CoreStar OMNI-200 Reference Manual

EddyVision Rev 6.5

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12. ERRATA

- EddyVISION 32 release 6.5 runs only on Windows 2000 Pro, Windows XP Pro SP 2 or higher, and Windows Vista;

- EddyVISION 32 release 6.5 makes use of a three (3) button mouse; certain features are not available to users with a two (2) button mouse;

- EddyVISION 32 release 6.5 requires at least 64meg of ram, 1024x768 pixel display, a 200MHz Pentium-type processor, and a 10Gb hard drive with at least 100Mb free space.

Table of Contents

1 Overview

This manual describes how to configure and operate the CoreStar OMNI-200 eddy current tester.

1.1 Terminology

Throughout the document, the phrases “tester turned on” and “tester turned off” mean the software was made to read data and stop reading data respectively. The phrase “tester powered on” and “tester powered off” will mean the tester was physically powered on or off (i.e. the POWER button on the front panel was pressed to the left to power it on or right to power it off).

1.2 User-Interface Conventions

The following conventions are used throughout the CoreStar EddyVision suite anywhere a value can be changed via mouse clicks:

MOUSE CLICK	ACTION
Left-click	Increase the value (usually by 1).
Shift+Left-click	Increase 10 times faster
Ctrl+Left-click	Increase 100 times faster.
Ctrl+Shift+Left-click	Increase 1,000 times faster
Right-click	Decrease the value (usually by 1).
Shift+Right-click	Decrease 10 times faster.
Ctrl+Right-click	Decrease 100 times faster.
Ctrl+Shift+Right-click	Decrease 1,000 times faster.
Middle-click	Set the minimum value (often 0).

Notes:

- In most cases, holding the mouse down will cause the value to change repeatedly until the button is released.
- For many tables, clicking in the heading of a column will change all the values in the given column.
- The word “click” by itself means a left-click.
- Mouse-click means the entire set of mouse click actions in the table above is supported.

2 OMNI-200 Tutorial

The CoreStar OMNI-200 tester has a very flexible configuration with numerous options that can be used to optimize the test for a wide variety of probes. The extensive set of options and settings can appear daunting, and the purpose of this tutorial is to provide a clear understanding of how to use them.

2.1 Quick Start

This section gives a quick overview of the steps needed to acquire data with the OMNI-200. Later sections give more detailed explanations of each step. To acquire data with an eddy current probe:

1. Connect the OMNI-200 power cord and make sure the **POWER** button is in the off position (the light on the switch will be off).
2. Connect the OMNI-200 to your computer via an Ethernet cable.
3. Connect an OMNI-200 ET pigtail to the **EDDY CURRENT** connector on the OMNI-200.
4. Connect the probe to the **Probe 1** connector on the pigtail.
5. Turn on the power to the tester using the **POWER** switch. The switch should glow red and the cooling fans will startup.
6. Boot the EddyVision **Acquisition & Analysis** software and click on the **TESTER CONFIG** button on the right side of the screen to display the OMNI-200 configuration dialog.
7. Configure network communication between the computer and OMNI-200. Use the **TEST LINK** button to verify that the tester and computer can communicate.
8. Create or open a suitable tester configuration.
9. Put the probe in a clean section of tubing and click **BALANCE** followed by **REF NULL**.
10. Click **Ok** to save the configuration and return to the main acquisition screen.
11. Acquire data.

WARNING: Always power off the tester before changing pigtails.

2.2 Setup the Hardware

Connect the power cord from the OMNI-200 into a standard power outlet. It supports both 120V and 240V and will auto switch between the two.

Connect a Cat 5e or higher grade Ethernet cable between the OMNI-200 and your computer. You can either connect it directly to your PC or go through an Ethernet switch. You should not use a crossover cable when connecting to your PC.

For eddy current, connect a CoreStar **OMNI-200 ABS/DIFF** pigtail to the **EDDY CURRENT** connector on the tester. Attach the probe itself to the **PROBE COIL 1** connector on the pigtail. If you are using a reference probe, connect it to the **REF COIL 2** connector on the pigtail.

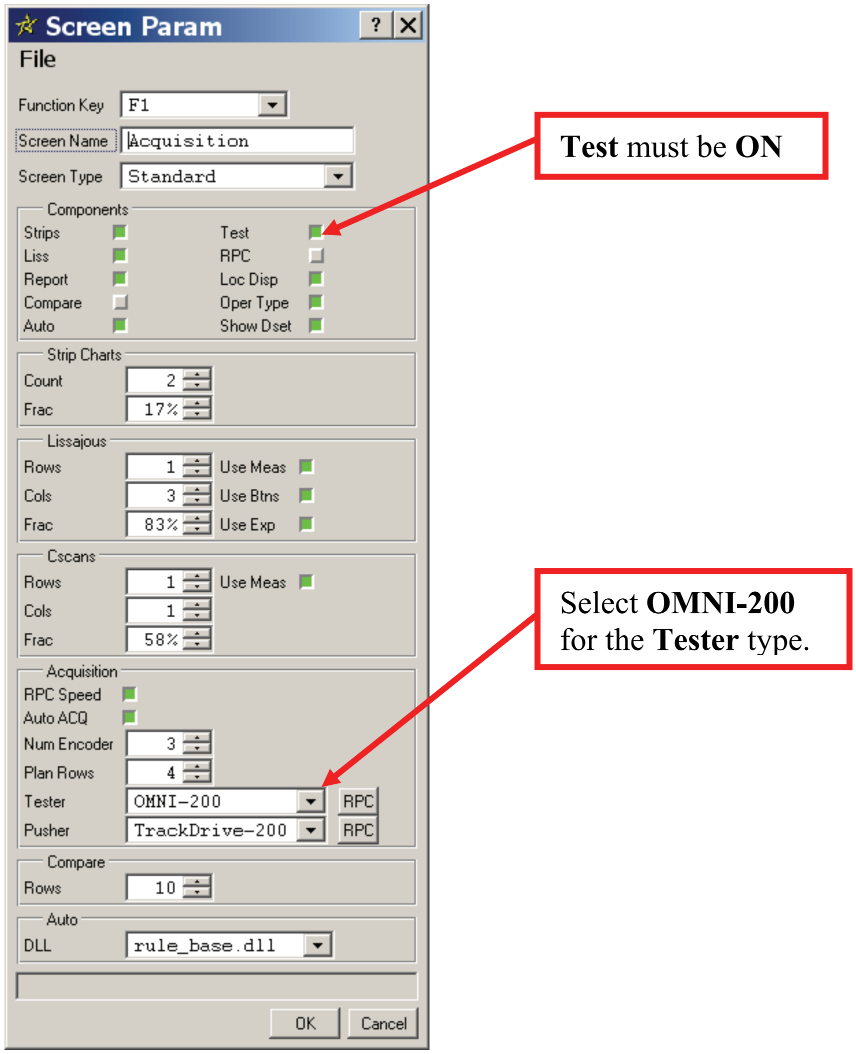
For RFT, use an OMNI-200 RFT pigtail and connect to the **DRIVER/PICKUP** connector on the OMNI-200.

WARNING: You must use an OMNI-200 pigtail; OMNI-100 pigtails will not work.

2.3 Software Setup

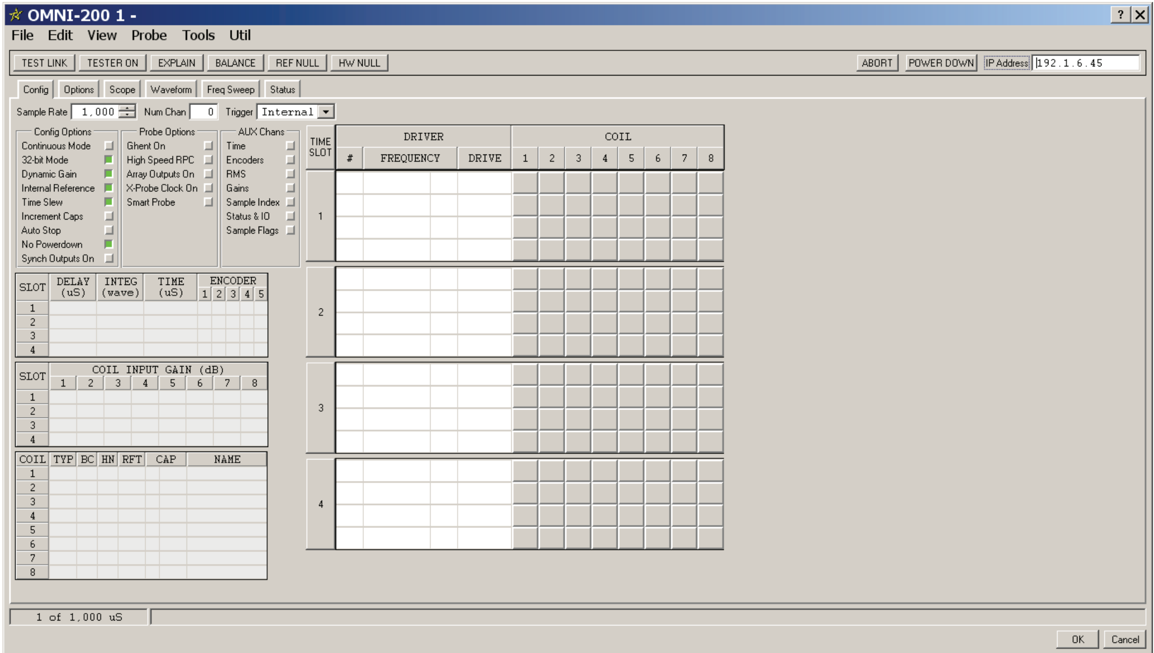
Boot the CoreStar **Acquisition & Analysis** software. Change to a screen that is enabled for Acquisition (see **EddyVision Acquisition & Analysis** manual for details).

A screen is enabled for acquisition using the **Edit | Screens** main menu option. Make sure **Test** is **ON** and **Tester** is **OMNI-200** as shown below:



When this is done, click **OK** and the **TESTER CONFIG** button will be created in the acquisition panel on the right side of the main screen. Click it to display the OMNI-200 configuration dialog.

Since we wish to create a configuration from scratch, choose **Edit | Clear Config** to clear any configuration that may be currently open. Also choose **View | Number of Slots** of 4 and **View | Slices Per Slot** of 4. This configuration dialog will now look like this:



2.4 Check Network Connectivity

Now that the tester is physically connected and the EddyVision Acquisition software is running, we need to verify the Ethernet connection to the PC. The PC and OMNI-200 communicate via Ethernet TCP/IP and UDP protocols. In order for this to work correctly, the IP (Internet Protocol) addresses of each must be setup correctly.

Each piece of equipment (usually called a node) on the network, including your PC and the OMNI-200, has a unique physical address, called the MAC (Media Access Control). This is assigned by the vendor during manufacturing and cannot be changed by users. The MAC address of each OMNI-200 is shown on a label on the front panel. The MAC address has six segments called octets (e.g. 00:14:B3:00:00:4B). The first three octets of an OMNI-200 are always 00:14:B3.

Each node also has a logical address, called its IP address, which can be set by the user. This address has four octets, such as 192.1.6.4. In order for your PC to successfully communicate with the OMNI-200, you must ensure:

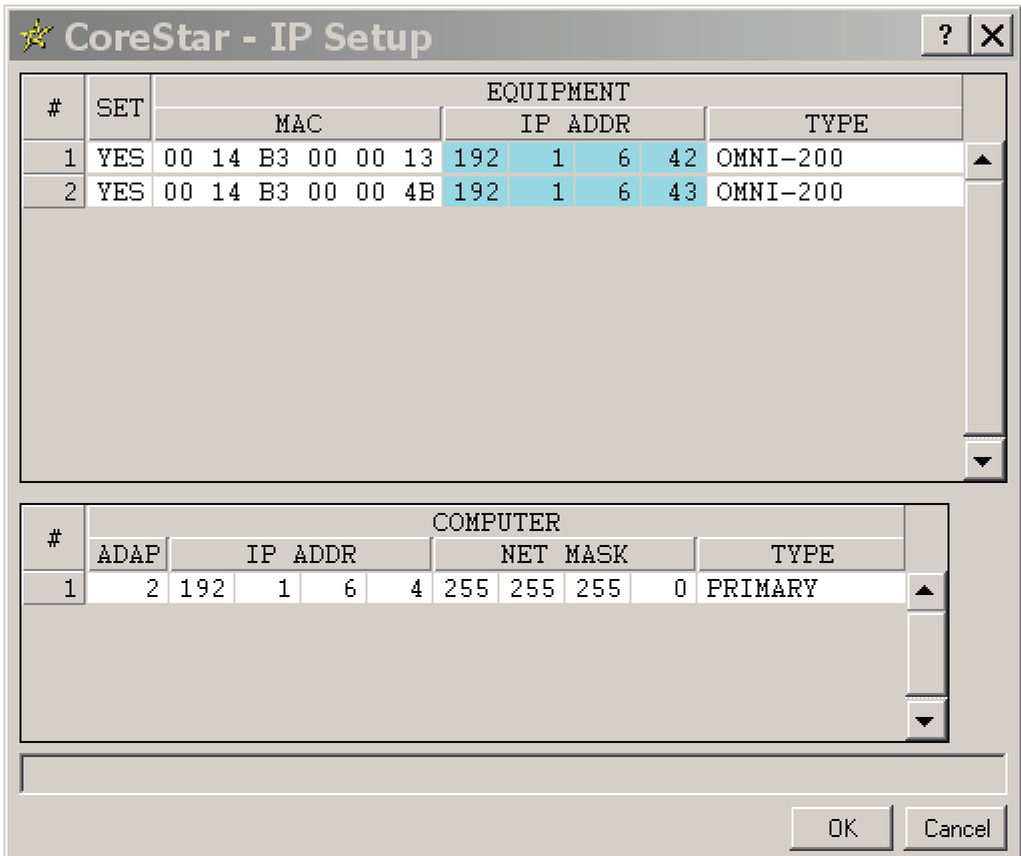
1. No two nodes on the network can have the same IP address.

2. The IP address of the OMNI-200 is compatible with your network.

3. The Acquisition software is using the correct IP address to communicate with the desired tester.

It is the user's responsibility to ensure item 1 is true. To get started and troubleshoot networking problems, it is often best to connect the OMNI-200 directly to the PC so that these are the only two nodes on the network.

For items 2 and 3, CoreStar has created a utility called **IP Setup**. Click **IP Setup** in the **Util** menu in the OMNI-200 dialog to display:

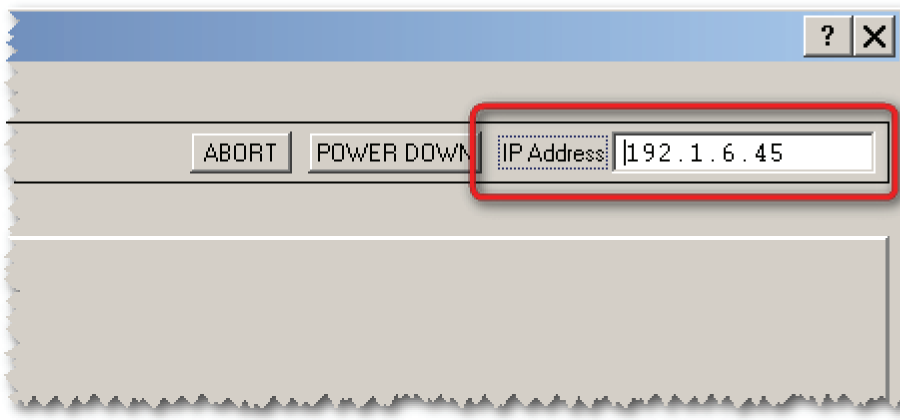


The top table of the IP Setup tool shows all OMNI-200 testers on the current network whether they are compatible with it or not. In this case, there are two with IP addresses of 192.1.6.42 and 192.1.6.43. These are the actual IP addresses of the testers. The MAC addresses displayed will match the MAC address label on the front panel of each tester. This can be used to pick a particular tester if there is more than one.

The IP addresses of the computer are shown in the bottom table. In this case, there is only one of 192.1.6.4. Assuming these are the only nodes on the network, Item 1 above is satisfied in that each node has a unique IP address.

WARNING: **IP Setup** only shows OMNI-200 testers and your computer. It is possible that other equipment on your network, such as another computer or network printer, could have a duplicate IP address that will cause conflicts.

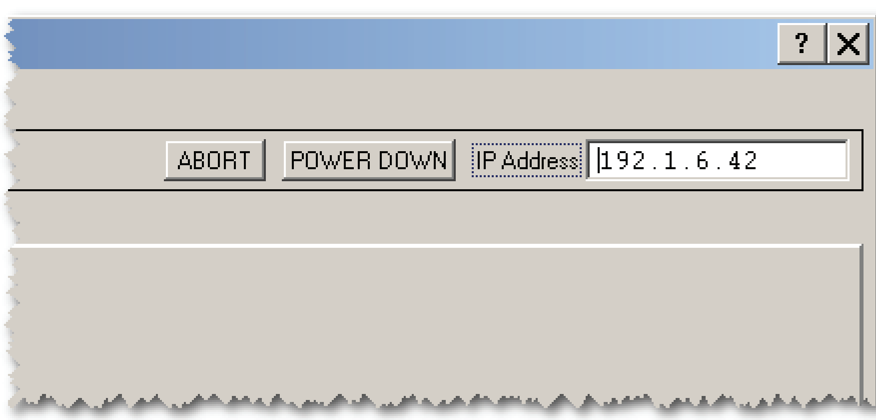
However, note that the **IP Address** box in the upper right corner of the main OMNI-200 configuration dialog is 192.1.6.45 as shown below:



This is the address the software will attempt to use to communicate with the tester, but it does not match the address actually stored in any tester (as shown in the **IP setup**). The **TEST LINK** button can be used to test connectivity to the tester. At this point, clicking it will result in an error message in the status bar at the bottom of the dialog:

To remedy the problem, you can either type in the address of a tester shown in the **IP Setup** (eg 192.1.6.42) or use **IP Setup** to change the tester's actual address to 192.1.6.45.

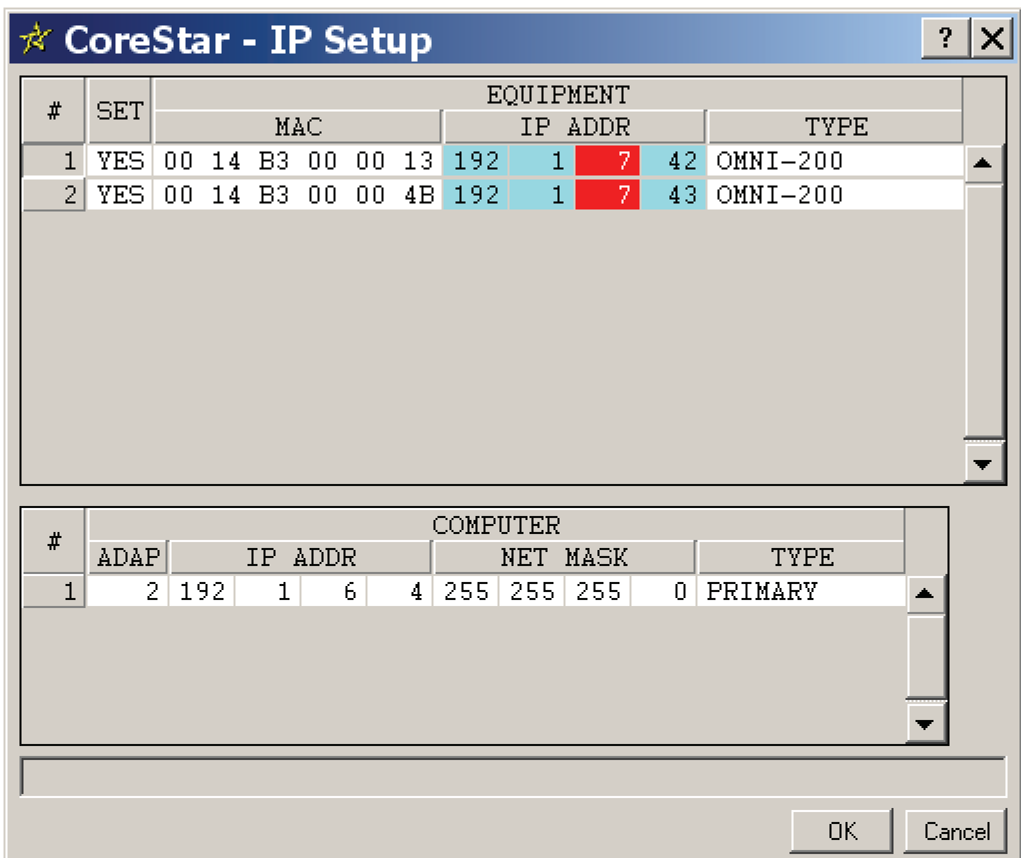
If we use the first option, so that the **IP Address** box looks like:



and click **TEST LINK** again, you will see a confirmation in the status bar that the link is good as shown below:

This confirms that the software is successfully communicating with the tester.

This method is not always possible since the tester IP addresses may not be compatible with the network. Whenever a tester's IP address is not compatible with the network, the incompatible octets are highlighted in red as shown below:

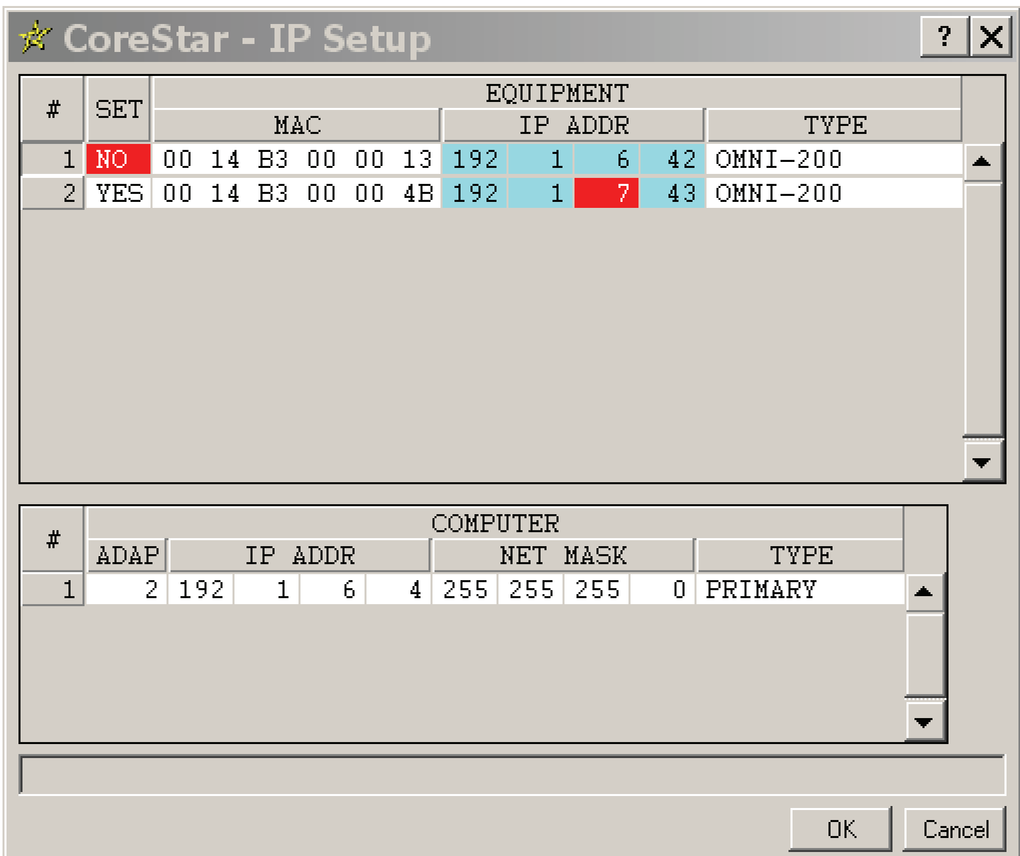


The reason for the incompatibility has to do with what is called a subnet mask. A detailed explanation of subnet masks is beyond the scope of this tutorial, but a few examples will suffice for our needs. Notice that the subnet mask of the computer is 255.255.255.0. This means that the first 3 octets of the IP address of all equipment on the network must be the same. But the first three octets of the computer's address are 192.1.6 and those of the testers are 192.1.7. The third octets are not the same (i.e. the computer is 6 and the tester is 7).

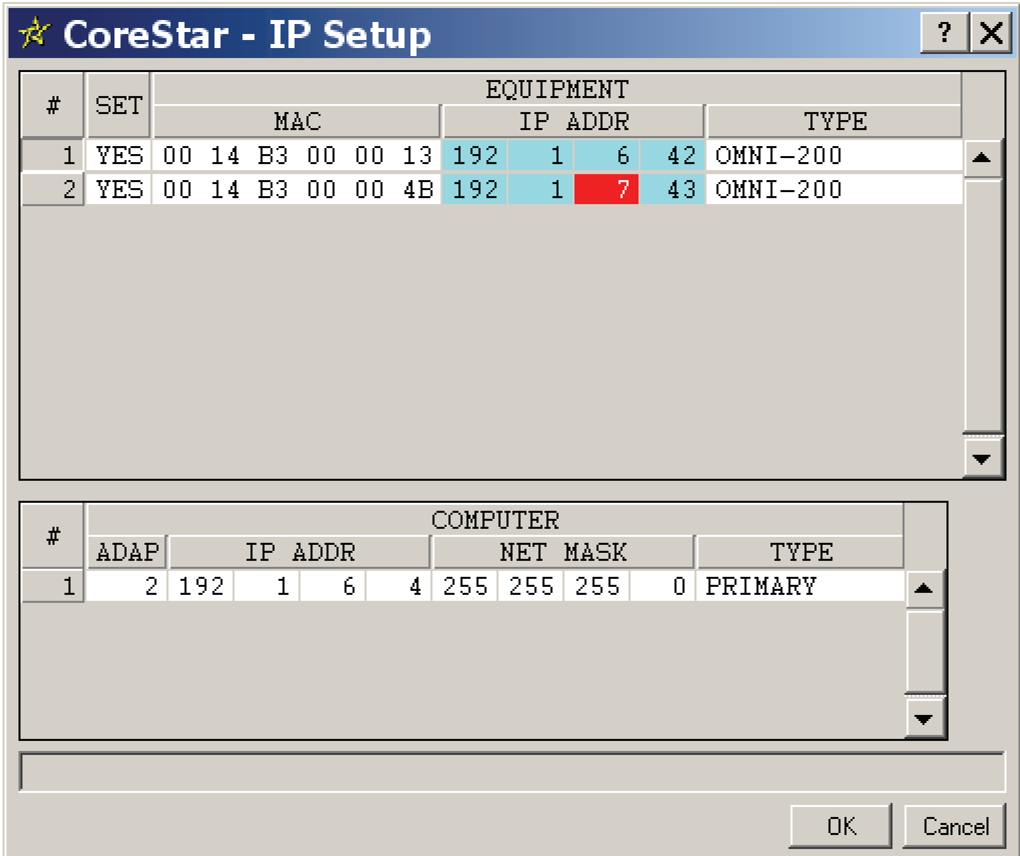
There are several ways to remedy the problem.

