Polar Instruments GmbH

GRS550 User Guide

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MAN586–1120

PRODUCT REGISTRATION

Registering your product ensures you can be kept up to date when upgrades or enhancements become available.

Please register using the form below.

To: Polar Instruments GmbH
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GRS550 serial number:	
Installed options:	
Name	
Company	
Job Title	
Address	
Post/ZIP Code	
Country	
Telephone	
Fax	
E-mail	

GRS550 with optional cart ACC225

GRS550 USER MANUAL

POLAR INSTRUMENTS GmbH

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TRADEMARKS

Declarations

European Community Directive Conformance Statement

This product conforms to all applicable EC Council Directives, including:

> EC Council Directive 89/336/EEC on the approximation of the laws of the Member States relating to electromagnetic compatibility.
>
> EC Council Directive 73/23/EEC on the harmonisation of the laws of the Member States relating to electrical equipment designed for use within certain voltage limits.

A declaration of conformity with the requirements of these Directives has been signed by:

> Polar Instruments GmbH
> Aichereben 16
> A-4865 Nussdorf
> Austria

Harmonised standards applied in order to verify compliance with these Directives:

> EN 50081-1:1992
> EN 50082-1:1992
> EN 61010-1:1993

Safety

CAUTION — HANDLING

CAUTION: Four person handling required

*Exercise caution when carrying or moving the GRS550. The GRS550 is extremely heavy (100 kg) — the GRS550 should not be moved or carried by fewer than **four** persons.*

WARNING

The LIVE and NEUTRAL lines on this unit are BOTH fused.

This unit contains no user-serviceable parts.

When the unit is connected to its supply, the opening of covers or removal of panels is likely to expose dangerous voltages. To maintain operator safety, do not operate the unit unless the enclosure is complete and securely assembled.

The unit is designed to be used with the OPERATE/ INTERLOCK OVERRIDE switch in the OPERATE position and the Perspex hood in the down position. *The INTERLOCK OVERRIDE position is for qualified service personnel only.*

DO NOT OVERRIDE THE SAFETY INTERLOCK.

The probe tip is extremely sharp — take care when fitting or removing boards.

GROUNDING

This unit must be earthed (grounded); **DO NOT** operate the instrument with the safety earth disconnected.

Ensure the instrument is connected to an outlet with an effective protective conductor terminal (earth).

DO NOT negate this protective action by using an extension cord without a protective conductor.

***Note**: This instrument is fitted with 3-wire grounding type plug designed to fit only into a grounding type power outlet.*

If a special local plug must be fitted to the power cord ensure this operation is performed by a skilled electronics technician and that the protective ground connection is maintained. The plug that is cut off from the power cord must be safely disposed of.

POWER CORD COLOUR CODES

Power cord colour codes are as follows:

Europe

brown	live
blue	neutral
green/yellow	earth (ground)

United States

black	live
white	neutral
green	ground

POWER SUPPLY

Line voltage setting

Check that the indicated line voltage setting corresponds with the local mains power supply. See the rear panel for line voltage settings.

To change the line voltage settings refer the instrument to a skilled electronics technician.

Instructions for changing the line voltage settings are contained in the Service Manual published by Polar Instruments.

GRS550 OPERATION

This document contains instructions and warnings that must be observed by the user to ensure safe operation. Operating this instrument in ways other than detailed in this manual may impair the protection provided by the instrument and may result in the instrument becoming unsafe. Retain these instructions for later use.

The unit is designed for use indoors in an electrical workshop or factory floor environment at a stable workstation comprising a bench or similar work surface. The optional custom cart ACC225 is available as accessory. ACC225 consists of a 19“ Rack for the GRS550 controller and optional system components, Monitor, Keyboard arm. Contact Polar Instruments GmbH for details.

Use only the accessories (e.g. test probes and clips) provided by Polar Instruments.

The instrument must be maintained and repaired by a skilled electronics technician in accordance with the manufacturer’s instructions.

If it is likely that the protection has been impaired the instrument must be made inoperative, secured against unintended operation and referred to qualified service personnel.

Protection may be impaired if, for example, the instrument:

- Shows signs of physical damage
- Fails to operate normally when the operating instructions are followed
- Has been stored for prolonged periods under unfavourable conditions
- Has been subjected to excessive transport stresses
- Has been exposed to rain or water or been subject to liquid spills

CAUTION

Electrical Isolation

Always disconnect the board under test from the local mains supply (including ground) before using this instrument.

Specifications

Electrical

Nodal Impedance Test Facilities

Test Ranges	Vpk	Ipk
Junction	1V	500µA
Logic	10V	5mA
Low	10V	150mA
Med	20V	1mA
High	40V	1mA
Test Frequencies		
Low	90Hz	
Medium	500Hz	
High	2kHz	
Tolerance adjustment	1 – 99%	

For electrical test specifications refer to the measurement system Operator Manual

Mechanical

Probe Head	Connected to Channel A output on rear panel
Table COM connections	4
Linear speed	190mm/second
X-Y Positioning System Accuracy	± 0.04mm over 300mm (± 0.0016” over 12”)
Resolution	0.016mm (0.0006”)
Repeatability	± 0.008mm (estimate)
Minimum pad size	0.3mm
Probing rate	5 tests/second (depending on test time & distance moved)
Probing force	6oz/170g (maximum)
Z-axis travel (Main)	100mm
Z-axis travel (Rapid)	10mm (via solenoids)
Max. flying height	100mm
Max. board size	330 x 630mm
Max. board weight	2kg
Max. probing area	330 x 450mm
Visual programming area	300 x 450mm
Interface	High-speed Ethernet

Environmental operating conditions

The instrument is designed for indoor use only under the following environmental conditions:

Altitude	Up to 2000m
Temperature	+5°C to +40°C ambient
Relative humidity	RH 80% maximum at 31°C — derate linearly to 50% at 40°C
Mains borne transients	As defined by Installation Category II (Overvoltage Category II) in IEC664
Pollution Degree	2 (IEC664)

Power Requirements

230V ± 10%, 115V ± 10% or 100V ± 10% at 50/60Hz, 250VA.

Line Fuses

Refer to the fuse values marked on the rear panel of the instrument.

Physical characteristics (excluding accessories)

Dimensions:

Width	650 mm (25.6 in.)
Depth	800 mm (31.5 in.)
Height (closed)	524 mm (20.6 in.)
Height (open)	524 mm (38 in.)
Weight	100kg (222 lb.)

Symbols

The following symbols are used in this instrument.

 CAUTION To prevent damage to this product and to ensure its safe use observe the specifications given in this manual when connecting to terminals marked with this symbol.

 COM This terminal is internally connected to earth (ground).

Accessories

Standard Accessories

Joystick lead	ACC591
Camera lead	ACC592
Test pin carrier	ACC594
Common lead	ACC198 x 2
Spring pin COM lead	ACC585 x 4
GRS550 lead (black)	ACC316
GRS550 lead (red)	ACC317
GRS550 to PC cable	ACC502
Test pin (pack of 25)	ACC505
Calibration compound	MPA192
Joystick + interface cable	ACC593
Grease for lead screw (syringe)	MPA197
Light Oil for linear bearings	MPA198
GRS550 Operator Manual	MAN586
GRS550 Software	FSW178

Options

Custom cart incl. Monitor + keyboard arm	ACC225
QR/Bar Code Reader	ACC349
Status light indicator (pole mounted)	ACC348
Active Test Option	ACC996
Tooling pins, 3.5mm for mounting of PCB´s	ET01140-02
Tooling pins, 4.5mm for mounting of PCB´s	ET01141-02
M3 support for mounting of PCB´s	ET02393-02
M4 support for mounting of PCB´s	ET02393-04
Spare aluminum mounting plate	ET00678-07

Contact Polar Instruments GmbH for details on system options

GUIDE TO THE MANUAL

Introduction	Introduces the Polar Instruments GRS550.
GRS550 general description	GRS550 controls and connectors, using COM lines and probes.
Installation/set up	Hardware and software requirements and instructions for installing and uninstalling the software.
Using the GRS550 software	Getting to know the GRS550, the GRS550 environment and menu system. Using the Live Instrument facility to examine nodal impedance signatures.
Creating test lists	Creating Test Lists from CAD data and manually progamming components. Creating and using board alignment points, excluding components from testing and controlling the GRS550 display.
Locating board faults with the GRS550	Using the GRS550 fault location modes to test boards and locate board faults. Acquiring reference signatures and testing components, using alternative signatures and Video Sectioning for visual board comparison
Maintenance	System maintenance and troubleshooting
Reference	Keyboard and display colour reference tables, ActiveX remote control command set

CONTENTS

SECTION 1 — INTRODUCTION

INTRODUCTION TO THE GRS550

The GRS550 Fixtureless Tester

The GRS550 Graphical Repair System is a flying-probe based PCB test and fault finding tool. Designed for fault finding on a wide variety of technologies, the GRS550 will accommodate surface mount components, BGA devices, through-hole legacy boards and boards using mixed technologies.

The GRS550 Fault Locator is designed to run under the control of an IBM PC or compatible controller within the Windows 7 or Windows 10 operating system.

Nodal impedance fault finding

The GRS550 probes test points using Polar's proven *Nodal Impedance* fault finding method to provide the user with highly effective trouble shooting on the most complex boards, regardless of technology. It displays CAD-derived or manually created board data (nets and test points) on screen and with its Virtual X-ray facility, allows the operator to visually follow the paths of suspect traces through all layers of a multi-layer board under test. The GRS550 intelligently creates a list of test points from the board CAD data (netlists). At the user's option the system will test every node on the board, every component with two or more pins or conduct just a single test per net for increased test speed.

On-screen video provides accurate board alignment, component selection and visual inspection.

Rapid program creation

With CAD data available, test programs to fault find on the most complex boards can be created in seconds with just a few mouse clicks.

For boards with no CAD data available manual placement of components is provided via the manual programming interface.

For boards with only Gerber data (Gerber files do not contain Component Names, Package Descriptions or Net Information) the GRS550 includes the facility to create virtual components from groups of logically related nodes.

Fault finding

The GRS550 will prove a powerful fault finding tool — for example, the troubleshooting technician can use the software to highlight failed nets. With the net highlighted the operator can easily determine which devices are connected to a node.

Nets may be highlighted using any of four methods — Point and Click, Net Name, Net Number or Component and Pin.

The GRS550's Live Instrument view allows the operator to use both channels of the measurement system to perform comparison tests between the board under test on the GRS550 table and a known good board outside the machine (a two channel measurement system will be required for this facility).

Using the GRS550's Visual Compare mode the operator is able to visually compare a board under test with a reference board using stored photographic snapshots of the known good board.

External instrument control

The External Instrument function exposes the GRS550 programming interface and allows the GRS550 to be controlled by external custom programs. In External Instrument operation the signal at the probe tip and **COMMON** on the table are routed to the **EXT. INST PROBE** connector and its **COM** connector on the GRS550 rear panel. Documentation is contained in Chapter **REFERENCE** of this manual.

Schematic display

The Schematic Link feature allows the user to include for display and printing schematic diagrams of the board under test in Adobe Systems® Portable Document Format (pdf).

Nodal Impedance

Using the Nodal Impedance technique the GRS550 tests nets and devices by applying a current-limited sinusoidal drive voltage across each net and monitoring the resultant current flow to display the nets' distinctive impedance signatures. The signatures for all the nets on a reference board are stored and used for comparison with boards under test. Differences between good and suspect net signatures are recorded as percentage deviations; the user specifies the percentage deviation that constitutes a PASS or FAIL so PASS/FAIL testing is performed automatically at machine speed.

Normal testing will be performed at high speed; however, each net can be selected for detailed inspection during trouble-shooting.

All testing is done with power disconnected from the circuit, so there is no risk to the user and components under test cannot be damaged. Test points may be derived directly from CAD netlists in most popular formats or programmed manually.

CAD Netlist files

The GRS550 graphically represents the board under test from pad and net data contained in a Computer Aided Design (CAD) data file — a file containing board layout information. The CAD data file defines all the pad and board trace information for the board. The GRS550 can import data from a wide variety of CAD Netlist formats.

Rapid test file generation

The combination of pad data and trace information provides all the connectivity of the board and allows the software to produce test files directly from the CAD data file. The operator can choose between creating test files which will probe every point on the board under test (this can result in each net being tested several times), testing every multi-pin device or testing every net just once. The software also allows for manual editing of the data before creating the test file, (adding, removing, offsetting test points, etc.) Areas of the board that prove difficult or impossible to probe can be marked as *Keep Out Areas*. The software will avoid generating test points in Keep Out Areas.

GRS550 features

The GRS550 works independently of fixturing and test systems and runs under the Microsoft Windows 7 or Windows 10 environment. The user interface is mouse or keyboard driven for ease of use and most common functions are performed by single keystrokes. Pausing the mouse over a toolbar button displays the button function and its associated keystroke.

The program main screen displays the test list, live camera view, component signature view, schematic view and a graphical display of the board, allowing the operator to view all screens simultaneously. The board view allows the operator to display each layer of the board under test in detail.

GRS550 integrated programming and test environment

The GRS550 windows comprise an integrated programming and testing environment. When selecting a device in the Test List, the selected device is highlighted in the Board View window and the signatures are updated in the Signature View window.

If a device pin is selected from the Component View of the Test List the Board View and signature Views reflect the selected pin; if Track Cursor Position has been selected from the Prober Options the GRS550 moves the probe to the selected pin. The probe position is shown in the Camera window.

The operator can perform a wide variety of operations on the loaded data, including panning, zooming, querying, measuring, moving and rotating and mirroring around the X or Y axes.

The GRS550 derives data directly from existing CAD systems, so does not rely on expensive test/fixturing software.

The software is able to import a wide variety of CAD file formats and, for simpler file formats such as Gerber Plot files, allows the user to combine groups of pins into components to produce more efficient test files.

Areas of application

The GRS550 is an ideal instrument for a wide range of applications:

Field Service	–	fault finding.
Manufacturing	–	low volume production testing/troubleshooting.

PC Control

The GRS550 software operates under the control of a Microsoft Windows environment.

The PC communicates with the integrated motion control system of the Flying Probe tester via a TCP/IP Ethernet connection.

Measurement data is transferred between the PC and the GRS500BxD measurement system over a high-speed RS232-C link via one of the PC´s serial communication ports. (see COM port settings in GRS configuration)

The two integrated cameras of the GRS550 communicate via two USB3 ports of the PC.

The program provides an integrated environment for writing test programs, acquiring, viewing and storing device signatures, and controlling system security. Signatures may be readily digitised and stored for reference on the hard disk of the controller and compared with the signatures of suspect devices or printed out for hard copy.

The system provides a highly effective method of pinpointing defects on boards that have failed electrical test. The GRS550 Board View presents a graphical indication of the pads and traces of the board under test and allows the operator to highlight the nets associated with the faulty nodes and rapidly to predict where the fault is most likely to exist.

GRS550 GENERAL DESCRIPTION

GRS550 Controls and connectors

The GRS550 Fixtureless Tester incorporates the following controls and connectors:

Front Panel

The Front Panel incorporates the following:

GROUND Socket

Use the ground/earth socket for connecting a wrist strap to prevent static damage when handling PCB assemblies.

EMERGENCY STOP Button

When the **EMERGENCY STOP** Button is pressed power is immediately removed from all motors.

Main Table

The Main Table incorporates the Rear Plate and PCB clips for mounting PCBs during testing along with the switchable **COM** and **EXTERNAL** connectors. During operation the Table will be driven in the Y-axis.

Probe Head

The Probe Head incorporates:

The test pin carrier with replaceable test pin

During operation the Probe Head will be driven in the X-axis by both, a stepper motor and two solenoids.

Camera Head + Laser Pointer

The Camera Head includes two USB3 Cameras, focussing rings and Illumination light emitting diodes. The camera head also includes the laser pointer, which can be turned on with the on/off toggle button in the menu bar.

Warning: Do not look into the laser beam!

Optional Bar Code/Matrix Code Reader

To the right of the camera head, the optional Bar Code reader may be installed. The Bar Code reader takes the bard code serial number from the PCB under test from a predefined coordinate and allows printing or saving of test results including the board´s serial number.

Table Outlet Panel

The Table Outlet Panel (located on the right of the Main Table) incorporates the following connections:

Four **COM** sockets — in normal operation all four sockets are switched to the **COM** socket on the rear panel.

In External Instrument operation the **COM** sockets are switched to the **PROBE COM** socket on the rear panel.

EXTERNAL connector — this general purpose 25 pin D-connector provides a straight-through connection to the **EXT. CONNECTIONS TO TABLE** socket on the rear panel (for use in External Instrument operation).

Rear Panel

The rear panel of the GRS550 incorporates the following connectors and switches:

IEC power connector

Power ON/OFF switch

Line fuses (x2) (See rear panel for values)

Line voltage selection switch

USB3 Camera Connections 2 x

JOYSTICK connector

LINK TO PC socket

EXT. CONNECTIONS TO TABLE socket

Channel **A** and **COM** (common return) to measurement system (e.g. PFL, GRS500BxD).

PROBE and **COM** (External Instrument) outputs.

Line voltage selection

Important: changing the line voltage setting should only be performed by a skilled electronics technician.

The GRS550 Flying Probe System uses wide input voltage range power supplies for 110V – 230V. Therefore, no line voltage selection is required on the GRS550.

However, the **GRS500BxD** signature acquisition unit shipped as part of the complete system does require the correct line voltage to be set:

1.) Remove Power from the GRS500BxD unit.

2.) Remove the outer covers by removing the plastic side covers and the metal panels.

3.) Invert the instrument, with the bottom of the GRS500BxD instrument facing up. The Line Selector switch is located on the main board near the power socket. Note the current setting on the switch.

4.) Change the switch setting using a screwdriver.

5.) Reassemble the enclosure — ensure that the cover ground cables are reconnected.

6.) Replace the line fuse(s) (located on the rear panel) with the new value (see SPECIFICATIONS) and change the marking on the rear panel to show the new setting.

Line fuse values:

200/250V Time Delay 200mA T

110/130V Time Delay 400mA T

Note: LIVE and NEUTRAL are BOTH fused

USB3 Camera connections

The two USB sockets connect the two USB3 Cameras on the camera head to the PC. Use only the high quality USB3.0 cables supplied with the instrument, otherwise data transmission errors may occur. Also connect the cameras only to the two USB3.1 ports designated. These are USB ports with increased output power for powering the cameras.

JOYSTICK connector

The Joystick is used to manually control the movement of the Table and Probe Head. The 25-pin D-type **JOYSTICK** socket is connected to the Joystick via the supplied Joystick cable.

LINK TO PC socket

The **LINK TO PC** socket is used to connect the GRS550 Fixtureless Tester via the supplied GRS550 network cable to the controlling PC.

EXT. CONNECTIONS TO TABLE socket

This general purpose 25 pin D-connector provides a straight-through connection to the **EXTERNAL** socket on the TABLE OUTLET PANEL (for custom applications using the External Instrument option).

CAUTION: *This connection is not switched*. *Ensure that power is not applied to the board via this connector when running in normal operation.*

In External Instrument operation the GRS550 table and probe are under the control of the external custom program. The GRS550 programming interface is exposed so that the programmer can use the GRS550 object's methods to perform commonly used functions, such as homing and aligning the board, moving the probe to a component or pin, probing the node and extracting the probe. The programmer should ensure that any supplied voltages or power are applied and removed as appropriate under program control or removed from this socket before switching from External Instrument operation to normal GRS550 operation.

Channel A probe output

The GRS550 Channel **A** probe output is connected to the Channel A input socket on the measurement system.

Channel A COM (common return) connector

The Channel A **COM** output is connected to one of the measurement system **COM** input sockets.

PROBE output

This socket is available (in External Instrument operation) for low frequency signal connection (e.g. for resistance and voltage measurements) to an external measurement system.

PROBE COM (common return) connector

In External Instrument operation the PROBE **COM** output should be connected to the external measurement system common return connection.

Using the manual GRS550 probes

The measurement system is supplied with a pair of DVM style probes and a clip-on common return lead, which may be connected to the **PFL A** and **COM** sockets respectively.

Connecting the test wires (PFL A and COM sockets)

Connect the red wire between the **PFL** socket **A** of the GRS550 and Channel A of its measurement system, and the black wire between the **PFL COM** sockets of the GRS550 and Channel A COM of the measurement system.

Switchable COM sockets

In normal operation the four **COM** sockets **1**, **2**, **3**, and **4** on the GRS550 table are switched to the rear panel **COM** socket under program control. This allows the operator rapidly to test boards with, for example, multiple ground planes or to connect power supply lines to ground during testing to improve signature stability.

The COM test clip(s) will normally be connected between the ground(s) of the board under test and the **COM** sockets on the GRS550 table.

In External Instrument operation the **COM** sockets are switched to the **PROBE COM** socket on the rear panel.

INSTALLING THE GRS550

Unpacking

CAUTION

Four person handling required

CAUTION: *The GRS550 is extremely heavy (100 kg) — the GRS550 should not be moved or carried by fewer than* ***four*** *persons.*

The system is shipped in sturdy transit packs. Open the packs carefully and remove the instruments and accessories.

Remove the four transit bolts which attach the GRS550 Prober to its transit pallet.

Retain the packs for possible future use. If the instruments are damaged in any way contact the local distributor or supplier.

The GRS550 packs should contain the instrument and its standard accessories (listed in the Specifications).

Note: If the system has been shipped or stored in a cold environment, allow the instrument to reach the temperature of its new location before applying power.

The GRS550 operating software

The GRS550 is normally supplied with all software fully installed. We recommend to create a shadow copy of the entire harddisk to be able to recover the installation in case of a computer hardware failure. From time to time, Polar Instruments GmbH releases new versions of the GRS550 operating software, which will be made available via download. Please update the GRS550 software only when instructed to do so.

Software Remote Support

Polar Instruments GmbH provides Remote Support via the preinstalled TeamViewer Software. Remote Support does require a fully functional internet access and the necessary ports enabled.

If due to a company security policies, remote support is not possible, Polar Instruments GmbH will provide new software versions via download links.

The GRS550 program icon

Hint: The program may be started each time Windows is started — navigate to the GRS550 destination folder and create a short cut to the GRS550 in the Windows **Startup** group.

For convenience create a short cut on the desktop. Note that the GRS550 application needs to be launched with administrator privileges.

The GRS550 environment

The GRS550 software is designed for use within the Microsoft Windows 7/10 environment. Familiarity with the Microsoft Windows environment is assumed.

For information on Microsoft Windows operation consult the Microsoft Windows User Guide.

GRS550 functions are controlled by selecting the associated commands from pull-down menus with the mouse. The most commonly used functions may also be controlled via toolbar buttons or shortcut keystrokes.

GETTING STARTED WITH THE GRS550

Starting the GRS550

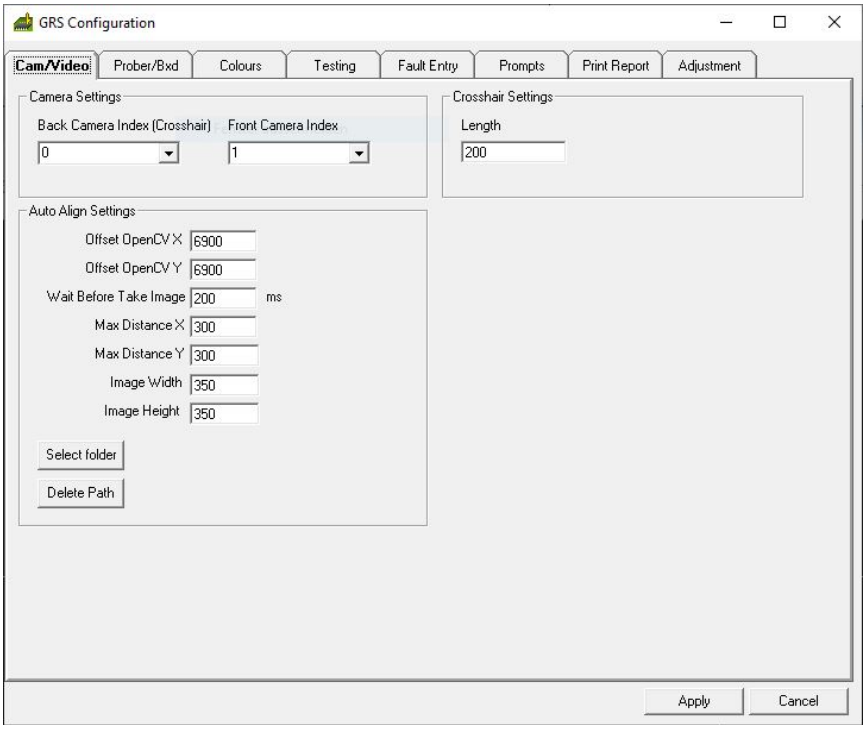
The GRS550 program icon

To start the program, press **Start|Programs|Polar GRS550 Software** or double click the icon on the desktop with the mouse or highlight the icon and press <**Enter**>.

Configuring the GRS550

Specific system configurations are defined via the following tabs in the “Tools” menu:

Cam/Video



Select the front and back camera system as necessary. When connecting the USB cameras for the first time or re-plugging the cameras, front and back camera need to be specified.

Auto Align Settings: These settings control the automatic image processing algorithm use in the Auto Align function. Leave the parameters in the default settings unless instructed otherwise.

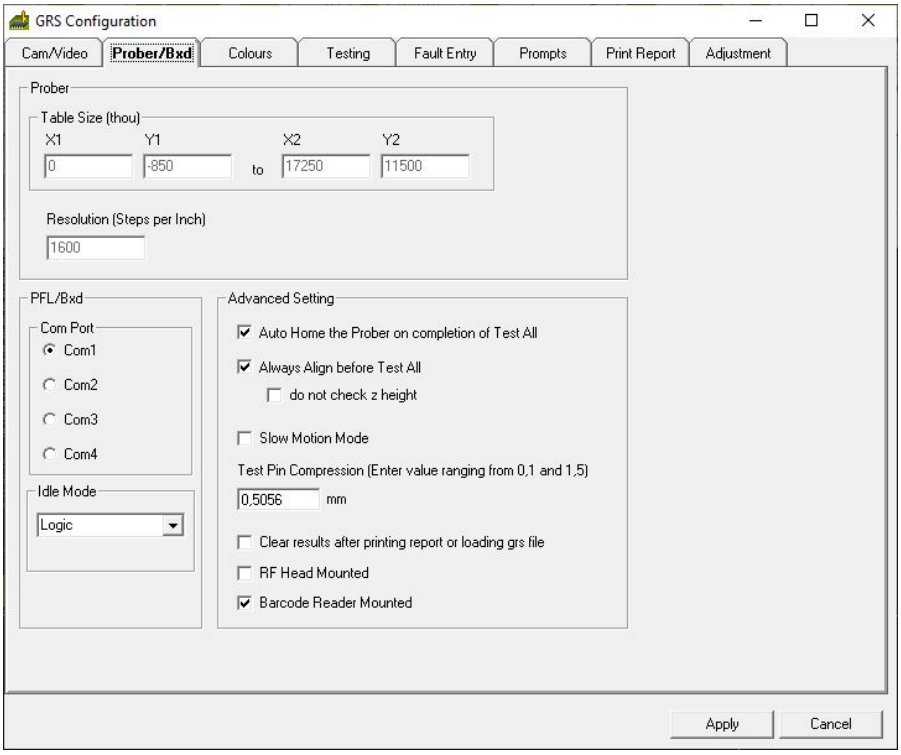
Select folder: selects the folder where the reference images for the Auto Align function are being stored. Make sure to select a

folder with full read/write privileges. For every new test program generated, the GRS550 software creates a subfolder in the selected path, that contains the two reference images - AlignmentPoint1.bmp and AlignmentPoint2.bmp

Delete Path: deletes the previously set folder for the Auto Alignment reference images.

Crosshair Settings: defines the size of the crosshair to match the size of the fiducials used.

Prober/BxD



PFL/BxD: specifies which serial communications port will be used by the host controller to transfer commands and data between the controller and the GRS550 measurement system.

Advanced Setting:

Auto Home the prober on completion of Test All – when ticked, the system automatically homes after completion of the test list.

Always Align before Test All – when ticked, a manual alignment on the fiducials by the operator is forced.

Do not check z height – when ticked, the z height is not checked on the second fiducial. Use this function when testing a larger number of identical boards that are all mounted at the same z height. For safety reasons, the z height is checked regardless each time a new *.grs file is loaded.

Slow Motion Mode – when ticked, the system performs a test run in slow motion mode, with a speed set in the motor.speed file. Use this function for first-time runs on critical boards where accessibility of components need to be checked in slow motion mode. Allows the operator to stop the motion using the Emergency-Off button at any time.

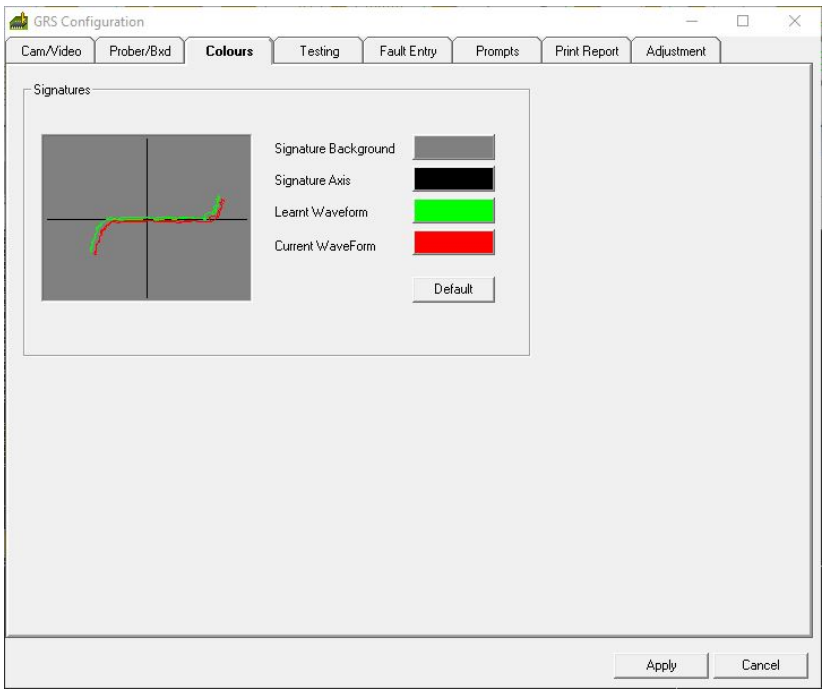
Test Pin compression – specifies the amount of compression that is applied to the test pin. Use a setting between 0.1 and 1.5mm with a typical value of 0.5mm.

Clear results after printing report or loading grs file – when ticked, this clears the PASS/FAIL indication in the test list to prevent accidental saving of PASS/FAIL results from a previous test run.

RF Head Mounted – tick this option when the optional rotating RF head is mounted. This requires the motion control system to be fitted with the optional rotation axis. Do not tick this option when the system is in normal GRS550 mode.

