TERADYNE Z1800-Series

PRISM-Z Analog Measurement Subsystem

Teradyne, Inc.
Assembly Test/Walnut Creek
2625 Shadelands Drive, Walnut Creek, California 94598-2597
Publication Number 1800M232

Product Warranty

THE STANDARD TERADYNE WARRANTY CONSTITUTES THE ONLY REPRESENTATION OR WARRANTY MADE BY TERADYNE WITH RESPECT TO ANY EQUIPMENT, GOODS OR SERVICES SUPPLIED BY TERADYNE. TERADYNE MAKES NO OTHER WARRANTIES OR REPRESENTATIONS, EXPRESSED OR IMPLIED, IN FACT OR IN LAW, INCLUDING THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. IN NO EVENT WILL TERADYNE BE LIABLE FOR INCIDENTAL, SPECIAL OR CONSEQUENTIAL PENALTIES OR DAMAGES, INCLUDING LOST PROFITS, OR PENALTIES AND/OR DAMAGES FOR DELAY IN DELIVERY OR FAILURE TO GIVE NOTICE OF DELAY, EVEN IF TERADYNE HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

Due to an ongoing policy of constantly updating equipment and procedures, the contents of this document are subject to change without notice.

Teradyne assumes no responsibility for errors or for any damages that result from the implementation of the procedures described in this publication. Teradyne also reserves the right to make changes in its products without incurring any obligation to incorporate such changes in units previously sold or shipped. Teradyne makes no commitment to update nor to keep current the information contained in this document.

Teradyne assumes no responsibility for the use of any circuitry other than the circuitry embodied as a Teradyne product. No other circuit patent licenses are implied.

This software system consists of computer software and documentation. It contains trade secrets and confidential information which are proprietary to Teradyne, Inc. Its use or disclosure in whole or in part without the express written permission of Teradyne, Inc. is prohibited.

This software system is also an unpublished work protected under the copyright laws of the United States of America. If this work becomes published, the following notice shall apply:

Trademarks

The following are trademarks or registered trademarks of Teradyne and may be used to describe only Teradyne, Inc., Assembly Test Division/Walnut Creek products:

- APC
- AutoLoad
- BoardWatch
- Boundary Scan Intelligent Diagnostics (BSID)
- CapScan
- Component Designer (CDES)
- Defect Display Station (DDS)
- DeltaScan
- Flying Prober
- FrameScan
- FrameScan Plus
- Inline Device Programmer (ILDP)
- InterScan
- Momentum
- MultiScan II
- Paperless Repair Station (PRS)
- PentaVision
- Perspective
- PRISM
- ProcessWatch
- Programmer Efficiency Package (PEP)
- Quick-Check
- Safecracker
- Spectrum 8800-Series Manufacturing Test Platform
- TestLink
- Test Studio
- Test Toolbox
- VICTORY
- WaveScan
- Z1800-Series Manufacturing Process Test System

The following are trademarks or registered trademarks of other companies:

Borland and Paradox are trademarks of Borland International, Inc.

C++ and UNIX are registered trademarks of AT&T Bell Laboratory.

Codewright is a trademark of Premia Corporation.

ETHERNET is a trademark of Xerox Corporation.

FABmaster is a registered trademark of FABMASTER S.A.

HP-UX is a registered trademark of Hewlett-Packard Company.

IBM, MicroChannel, and PS/2 are registered trademarks of International Business Machines, Inc.

Impromptu and PowerPlay are registered trademarks of Cognos Corporation.

LabWindows, LabWindows/CVI, NI-488.2, and NI-VXI are trademarks of National Instruments Corporation.

Microsoft, MS-DOS, QuickC, SQL Server, Windows 95, and Windows NT are either registered trademarks or trademarks of Microsoft Corporation in the United States and/or other countries.

Okidata and Microline are registered trademarks of Oki Electric Industry Company, Ltd.

OS-9 and Microware are registered trademarks of Microware Systems Corporation.

SunOS and Solaris are registered trademarks of Sun Microsystems, Inc.

PRISM-Z Analog Measurement Subsystem

Manual History

- Second Edition, March 1999, Version F.2b system software
- First Edition, October 1997, Version F.2a system software

Publications No. 1800M232

Assembly Test/Walnut Creek
2625 Shadelands Drive · Walnut Creek, CA 94598 ·
(925) 932-6900
Customer Service Hotline (800) 457-8326

TABLE OF CONTENTS

PRISM-Z
Analog Measurement Subsystem

Introduction

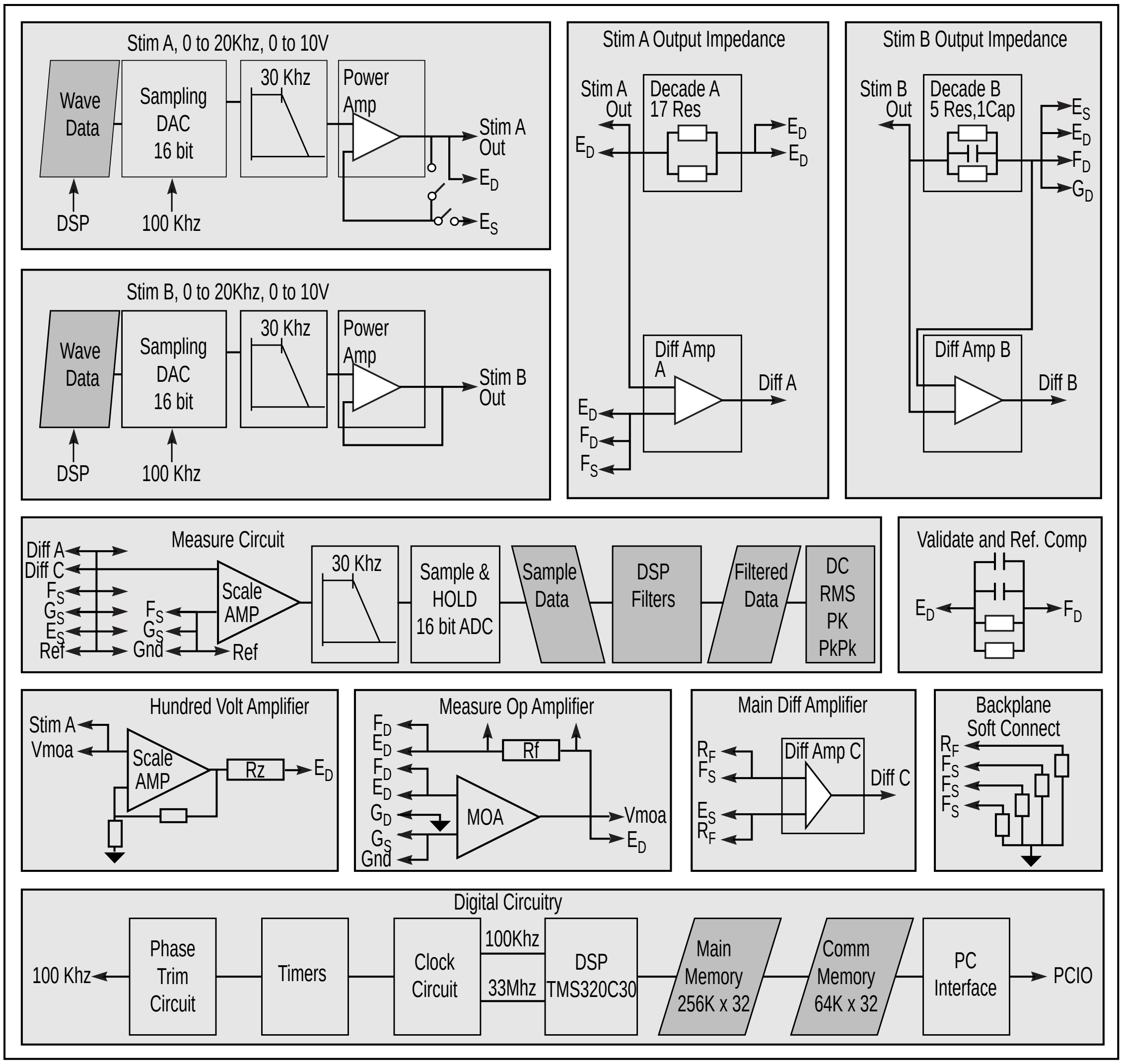
The PRISM-Z (**PR**ecision **I**ntegrated **S**ignal **M**easurement) module is an analog measurement subsystem for in-circuit testers. It is a Digital Signal Processor-based (DSP) design that can accurately measure values and circuit configuration found on today's products. The PRISM-Z instrument is standard on new Z1888 systems and is also supported as an upgrade for existing Z1805-1, Z1808, Z1840, Z1860, Z1880-1, Z1880-2, and Z1890 testers. The PRISM-Z offers benefits in the following five major areas over existing systems.

- Throughput
- Accuracy/Repeatability
- Stability long and short-term
- Broadened range
- Flexibility/Potential

Systems which include the PRISM-Z option retain the Analog Test Board (ATB) to guarantee backward compatibility with existing programs as well as for ordinary tasks such as shorts, continuities, and Node Finder.

The PRISM-Z Instrument

The following diagram shows the logical blocks of the PRISM-Z. The blocks can be soft configured for a particular measurement application, unlike the ATB which is partially preconfigured for certain test modes.



Stimulus Section

PRISM-Z's Stim A senses around the stimulus path for low impedance components and uses a sampling DAC which is fed waveform data by the DSP once every 10 µs. For default frequencies, the data comes from a precomputed wave table. For arbitrary frequencies, the DSP creates the data on the fly. Possible frequencies are between 12.5 Hz and 20 kHz in increments of 10 µs periods.

Because the DACs are referenced from a single DC source, as opposed to three different AC sources in the ATB, the accuracy of the stimuli is increased by 2 orders of magnitude. The following stage is comprised of an 8-pole Butterworth filter (reconstruction filter) with a bandwidth of 0 to 30 kHz. It eliminates the 100 kHz switching by-products. The resulting waveform has a distortion of less than 0.1% over the entire frequency range. The filter output feeds a multistage power amplifier. The thermal stability properties are improved by orders of magnitude compared to previous designs due to the physical decoupling of the gain and power stage. The current output of this stage is specified at 300 ma with additional current reserves. The open-circuit output impedance is below 1Ω to guard against unwanted phase shifts.