2.4.1 SOLUTION 1: Modify the Testers IP Address (Recommended)

If wish to talk with say the first tester in the list, the simplest solution in this case is to change the 7 to a 6:



Notice that the third octet is no longer red since there is no conflict, but the SET column shows NO. This means that the displayed IP address for tester 1 has not actually been stored in the tester. To do so, click on the NO to get:



Clicking **OK** will set the IP address of tester 1 in the **IP Address** box. Click **TEST LINK** to verify that the link is good.

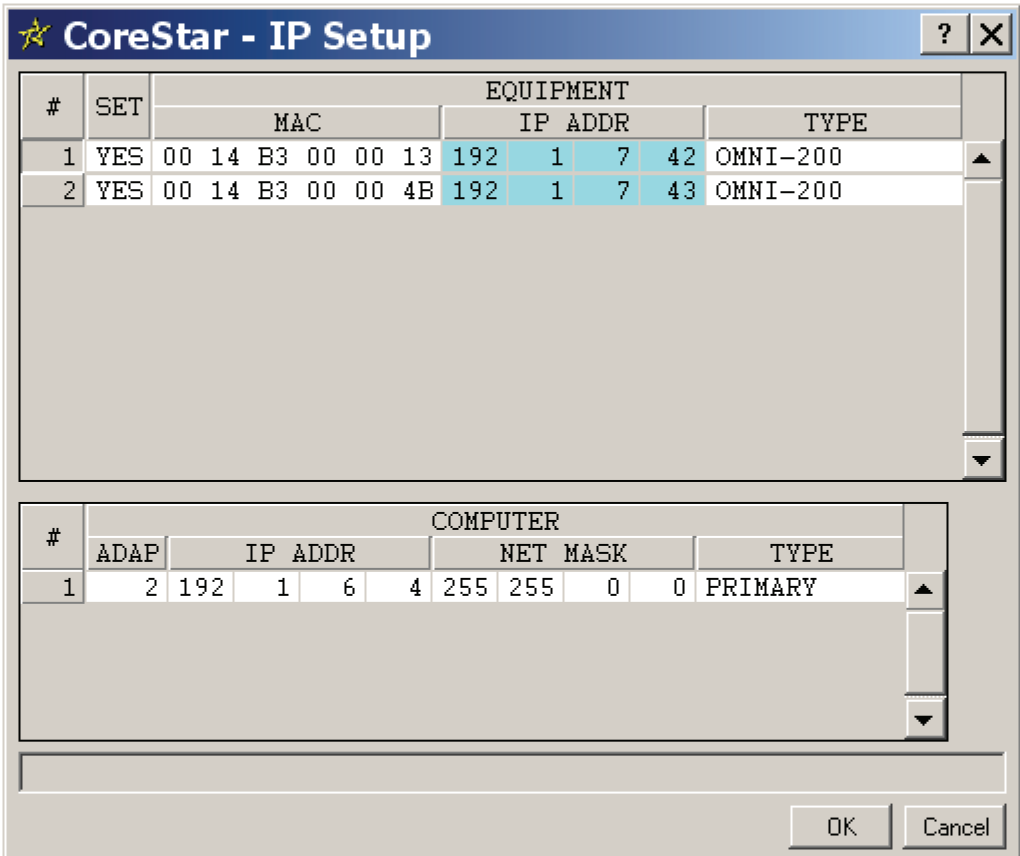
2.4.2 SOLUTION 2: Modify the Computers Subnet Mask

Instead of changing the IP address of tester 1 from 192.1.7.42 to 192.1.6.42, another option would be to change the subnet mask of the PC. This can be done using the Microsoft Windows network tools. If it is changed to 255.255.0.0, then only the first two octets of the IP addresses must match.

On Windows XP, this can be done by:

1. Select **Network Connections** from the Control Panel.
2. Select **Local Area Connection** from the list of Network Connections.
3. Click **Properties** button in the **Local Area Connections Status** dialog.
4. Click on **Internet Protocol (TCP/IP)** in the table of protocols and then **Properties**
5. Enter the desired **Subnet Mask** of 255.255.0.0

At this point, an IP address of 192.1.7.42 for tester 1 and 192.1.6.4 for the computer are compatible as shown below:



2.4.3 SOLUTION 3: Modify the Computers IP Address

A third option would be to change the computers IP address to say 192.1.7.4, so that its IP address is compatible with the testers. This is usually not a good idea since your network administrator may want your network setup in a certain way.

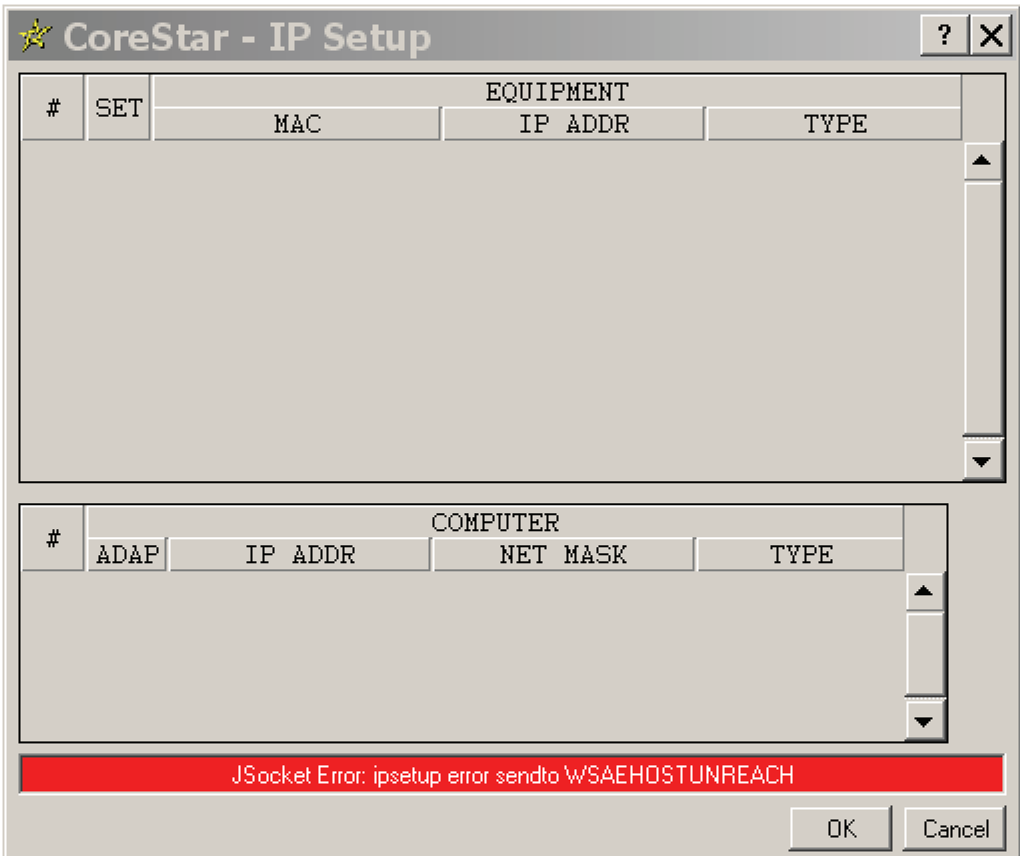
2.4.4 SOLUTION 4: Use DHCP or BOOTP

Another solution is to use DHCP (Dynamic Host Control Protocol). This is rarely used by most users, but can be useful. It requires a DHCP server on your network. Your DHCP server must be configured with the MAC address of all testers you wish to use, along with the IP address you wish to assign to the tester. Put this IP address in the **IP Address** box of the OMNI-200 configuration dialog.

You must also configure your computer to be in DHCP mode. The person administering your DHCP server can tell you how to do this.

Whenever you power on the OMNI-200 tester, it will send out a BOOTP request, which is compatible with DHCP, and if the DHCP server has its MAC address, it will respond with the desired IP address. The tester will use this address instead of the one stored in it.

Whenever your computer is in DHCP mode, **IP Setup** will be blank as shown below:

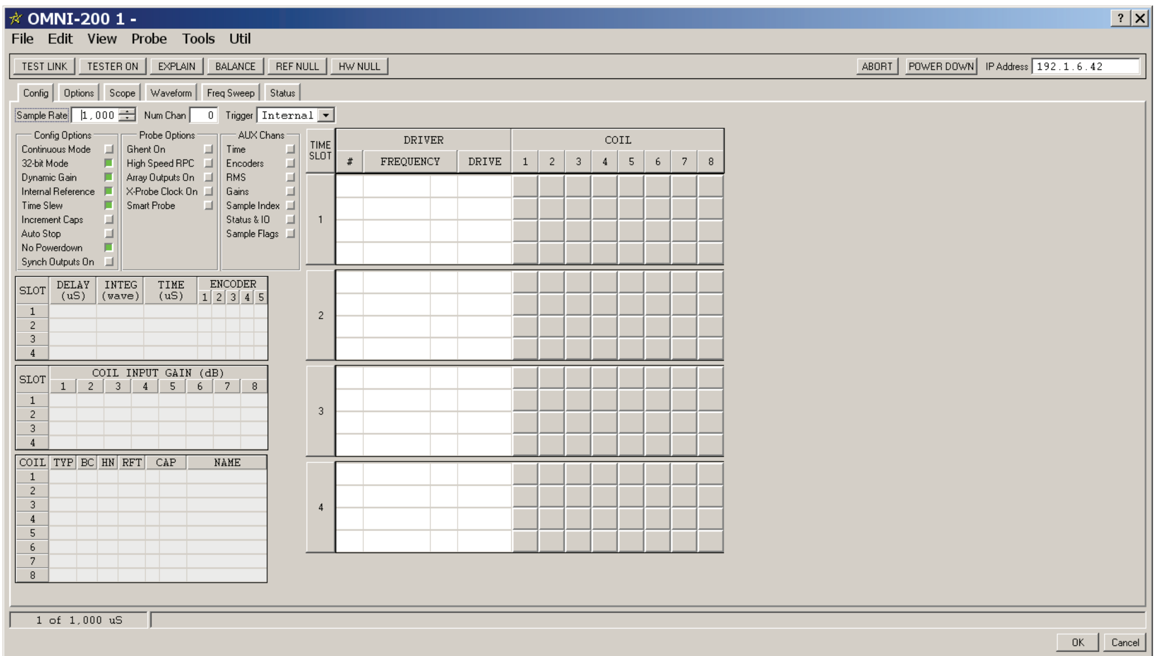


If this is the case, and you do not with to use DHCP, you must disable DHCP mode (see **Disabling DHCP on Your Computer** on page 96.

2.5 *Create Configuration*

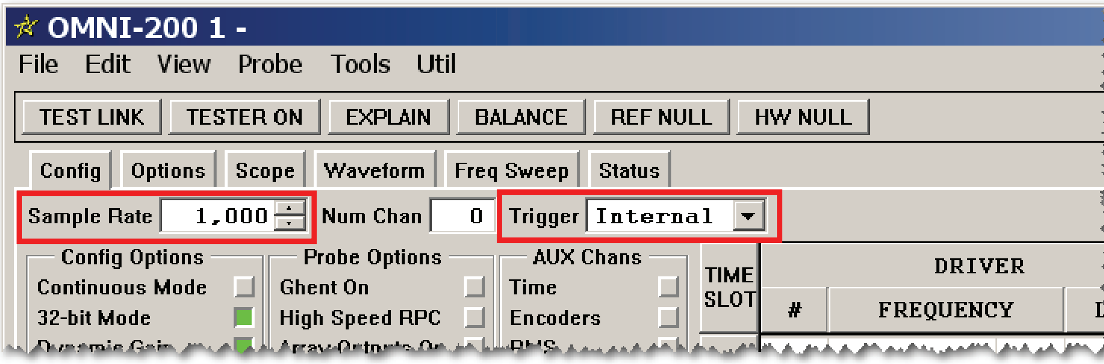
We will start with explaining how to configure a common bobbin probe. We will use a CoreStar **CA-460/UBF/MF/BC** probe which is 0.460 inches in diameter. The internal reference feature will be used so that no reference probe is required. The material to be inspected is 5/8 inch OD, 0.058 wall thickness, 304 stainless steel. We will use an **AS-015-07** standard which has an ID groove, OD groove, 20%, 40%, 60% 80%, and 100% defects.

After **Edit | Clear Config**, the OMNI-200 configuration will appear as follows:



2.5.1 Setting the Sample Rate

The first step is to set the desired **Sample Rate** and **Trigger** mode in the upper left part of the screen:

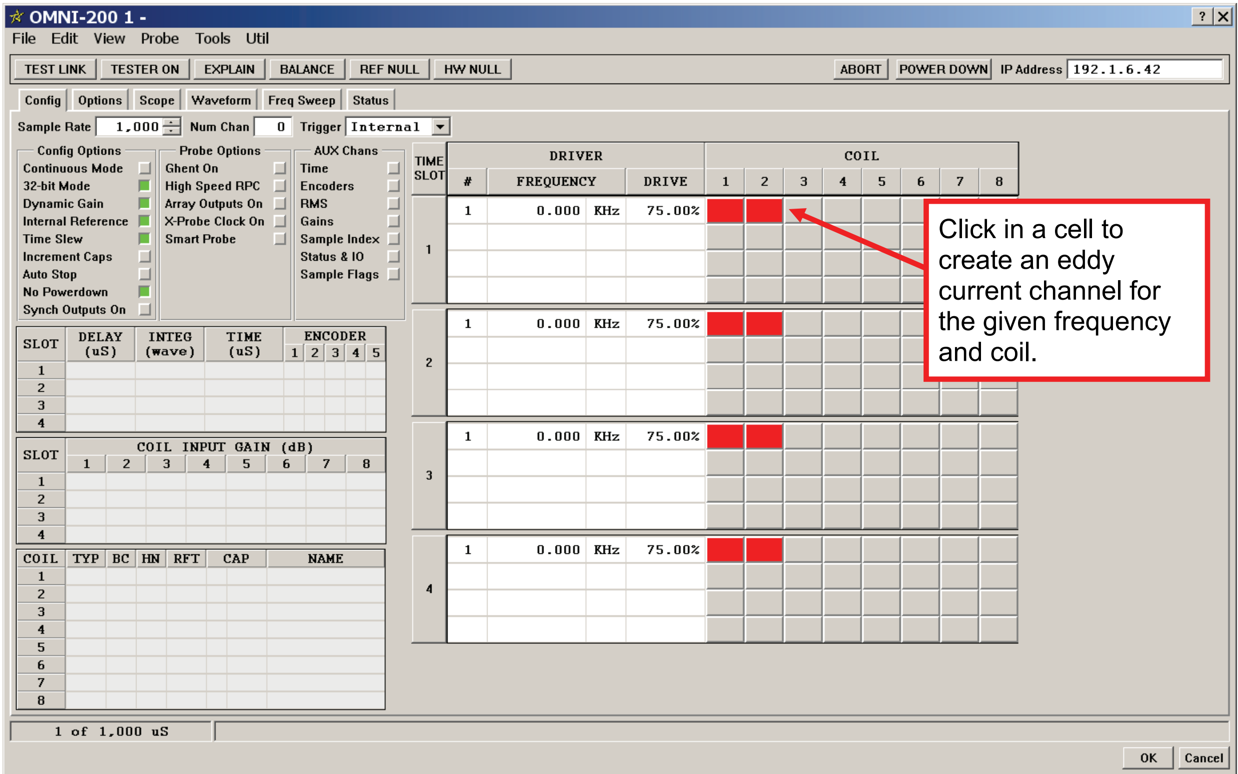


The **Trigger** mode should almost always be set to **Internal**. In this mode, samples will be taken at the rate shown in the **Sample Rate** box. The other **Trigger** modes are for advanced applications that trigger based on an external encoder or trigger signal.

The **Sample Rate** is typically chosen to provide at least 30 samples per inch for the desired probe speed. Using higher values allows for higher probe speeds, but reduces the amount of time per sample. In this case, we will use 1000 samples per second.

2.5.2 Selecting the Test Coils

Click on a coil box to select the desired test channels. We are using a bobbin probe and the CoreStar **AM-201** probe module. This module uses coils 1 and 2 for the differential and absolute channels.



The enabled channels show up in red since we have not yet chosen a frequency. Anytime something in the OMNI-200 configuration is in red, it indicates an error or something that is not complete. To see a description of the error, click the **EXPLAIN** button.

2.5.3 Setting up the Test Frequencies

Next we need to decide on the set of test frequencies. This document is not intended to explain eddy current theory, so we will just outline how the frequencies would typically be chosen, and then explain how to set them.

Whenever the magnetic field of the probe encounters a conductive material, the amplitude of the signal will be increasingly attenuated the farther it penetrates. The equation that defines when the signal will be 1/e (where e = 2.718) times its value at the surface is:

$$\delta = \sqrt{\frac{\rho}{\pi\,\mu_0\,f}} \approx 503.29\sqrt{\frac{\rho}{f}}$$

where:

$\mu_0 = 4\pi \times 10^{-7}\ H/m$ is the magnetic permeability of free space

$\rho =$ the resistivity of the material in Ωm
$f =$ the frequency in Hz

Solving for the frequency in terms of skin depth gives:

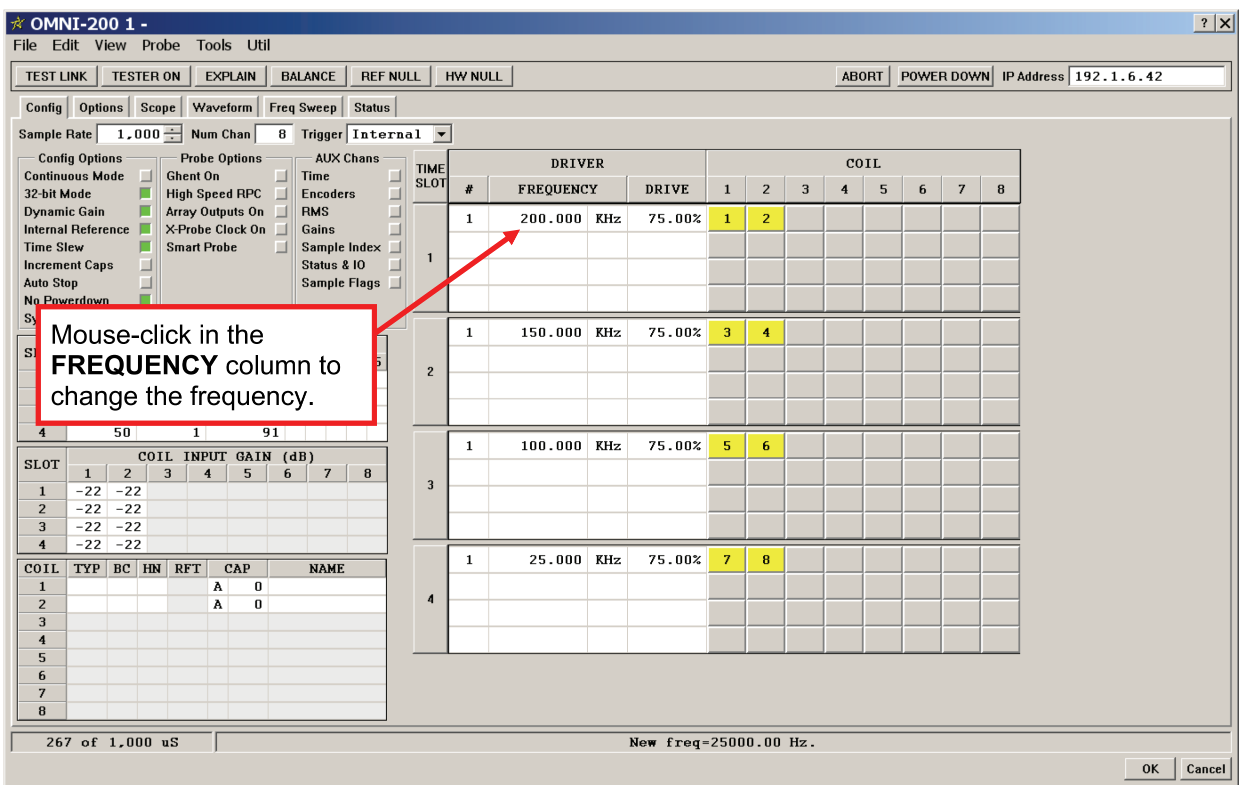
$$f = 2.533 \times 10^5 \frac{\rho}{\delta^2}$$

The resistivity of **304SS** is $68.970 \times 10^{-8}\, \Omega m$ and the wall thickness is 0.058 inches or $1.47 \times 10^{-3} m$. So the frequency at which the wall thickness is one skin depth is:

$$f = 2.533 \times 10^5 \frac{68.970 \times 10^{-8}}{(1.47 \times 10^{-3})^2} = 80.8\, Khz$$

A rule of thumb is to use 2 or 3 times this frequency for the highest inspection frequency, so we will use 200 KHz. We will use additional frequencies of 150 KHz, 100 KHz, and 25 KHz.

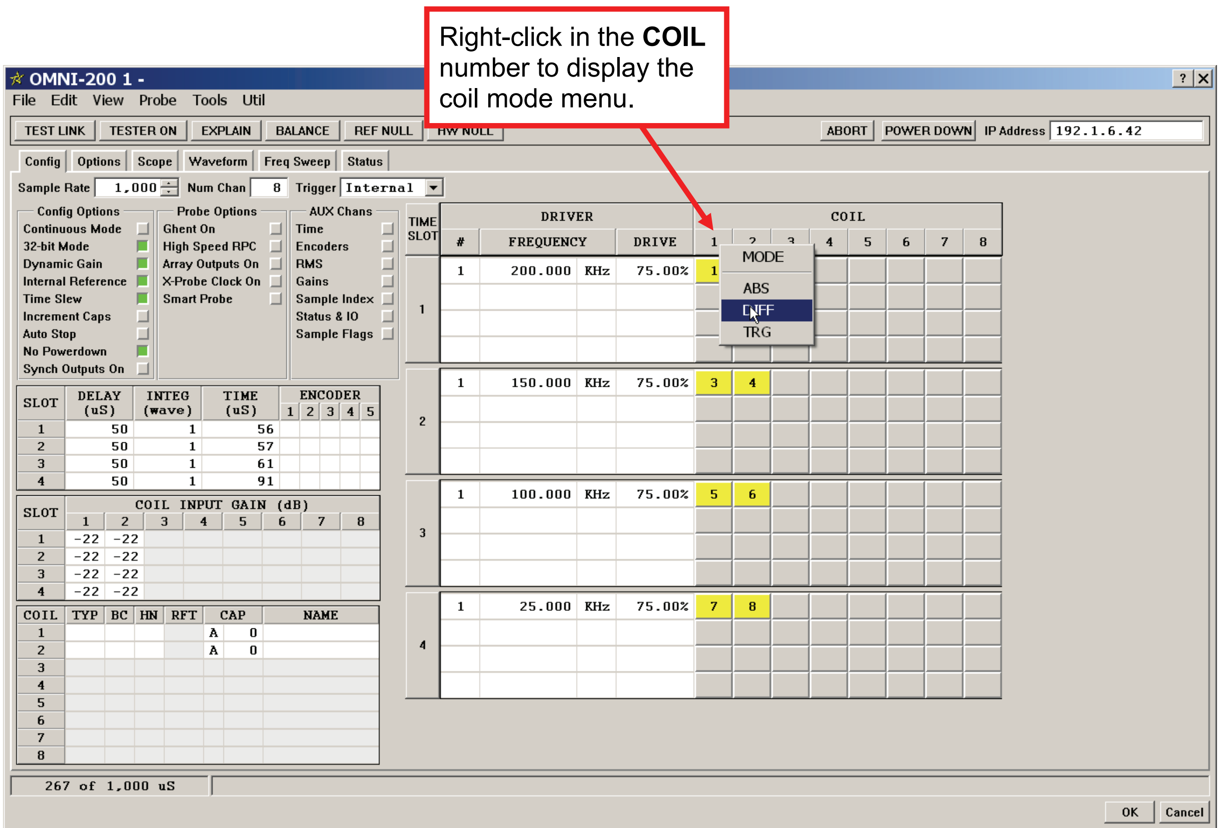
Mouse-click to adjust the frequencies:



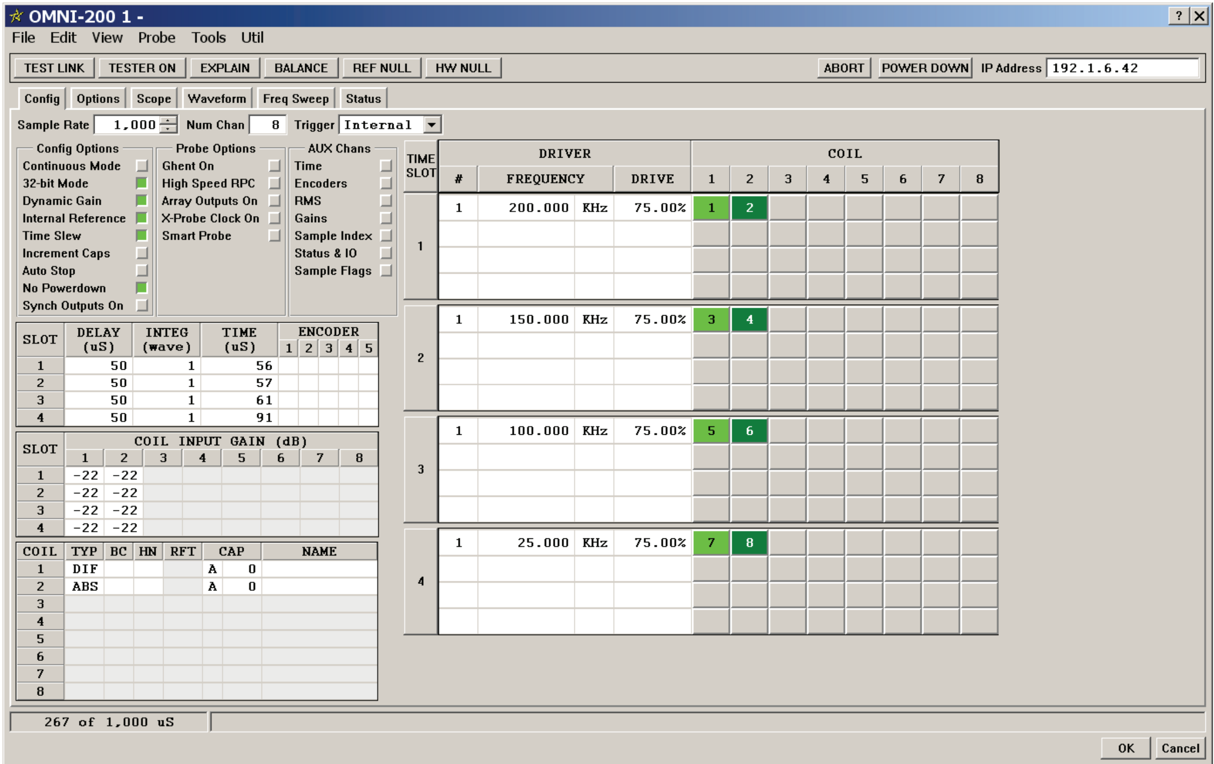
HINT:

- Click to the left of the decimal point to change the integral part of the frequency, and to the right of it to change the decimal part.
- Hold down the Shift key to change 10 times faster.
- Hold down the Shift key to change 100 times faster.
- Click the middle button to set to zero.