Bar Code Reader mounted – tick this option to enable the optional Bar Code Reader to read the serial number from the Board under test. This requires the RS232 module be fitted in the motion control system.

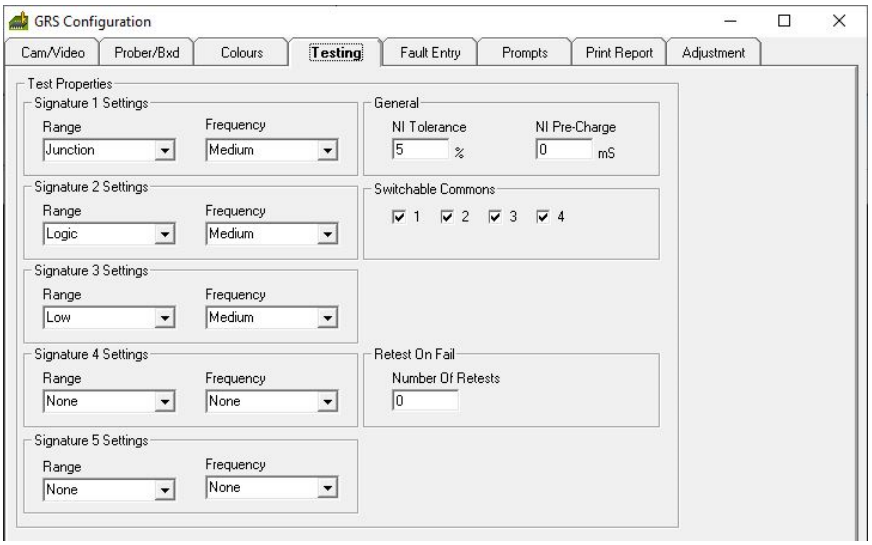
Setting screen colours



Use the options in the **Colours** tab to specify signature screen colors. Click the Default button to return to the factory settings

Testing

When test points are allocated the GRS550 assigns test parameter settings to each component (or component pin). The user is able to specify the default values and settings via the **Testing** tab.



Choose the voltage range and frequency settings and which common will be connected to the measurement system common at test time. See **Live Instrument Testing: Using the GRS550 COM sockets** and **Defining test conditions** for details on these settings.

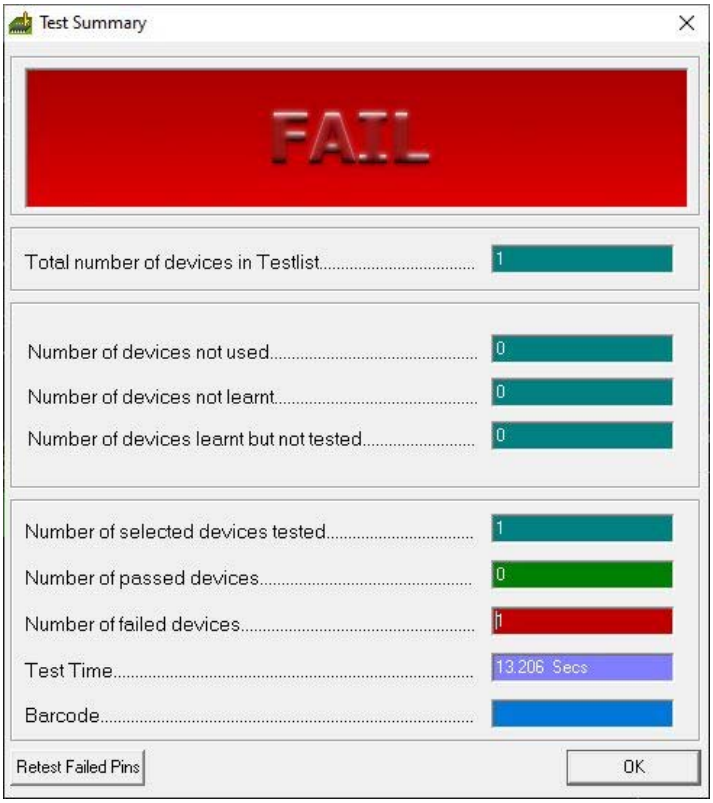
Note: Values may subsequently be modified for any component when viewing the Test List or any pin via the Component and Pins List.

NI Tolerance: defines the tolerance for discriminating between PASS and FAIL signatures. Typical tolerances are between 3% and 5%

NI Pre-Charge: defines the time delay between applying the Analog Signature stimulus signal and the acquisition of the signature. Typical values range from 30 ms to 200 ms. Leave this setting at the default value 0 ms and only enter values larger than 0 when noticing charging effects on signatures.

The Retest on Fail button

Retest On Fail: defines the number of retests on signatures that show a FAIL. A Retest on Fail may be initiated via the Tool Bar menu button or via the “Retest Failed Pins” Button in the Test Summary:

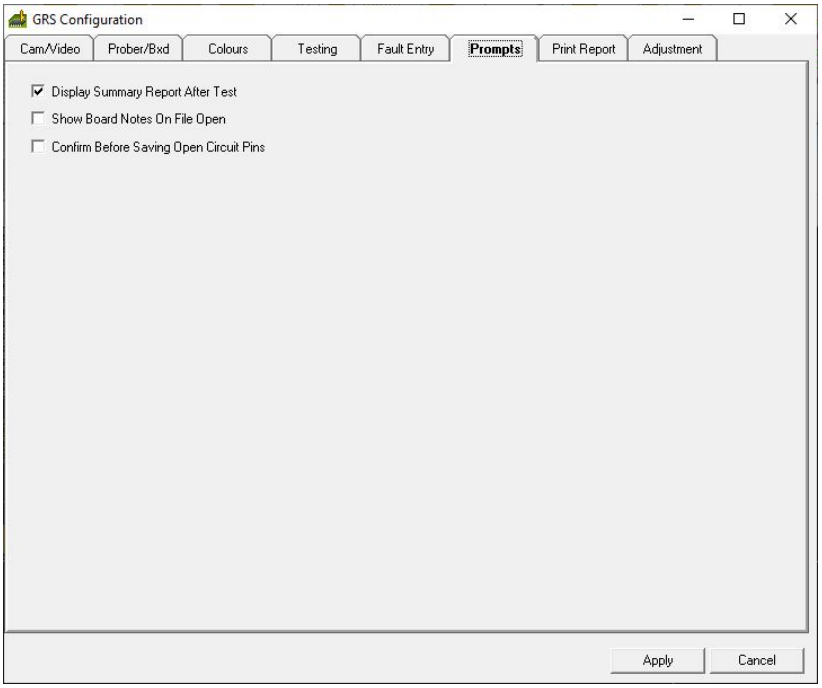


Note: Values may subsequently be modified for any component when viewing the Test List or any pin via the Component and Pins List.

Specifying Fault Entry

Users can choose between selecting nets by name, by number or by component and pin. Select the Fault Entry mode as required. See **Highlighting Nets**.

Setting system prompts



The GRS550 will issue warnings and messages during significant operations. These messages can be disabled if required.

Display Summary Report After Test allows the GRS550 to display a PASS/FAIL summary after each board test indicating the number of devices tested, number of passed and failed tests, etc. (see **Testing components**).

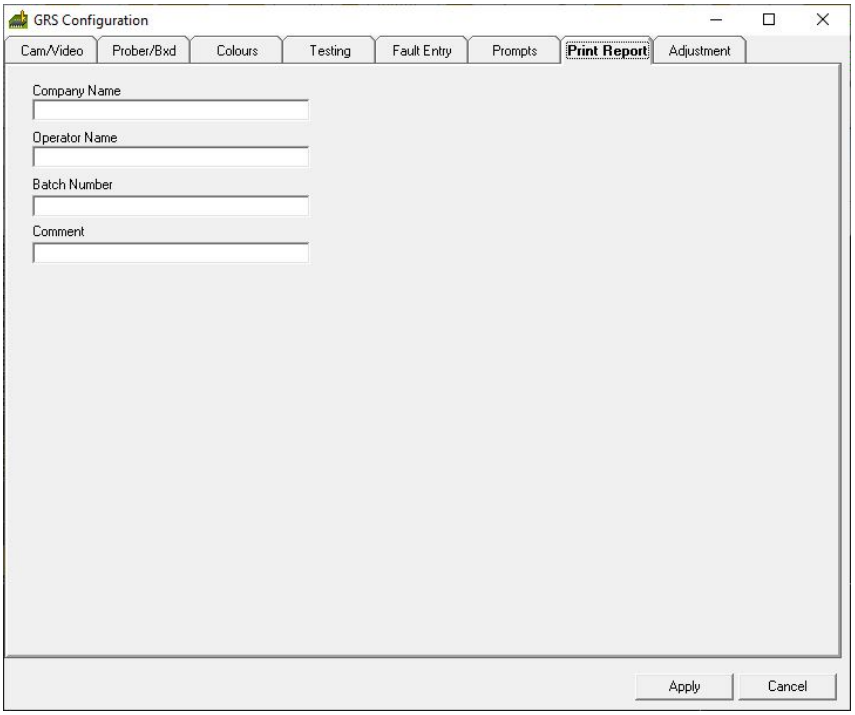
Show Board Notes on File Open displays explanatory information or instructions relating to the board under test as the board test file is opened

Confirm Before Saving Open Circuit Pins During reference signature acquisition, the GRS550 will check for open circuit signatures for each device. Open circuit signatures may indicate a badly positioned test point, flux on a board or a missing ground connection, etc. The GRS550 can display a warning dialog to allow the operator to choose to save as reference or discard a signature that displays as open circuit (see **Acquiring reference signatures**).

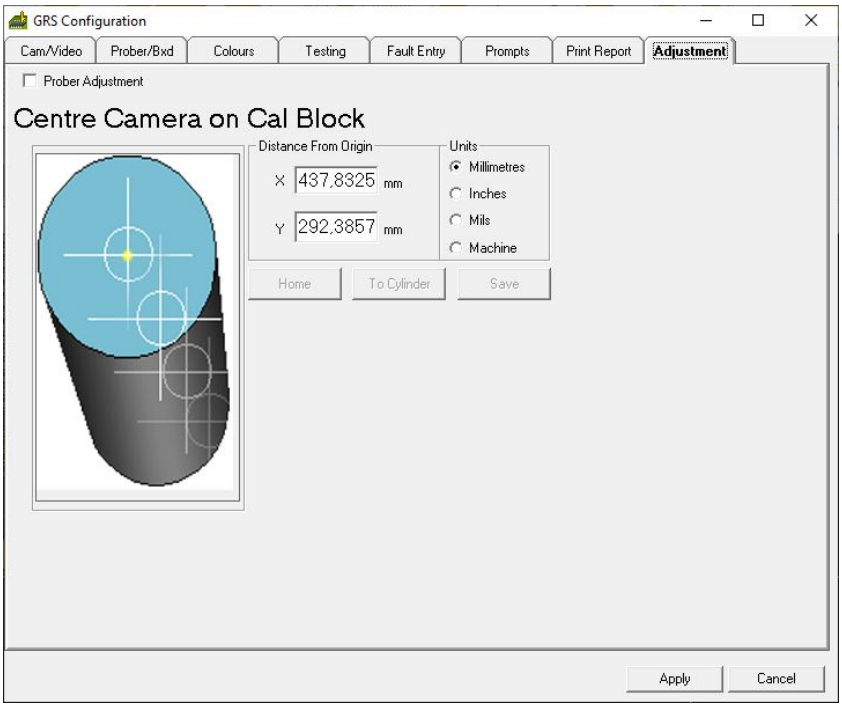
Check each box as desired.

Print report

Enter print report details to be used as default for each test report printed.



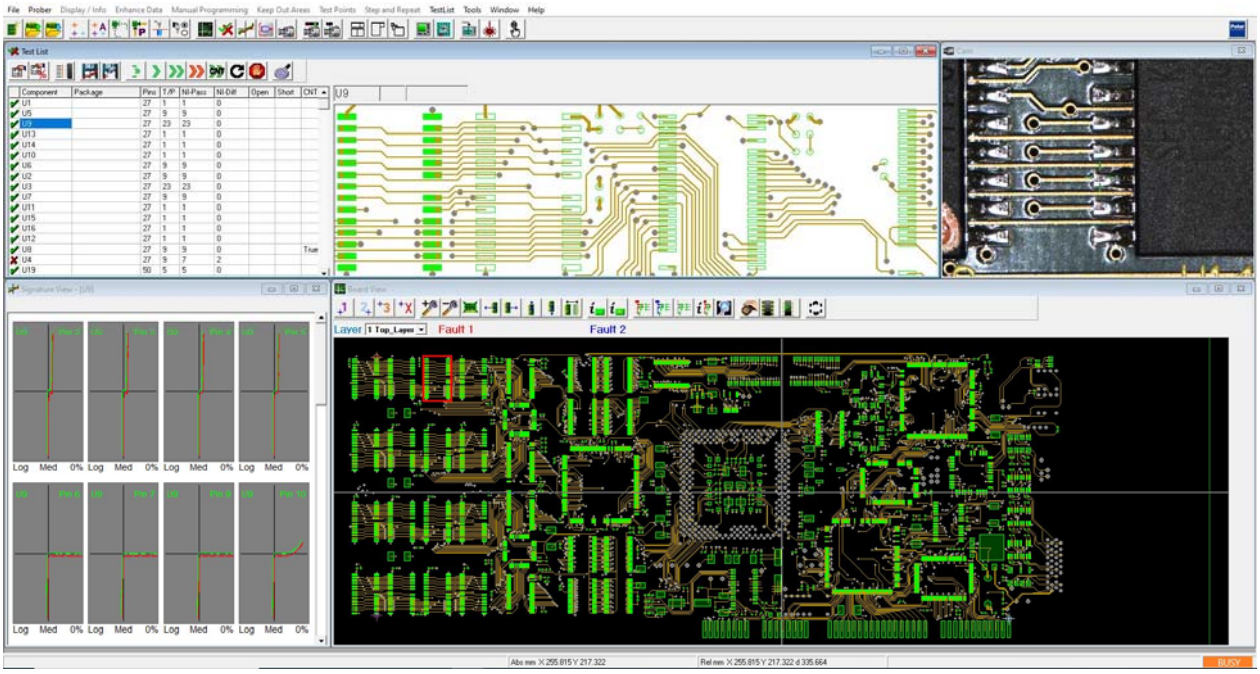
Adjustment



Allows precise alignment of multiple GRS550 systems so that *.grs test files may be transferred between systems without realigning. Requires special alignment tools. Only to be used by authorized service personnel or when instructed.

The GRS550 screen

The GRS550 presents an integrated environment displaying the test list, component view, camera view, component signature view and schematic view in a single window board view



GRS550 main screen

The main GRS550 main screen comprises:

- The Menu bar containing the GRS550 commands.
- The Tool bar containing the most frequently used commands and functions common to all windows
- The Test List window, displaying the list of components along with a representation of the selected component showing pins and test points
- The Board View Window, where the board layout is displayed and the GRS550 test points may be viewed and edited. The Board View Window can also be used to highlight nets during fault finding. The Board View includes the Layer dropdown box, allowing the operator to select for viewing a single layer of a multi-layer board. The Board View includes crosshairs to allow the operator to highlight nets using Point and Click.
- The live Camera view, to allow for board and probe alignment and visual inspection
- The Signature View window, displaying the signatures for the component selected in the Test List

- The Schematic View window, which displays the linked scematic for the board under test
- Status Bar displaying Co-ordinates

The Test List and Board View windows contain toolbar button shortcuts to commonly used commands.

The main screen window will normally be maximised to full screen view — click the **Maximise** button (or double-click the GRS550 Title Bar or press **Alt+Spacebar** then **X**).

Using the GRS550 windows

The GRS550 opens displaying all windows tiled on screen, the Test List View, the Camera, the Signature View and The Board View. Use the windows tools to set the focus to the window of interest or to return the screen to a standard window layout.

Use the Window buttons to set the window focus or choose a layout as detailed below.

 Board View

 Test List View

 Signature View

 Camera View

 Camera On/Off

 Camera Window size

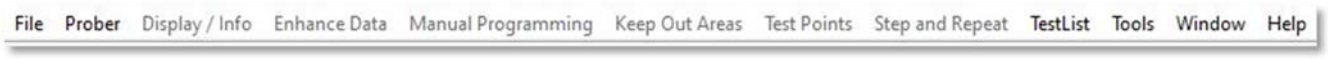
 Standard Tiled Window layout

 Large Window layout

 Cascaded Window layout

The GRS550 menu system

All GRS550 commands are available from pull-down menus; commands can be accessed via the mouse or shortcut keys.



GRS550 main menu bar

The most frequently used commands are incorporated in the tool bar for each window.

GRS550 main toolbar

The menus and tool bar items are arranged so that the operator logically works from left to right across the menu/toolbar system, from mounting and aligning the board, loading board data through specifying keep-out areas and test points to testing the board.

Short cut keys are shown on the pull-down menus alongside their associated commands.

To see which function a button performs pause the mouse over the button to display its screen tip.

Selecting commands

Using the mouse

To display a menu command list, point to the menu name on the menu bar and click the left mouse button.

Point to the command name and click the left mouse button.

Selecting a command name that is followed by ellipses (...) displays a dialog box containing options that qualify the command.

Clicking the **OK** button corresponds to pressing the <CR> or <Enter> key on the keyboard.

Clicking the **Cancel** button corresponds to pressing the <Esc> key on the keyboard.

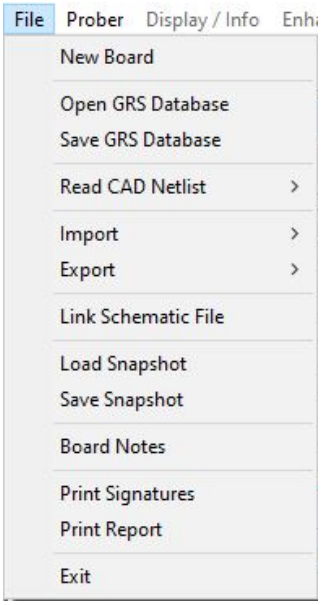
Using the keyboard

Select each command using the *Alt + accelerator key* combination to select the menu then the *accelerator key* to select the command within the menu; e.g. *Alt + F* then *O* to open a database.

*Hint: use **Ctrl + A** to start a Test All with Auto Align*

The File menu

The **File** menu provides the commands for saving and recalling a complete set of data for a board. The database facility allows the netlist and GRS550 files to be saved for subsequent review.

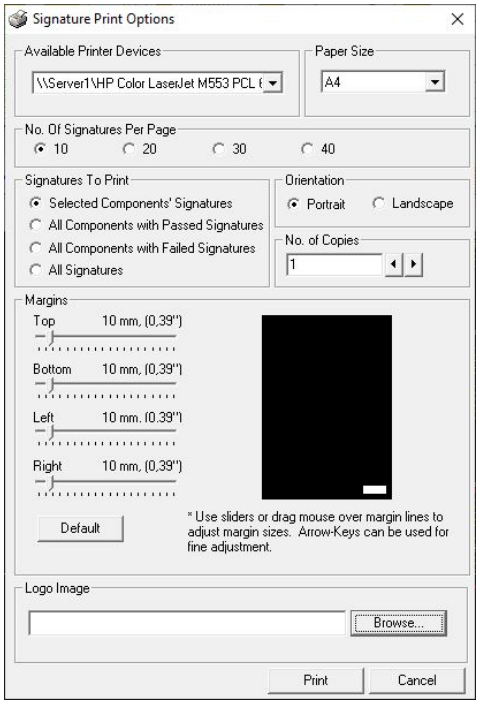


Use the **File** menu commands to:

Create a new set of board data

Open and save a database — a set of board data along with test point information and signatures

Print signatures and test results; selecting the Print Signatures displays the Print Options dialog box.



(Use this dialog to specify margins, paper size, orientation and number of signatures per page.)

Read a set of board data

Import data from earlier versions of software

Select a schematic file (in Adobe Systems' .pdf format) to link to the current board

Save and Load board snapshots — the data and test results for a board

Exit from the GRS550 program.

Read CAD Netlist command

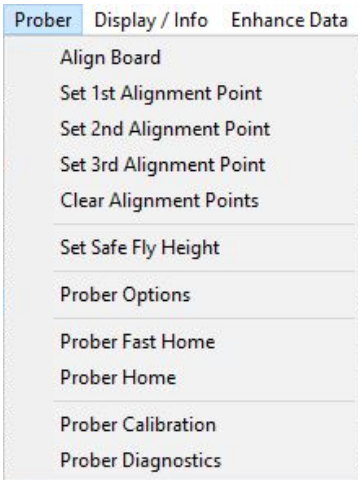
The **Read CAD Netlist** command contains the commands to load the conversion filters for the CAD data files.

Choose the CAD file type, select the data file and press **Open**.

Note: Selecting the Gerber Plot Data command will display the **Read Gerber Plot Data** dialog box to request Gerber File and Aperture List details. It will be necessary to specify the Gerber File details as the file is loaded; with the file loaded Aperture List details can be modified as necessary. The resulting information — Gerber plot data, pad shapes and created components — can be stored as a GRS550 database for future use.

Prober menu

The **Prober** menu provides the commands and options to assign pads on the board as alignment points and align the board during the test process.

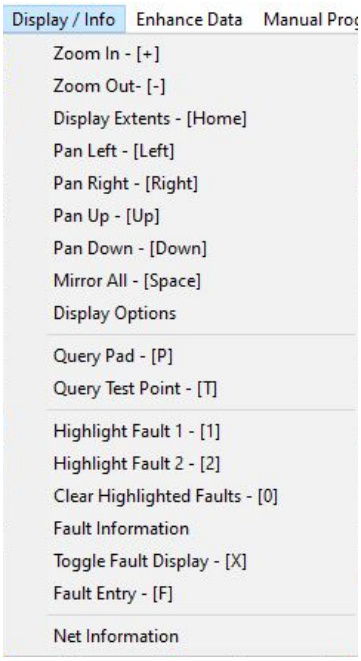


The Set Safe Fly Height command records the height of the tallest components so as to ensure clearance for the probe between test points.

The Prober Options allow the probe to track on the board the position of the crosshair on screen. The Home commands return the table and probe to their reference positions. Prober Calibration ensures accurate alignment between probe tip and crosshair.

The Display/Info menu

The **Display/Info** menu provides control over the presentation of board and net data and information



The menu provides the commands to:

Zoom, pan and mirror the display.

Query a Pad or Test Point.

Set the display options to display pad, track and test point data

The Fault commands allow the user to trace faulty nets through a board during troubleshooting.

Select nets for display.

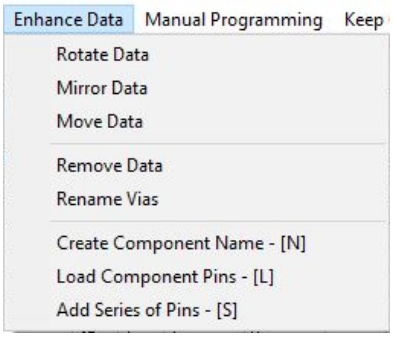
Display the highlighted nets on either the current layer only or on all layers.

Activate the Fault Entry area on the Toolbar.

The Net Information command displays a list of all nets on the board.

The Enhance Data menu

Data derived from CAD files may require some pre-processing prior to use in defining test points. For example, the entire board image must be located within the boundaries of the GRS550 table area. Use the **Rotate, Mirror** or **Move Data** commands to rotate, mirror and move the CAD Netlist layer as necessary.



Remove Data

The **Remove Data** command allows the user to trim the board data to exclude CAD information outside the board area to be tested (for example, CAD data that would appear outside the GRS550 table boundaries or registration or fiducial data beyond the immediate board dimensions).

Some file formats (e.g. Gerber Plot Data) do not contain component names, package descriptions or net information. The resulting test lists produced by the software would contain a series of single pin components. The Enhance Data menu allows the user to specify individual test points as belonging to components to reduce board test times.

Components can consist of a wide range of device configurations, from two or three pin devices containing groups of pins to multi-pin ICs built from series of pins.

Rename Vias

The **Rename Vias** command allows the operator to rename all vias to individually named via (e.g. VIA001, VIA002, etc.) By default all vias are assigned the name VIA and would be regarded by the GRS550 as a single component called VIA.

When test points are allocated to the board under test, the Test Point Allocation process provides the option to exclude vias from the test list (vias are often difficult or impossible to probe, being drilled or covered by solder mask).

On many boards however (e.g. boards using BGA devices) a via may well be the only accessible node on a net. Renaming the vias disables the exclusion process for all vias.

Vias are often designated by default as Keep Out nodes, so to enable a via for testing it is necessary to make each renamed via to be tested Not Keep Out.

To enable a via for testing, *prior to allocating test points* perform the Rename Vias command, make the via Not Keep Out then run the Allocate Test Points command.

The **Manual Programming**, **Keep Out**, **Test Point** and **Fault Finding** menus provide the commands and functions for each stage of the board fault repair process.

Use the Manual Programming menu to create test points for PCBs with no data available.

The Keep Out menu allows the user to exclude from test components that are difficult or impossible to probe.

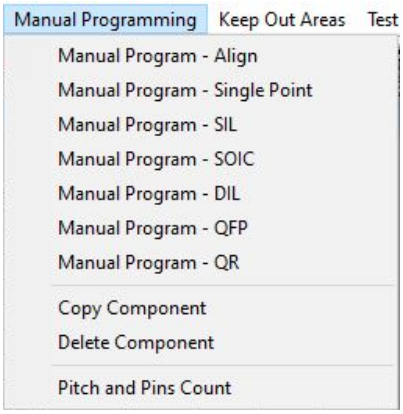
Utilize the Test Point menu to provide intelligent allocation of test points to net nodes and components.

The Fault Finding mode allows the operator to use the board results to pinpoint problems with faulty nets and devices.

Clicking each menu activates the associated toolbar in the Co-ordinates and Highlighted Error Display Area.

The Manual Programming menu

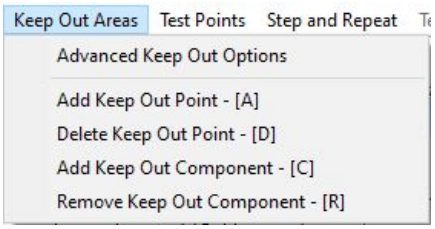
The **Manual Programming** menu, activated in Manual Programming mode, allows the user to create data for the board under test with no CAD data available for the board



Use the Manual Programming menu to create a wide variety of components, from single test points to quad flat pack devices.

The Keep Out Areas menu

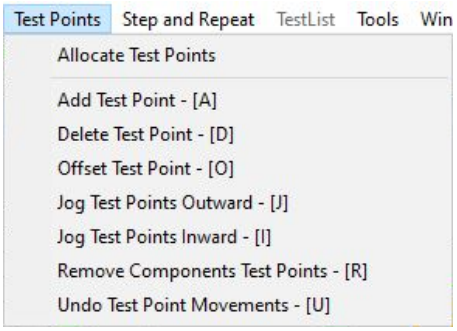
The Keep Out Areas menu, activated in Keep Out Mode, allows the operator to mark nodes and components that should not be probed as “Keep Out”. During the Test Point Allocation process, points marked as “Keep Out” will not be included in the list of points to be probed.



The user can nominate individual pins or whole devices for exclusion. Excluded areas are shown on screen in a darker shade of their original colour.

The Test Points menu

Use the **Test Points** menu, activated in Test Point Mode, to allocate test points to the CAD Netlist.



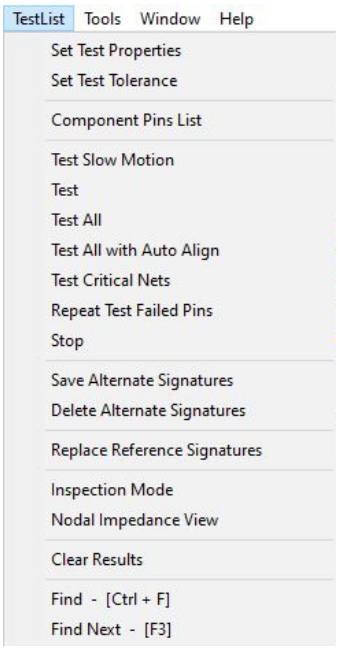
Test points may be allocated:

- To every point on the board under test
- To every device with more than 2 pins
- On a one test point per net basis (for faster testing)

The Test Points menu allows the operator to edit the test points allocated; test points may be added, removed or offset (moved to a new location).

The Test List menu

The Test List menu supplies the command and functions for working within the Test List window.

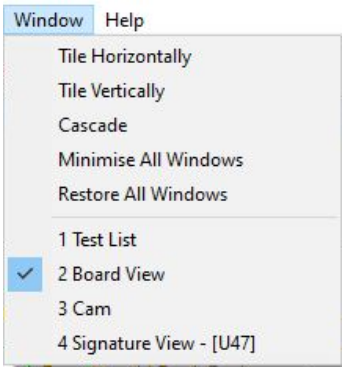


The Test List menu includes commands to:

- Set test properties and parameters
- Control board testing
- Work with alternate signatures
- Replace reference signatures
- Clear device results
- Locate components in the test list

The Window menu

Use the **Window** menu to change the layout of the program windows and to switch the focus between windows.



Use the **Windows** command in conjunction with the preset **Windows Layout** and **Toggle Camera Size** buttons.

- Turn the video camera on or off and choose between Camera window sizes.
- Switch to the Test List view to edit the test list and test the board

Switch to Board View to view track and pad data

Switch to Signature View to view the reference and test signatures for the selected device.

The Configure menu

The **Configure** menu allows the user to alter camera settings, test default parameter settings, screen colors and the Fault Entry (net highlighting) method.

The Help menu

Select **About** for system information (firmware versions, etc.)

Using the GRS550 COM sockets

The GRS550 displays the impedance of the node under test between the probe tip and COM. The GRS550 table incorporates four COM sockets to accommodate boards that use separate ground planes or tests where the COM is connected to other (non-ground) parts of a circuit. During normal testing the measurement system COM is switched under program control to the ground associated with the net under test.

The Common line(s) connected are a component of the test point parameters assigned during test point allocation.

Common line connection may be specified for the whole board, for each device or for each pin of a device (see **Test Point Allocation**).

In Live Instrument operation all four COM table sockets are connected to the measurement system COM socket.

If External Instrument operation has been enabled (see Configuring the GRS550 — External Instrument operation) clicking the External Instrument button switches control from the GRS550 software to an external program.

In External Instrument operation the signal at the probe tip and **COMMON** on the table are routed to the **EXT. INST PROBE** connector and its **COM** connector on the GRS550 rear panel.

Connecting the test cables

Connect the Red wire between the GRS550 Channel A socket and Channel A of the measurement system, the Black wire between the GRS550 and measurement system COM sockets.

Connect the COM test clip to the ground of the board under test and a COM socket on the GRS550 table. For boards with split ground planes ensure the COM is connected to the ground associated with the nets under test. It is a recommended practice to connect for example COM1 to the board GND and COM2 to the board Vcc. This will prevent charging effects on power supply rails of the board under test, causing instable signatures.

