics. PinScan and its laptop computer are shipped with the COM ports set properly so no attention from the user is necessary. If the software is set up on a different computer or if there is any conflict with the COM port numbers, follow the steps in this section.

- Find the **SETUP** tab above the Discharge indicator and click on it. You will see 3 items listed, each with a pull-down menu. These are the 3 communication channels used by PinScan.



- Pull down the menu for PSChB and you will see windows' list of available com ports as shown at right. Click on the last entry "Refresh" to update the list.
- Click on the PSChB menu again and click on the last "COM" entry on the list. In the example at right, select COM8. This assigns COM8 to PSChB.
- Now pull down the menu for PSChA and click on the next-to-last COM entry. This assigns COM7 to PSChA in our example.
- Now pull down the menu for Device 9910 and click on the 3rd-from-last COM entry. This assigns COM6 to Device 9910 in the example. You should finish with the PinScan COM port list identical to the last 3 COM items appearing on the pull-down menus.
- Pull down any one of the menus and click on the Refresh entry.
- If the "Green light" indicator test during test preparation showed Red ON and Green OFF, swap the ports for PSChA and PSChB. In this example that would assign COM8 to PSChA and COM7 to PSChB.