Note that the coils now show a number. This is the eddy current channel number that will appear in the **Acquisition & Analysis** software. They are shown in yellow because we have not yet set the coil type.



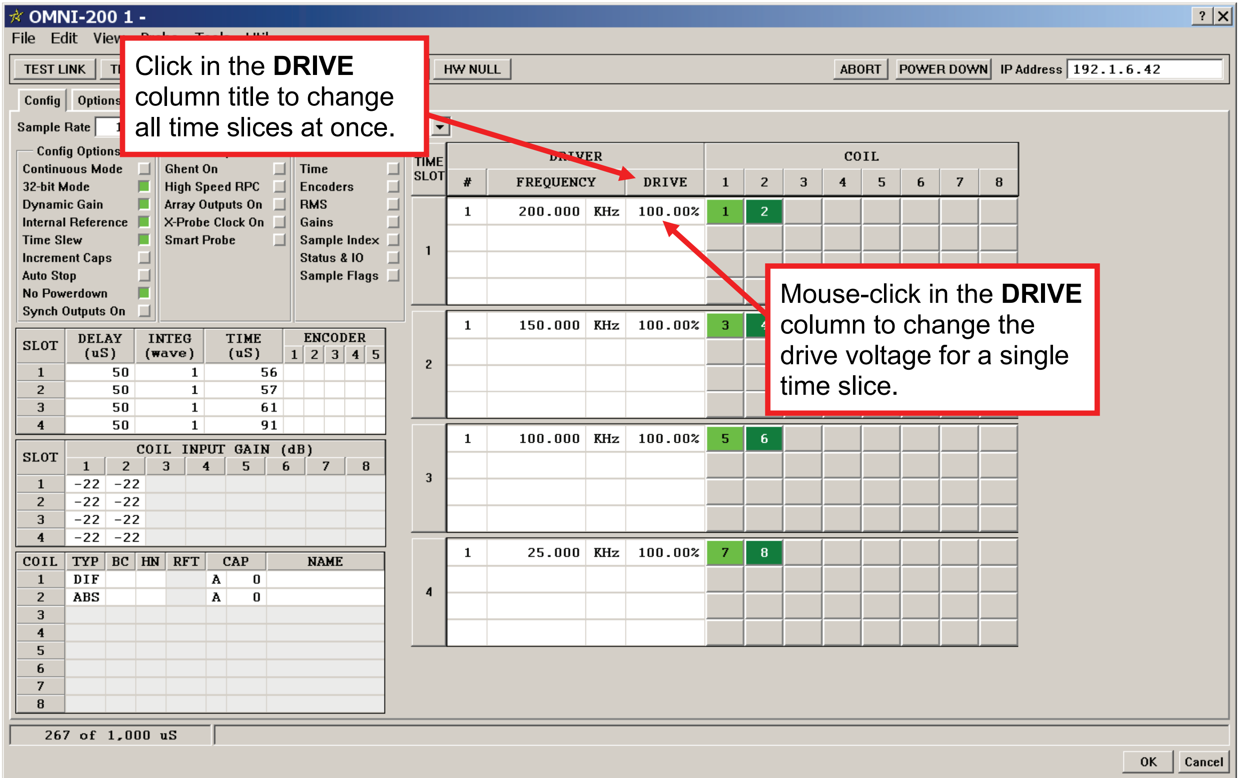
Set coil 1 to DIFF and coil 2 to ABS. It will now look like:



2.5.4 Setting Drive Voltage

The drive voltage of the OMNI-200 varies from 0 Vpp to 20 Vpp. In the OMNI-200, this is expressed as a percentage of full-scale with a default of 75% (i.e. 15 Vpp). To adjust it, mouse-click in the **DRIVE** field.

Normally, higher drive voltages improve the signal to noise ratio, but if saturation occurs, it may be necessary to reduce it. For this example, we will set them all to 100%.



HINT:

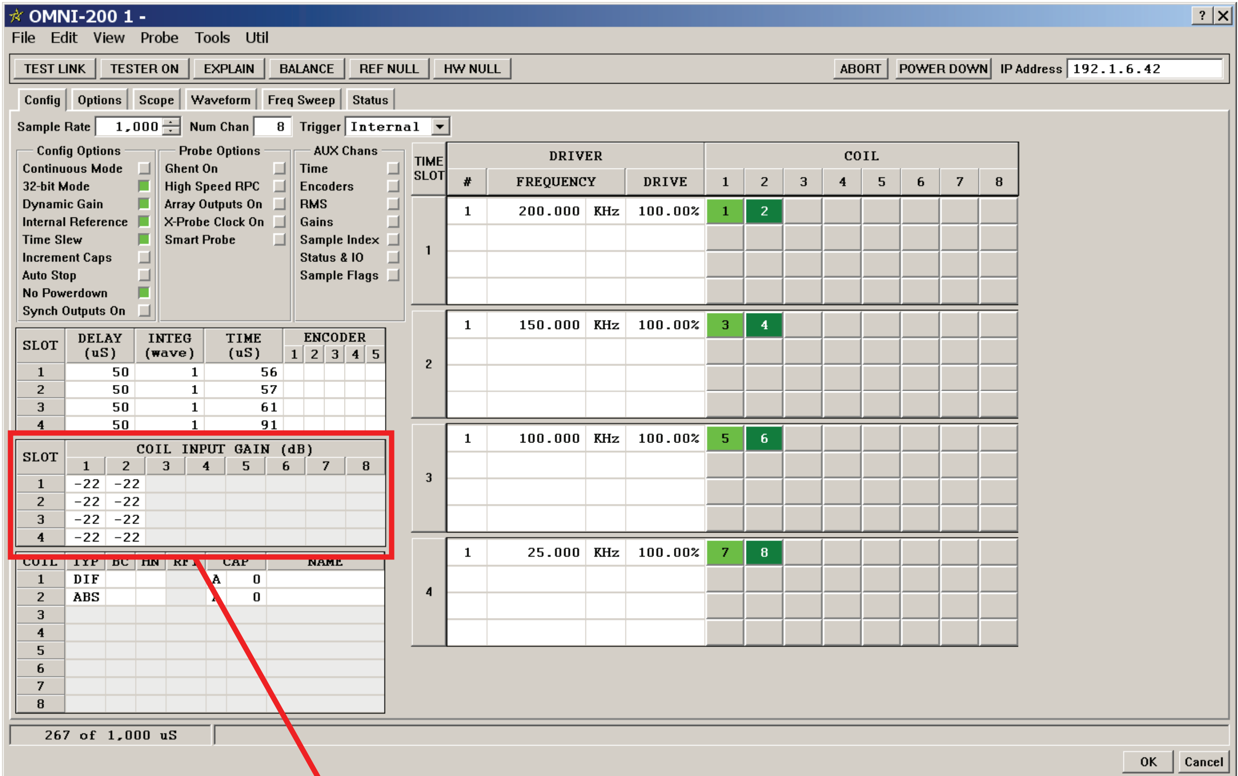
- The simplest way to get to 100% drive it to middle-click to get to 0% and then right-click to get to 100%.
- To change all drive values at once, click in the **DRIVE** title area.

2.5.5 Set Coil Input Gains

The coil input gain is the final gain stage prior to analog to digital conversion in the OMNI-200. Its value ranges from -22 dB to 20 dB.

When dynamic gain is ON, the actual gain value for a given sample may be stepped down from this value to avoid saturation. If **32-bit Mode** and **Dynamic Gain** are ON, it is usually possible to simply use the maximum gain of 20 dB. In 16-bit mode, it may be necessary to lower the value to avoid saturation.

To change a given gain value, click on the gain value for the given slot and coil. To change all the gains for a given coil, click on the coil numbers as shown below:



SLOT	COIL INPUT GAIN (dB)							
	1	2	3	4	5	6	7	8
1	-22	-22						
2	-22	-22						
3	-22	-22						
4	-22	-22						

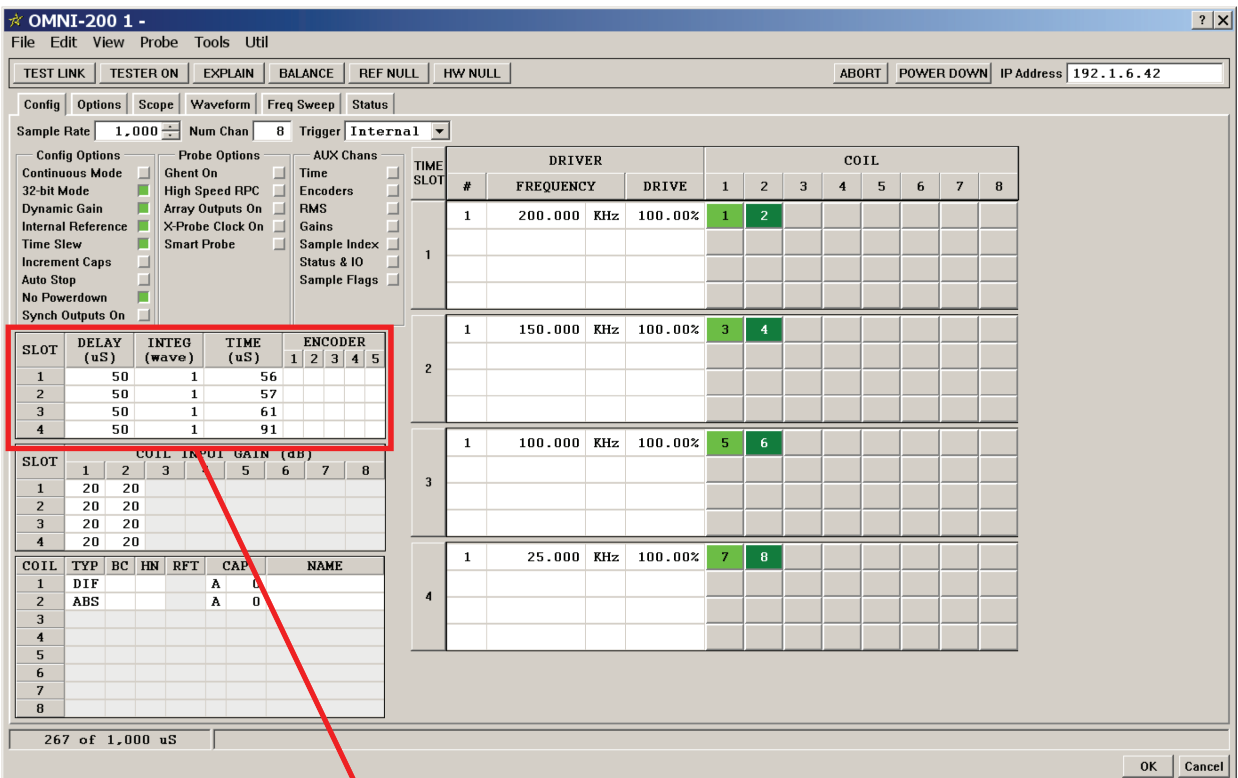
For this example, left-click on the titles of coils 1 and 2 to set all gains to 20 dB as below:

Mouse-click in the **COIL** number to modify the gains for all time slots at once.

SLOT	COIL INPUT GAIN (dB)							
	1	2	3	4	5	6	7	8
1	20	20						
2	20	20						
3	20	20						
4	20	20						

2.5.6 Setting Delays

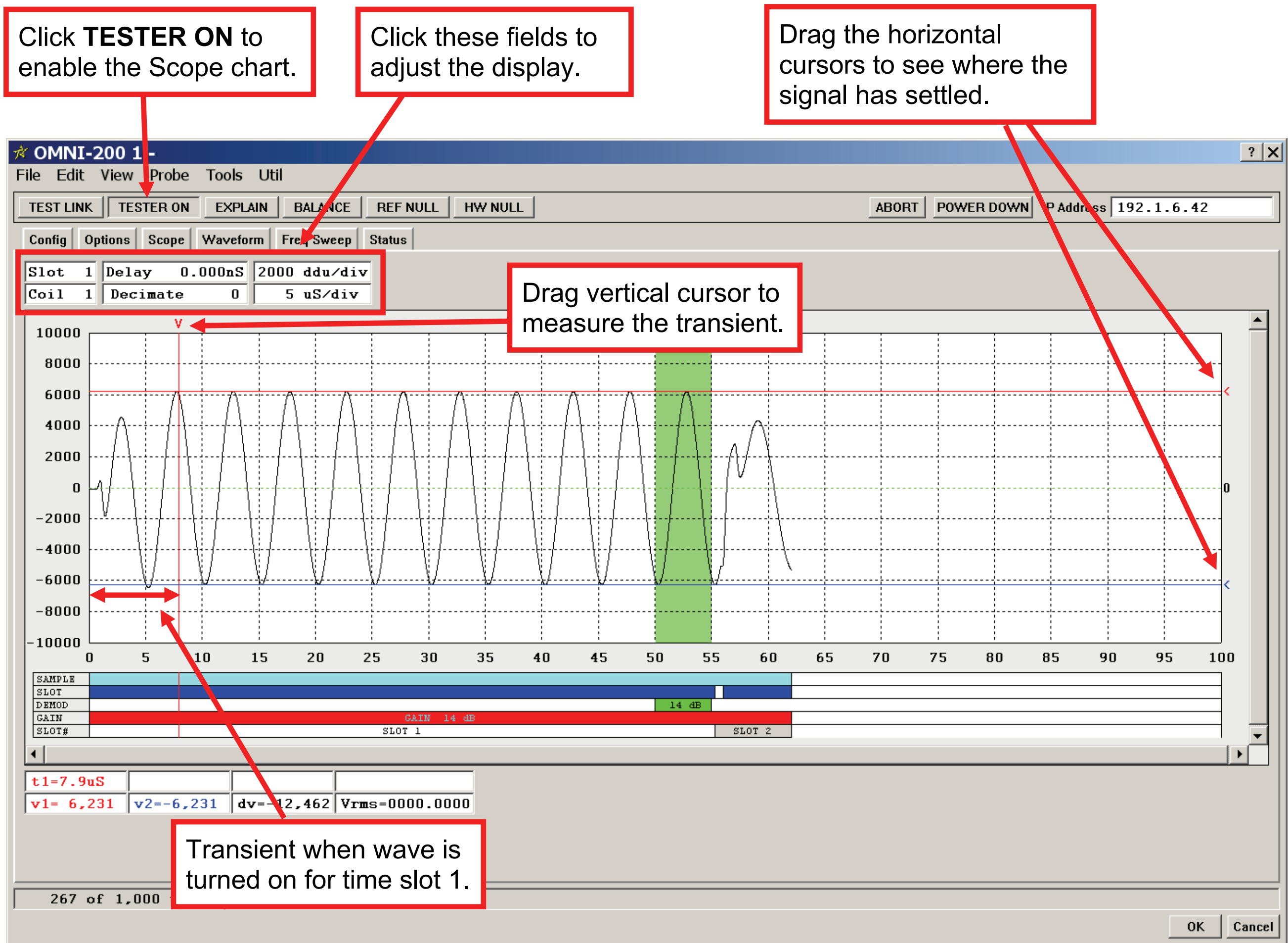
The delay table allows the user to set the delay between the time the sine wave to the probe is turned on and the time when the actual demodulation of the signal begins. This time is to allow the wave to settle in the tube material.



SLOT	DELAY (uS)	INTEG (wave)	TIME (uS)	ENCODER 1	2	3	4	5
1	50	1	56					
2	50	1	57					
3	50	1	61					
4	50	1	91					

The default value for delay is 50 µs, which is usually sufficient, but not optimum. The optimum value is one that delays the demodulation until transients have settled. The OMNI-200 scope feature provides a way of determining this.

Click on the **Scope** tab and adjust the display parameters until you can see the wave:

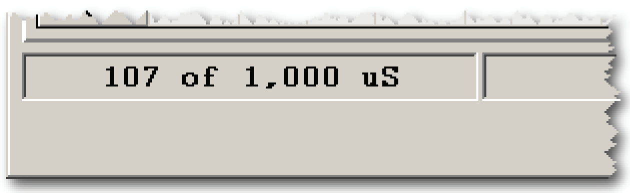


The scope shows that a value of 10 µs is sufficient to skip over the transient. You should look at each slot since the value may vary with frequency. You do not want to set the delay any larger than necessary since that will reduce the amount of time available for demodulating the signal. A conservative value in this case is 20 µs as shown below:

SLOT	DELAY (uS)	INTEG (wave)	TIME (uS)	ENCODER				
				1	2	3	4	5
1	10	1	16					
2	10	1	17					
3	10	1	21					
4	10	1	51					

2.5.7 Setting Integrations

The delay table is also used to set the number of waves used to demodulate each time slot. Using more waves increases the signal to noise ratio, but also consumes more time. The total amount of time available is limited by the **Sample Rate**. This, along with the amount of time used by the current configuration, is shown in the lower left part of the status bar:



Mouse-click in the **INTEG** field in order to adjust the waves. A good starting point is to adjust the number of waves in each slot so that each uses about the same amount of time. Since the total amount of time available is 1000 µs, this is around 250 µs:

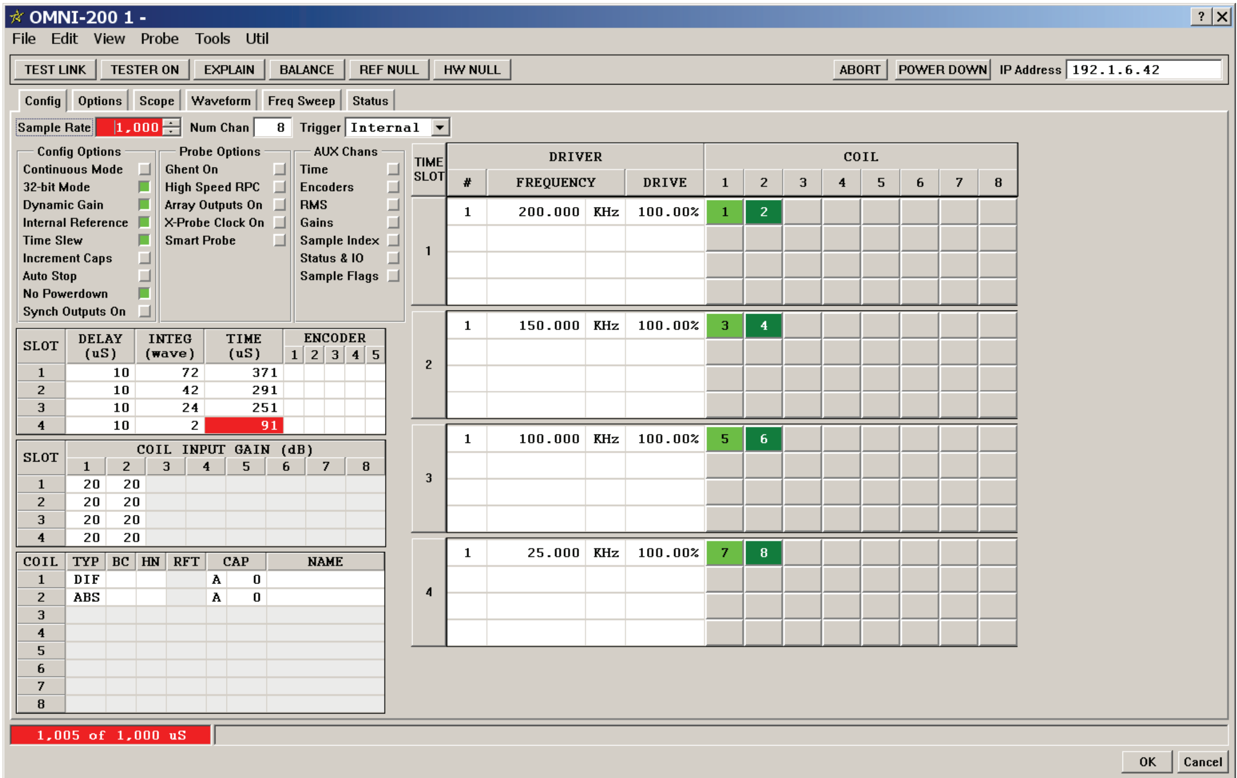
SLOT	DELAY (uS)	INTEG (wave)	TIME (uS)	ENCODER				
				1	2	3	4	5
1	10	49	256					
2	10	36	251					
3	10	24	251					
4	10	5	211					

Adjust the values in the **INTEG** column to roughly equalize the values in the **TIME** column.

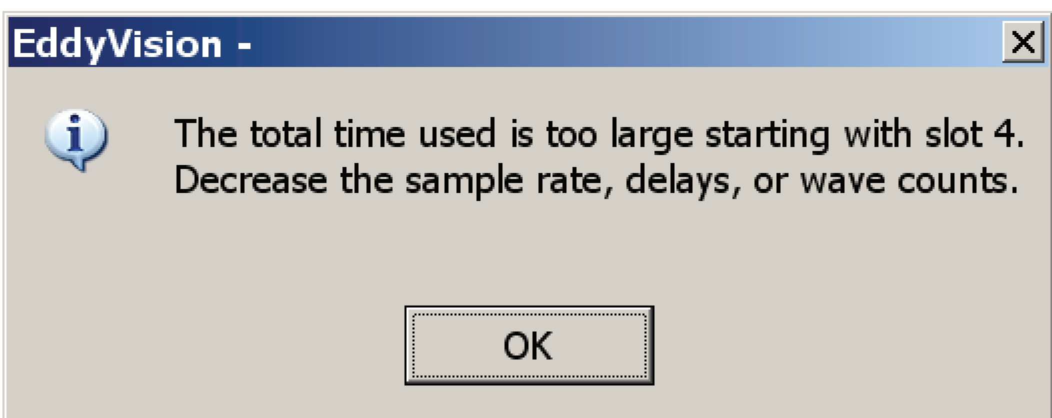
This is usually not optimum, which is why the OMNI-200 allows you to adjust it. For example, the 25 KHz is often nothing but a locator channel so we will set it back to 2 waves. This frees up time to add waves to other slots. The 200 KHz and 150 KHz are our prime analysis frequencies, so we will increase them as much as possible:

SLOT	DELAY (uS)	INTEG (wave)	TIME (uS)	ENCODER				
				1	2	3	4	5
1	10	71	366					
2	10	42	291					
3	10	24	251					
4	10	2	91					

At this point, the status bar shows we have used 1000 µs out of 1000 µs and we cannot add any more integrations. If we attempt to do so, errors will be shown in red:



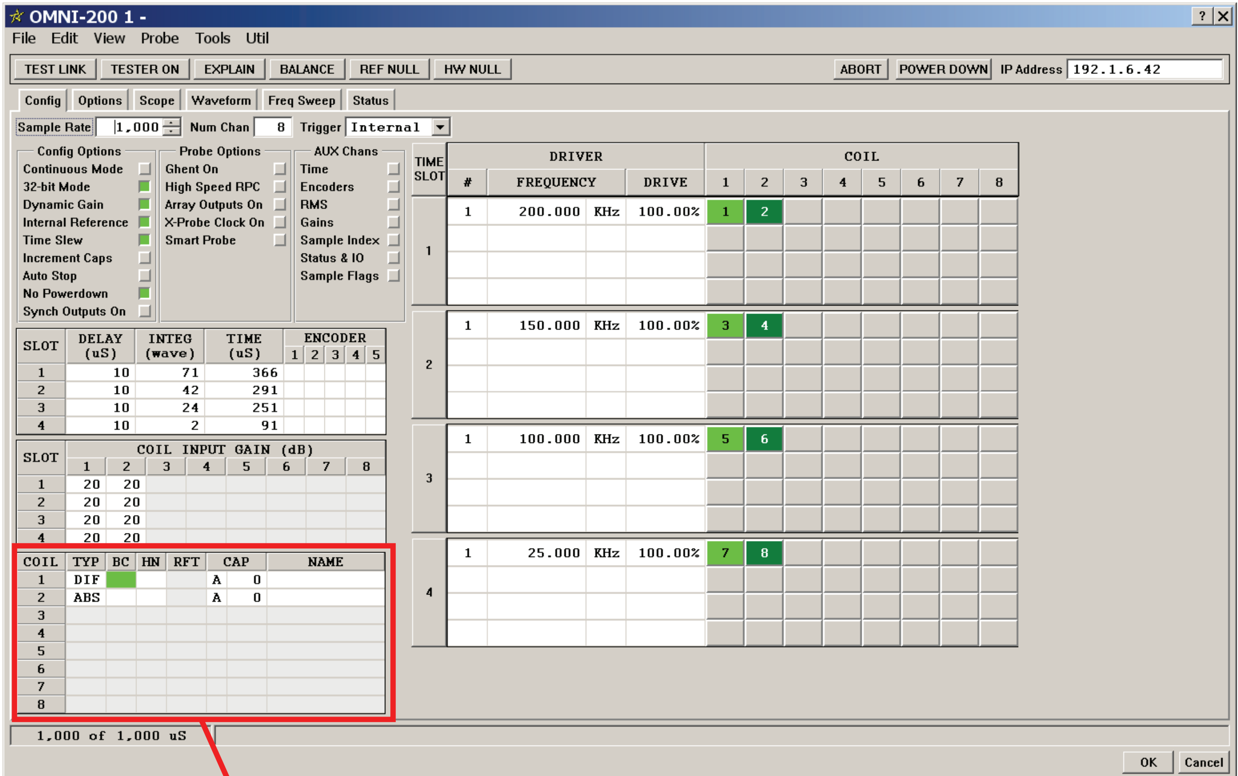
To see the cause of the errors, click the **EXPLAIN** button to see:

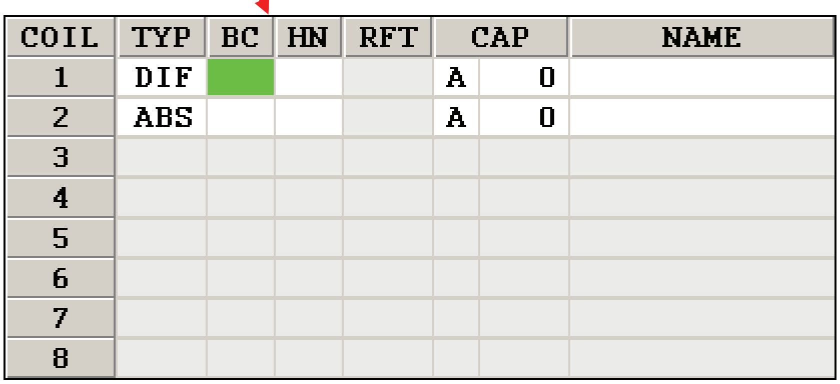


Along with the source of the error, the **EXPLAIN** dialog usually says how to correct the situation.