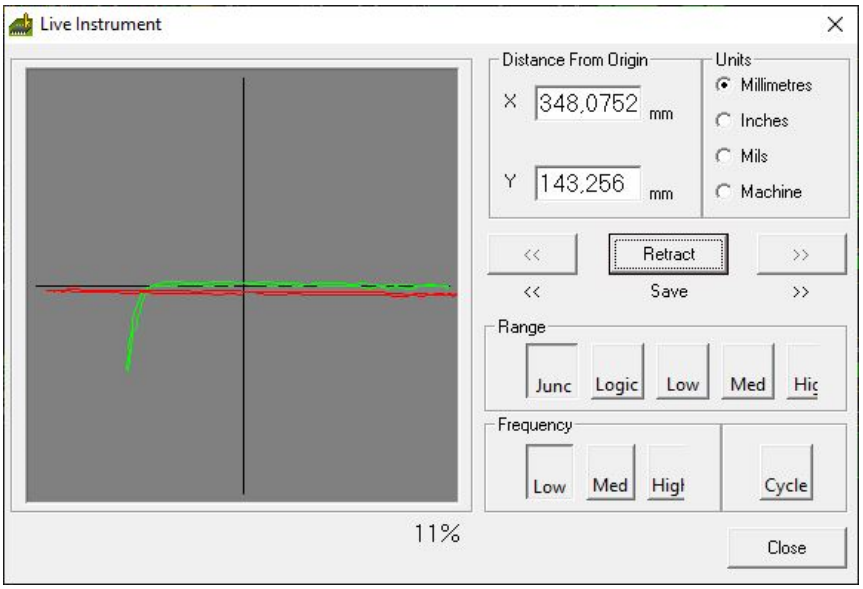
Live Instrument testing

Live Instrument screen

The **Live Instrument** screen allows the operator to test nets and devices directly using the GRS550 nodal impedance display and, using both channels of the measurement system, compare them with the corresponding signatures of a known good board — use the **Live Instrument** function to display the impedance (i.e. applied voltage v resultant current) signature of a net.

Live Instrument button

Click the **Live Instrument** button — the **Live Instrument** screen is shown below.



Live Instrument screen

Component signatures are displayed in the Live Instrument window of the GRS550 screen.

In **Live Instrument** the GRS550 may be driven to any location within the table area via the joystick.

Ensure the GRS550 has been calibrated (see the Prober Calibration command from the Prober menu) and the board aligned (Align Board from the Prober menu).

Click on a Voltage range button to select the voltage to be applied to the node under test.

Click on the Frequency button to choose the test frequency.

(See **Defining test conditions** for details of test voltages and frequencies.)

Use the joystick and camera to locate the probe over a device or net to be tested and click the **Probe** button to display the signature on the node.

If comparing with a known good board off table connect the external probes to Channel B of the measurement system and probe the corresponding net and common (ground, Vcc, etc.) on the reference board.

Click on **Retract** to withdraw the probe from the board surface.

Defining test conditions

Test Range selection

The **Live Instrument** screen provides for both manual and cyclic selection of drive voltages and frequencies. This allows rapid selection of the most appropriate voltage and frequency range for a component or circuit under test.

To specify test conditions manually, click the voltage and frequency buttons as appropriate (see **Selecting the Voltage range**).

Selecting the Voltage range

The GRS550 provides a range of current limited drive voltages. Only one drive voltage can be selected at a time.

Setting	Voltage Range	Application
Junction	1V AC peak 500µA current limit	Use on nets that contain semiconductor components and circuits, e.g. signal diodes, ICs.
Logic	10V AC peak 5mA current limit	Safe for use on most circuits. Ideal for light emitting diodes. Low voltage and current reduce the possibility of over stressing components.
Low	10V AC peak 150mA current limit	Low resistance circuits and power diodes. Not suitable for low power components.
Med	20V AC peak 1mA current limit	Medium resistance circuits or components, Zener and other diodes with breakdown voltages up to 20V. Useful for checking diode leakage.
High	50V AC peak 1mA current limit	High resistance components. Diodes with breakdown voltages in the 20V to 50V range, and diode leakage.

Select the drive voltage to provide meaningful signatures (this will usually mean choosing the range which produces maximum deflection).

By selecting the higher voltage ranges larger values of current flow and more recognisable sloping signatures are displayed.

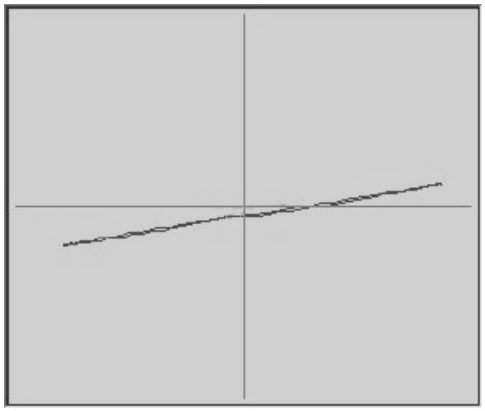
Hint - use the test list columns “Open” and “Short” for optimising test ranges: Components pins showing an Open (high impedance) are best tested using “Med” or “High” Ranges, components pins showing a Short (low impedance) are best tested using Low Range.

	Component	Package	Pins	T/P	NI-Pass	NI-Diff	Open	Short
✘	U1		27	27	26	1		3
✔	U5		27	27	27	0		2
✔	U9		27	27	27	0		3
✔	U13		27	27	27	0		4
✔	U14		27	27	27	0		2
✘	U6		27	27	26	1	1	2
✔	U2		27	27	27	0		2

Selecting the Frequency range

Resistive signatures

The signature produced by a net containing a pure resistance is an inclined straight line whose slope (gradient) is dependent on the value of the resistance.

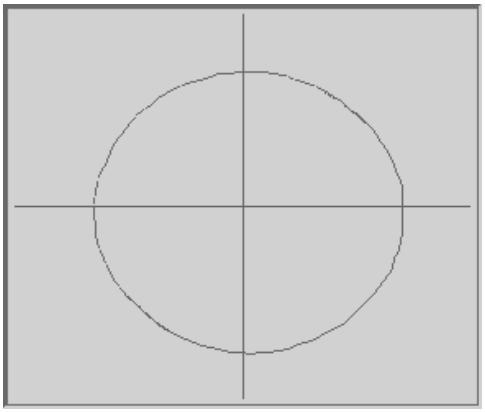


Signature of resistor

For a purely resistive component the frequency selected will not significantly affect the appearance of the signatures.

Reactive signatures

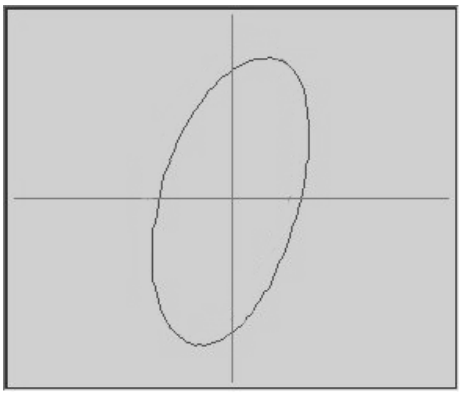
Due to their energy storage characteristics, reactive components produce a phase shift between voltage and current flow. This is displayed as a circular or elliptical signature. For a pure reactance the major and minor axes of the ellipse align with the display axes.



Signature of capacitor

In a capacitor more current flows at higher frequencies and produces a larger vertical excursion of the signature. In an inductor more current flows at lower frequencies.

If the resistive component of a circuit is significant compared with the impedance of the reactive component, the elliptical signature will be tilted.



Tilted elliptical signature

By choosing a different test frequency to vary the impedance, the effect of resistance can be exaggerated or minimised as required.

The following table is included as a guide to frequency selection. Only one frequency can be selected at a time.

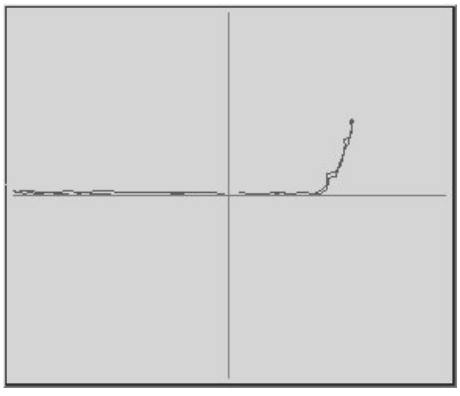
Setting	Application
Low	90Hz signal used to produce signatures of circuits with larger value inductors or capacitors; e.g. components in power supply circuits.
Med	500Hz signal is used for most troubleshooting.
High	2kHz signal used to produce signatures of circuits with small value inductors or capacitors.

Note: some "looping" of the displayed signature (due to stray capacitance) may occur even when the probes are not connected to the circuit under test, especially if **High** frequency is selected.

Semiconductor signatures

Diode signatures

The Nodal Impedance technique use in the GRS550 is especially useful for locating defective active devices that may be inserted correctly, and therefore measure correctly when tested for simple forward and reverse resistance, but exhibit, for example, a “soft knee” characteristic. Such defects readily show up with signatures distinctly different from good devices. When forward biased, a diode exhibits a low resistance and a voltage drop of approximately 0.6V. This produces a signature with the characteristic diode V-I curve; see the diagram below.

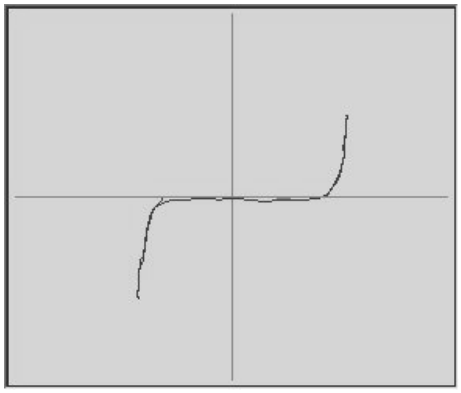


Diode signature

When reverse biased, the high resistance characteristics of the diode approaches that of an open circuit, producing a horizontal trace close to the X axis. A light emitting diode (LED) shows a similar signature to a conventional diode, except that the forward voltage drop is approximately 1.5V.

Bus signatures

When testing bus-based nets, the signature will often be a composite of many devices in parallel. This is most often the case when diagnosing faults in service. For bus-based devices, e.g. memory chips, I/O devices, bus buffers, etc. the signature will probably be dominated by the I/O protection diodes.



Typical bus signature

The characteristic signature at any probing point in a circuit is unique for that circuit. A faulty component may well affect the signatures of several connected nets. The operator can usually 'home-in' on a fault by probing several nets on the PCB.

When a number of devices are connected together on a common bus, the signatures on the bus lines adjacent to the suspect line may be compared to look for differences. Lines on the same bus will usually have similar signatures (e.g. all data lines will be similar to each other). If one line has a different signature from other lines on the same bus, this suggests that a device on that bus is faulty.

Locating faults on bus-connected nets

A fault causing an incorrect signature on a net will cause every node on the net to display the fault. To isolate the fault to a specific device there are a number of methods of locating the cause of an incorrect signature. If any devices are socketed, remove them one by one until the defective line's signature matches the other lines.

Using the COM line to isolate devices.

During normal testing the GRS550 allows the measurement system COM line to be connected under program control to one or more of four COM lines on the GRS550 table. In Live Instrument it will be necessary to move the COM manually to a ground plane associated with the net under test.

Every device on a board will have one or more pins that are *not* connected to a bus, e.g. /CE (Chip Enable) or /OE (Output Enable). This provides a method for looking at each IC individually.

If a bus line shows up as defective, *remove the COM input from Vcc or ground, and connect it to the defective bus line*.

Probe each of the devices' /OE or /CE pins, looking for a device whose signature differs from other similar devices.

If neither of the above methods locates the fault, it may be necessary to unsolder devices until the fault is cleared.

Comparing signatures with known good signatures

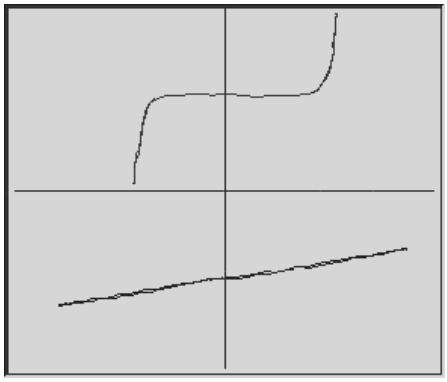
The most effective method of establishing good signatures is comparison with known good boards.

Without access to a good board, however, a good start is to look for areas of the board that should be the same. Does the board have more than one channel? If one channel is good compare it with the others.

Looking for characteristic signatures

When testing nets containing integrated circuits look for an absence of sharp curves that signify protection diodes are damaged.

In the signature diagram below showing good and bad signatures the lower bus signature indicates that the device protection diodes are damaged and have been reduced to simple resistances.



Good and damaged protection diodes signatures

Look for vertical lines (shorts).

Short circuit signature

Look for horizontal lines (opens). Try looking at signatures using several voltage ranges; some faults only show up on certain ranges.

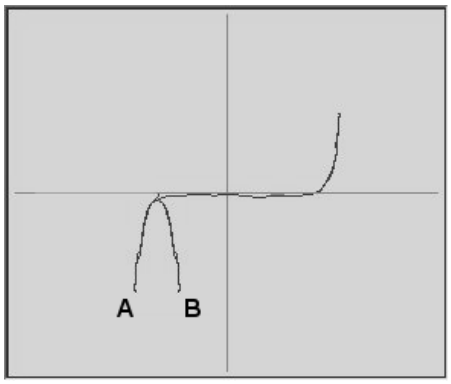
In a service environment where the boards under repair have already worked, then it's always a good idea to look for faults on nets that connect to edge connectors or power supplies. Checking large nets will check high numbers of devices. Check that socketed components have all their pins correctly plugged in.

In manufacturing, where the component and the board may never have functioned, look for missing, reversed, or short-circuited components.

Signature stability

When using Nodal Impedance Analysis to locate faults in a circuit it may prove difficult under certain conditions to achieve stable signatures. On occasions the signature on a net may even alternate between good and bad on repeated tests.

Observing the signatures using Live Instrument can show up "jitter" on the screen as signatures jump between two or more shapes. This phenomenon will probably occur most often when testing digital ICs. It will produce effects similar to the signature in the diagram below where the portion of the signature in the lower left quadrant switches rapidly between the shapes A and B.



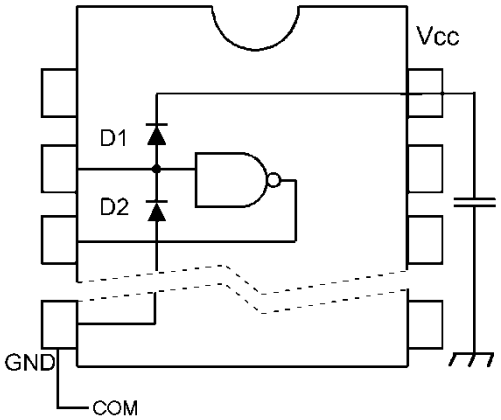
Unstable digital IC signature

Instability or oscillation in signatures are often the result of capacitive circuits and can be reduced by using the GRS550's facility to insert a delay prior to each test using the Pre Charge function.

Sometimes, however, a rapidly changing signature is the result of the combination of circuit configuration and the method the fault locator uses to produce the signature.

Noise reduction decoupling

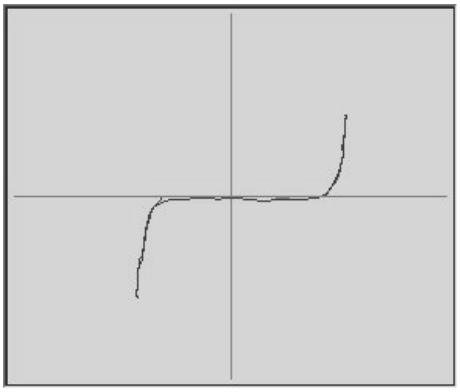
Consider a typical digital IC under test as it appears to the fault locator.



Typical IC input protection and decoupling

Note the decoupling capacitor on the Vcc pin of the IC. Many digital circuits utilise an even distribution of decoupling capacitors to assist in reducing noise, much of which is locally generated (e.g. by local lead inductance). Commercial circuits will typically employ one decoupling capacitor for each digital device.

During IC testing the fault locator scans the pins of the IC and applies a sine wave stimulus between each pin under test and COM. Each pin will be stimulated by several sine wave cycles, the actual number will depend on the test frequency, the number of test ranges employed for the test and any delay specified.



Typical signature for input protected IC

In the circuit diagram above, as the NAND input pin is tested the sine wave drive voltage causes D1 and D2 to conduct on alternate half cycles to produce the characteristic digital IC signature

However, as D1 conducts during the positive half-cycle of the drive voltage it will allow charging current to flow in the decoupling capacitor for the device. (Other decoupling capacitors on the supply line will appear in parallel.)

The voltage on Vcc will therefore rise as the decoupling capacitor is charged. Under some combinations of test voltage range and circuit configurations Vcc may rise enough to turn on portions of the IC; the current drawn will immediately discharge the decoupling capacitor. This sequence of events represents a rapidly changing impedance at the node under test and causes the

impedance signature to appear unstable. The effect is usually most pronounced when a high current capacity range such as the LOW voltage range is included in the test.

This problem can be reduced significantly or even eliminated by connecting both Vcc and GND to a COM connection the decoupling capacitor is effectively short-circuited and the two protection diodes appear in parallel.

Cycle

Select **Cycle** to continuously cycle through each voltage range, displaying the signatures. To stop cycling, select a drive range, or select **Auto**.

CREATING THE TEST LIST

The board testing and fault finding process will normally consist of the following sequence of steps:

1. Mount the board onto the GRS550 table
2. Home the GRS550
3. Calibrate/align the probe
4. Load the CAD data via:
   -the CAD Netlist for the board
   -the GRS550 database for the board if one has already been created
   -Manually programming devices
5. Link a schematic file (if available) to the board data (schematic file must be in pdf Format)
6. Allocate three alignment points for the board
7. Align the board (manual or Auto Align)
8. Assign Keep Out areas for components which cannot be probed
9. Assign test points and generate the test list
10. Test the board (or individual components)
11. Learn a safe fly height if necessary
12. Display the net(s) and use the GRS550 display to assess where the fault is most likely to occur and follow the nets through the board layers

Mounting the board

The GRS550 is able to accommodate a wide range of PCB sizes and layouts. When mounting a PCB for testing the user will need to consider the size and shape of the board. A number of mounting options are available:

- PCB Clips
- PCB tooling pins
- PCB mounting with knurled screws
- Custom made mountings (contact Polar)

Board height

Boards must be mounted exactly parallel with respect to the main table. The GRS550 senses the height of the board under test from the third alignment point and records the height of every node under test with respect to the board height. Note the setting “do not check z height” in the system configuration.

Board angle

PCBs will normally be mounted orthogonal to the table (i.e. with the edges in parallel with the table edges). The board can, however, be rotated to any angle with respect to the table. Using the two alignment points, the prober coordinate system is aligned to the actual mounting position and rotation.

Homing the GRS550

Before using the GRS550 it will be necessary to “home” the table and probe to their reference locations.

Click the Home button to calibrate the Prober to the Home position

From the **Prober** menu choose the **Prober Home** command; the probe and table will be returned to their reference positions. The **Home** command calibrates the Home position. It will be necessary to perform a **Home** at system start up or if, for example, the user hits the Emergency Stop button, opens the safety lid or otherwise interrupts the Prober in normal operation.

Use the Park button to perform a fast transit to the Home position

Use the **Park** button to return the Prober to the Park-Position bringing the table to the front position for easy access and to replace the board under test.

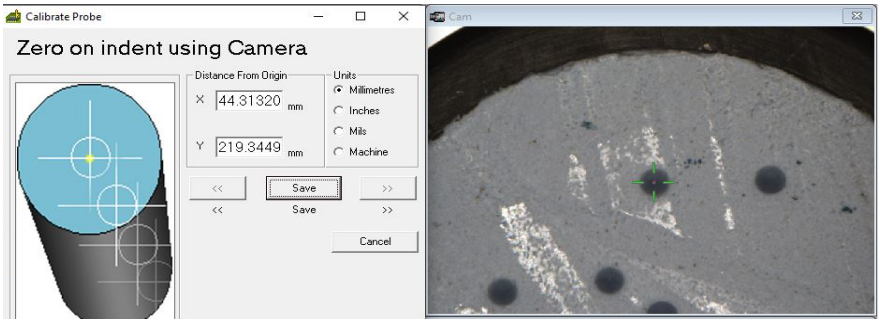
Calibrating the Probe

Probe calibration consists of aligning the camera crosshair with the probe tip so as to ensure perfect registration between camera and probe. While the system reaches normal operating temperature, it may be necessary to re-calibrate from time to time for maximum accuracy. Probe calibration should be performed when:

- The system is turned on
- The ambient temperature has changed
- The system has reached operating temperature
- The test pin gets replaced
- Prior to testing a batch of boards
- in certain intervals
- when noticeable mis-registration occurs between camera and probe (test pin misses the test points)

Screw the Probe Calibration Block into one of the threaded holes in the table near the board under test. The surface of the block is coated with a smooth layer of “Blu-Tack” or similar material.

From the **Prober** menu select **Calibrate Probe** — the **Calibrate Probe** dialog box is displayed.



The Calibrate Probe dialog box

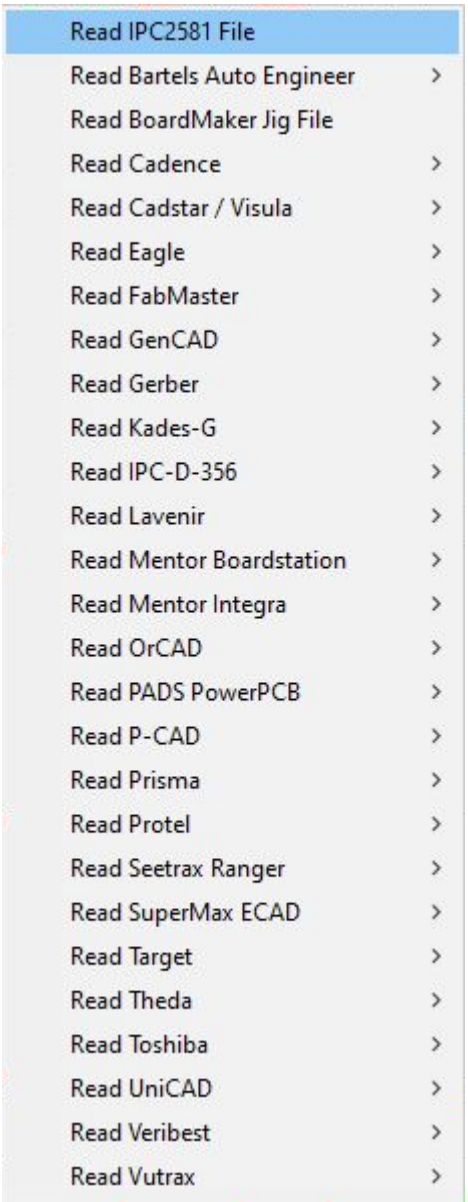
Use the joystick to centre the camera on the Calibration Block and click the **Save** button — the GRS550 will record the crosshair position and produce a probe pin indentation close to the same point on the Calibration Block.

Adjust the joystick so that the camera crosshair is precisely positioned on the indentation made by the probe pin and press **Save**. This completes the probe calibration. Repeat this process whenever a misalignment of the test pin is suspected.

Creating the Test List (programming test points)

Creating the test list

The list of points and components to be tested may be derived from CAD data if available (see **Creating test points from CAD data**) or created using the manual programming interface (see **Creating test points manually**). The GRS550 includes a full range of file import formats as shown in this list:

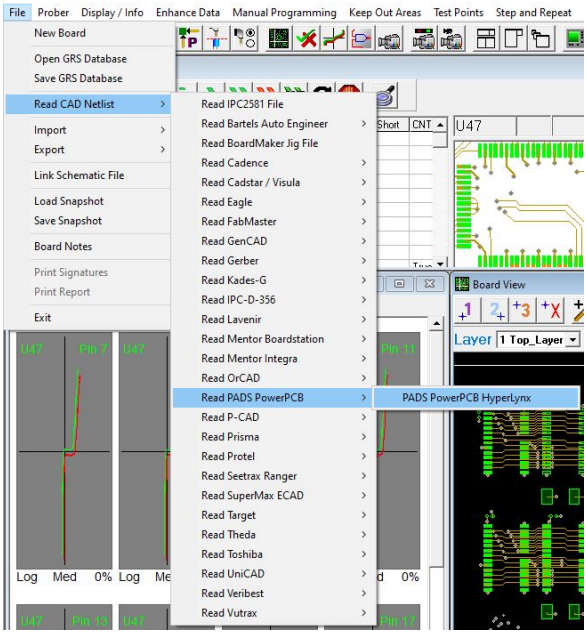


Creating test points from CAD data

Loading the CAD Netlist file

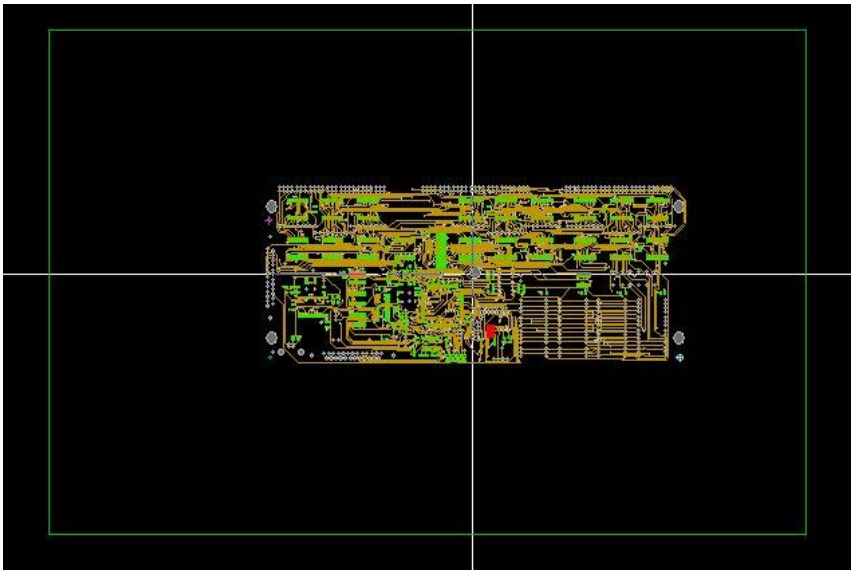
Use the **Read CAD Netlist** command from the **File** menu to choose the appropriate CAD netlist file, the pad and trace data file for the board under test.

Click on the **File|Read CAD Netlist** menu item and choose the netlist format from the dropdown list, e.g.



Select the file from the dialog box and press **Open**. The GRS550 displays the pad and trace data for the board. If necessary, use the **Enhance Data|Rotate Data** command to rotate to a suitable orientation.

The CAD board data image should all fall inside the green box (the green box represents the GRS550 table area). If parts of the image fall outside the green box, use the **Enhance Data|Move** command to move the display within the box (see **Moving round the GRS550 display**). (When the board is aligned it will be placed in its true position and orientation within the table area.)

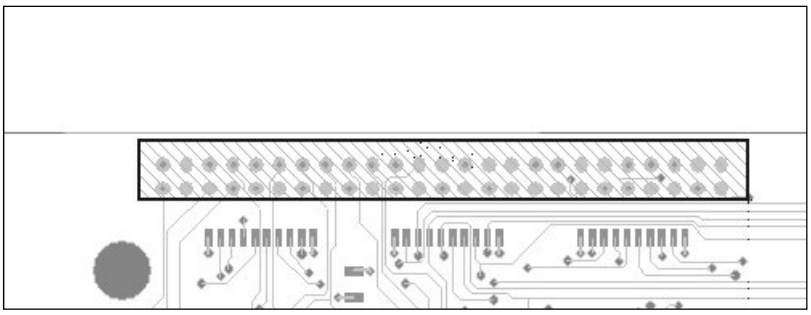


Board data located within table area

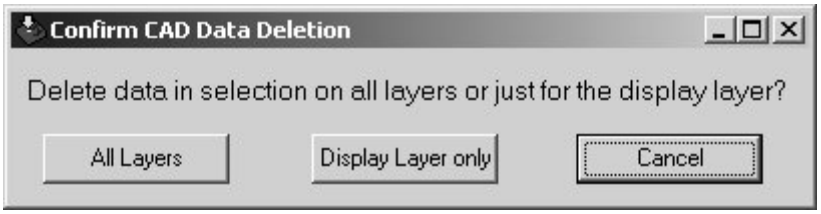
Removing superfluous data

Some CAD data files include data outside of the board area to be tested, registration information, points that would fall outside the table area, etc. Use the **Enhance Data|Remove Data** command to erase unnecessary data (choose the **Remove Data** command and follow the instructions in the Status Bar).

Select the **Enhance Data|Remove Data** command and locate the crosshair at the top left of the area to be removed, press M (Mark Pad), move the crosshair to the lower right corner of the removal area and press M again to draw a box round the removal area (as shown below).



(Pressing the Esc key cancels the operation.) Use the confirmation dialog box to select data for deletion on the layer on display or on all layers.

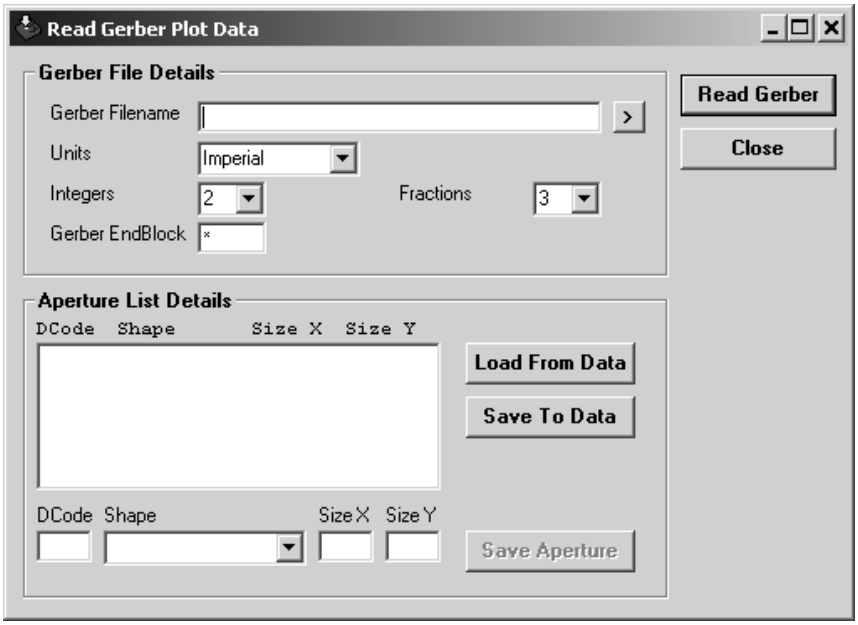


Loading Gerber Plot Data

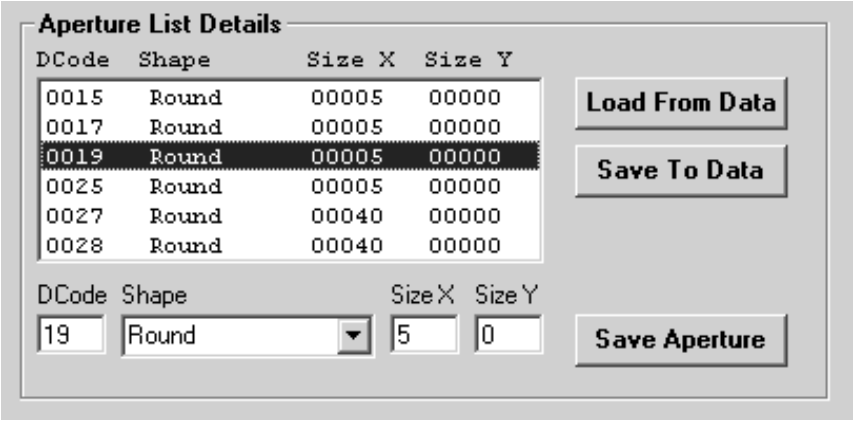
Gerber format is a global photo-plotting format available from all CAD systems.