Output Impedance A and B

Two separate sets of precision resistor decades are provided. Impedance A provides 17 resistors in a 1 - 2 - 5 sequence where Impedance B contains 5-decade resistors and one 1 nF capacitor. Impedance A can reach both F and E poles and its associated differential measure amplifier has direct inputs for the 4 lowest ohm resistors as well as connectivity to the backplane poles. Output B can reach Es, Ed, Fd, and Gd, while its associated differential amplifier always measures the voltage across the resistor.

Measure Circuit

The measure circuit is laid out as a general purpose voltmeter with connection to all poles in the system. Its internal inputs from the differential amplifiers A, B and C are switched by means of solid state relays for fast reconfiguring. All external inputs are protected to ±100V. The scale amp has four ranges: 0.3, 3, 30, and 300 (restricted to 100V maximum). The following 8-pole Butterworth filter (anti-alias filter) is identical to the stimulus filters and is used to further reduce switching by-products possibly amplified by the MOA. The precision sample and hold ADC has a full scale range of

±3V with a resolution of 9µV. It samples the input waveform at a rate of 100kHz and, using a DMA (Direct Memory Access) channel of the DSP, stores the values into main memory.

The rest of the measure circuit block is strictly software processing. In the period between 100 kHz intervals as the DSP works on the sampled data and converts it to floating point values, it applies DSP filtering to the data depending on overall measure configuration and stimulus frequency used. As a byproduct of these computations, the resulting values of RMS, Total RMS, PK, and PKPK fall out. PK is the largest excursion of the waveform where RMS is calculated by squaring and adding all measure points within a single sine wave of the measure signal. This provides very fast way to establish RMS compared to the hardware approach of the ATB which needs 500ms of conversion time.

High Volt Amplifier

The PRISM-Z high volt amplifier is a basic times-10 amplifier which can be powered by up to ±120V. It is used for stimulus above 9.99V. Unlike the ATB, it has a variable output impedance of 1kΩ to 10kΩ. The amplifier, when used in the MOA feedback, has a bandwidth of 1kHz. The high volt amplifier is a permanent part of the board.

Measurement Operational Amplifier (MOA)

Although not new in concept, the MOA circuit consists of three stages. Stage 1 provides input protection and an extremely high input impedance. Stage 2 provides the gain for a unity gain bandwidth of 1.4MHz, whereas stage 3 provides the current. Since the three individual tasks are not folded into one stage, temperature and phase stability as well as linearity is achieved.

The feedback path as shown in “Rf” is provided by nine reference resistors between 1Ω and 100MΩ. The design incorporates an optional bandwidth limiting circuit set to 3.2kHz. The MOA can be connected to all the viable poles. There is no separate guard amplifier in this design. Instead the MOA takes the reference from the Gs and provides a hard ground connection for Gd, thus eliminating the potential for guard amplifier errors such as offsets and instability. Throughout the design, very low temperature coefficient amplifiers are used. Compared to the ATB, these amplifiers are 30 times less susceptible to temperature changes and therefore make the PRISM-Z much more stable across a wider range of temperature.

The main differential amplifier is usually connected across Rf, but it can also measure across Es/Fs. Its purpose is to measure the voltage over Rf. It has separate inputs for the four low order resistors (1Ω to 1kΩ) so that trace and relay contact resistance are eliminated.

Backplane Soft Connect

For poles which can provide a low impedance path, four soft connect relays and discharge resistors are provided. Since the Z1800-Series driver/receiver cards don't provide a soft connect mechanism, PRISM-Z is equipped with a path to discharge the poles before establishing a measure setup. This soft connect combined with automatic removal of the stimulus before disconnecting from a measure setup, provides backplane protection without a loss of throughput.

Digital Section

Noise suppression from the digital side is provided by a wide ground path called the MOAT which runs between the two sides and is augmented by an aluminum stiffener bar.

The PC interface serves two purposes. Its primary function is to interface between the PCIO card and the PRISM-Z internals, but it also provides signal reconditioning and buffering for the down-stream devices such as VP/THC, DeltaScan, FIB, and other boards.

The 256-Kb communication memory is dual-ported to allow the PC to access it without disturbing the DSP. It is used to send a measure request message and then read the response data.

The 1MB main memory holds the code and default waveform data tables but is also used for data storage out of the ADC. A 1MB main memory gives ample room for growth since only about 250Kb is used for basic operation.

The DSP chip is the Texas TMS320C30. It runs on a 33MHz clock and is tied to the 100kHz clock for interrupt service handling.

A phase trim circuit provides absolute identical timing of the 100kHz signals to the DACs and ADC. It has programmable delay lines which adjust for delay times due to manufacturing and temperature induced differences. Absolute identical timing for the two stimuli is needed for bridge mode measurements where the phase angle of the two needs to be exactly 90 degrees. The phase relationship between the two stimuli can be adjusted to within 1/100 of a degree.

Installing the PRISM-Z in the Card Cage

The PRISM-Z is installed at the factory if you have purchased this option with a new system. If you have purchased PRISM-Z as a retrofit, a Teradyne engineer will install it at your site. The PRISM-Z installs in various places depending on your tester and its configuration.

2-cage system	Install next to the VP in an instrument slot.
1024-node system	Install in the second to last DR slot (with DeltaScan in the last slot). It occupies two DR slots.
640-node system	Install in the last DR slot. It occupies two DR slots.

If PRISM-Z is installed in a DR slot, you must ensure adequate air flow under that slot.

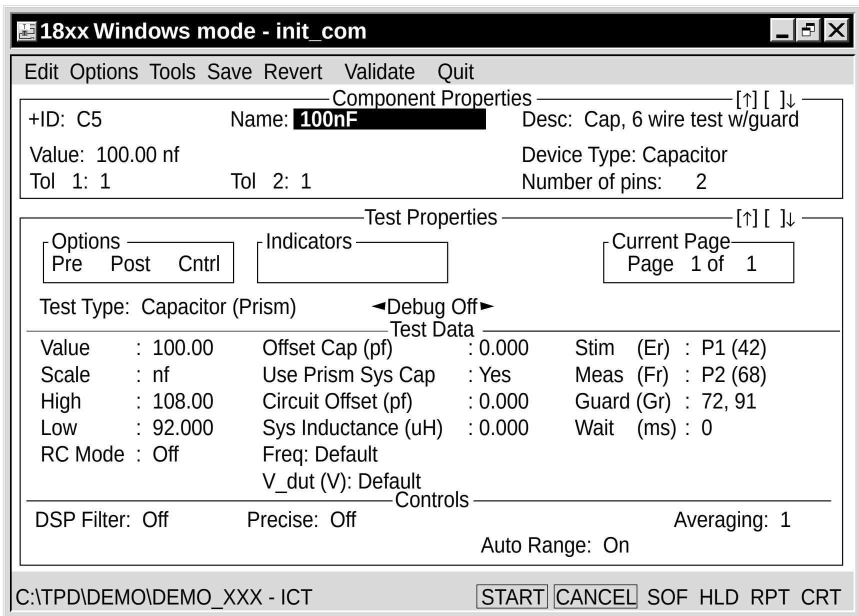
Important: For optimal PRISM-Z performance, the external line conditioner assembly should be located NO CLOSER THAN three feet from the tester.

New Worksheet Test Types

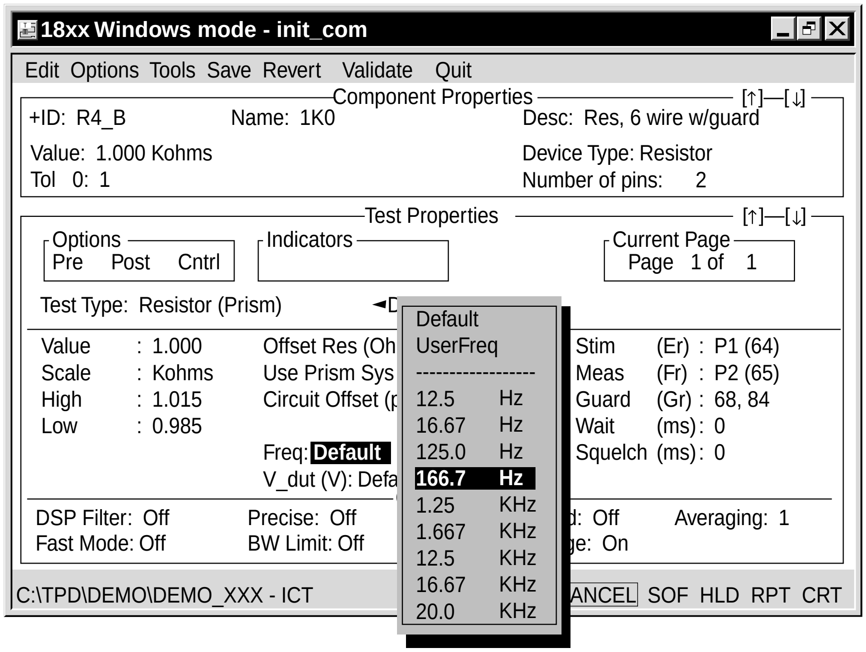
In F.2a and later versions of the 18xx system software, PRISM-Z versions of the following tests types are available. The PRISM-Z versions of these test types are identified by the word (Prism) following the test type in the Test Type selection list.

- Capacitor (Prism)
- Inductor (Prism)
- Resistor (Prism)
- Test I Stim V (Prism)
- Test V (Prism)
- Test V Stim I (Prism)
- Test V Stim V (Prism)

An example of a PRISM-Z capacitor worksheet appears below.



An example of a Prism-Z Test V Stim V longhand worksheet appears below.



To enable dual stimulus for longhand test types, use the Dual Stim control in the Test Properties section of the worksheet. For more information, see page 18.

Converting Existing Programs

Using the 18xx Global Editor, you can easily change component tests which use ATB worksheets to tests which use PRISM-Z worksheets and visa versa. The Global Editor screen has two new modes of operation: Conv_to_Prism and Conv_to_ATB.

Individual Test Type Conversion

To convert certain types of components to PRISM-Z tests (Change all resistor tests, for example, from using the ATB to using the PRISM-Z) create an agent such that

```
Test_type == Resistor;

: Conv_to_Prism;
```

and select Execute from the Global Editor Main menu. This action changes all resistor tests from ATB resistor tests to PRISM-Z resistor test.

It is also possible to convert an individual component test to PRISM-Z by simply switching the test type.