2.5.8 Setting Coil Parameters

The final table we must setup is the coil parameters:





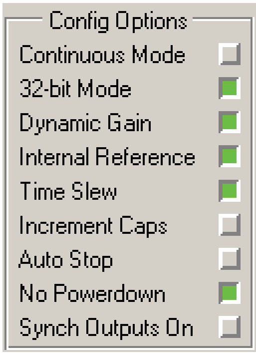
COIL	TYP	BC	HN	RFT	CAP		NAME
1	DIF				A	0	
2	ABS				A	0	
3							
4							
5							
6							
7							
8							

They **TYP** column is already set since we already configured the coil types. Click on the **BC** (Balance Coil) column for coil 1 to enable coil balancing on the differential channel. Only coils with **BC** enabled will be balanced.

2.5.9 Setting Options

2.5.9.1 Config Options

The recommended **Config Options** are shown below:



We will be running in multiplex mode, so **Continuous Mode** is OFF. In **Continuous Mode**, there is only one time slot and all frequencies are excited at the same time. The advantage of this is it allows higher sampling rates and avoids transients. However, it also limits the output drive voltage of each frequency as well as the allowable choices of frequency. It is primarily needed for very low frequency tests.

In **32-bit Mode**, each X and Y value is 32-bits; otherwise it is 16-bits. Using **32-bit Mode** will double the size of the data file, but disk space is cheap and we recommend it to help avoid saturation.

Dynamic Gain is a feature of the OMNI-200 that allows it to scale down the probe inputs in order to avoid saturation. The OMNI-200 uses 14-bit ADC, but the dynamic gain feature makes it effectively a 21-bit tester. To fully take advantage of this, you must use **32-bit Mode** since in 16-bit mode the upper 5 bits will be truncated. We recommend that you always run with **Dynamic Gain** ON.

Internal Reference avoids the need for a physical reference probe. The absolute signals will be somewhat noisier than those of a physical reference probe. This can usually be handled by adding some filters in the analysis software, but if this is an issue, turn this OFF and connect a reference probe to the **Probe 2** connector on the pigtail.

Internal Reference only supports one absolute coil.

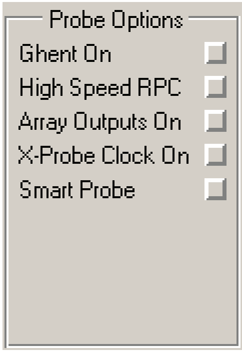
We recommend turning **Time Slew** ON since it improves the quality of mixes.

Increment Caps, **Auto Stop**, and **Synch Output On** should always be OFF.

No Powerdown should always be ON.

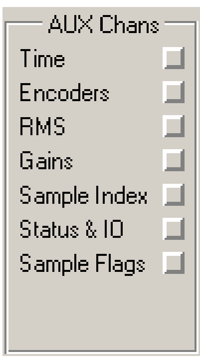
2.5.9.2 Probe Options

These are options that only apply to special probes. If you are not using such a probe, leave the options OFF.



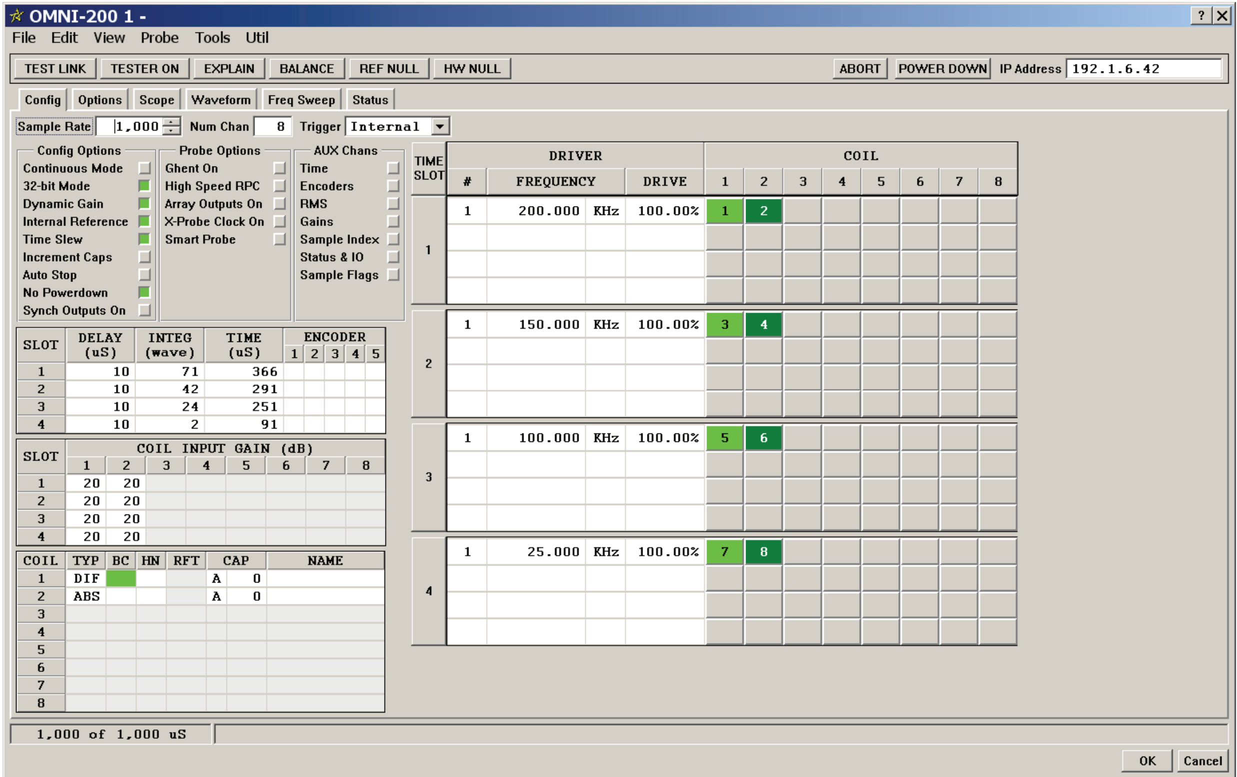
2.5.9.3 AUX Chans

The AUX Chans should normally be left OFF.



2.6 Using the Configuration

We have now created the complete configuration shown below:



To use it, place the probe in a clean section of tubing and click **BALANCE**. The progress of the balance will be displayed in the status bar. Once complete, the value of the caps chosen will be shown in the **CAP** column of the coil table:

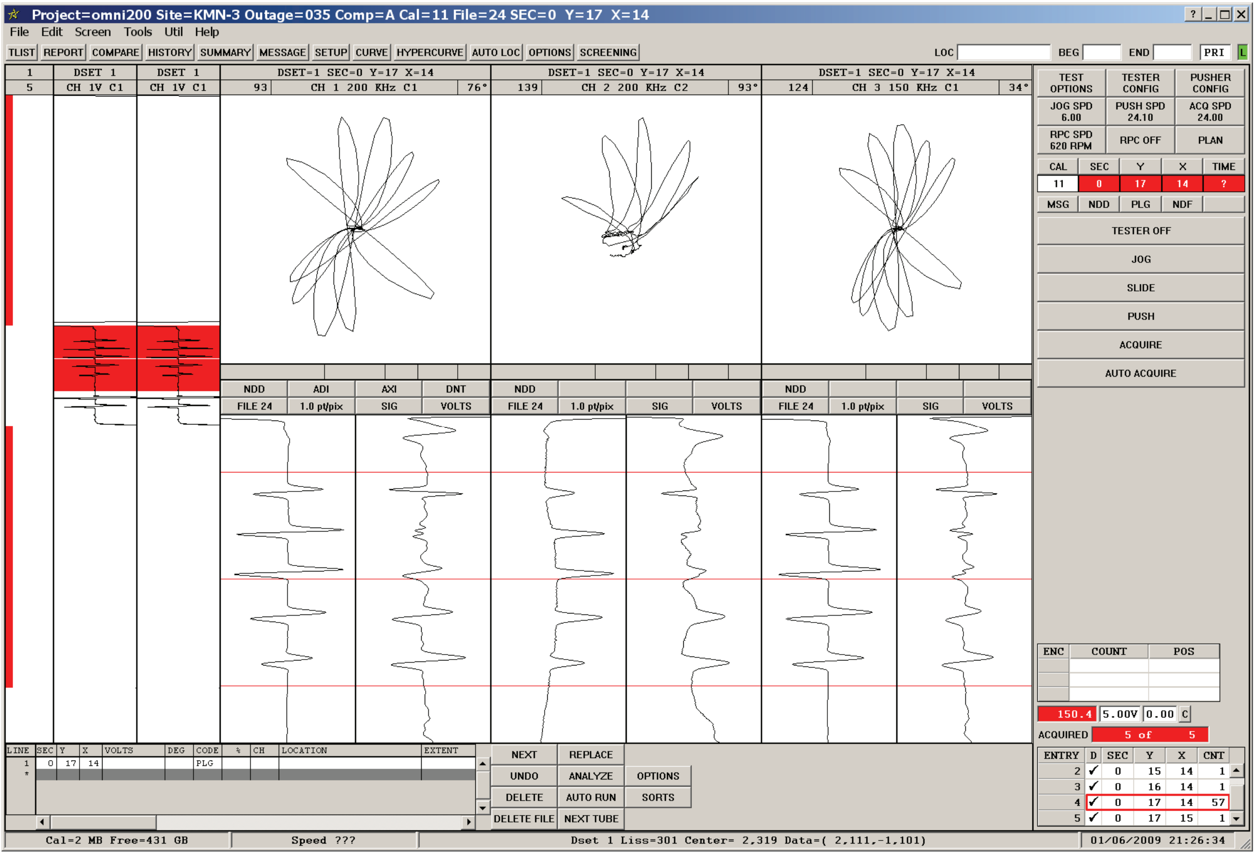
COIL	TYP	BC	HN	RFT	CAP		NAME
1	DIF				A	58	
2	ABS				A	0	
3							
4							
5							
6							
7							
8							

Note that only coils with the **BC** column enabled are balanced.

For a good probe, this value should be fairly small. If it is in the hundreds, it means the two coils are severely out of balance.

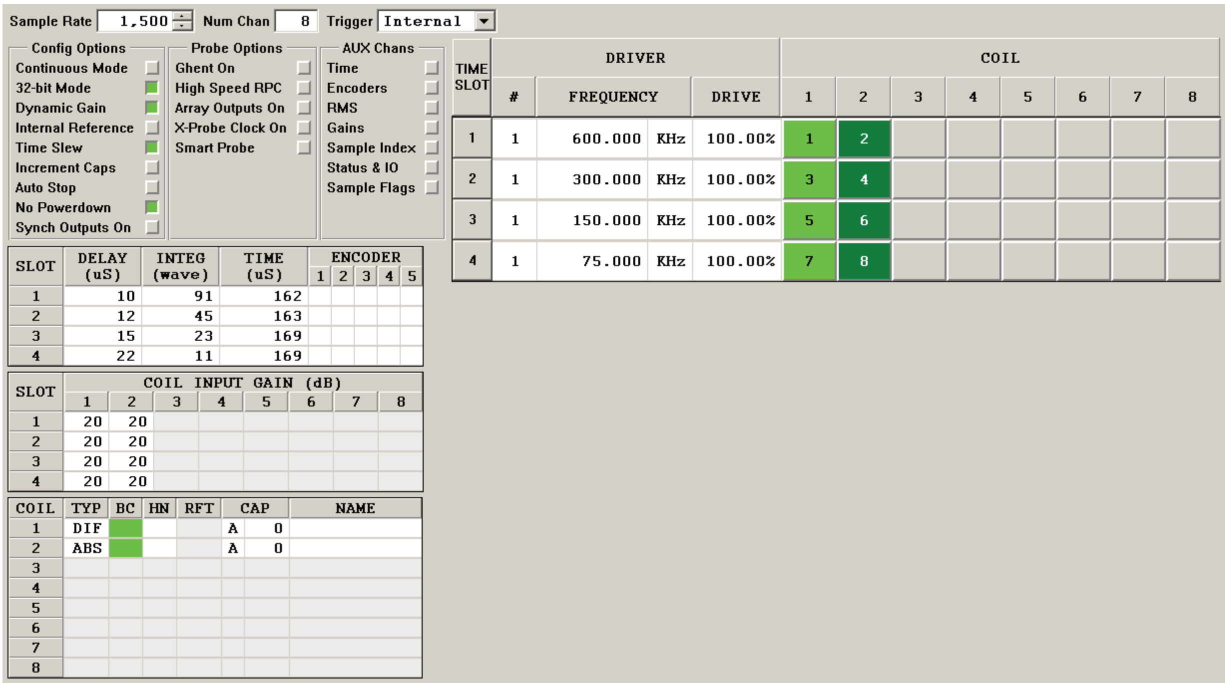
Since we are using **Internal Reference**, click **REF NULL**. This is complete when “Done” appears in the status bar.

Now choose **Save As** from the **File** menu and save the configuration to a file. We have used *tutorial.cfg*. Click **Ok** to get back to the main acquisition screen. Click the **TESTER OFF** button to acquire data:



2.7 *Sample Configurations*

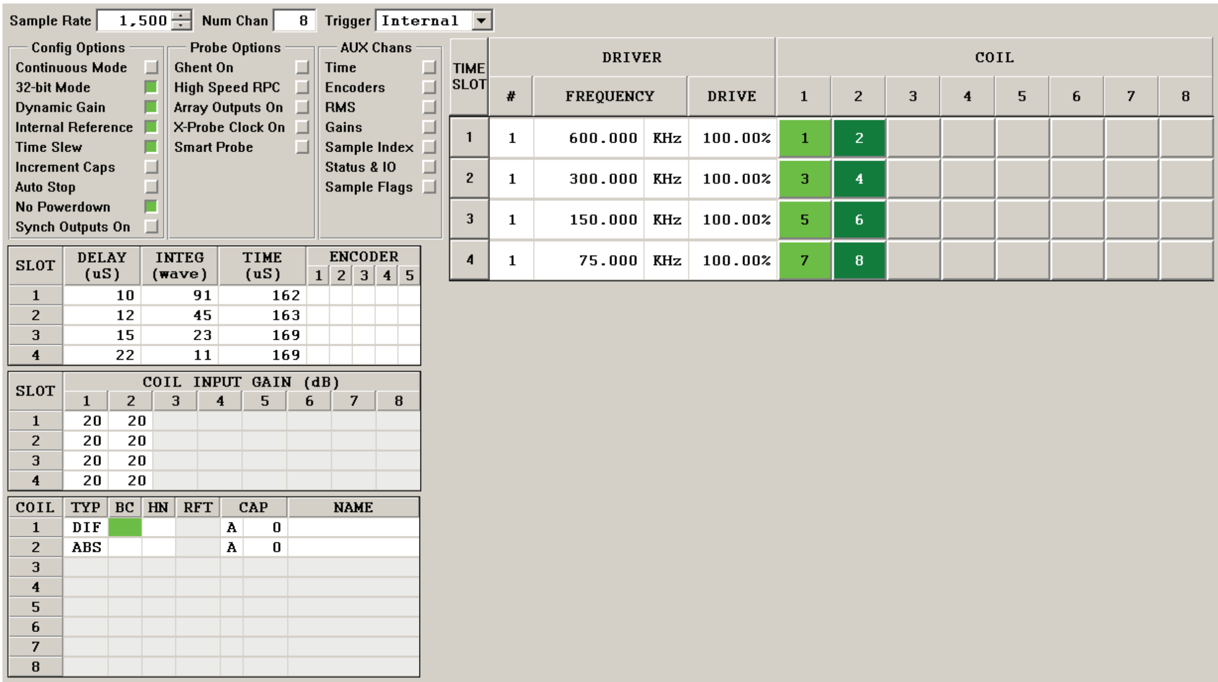
2.7.1 High Frequency with External Reference



Notes:

1. Use the **View** menu to select **Number of Slots** of 4 and **Slices per Slot** of 1.
2. The **Internal Reference** option is OFF and the **REF NULL** button is disabled.
3. Since **Internal Reference** is not being used, it makes sense to balance the ABS coil.

2.7.2 High Frequency with Internal Reference



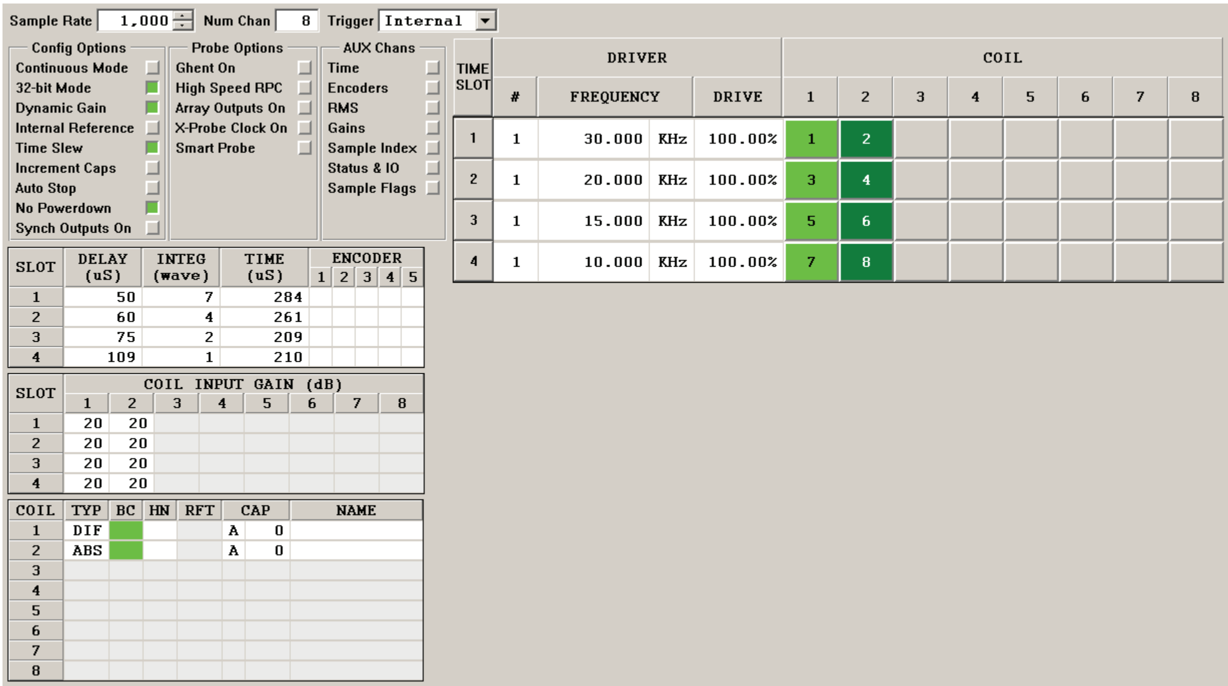
Notes:

1. The only difference between this configuration and the previous one is that **Internal Reference** has been turned ON.

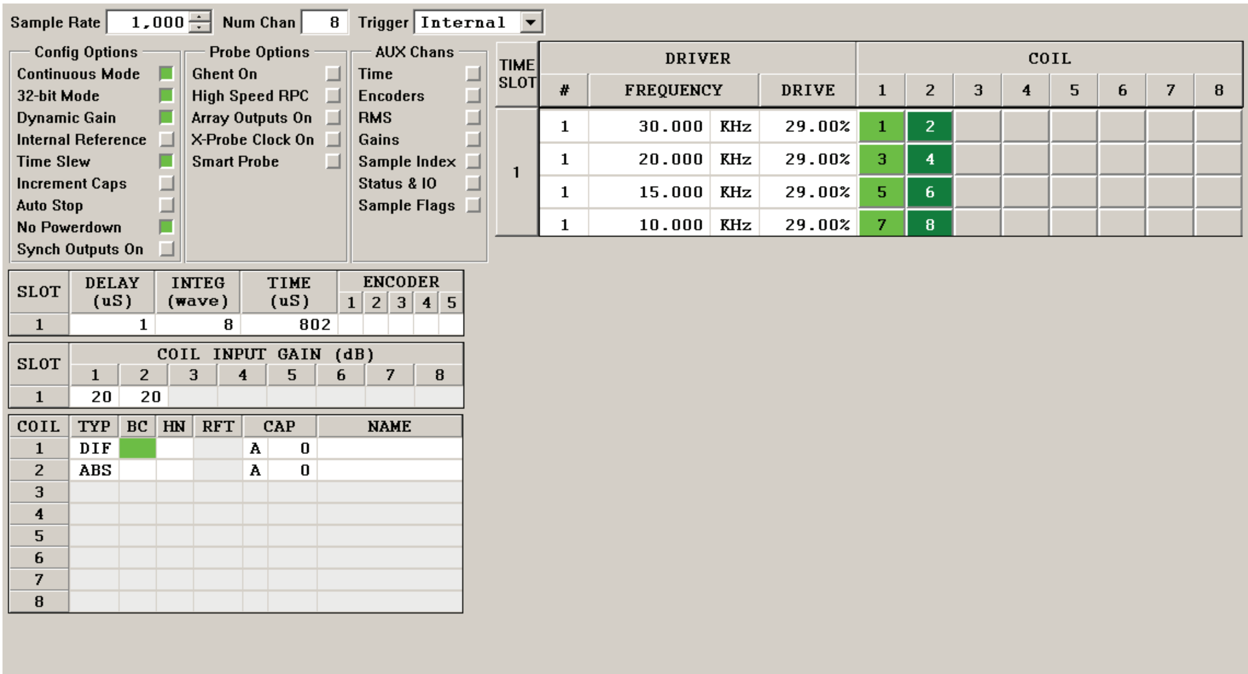
2. Since **Internal Reference** is ON, you must perform **REF NULL** after doing the **BALANCE**.

3. The ABS coil is not balanced with **Internal Reference** ON.

2.7.3 Low Frequency with External Reference



2.7.4 Low Frequency with Simultaneous Injection



Notes:

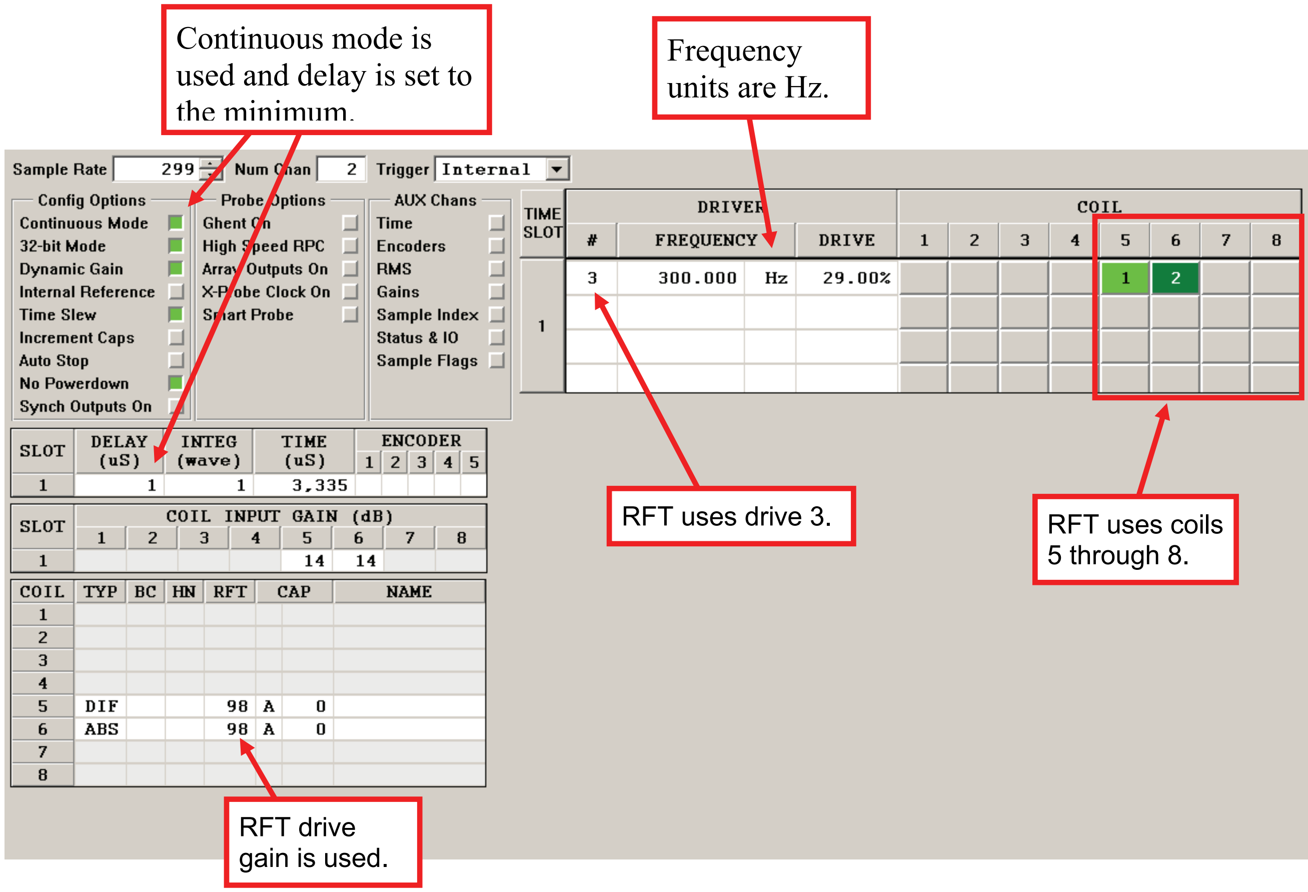
1. In the **View** menu, select **Number of Slots** of 1 and **Slices per Slot** of 4.

2. Since there is only one time slot, turn on **Continuous Mode**.

3. In **Continuous Mode**, the delay is set to the lowest value.

4. Each of the four frequencies has a drive of 29% which would seem to add up to 116%. This is possible since the peaks of the various frequencies occur at different times. Click on the **Waveform** tab to see that the composite waveform does not exceed 100% at any point.