The Gerber file format, however, does not contain Component Names, Package Descriptions or Net Information.

If the Gerber file format is chosen for import (**File**|**Read Cad Netlist**|**Read Gerber**|**Gerber Plot Data**) the **Gerber Plot Data** command displays the **Read Gerber Plot Data** dialog box.



Specify the file name in the Gerber Filename field or use the browse button to navigate to the folder containing the file and choose the file from the file list. Enter the Gerber File details — measurement units, integer/fraction number format, etc. — and click the **Read Gerber** button. Pad shape details are displayed in the Aperture List Details text box.



Edit pad shape details if necessary — double click on the aperture type in the list and modify the details in the associated text and list boxes. Click the **Save Aperture** button to store the changes.

Creating Components

Simple file formats such as Gerber Plot Data do not contain component names, package descriptions or net information. The resulting test program produced by the **Allocate Test Points** command would contain a series of single pin components.

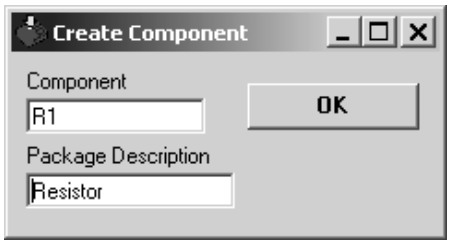
The **Create Component** function allows the user to specify individual pads on the plot as belonging to actual components. Grouping pads to form components can greatly reduce board test times. Components can consist of a wide range of device

configurations, from two or three pin devices containing groups of pins to multi-pin ICs built from series of pins.

Creating the component

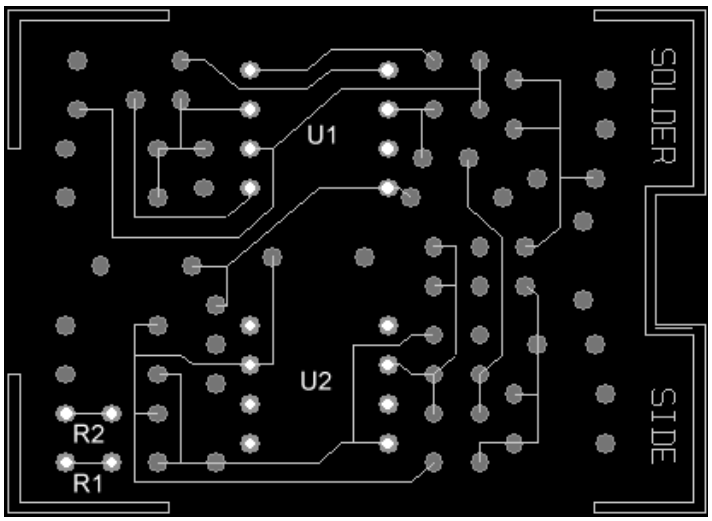
To create components the operator defines and describes the component using the **Create Component Name** command and adds individual pins in the case of small pin-count components such as resistors, diodes, transistors, etc. or series of pins for larger components, such as memory chips, microprocessors, etc.

From the **Enhance Data** menu choose **Create Component Name**. Enter the name and package description and press **OK**.



Small pin count components

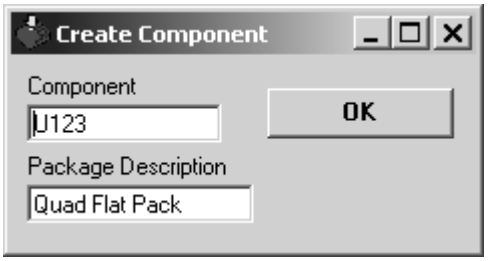
For small pin count components (e.g. R1, R2, U1 and U2 in the example below) use the **Load Component Pins** command to add a pin to a component. Locate the crosshair over the first component pin and press **L**, repeat the procedure for each pin.



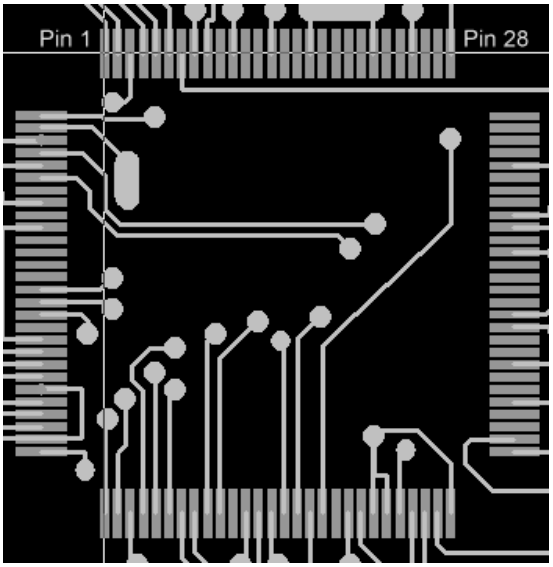
High pin-count components

For components with high pin counts, dual in-line package ICs, quad flat-pack devices, etc. use the **Add Series of Pins** command.

Name the component, e.g. U123, supply the package description and press **OK**.



Locate the crosshair over the first pin (Pin 1 in the example below) and press **S — Add Series of Pins**. Follow the prompts on the Status Bar — press **M** to mark the pad as the first pin in the series, move the crosshair to the last pin in the series (Pin 28 in the example) and press **M**.



Locate the crosshair on the first pad in the next series and repeat the process for each series of pins. All the marked pins will be regarded as a single component.

Repeat the process for each component.

Creating test points manually

With no CAD data available it will be necessary to create suitable board alignment points and to create components manually.

Important: when creating test points manually do not move the board during the programming process. Program every point, including alignment points, for the whole board without disturbing the position or orientation of the board.

Ensure the camera view is visible on screen before beginning the process of creating alignment and test points manually. If necessary click the **Default Windows Layout** *or* **Large windows Layout** *button to return the display to a standard view.*

Laser Pointer toggle button

Use the Laser pointer feature to support the programming work and to ease the location of the components on the PCB assembly. Note – the laser pointer is aligned with a small offset to the yellow crosshair, so as not to obstruct the view of the exact test point location.

Creating a new board

From the **File** menu choose **New Board**: the GRS550 clears all data and displays the table area (a green rectangle approximately at screen center).

Manual Programming Mode button

Click the **Manual Programming Mode** button to display the **Manual Programming** tool bar.

Manual Programming tool bar

The Manual Programming tool bar incorporates the functions for creating, copying and deleting components in a wide variety of formats, from single test points to quad flat packs.

Alignment Point

Single Point

Single In-line Package

Small Outline IC

Dual In-line Package

Quad Flat-Pack

Copy Component

Pitch and Pins Count

Delete Component

QR Code Position

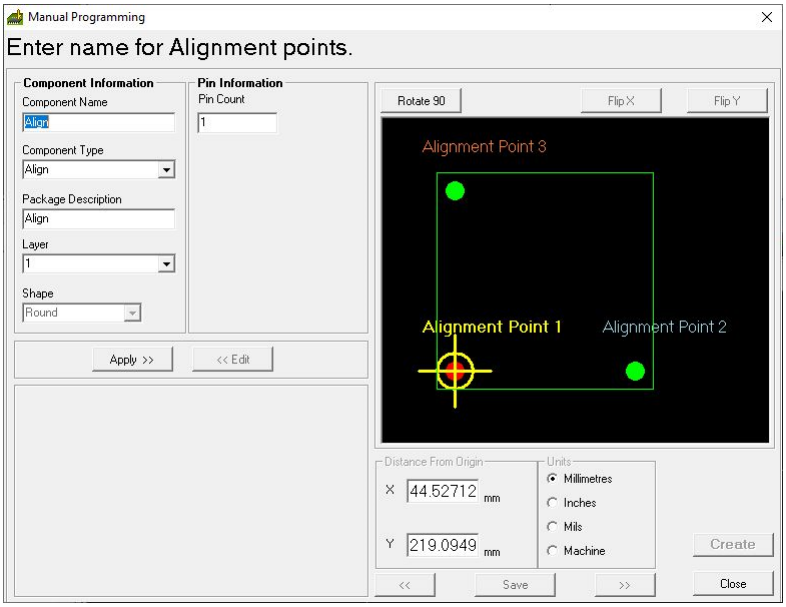
Creating alignment points

Each PCB will require three data points (*alignment points*) to be used to establish the height, position and orientation of the board data at test time. The **Alignment Point** function is used to create data points and assign them as alignment points. The alignment points may, if desired, be designated as Keep Out points: see **Excluding areas of the board from testing**.

As the GRS550 uses the three alignment points to determine board height, position and orientation at test time, all alignment points should be chosen from points exactly level with the board surface (i.e. not on points raised above the plane of the board surface, such as component pins or end pads).

Alignment Point button

Click the **Alignment Point** button to display the Manual Programming alignment Points dialog box.



Choosing alignment points

Consider the following points when choosing alignment points:

- If available, use the centre indicators on the tooling pins.
- If the board already incorporates accurate fiducial marks, use them!

Important: It is **absolutely critical** to place the three alignment points at their corresponding positions:

Alignment Point 1 button

1st Alignment Point **on front left** of board.

Alignment Point 2 button

2nd Alignment Point **on front right** of board.

Alignment Point 3 button

3rd Alignment Point **on rear left** of board. (do not place on a via hole as it would result in a wrong Z-height measurement)

- Choose points on the reference board that are easily identified — e.g. an inside corner of a circuit board track.
- Choose an object that has been *etched* onto the board — don't rely on silk screened or printed characters (e.g. circuit references).

Avoid using a through hole as third alignment point. The Z-axis height is being measured on the third alignment point and probing into a hole may result in a wrong Z-value

Assign a name to the first alignment point and click **Apply**; following the instructions on screen use the joystick and camera to locate the first alignment point. Click **Save** to save the first alignment point.

Select and **Save** the second alignment point.

Select and **Save** the third alignment point.

Click **Create** to confirm the alignment points.

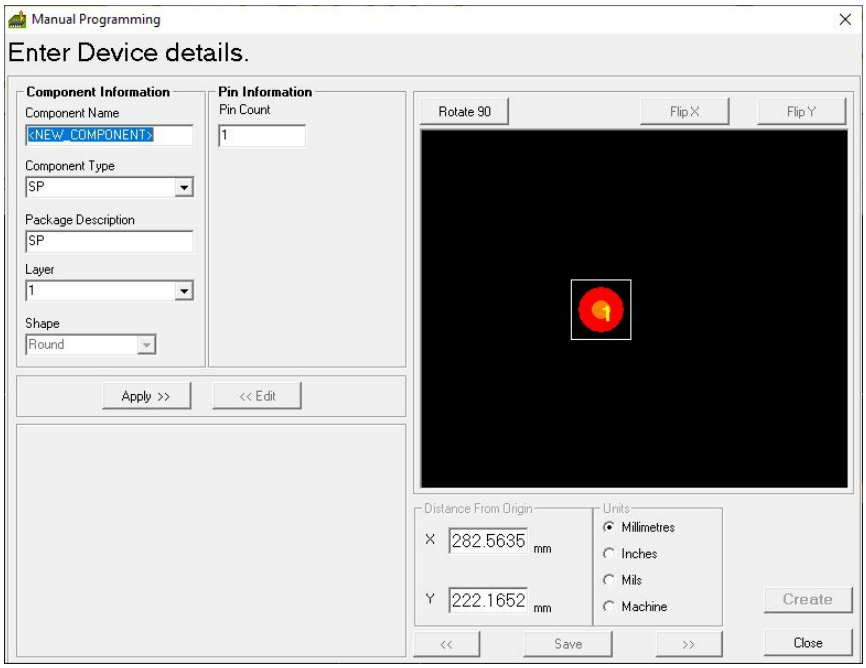
Creating components manually

Creating Single Point components

Single Point button

The Single Point function is used to create data points for single nodes on a PCB, such as circuit test points; similarly, some devices that may prove difficult to test as single components may be divided up into several single point devices.

Ensure the camera view is visible on screen and click the **Single Point** button to display the Single Point dialog.



Single Point Component/pin information

Supply the component information for the point and click **Apply**.

Note: the Component and Pin Information sections must be filled in correctly prior to specifying its location. If the details are incorrect click the **Edit** button to make corrections then click **Apply** to continue.

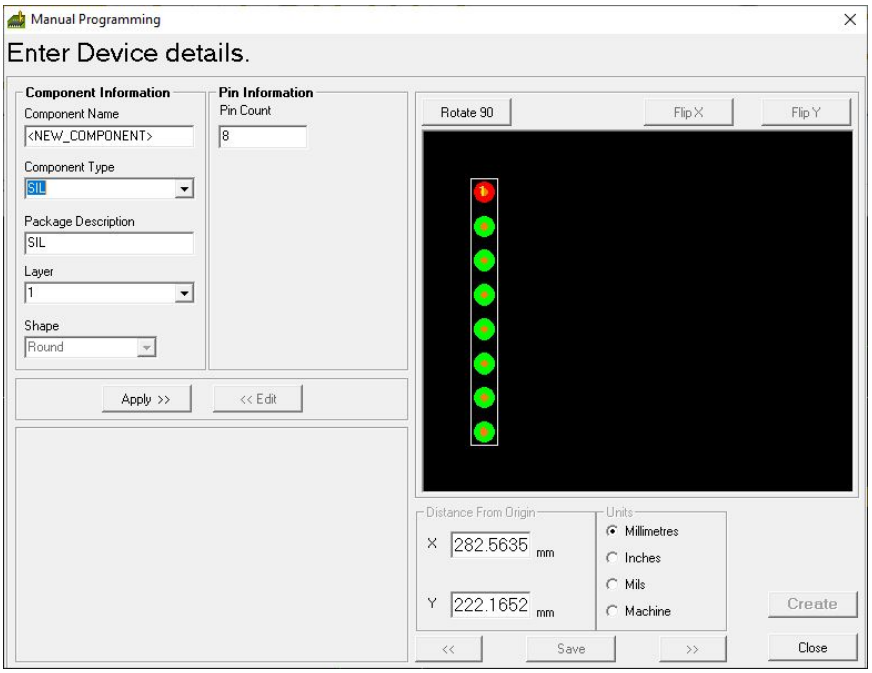
Use the camera and joystick to locate the data point and click **Save**. The GRS550 creates the component and assigns it a test point (denoted by the orange dot). With the component defined, click **CREATE**. Repeat for all single point components.

Creating single in-line packages

To create a single in-line device it will be necessary to define the device and specify the layer, pin count and location of the first and last pins and the orientation of the device.

Single In-line Package button

Click the **Manual Programming SIL** button to display the SIL dialog.



SIL dialog with pin count and orientation specified

Specify the component name, type and description, pin count and board layer and click **Apply** (use **Edit** to make corrections).

Click **Rotate 90** until the orientation shown in the dialog matches that of the device on the board and position the crosshair on the centre of the first pad in the component; click **Save**.

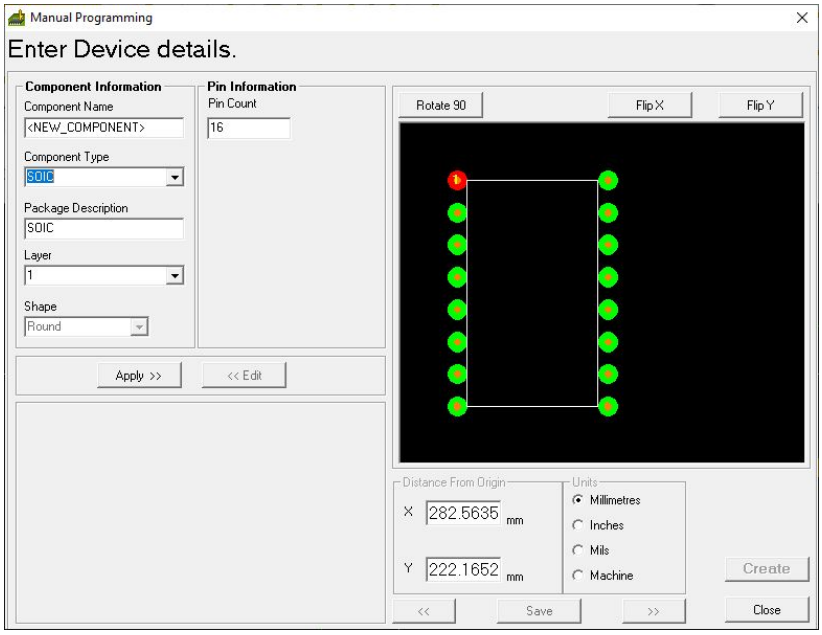
Following the on screen instructions, move the crosshair to the last pin and click **Save** then click **CREATE** to create the component.

The component will be added and displayed in its correct location with test points assigned within the table area.

Creating small outline IC (SOIC) devices

Small Outline IC button

Click the **Manual Program SOIC** button to display the Manual Programming SOIC dialog.



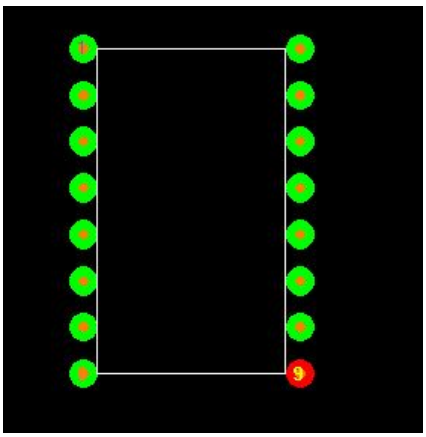
SOIC dialog with component information

Enter the component information and pin count and click **Apply**.

Move the crosshair to pin 1 of the device. Use the Rotate 90 and Flip X and Flip Y buttons to orientate the graphical representation of the device to that of the device on the board. Click **Save**.

Move to the last pin on the first side of the device and press **Save**.

Move to the first pin on the second side of the device and click **Save**.



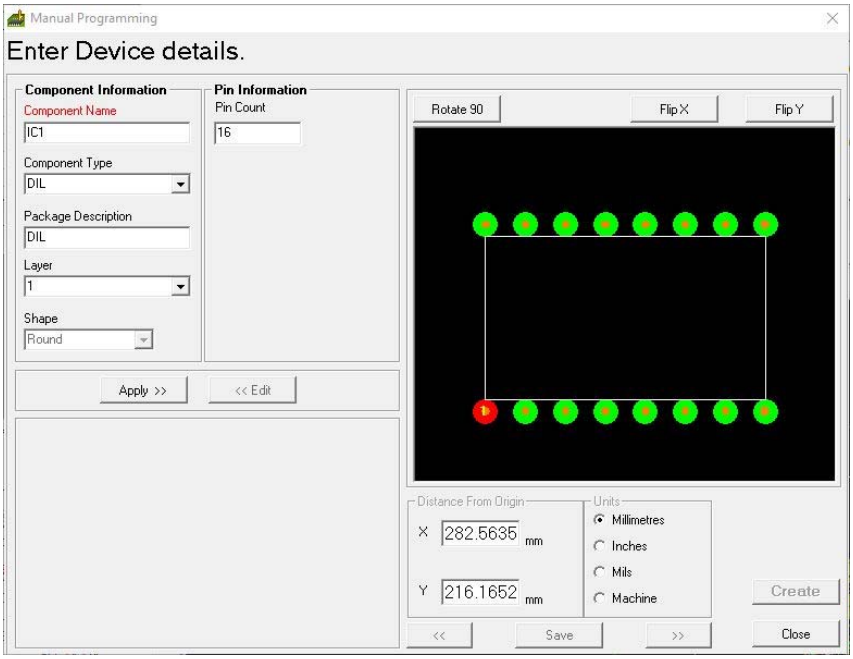
SOIC device with first pin highlighted

Click **CREATE**; the device is located in position on screen in the table area with a test point allocated to each pin.

Creating dual in-line package devices

Dual In-line Package button

Click the **Manual Program DIL** button to display the Manual Programming DIL dialog.

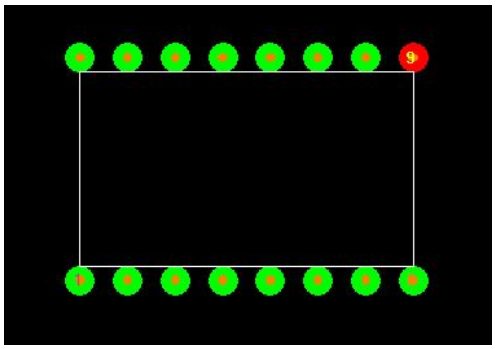


DIL dialog with component information

Enter the component information and pin count and specify the pad shape and use the Rotate 90 and Flip X and Flip Y buttons to orientate the graphical representation of the device to that of the device on the board then click **Apply**. Move the crosshair to pin 1 of the device. Click **Save**.

Move to the last pin on the first side of the device and press **Save**.

Move to the first pin on the second side of the device and click **Save**.



DIL device with first pin on second side highlighted

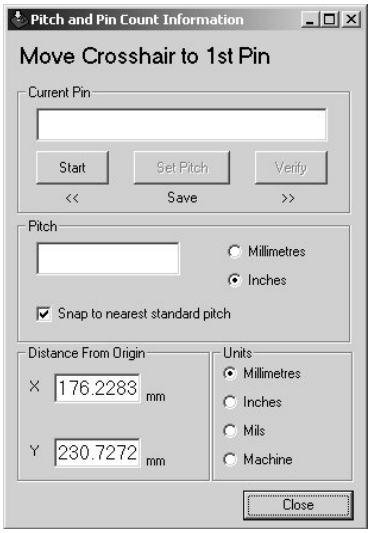
Click **CREATE**. The device is located in position on screen in the table area with test points assigned to each pin.

Determining device pin pitch and count

For devices with high numbers of pins or fine pitch components use the **Pitch and Pins Count** function to determine the number of pins and pin pitch.

Pitch and Pins Count button

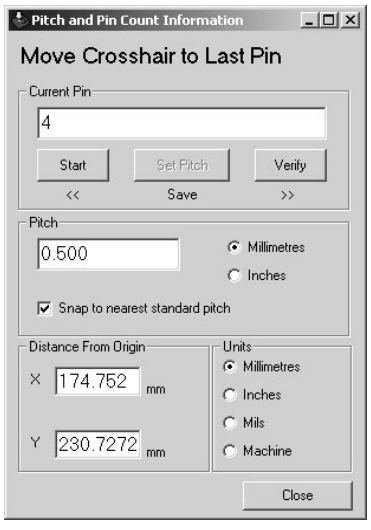
Click the **Pitch and Pins Count** button to display the Pitch and Pins Count dialog.



Pitch and Pin Count dialog with crosshair on first pin

Position the crosshair precisely on the center of the first pin of the device and click **Start** to record the position of the first pin.

Move the crosshair to the fourth pin and click **Set Pitch**. The GRS550 calculates and displays the device pin pitch. If desired click the **Snap to nearest standard pitch** check box.



Pitch and Pins count dialog with derived pitch of device

Move the crosshair to the last pin and click **Verify**. The GRS550 calculates and displays the number of pins and steps back over each pin to confirm the position of each pad.

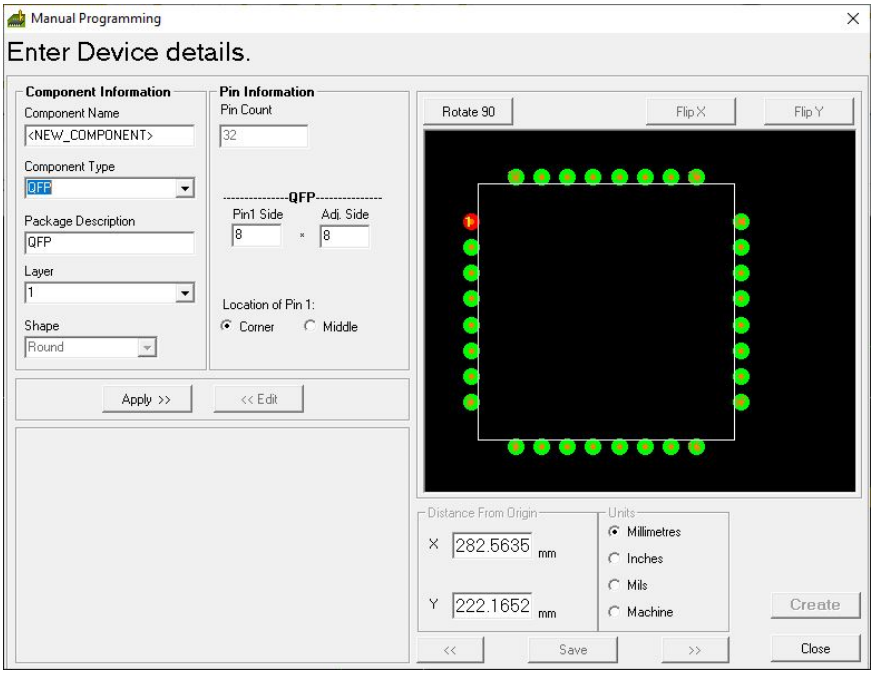
Creating quad flat-pack devices

Note: because many large quad flat-pack devices are densely packed and have a high pin count it can prove difficult to determine visually the number of pins on such devices.

Use the Pitch and Pin Count function to determine the number and pitch of the device pins *prior* to creating the component.

Quad Flat-Pack button

Once the number of device pins on each side is known, click the **Manual Programming QFP** button to display the Manual Programming QFP dialog.



QFP component and pin information

Enter the component information (name and type, etc.), the number of pins on the Pin1 and Adjacent sides of the device and the location of Pin 1 (corner or middle). The Pin Count text box will be filled in automatically.

Note that the minimum number of pins on each side of a quad flat pack device is four.

Click the **Rotate 90**, **Flip X** and **Flip Y** buttons so that the orientation of the component graphic matches the board device and click **Apply**.

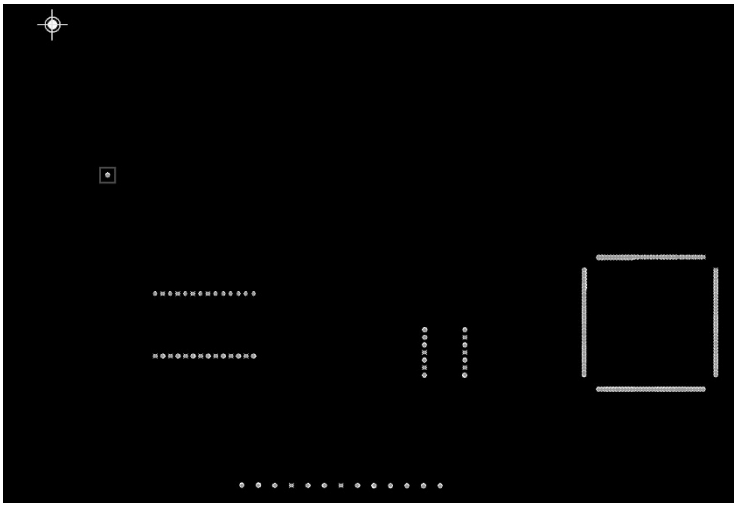
Move the crosshair to Pin 1 of the device.

Follow the steps on screen to locate and save the positions of the first and last pins on all four sides of the device.

Click **Save** then click **CREATE**: the device is located in position on screen in the table area with test points assigned to each pin.

Note: it is recommended that users save board and device information frequently during the programming process.

The diagram below contains a selection of device types located on a board layout, alignment point, single point, SIL, SOIC, DIL and QFP.

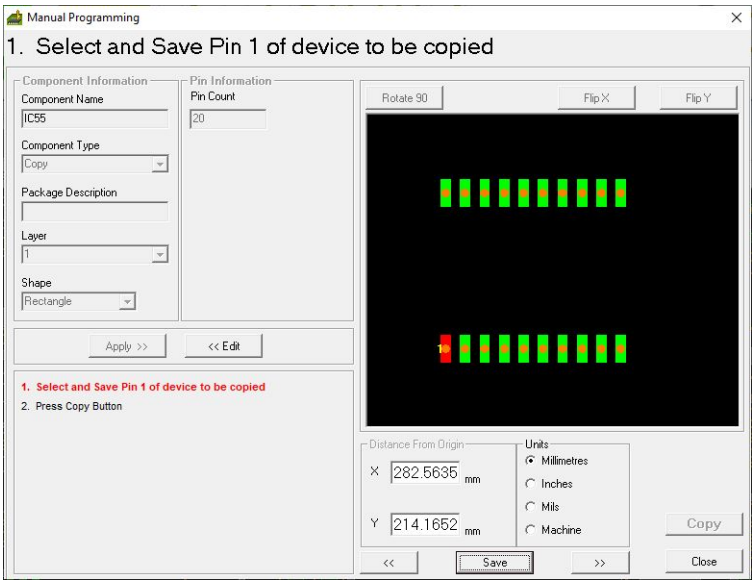


Copying devices

PCBs frequently contain multiple devices of similar outline. If a component already exists (whether derived from currently displayed CAD data or created manually) the **Copy Component** function can be used to replicate the component in other locations on the board.

Copy Component button

With the board component outlines displayed on screen click the crosshair over the component to be copied (if the crosshair is not directly over the device the crosshair will snap to the nearest component) and click the **Copy Component** button. Check the component details and graphic match the device to be copied



Copy Component dialog

Add the component name and description. If necessary rotate and flip the graphic so that it matches the orientation of the device on the board and click **Apply**.