Global Conversion

To convert all tests to PRISM-Z in the Global Editor create an agent such that

```
ID == *;

: Conv_to_Prism;
```

1. **Select ID as the attribute of the qualifier.**
2. **Select “==” as the operator.**
3. **Enter the character “*” as the value.**

   The asterisk “*” entered in the value field is a special wildcard character. This wildcard character will result in a match with all test step IDs, thus qualifying all test steps in the program. The effect of this agent is to modify all Capacitor, Cap Phase, Inductor, Resistor, TISV, TISVSV, TV, TVSI, TVSISV, TVSV, and TVSVSV test steps in the currently selected ICT program to their PRISM-Z equivalents.

4. **Then choose Conv_to_Prism as the edit mode.**
5. **Choose Execute from the Global Editor Main menu to execute the changes.**

Notes on Converting To PRISM Test Types

Using the Global Editor speeds up the process considerably. The conversion can be viewed as a two step process:

1. Converting the ATB test types to PRISM.

2. Modifying the various worksheet control fields as desired.

Step one has been extensively described in text. However, you can also use the Global Editor to modify worksheet control fields to optimize the testing performance. To modify a control field,

1. **Select the attribute (ID, Device Type, and so forth)**
2. **Select MODIFY.**
3. **Select the attribute to change (Fast Mode, Precise, and so forth) and the value (On, off, <value>, and so forth.)**

HINT: You may select multiple actions in a single execution pass.

```
:Modify
Fast_Mode = on;
Precise = off;
```

Assuring Test Accuracy Repeatability

- Turn on Precise mode, turn off Fast Mode.
- Use remote sensing on low impedance tests (multiple nails).
- With RL and RC tests, always use the same node configuration for the resistance test page as for the inductor or capacitor test page.
- In heavily guarded situations, slightly reducing the stimulus frequency from the default may allow a better test result.
- Use Debug components to assure a valid test result.
- In debug mode, use Validate to determine system offset capacitance.
- In Setup/Validate Configuration, turn on Learn Cap Offsets to allow the system to determine run-to-run system offset capacitance.
- Avoid using Circuit Offset in multiple tester applications of a program. It is strictly an empirically derived value established by the customer, and is NOT updated with each run as Offset Cap is (when set globally).
- In RC Impedance Mode, use higher frequency if guarding allows it.
- Disable test-jack panel “Poles” in Setup System Vars.

Optimizing PRISM-Z Tests

- Disable Tokenlog capability in Setup/Device & Channel Data, in Program Execute and in Section Execute channels. Disabling tokenlog considerably reduces overall test execution time.
- Turn off Precise mode, turn on Fast Mode.
- Add in only a minimum required wait time, based on debugging observations with an oscilloscope connected to the M-sig output. In most cases, less than 0.5 ms of wait time is sufficient.
- Set averaging to 1.
- Use Line Reject appropriately; the execution time is between 16.6 and 20 ms, depending on the line frequency setting.
- For RC tests, try Impedance mode first before Bridge mode, as it is much faster.
- Do not mix Prism tests with ATB test; group them separately, with ATB tests run first. (ATB recovery times would slow a mixed set of tests; with all ATB tests grouped first, recovery time is not an issue.)
- Disable all test-jacks in Setup System Vars.

Program Generation

The 18xx input list format has not changed in order to accommodate generating PRISM-Z tests. The standard Resistor (R), Capacitor (C), and Inductor (L) Input List Tokens are used. The program generator can be directed to generate either ATB or PRISM-Z tests for inductors, capacitors, and resistors by means of a new Pgen Config variable—PRISMGEN.

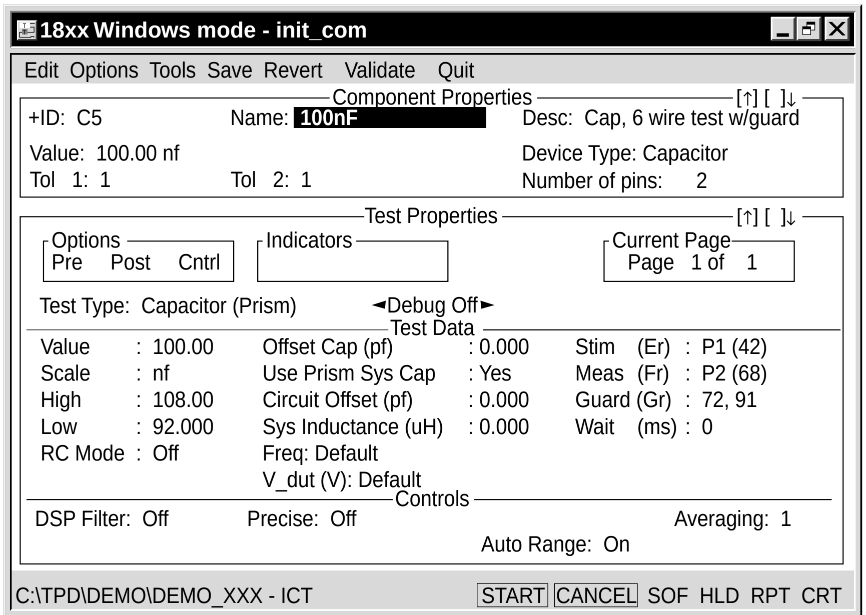
The PRISMGEN variable, when it is not selected or when it is selected but empty, results in the program generator creating ATB tests for the component types mentioned above. To have the program generator create PRISM-Z tests, the PRISMGEN variable must to set to one of C, L, R, LC, RC, LR, or RLC. This level of control lets you select from the types of components that PRISM-Z supports, those components that you want the program generator to generate PRISM-Z tests for.

When the program generator creates an inductor test, it automatically creates a two-page test. The first page is a PRISM-Z resistor test, and the second page is the PRISM-Z inductor test. The PRISM-Z resistor page measures the resistive element of the inductor. The expected resistance varies depending on the value of the inductor.

Worksheet Parameters

PRISM-Z tests have more controls available than their ATB counterparts. Presented below are the individual PRISM-Z worksheets and their associated PRISM-Z specific controls. Controls which are named the same and perform the same function as the ATB version of that test are not mentioned.

PRISM-Z Capacitor Test



RC Mode: The RC Mode field on a Capacitor (Prism) test is used when testing a parallel RC component network using the PRISM-Z board. Clicking this field displays a pop-up window with the choices: Off, Impedance and Bridge.

Off is self-explanatory; there is no parallel resistance.

For RC networks with a time constant under 10 µs, choose **Bridge mode**. The PRISM-Z then uses a balanced bridge technique to null the real (resistance) and imaginary (reactance) components of the network. Note: a preceding resistor test page is still required. If the RC time constant is equal to or greater than 10 µs, choose Impedance. The PRISM-Z then uses a test method similar to the ATB and subtracts the resistance result, which should have been tested on the previous page of the test step. If an error message appears while you are in impedance mode informing you that the phase angle is too small, use User Freq to increase the test frequency, therefore relaxing the phase angle.

The **Offset Cap** field is provided to hold the system's contribution to the actual value measured at the DUT. If the Learn Cap Offsets feature is enabled in Setup/Validate Configuration, it modifies this value each time you choose Run from the Main menu. The value reported as the result of this test page will be the value actually measured at the DUT minus this Offset value. Teradyne strongly recommends that you always use Learn Cap Offset.

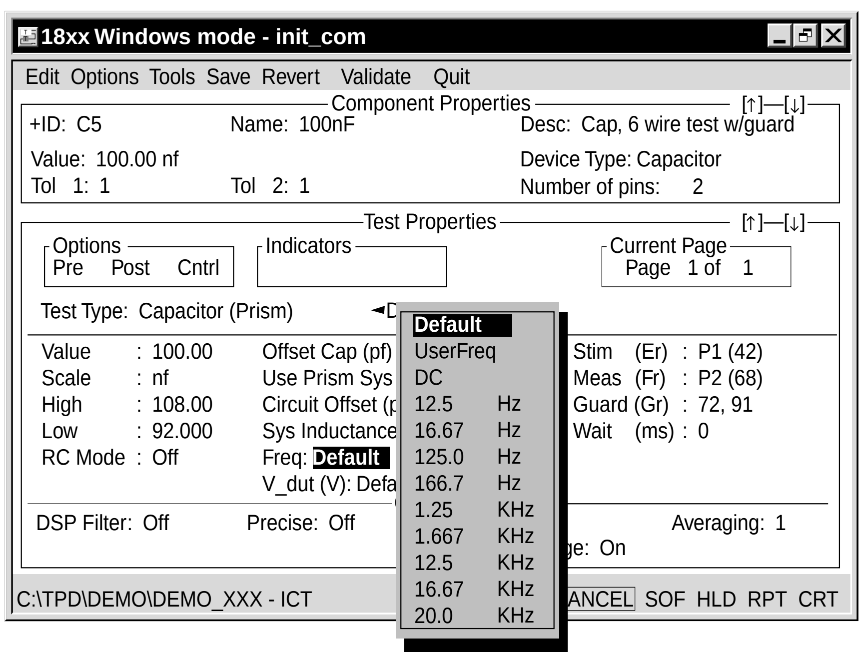
As with the Offset Cap field above, **Circuit Offset** is yet another value that is subtracted from the value actually measured at the DUT prior to reporting the measured value. Unlike the Offset Cap field, this field is completely under user control and is not updated at run time. The purpose of this field is to provide you with a place to enter contributions to the measured value which come from surrounding circuitry of DUT.

NOTE: The **Use Prism Sys Cap** field should not be used in conjuncton with the Offset Cap field explained above; it causes the runtime software to subtract the fixed (static) Prism System Capacitance value entered in the Setup menu's System Variables screen from the value actually measured at the DUT prior to reporting the measured value.

Important: The Learn Cap Offsets control in Setup/Validate Configuration does NOT modify the Circuit Offset field.

V_dut (V): When Default is active, the system chooses the stimulus voltage and polarity; when PK-PK is active, the user enters the stimulus voltage and polarity (polarity affects DC and AC-phase).