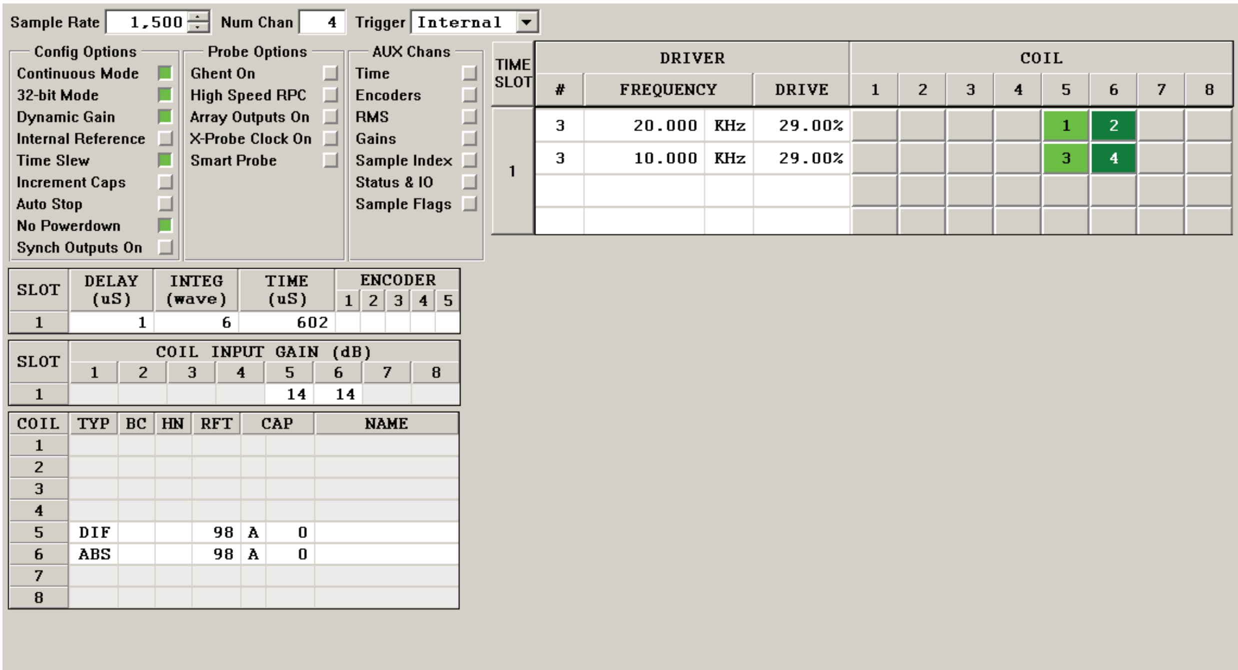
2.7.5 Low Frequency RFT



Notes:

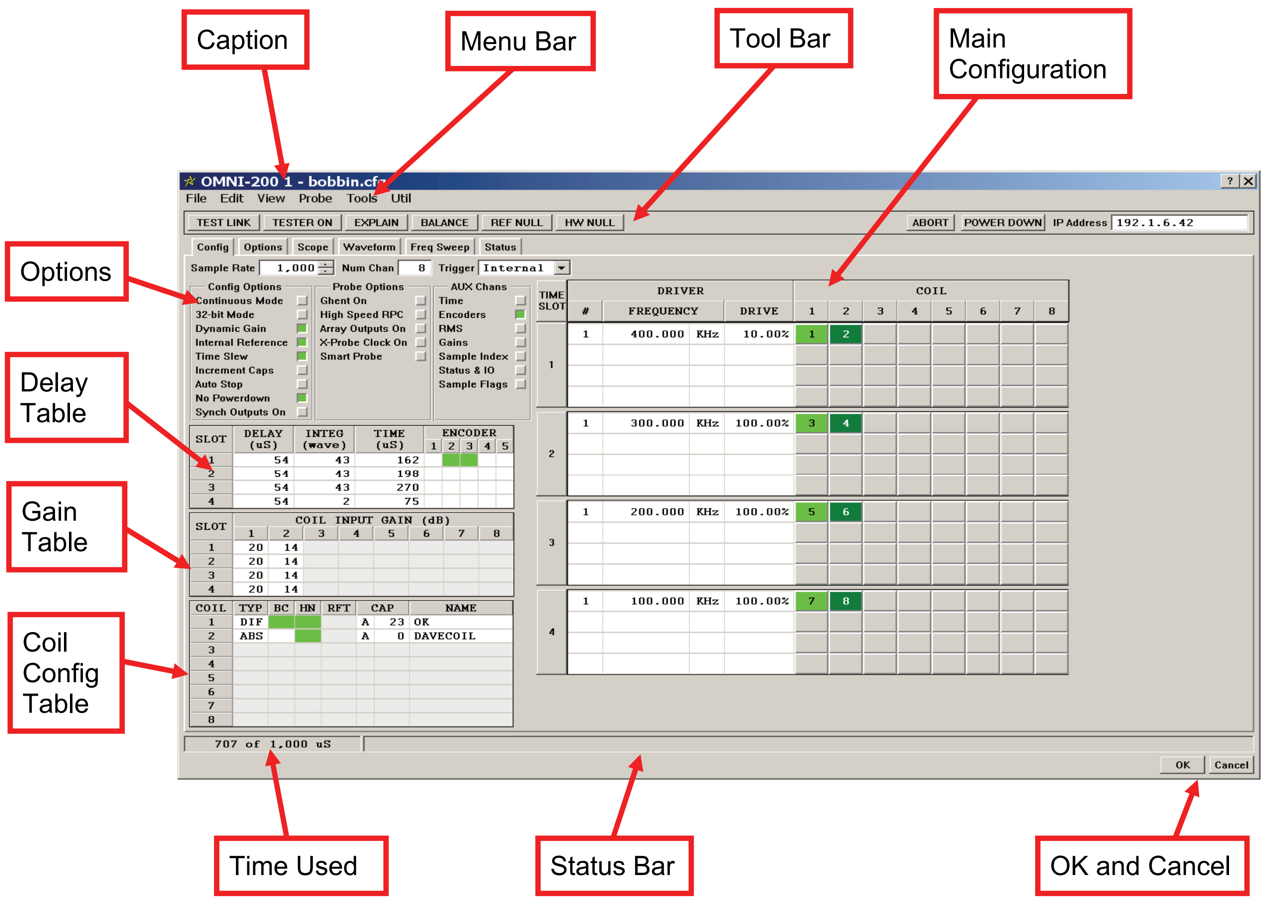
1. RFT uses coils 5 through 8.
2. Use **DRIVER** 3 for RFT.
3. The units of frequency have been changed to Hz instead of KHz. So the frequency in this sample is 300 Hz.
4. RFT has an additional gain stage ranging from 1 to 730. In this case, it is set to 98.

2.7.6 High Frequency RFT



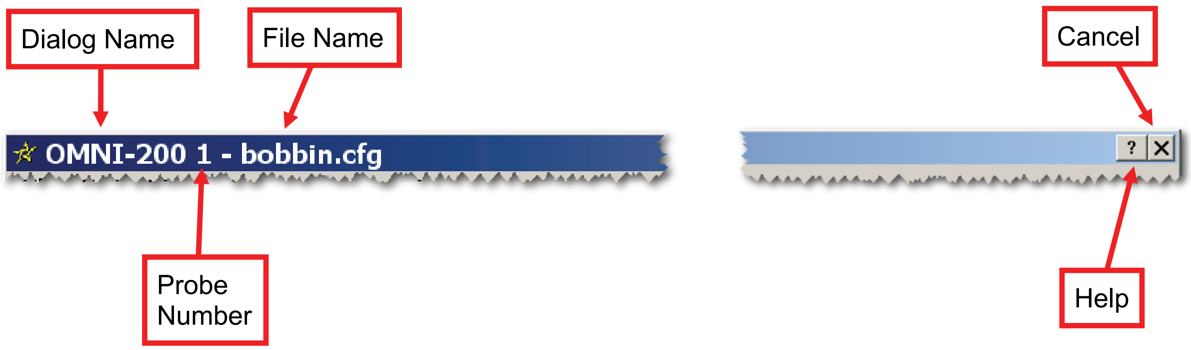
3 Tester Configuration Dialog

The main OMNI-200 configuration screen is shown below. The exact appearance will depend upon options selected in the View menu. The one shown is for a typical bobbin probe configuration.



3.1 Caption

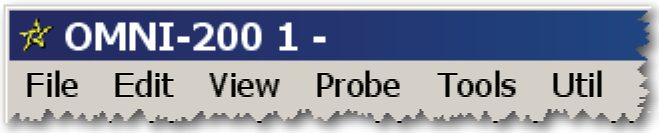
The caption at the top of dialog shows the current configuration file.



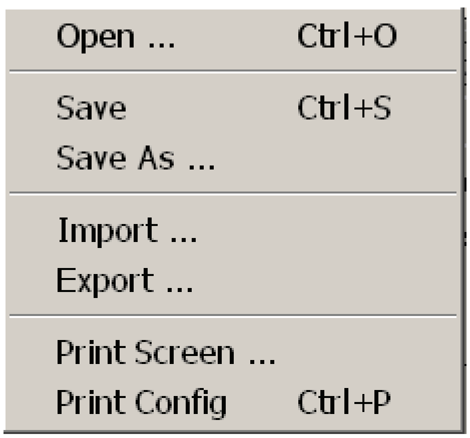
Dialog Name	Shows that this is the OMNI-200 configuration tool.
Probe Number	EddyVision acquisition can support up to four probes, each using an independent OMNI-200 tester.
File Name	Shows the currently loaded configuration file. This will be blank for a new configuration. If the file is located in the **`tester_configs\OMNI-200\`** directory of the current project, only the file name is shown. Otherwise, the full path of the file is shown.
Help	Clicking the ? will cause help information to be displayed whenever the cursor hovers over an area of the screen.
Cancl	Clicking the X has the same effect as the **CANCEL** button.

3.2 Menus

This section describes the menu commands found at the top of the configuration dialog.



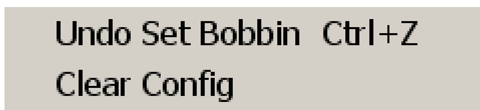
3.2.1 File Menu



Open …	Load a tester configuration that has been saved to a file. The initial directory will be **`tester_configs\OMNI-200\`** of the current project.
Save	Save the current tester cofiguration to the file name shown in the caption.
Save As …	Save the current configuration to a new file.
Import …	Load a tester configuration that has been saved to the central user directory for use in multiple projects. This will typically be **`C:\Program Files\CoreStar\EddyVision 6.4\user\tester_configs\OMNI-200`**
Export …	Export to the common user directory.

Print Screen …	Print a screen capture of the current configuration.
Print Config	Displays a plain text version of the configuration in a text editor which the user can then save or print.

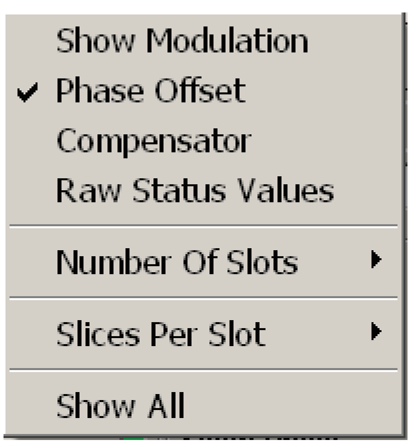
3.2.2 Edit Menu



Undo	Nullify a recent configuration action. If you have not performed and action that can be undone, this item is grayed out. Otherwise, it will show the most recent action that can be undone. After undoing an action, the next action that can be undone will be displayed.
Clear Config	Clear the configuration to a default state.

3.2.3 View Menu

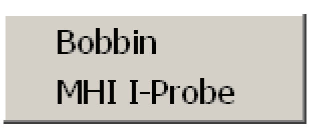
The **View** has options to customize the tester configuration display. When an option is active, a check mark will be displayed beside it.



Show Modulation	Show the overall modulation frequency of the OMNI-200 driver outputs. This is not used by any standard probe and should be unchecked.
Phase Offset	Show a PHASE column in the main configuration table which represents the phase offset of that time slice.
Compensator	Show PHASE and GAIN columns in the main configuration table which represent the phase and gain of the compensator driver used for internal reference. Although they can be manually adjusted, these are normally for information purposes only and need not be displayed.
Raw Status Values	This will display the raw measurements used to compute temperature and voltages in the **Status** tab. These are not normally needed by end users and this option should be off.
Number of Slots	Used to select the total number of timeslots displayed.
Slices Per Slot	Used to select the number of frequency slices in each time slot.
Show All	Used to turn on all viewing options and display the maximum number of slots and slices.

3.2.4 Probe Menu

These commands create a default configuration for certain probes. This can be used as a starting point. Each of these commands will add an entry to the **Edit | Undo** menu.



Bobbin	Sets a default configuration for a typical bobbin probe.
MHI I-Probe	Sets a default configuration for the MHI Intelligent Probe.

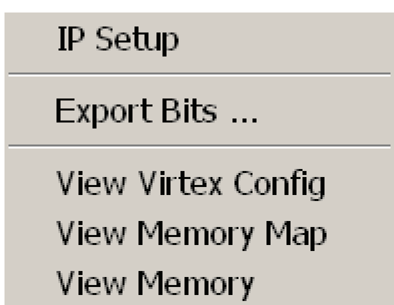
3.2.5 Tools Menu

The Tools menu is used to display menus that show detailed information about the current configuration. These are rarely needed by users.

Gain Cal …	Opens the Gain Calibration tool which enabled you to view and print information about the gain calibration stored in the tester. For more information see **Gain Calibration Tool** on page 88.
Hardware Null …	Opens the Hardware Null tool which enables you to view the offsets used by the hardware null. For more information, see **Hardware Null Tool** on page 91.

3.2.6 Util Menu

This menu has various commands used to view detailed information about the tester configuration and configure the networking. Only the **IP Setup** utilitiy is commonly used.



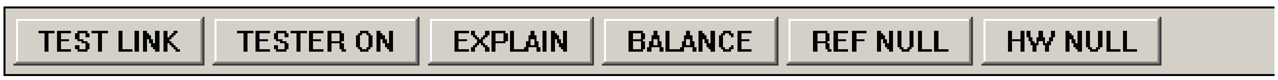
IP Setup	Shows the IP Setup tool which allows the user to configure the network. See **IP Setup Utility** on page 93 .
Export Bits …	Export the current tester configuration as a special "bits" file used by certain third party software.
View Virtex Config	Show the current tester configuration in plain text form in a text editor.

View Memory Map	Show the contents of the testers processor memory map in a text editor.
View Memory	Show a hex dump of the contents of the testers working memory.

3.3 Toolbar

The toolbar contains a number of buttons to quickly access certain commands regardless of which tab is currently displayed.

3.3.1 Toolbar Left



TEST LINK	Test the network link between the software and the tester. If successful, a "Link Good" message will be displayed in the status bar. If an error is displayed, see the troubleshooting section XXX.
TESTER ON	Turns on the tester. This is used for certain actions such as the **Scope** tab.
EXPLAIN	If any fields are displayed in red, which indicates an error, click the button to see an explanation and possible remedy.
BALANCE	Balances the probe coils (see section 3.3.1.1).
REF NULL	Compute and store the internal reference signal (see section 3.3.1.2).
HW NULL	Compute and store the hardware null (see section 3.3.1.3).

When performing the **BALANCE**, **REF NULL**, and **HW NULL** operations, they should be done in order from left to right.

3.3.1.1 Balance Probe Coils

The OMNI-200 can apply capacitance to either the A or B probe coil on order to balance the impedance of the two sides. To balance the coils:

1. Place the probe in a clean section of tubing.

2. Select the coils to balance in the **Coil Config** table by clicing the **BC** column for the appropriate coils. Selected coils are colored green.

3. Press the **BALANCE** button in the toolbar.

The progress of the balance operation is displayed in the status bar. It will display "Balance Done" when complete and the results will be displayed in the **CAP** column of the **Coil Config** table (see **Coil Config Table** on page 62). The value is in picoFarads.

A good balance value should be relatively low. A high value in the hundreds of pF man indicate a defective or malfunctioning probe.

3.3.1.2 Generate Internal Reference

The OMNI-200 has the ability to replace a physical external reference probe with a virtual reference. The tester generates a signal that is equivalent to the one produced by a physical reference. To generate this signal:

1. Make sure that **Internal Reference** is enabled in the **Config Options**.

2. Select one coil to be the absolute coil. Do this either by clicking on the **TYP** column for the given coil in the **Coil Config** table or by right clicking on the coil number in the **COIL** column of the **Main Config** table. In both cases, select **ABS** for the coil type.

3. Place the probe in a clean section of tubing.

4. Click **REF NULL** in the toolbar.

The progress of the operation is displayed in the status bar. It will show "Done" when completed and the computed values will be displayed in the **COMPENSATOR** columns of the **Main Config** table (these are only visible if the **View | Compensator** menu item is checked.

The quality of the internal reference can be viewed by selecting the absolute coil in the **Scope** tab (see **Scope Tab** on page 68).

3.3.1.3 Generate Hardware Null

The OMNI-200 can add a digital offset to the data to center it around zero. This is usually only required for certain analysis systems that use the absolute voltage values instead of relative voltages. It has no effect on standard measurements, such as volts peak-to-peak.

It can also be useful for poorly balanced probes in 16-bit mode. Internally, the OMNI-200 always operates in 32-bit mode; truncation to 16-bit data only occurs at the very end prior to sending it to the PC. If the overall signal size is within the 16-bit range, but it so far offset that parts of it will be truncated, it may be helpful to center it around zero first.

To generate the hardware null:

1. Place the probe in a clean section of tubing.
2. Select the coils to null in the **Coil Config** table by clicking on the **HN** column.
3. Click on **HW NULL** in the toolbar.

The hardware null values are generated and stored in the tester. They may be viewed using the **Tools | Hardware Null** menu.

3.3.2 Toolbar Right

ABORT	Perform a warm reboot of the tester. This is not needed by most users.
POWER DOWN	Power down the analog portions of the tester. This is not needed by most users.
IP Address	This field shows the IP address of the tester the software will attempt to connect to. For more information, see **IP Setup Utility** on page 93.

3.4 Config Tab

The Config tab is the main tab of the tester configuration window and contains most of the options you will need.

3.4.1 Fields Left

The upper left side of the **Config** tab displays the following fields:

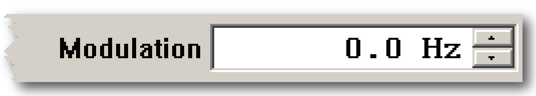
If **Trigger** is set to **Encoder**, two additional fields are displayed as shown below:

Sample Rate	When using an internal trigger, this is the number of eddy current samples acquired each second. This defines the time duration of each sample which is displayed in the **Time Used** display to the left of the **Status Bar** at the bottom of the window. When not using an internal trigger, this can be used to define the maximum number of samples per second (see **Trigger** below). Adjust it so that the **Time Used** is as large as possible. This will determine the maximum sample rate for the external trigger or encoder. If the **Time Used** is less than the time available, the maximum sample rate for **Trigger** modes other than **Internal** can be determined by taking the inverse of the **Time Used** (so long as nothing is in red). For example, if the **Time Used** is 800 µs, the maximum sample rate is: $SR_{MAX} = \frac{1}{t_{used}} = \frac{1}{800\,x10^{-6}} = 1{,}250$
Num Chan	A read-only field showing the total number of eddy current channels. This is equal to the number of active blocks in the **COIL** columns of the **Main Config** table.

Trigger	Determines what will cause a sample to be acquired: **Internal** — Samples will taken at the rate shown in the **Sample Rate** field. **External** — The tester samples each time the external trigger input goes high. If the trigger rate exceeds the maximum sample rate, some triggers will be ignored and errors will be generated. These can be viewed in the **Trigger Errors** field of the **Status** tab. **Encoder** — The tester samples based on an encoder input. The triggers per second should not exceed the maximum sample rate or some will be ignored and errors generated. These can be viewed in the **Trigger Errors** field of the **Status** tab.
Enc Num	(Only visible if **Trigger** is set to **Encoder**). Defines which encoder is used as the trigger.
Enc Inc	(Only visible if **Trigger** is set to **Encoder**). Encoder triggers occur at multiples of this increment.

3.4.2 Fields Right

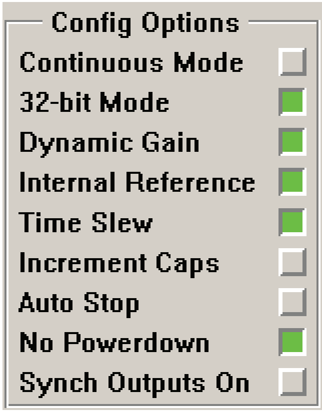
The upper right side of the **Config** tab displays the Modulation field:



This is only visible if **View | Modulation** is checked. For normal operation, this value should be zero.

3.4.3 Config Options

These options control how the tester generates signals and collects data:

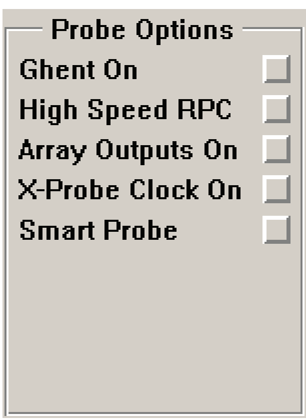


Continuous Mode	**ON**	The tester is in simultaneous mode where the output drive is left on at all times. Advantages include: 1. This eliminates transients that result when the drive is turned on and off as it is in “multiplex mode”. At high frequencies, this is usually not important since delays can be set high enough to bypass the transient. 2. At low frequencies, this also allows for higher sampling rates since there may not be enough time for multiplexing. 3. The quality of mixes may be improved since all frequencies are sampled at the same time, and thus at the sample position in the tube. Enabling the **Time Slew** option can achieve the same effect in multiplex mode. However, only one time slot is available and the drive output for each simultaneous frequency is limited since the total cannot exceed 100%. The choice of simultaneous frequencies is also limited since they must be compatible with each other.
	OFF	The tester is in “multiplex” mode. For each sample, the output drive is turned on at the start of each time slot and off at the end. This generates transients, however, the limitations mentioned above are avoided.

32-bit Mode	**ON**	Raw x,y data is collected with 32-bit resolution. The advantage is that saturation is much less likely, even at tube ends. The disadvantages is that data files will be twice as large. This is the recommended setting when using CoreStar analysis.
	OFF	Raw x, y data is collected with 16-bit resolution.
Dynamic Gain	**ON**	Input gain settings are automatically adjusted for each sample to avoid signal saturation of the ADC. The output drive to the probe is not modified in any way. This is the recommended setting.
	OFF	Input gain settings remain constant at all times. For more information, see **Config Options** on page 25 .
Internal Reference	**ON**	Use the OMNI-200 internal reference. The advantage is that no physical reference probe is required, however the absolute channels may be somewhat noisy. See **Config Options** on page 25 for more information.
	OFF	Use an external reference probe for absolute channels.
Time Slew	**ON**	Data is linearly interpolated so that all channels are effectively sampled at the same time as time slot 1. This can greatly improve the quality of mixes and is the recommended setting whenever the probe speed is reasonably constant or sampling is triggered by an encoder.
	OFF	Data is not interpolated.
Increment Caps	**ON**	This setting is only used during manufacturing and testing.
	OFF	Always set to Off.
Auto Stop	**ON**	This setting is only used during manufacturing and internal purposes.

	OFF	Always set to Off.
No Powerdown	**ON**	Analog parts of the tester always remain powered on even when the tester is not acquiring data. This is the recommended setting.
	OFF	Analog parts of the tester will power down when it is not acquiring data.
Synch Outputs On	**ON**	A synchronization output pulse is generated at the start of each sample. This signal is available on pin on the Remote I/O connector on the front panel of the tester. This is commonly used as the external trigger input of a second tester.
	OFF	No synchronization pulse is generated.

3.4.4 Probe Options

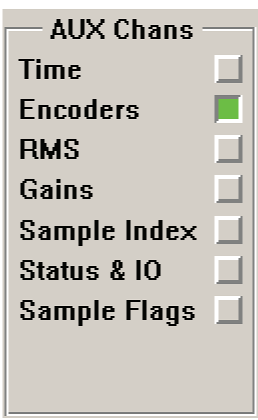


Ghent On	**ON**	Turn on when using a Ghent probe.
	OFF	Turn off for any other type of probe.
High Speed RPC	**ON**	Turn on if you are using a high-speed RPC motor unit.
	OFF	Turn off for non-RPC probes or regular motor units.

Array Outputs On	**ON**	Turn on when using address-based array probes such as the MHI I-Probe.
	OFF	Turn of otherwise.
X-Probe Clock On	**ON**	Turn on if using an X-Probe.
	OFF	Turn off otherwise.
Smart Probe	**ON**	Turn on if using NEL Smart probe.
	OFF	Turn off otherwise.

3.4.5 AUX Chans

This panel is used to enable optional channels. The values of these channels can be viewed in the balance dialog in the main acquisition/analysis screen.



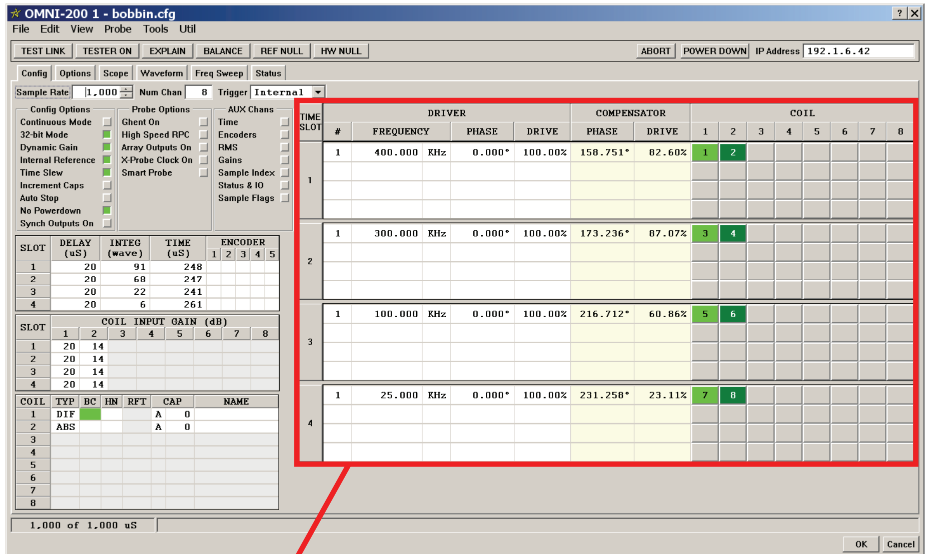
Time	Includes a 64-bit time value for each sample. It is the time in nanoseconds since the tester was turned on. This mostly useful when not using internal trigger mode.
Encoders	Enables encoder channels (see **Delay Table** on page 58).
RMS	Includes the averages and root-mean-square (RMS) value of the ADC inputs for each coil during the demodulation process.