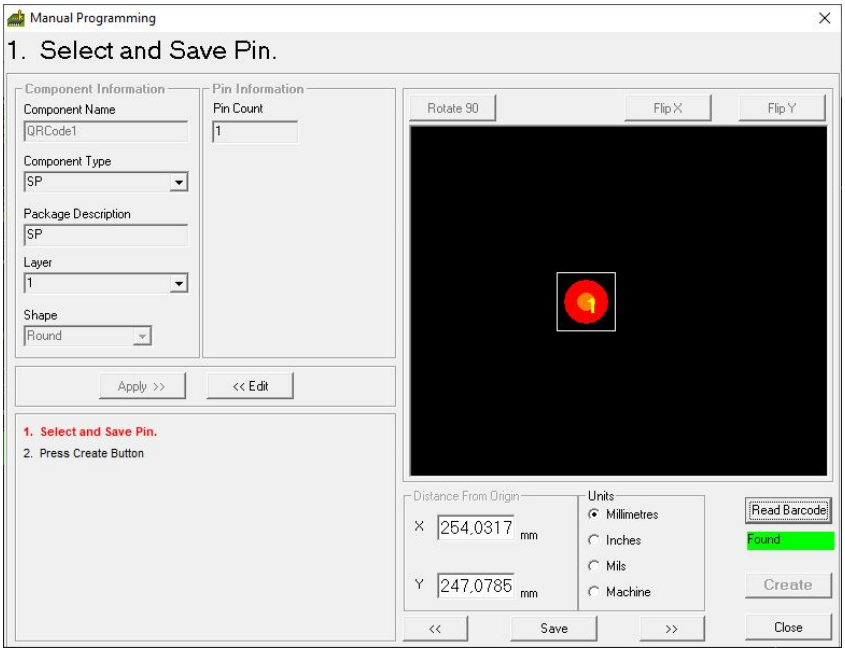
Move the camera crosshair over pin 1 of the component to be created, click **Save** then **COPY**. Repeat for each device to be copied.

Devices which have been created via the Manual Programming interface will have test points allocated to all pins by default and will therefore appear in the test list. Clicking on a device in the test list will display the device in the Test List Component View windowpane and highlight the device in the Board View window.

Adding a QR/Bar Code Position

When the QR Code Reader option is installed and activated in the system´s configuration, the additional QR/Bar Code button appears in the manual programming tool bar. Use this button to program the physical location of the bar code for automatic reading of the board´s serial number and subsequent storing of test results.

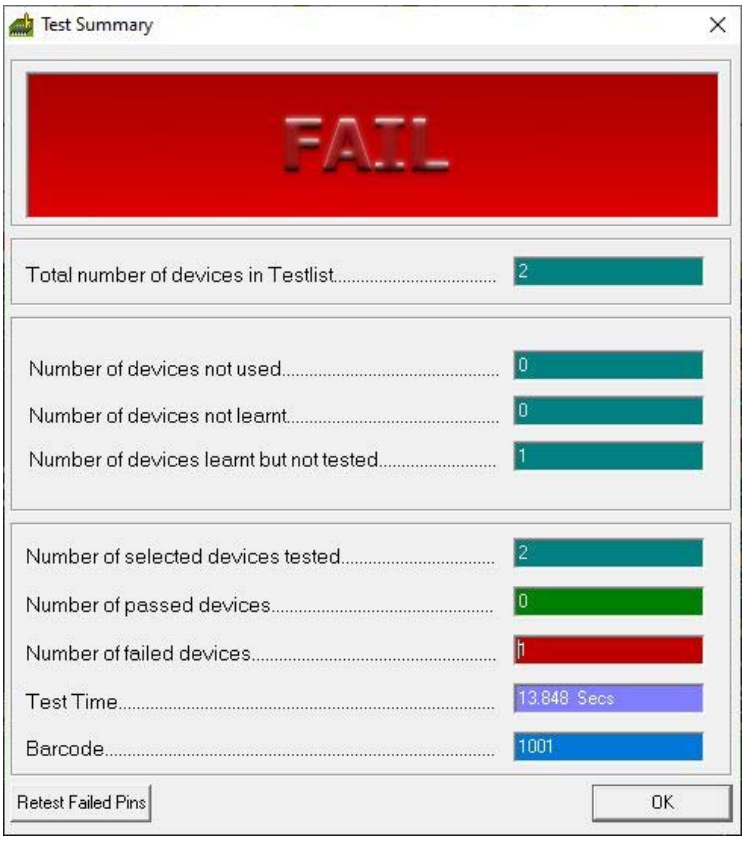
QR/Bar Code button

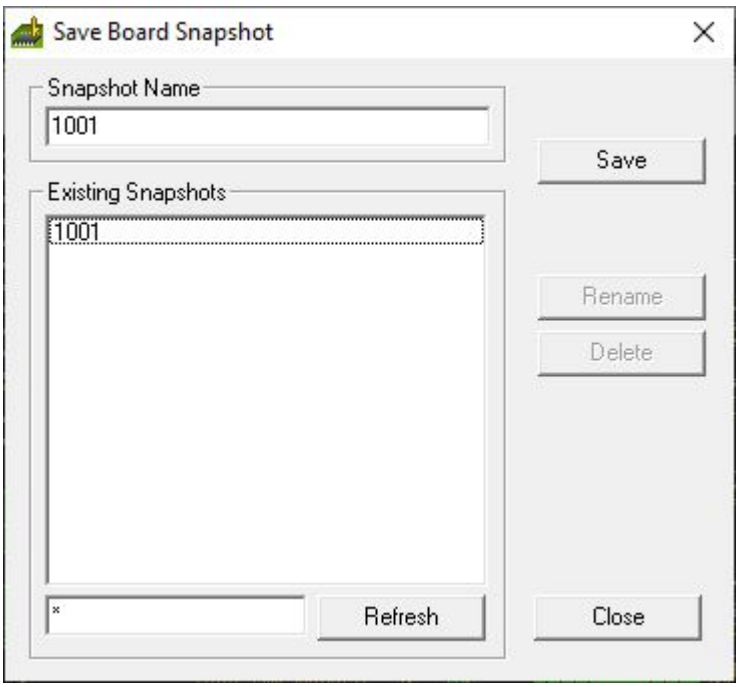


Note the component name is predefined as “QRCode1”. Click the the “Read Barcode” button and use the joystick to move the camera head to the bar code position. The Bar Code reader projects a green illuminated field-of-view onto the PCB, indicating the actual reading window of the Bar/QR Code. Once the Bar/QR Code is within the reading window, the system reads the Bar/QR Code and displays “Found”. Press “Save” to store the actual position of the bar code. Note that the actual position of the newly created component “QRCode1” on the CAD coordinates may not correspond with the physical location of the QR code on the PCB. This is perfectly acceptable as long as the code is within the reading window of the QR Code reader.

For fine tuning the Bar/QR Code Reader, see also “Bar Code Reader” in “Prober” – “Prober Diagnostics”

The result of the bar code reading process is automatically transferred to the Test Summary and to the “Save Board Snapshot” serial number text box, eliminating manual operator input:





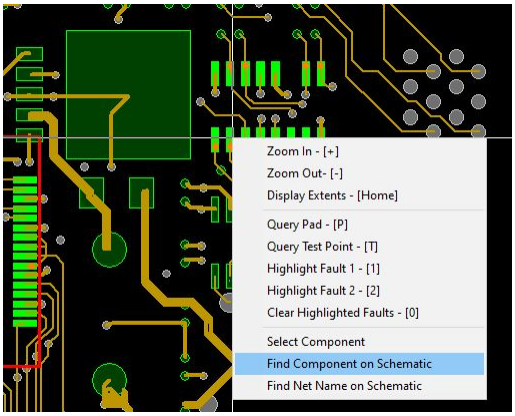
Linking schematics to the board type

To assist in test and troubleshooting, the GRS550 allows the operator to attach schematic diagrams in Adobe Systems' *portable document format* (.pdf) to the board test file (requires Adobe Acrobat Reader DC). If a suitable schematic is available select the **File|Link Schematic File** command, navigate to the file location and choose the file and click Open. The schematic file will be copied to the folder containing the GSR550 database file and renamed to the name of the GRS550 database file but with the .pdf file extension. The resulting schematic file will be displayed by Adobe Reader in the Schematic View window. Use the Adobe Reader controls to pan and zoom the schematic.

Note: Any file in the portable document format will display in the Schematic View window, including text or documentary files; use this facility to include board information, explanatory text or instructions for board setup and testing.

Searching for components

Use the Adobe Reader search function to locate components and nets on the schematic. To locate a component or net, switch to Board View and position the cross hairs over the component or right click the mouse and choose **Find Component On Schematic** or **Find Net Name On Schematic**.



The component circuit reference or net name is entered automatically into the Adobe Reader **Search** box; click **Search**. Adobe Reader will search for and display all instances of the text. Choose the device from the results list, hide the search window and if necessary zoom in to the component on the schematic.

Schematics may be created directly from the CAD package netlist or scanned from good quality printed schematic diagrams.

Note: the Adobe Search function is dependent on the existence of text within the .pdf file. The Search function will not find manually scanned text saved in graphic format.

Setting alignment points

When a board has CAD data available, use suitable data points as alignment points (see **Choosing alignment points** for a discussion of suitable alignment points).

Use the Alignment Point buttons on the toolbar to set alignment points and align the board. The Alignment Point buttons on the associated toolbars are shown below:

Set 1st Alignment Point **on front left** of board

(Board View toolbar)

Set 2nd Alignment Point **on front right** of board

(Board View toolbar)

Set 3rd Alignment Point **on rear left** of board

(Board View toolbar)

Delete Alignment Points (Board View toolbar)

Align Board (Test List toolbar)

Auto Align Board (Test List toolbar)

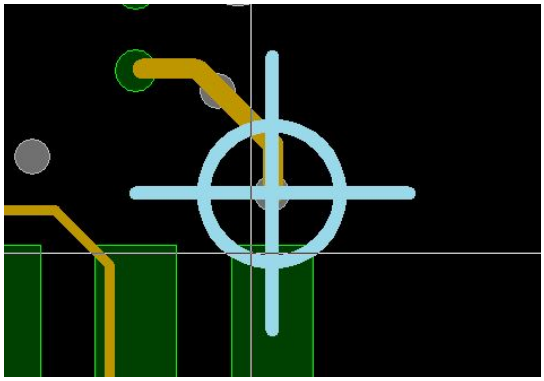
Important: It is **absolutely critical** to place the three alignment points at their corresponding positions:

- 1st Alignment Point **on front left** of board
- 2nd Alignment Point **on front right** of board
- 3rd Alignment Point **on rear left** of board

By using the positions of the alignment points, the GRS550 determines the true physical dimensions of the board in both, X and Y direction and applies scaling factors to align the CAD Data with the physical board size.

Choosing alignment points from CAD data

To assign alignment points for a board with CAD data available, load the data for the board and choose a suitable alignment point and click the Set 1st Alignment Point, Set 2nd Alignment Point and Set 3rd Alignment Point button.



Alignment point assigned to via

Each data point that is designated as an alignment point is shown as a crosshair and circle in corresponding colour.

To delete alignments points, choose the **Delete Alignment Points** command from the Prober menu.

Excluding areas of the board from testing

CAD data points derived from the netlist may result in nodes that are inaccessible to test probes. Pins or components that will prove difficult or impossible to test may be marked for exclusion from the test list (the list of points to be tested) that will be created by the Test Points Allocation process.

Click the Keep Out Mode button to display the Keep Out tools.

Click the **Keep Out Mode** button to switch to Keep Out Mode and display the Keep Out tools.

The Keep Out Mode buttons are displayed in the Co-ordinates and Highlighted Error Display Area. The keyboard short cuts are shown in parentheses

Keep Out tool bar

Advanced Keep Out options

Add Keep Out Point (A)

Delete Keep Out Point (D)

Add Keep Out Component (C)

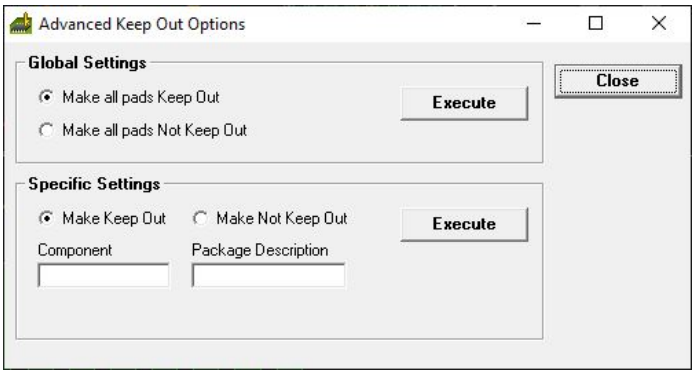
Remove Keep Out Component (R)

Advanced Keep Out Options

Advanced Keep Out options

Choose the **Advanced Keep Out Options** command to apply Keep Out settings to all pads, to specific components or to groups of components.

To apply Keep Out settings globally choose **Make all pads Keep Out** or **Make all pads Not Keep Out** as required and press **Execute** to apply the settings — the dialog box remains displayed.



To apply Keep Out settings to a specific component enter the Component name and Package Description, specify the setting and press **Execute**.

To exclude all components of similar nomenclature, type the circuit reference in the Component text box or the package description in the Package description box, select the Make Keep Out option and click **Execute**.

For example, to exclude all packages with circuit reference U*xxx* type U in the Component text box, select Make Keep Out and click **Execute**.

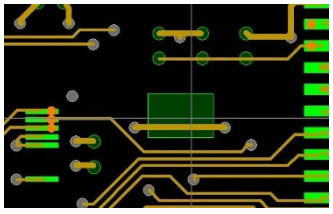
Excluding single test points and components

Add Keep Out Point button

To mark a point for exclusion from the test list, locate the crosshair over the pad and click the **Add Keep Out Point** button or press **A.**

The pad will not be included in the test list. Excluded pads are shown in a darker shade of their original colour.

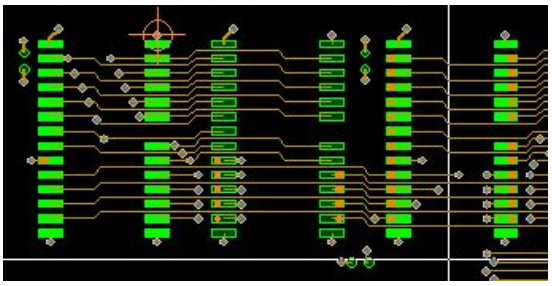
Click the **Delete Keep Out Point** button or press **D** to remove the deleted test point.



Add Keep Out Component

To add a component to the Keep Out list, locate the crosshair over any of the component pins and click the **Add Keep Out Component** button or press **C**.

The component will be displayed in dark green and excluded from the test list.



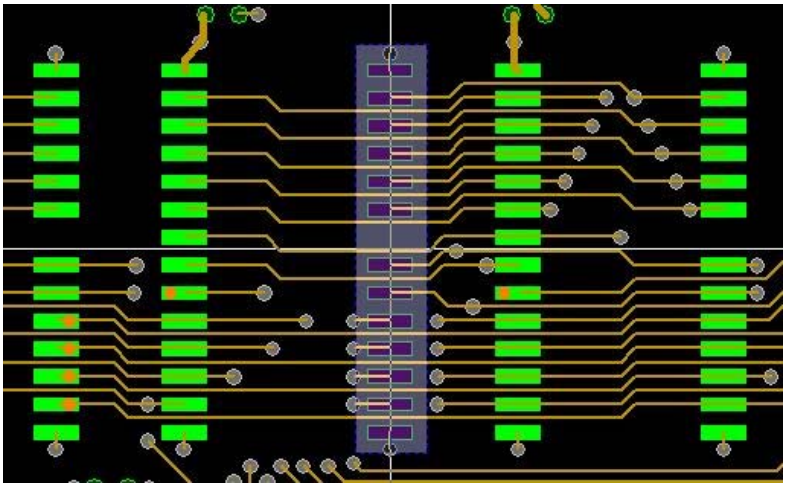
Remove Keep Out Component

To restore the component to the test list click the **Remove Keep Out Component** button or press **R**.

Note: if components are designated Keep Out after the test list has been compiled it will be necessary to reallocate test points.

Excluding test points and components by window

To select an area on the board for exclusion drag the mouse over the area to form a rectangle.



Click the **Add Keep Out Points** button; all points within the area will be marked as Keep Out. To re-enable the test points, click the **Delete Keep Out Points** button.

Allocating Test Points

To allocate test points for a board, the operator will normally use the **Allocate Test Points** command to assign test points automatically then manually edit the resulting test point list.

Test points allocation will depend on how the board data are produced. Board data can be derived from CAD data if available or programmed manually. For manually programmed data (i.e. boards with no CAD information) it will probably be most appropriate to test every point on the board.

For data derived from CAD files the GRS550 can intelligently allocate test points:

- to test all multi-pin devices, i.e. devices with more than 2 pins
- to test each net once only (each net will normally connect to several devices, so each node will produce the same signature).

This can significantly reduce the test time for a board.

Test Points Mode button

With the board data displayed and the KeepOut areas defined, click the **Test Points Mode** button to switch to Test Points Mode.

Test Points tool bar

The Test Points tool bar is displayed in the Board View window.

Test Points tool bar functions

The Test Point tool bar functions and their associated keyboard short cut keys are shown below:

Allocate Test Points

Add Test Point (A)

Delete Test Point (D)

Offset Test Point (O)

Jog Test Points Outward (J)

Jog Test Points Inward (I)

Move Test Points in selected window to the Left

Move Test Points in selected window to the Right

Move Test Points in selected window Up

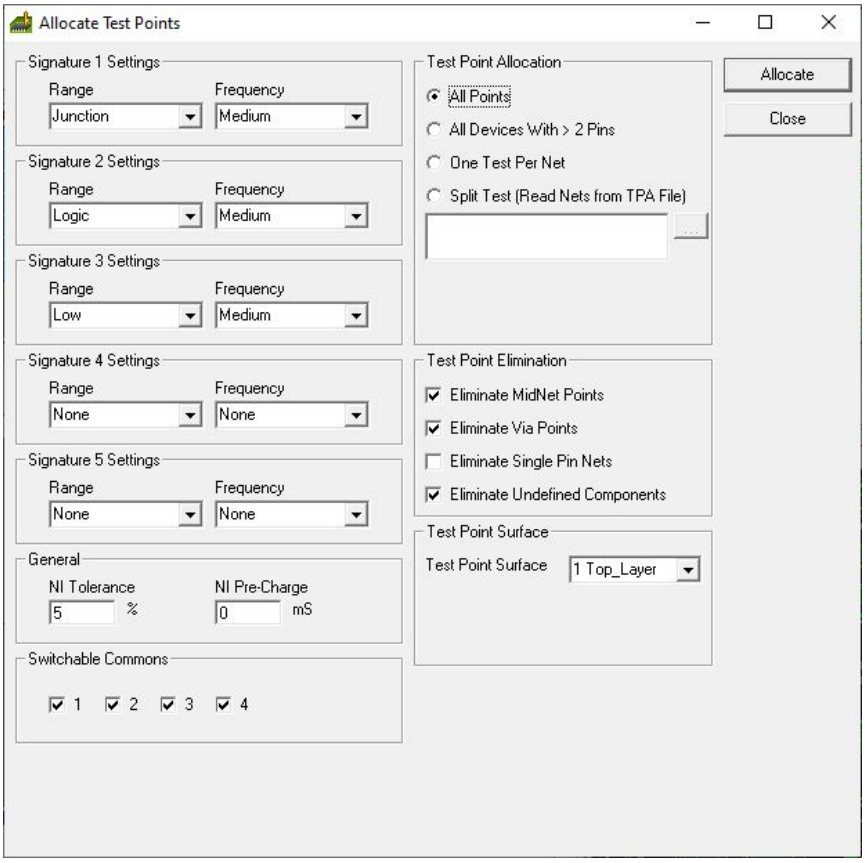
Move Test Points in selected window Down

Remove Components Test Point (R)

Undo Test Point Movements (U)

Allocate Test Points button

Press the **Allocate Test Points** button (or choose the **Allocate Test Points** command from the **Test Points** menu) to display the **Allocate Test Points** dialog box and specify the nodal impedance test parameters and how test points are allocated.



Using the Allocate Test Points dialog the operator can

- Specify the Nodal Impedance test parameters
- Control how test points are allocated
- Control how test points are excluded
- Specify which test point surface (top or bottom of board) is to be used for testing
- Specify which common lines are connected to the measurement system common.
- Use “Split Test” in case the board needs to be tested from both sides. Split Test will allocate only test points to nets, that are inaccessible on the first test point allocation run. Inaccessible nets are stored in a *.tpa text file. (See “Test point surface selection” below)

Test parameters

Use the check boxes and option buttons to select the Nodal Impedance voltage ranges and test frequencies to be applied during testing. Set the Nodal Impedance Tolerance and Pre-Charge via their respective text boxes.

The default settings will probably be found suitable for most testing. See **Defining Test Conditions** for a discussion of voltage ranges and frequencies and signature shapes for nets.

The test allocation process assigns the test parameters to every test point on the board. To specify different parameters for individual test points and devices select the devices from the test list in **Test List** view and modify the device properties. (See **Test List**.)

Test Point Allocation

Test points may be allocated:

To test every point on the board

To test all multi-pin devices, i.e. devices with more than 2 pins

To test each net once only

A net will typically include several test points over the length of the net. Testing **All Points** (every point on the board) will therefore result in each net being tested several times.

Although this is the most comprehensive method of testing and can assist in building up a fault profile for the board it can prove costly in test time on large and complex boards.

Testing **All devices with > 2 pins** can reduce the test time.

Use the **One Test Per Net** option to test each net once only. This will result in the shortest test time for a board while guaranteeing a test of all accessible nets.

Eliminating test points

The check boxes in the **Test Point Elimination** group allow the GRS550 software to exclude unwanted test points during test point allocation.

If **All Points** or **All devices with > 2 pins** have been specified via the **Test Point Allocation** group, clicking the associated **Eliminate** check box to exclude mid-net points and via points will ensure only the net end points will be tested. (Not all CAD formats specify mid-net points, so they may not be eliminated.)

If the **One Test Per Net** option has been specified click the **Eliminate Single Pin Nets** check box to exclude single pin nets. These are typically tooling or mounting holes, or unconnected pins of devices and connectors.

To eliminate test points not included in component definitions click **Eliminate Undefined Components**.

Test Point Surface selection

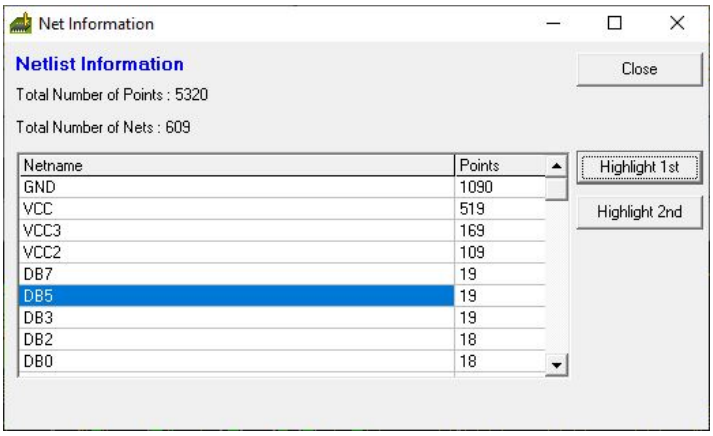
Use the **Test Point Surface** drop down list box to specify which test point surface will be used for the test. Click the list box arrow to select the test surface from the list of surfaces.

When all options have been specified, click **Allocate** to generate the test point list. The GRS550 software generates the test point file and displays a report summarising test point allocation.

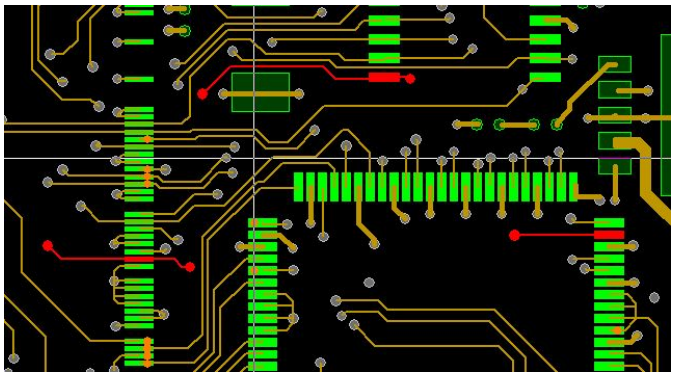
```
*****************************************************
GRS550 Test Point Allocation Report
*****************************************************

Unable to Allocate Net Test Point to Selected Surface : N08083
Unable to Allocate Net Test Point to Selected Surface : N146056

Total Test Points (One Test Per Net)  : 311
Test Points Eliminated              : 208
Test Points Not Accessible          : 2
Test Points Allocated               : 309
```

Click **Close** to close the dialog box. The allocated test points are shown in orange superimposed on the CAD Netlist layer.

The Test Point Allocation Report indicates the nets to which it was not possible to allocate test points. To view a listed net, from the **Display/Info** menu select **Net Information**, choose the net from the list and click Highlight 1st or 2nd.



Close the dialog; the selected net will be highlighted in Board View. The highlighted net is shown in red below.



Editing the Test Point list manually

The allocated test point list may be edited manually. Test points may be added, deleted or offset. To select edit mode, press the **Test Points/Keep Out Areas button** to display **Test Points**.

Adding a test point

Add Test Point button

To add a test point locate the crosshair on a pad on the test surface and click the **Add Test Point** button or press the **A** key.

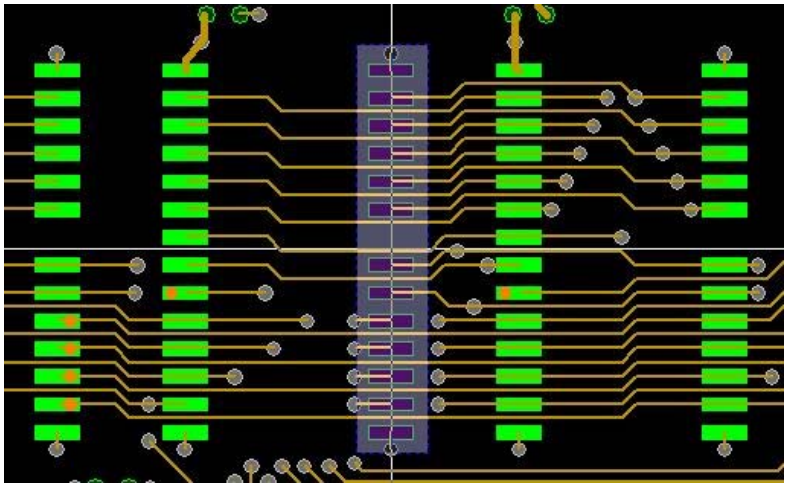
Deleting a test point

Delete Test Point button

To delete a test point locate the crosshair on the test point and click the **Delete Test Point** button or press the **D** key.

Adding and deleting test points by window

To add test points to a block of nodes drag the mouse in the Board View window over the area of the board containing the nodes.



Click the **Add Test Point** button; test points will be added to all nodes within the highlighted area.

Note: VIA points within the selected area will not be assigned test points. Click the **Delete Test Point** button to remove test points from within the highlighted area.

Offsetting a test point

Offset Test Point button

To offset a test point, locate the crosshair on the test point and press the **O** key. Move the crosshair to the new location and click the **Offset Test Point** button or press the **O** key — the test point will appear at the new location.

Jogging a test point (for device based allocation)

It will be necessary on occasions to shift the test point (*jog*) for a device to a different location on the pad to improve probe contact during testing (for example, to allow the test probe to avoid a device leg).

Jog Test Points Outward button

To jog a test point outwards locate the crosshair on the test point and click the **Jog Test Point Outwards** button or press the **J** key.

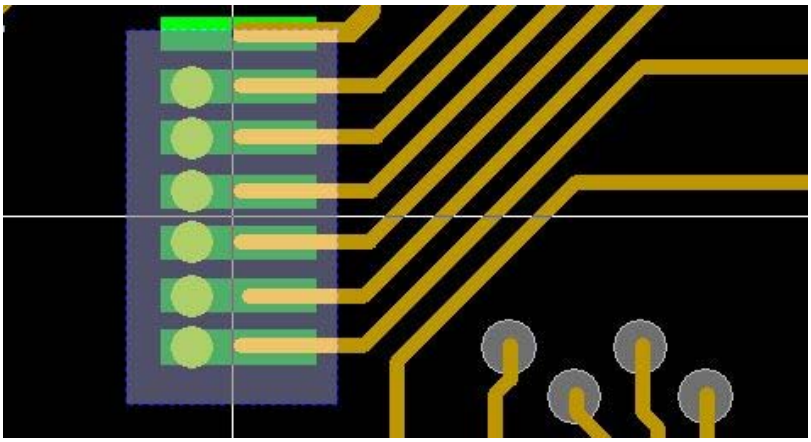
The test point will be shifted outwards by approximately 10% of the pad length.

To jog test points inwards click the **Jog Test Point Inwards** button or press the **I** key.

Jogging test points by window

It will often be found convenient to jog groups of pins (e.g. one whole side of a device) to improve probe contact.

Use the mouse to draw a window round the device pins. Click the Offset Test Point buttons to offset the test point in the appropriate direction



Offset Test Points toolbar

Offset Test Points Left button

Offset Test Points Right button

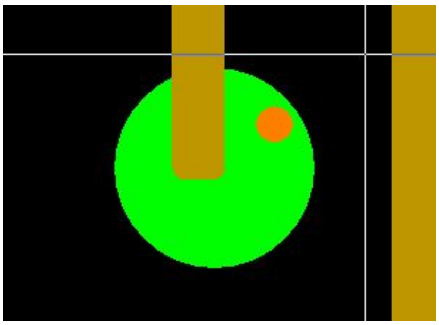
Offset Test Points Up button

Offset Test Points Down button

The diagram above shows the effect of offsetting the test points for one whole side of a DIL package.

Offsetting test points on round pads

The GRS550 Offset Test Points Toolbar allows test points to be offset in all directions, up, down , left and right, This will be found especially useful for offsetting test points on round pads.

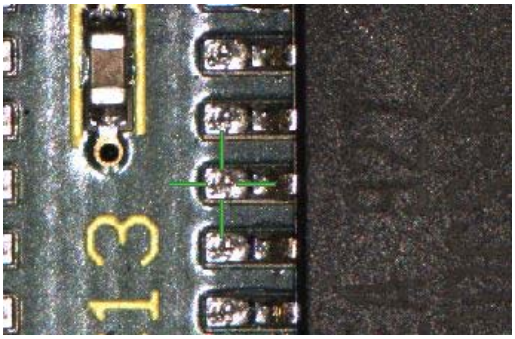


In the graphic above the right pad shows the test point offset diagonally from the pad center.

Prober Options button

To view the actual probe position on the pad set the Prober Options (Prober menu) to **Track Cursor Position**

Use the **J** and **I** keys and the camera to locate the probe precisely on the most suitable position on the pad. The diagram below shows the probe location jogged to the edge of the pad.



Slow Move Down button

Use the Slow Move Down Button to move the probe slowly down at the actual position to verify the best suitable probing point.