The **Freq** field corresponds to the Stim field. With PRISM-Z tests,



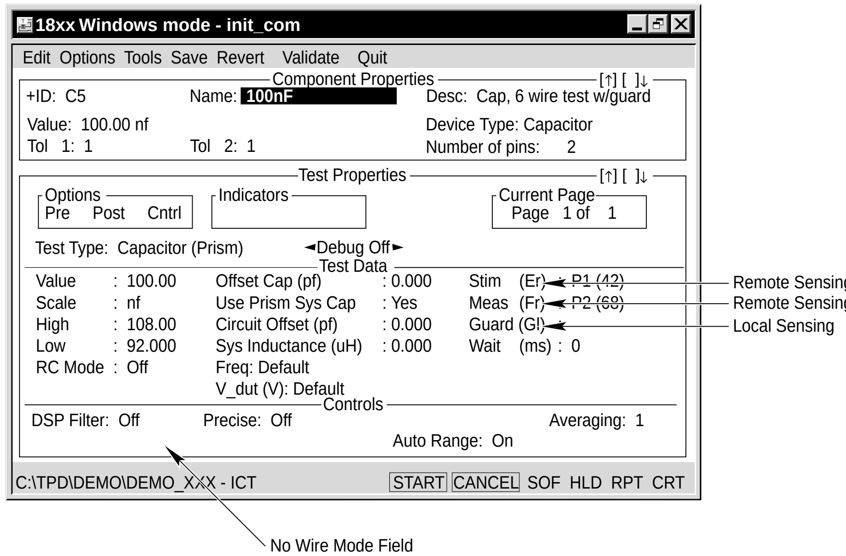
you have two methods for choosing AC frequencies. When you choose the Freq field, a list is displayed that includes the default DC choice, a User Freq choice, and several AC frequency choices. The choices listed for AC are multiples of the 12.5 Hz and 16.67 Hz base frequencies, up to 20 kHz.

To choose a frequency other than one of the listed choices, select **UserFreq** from the Freq field. Four new fields will appear to the right of the Freq field. These new fields are an increment frequency field “+”, a decrement field “-”, a frequency value field, and frequency scale field (Hz or kHz). The lowest frequency allowed is 12.5 Hz and the highest frequency allowed is 20.0 kHz.

Not all values between 12.5 Hz and 20.0 kHz are available with the PRISM-Z in **shorthand** tests. If a value is entered for the UserFreq which is not supported by the PRISM-Z software, the worksheet rounds the value to the nearest supported value and displays that value on the worksheet when the cursor is moved off the field. The increment frequency (“+”) and decrement frequency (“-”) buttons provide the finest level for adjusting the frequency in shorthand tests. A single click on the increment or decrement button changes the frequency to the next highest or lowest supported frequency; continuing to press the mouse button on increment or decrement increases or decreases the frequency until you release the mouse button. When the end of the range is reached, the PC responds with a beep.

Longhand tests allow much finer control of the frequencies, which are manually entered, though such typed-in frequencies may still be automatically rounded to match practical system design limits. The increment and decrement frequency buttons (“+” and “-”) provide the same resolution as in shorthand tests, described above.

Local and Remote Sensing



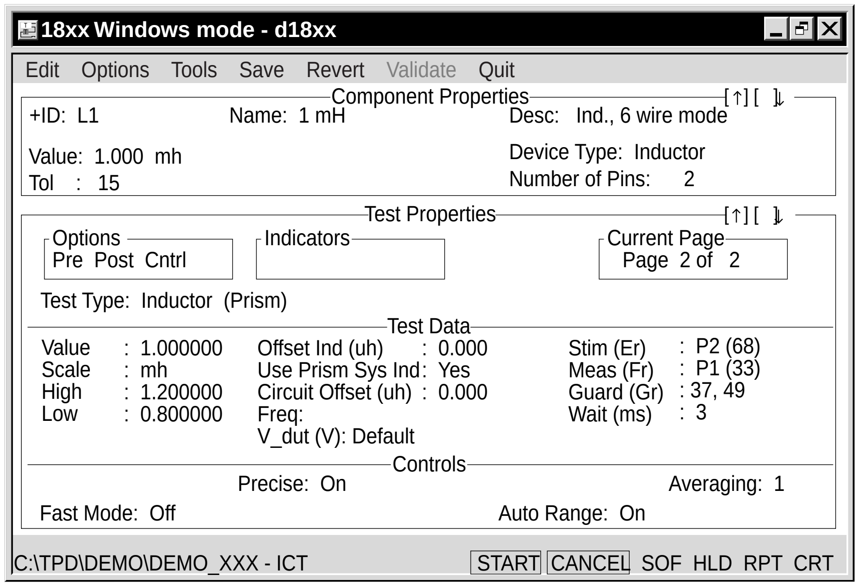
Unlike their ATB equivalents, all PRISM-Z tests have **local** and **remote sensing** on each pole (stimulus, measure, and guard). PRISM-Z worksheets do not have a Wire Mode field in the Controls section of the worksheet. Instead, each node field has a new field adjacent to it which can toggle between “l” (local) and “r” (remote). With this level of control, a PRISM-Z worksheet can individually select remote sensing on any pole. When remote sensing is selected on a pole, that pole must have at least one node which can connect to the drive pole and one node that can connect to the sense pole.

The **DSP Filter** parameter controls a low-pass filter which cuts off frequencies above the next frequency which is $2*(10^n)$ (2 times ten to the nth power). For example, with a stimulus of 125 Hz, the DSP Filter attenuates frequencies above 200 Hz. This feature should be used only if the stimulus frequency has the form of $1.25*(10^m)$, such as 125 Hz, 1.25 kHz, and so on.

Auto Range is an integral part of PRISM-Z, allowing for valid measurements. It should not be disabled except for debugging; otherwise, the PRISM-Z might not be able to produce a valid result even if the DUT value is within the low and high threshholds.

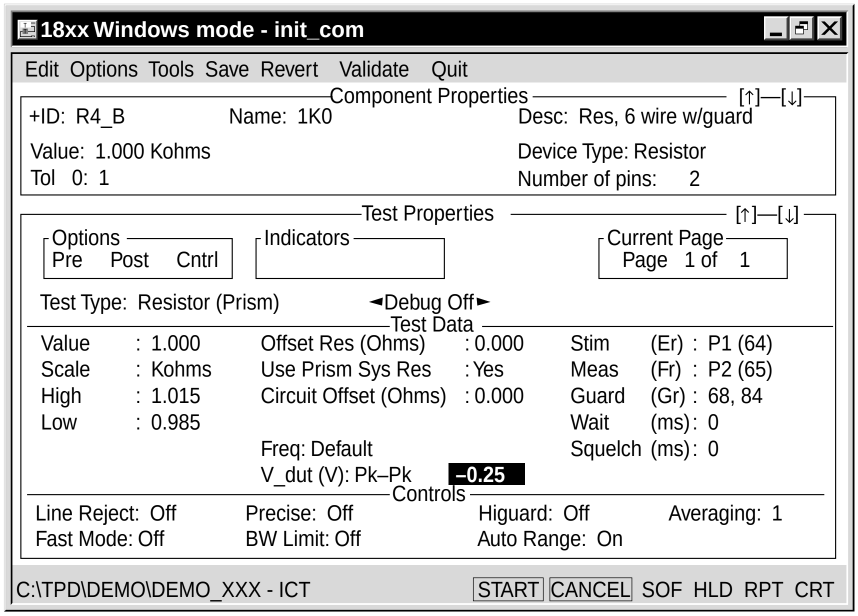
When Auto Range is “Off,” the PRISM-Z is configured to make a single measurement based on the expected value entered on the worksheet. If the actual value measured is outside of the measurement range for instruments configuration required by the expected value, the PRISM-Z issues an Overflow or Underflow error and the test fails. When “On,” Auto Range allows the PRISM-Z to remeasure until a valid measurement is achieved. The initial measurement with Auto Range On is still configured based on the expected value listed on the worksheet. Therefore, in practice, if a correct and passing component is installed in the board under test, and Auto Range is turned On, it is not necessary for PRISM-Z to actually reconfigure itself and make additional measurements. The initial configuration of the instrument and measurement of the component will yield a valid measurement and the throughput of the test will not be affected.

PRISM-Z Inductor



Offset Ind	Refer to PRISM-Z Capacitor.
Use Prism Sys Ind	Refer to PRISM-Z Capacitor.
Circuit Offset	Refer to PRISM-Z Capacitor.
Local/Remote Sensing	Refer to PRISM-Z Capacitor.
Auto Range	Refer to PRISM-Z Capacitor.

PRISM-Z Resistor



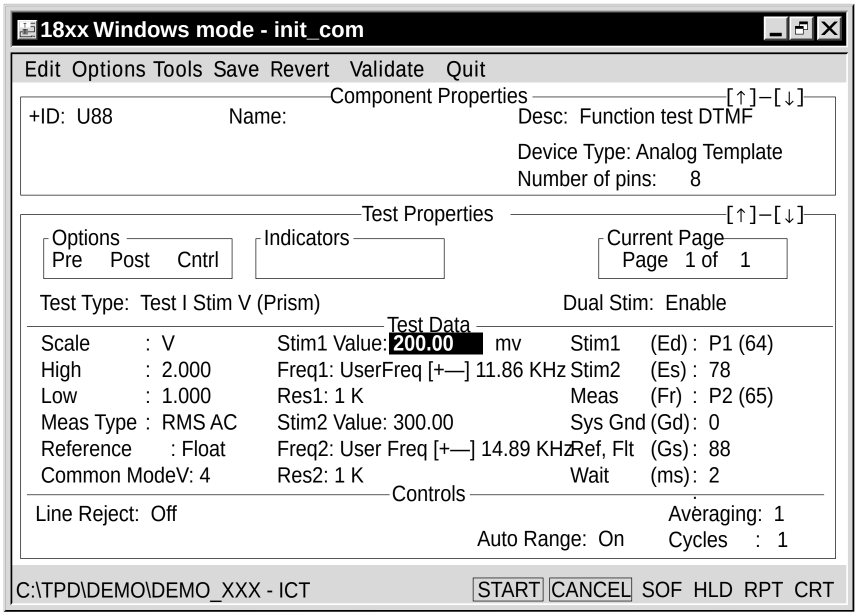
Offset Res	Same as in PRISM-Z Capacitor.
Use Prism Sys Res	Same as in PRISM-Z Capacitor.
Circuit Offset	Same as in PRISM-Z Capacitor.
Local/Remote Sensing	Same as in PRISM-Z Capacitor.

Line Reject eliminates noise from the measurement at the cost of throughput. When On, Line Reject causes runtime software to execute measurements over a complete line frequency cycle and average out potential line noise. The number of measurements taken is a function of the Prism Line Frequency entered in the Setup/System Variables worksheet. Line Reject applies only to DC measurements.