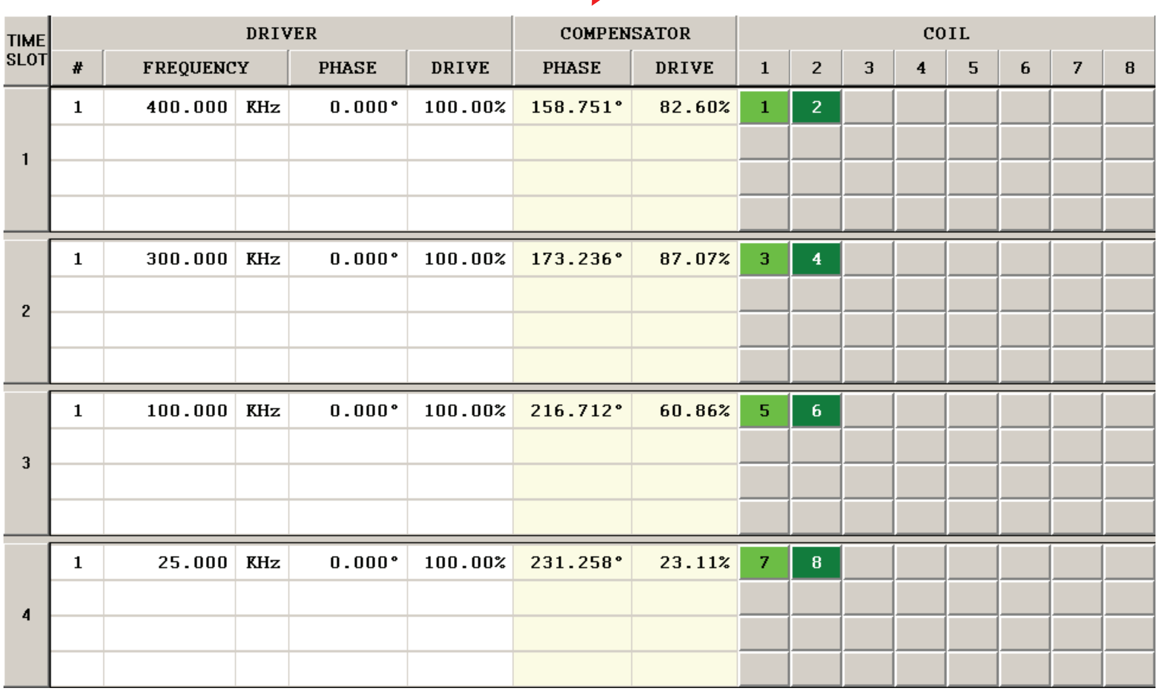
<table>
<tr><td>Gains</td><td>Includes the gain values for each dynamic gain amplifier for the given sample. The data can be color coded by enabling Color Code Gains in the OPTIONS dialog.</td></tr>
<tr><td>Sample Index</td><td>Include a 32-bit sequential sequence number, starting at 0, with each sample. This can be used to verify that no samples are missed. EddyVision32 acquisition will display an error message if there is such an error.</td></tr>
<tr><td>Status & IO</td><td>This option includes a 4-byte channel for each time slot of each sample. The bytes are defined as follows:
<table>
<tr><th>BYTE OFFSET</th><th>NAME</th><th colspan="2">DESCRIPTION</th></tr>
<tr><td>0</td><td>overflow</td><td colspan="2">Bit n = 1 if the ADC for coil n was saturated at any time during the demodulation.</td></tr>
<tr><td rowspan="2">1</td><td rowspan="2">errors</td><td>Bit 0</td><td>1 if the FPGA FIFO overflowed since the tester was last turned on. The number of errors can be seen in the Status tab.</td></tr>
<tr><td>Bits 0-7</td><td>reserved</td></tr>
<tr><td>2</td><td>inputs</td><td colspan="2">Bit n is the state of AUX input n at the start of the time slot.</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><td></td><td><table><tr><td>3</td><td>outputs</td><td>Bit n is the state of AUX output n at the start of the time slot.</td></tr></table></td></tr>
<tr><td>Sample Flags</td><td>A 4-byte channel that includes the following information:
<table>
<tr><th>BYTE</th><th>BIT</th><th>DESC</th></tr>
<tr><td rowspan="5">0</td><td>0</td><td>1 if a probe is attached, 0 otherwise.</td></tr>
<tr><td>1</td><td>1 if a probe has been changed.</td></tr>
<tr><td>2</td><td>Sore Data</td></tr>
<tr><td>3:4</td><td>RPC Speed</td></tr>
<tr><td>5:7</td><td>reserved</td></tr>
<tr><td>1</td><td>0:7</td><td>reserved</td></tr>
<tr><td>2</td><td>0:7</td><td>reserved</td></tr>
<tr><td>3</td><td>0:7</td><td>reserved</td></tr>
</table></td></tr>
</table>

3.4.6 Main Configuration Table

The **Main Config** table is used to enter frequencies, drive strengths, and configure the channels.



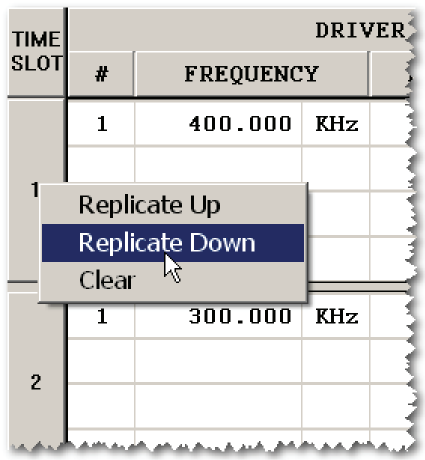


TIME SLOT	DRIVER #	DRIVER FREQUENCY		DRIVER PHASE	DRIVER DRIVE	COMPENSATOR PHASE	COMPENSATOR DRIVE	COIL 1	COIL 2	COIL 3	COIL 4	COIL 5	COIL 6	COIL 7	COIL 8
1	1	400.000	KHz	0.000°	100.00%	158.751°	82.60%	1	2						
2	1	300.000	KHz	0.000°	100.00%	173.236°	87.07%	3	4						
3	1	100.000	KHz	0.000°	100.00%	216.712°	60.86%	5	6						
4	1	25.000	KHz	0.000°	100.00%	231.258°	23.11%	7	8						

The exact appearance will depend upon the **View** menu settings (see **View Menu** on page 39). The example above is configured for 4 time slots, 4 slices per slot, and view compensator on. The columns are defined as follows:

<table>
<tr>
<td>TIME SLOT</td>
<td>In multiplex mode, each sample is divided into time slots (the maximum is 16). Each time slot is divided into up to 4 time slices, each with its own frequency. The frequencies within a time slot are simultaneously injected into the probe.

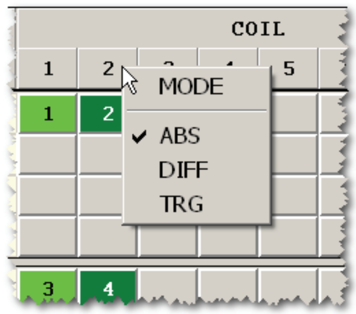
Right-click on a time slot cell to popup a menu to perform certain operations:



<table>
<tr><td>Replicate Up</td><td>Copy the current time slot settings to all slots above it in the table.</td></tr>
<tr><td>Replicate Down</td><td>Copy the current time slot settings to all slots below it in the table.</td></tr>
<tr><td>Clear</td><td>Clears all settings.</td></tr>
</table>
All of these actions can be undone using the Edit | Undo command.</td>
</tr>
<tr>
<td>DRIVE #</td>
<td>The output driver used to generate the signals for that time slice. Mouse-click in the cell to change the value. Only drivers 1 and 3 are available for end-users. Drivers 2 and 4 are used to create absolute reference signals.</td>
</tr>
<tr>
<td>DRIVER FREQUENCY</td>
<td>The frequency that is output by the given driver for this time slice during this time slot. The actual wave form produced during that time slot for the given driver is the sum of all the time slices and can be viewed in the Waveform tab.

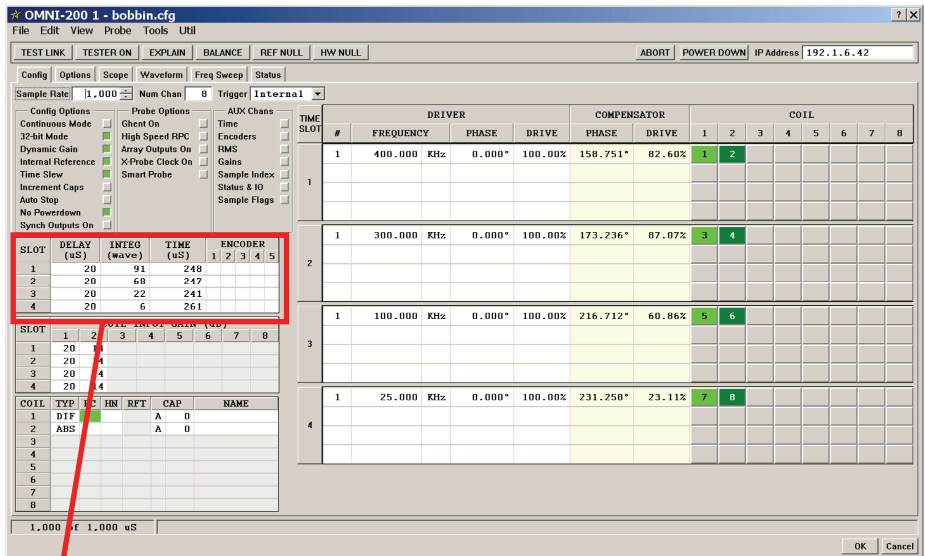
The frequency can be changed via standard mouse clicks. If you click to the left of the decimal point, it will change the integral part of the frequency while clicking to the right will change the</td>
</tr>
</table>

	fractional part. Clicking on the units will change the units to Hz, KHz, or MHz. All of the frequencies in a given time slot must be compatible. The fundamental frequency is the lowest frequency in that slot divided by the number of waves specified in the **INTEG (wave)** column of the **Delay** table (see **Delay Table** on page 58). All frequencies must be an integral multiple of the fundamental. If they are not, the incompatible frequencies are displayed in red and the **EXPLAIN** button can be used to show the reason.
DRIVER PHASE	The phase offset of the wave for this time slice. This column is only visible if **View | Phase Offset** is checked. These values are typically left at zero, but with simultaneous injection, it may be possible to increase the available driver gain beyond 100% by adjusting the phase of certain components.
DRIVER DRIVE	The actual drive voltage as a percent of the maximum. The total drive must not exceed 100% of the drivers maximum output. However, this does not necessarily mean that the sum of the driver values for the given slot must be less than or equal to 100%. By adjusting the phase offsets, it is often possible to get slightly more gain for certain components.
COMPENSATOR PHASE	This is the phase offset used by the compensator to create the absolute reference. The values in the **COMPENSATOR PHASE** and **GAIN** columns are computed when the **REF NULL** button is clicked (see **Toolbar Left** on page 43). These values are editable to optimize the absolute channels, but this is usually not required.
COMPENSATOR DRIVE	This is the drive value used by the compensator to create the absolute reference.
COIL 1 to 8	Each of the eight columns corresponds to an OMNI-200 input coil. Click a cell to create an eddy current channel for that coil during that time slice. The number in the cell corresponds to the eddy current channel number shown in the acquisition & analysis software. Right-click in a coil number to display a menu used to select the type of coil:

	 When using **Internal Reference**, it is important that the absolute coil is properly configured. Left-click in a coil number to turn all cells in that column on or off. If you have not specified a nonzero frequency, the cell will be displayed in red. If you have not specified the type of coil, it will be shown in yellow.

3.4.7 Delay Table

Use the **Delay** table to optimize time usage during data acquisition.



SLOT	DELAY (uS)	INTEG (wave)	TIME (uS)	ENCODER 1	ENCODER 2	ENCODER 3	ENCODER 4	ENCODER 5
1	20	91	248					
2	20	68	247					
3	20	22	241					
4	20	6	261					

It has the following columns:

SLOT	The time slot of this row of the table. The number of rows matches the number of time slots chosen in the **View | Number of Slots** menu.
DELAY (µs)	The time, in µs, to wait after the driver is turned on for this time slot and to when the demodulation begins. In multiplex mode, this allows time for the wave to settle in the tube. In continuous mode, the output is always left on an this value can be set to the minimum of 1. You can use the **Scope** tab, which shows the actual probe signal, to

	determine how much time is required (see **Scope Tab** on page 68).
INTEG (wave)	The number of waves over which demodulation is performed during that slot. Higher numbers yield cleaner data due to noise averaging, but reduce the maximum sample rate and reduce the bandwidth.
TIME (µs)	A read-only field that shows the total duration of the time slot. It includes the delay, demodulation, and overhead time. If the total time available has been exceeded, this column will be red.
ENCODER 1 to 5	If encoders are enabled in the **AUX Chans** section, these cells indicate which encoders are active during each time slot. Click on a cell to activate it. Active encoders are shown in green. Click on an active encoder to deactivate it. If encoders have not been enabled in the **AUX Chans** section, cells will be colored red.

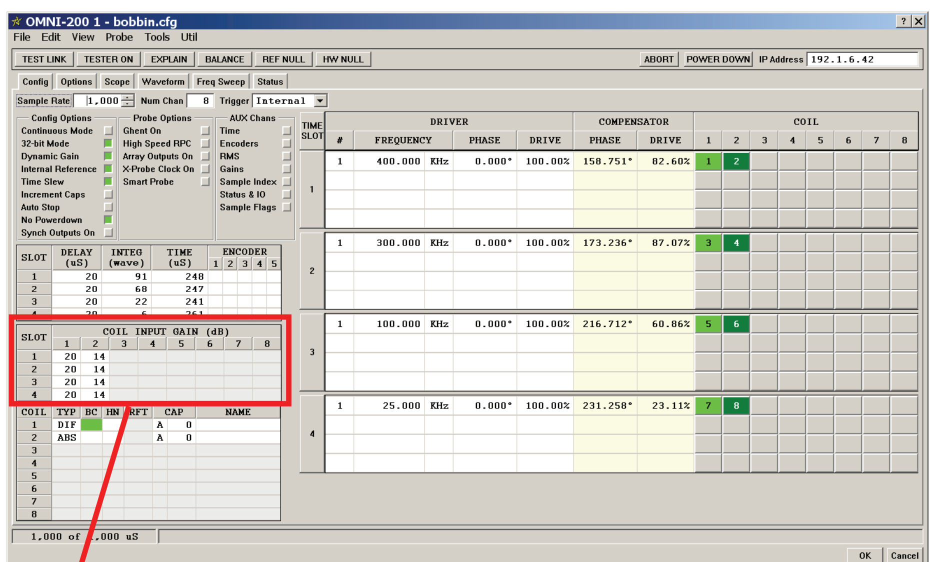
Clicking in the heading of a column modified all cells in the column.

3.4.8 Coil Input Gain Table

Use this table to set the input amplification for each coil. It is desirable to set the gain as large as possible to improve signal to noise. However, too high a value may cause some signals to saturate.

If **Dynamic Gain** is off (which is not recommended), the gain values are fixed at the values shown in the table. If **Dynamic Gain** is on, the values are the maximum values. For each sample, the tester examines the size of the signal coming into the ADC and steps the gain down as required in order to avoid saturation. A multiplication factor is applied to the final x, y value to scale it back up so that all samples are effectively at the same gain value. These numbers come from the gain calibration tables stored in the tester during manufacturing (see **Gain Calibration Tool** on page 88).

Internally, the OMNI-200 processes all signals as 32-bit data. However, some third party programs require 16-bit data. In 16-bit mode, the 32-bit x, y values are limited to the signed 16-bit range. Thus, even with **Dynamic Gain** on, it is possible to have saturated signals and it may be necessary to limit the maximum gain. But in 32-bit mode with **Dynamic Gain** on, it is almost impossible to saturate and we recommend setting the gains to the maximum.



SLOT	COIL INPUT GAIN (dB)							
	1	2	3	4	5	6	7	8
1	20	14						
2	20	14						
3	20	14						
4	20	14						

Mouse-click in the cell for a given slot and coil to change the gain. Mouse-click in the column heading to change the gain for the given coil for all time slots at once.

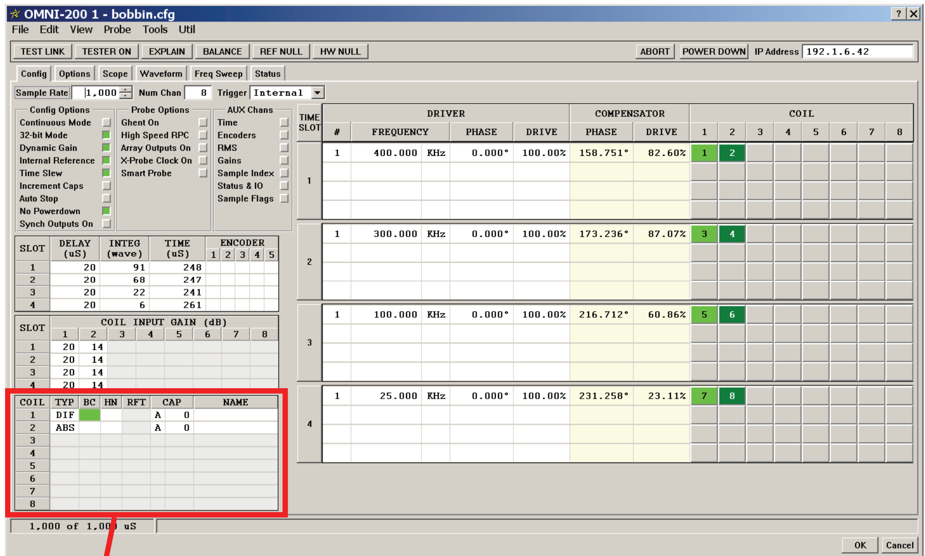
The recommended rules of thumb for the coil input gain are:

1. Always use **Dynamic Gain**.

2. Use 32-bit mode when using EddyVision **Acquisition & Analysis** and set the gains to the maximum value.

3.4.9 Coil Config Table

Use this table to configure various options for each coil.



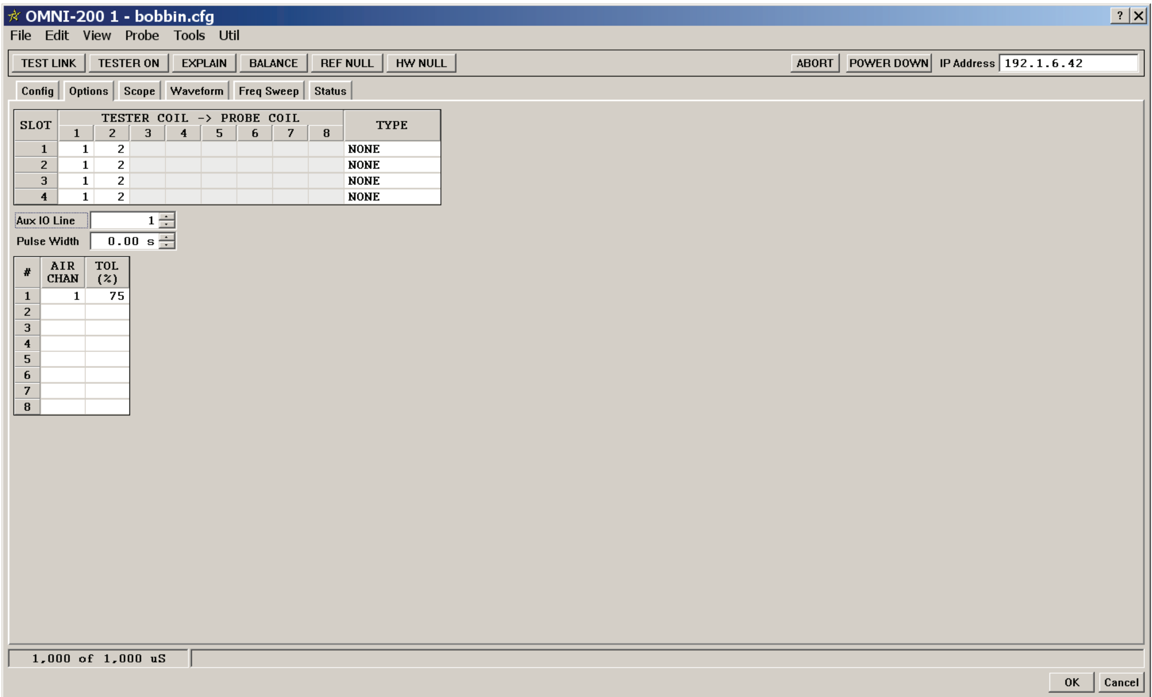
COIL	TYP	BC	HN	RFT	CAP		NAME
1	DIF				A	0	
2	ABS				A	0	
3							
4							
5							
6							
7							
8							

COIL	The coil to configure.
TYP	Configure the type of the coil: **ABS** - Absolute coil **DIF** - Differential **TRG** - Trigger

	This can also be done by right-clicking in the coil of the **Main Config** table.
BC	**B**alance **C**oil if enabled. This coil will be balanced when **BALANCE** is clicked (see **Toolbar Left** on page 43).
HN	**H**ardware **N**ull this coil if enabled. A hardware null will be performed on this coil when the **HW NULL** button is clicked (see **Toolbar Left** on page 43).
RFT	Sets the RFT gain value. This is an extra gain stage in the RFT module.
CAP	The OMNI-200 can apply a capacitance to one side or the other of a probe coil in order to balance the impedance (see **Toolbar Left** on page 43). This column shows the results. It can also be changed manually by clicking in a cell or the heading.
NAME	Enter a text label here to identify a coil if desired. This is not currently used in the acquisition & analysis software.

3.5 Options Tab

The **Options** tab shows miscellaneous settings for the tester.



3.5.1 Coil Mapping Table

This table is used to map physical tester coils to logical probe coils. For most probes this is a one-to-one mapping, which is the default, and need not be modified (see below).

SLOT	TESTER COIL -> PROBE COIL								TYPE
	1	2	3	4	5	6	7	8	
1	1	2							NONE
2	1	2							NONE
3	1	2							NONE
4	1	2							NONE

For array probes, where the physical probe coil changes based on the time slot, you must use this table to set the mapping. For example, for the MHI Intelligent probe, which has 24 array coils and 2 bobbin coils, the mapping looks like this:

SLOT	TESTER COIL -> PROBE COIL								TYPE
	1	2	3	4	5	6	7	8	
1						1	9	17	ARRAY
2						5	13	21	ARRAY
3						2	10	18	ARRAY
4						6	14	22	ARRAY
5						3	11	19	ARRAY
6						7	15	23	ARRAY
7						4	12	20	ARRAY
8						8	16	24	ARRAY
9	25	26							BOBBIN
10	25	26							BOBBIN
11	25	26							BOBBIN
12	25	26							BOBBIN

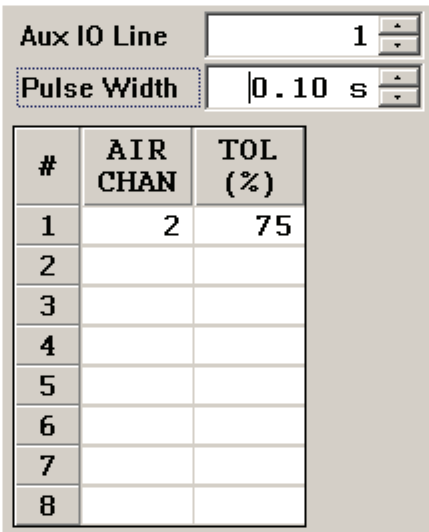
In this case, for example, in time slot 3, tester coil 8 corresponds with probe coil 18. The coil displayed in the lissajous and other areas of the **Acquisition & Analysis** software is the probe coil, not the tester coil.

The values in the table can be modified by clicking in a cell or the heading. For certain special probes, such as the I-Probe, the values can be set automatically using the **Probe** menu.

3.5.2 Air Out Table

This section configures the OMNI-200 air detection. When the tester determines that the probe is in air, it can drive one of the Aux IO lines high.

In the example below, if either the x or y value on channel 2 exceeds 75% of the range of a 16-bit integer, then AUX IO line 1 will go high and remain high for a minimum of 0.1 seconds.



The **Air Out** section has the following fields:

Aux IO Line	The physical IO line on the front panel of the tester to use for AIR OUT (see XXX). If set to **NONE**, no signal will be output on the front-panel, however, the AIR signal between the OMNI-200 tester-in-pusher and TrackDrive-200 Galil control board will still be driven (see XXX).
Pulse Width	The minimum duration of the AIR OUT signal.

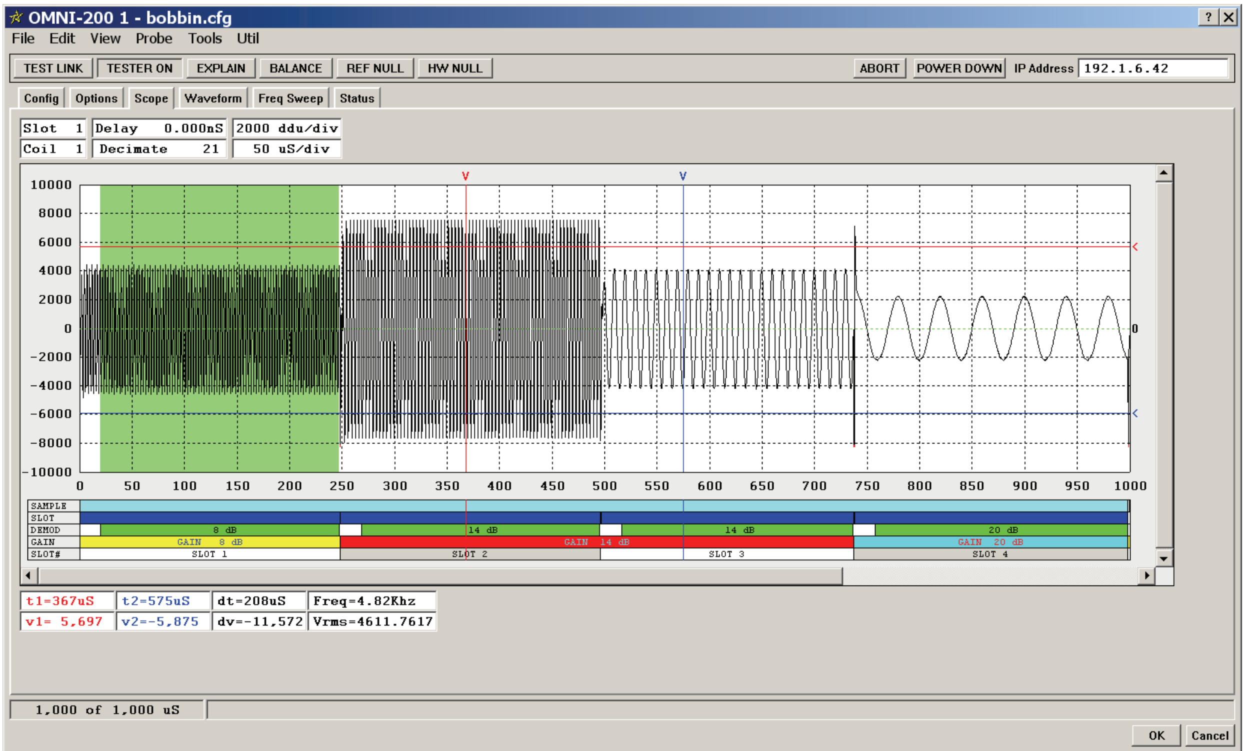
The **Air Channel** table configures which eddy current signals are used to detect air. The AIR OUT signal will be asserted if any of the eight channels is in air. This has the following columns:

#	The line of the table.
AIR CHAN	The eddy current channel to monitor. These are the same numbers displayed in the cells of the **Main Config** table.