Undoing test point movement

To undo test point movements click the **Undo Test Point Movements** or press the **U** key — all offset test points will return to their original locations.

Note: the test point allocation process assigns all test points to the centers of pads. This will remove jogs and offsets applied manually.

Removing Component Test Points

Use the **Remove Components Test Points** command to remove test points resulting from created components. Changes are reflected on screen

Saving the board information to a database

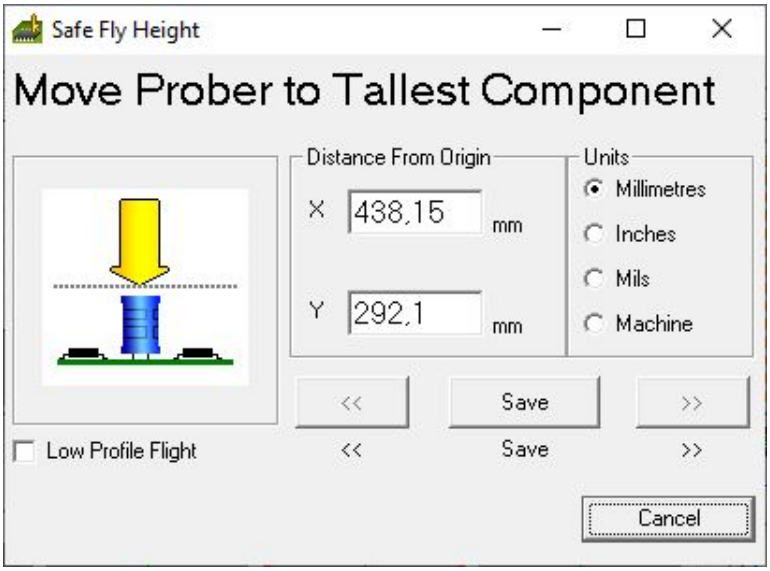
Click the Save GRS Database button to save board information

The fully defined board information, file data, component definitions, excluded areas, alignment points and allocated test points can be saved to a GRS550 database for future reference.Select **Save GRS Database** from the File menu, choose a file name and location and press **OK**. Saved databases can be retrieved using the **Open GRS Database** command. It is highly recommended to use the “Save GRA Database” function in certain intervals during programming, to save any changes.

Setting the Safe Fly Height

Set Safe Fly Height for Prober button

The **Safe Fly Height** command (in the **Prober** menu) allows the operator to record the height of the tallest component on the board under test. The GRS550 uses the setting to clear tall components during testing. From the **Prober** menu choose the **Set Safe Fly Height** command (or press the **Set Safe Fly Height for Prober** button). The **Safe Fly Height** dialog is displayed.



Use the joystick and camera to locate the tallest component and click **Save**. The GRS550 will probe the component and record its height; retracting the GRS550 probe sufficiently to clear this height between tests rather than retracting to the full vertical home position can provide useful speed improvements during testing.

PCB assemblies with very low components (e.g. SMD components) may be tested with the “**Low Profile Flight**” option enabled. With this option turned on, the Z-Axis Stepper motor will maintain the down-position during the entire test and probing is only performed using the probe head´s solenoids. Make sure the

board does not include any components taller than 5mm, else this may result in damage to the PCB and the probe head. Low Profile Flight turned on provides another significant saving in test time.

 Use this feature with caution!

Moving round the GRS550 display

The toolbar incorporate the functions for viewing, panning and zooming the board data.

Board data viewing tools

The button function are as shown below; the keyboard shortcut keys are shown in parentheses.

 Zoom In (+)

 Zoom Out (–)

 Display Extents (Home)

 Pan Left (Left)

 Pan Right (Right)

 Pan Up (Up)

 Pan Down (Down)

 Mirror All (Space)

Changing the view magnification (zooming)

The board layout can be viewed at a wide range of magnifications. To “zoom in”, position the crossover the area of interest and click the **Zoom In** button. Click the **Zoom Out** to “zoom out”. Alternatively, use the mouse scroll wheel to zoom in/out.

The **Display Extents** button zooms the display to include the extent of the data, i.e. every data point on the board.

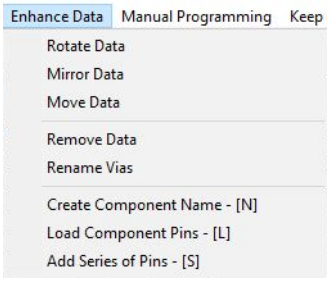
Panning the display

Use the **Pan Left**, **Right**, **Up** or **Down** to pan the display.

Use the arrow keys to pan the display in large steps.

The current crosshair co-ordinates are shown in the co-ordinates area.

With the CAD Netlist loaded it may be necessary to rotate, mirror and move the CAD Netlist/Test Points layer. Use the **Rotate/Mirror/Move Data** command from the **Enhance Data** menu commands to manipulate the Netlist/Test Points layer.



Rotating the display

To rotate the display choose the **Enhance Data** menu then choose **Rotate**, specify the rotation angle and click **OK**.

Mirroring the display

When a trace moves between upper and lower layers it may be helpful to view the display “mirrored” to simulate “turning the board over”.

Select the **Enhance Data** menu and choose **Mirror** — the **Mirror Data** dialog box is displayed. Choose the mirror axis, X or Y, and press **OK**. This mirrors the CAD Netlist/Test Points layer.

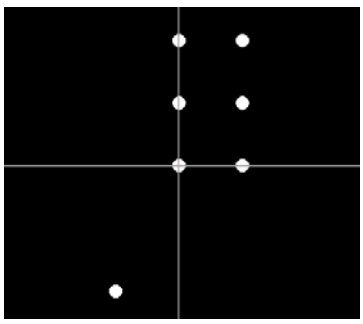
Press the space bar to perform an X-axis mirror of the current display. This mirrors the CAD Netlist/Test Points layer — this is the best and quickest way to flip the data.

Moving the display

Select the point to move with the crosshair click the **Enhance Data** menu and choose **Move** then follow the prompts on the Status Bar.

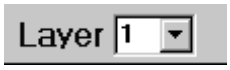
For example, to displace the CAD Netlist layer, locate the crosshair on a data point, select the **Enhance Data** menu and choose **Move** — the status bar displays a prompt **Select Crosshair destination point**.

Locate the crosshairs over a new point and Mark with the **M** key to move to the destination point. If necessary, e.g. when working with large design netlists, use the zoom and pan facilities while marking points.



Viewing individual layers

To view a single layer in a multi-layer board click the **Layer** dropdown list box and choose the layer of interest.



The number of layers is derived from the CAD data file.

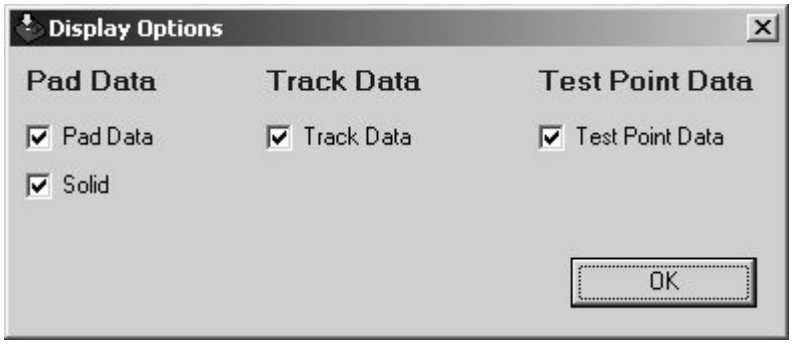
Controlling the display

Display Extents

Press **Display Extents** to zoom the entire board layout to exactly fill the display.

Display Options

The Display Options command allows the operator to select items (Pad data, Trace data, Test Point data.) for display. Use this command to reduce the level of displayed information on screen and increase the visibility of highlighted nets.



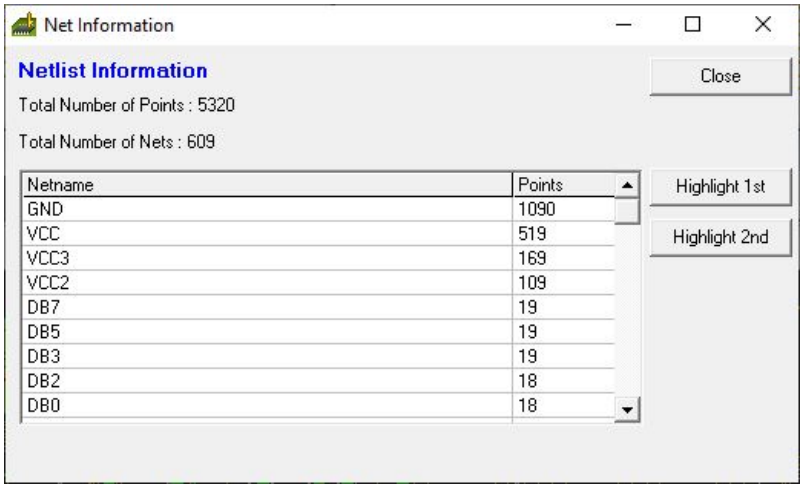
The Display Options dialog box allows the operator to select for viewing:

- Pad data — with the option of displaying pad data as outlined or filled (**Solid**)
- Track data — turn track data on or off
- Test Point Data

The GRS550 displays all data by default; uncheck an item to remove it from the display

Net Information

Select the **Net Information** command from the **Display/Info** menu to display summary information on the currently displayed CAD Netlist.



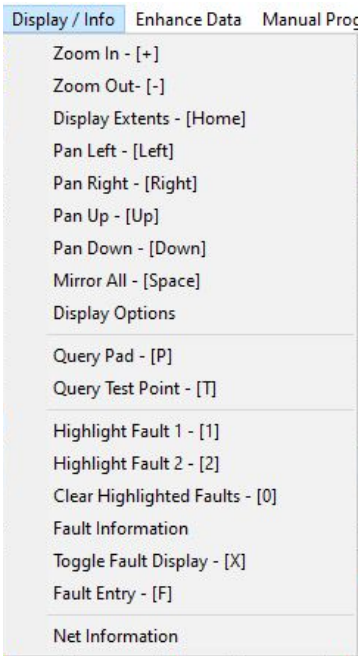
Net Information dialog showing netlist

To trace nets through the board (for example to see where nets may be shorted) choose the nets from the list and click **Highlight 1st** and **Highlight 2nd** to display the selected nets in the board view screen.

Note: click on the “Points” Column header to sort the number of points on a net in ascending or descending order. This is a useful feature to identify the nets with the most components attached to use as board reference for signature analysis testing.

Highlighting nets

To highlight nets for display (during fault tracing, etc.) select the **Display/Info** menu. (See the *Point and Click* method to highlight nets using keyboard shortcuts.)



The **Display/Info** menu provides the commands to:

Select nets for display. Locate the crosshair over a pad on the first net and select **Highlight Fault 1** to highlight the first net. Locate the crosshair over a pad on the second net and press **Highlight Fault 2** to highlight the second net. Select **Clear Highlighted Faults** to clear both nets from the display.

Toggle Fault Display button

Display the highlighted nets on either the current layer only or on all layers. Use **Toggle Fault Display** to select **Display Layer** or **All Layers** modes. When displaying faults on the current layer only (**Display Layer** mode), regardless of layer, the first net will be displayed in red, the second net will be displayed in blue. In **All Layers** mode the highlighted nets will be coloured as detailed in *Displaying Highlighted Nets*.

Activate the Fault Entry area on the Toolbar. The GRS550 will use the Fault Entry method selected via the **Configure** menu. Press **OK** in the Fault Entry area to confirm the selected nets or to dismiss the Fault Entry area.

Control the display. Choose **Zoom In** to increase magnification, **Zoom Out** to decrease magnification. Select **Display Extents** to display the entire Netlist. Choose **Mirror All** to mirror the display.

Query a Pad or Test Point. Use *Point and Click* to choose a point on the selected layer then choose the associated Query command.

Displaying highlighted nets

In **All Layers** mode the highlighted nets will be coloured as detailed in the **Reference Section**.

The GRS550 provides four methods of Fault Entry (highlighting faulty nets):

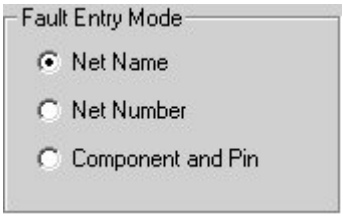
Point and Click

Net Name

Net Number

Component and Pin

Choose the **GRS Configuration** command from the **Configure** menu and click the **Fault Entry** tab to specify the Fault Entry (net highlighting) method.



The **Net Name** method is selected by default.

Point and Click

The Point and Click method is always available regardless of Fault Entry method selected. Locate the crosshair over a pad on the first net and press **1** on the keyboard to highlight the first net.

Locate the crosshair over a pad on the second net and press **2** on the keyboard to highlight the second net.

To clear the highlighted nets press **0** on the keyboard.

Fault Entry: Net Name

From the **Fault Entry** tab select **Net Name**. Press **F** on the keyboard — the Fault Entry area on the Toolbar is activated:

Enter the name for the net(s) and click **OK**. The GRS550 will highlight the selected net(s).

Fault Entry: Net Number

From the **Fault Entry** tab select **Net Number**. Press **F** on the keyboard — the Fault Entry area on the Toolbar is activated:

Enter the number of the net(s) and click **OK**. The GRS550 will highlight the selected net(s).

Fault Entry: Component and Pin

From the **Fault Entry** tab select **Component and Pin**. Press **F** on the keyboard — the Fault Entry area on the Toolbar is activated:

Enter the component and pin number for the net(s) and click **OK**. The GRS550 will highlight the selected net(s).

Note: Entries to be made for Net Name and Component and Pin fault entry are case sensitive. Some Unix-based CAD systems differentiate separate nets by using upper and lower case.

Follow the net pads and traces to determine which devices are connected to the net.

Displaying highlighted nets

Traces on multi-layer boards frequently traverse between layers. The GRS550 includes the option to display the highlighted nets on either the current layer only (the *Displayed* layer) or on *All* layers.

Toggle the Fault Display between **Display Layer** and **All Layers** modes with the **X** key. When displaying faults on the current layer only (**Display Layer** mode), regardless of layer, the first net will be displayed in red, the second net will be displayed in blue.

In **All Layers** mode the highlighted nets will be coloured as detailed in the **Reference Section** – *GRS550 DISPLAY WINDOW COLORS*.

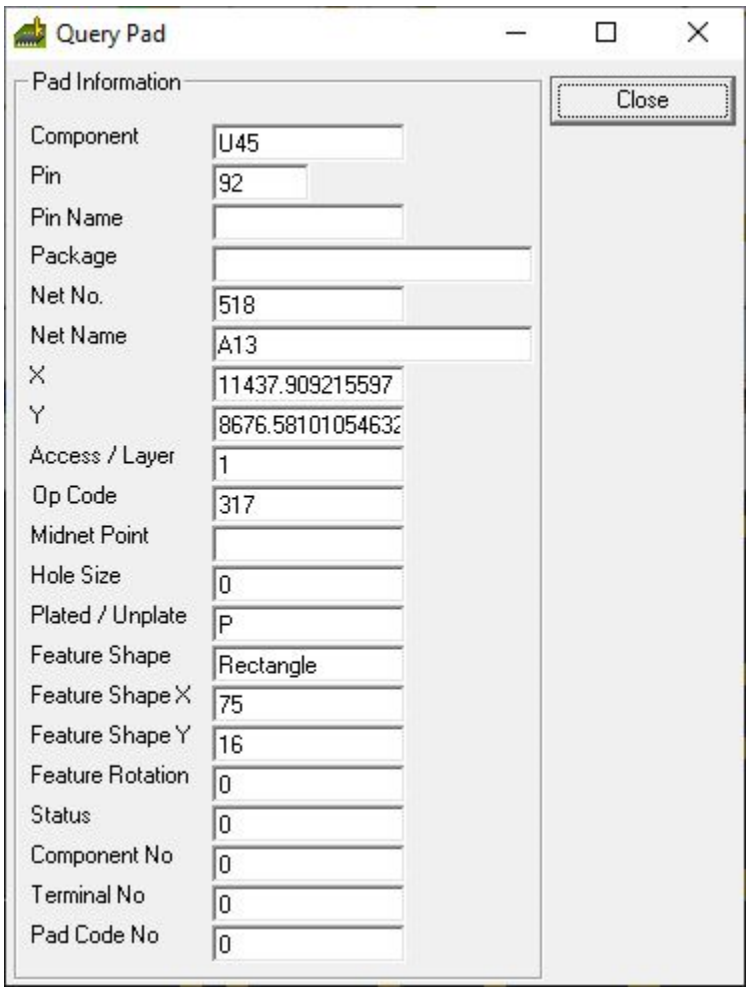
Querying pads and test points

Query Pad

The **Query Pad** function (**Display/Info** menu) allows the user to display detailed device, net and position information for the pad.

Query Pad button

Using the Board View window, position the crosshair over the pad (if necessary **Zoom In** to the component) and click the **Query Pad** button (or press the **P** key). Click **Close** to dismiss the dialog box.



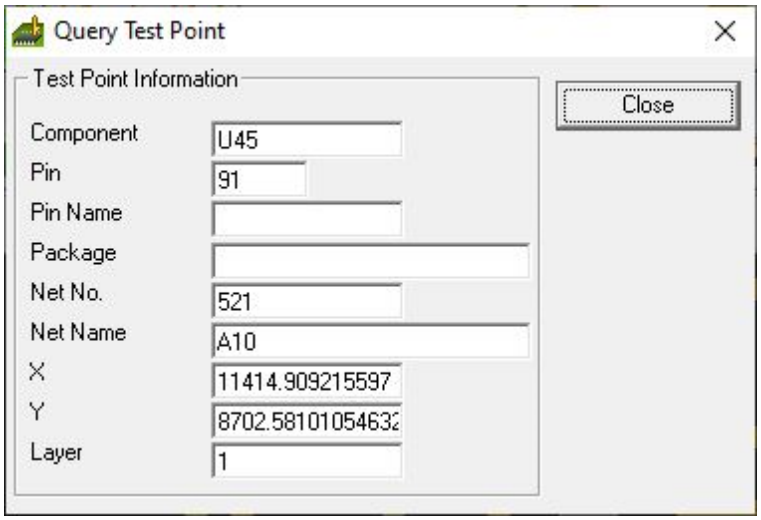
Query Pad dialog

Query Test Point

The **Query Test Point** function (**Display/Info** menu) allows the user to display test point information, reference signatures and test parameter settings for the selected test point.

Query Test Point button

Position the crosshair over the pad in Board View (**Zoom In** if necessary) and choose **Query Test Point** button (or press the **T** key).



Use the Board View pane to select a different device for inspection. Click the device on the board image then click on the pin in the Component View pane to query the pin.

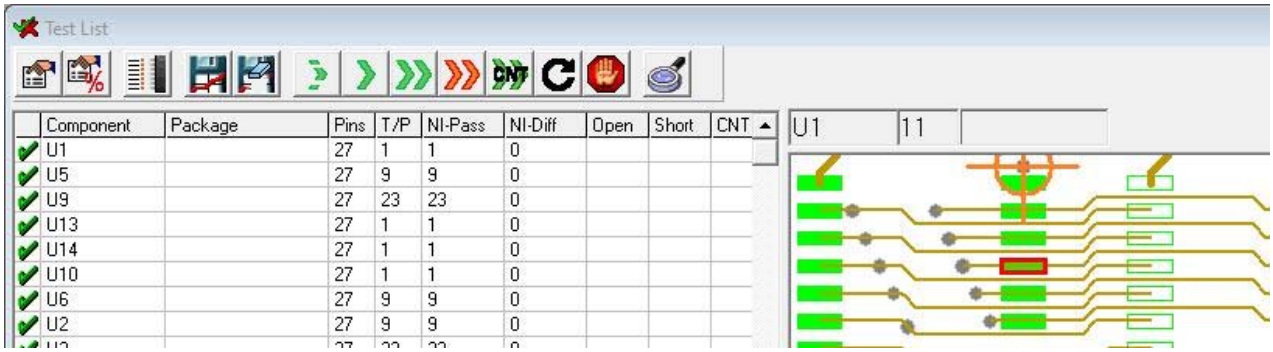
If **Track Cursor Position** is turned on (**Prober|Prober Options**), as each pin is queried the camera is located over the pin in the Camera View.

TESTING BOARDS

Prior to testing a board ensure the Prober has been homed and the probe calibrated. (see "Prober" – "Prober Calibration")

Test List view button

With all test points defined, switch to the Test List Window. The Test List window contains a list of all devices on the board under test for which test points have been assigned



Test List window displaying selected device

The Test List view comprises:

The Test List Toolbar

The Test List pane (the list of devices to be tested). As each device is tested, its status symbol indicates a PASS or FAIL

The Component pane, displaying the device selected in the test list, showing which pins have test points assigned. At the end of the test the colour of the each test point indicates a PASS or FAIL result.

The Test List window contains the commands to start and stop testing a single device, a group of devices or the complete list of devices.

To accommodate variations in device signatures due to manufacturing tolerances or devices from different manufacturers, each device can contain multiple reference signatures against which its live signature can be tested.

Test parameters can be varied on a pin by pin basis from those set during test point allocation to accommodate charging effects or to specify more effective voltage and frequency ranges.

The Test List toolbar

The Test List tools are described below

 Device properties

 Set Test Tolerance

 Component Pins list

 Save alternate signatures

 Delete alternate signatures

 Test selected device in slow motion

 Test selected device(s)

 Test all devices

 Test all devices with Auto Align

 Test critical nets only (see CNT function)

 Retest all failed pins

 Stop test

 Inspection view

The Test List pane

The Test List pane lists all the components defined for the board.

	Component	Package	Pins	T/P	NI-Pass	NI-Diff	Open	Short
✘	U1		27	27	26	1		3
✔	U5		27	27	27	0		2
✔	U9		27	27	27	0		3
✔	U13		27	27	27	0		4
✔	U14		27	27	27	0		2
✘	U6		27	27	26	1	1	2
✔	U2		27	27	27	0		2

The components can be sorted by column heading.

Click the Component button (at the top of the Component column) to sort in ascending or descending alphabetical order.

The component list can also be sorted by package type, number of pins, number of test points for a component, pass/fail status, nodal impedance variation, Opens and Shorts.

The leftmost column indicates the status of the component.

The  symbol signifies that no reference signatures have been acquired for the component.

A blank square signifies that the device has reference signatures but has not been tested.

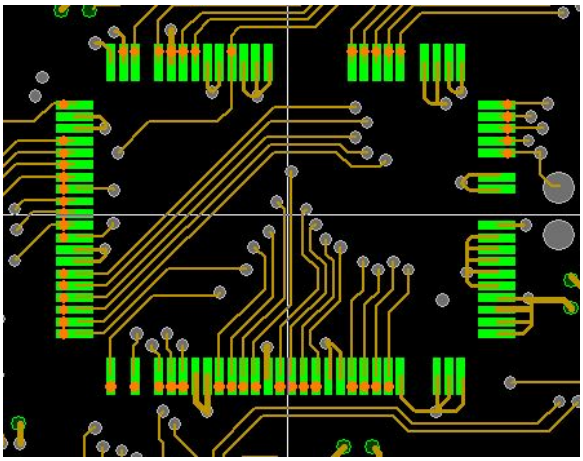
The arrow symbol  indicates that the component is being tested

Pass and fail results for the component are indicated by a green tick  or a red cross  .

Selecting a component in the list displays the component in the component pane and highlights the component in the board view. If signatures have been acquired for the component they are shown in the Signature View window.

The Component pane

The Component pane displays the component highlighted in the test list.



Nets are shown in grey, the pads are displayed in green and the test points are shown in orange.

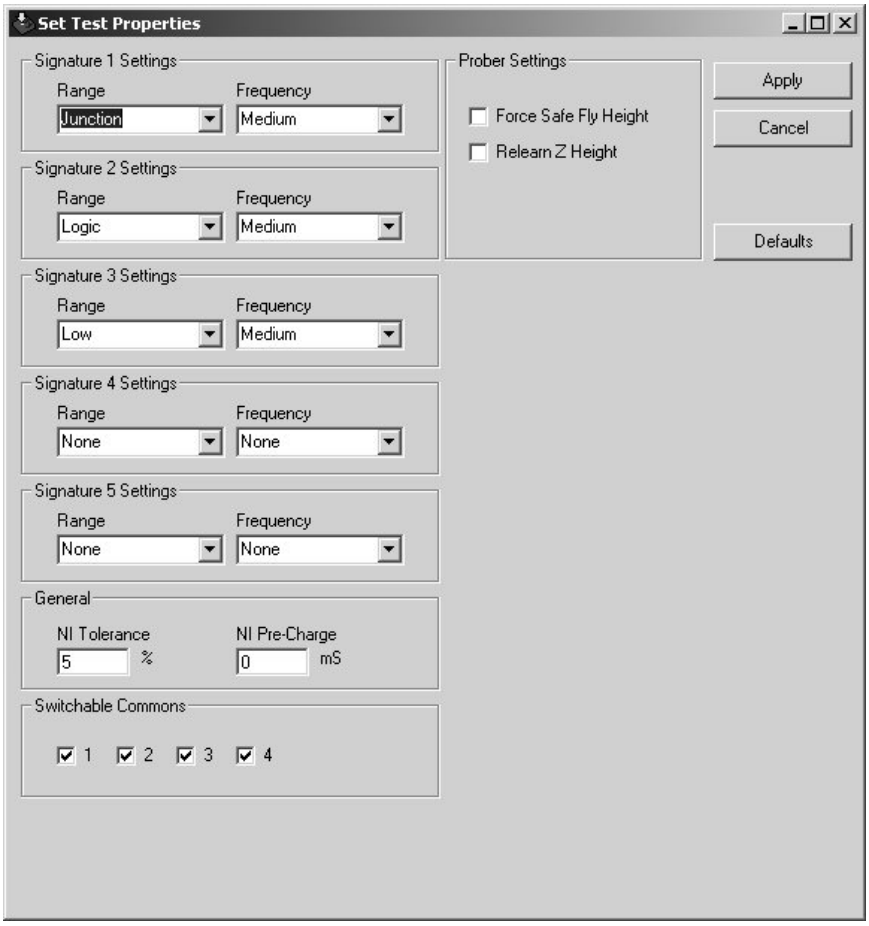
After testing the component, test points that failed the nodal impedance test are shown in black.

Modifying test parameters for individual devices

The Allocate Test Points process assigned the specified test parameters (test voltage range, frequency, etc.) to every test point in the list.

Properties button

To change the parameters for a component select the component from the test list and click the **Set Test Properties** button to display the Set Test Properties dialog.



Set Test Properties dialog

Modify the test parameters as required and click **Apply**. See **Defining Test Conditions** for a discussion on choosing the most effective voltage and frequency ranges for device testing.

The GRS550 normally retracts the probe a short distance as it moves from pin to pin on a device. Click the **Force Safe Fly Height** check box to force the GRS550 probe to retract to the safe fly height between test points on the same device. Use this feature when testing components with a height of more than approx. 5mm to allow sufficient clearance when moving from one pin to the other.

When changing test parameters such as voltage range and test frequency for a device or pin the GRS550 does not normally relearn the height of the device. Click the **Relearn Z Height** check box to re-learn the component height after parameter changes.

Click the **Defaults** button to apply the default values specified in the **Configure|GRS Configuration|Testing** tab.

Press **Cancel** to leave the device parameters unchanged.

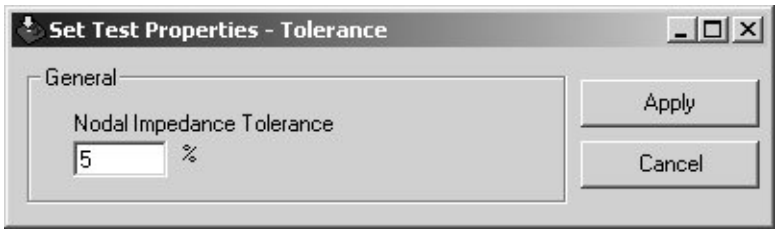
Note: each time test parameters are changed for an item in the test list the reference signatures will need to be re-acquired.

The settings above are normally performed for a whole device. To change the test parameters for a single pin or groups of pins select the device from the Test List and switch to the Component Pins List to display the list of pins for a device.

Setting test tolerances

Set Test Properties – Tolerance button

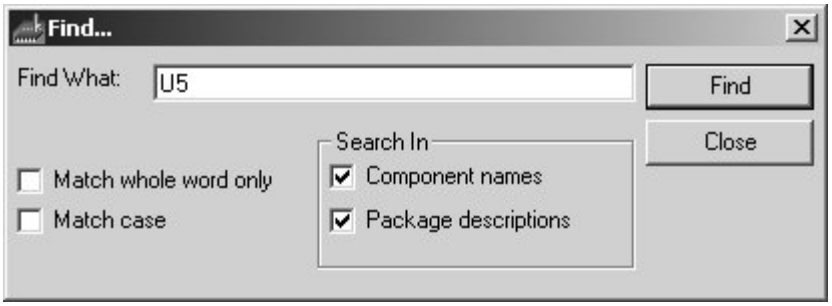
It will sometimes be necessary to change just the test tolerance without changing other test parameters. Choose the Set Test Tolerance command from the Test List menu



Specify the new tolerance and click **Apply**.

Locating devices

Use the **Find** function in the **Test List** menu to locate devices in the test list. From the **Test List** menu click **Find** and supply the device name or package description.



Select the **Find** options as required to refine the search.

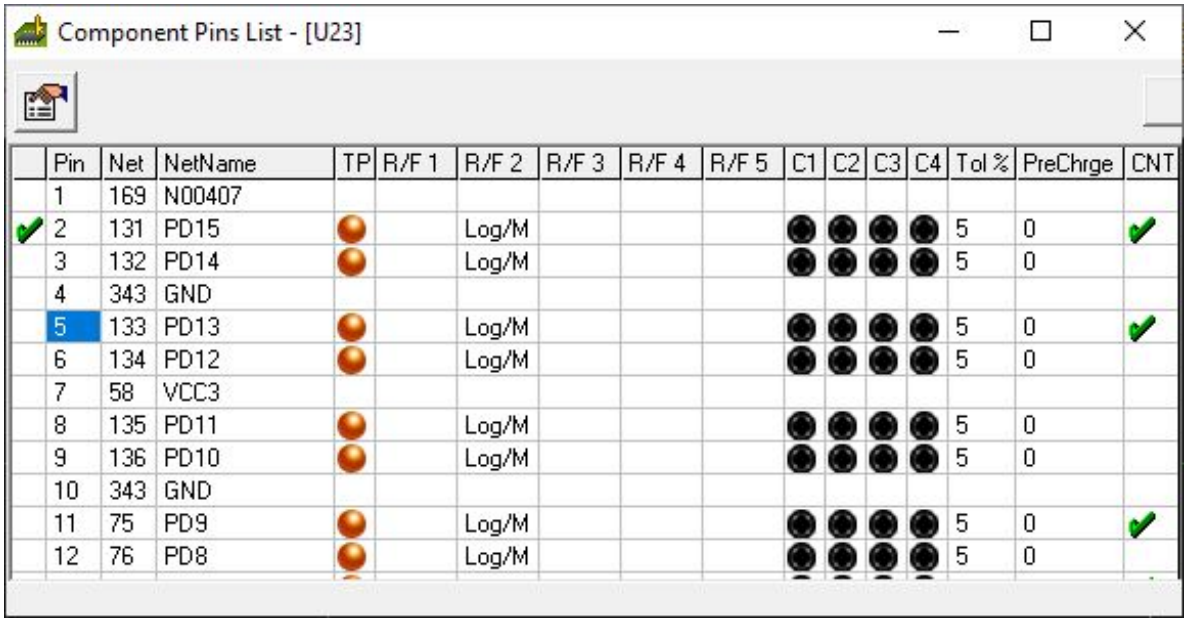
Press the **F3** function key to find the next occurrence of the search text (if any).