BW Limit allows you to limit the bandwidth in the MOA circuit. Limiting the bandwidth reduces ringing caused by the capacitance load.

Auto Range	Refer to PRISM-Z Capacitor.

PRISM-Z Test I Stim V



Freq1 Refer to PRISM-Z Capacitor Freq field.

Freq2 Refer to PRISM-Z Capacitor Freq field.

The resistor value selected by the **Res2** field is placed in series between the stimulus source and the DUT.

The **Dual Stim** field on PRISM-Z longhand tests is a method to incorporate both single and dual stimulus tests using a single PRISM-Z Longhand Test Type. When Disable is displayed for Dual Stim, the test page is in single stimulus mode. When Enabled is displayed for Dual Stim, the test page is in dual stimulus mode.

Once Dual Stim is enabled, the Stim2 Value, Freq2, Res2, and Stim2 node fields on the PRISM-Z longhand worksheet are available. The second stimulus is always a voltage stimulus. The operation of the Freq2 field is identical to the Freq field described for the PRISM-Z Capacitor test above. The nodes entered in the Stim2 field are connected to the E-sense pole, and the nodes entered in the Stim1 field are connected to the E-drive pole when Dual Stim is enabled.

Local/Remote Sensing Refer to PRISM-Z Capacitor.

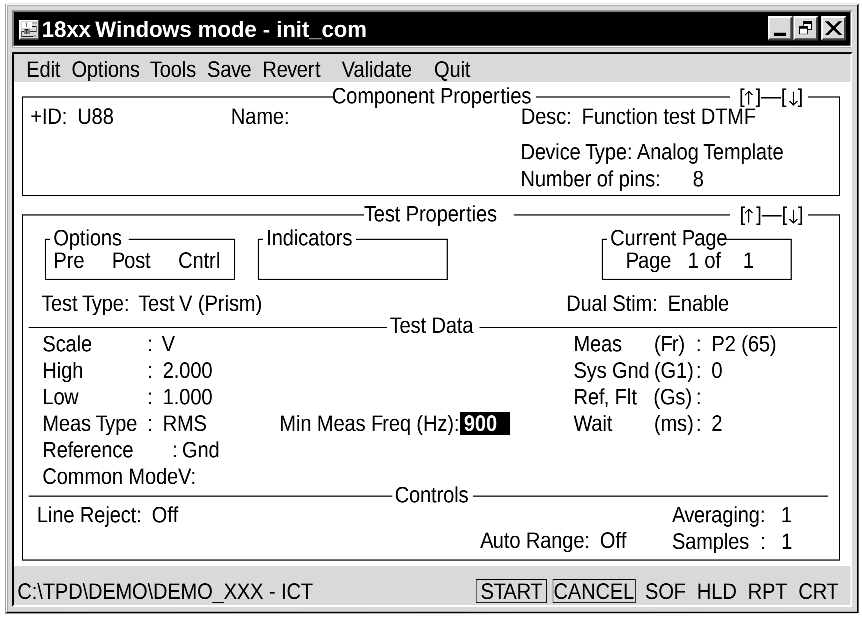
The ground reference node is specified is **Sys Gnd**. Alternatively, you can specify it in the Ground Ref Nodes field of the PRGMVARS worksheet.

Line Reject Refer to PRISM-Z Resistor.

Auto Range Refer to PRISM-Z Capacitor.

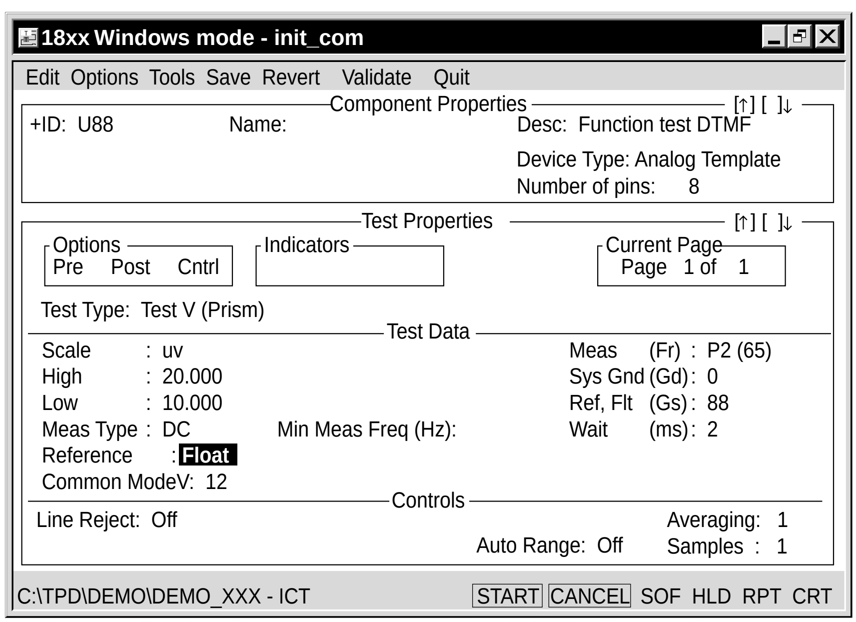
The parameter **Samples** (or **Cycles**, in AC measurements) allows a programmer to specify the number of samples to be taken for each set of readings to be averaged. The default is 32 samples per set, each sample taken at 10 µs intervals. Thus, if averaging is set to 10, and the samples field reads 20, the total number of readings taken is 20*10, or 200.

PRISM-Z Test V



Use the **Reference** field to choose whether to have the voltage measurement referenced to system ground or to float the reference point.

If GND is chosen, then the reference is to system ground, and the circuit point should be connected to the reference (Gd) pole, which is connected to system ground through a relay on the PRISM-Z board. The reference node should be listed in the Ground Ref Nodes field of the PRGMVARS test step or next to the Sys Gnd (Gx) field.



If Float is chosen, then the voltage of the reference point, with respect to system ground, should be specified in the Common Mode V field. Also, the Sys Gnd field should be left blank, and the reference node on the board should be specified in the Ref,Flt field (Gs pole).

The **Common ModV** field is used only if the Reference field above is set to Float. You should then specify the voltage at the reference point, as measured relative to system ground.

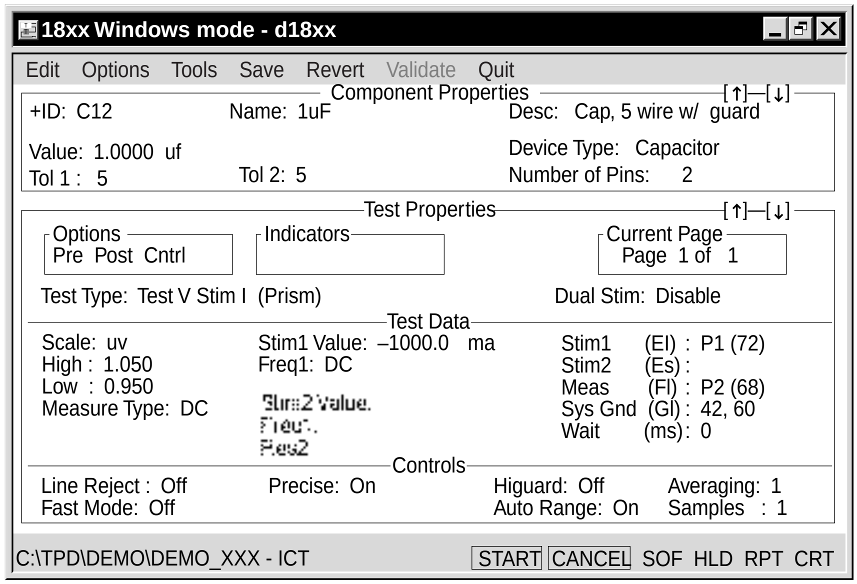
The **Min Meas Freq** field is used to enter the lowest expected signal frequency for asynchronous RMS and PK measurement methods; Prism uses the frequency entered to determine the measure gate time. For the RMS detection method, it is important to enter data as precisely as possible, since incorrect data reduces accuracy. When the signal frequency is known, the exact value should be entered here; if the frequency is not known or is a mix of multiple frequencies, the lowest frequency should be entered (12Hz). The least accuracy can be expected when the data entered and the actual measure signal differ by one quarter cycle, as when 50 Hz entered with a 66.6 Hz signal. The potential error is most significant at very low frequencies, due to fewer cycles per measurement.

For PK and PK-PK measurement types, the field is less critical as long it yields at least one full cycle gate time.

The **Ref, Flt** field can be used only if the PRISM-Z Reference field is set to Float. Then, this field should be used to specify the reference floated node on the test board, and the Sys Gnd field above (Gd pole) should be left blank or the Ground node of the DUT should be deleted. This node will be connected to Sys Gnd during the test and any voltage potential on it will therefore be shorted to Sys Gnd.

Line Reject	Refer to PRISM-Z Resistor.
Auto Range	Refer to PRISM-Z Capacitor.
Samples	Refer to PRISM-Z Test I Stim V.

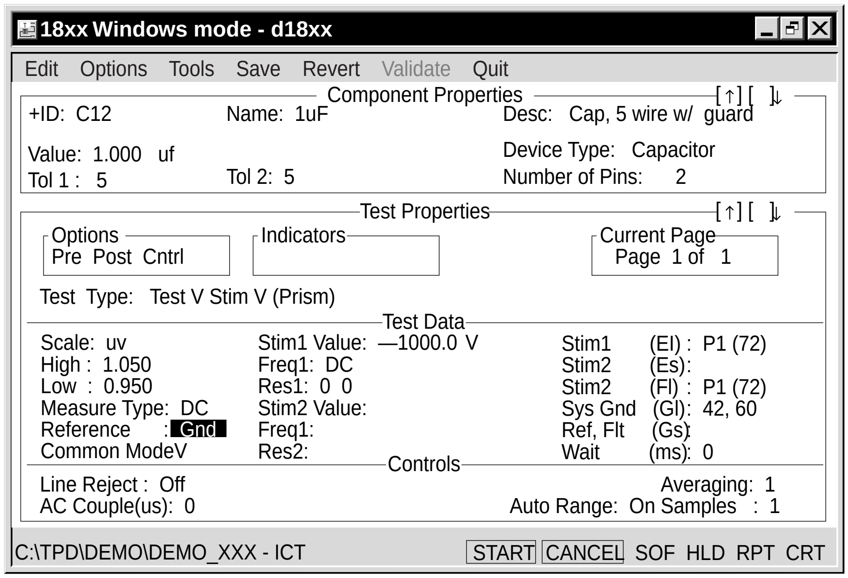
PRISM-Z Test V Stim I



Freq1	Refer to PRISM-Z Capacitor Freq field.
Freq2	Refer to PRISM-Z Capacitor Freq field.
Res2	Refer to PRISM-Z Test I Stim V Res2 field.
Dual Stim	Refer to PRISM-Z Test I Stim V.
Local/Remote Sensing	Refer to PRISM-Z Capacitor.
Line Reject	Refer to PRISM-Z Resistor.
Auto Range	Refer to PRISM-Z Capacitor.
Samples	Refer to PRISM-Z Test I Stim V.