TOL (%)	Assert the AIR OUT signal if either the x or y values exceeds this percentage of a 16-bit signed integer.

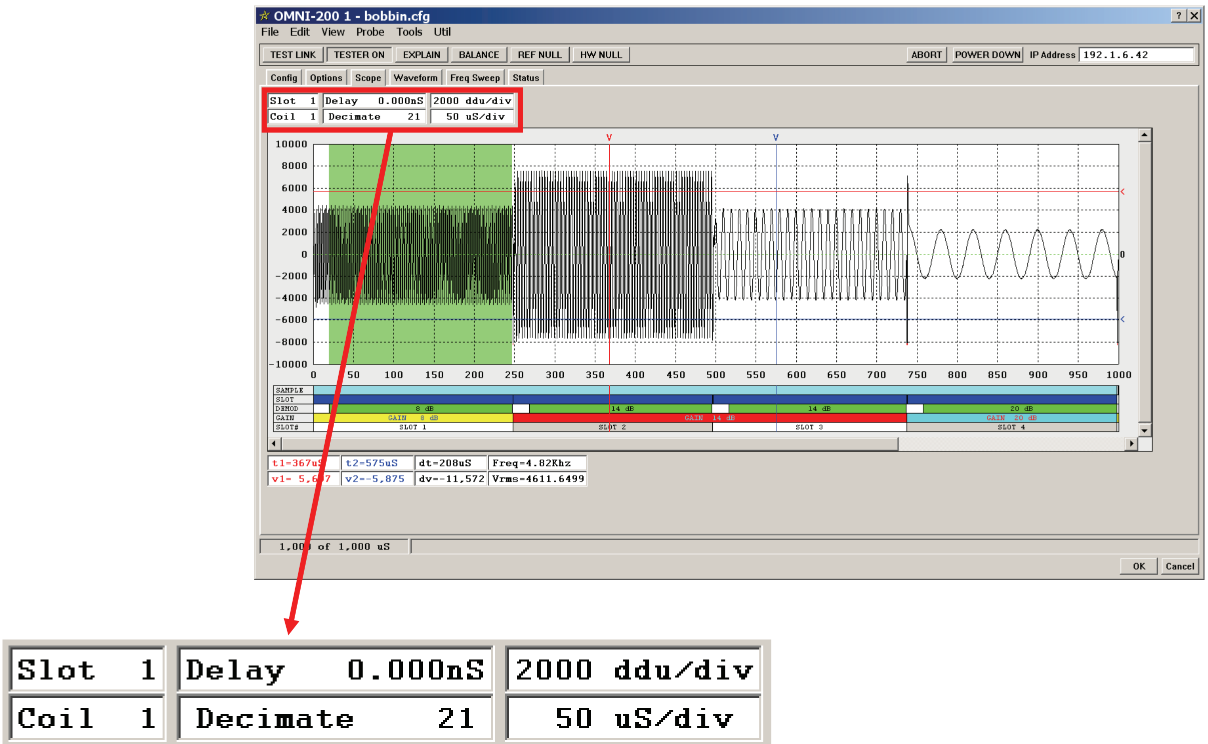
3.6 Scope Tab

The **Scope** tab presents an oscilloscope style display of the signals being received by the tester coil inputs. The actual digital outputs of the coil ADC are shown along with other information about the current configuration. For the Scope to function, the software must be properly configured to communicate with the tester and the **TESTER ON** button must be clicked.



3.6.1 Scope Chart Display Parameters

Directly above the chart are a number of fields that determine what data is displayed.



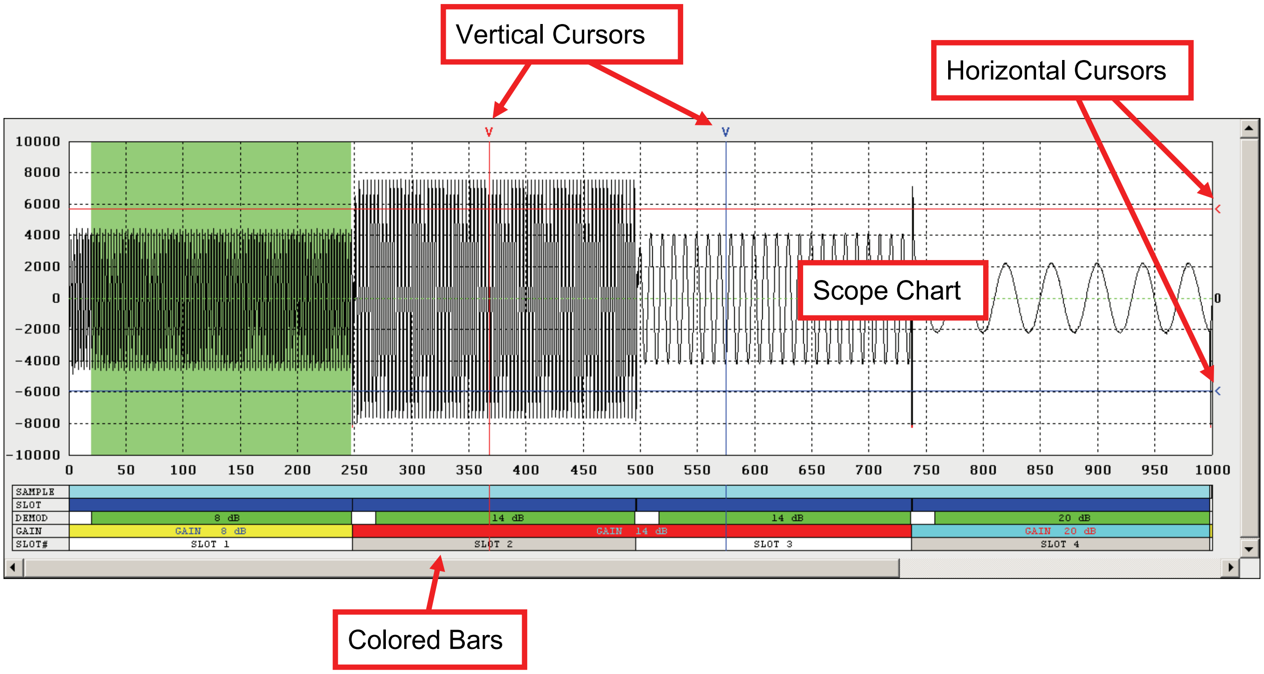
These fields are defined as:

Slot	The time slot that is currently selected for viewing.
Delay	The delay in ns from the start of the time slot to the start of scope sampling.
ddu/div	The number of ADC digital data units per vertical division on the chart.
Coil	The tester coil currently selected for viewing.
Decimate	The scope can store a maximum of 4096 ADC samples. Since the clock rate of the OMNI-200 is 66 MHz, this would only allow for 62 µs of total storage time. To overcome this limitation, decimation can be used to skip samples. If it is zero, all samples are stored, if it is 1, every other sample is stored. Higher values allow you to see a longer time period, but reduce the resolution at which you are

	seeing it.
µs/div	The number of µs per horizontal division on the chart.

3.6.2 Scope Chart

The **Scope Chart** shows the actual data along with cursors to make measurements and colored bars to display information about a given time period.



The **Scope** chart has two vertical and two horizontal cursors. If the cursors are not visible, click in the light gray region above the chart to turn on the vertical cursors, and in the light gray region to the right of the chart for the horizontal cursors. Click and drag an existing cursor to move it. Middle-click on a cursor to remove it.

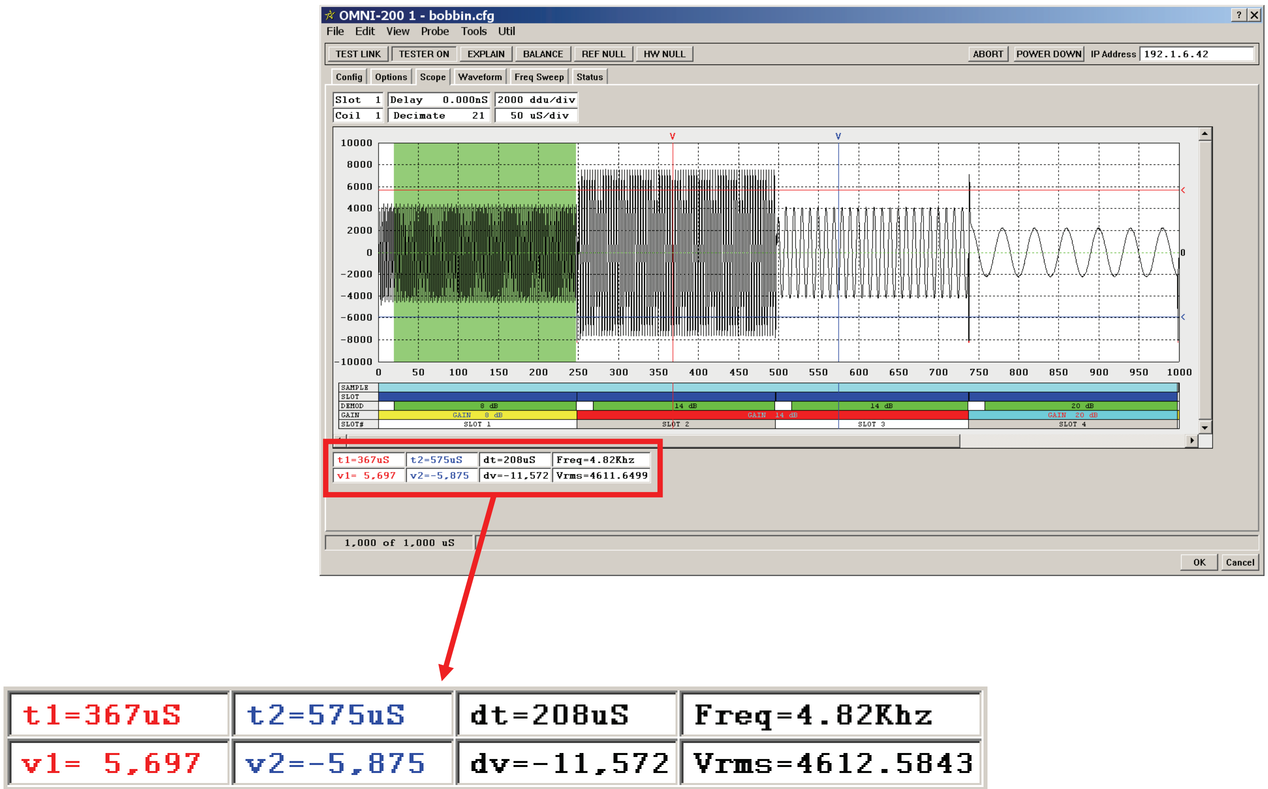
At the bottom of the chart there are a series of colored bars that show information about that time period. The lines are:

SAMPLE	Blue during times when the sample is being taken. Note that the length of the segment closely matches the amount of time used shown in the **Time Used** status display in the lower left part of the dialog. In the case above, the vertical blue cursor is at t2 = 941 µs and the time used is 944 µs.
SLOT	Dark blue when a slot is being processed.
DEMOD	Green during the demodulation phase of each slot. The text within a bar shows the dynamic gain setting.

GAIN	The dynamic gain setting at the given time.
SLOT #	The time slot number at the given time.

3.6.3 Scope Chart Measurements

Directly below the chart are the fields that display the cursor measurements.



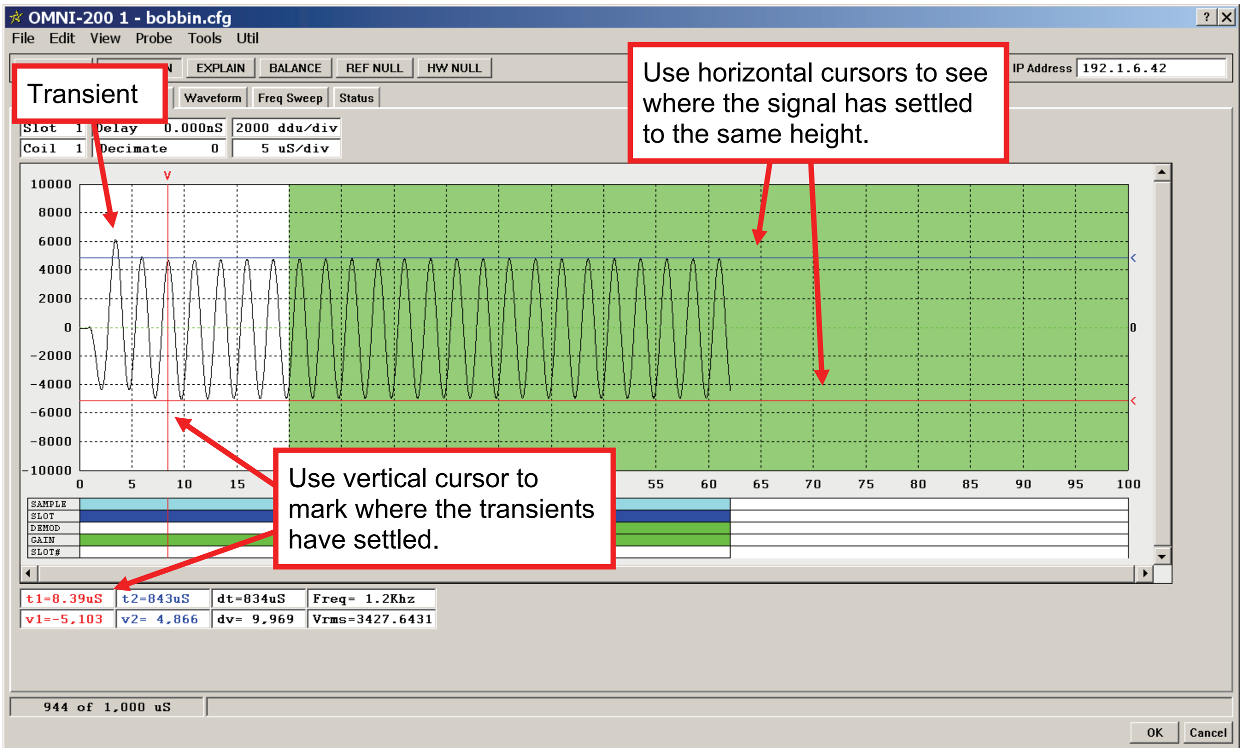
These fields are defined as follows:

t1	The time value of the red vertical cursor.
t2	The time value of the blue vertical cursor.
dt	dt = t2 – t1 if both vertical cursors are displayed.
Freq	Freq = 1.0 / dt. This can be used to verify the frequency of a signal.
v1	The voltage, in ddu, of the red horizontal cursor.
v2	The voltage, in ddu, of the blue horizontal cursor.
dv	dv = v2 – v1 if both horizontal cursors are displayed.
Vrms	The root-mean-square voltage of the signal between the two

	vertical cursors.

3.6.4 Using the Scope to Determine Delay Values

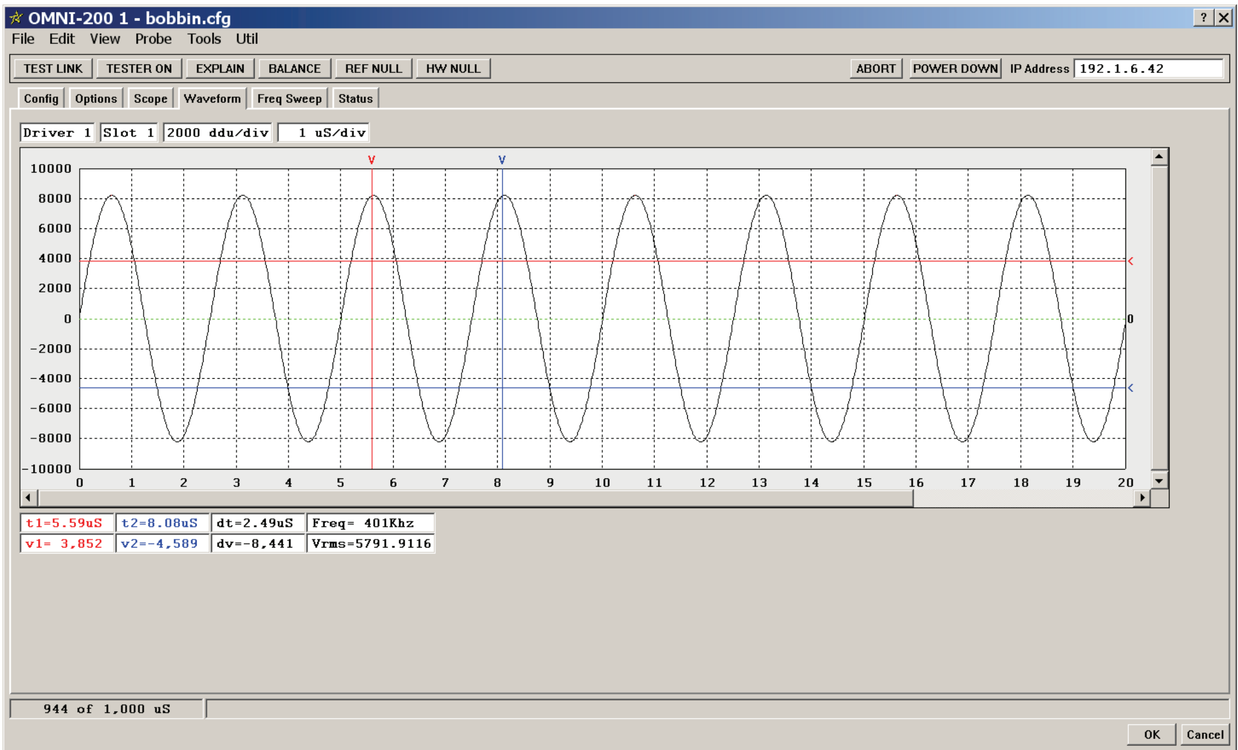
The Scope has many uses. One of the most important is to determine good values for the delay settings (see **Delay Table** on page 58). In the picture below, we can see that the signal has settled after about 8.4 µs on coil 1.



It's important to check all the coils. In this case, about 10 µs would have been enough settling time and the delays for slot 1 could have been set to 10.

3.7 Waveform Tab

This tab displays the waveform that will be output to the probe for a particular driver during a given time slot. This is a mathematical representation only and is based on the configuration settings, including frequency, drive, and phase offset, in the **Main Config** table.



The cursors and associated information work the same way as in the **Scope** tab (see **Scope Tab** on page 68). The fields above the chart are:

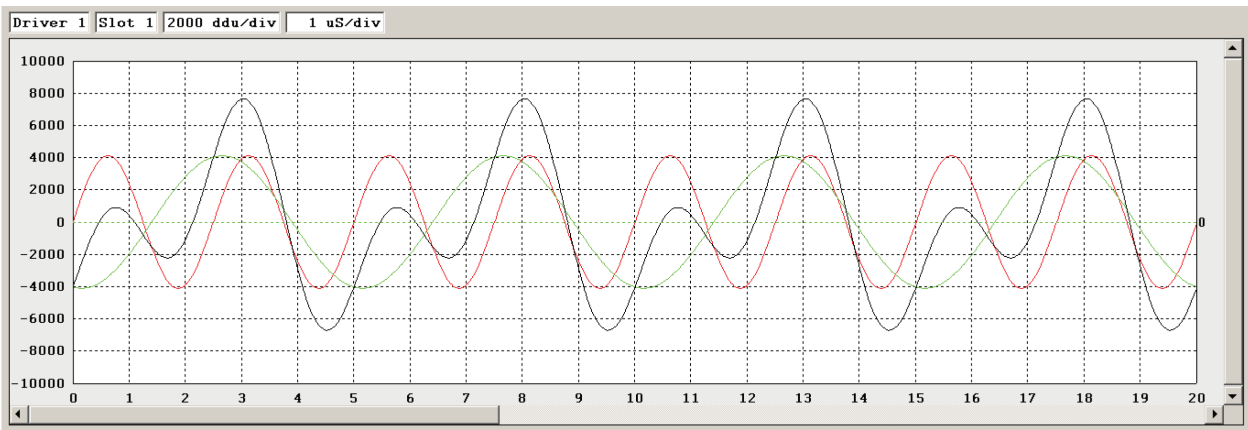
Driver	Choose the driver to display.
Slot	The time slot to view.
ddu/div	The number of digital data units (ddu) in each vertical division.
µs/div	The number of µs per horizontal division of the chart.

3.7.1 Simultaneous Injection Waveforms

The Waveform tab is most useful when using simultaneous injection. For example, if we configure two frequencies in time slot 1 as shown:

TIME SLOT	DRIVER				COIL							
	#	FREQUENCY	PHASE	DRIVE	1	2	3	4	5	6	7	8
1	1	400.000 KHz	0.000°	50.00%	1	2						
	1	200.000 KHz	101.000°	50.00%	3	4						

the waveform will appear as follows:

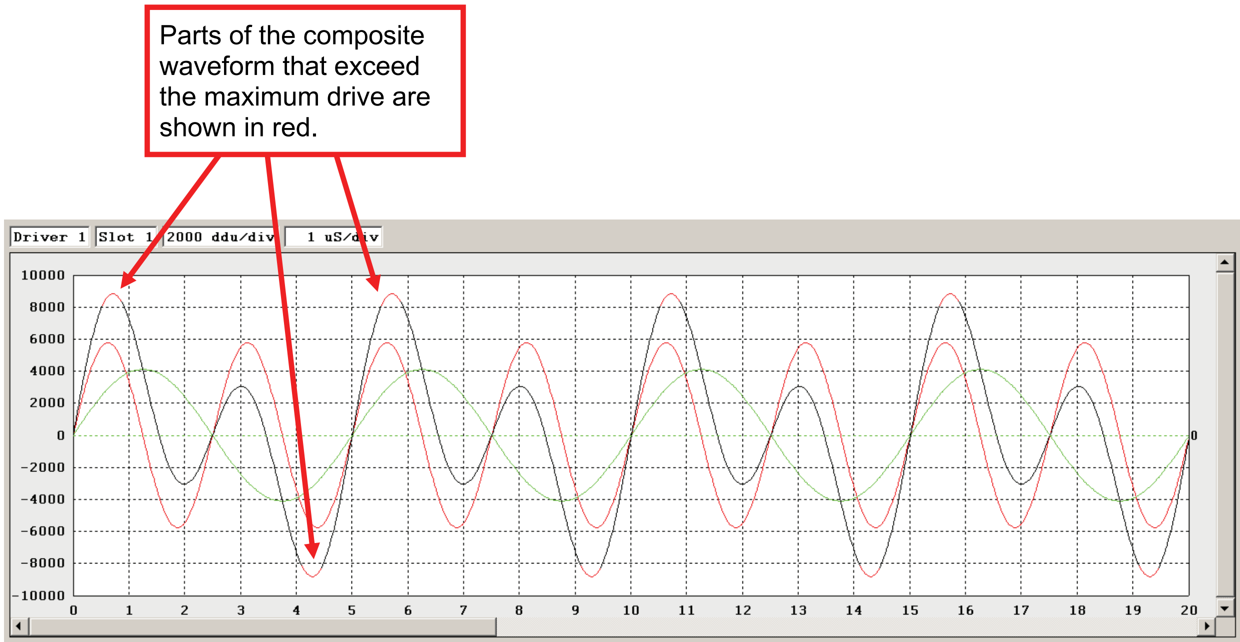


The individual components are shown in color (in this case 200 KHz in green and 400 KHz in red) and the composite waveform is always shown in black. The composite waveform is the sum of all the time slices for that driver for that slot and is the signal that will actually be driven to the probe.