Component Pins List

The Component Pins List allows the user to view the net and test information and modify the test parameters for each pin of a component.

Component Pins List button

To view details of a device click the **Component Pins List** button. The Component Pins List displays net and test information for the selected device.



	Pin	Net	NetName	TP	R/F 1	R/F 2	R/F 3	R/F 4	R/F 5	C1	C2	C3	C4	Tol %	PreChrge	CNT
	1	169	N00407													
✔	2	131	PD15			Log/M								5	0	✔
	3	132	PD14			Log/M								5	0	
	4	343	GND													
	5	133	PD13			Log/M								5	0	✔
	6	134	PD12			Log/M								5	0	
	7	58	VCC3													
	8	135	PD11			Log/M								5	0	
	9	136	PD10			Log/M								5	0	
	10	343	GND													
	11	75	PD9			Log/M								5	0	✔
	12	76	PD8			Log/M								5	0	

The Component Pins List dialog

The Component Pins List displays test results, pin and net information and test parameters for each pin of the selected device.

The device outline and test points are shown in the Component pane. Test points are shown in orange; test points that failed the nodal impedance test are shown in black.

Note: When an individual pin is shown as failed in the Component Pins List, the whole device is shown as failed in the Test List.

Component test parameters

All component details are shown in the Pins List pane.

Test parameters include voltage and frequency ranges, which Switched Common connections are in use and tolerance and pre-charge value. The list shows Switched Common connections as:

- Switched Common connection closed
- Switched Common connection open

To modify the test parameters for a device pin select the pin from the Component Pins List and click the **Set Test Properties** button to display the Set Test Properties dialog. Change the test parameters as described for whole devices and close the dialog.

Note: altering the parameters for any pin will require that the whole device be marked with a ⚠ symbol (requiring that the reference signatures be re-acquired).

If the test parameters are modified for a single component pin the settings for the whole component are shown in grey.

Acquiring reference signatures

Acquiring reference signatures for a device

Ensure the Prober has been homed and the probe calibrated.

Align the board.

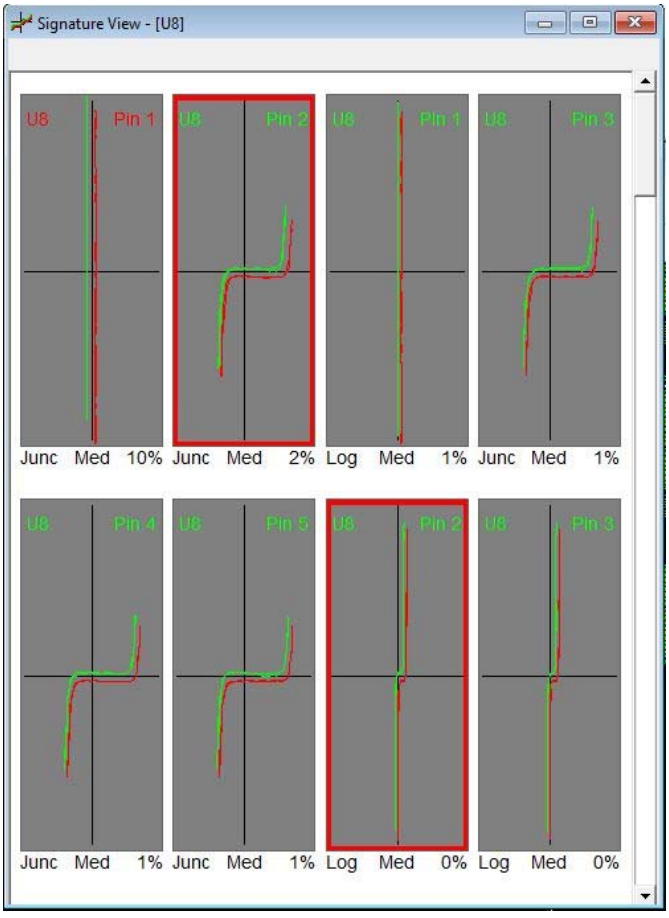
Select the device from the test list and click the **Test Selected** button. The GRS550 will probe the device to determine its height and acquire reference signatures for the device. The ⚠ symbol signifying that no reference signatures have been acquired for the component is cleared.

Acquiring reference signatures for the whole board

To acquire signatures for every test point on the board under test click the **Test All** button.

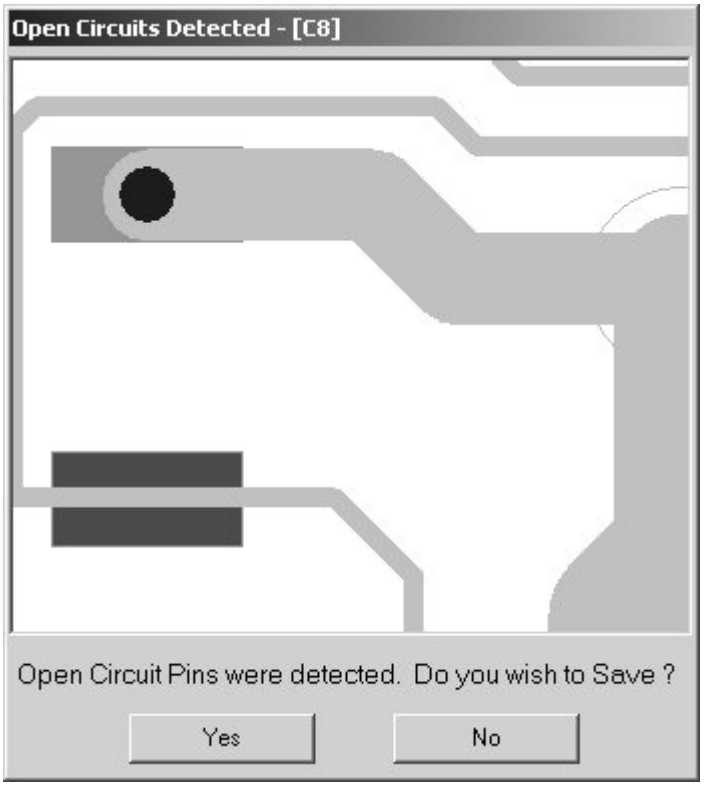
The GRS550 will probe every test point on the board, sensing the height of each component.

With reference signatures acquired for the board, use the Save Database command to store the signatures along with the net data. To view the acquired signatures for a device pin, choose the device in the test list and click on the test point for the pin in the Component window; the Prober moves to the pin and displays its signatures in the Signatures View window.



During reference signature acquisition, the GRS550 will check for open circuit signatures for each device. Open circuit signatures may indicate a badly positioned test point, flux on a board or a missing ground connection, etc.

The GRS550 displays a warning dialog if “Confirm before saving open circuit pins” has been activated in the GRS Configuration – Prompts Tab.



Click **Yes** to save the signature as reference or **No** to discard the signature.

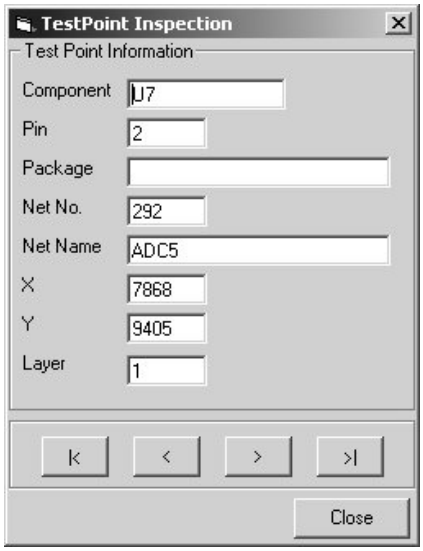
If the open circuit is unexpected, check the Prober Calibration, check for COM lines connected to the correct ground planes, correctly registered alignment points and surface contamination, etc.

Inspection Mode — verifying probing accuracy

Inspection Mode allows the operator visually to check the board under test (e.g. for shorts between device pins) and to verify that each device pin will be probed correctly; click the **Inspection Mode** button to display the **Inspection Mode** dialog.

Test Point Inspection Mode button

Select a device from the test list and click the **Test Point Inspection Mode** button to display the **Test Point Information** dialog.



Test Point Information dialog

The **Test Point Information** dialog opens and the crosshair is located over the first test point for the device. Use the direction arrows to step through the test points of a device and display the associated test point information.

The device appears in the Component pane with the test points marked in orange.

If a jog or offset has been applied to a test point the jog or offset distance is shown in the Component and Board View windows. Use the direction buttons to step forwards or backwards through the test points on the device. Check that for each test point the crosshair is precisely aligned over the pad.

If necessary zoom in to the device

Prober Options button

To view the actual probe position on the pad set the Prober Options (Prober menu) to **Track Cursor Position**.

Use the camera window to check that for each test point the probe crosshair is precisely aligned over the correct portion of the pad.

If a jog or offset has been applied to a test point the jog or offset distance is shown in the Camera View window. This allows the operator to verify the actual probe position visually.

Slow Touch button

Use the **Slow Touch Button** to move the probe down at the actual selected position to verify the correct probing position.

Use the camera window to check that for each test point the probe crosshair is precisely aligned over the correct portion of the pad.

Testing components

Testing a single selected component in slow motion

Test Selected in slow motion button

For debugging purposes it may be helpful to first test a component in slow motion mode to verify the correct probing positions. With the reference signatures for a component acquired, choose the component from the Test List and click the **Test Selected in slow motion** button to test the component.

Testing a single selected component

Test Selected button

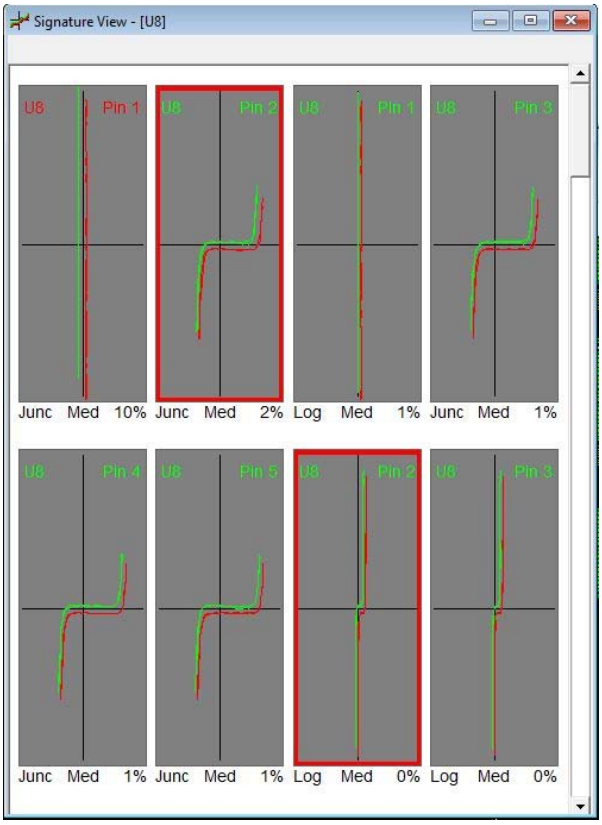
With the reference signatures for a component acquired, choose the component from the Test List and click the **Test Selected** button to test the component.

The GRS550 tests the device and displays its test result (PASS or FAIL) as a green tick or a red cross.

Test results for each device are shown in the Component windowpane; an orange test point indicates a PASS result for a pin, failed tests are shown as black test points.

During testing the camera displays the device test, allowing the operator to verify that each device is being probed correctly.

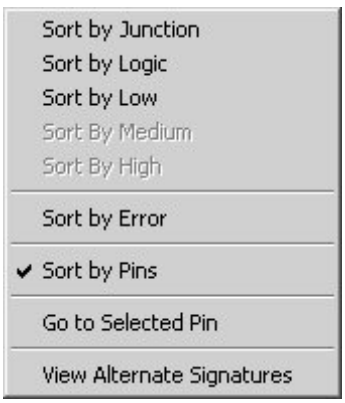
The resulting device signatures are shown in the Signature View window. The red test and green reference signatures are displayed together for comparison. Clicking on each pin in the component window displays the corresponding signature set.



Signatures that appear to have failed may actually be changing over time, usually as a result of charging effects at a node. Double click a signature to display the Nodal Impedance View (live display) for that signature. It will often be possible to watch the signature change from bad to good over the space of two or three seconds. Applying a pre-charge time can compensate for this effect. Some devices, however, will prove difficult or impossible to test because their signatures never fully stabilise. It may be necessary to exclude these devices (i.e. make Keepout) from the test list.

Sorting signatures

Signatures may be sorted by voltage range, by error (percentage deviation from the reference signatures) or by pin number. Right-click the signature view and choose the sort range as appropriate.



Displaying live signatures

To display a live view of a signature double click the signature of interest (the **Live Nodal Impedance** view).

Note: the probe remains in the down position until the Live Nodal Impedance window is closed.

Click **Close** to dismiss the Nodal Impedance View and return to the Signature View window.

Testing multiple components

To test multiple components select the components to be tested from the test list.

Click on each component of interest while pressing the Ctrl key to select non-adjacent components.

Clicking on two components with the Shift key depressed selects all components between the two selected.

With the components selected, click the **Test Selected** button. All selected components will be tested.

Test All button

Select the **Test All** button to test the whole board.

Testing multiple components using Auto Align

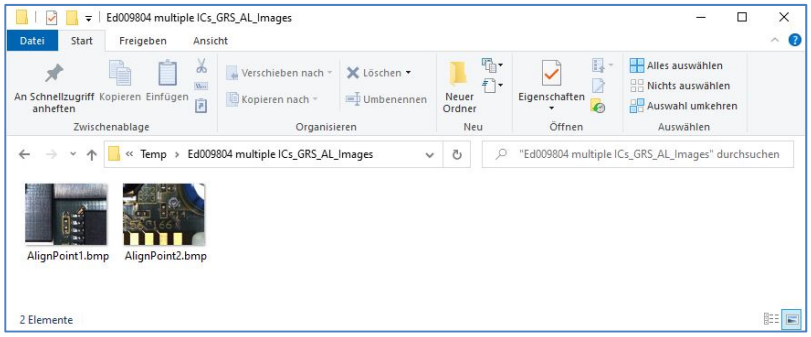
The GRS550 provides an Auto Align function to automatically align the camera crosshair onto the board´s fiducial using a powerful image processing algorithm.

To use this feature, a manual alignment needs to be run once to store the reference images of the selected fiducials. If no reference images have been stored, the “Test All with Auto Align” button is greyed out and the user is prompted to perform a manual alignment.

Test All with Auto Align button (Ctrl + A)

Select the **Test All with Auto Align** button (or use the Keyboard Ctrl + A) to test the whole board using the automatic centring onto the board´s fiducials.

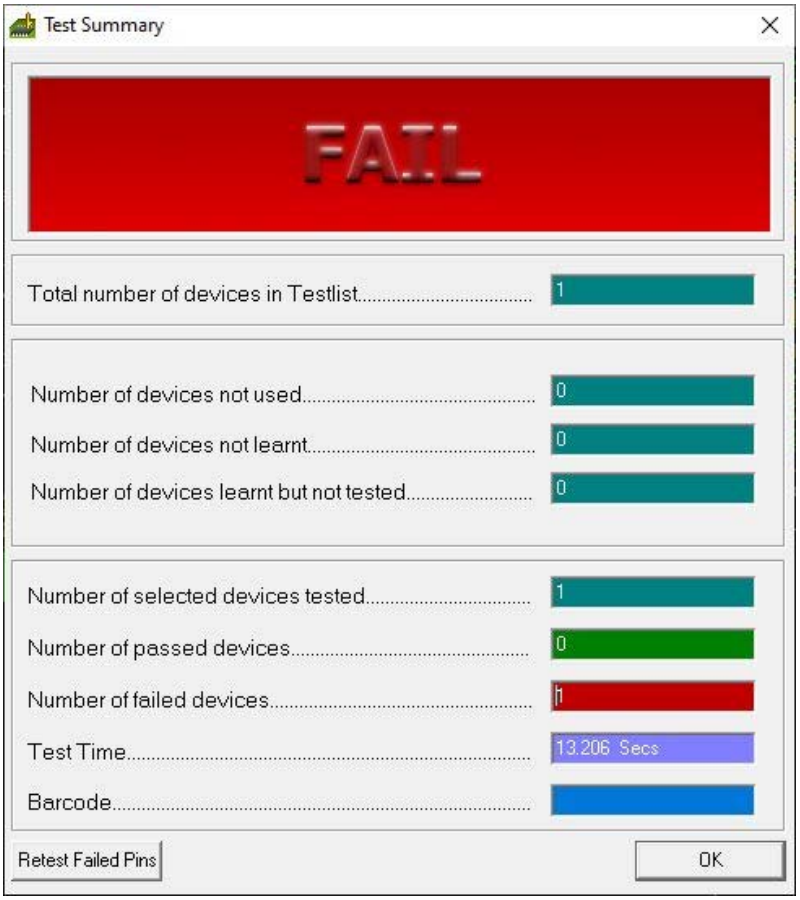
The reference images need be stored for each board type and are specific for each *.grs test file. During the initial manual alignment, a subfolder with the name of the *.grs test file will be created automatically in the file path specified in the GRS configuration. The reference images of the two fiducials named “AlignmentPoint1.bmp” and AlignmentPoint2.bmp” will subsequently be stored in that folder and used for image comparison during Auto Align:



Note that if the file name of the *.grs file changes, a new subfolder is created for the alignment point images. On **Test All with Auto Align**, the GRS550 software checks if reference images exist in the specified folder. If no images exist, then the operator is prompted to perform a manual align first. If reference images exist from the same board but under a different file name, it is possible to copy the two files “AlignmentPoint1.bmp” and AlignmentPoint2.bmp” manually across to the relevant folder. If for some reason, the stored Alignment point images need to be replaced (for example, when different alignment points are to be used), simply run a manual alignment using the “Align” button.

Displaying the test summary

At the end of each test or group of tests the GRS550 displays the test summary detailing the test statistics and results.



Use the **Display Summary Report After Test** option from the **Prompts** tab of the **Configure** menu to allow the GRS550 to display the PASS/FAIL summary. If the Bar Coder Reader option is installed and the Bar /QR Code position learned, then the barcode serial number is displayed as well.

Retest Failed Pins button

The **Retest Failed Pins** button selects all failed pins and performs a retest to confirm that the pins have genuinely failed and pseudo errors due to contact issues are eliminated. The number of retests is specified in the GRS configuration/Testing tab. **Retest Failed Pins** may also be initiated from the Tool Bar button.

Clearing test results from a component

Choose the **Clear Results** command from the **Test List** menu to remove Pass/Fail information from the component.To clear results from multiple components, select the devices as described above then choose **Clear Results**.

Use the **Clear Results after printing or loading grs file** function from the GRS Configuration to automatically clear PASS/FAIL information in the test list after printing the test results or when a new grs file is loaded.

CNT Critical Net Test

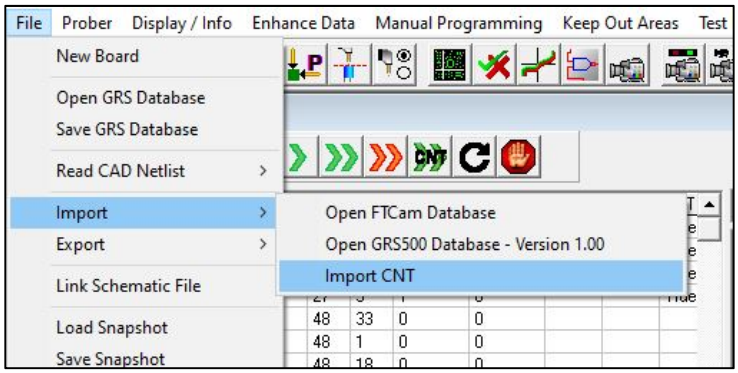
The Critical Net Test function allows to test a subset of nets that are marked as “CNT” via the Component Pins List. This is a very useful feature to test only a few selected nets that are considered to be very critical and are tested in a pre-screening run.

CNT button

To run a subset of tests marked as “CNT”, click the CNT button from the test list tools.

To mark nets as CNT, use one of these two methods described:

- Loading a list of nets using File – Import – Import CNT

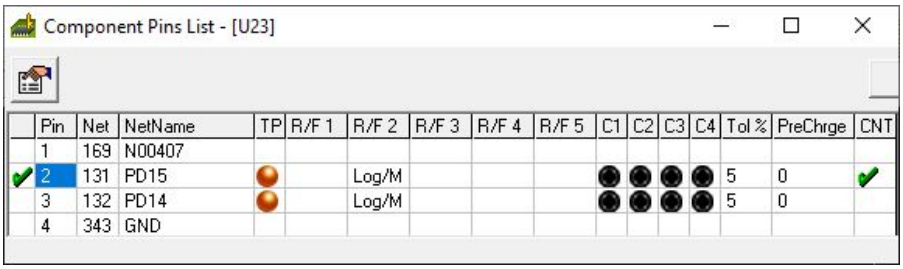


The required format of the CNT *.xml list is as follows:

```
<CriticalNets>
  <CriticalNet Name="N05254">
  </CriticalNet>

  <CriticalNet Name="D11">
  </CriticalNet>

  <CriticalNet Name="N24176">
  </CriticalNet>

  <CriticalNet Name="N06893">
  </CriticalNet>
</CriticalNets>
```

The purpose of the xml import is to read critical nets from a repair history database, testing only nets that have recorded a high failure rate.

- Manually marking a net as CNT in the Component Pins List, by clicking at the CNT column for the relevant pin. A green tick indicates a net as CNT. Note that only pins with a test point allocated may be marked as CNT.



	Pin	Net	NetName	TP	R/F 1	R/F 2	R/F 3	R/F 4	R/F 5	C1	C2	C3	C4	Tol %	PreChrge	CNT
	1	169	N00407													
✔	2	131	PD15	●		Log/M				●	●	●	●	5	0	✔
	3	132	PD14	●		Log/M				●	●	●	●	5	0	
	4	343	GND													

Remember to save the *.grs file in order to save the Critical Net Test information.

Once nets have been declared as “CNT”, use the CNT button to test these nets only. If a subsequent full test is required, click on

 Test all devices

or

 Test all devices with Auto Align

Replacing reference signatures for a component

If the most recently acquired signatures reflect the true device signatures more accurately than the reference signatures, select the **Replace Reference Signatures** command to assign the current test signature as the reference signature.

Nodal Impedance button

Double-click the signature pane to view a “live” view of the signature of interest, the **Nodal Impedance View**. The GRS550 probes the point and displays the live signature along with the reference signature for comparison.

Using alternate signatures

The GRS550 allows the operator to store up to five reference signatures for each test point on a board.

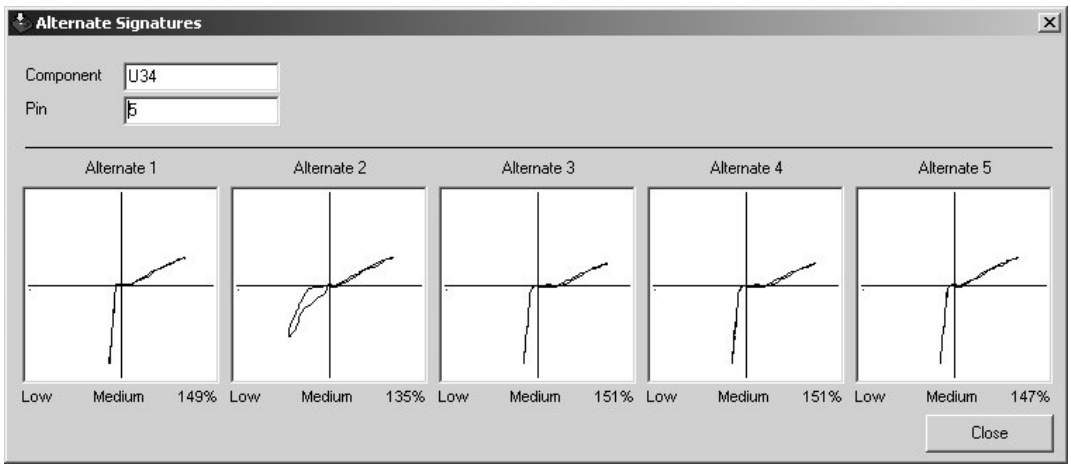
For example, sets of signatures for devices from different vendors can be stored as reference. This can eliminate spurious device failures caused by slight variations in signatures in good devices from different manufacturers.

When the GRS550 executes a test it tests against all reference signatures until a match is found.

Save Alternate Signatures button

To store alternative signatures for a device, test the device then choose the **Save Alternate Signatures** command from the **Test List** menu. Up to five signatures may be stored for each device.

To view the alternate signature for a pin, right-click on the pin signature in the Signature View window and choose the **View Alternate Signatures** command from the short cut menu.



Alternate Signatures View with five alternate signatures

Alternate Signature 1 is stored as the first learnt signature.

During a board test the alternate signature that passed will automatically be displayed in the Signature View. If no signature passed, Alternate Signature 1 will be displayed.

Delete Alternate Signatures button

To delete the alternate signatures choose the **Delete Alternate Signatures** command from the **Test List** menu.

Signatures Alternate 2 through 5 are deleted.

Click Close to return to the Signature View window.

Using board snapshots

The GRS550 allows the operator to save the board database along with the test results for the board as a *snapshot*. The board snapshot may then be used for offline repair.

From the **File** menu choose the **Save Snapshot** command; name the snapshot and click **Save**.

If the Bar/QR Code reader option is installed, the serial number of the board is automatically entered into the snapshot name field.

Recall the snapshot with the **File|Load Snapshot** command.

Using board notes

Use the **File|Board Notes** command to create and save short explanatory notes (for example, to instruct an operator to preset switch positions, check for component orientation, etc.) for display as a board file is loaded.

Add the notes to the text box and click **OK**.

Use the **Configuration|GRS Configuration|Prompts** command to control the display of board notes.

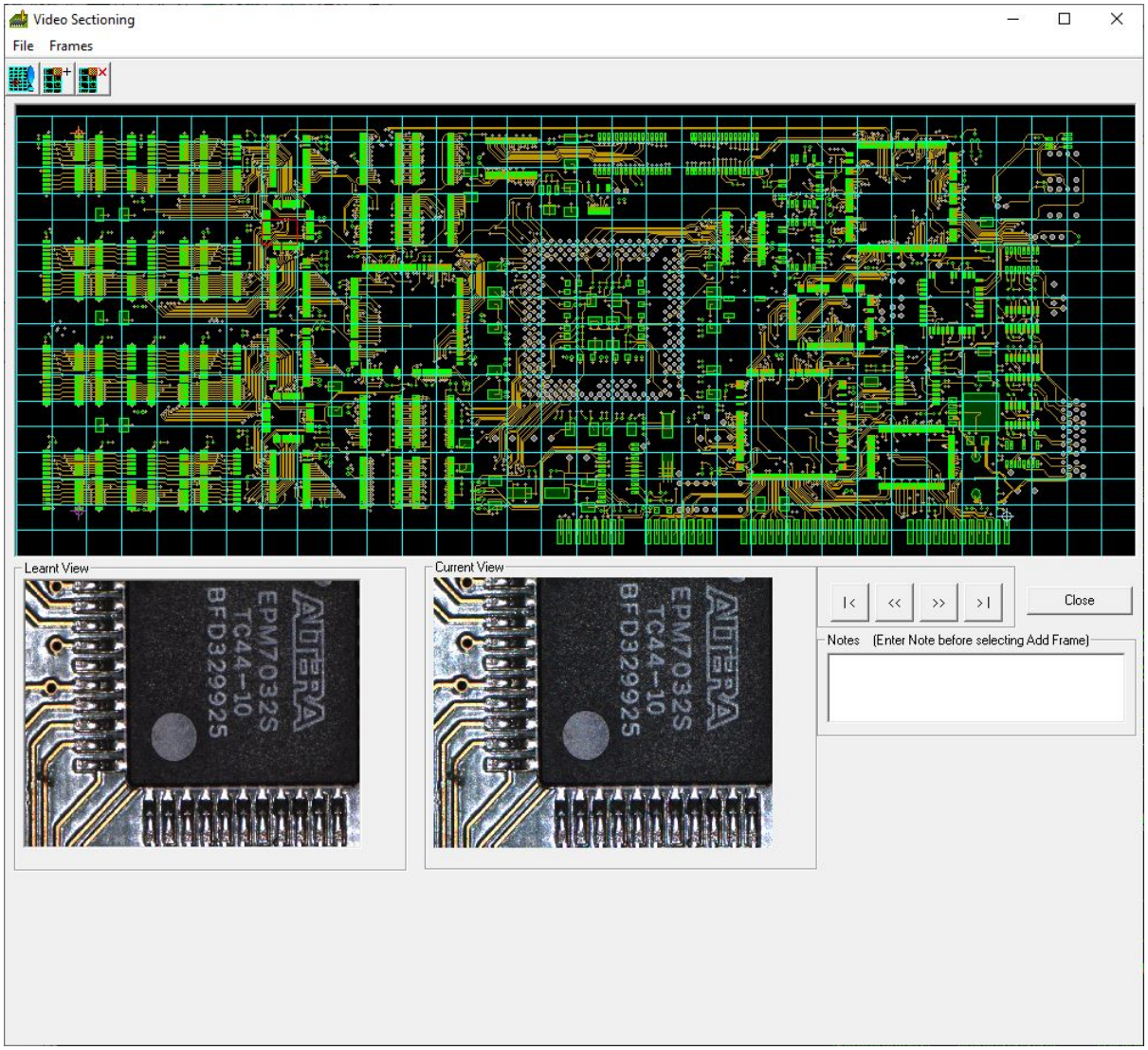
Video Sectioning

The Video Sectioning function allows the user to store a sectioned visual image of a known good reference board and use it for subsequent comparison with a board under test. Video Sectioning will assist in locating missing components, reversed diodes, solder bridges, etc.

Video Sectioning will also prove useful for checking that a board is in a known state prior to testing, e. g. the user can verify that the state of a bank of DIP switches on the board under test matches that of the reference board.