The ground reference node is specified is **Sys Gnd**. Alternatively, you can specify it in the Ground Ref Nodes field of the PRGMVARS worksheet.

PRISM-Z Test V Stim V

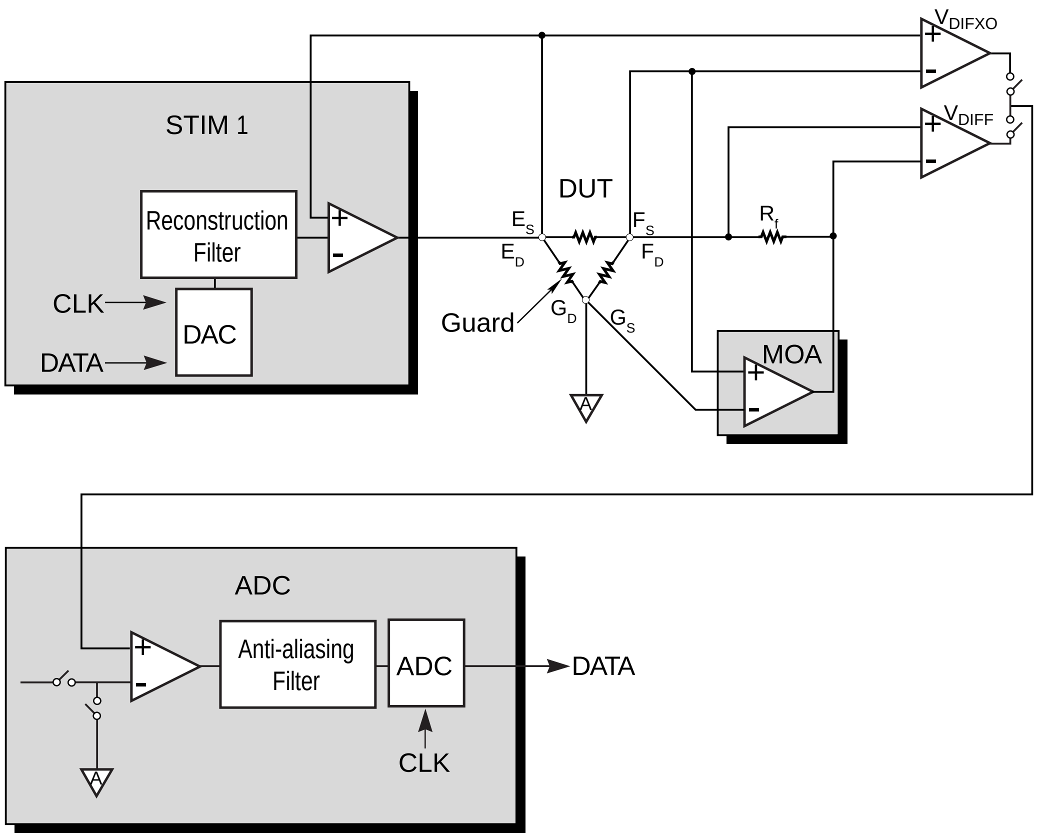


Reference	Refer to PRISM-Z Test V.
Common ModeV	Refer to PRISM-Z Test V.
Freq1	Refer to PRISM-Z Capacitor Freq field.
Res1	Refer to PRISM-Z Test I Stim V Res2 field.
Freq2	Refer to PRISM-Z Capacitor Freq field.
Res2	Refer to PRISM-Z Test I Stim V Res2 field.
Dual Stim	Refer to PRISM-Z Test I Stim V.
Ref, Flt	Refer to PRISM-Z Test V.
AC Couple	Refer to PRISM-Z Test V.
Local/Remote Sensing	Refer to PRISM-Z Capacitor.
Sys Gnd	Refer to PRISM-Z Capacitor.

PRISM-Z Basic In-Circuit Measurement Configurations

Constant Voltage (CV) Mode

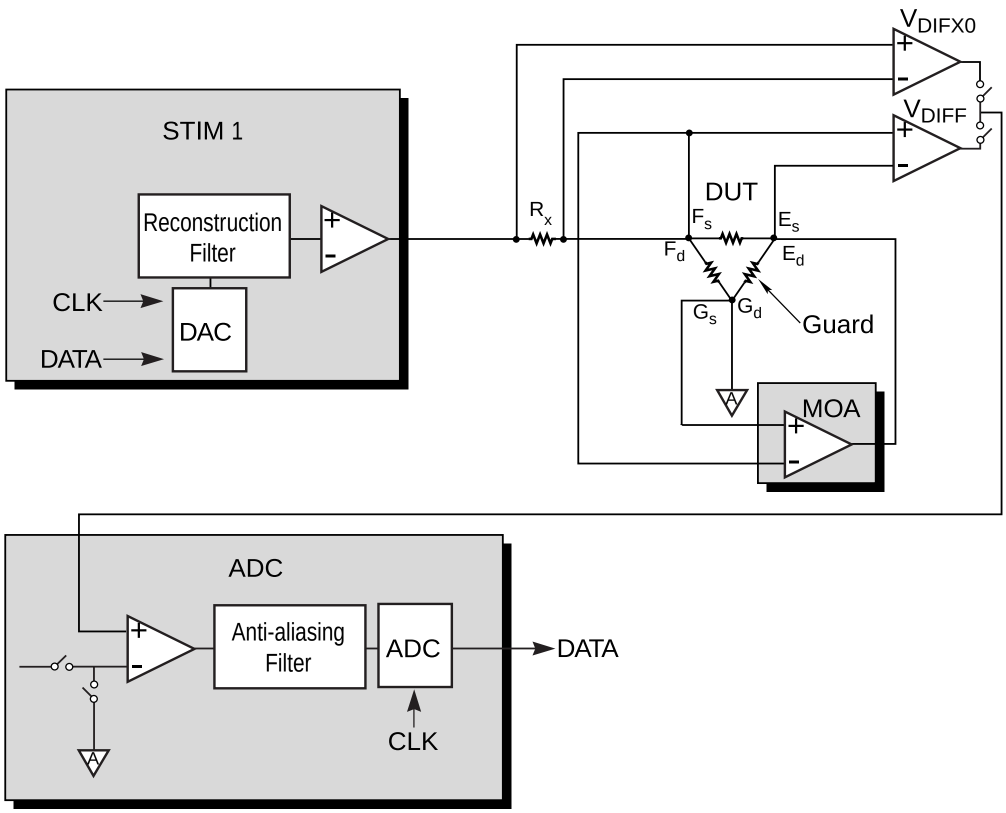
PRISM-Z CV mode: resistor, inductor, capacitor >10 µs RC



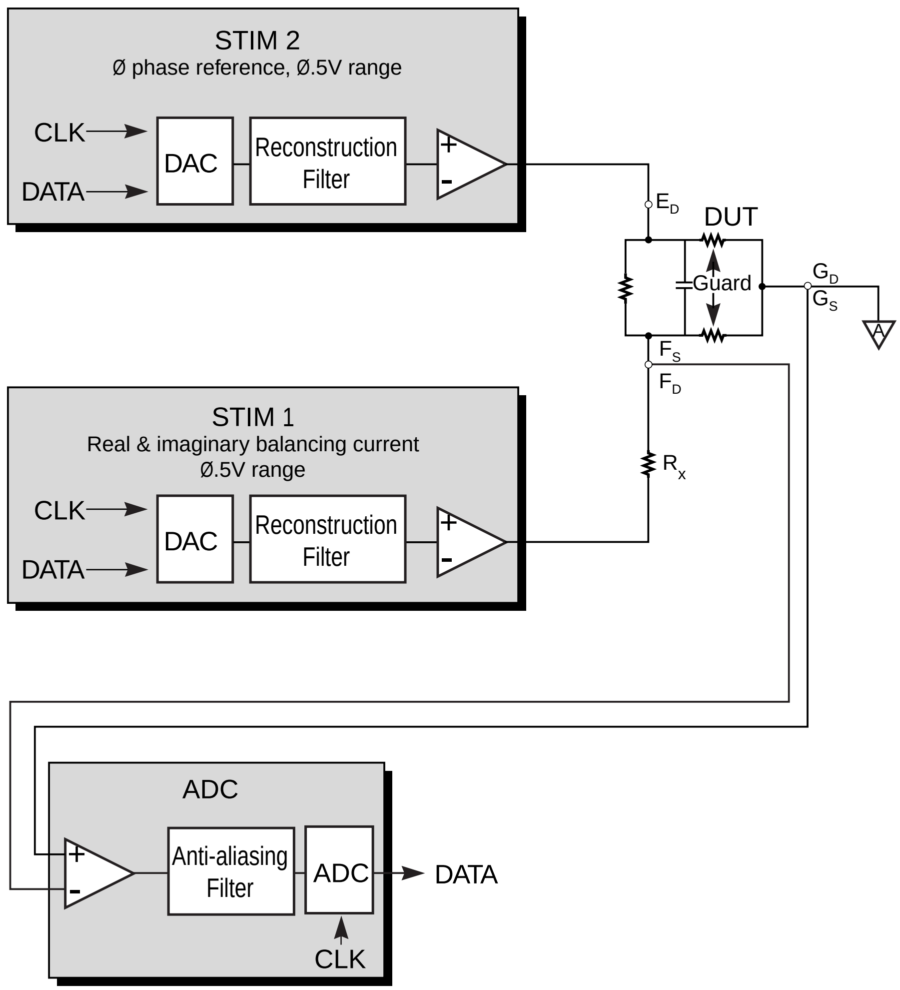
Important: In this document, Stim1 and Stim2 correspond to Stim0 and Stim1 on the schematics. Please make note of this difference.

Constant Current (CI) Mode

PRISM-Z mode: diode, zener, large capacitor



PRISM-Z Balanced bridge RC testing

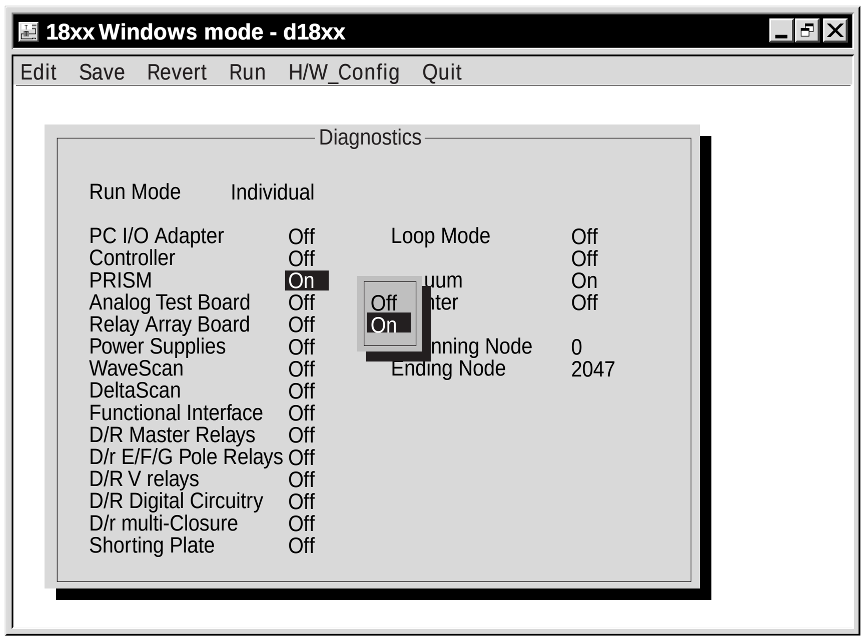


PRISM-Z Diagnostics

When PRISM-Z is in your system, the PRISM diagnostics need to be run with the rest of the diagnostics. Teradyne recommends that PRISM diagnostics be run as part of daily maintenance of the tester.

To run the PRISM diagnostics, follow the same procedures you would use to run any diagnostic program.

1. **From the main Diagnostics interface, select which Run Mode is desired (Individual or Chain).**
2. **Enable PRISM by selecting On in the table opposite Prism.**
3. **Select any other options desired; then select Run from the top of the Diagnostics interface menu.**



When PRISM diagnostics are executed, a memory test is run through the Z18xx operating system, then the image file (DIAPRISM.IMG) is loaded for the DSP. If these operations fail, or if there is not a PRISM-Z in the tester, the diagnostics will indicate such and not run the tests.

PRISM diagnostics use the loop-back features designed into the board, and therefore do not need a self-test assembly. Refer to the schematic (03B51071) for descriptions of the tests that follow.

PRISM test **190** tests the Phase Trim required for the board. The two stimulus sources are measured to determine the phase difference of Stim2 relative to Stim1. The maximum difference allowed is 2 degrees.

PRISM tests **200–203** verify some of the reference voltages on the board as measured through the Scale Amp. Test 200 is used to test the ground off-set of the Scale Amp circuit on page 4, and the value measured is used to adjust the tolerances in the rest of the tests in this series (201-203), as well as the Stim DAC tests (240-251 and 260-271). The tests (201-203) use the ±5V references available through U35 to the 1:1 and 100:1 attenuators circuit on page 3.

Test **220** verifies the E-drive pole connection to the Scale Amp. A stimulus of 0.25V is produced using the Stim1 Amp. The output from Stim1 Amp is connected through K28 (Rx0) and K111 to the E-drive pole. Relay K86 connects the E-drive pole back to the Scale Amp input.

Test **230** verifies the F-drive pole connection to the Scale Amp. A stimulus of 0.25V is produced using the Stim1 Amp. The output from Stim1 Amp is connected through K28 (Rx0) and K98 to the F-drive pole. Relay K101 connects the F-drive pole back to the Scale Amp input.

Tests **240–251** verify proper operation of each bit of the Stim1 DAC. The DAC (AR21) is programmed to produce the expected voltage through the Stim1 Filter and relay K17 to the Stim1 Amp "+" input. The output of the Stim1 Amp is connected to the E-drive pole through K28 (Rx0) and K111. The Scale Amp measures the voltage, which is connected through relay K86.

Tests **260–271** verify proper operation of each bit of the Stim2 DAC. The DAC (AR12) is programmed to produce the expected voltage through the Stim2 Filter and relay K7 to the Stim1 Amp "+" input. The output of the Stim2 Amp is connected to the E-drive pole through K50 (Ry0) and K109. The Scale Amp measures the voltage, which is connected through relay K86.

Prism test **280** verifies the operation of the VdifX0 Amp. The test connects the AR25 input to ground through K15, K111 and K113. Stim1 is used to produce 0.25V into AR23. The VdifX0 Amp output is then measured by the Scale Amp by connecting to the Scale Amp input through U34, pin 3 and relay K87.

Prism test **290** verifies the operation of the VdifX1 Amp. The test produces 0.25V at the AR35 input using Stim2. Stim1 is used to produce 0V into AR33 on the E-drive pole through K111, K109 and K49. The VdifX1 Amp output is then measured by the Scale Amp by connecting to the Scale Amp input through U34, pin 6 and relay K87.

PRISM tests **300–332** verify the values of the series resistors (Rx) and feedback resistors (Rf) on the board. For each test, Stim1 generates 0.25V. The series resistor (Rx) is changed for each test as shown in the table below. Through relays K98 and K99, the signal is connected to various feedback resistors (Rf) as shown below and then to the “-” input of the MOA through K57, K77 and K73. The “+” input of the MOA is grounded through R174 and K29.

Test Number	**Rx**	**Rf**
300	R104 (1Kohm)	R149 (1Kohm)
301	R78 (10ohm)	R155 (1ohm)
302	R78 (10ohm)	R154 (10ohm)
303	R146 (21.5ohm)	R154 (10ohm)
304	R146 (21.5ohm)	R151 (100ohm)
305	R105 (46.4ohm)	R154 (10ohm)
306	R105 (46.4ohm)	R151 (100ohm)
307	R77 (100ohm)	R151 (100ohm)
308	R77 (100ohm)	R149 (1Kohm)
309	R100 (215ohm)	R151 (100ohm)
310	R100 (215ohm)	R149 (1Kohm)
311	R106 (464ohm)	R151 (100ohm)
312	R106 (464ohm)	R149 (1Kohm)
313	R104 (1Kohm)	R149 (1Kohm)
314	R104 (1Kohm)	R144 (10Kohm)
315	R101 (2.15Kohm)	R149 (1Kohm)
316	R101 (2.15Kohm)	R144 (10Kohm)
317	R107 (4.64Kohm)	R149 (1Kohm)
318	R107 (4.64Kohm)	R144 (10Kohm)
319	R76 (10Kohm)	R144 (10Kohm)
320	R76 (10Kohm)	R145 (100Kohm)
321	R102 (21.5Kohm)	R144 (10Kohm)
322	R102 (21.5Kohm)	R145 (100Kohm)
323	R108 (46.4Kohm)	R144 (10Kohm)
324	R108 (46.4Kohm)	R145 (100Kohm)
325	R75 (100Kohm)	R145 (100Kohm)
326	R75 (100Kohm)	R143 (1Mohm)
327	R103 (215Kohm)	R145 (100Kohm)
328	R103 (215Kohm)	R143 (1Mohm)
329	R98 (1Mohm)	R143 (1Mohm)
330	R98 (1Mohm)	R146 (10Mohm)
331	R72 (10Mohm)	R146 (10Mohm)
332	R72 (10Mohm)	R229 (100Mohm)

PRISM tests **340–344** verify the values of the series resistors (Ry) and feedback resistors (Rf) on the board. For each test, Stim1 generates 0.25V. The series resistor (Ry) is changed for each test as indicated in the table below. Through relays K109 and K110, the signal is connected to various feedback resistors (Rf) as indicated in the table below and then to the "-" input of the MOA through K57, K77 and K73. The "+" input of the MOA is grounded through R174 and K29.

Test Number	**Ry**	**Rf**
340	R184 (1Kohm)	R149 (1Kohm)
341	R182 (100ohm)	R149 (1Kohm)
342	R185 (10Kohm)	R149 (1Kohm)
343	R182 (100ohm)	R151 (100ohm)
344	R179 (10ohm)	R151 (100ohm)

PRISM test **360** verifies the operation of the Vdiff Amp. Using Stim1, 0.25V is applied to the Vdiff Amp input at AR28 through K28, K98 (F-drive pole), K99 and K72. Stim1 is used to produce 0.75V to the Vdiff input at AR29 through K50, K78 (E-sense pole), and K79. The Vdiff Amp output from AR30 is then measured by the Scale Amp by connecting to the Scale Amp input through U35, pin 14 and relay K87.

Additional tests will be added to the diagnostics as they are developed.

PRISM-Z Calibration

The calibration program for PRISM-Z presents a series of menus and instructions which can be run only from the main tester console.

Messages in the calibration program list the necessary test equipment, test points, values, and tolerances. To assist with locating the test points and potentiometers, a diagram has been provided with the tester or the retrofit kit. Refer to the “PRISM Locations of Test Points and Resistors” diagram (PN 048-241-00).

All adjustments require external test instruments with the exception of the ADC Zero Adjustment and ADC Reference Voltage Adjustment. In these cases, the adjustment is made based on values measured by PRISM-Z and displayed on the CRT.

The PRISM-Z board is adjusted in the factory before the tester is shipped to your site. This calibration is good for one year. After the first year, you should recalibrate it annually.

Procedural Notes

Windows for the PRISM-Z calibration are similar to standard diagnostic windows. At the top, the window contains the title of the calibration being performed. Step-by-step instructions appear in the middle, and, when used, the measured results appear at the bottom.

Calibration adjustments must be performed in the order presented since many of the steps are interrelated. If at any time during the calibration process you need to quit from the procedures, the <CANCEL> function key 4, mouse click on Cancel, and the table top Cancel button all function as in standard diagnostics procedures.