Video Sectioning button

Click the **Video Sectioning** button to open the Video Sectioning window. The window comprises the Board View pane, divided into a grid of frames, each frame containing a video camera snapshot of the corresponding board area.



Video Sectioned board

To create a new video section of the board, ensure the board is aligned; click the **Learn Frames** button; the GRS550 steps

Learn Frames button

across the board taking video snapshots of every frame in the board section.

The complete board is stored as reference. Click into a frame to compare the reference frame (Learnt View pane) with the live frame (Current View pane).

Comparing boards

To compare the board under test with the reference board mount the board on the GRS550 table and align the board.

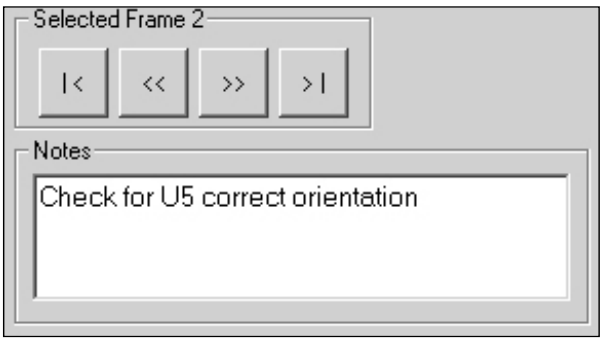
Click the frame of interest; the GRS550 displays the Current (live) view of the board alongside the reference (Learnt) view.

Selecting frames for reference

Video Sectioning mode incorporates the facility to mark frames and add an explanatory or instructional note to each frame, e.g. to warn an operator to check for common faults, check that switches are in the correct positions, etc.

Once the board has been stored choose a frame, add explanatory text in the Notes text box (up to 100 characters) and click the Add Frame button (or press Key A) to store the frame. Repeat for each frame as required.

The frames are stored as a sequence; use the frame navigation buttons to step forward or backwards through the frame set.



Frame navigation buttons and notes text box

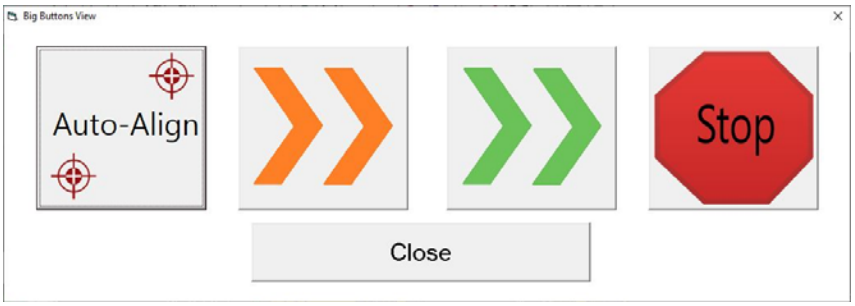
To delete a frame click the Delete Frame button (or press key D).

Use the **Save GRS Database** command to save the frame information to the GRS database.

When Video Sectioning view is selected the GRS550 selects the first frame in the frame sequence.

Simplified User Interface

Use the simplified user interface when operating the system in a manufacturing test environment. The simplified user interface provides a very basic functionality with large buttons to be used for a touch screen monitor:



Four buttons are provided:

Simplified user interface button

Auto Align to trigger an Auto Alignment (without subsequent test)

Test All with Auto Align button

Test All

Stop

Close the simplified user interface when not in use. Note that all other menu items are locked out while the simplified user interface

Status Light

The optional ACC348 pole-mounted status light (traffic light) with 3 high-intensity LED´s provides the operator a quick status information on the system state. All system states are duplicated in the status bar.

Green LED – System is idle

Orange LED – System is operating or awaiting user interaction

Red LED – System is in error state and requires urgent user interaction

Exiting the program

Select **Exit** from the **File** menu to leave the program. Ensure board data and results are saved before exiting.

MAINTENANCE

GRS550 Basic Maintenance and Troubleshooting

Periodic maintenance

Like any complex mechanical system, the GRS550 does require some basic maintenance to ensure maximum uptime.

The motion control system of the GRS550 is maintenance free but Polar Instruments GmbH will provide firmware updates from time to time to add new features and to optimize the motion dynamics.

The system is based on high performance stepper motors with rotation encoders. The stepper motors move the X, Y and Z axis via leadscrews and linear bearings.

It is recommended to grease the leadscrews in 6-month intervals using the supplied grease MPA197 and to oil the linear bearings in 6-month intervals using the supplied oil MPA198.

Replacing the test pin

The GRS550 system is shipped with the standard test pin Type ACC505. This test pin provides a sharply pointed shape that penetrates through most flux, solder residue, oxide and ensures reliable contact. The test pin is a consumable and it´s useful lifetime is subject to wear and tear. When programming test coordinates, try to touch any pads and components in a perpendicular mode rather than touching on sloping surfaces that could bend the test pin. Probing hard surfaces such as component pins will cause more wear as opposed to testing on softer solder surfaces.

Ensure the test pin is properly calibrated prior to running a test. See **Prober Calibration** in this manual for details.

Certain applications will call for different probe pin shapes which we can offer on request. Please contact Polar Instruments GmbH for details.

Replacing the test pin carrier

The test pin is inserted in the receptacle, which in turn is fitted to the test pin carrier ACC594. It is a rigid construction made of anodized aluminium. In case of a head crash, check the complete assembly for any damage and replace the test pin / test pin carrier / probe head linear bearing if required.

Replacement of the probe head linear bearing

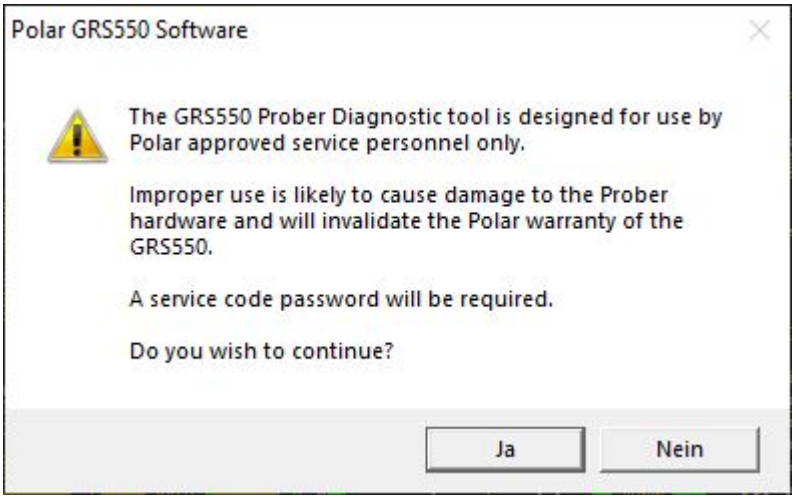
The Test pin carrier travels on a linear bearing which is a critical part determining the system´s probing accuracy. Check the linear bearing for any play or other mechanical defects and replace with Part Number ES003499 if required.

Replacement of the probe head assembly

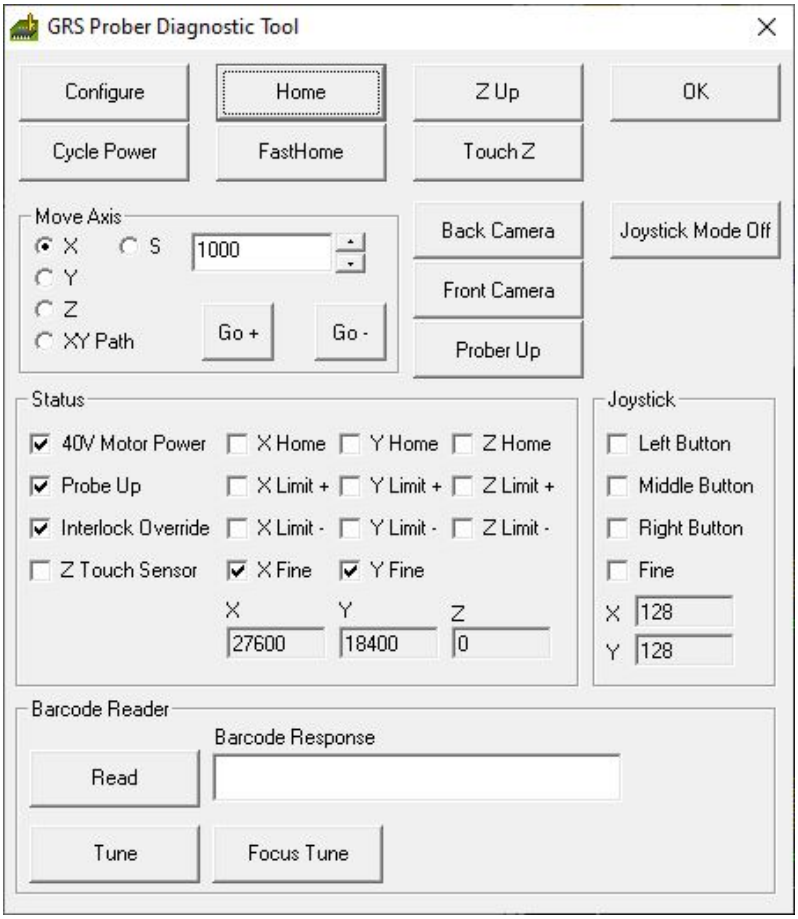
After an extended period of use, the probe head assembly may need an overhaul or replacement. Polar Instruments GmbH offers an exchange program by taking back used probe heads against factory refurbished probe heads. Contact Polar Instruments GmbH for details.

GRS550 Diagnostics Menu

The GRS550 provides a diagnostics interface for basic troubleshooting. Troubleshooting should only be performed by a qualified technician or when instructed by Polar Instruments GmbH. Use the **Prober** – **Prober Diagnostics** menu to access diagnostics:



Enter the password “**GRS550**”.



The diagnostics interface provides various functions to test the motion control system, probe head, camera system, joystick and Barcode reader.

For a basic functionality check, toggle the Joystick Mode button to **Joystick Mode On** and use the joystick to drive the probe head in X and Y direction.

Toggle the **Prober Up/ Down** Button to move the probe head´s solenoid up and down.

Move the probe head via the joystick above a suitable point on the PCB and click **TouchZ** – the probe head moves down until the probe touches the board. Note the activated **Z Touch Sensor tick box**. Use **Z Up** to return the Z-Axis to it´s home position. Note the activated **Probe Up tick box.**

Press all the buttons on the joystick and note the tick boxes for the **Left**, **Middle**, **Right** and **Fine** buttons.

The Joystick X and Y values should dither around 128 when in center position. If required, adjust the values to near 128 using a small screw driver by pressing the +/- buttons on the back of the

Joystick. Note the LED´s on the back of the joystick indicating center and end point positions while the joystick is moved.

Select the **Front Camera** and **Back Camera** buttons – note the video image switching between front and back view.

Use **Joystick Mode On** and drive the Barcode Reader to a bar code position. Select **Tune** and **Read** to read a barcode.

Select **Home** to move all axis to their home positions.

Remote Troubleshooting

Polar Instruments GmbH provides Remote Troubleshooting and Support via the preinstalled TeamViewer Software. Remote Support does require a fully functional internet access and the necessary ports enabled.

If due to a company security policies, remote support is not possible, Polar Instruments GmbH will endeavour to provide support by telephone and E-Mail .

REFERENCE

GRS550 Display Window Colours

Loaded data colours

The table below defines the colours for each layer.

Layer	Colour
Pad Data for upper layer	Green
Pad Data for lower layer	Magenta
Pad and Trace data for all layers	Grey
Test points (assigned during Test Point allocation)	Orange

Notes:

1.Low intensity colours show pads allocated as Keep Out Areas
2.Datasets that do not contain component definitions (Gerber) will display in a dark shade of green until they are converted to genuine components using the Create Component facilities.

Highlighted item colours

In **All Layers** Fault Display mode highlighted nets are coloured according to the table below.

Layer	Colour
First net for upper layer (pads and traces)	Red
First net for lower layer (pads and traces)	Pink
First net for inner layer (pads and traces)	Orange
Second net for upper layer (pads and traces)	Blue
Second net for lower layer (pads and traces)	Purple
Second net for inner layer (pads and traces)	Cyan

Keystroke and Mouse Functions

Pan and Zoom (Display/Info)

+ or Left double-click	Zoom in

– or Right double-click	Zoom out
Mouse Wheel	Zoom in/out
Arrow keys	Pan
World View left click	Pan display to world view
Space bar	Mirror current view
Home	Display extents

Query items (Display/Info)

P	Query netlist point
T	Query test point
1	Highlight first net
2	Highlight second net
0	Clear highlighted nets
P	Query pad
T	Query test point
X	Fault display toggle (Displayed/All)

Z	Zero relative measurement

Enhance data

N	Create Component Name
L	Load Component Pins
S	Add Series of Pins

Test points

A	Add test point
D	Delete test point
J	Jog test point outwards
I	Jog test point wards
0	Offset test point
U	Undo and return test points to original positions
B	Name Alignment Point
R	Remove Components Test Points

Keep Out Areas

A	Add Keep Out Point

D	Delete Keep Out Point
C	Add Keep Out Component
R	Remove Keep Out Component

Testing

Ctrl + A	Performs a Test All with Auto Align

ActiveX Remote Control command set

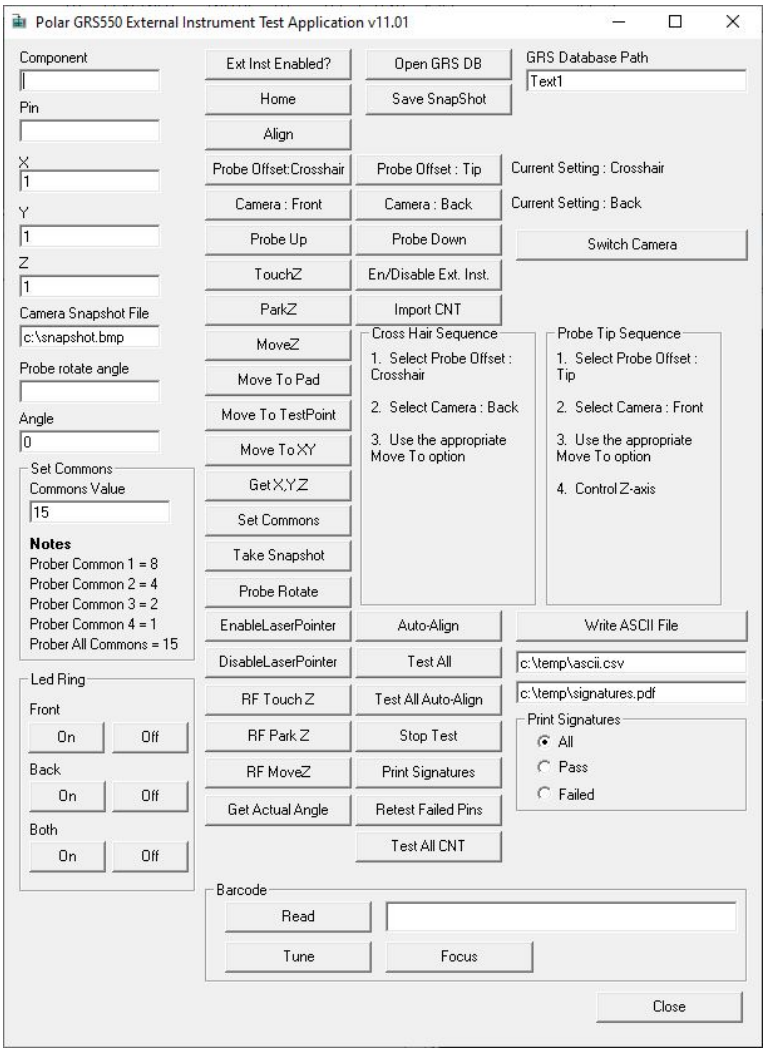
External Instruments button

The GRS550 allows full remote control via a GRS500 External Instruments Programming Interface. This enables control of the GRS550 and any other connected hardware through third party software such as National Instruments LabVIEW/TestStand or custom specific software.

While Polar Instruments GmbH provides full documentation for the ActiveX remote control interface, we assume no responsibility for third party software.

In order for the GRS550 to accept remote control commands, the system needs to be switched to the External Instruments mode via the External Instruments button in the tool bar.

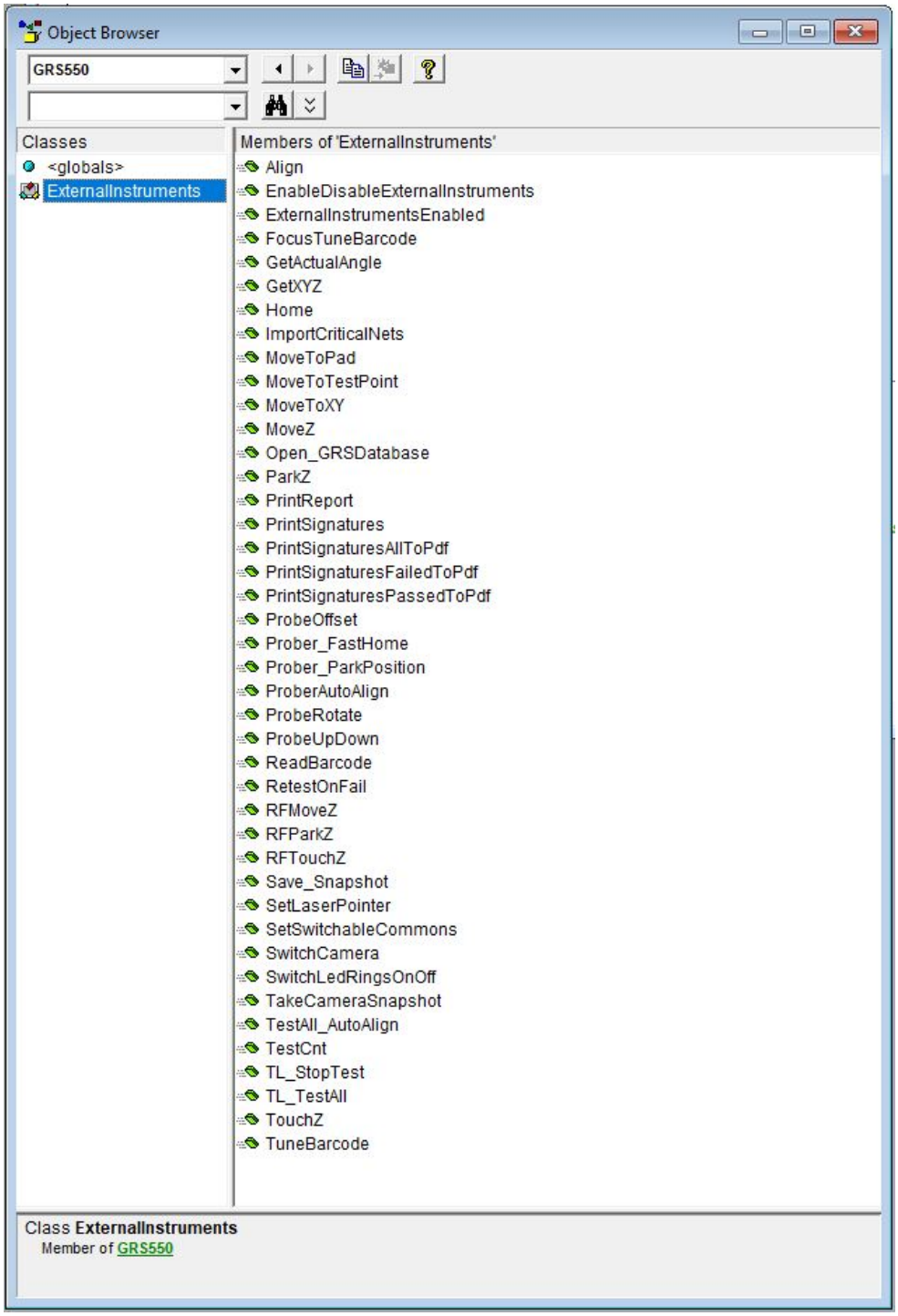
A test user interface is provided to execute a number of remote control commands for testing/debugging purposes:



The **GRS550** object has one class called **ExternalInstruments**

The int parameters defined below are Int32, not Int16. Please ensure that you match the data types correctly.

The Class currently has 42 member functions:



1. ExternalInstrumentsEnabled

```
Public Function ExternalInstrumentsEnabled() As Boolean
   ' External Instruments Enabled
   ' Returns a boolean that determines whether External Instruments is enabled.  Will allow the calling application' to flag a warning if the mode is not enabled
End Function
```

2. EnableDisableExternalInstruments

```
Public Function EnableDisableExternalInstruments()
   ' Enable Disable External Instruments
   ' Sets the External Instruments Enable/Disable Mode
End Function
```

3. Align

```
Public Sub Align()
   ' Align
End Sub
```

Display Prober Alignment dialog for manual alignment by operator

4. ProberAutoAlign

```
Public Function ProberAutoAlign() As Boolean
        ' Call the AutoAlign function.
End Function
```

Attempts an Auto-Alignment on fiducials using previously stored reference images. Requires a manual alignment using "Align" to be run first to store the reference images.

Return value: True → Prober is aligned, False → Alignment not possible

5. Open_GRSDatabase

```
Public Function Open_GRSDatabase(strfilename As String)
        ' Load the given grs-File.
End Function
```

*Loads a *.grs file containing component coordinate and net information. A *.grs file may be generated manually via camera/joystick or via CAD data import.*

6. TL_TestAll

```
Public Function TL_TestAll() As Boolean
```

```
        ' Call the TestAll function.
End Function
```

Starts a complete test of all steps in test list. Use only for GRS Type systems

7. TestAll_AutoAlign

```
Public Function TestAll_AutoAlign()
        ' Call the AutoAlign function and starts the TestAll.
End Function
```

Attempts an AutoAlign on previously stored fiducial images and starts a complete test of all steps in test list. Use only for GRS type system.

8. RetestOnFail

```
Public Sub RetestOnFail()
   ' Call retest on fail.
End Sub
```

Retests all failed components/pins. Use only for GRS Type systems

9. TL_StopTest

```
Public Function TL_StopTest()
        ' Call Stop Test
End Function
```

Stops current test, triggered by "TL_TestAll" or "TestAll_AutoAlign", Use only for GRS type system.

10. ReadBarcode

```
Public Function ReadBarcode() As String
        ' Call read barcode
End Function
```

Reads the barcode, requires the BarCode Reader option to be installed. Use this function in combination with "MoveToTestPoint(strComponent, strPin)" to move to the BarCode position.

11. TuneBarcode

```
Public Function TuneBarcode() As String
        ' Call tune barcode
End Function
```

Tunes the BarCode reader to the target Barcode for optimum readability

12. FocusTuneBarcode

```
Public Function FocusTuneBarcode() As String
        ' Call focus tune barcode
End Function
```

Tunes and focuses the BarCode Reader

13. Save_Snapshot

```
Public Function Save_Snapshot(strfilename As String)
        ' Save the snapshot at the given path
End Function
```

*Only to be used for GRS type system. Saves Analog Signature Test results as *.grs file*

14. PrintReport

```
Public Function PrintReport()
   ' Call PrintReport(frmGRS_PrintReport.txtCompanyName.Text,
frmGRS_PrintReport.txtOperatorName.Text, frmGRS_PrintReport.txtBoardType.Text,
frmGRS_PrintReport.txtBatchNumber.Text, frmGRS_PrintReport.txtSerialNumber.Text,
frmGRS_PrintReport.txtComment.Text, 0)
End Function
```

*Prints test results into a *.txt file. Use only for GRS type system.*

15. PrintSignatures

```
Public Function PrintSignatures(strfilename As String)
   ' The test result is written to a csv file
End Function
```

Prints signatures to a csv file, Use only for GRS type system.

16. PrintSignaturesPassedToPdf

```
Public Sub PrintSignaturesPassedToPdf(fileName As String)
            ' Only the passed test result is written to a pdf file
End Sub
```

Use only for GRS type system.

17. PrintSignaturesFailedToPdf

```
Public Sub PrintSignaturesFailedToPdf(fileName As String)
   ' Only the failed test result is written to a pdf file
End Sub
```

Use only for GRS type system.

18. PrintSignaturesAllToPdf

```
Public Sub PrintSignaturesAllToPdf(fileName As String)
   ' The test result is written to a pdf file
End Sub
```

Use only for GRS type system.

19. GetXYZ(intX,intY,intZ)

```
Public Function GetXYZ(lngX As Long, lngY As Long, lngZ As Long)
   ' Get Prober XYZ.  Return coordinates in machine units
End Function
```

Returns the current X, Y and Z position in machine counts

20. Home

```
Public Sub Home()
   ' Home
End Sub
```

Homes the Prober

21. Prober_FastHome

```
Public Function Prober_FastHome()
        ' Call the FastHome function.
End Function
```

Homes the prober with fast speed

22. MoveToPad(strComponent, strPin)

```
Public Function MoveToPad(strComponent As String, strPin As String) As Boolean
   ' Move To Pad.  Move prober and graphic cross-hair to Pad for Component & Pin passed
End Function
```

Requests prober to move to specified pin on loaded GRS database

Boolean=GRS500.MoveToPad(strComponent, strPin)

If Boolean equals False then strComponent, strPin were not found

23. MoveToTestPoint(strComponent, strPin)

```
Public Function MoveToTestPoint(strComponent As String, strPin As String) As Boolean
   ' Move To TestPoint.  Move prober and graphic cross-hair to TestPoint component pin passed
End Function
```

Requests prober to move to specified test point on loaded GRS database

Boolean=GRS500.MoveToTestPoint(strComponent, strPin)

If Boolean equals False then strComponent, strPin were not found

24. MoveToXY (intX,intY)

```
Public Function MoveToXY(lngX As Long, lngY As Long)
   ' Move To XY.  Move prober to XY(machine units)
End Function
```

Request the prober to move to the absolute XY coordinate, with the origin 0,0 being at the bottom left of table. Coordinates will be in machine counts and need to be determined by using the GRS functions prior to using external instruments.

25. MoveZ(intZ)

```
Public Function MoveZ(lngZ As Long)
   ' MoveZ.  Move prober Z-axis stepperby specified number of machine units
End Function
```

Move Z-axis stepper by specified number of number of machine counts

26. ParkZ

```
Public Function ParkZ()
   ' ParkZ.  Request the prober to use the ParkZ option
End Function
```

Return Z-axis to the park position.

27. ProbeOffset(intProbeOrCrosshair)

```
Public Function ProbeOffset(lngProbeOrCrosshair As Long)
   ' Set ProbeOffset.  Set whether probe should move to crosshair or probe tip position
   ' during next move.
End Function
```

Request prober to move to probe tip or crosshair position when next using MoveTo command. Valid parameter values for intProbeOrCrosshair:

0=Crosshair
1=Probe Tip

28. ProbeUpDown(intProbePosition)

```
Public Function ProbeUpDown(lngProbePosition As Long)
   ' Probe Up Down.  Control Z-axis solenoid
End Function
```

Control Z-axis solenoid. Only for GRS Instrument, not for RITS/DVS. Valid parameter values for intProbePosition:

0=Probe Up
1=Probe Down

29. SetSwitchableCommons(intSwitchableCommonsValue)

```
Public Function SetSwitchableCommons(intSwitchableCommonsValue As Integer)
   ' Set Switchable Commons
```

```
   ' Sets Relay Matrix appropriately using intSwitchableCommonsValue passed.  Switchable
Commons values allocated as normal
   ' but PORTB and PULSE bits must be set
   ' Table Common 1 = gintProberSET_RELAY_MATRIX_1 = 8
   ' Table Common 2 = gintProberSET_RELAY_MATRIX_2 = 4
   ' Table Common 3 = gintProberSET_RELAY_MATRIX_3 = 2
   ' Table Common 4 = gintProberSET_RELAY_MATRIX_1 = 1
End Function
```

Requests prober to switch Commons. Only for GRS instrument, not for RITS/DVS
GRS500.SetSwitchableCommons(intSwitchableCommonsValue)

Where intSwitchableCommonsValue equals one of the following values:
Prober Common 1 = 8
Prober Common 2 = 4
Prober Common 3 = 2
Prober Common 4 = 1
Prober All Commons = 15

30. SwitchCamera(intCameraPosition)

```
Public Function SwitchCamera(lngCameraPosition As Long)
   ' Switch Camera.  Switch between front and back camera
End Function
```

Switch between front and back camera. Valid parameter values for intCameraPosition:

0=Front
1=Back

31. TouchZ

```
Public Function TouchZ()
   ' TouchZ.  Request the prober to use the Z-axis TouchZ option
End Function
```

Request the prober to use the Z-axis touch z option. Use only for GRS type system

32. TakeCameraSnapshot

```
Public Function TakeCameraSnapshot(strSnapShotFilename As String)
   ' Take Camera Snapshot.  Write current camera bmp image to file
End Function
```

*Saves a *.bmp file of the camera image at a specified path and file name.*

33. ProbeRotate

```
Public Function ProbeRotate(lngAngle As Long)
        ' Rotates the test head
End Function
```

Rotates the probe head by a specific angle (requires rotating probe head option)

34. GetActualAngle

```
Public Function GetActualAngle(lngAngle As Double)
        ' Gets the actual test head angle
End Function
```

Returns the current angle of the probe head using the rotation encoder

35. RFParkZ

```
Public Function RFParkZ()
   ' RFParkZ.  Only for 4 axis prober
End Function
```

Parks the RF Probe head in the uppermost position (Zero). Use this command only if the rotating probe head is mounted (RITS/DVS system). For GRS Type systems use “ParkZ” instead

36. RFMoveZ

```
Public Function RFMoveZ(lngZ As Long)
   ' RFMoveZ.  Only for 4 axis prober
End Function
```

Move Z-axis stepper by specified number of number of machine counts, use this command only when RF Head is mounted (RITS/DVS Instrument). For GRS Type systems use “MoveZ” instead

37. SetLaserPointer

```
Public Function SetLaserPointer(bIsEnabled As Boolean)
```

```
        ' Switch on/off the laserpointer
End Function
```

Turns on/off (toggle) the laser pointer

38. RFTouchZ

```
Public Function RFTouchZ()
   ' RFTouchZ.  Only for 4 axis prober
End Function
```

Requests the prober to move the Z-Axis down until the probe touches the board. Use this command only if RF head is mounted. (RITS/DVS Instrument). For GRS Type systems use "TouchZ" instead

39. SwitchLedRingsOnOff

```
Public Function SwitchLedRingsOnOff()
```

40. Prober_ParkPosition

```
Public Function Prober_ParkPosition()
   ' Prober_ParkPosition.  Parks the Probe x/y in the grs-file specified position.
End Function
```

41. ImportCriticalNets

```
Public Function ImportCriticalNets(strfilename as String)
   ' ImportCriticalNets.  Imports critical nets for testing.  (Defined xml-fileformat)
End Function
```

42. TestCnt()

```
Public Function TestCnt()
   ' Test CNT.  Tests only nets marked as critical.  (Defined xml-fileformat)
End Function
```