Equipment

To perform calibration, you will need the following equipment:

- Keithley Model 2001 multimeter or equivalent
- Keithley 4-wire probe #5806-306 or equivalent
- Tektronix X1 probe #TekP6101A or equivalent, with BNC to banana jack adapter
- Potentiometer adjustment tool (tweaker)
- Z18XX Self-Test Assembly
- Flashlight

WARNING: Potentially lethal voltages are present on the PRISM-Z. Calibration procedures should be performed by qualified maintenance personnel only. Care should be taken when the PRISM-Z is being contacted and power is applied. High voltage is present on J1 of the PRISM-Z and on the high voltage amplifier. The cable that connects to J1 of the PRISM-Z brings ±120 VDC into the PRISM-Z. Be especially cautious around TP7 and the area near J1 and AR22.

Calibrating the PRISM-Z – Part 1

The first part of the PRISM-Z calibration requires that you remove the board from the tester and measure the resistors using the Keithley Model 2001 multimeter or equivalent. Follow the steps below.

1. **Shut off the tester power.**
2. **Open or remove the access door to the PRISM-Z.**
3. **Remove the cables connected to the board and remove PRISM-Z from the cage.**
4. **With the PRISM-Z board on a workbench, use the following table to verify the reference resistors listed.**

Probe	Resistor	Value	Upper Limit	Lower Limit
4-wire	R155	1Ω	1.005	0.995
4-wire	R154	10Ω	10.005	9.995
4-wire	R151	100Ω	100.01	99.99
4-wire	R149	1,000Ω	1,000.1	999.9
4-wire	R144	10,000Ω	10,001	9,999
4-wire	R145	100,000Ω	100,010	99,990
Tektronix	R143	1,000,000Ω	1,000,200	999,800
Tektronix	R146	10,000,000Ω	10,010,000	9,990,000
Tektronix	R229	100,000,000Ω	100,500,000	99,500,000

If any resistor reads outside the limits of this test, return the board to Teradyne for replacement.

5. **Reinstall the PRISM-Z in the cage and reconnect the cables you removed in step 3.**
6. **Close the access door and reapply power.**

Calibrating the PRISM-Z – Part 2

The second part of the PRISM-Z calibration is performed inside the tester. Refer to the Site and Tester Preparation below, for instructions about your particular system type.

Site and Tester Preparation Z1880-1

1. **Prepare the work site by keeping at least three feet of clearance around the console.**
2. **Shut off tester power.**
3. **Remove the access panel from the front of the console.**
4. **Remove as many Driver/Receiver boards to the right of the PRISM-Z as are necessary to access the test points and potentiometers.**

   If the cage is full, removing eight boards is usually sufficient.

Important: PRISM-Z cannot be adjusted on an extender board. PRISM-Z must be adjusted in the test head cage in a slot with the system fan below it.

5. **Turn on the tester power and the multimeter and allow a 30-minute warm-up period before continuing.**

   If the tester has been turned off briefly, allow twice the off time for warm-up, up to a maximum of 30 minutes.

Site and Tester Preparation for Z1890 and Z1880-2

1. **Prepare the work site by keeping at least three feet of clearance around the console.**
2. **Shut off tester power.**
3. **Remove the access panel from the front and rear of the console.**
4. **Disconnect the cables from the PRISM-Z, noting where they are connected on PRISM-Z.**
5. **Remove the PRISM-Z from the front of the test head cage.**

6. **If the rear cage is populated with driver/receiver boards to the right of the ATB, remove the first 8 boards closest to the ATB.**

7. **Insert the PRISM-Z board in the first available slot to the right of the ATB (in the rear cage).**

Important: PRISM-Z cannot be adjusted on an extender board. PRISM-Z must be adjusted in the test head cage in a slot with the system fan below it.

8. **Move the cables that connect to PRISM-Z from the front cage to the rear cage.**

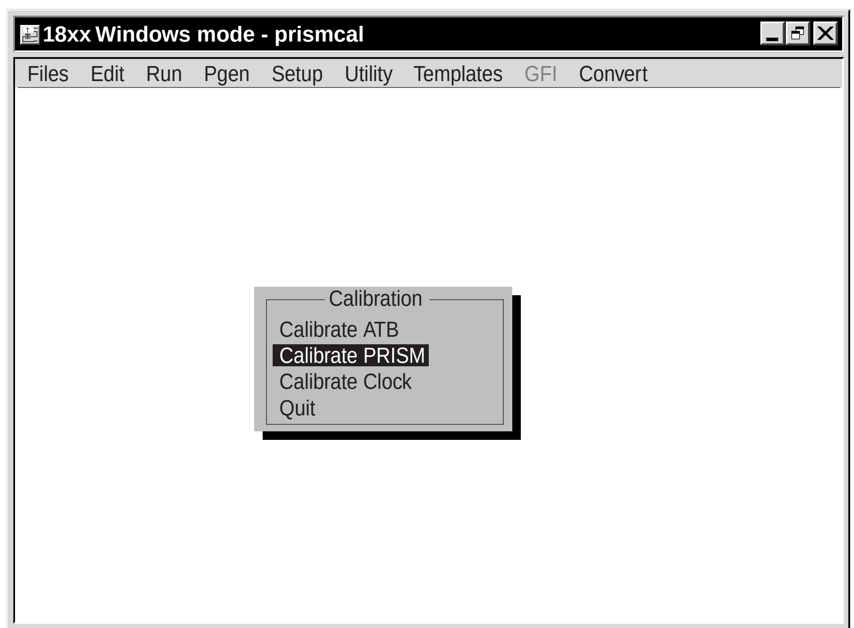
9. **Reconnect the cables to the PRISM-Z board.**

10. **Turn on the tester power and the multimeter and allow a 30-minute warm-up period before continuing.**

    If the tester has been turned off briefly, allow twice the off time for warm-up, up to a maximum of 30 minutes.

Accessing the Program

To access the PRISM-Z calibration program, first choose Utility from the Main menu; then choose Calibration/Calibrate PRISM.



The PRISM Calibration menu appears as shown below. Follow the instructions in the menu to run calibration procedures.

```
PRISM CALIBRATION
Equipment Required:
* Keithley Model 2001 Multimeter (or equivalent 7.5
digit meter).
* Z18xx Self-Test Assembly.

Press <START> To Begin Calibration or <CANCEL> To
Quit.
```

The next set of instructions tells you how to configure the multimeter.

```
METER SETUP
STEP 1: If using a Keithley Model 2001 Multimeter,
configure as follows.
   SPEED               Normal
   FILTER              Auto
   RESOLUTION          7.5d
   ANALOG-FILTER       On
Press START To Continue.
```

When ready, press Start to calibrate the board. Follow the directions on the screen. When the program finishes, you have one more measurement to take.

DSP 100 kHz Clock Verification

Using the multimeter with a Tektronix probe, put the ground lead on TP17 and the positive lead on resistor R41. Adjust for 100 kHz ±0.02 kHz at R172 (high limit 100.02 kHz, low limit 99.98 kHz). Make your notations in the Calibration Verification Table on the following page.

After completing calibration, power down the tester, return all boards to their original positions, reconnect all cables, and replace the access panel.

Power up the tester and run diagnostics.

Calibration Verification Checklist

System Information:________________ Model___________________ Serial No.___________________________

Self-Test Assembly Information:______Part No._________________ Serial No.___________________________

Date Calibrated:____________________Next Due:________________ Performed By:_______________________

Resistor	Nominal Value	High	Low	Measured Value
R155	1Ω	1.005	0.995	
R154	10Ω	10.005	9.995	
R151	100Ω	100.01	99.99	
R149	1,000Ω	1,000.1	999.9	
R144	10,000Ω	10,001	9,999	
R145	100,000Ω	100,010	99,990	
R143	1,000,000Ω	1,000,200	999,800	
R146	10,000,000Ω	10,010,000	9,990,000	
R229	100,000,000Ω	100,500,000	99,500,000	
DSP 100kHz Clock	100kHz	100.02kHz	99.98kHz	
Note: You should attach a diagnostic printout compiled using AllPrint to this Calibration checklist.				

Specifications

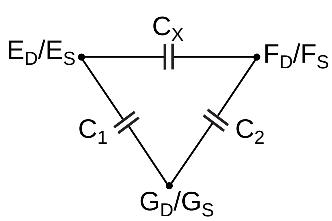
Capacitor / Resistor (TC ≥ 10µs)

Range Capacitors	1.0 pF - 424. µF System capacitance is added to DUT to compute RC phase angle.
Resistor Range	> 3Ω
Impedance range	> 3Ω
Phase Angle	> 38 degrees at test frequency, see stimulus.(DUT TC > 10 µs)
System Capacitance	25 pF typical (subtracted)
System Resistance	< 1.8Ω(subtracted 2-wire measurements)
Stimulus	
Resistor	200 mVDC max.
Capacitor	200 mV peak sinewave max. 1.250 kHz or 12.50 kHz selected for > 38 phase angle and > 3Ω impedance.

Accuracy (6 wire if resistors < 1 K or capacitors > 10 nF)

Resistor	Standard Resistor accuracy	
Capacitor	RC TC	Accuracy
	≥ 1400 µs	Standard capacitor accuracy
	≥ 20 µs	1.0% ±1 pF
	≥ 10 µs	2.0% ±1 pF

Guard Ratio



Cx = 1000 pF
Rx = 150k
C1 = C2
Guard Ratio = Cx / C1

Guard Ratio	**Error**	**6 wire**
GD/GS	10	1.0%
HIGUARD	100	2.0%
HIGUARD	1000	15%

Measurement Speed

10 pF/1 M	TBD
1 nF/10K	TBD
100 nF/100	TBD

Capacitor / Resistor (TC = <10 µs to >100 ns)

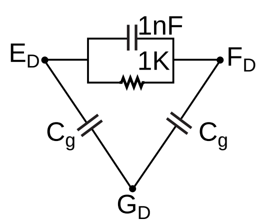
Range Capacitors	1.000 pF - 850 nF
Range Resistors	> 15Ω
Stimulus	200 mV peak AC, 12.50 kHz
System Capacitance	25 pF typical subtracted

Accuracy

Resistor Capacitor TC	Accuracy
< 10 µs> 1µs	5% ±2 pF
> 500 ns	7% ±2 pF
> 100 ns	10% ±2 pF

Measurement Speed TBD

Guard Ratio



Guard	Accuracy
Cg =10 nF	5%
Cg = 100 nF	5%