If the total drive is too high, as is the case with the config below:

TIME SLOT	DRIVER				COIL							
	#	FREQUENCY	PHASE	DRIVE	1	2	3	4	5	6	7	8
1	1	400.000 KHz	0.000°	70.00%	1	2						
	1	200.000 KHz	0.000°	50.00%	3	4						

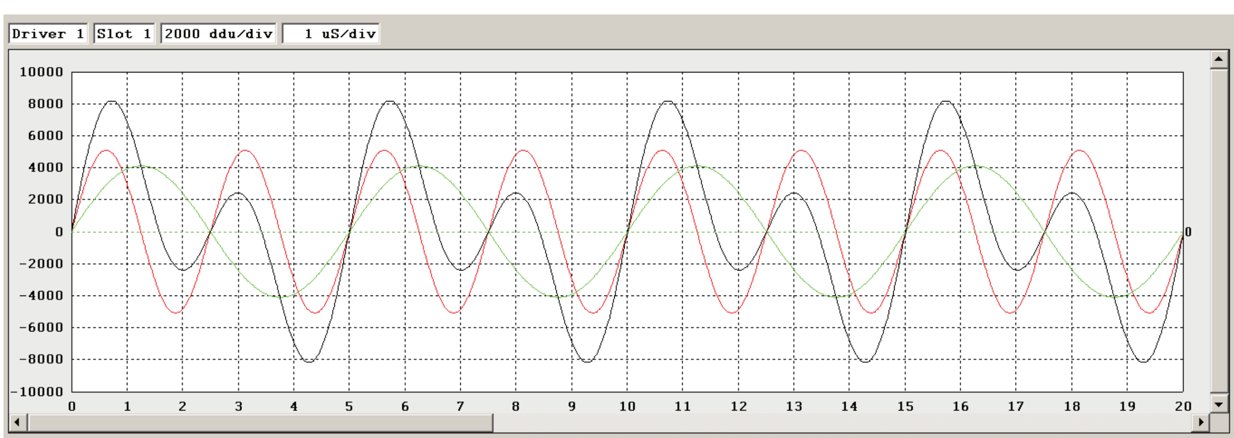
the parts of the waveform that exceed the maximum drive will be shown in red:



However, it is important to note that the sum of the drives is not necessarily limited to 100%. For example, the following, where the total is 112%, is fine:

TIME SLOT	DRIVER #	FREQUENCY		PHASE	DRIVE	COIL 1	2	3	4	5	6	7	8
1	1	400.000	KHz	0.000°	62.00%	1	2						
	1	200.000	KHz	0.000°	50.00%	3	4						

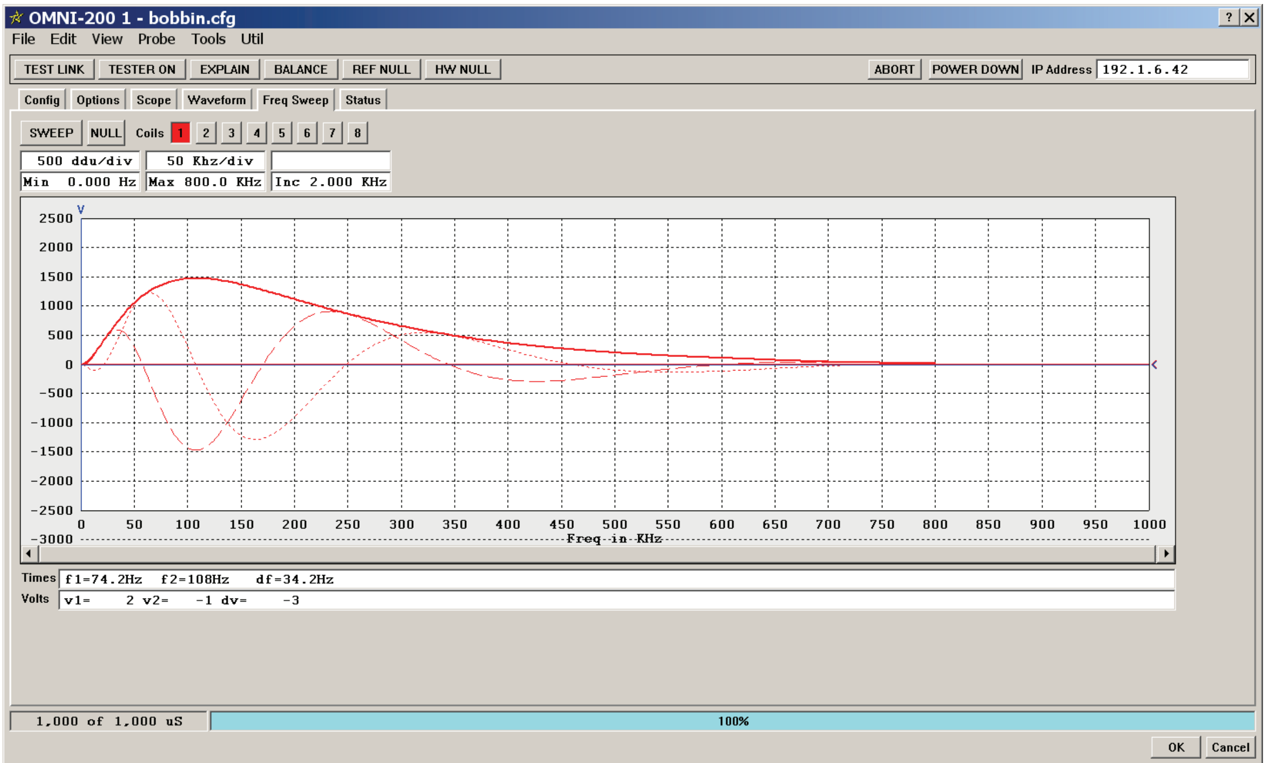
This occurs because the peaks of the individual components do not occur at the same time:



In some cases it is also possible to adjust the phase offsets of some components in order to move the humps and increase the drive.

3.8 *Frequency Sweep Tab*

This tab is used to perform a frequency sweep of the probe and material under inspection. This can be used to determine the resonant frequency and optimum test frequencies.



3.8.1 Frequency Sweep Controls

There are a number of buttons above the frequency sweep chart that control the display and perform the sweep:

SWEEP	Click this button to perform that actual frequency sweep. It will not be active until the NULL step has been performed.
NULL	Click this button to compute the baseline impedance at each frequency.

COILS 1 to 8	Click these buttons to determine which coils will be displayed. The color of the button is the same as the color of that coils plot. For example, coil 1 is red and its sweep results are shown in red in the chart.
ddu/div	Click to adjust the number of digital data units per vertical division.
KHz/div	Click to adjust the frequency increment in each horizontal division of the plot.
Min	Click to adjust the starting frequency of the sweep.
Max	Click to adjust the ending frequency of the sweep.
Inc	Click to adjust the frequency increment of the sweep. The sweep will start at the **Min** value and increment by this amount until the **Max** value is reached.

3.8.2 Performing a Frequency Sweep

1. Select which coils to display by clicking on the coil number. In this case, only coil 1 is selected.

2. Select the frequency range by choosing a **Min** frequency, **Max** frequency, and **Inc**. Make sure the **Inc** is not too small or the sweep will take a very long time.

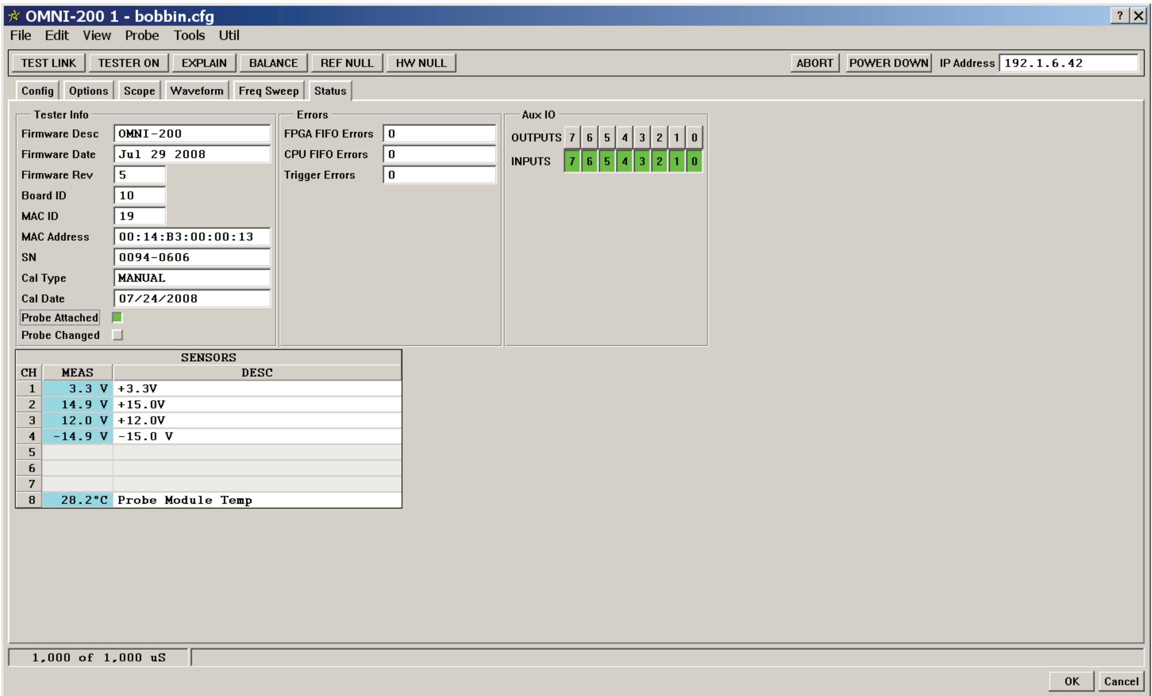
3. Move the probe to a clean section of tubing and click **NULL**. The percentage done will be displayed in the status bar but nothing will be displayed in the chart at this point.

4. Move the probe near a defect and click **SWEEP**. Once the sweep is complete, the impedance at each frequency will be displayed.

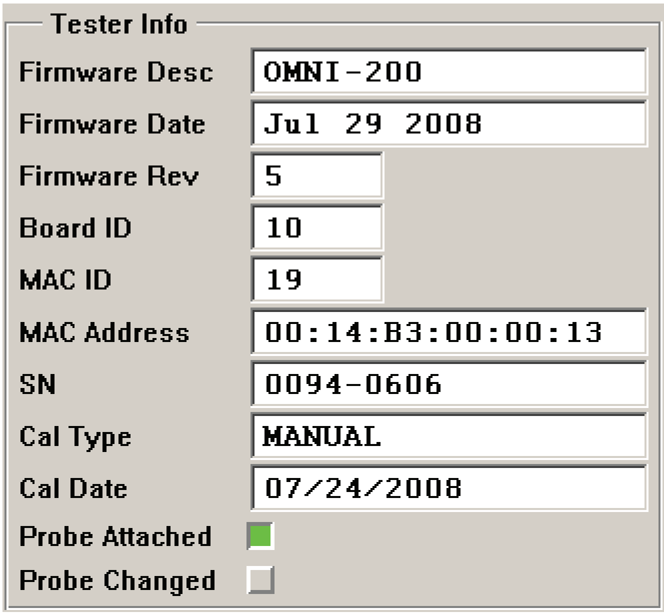
In this case, the resonant point is around 100 KHz.

3.9 Status Tab

This tab displays various status information read from the tester. The information is read once per second and you will receive errors if the software cannot communicate with the tester.



3.9.1 Tester Info

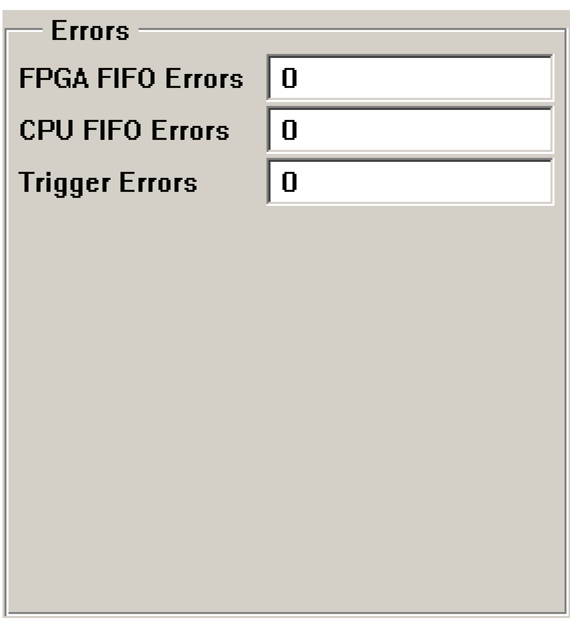


This frame displays the following information:

Firmware Desc	This will always be **OMNI-200**.
Firmware Date	The creation date of the firmware that is stored in the tester.
Firmware Rev	The revision number of the firmware that is stored in the tester. This must be compatible with the software used to communicate with tester.
Board ID	The OMNI-200 supports a variety of probe modules. Each has a unique ID number that enables the configuration software to identify it and its capabilities (see XXX).
MAC ID	The last two segments of the testers Ethernet MAC address expressed as a decimal number.
MAC Address	The Ethernet MAC address of the tester.
SN	The serial number of the tester that is assigned during manufacturing. It can also be modified using the CoreStar OMNI-200 ASME/JEAG calibration software.
Cal Type	The type of calibration most recently performed on the tester.

	Possible values are: • MANUAL • ASME • JEAG If the tester was calibrated with the **OMNI-200 ASME/JEAG Calibration** software, the type will be ASME or JEAG. Otherwise, it will be MANUAL.
Cal Date	The date the latest calibration was done.
Probe Attached	ON if a probe is attached and OFF otherwise. For units other than tester-in-pusher, this is always ON.
Probe Changed	ON if the probe was removed since the last time the tester was turned on. If it has been changed, you may need to rerun the standard pulls. This feature only functions on tester-in-pusher units.

3.9.2 Errors



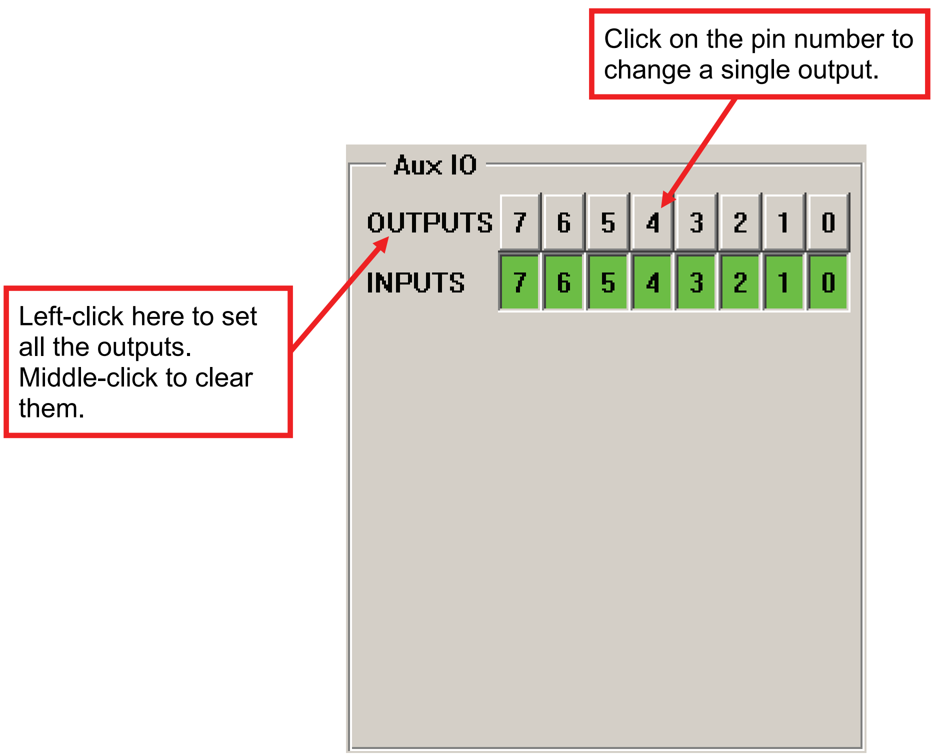
FPGA FIFO Errors	The number of times the **F**irst **I**n **F**irst **O**ut (FIFO) buffer of the FPGA has overflowed since the last time the tester was turned on.

CPU FIFO Errors	The number of times the FIFO in the testers CPU has overflowed since the last time the tester was turned on.
Trigger Errors	These only occur if the tester is triggered externally or by encoder. If the triggers occur more quickly than the maximum sample rate for the current configuration, the sample will be missed and the error count is incremented.

WARNING: Using the Scope tab will cause FPGA and CPU FIFO errors since the tester is on but the data is not being read. These errors are not important and will be cleared the next time the tester is turned on.

3.9.3 Aux IO

This section displays the current state of the testers auxiliary IO lines. If a line is high, it will be shown depressed and green.



OUTPUTS 7 to 0	Displays the status of the output lines. The user can also click on a line to toggle its state.

	Left-click on **OUTPUTS** to make them all high. Middle-click to make them all low.
INPUTS 7 to 0	A read-only display of the status of the input pins. If nothing is connected, these are all pulled high.

3.9.4 Sensors

This section displays the current value of the OMNI-200 voltage and temperature sensors.

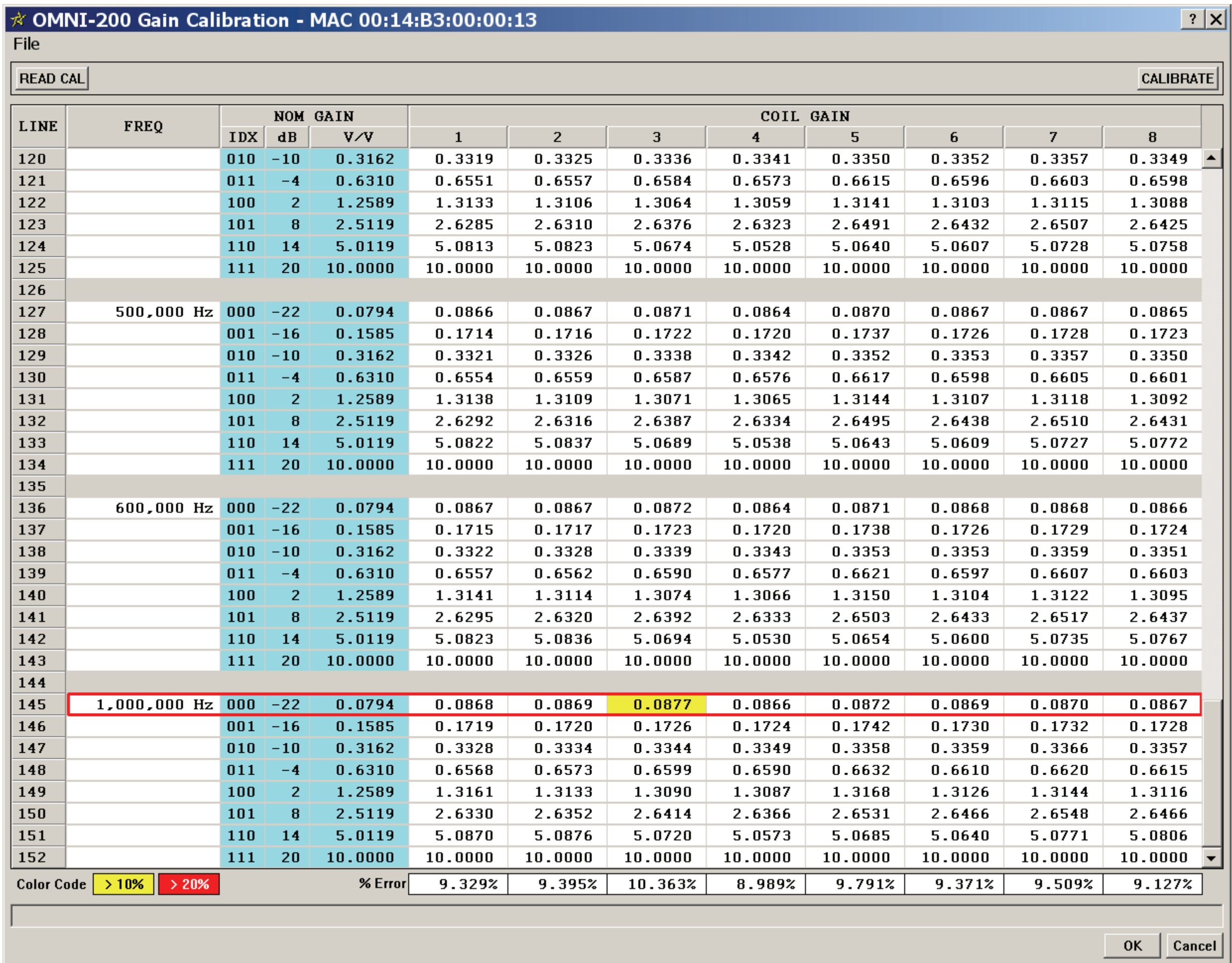
SENSORS		
CH	MEAS	DESC
1	3.3 V	+3.3V
2	14.9 V	+15.0V
3	12.0 V	+12.0V
4	-14.9 V	-15.0 V
5		
6		
7		
8	28.1°C	Probe Module Temp

CH	The sensor channel.
MEAS	The current value
DESC	A description of the sensor channel or the expected value.

If the measured value is outside the acceptable range, it will be shown in red.

4 Gain Calibration Tool

This tool is used to calibrate the OMNI-200 dynamic gain amplifiers and display the results. It can be accessed using the **Gain Cal** choice from the **Tools** menu. This tool is normally only used during manufacturing and is not typically needed by users.



LINE	FREQ	NOM GAIN			COIL GAIN							
		IDX	dB	V/V	1	2	3	4	5	6	7	8
120		010	-10	0.3162	0.3319	0.3325	0.3336	0.3341	0.3350	0.3352	0.3357	0.3349
121		011	-4	0.6310	0.6551	0.6557	0.6584	0.6573	0.6615	0.6596	0.6603	0.6598
122		100	2	1.2589	1.3133	1.3106	1.3064	1.3059	1.3141	1.3103	1.3115	1.3088
123		101	8	2.5119	2.6285	2.6310	2.6376	2.6323	2.6491	2.6432	2.6507	2.6425
124		110	14	5.0119	5.0813	5.0823	5.0674	5.0528	5.0640	5.0607	5.0728	5.0758
125		111	20	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000
126												
127	500,000 Hz	000	-22	0.0794	0.0866	0.0867	0.0871	0.0864	0.0870	0.0867	0.0867	0.0865
128		001	-16	0.1585	0.1714	0.1716	0.1722	0.1720	0.1737	0.1726	0.1728	0.1723
129		010	-10	0.3162	0.3321	0.3326	0.3338	0.3342	0.3352	0.3353	0.3357	0.3350
130		011	-4	0.6310	0.6554	0.6559	0.6587	0.6576	0.6617	0.6598	0.6605	0.6601
131		100	2	1.2589	1.3138	1.3109	1.3071	1.3065	1.3144	1.3107	1.3118	1.3092
132		101	8	2.5119	2.6292	2.6316	2.6387	2.6334	2.6495	2.6438	2.6510	2.6431
133		110	14	5.0119	5.0822	5.0837	5.0689	5.0538	5.0643	5.0609	5.0727	5.0772
134		111	20	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000
135												
136	600,000 Hz	000	-22	0.0794	0.0867	0.0867	0.0872	0.0864	0.0871	0.0868	0.0868	0.0866
137		001	-16	0.1585	0.1715	0.1717	0.1723	0.1720	0.1738	0.1726	0.1729	0.1724
138		010	-10	0.3162	0.3322	0.3328	0.3339	0.3343	0.3353	0.3353	0.3359	0.3351
139		011	-4	0.6310	0.6557	0.6562	0.6590	0.6577	0.6621	0.6597	0.6607	0.6603
140		100	2	1.2589	1.3141	1.3114	1.3074	1.3066	1.3150	1.3104	1.3122	1.3095
141		101	8	2.5119	2.6295	2.6320	2.6392	2.6333	2.6503	2.6433	2.6517	2.6437
142		110	14	5.0119	5.0823	5.0836	5.0694	5.0530	5.0654	5.0600	5.0735	5.0767
143		111	20	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000
144												
145	1,000,000 Hz	000	-22	0.0794	0.0868	0.0869	0.0877	0.0866	0.0872	0.0869	0.0870	0.0867
146		001	-16	0.1585	0.1719	0.1720	0.1726	0.1724	0.1742	0.1730	0.1732	0.1728
147		010	-10	0.3162	0.3328	0.3334	0.3344	0.3349	0.3358	0.3359	0.3366	0.3357
148		011	-4	0.6310	0.6568	0.6573	0.6599	0.6590	0.6632	0.6610	0.6620	0.6615
149		100	2	1.2589	1.3161	1.3133	1.3090	1.3087	1.3168	1.3126	1.3144	1.3116
150		101	8	2.5119	2.6330	2.6352	2.6414	2.6366	2.6531	2.6466	2.6548	2.6466
151		110	14	5.0119	5.0870	5.0876	5.0720	5.0573	5.0685	5.0640	5.0771	5.0806
152		111	20	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000
				% Error	9.329%	9.395%	10.363%	8.989%	9.791%	9.371%	9.509%	9.127%

WARNING: The **Ok** and **Cancel** buttons in this tool simply close the dialog. The **Cancel** button will not undo the actions of the **CALIBRATE** button.

4.1 Gain Cal Menu

The only menu is the File menu:

Print	Print the table to a file.

Export	Export a text version of the calibration to a text editor.

4.2 Gain Cal Toolbar

The toolbar contains the following buttons:

READ CAL	When the tool is first displayed, it will be blank. Click this button to read the calibration information from the tester and display it in the table. The caption will display the MAC address of the tester.
CALIBRATE	Click to initiate the calibration. This requires the special gain calibration module, which has a **Board ID** of 0, and will have no effect if a standard probe module is attached. This is normally only done during manufacturing.

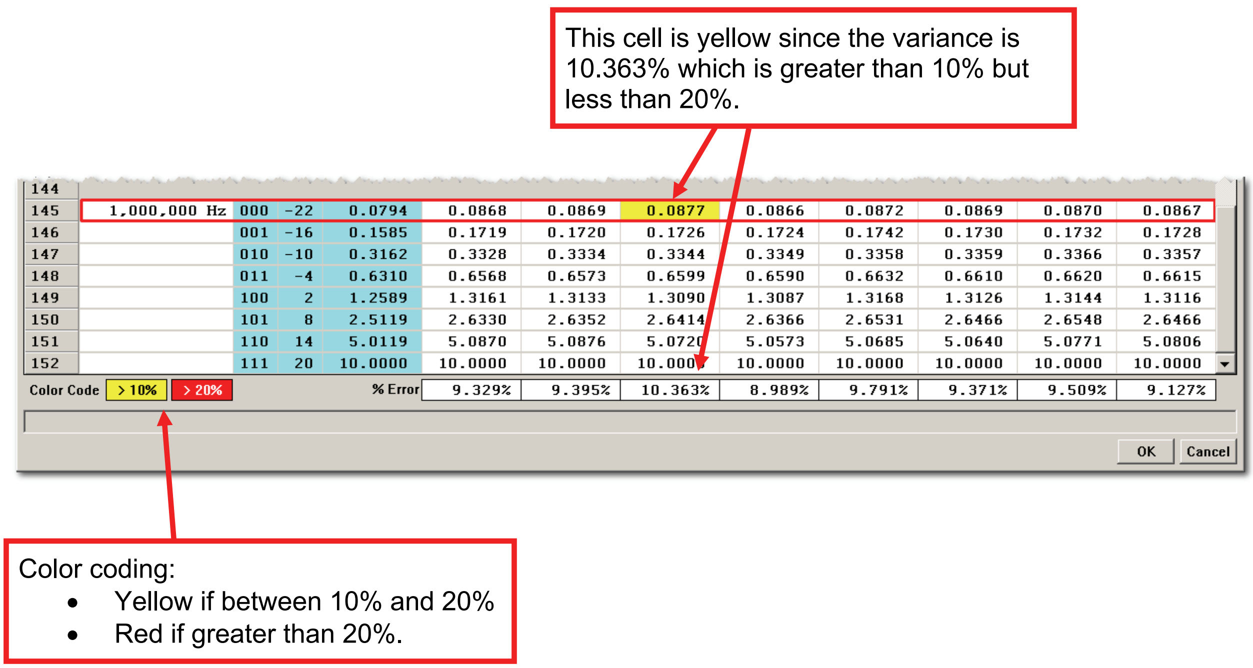
4.2.1 Gain Cal Table

The calibration table has the following fields:

LINE	An index number for that line of the table.
FREQ	The frequency at which that section of the calibration was performed. Whenever the user downloads a configuration, the section of the calibration with the closest frequency is used for dynamic gain corrections. In practice, the dynamic gain amplifiers have a nearly flat frequency response, but the calibration is done at a wide range of frequencies to produce the best possible results.
NOM GAIN IDX	The index, in binary, of the gain stage of the amplifier at that line of the table. The OMNI-200 dynamic gain amplifiers have eight stages.
NOM GAIN DB	The nominal gain, in dB, at that gain stage of the amplifier.
NOM GAIN V/V	The nominal gain, in terms of output divides by input, at that stage of the amplifier.

COIL GAIN 1 to 8	Each column displays the measured gain for that amplifier gain stage for that coil. Each cell is color coded based on the its variance from the nominal value. If it is white, it is within 10%. Otherwise, the color coding shown at the bottom of the table is used. A certain variation from the nominal is perfectly normal and not an issue for concern; that is the purpose of the calibration. If any cells are in red (i.e. greater than 20% error), that may be an issue for concern.

Clicking on a row in the table will highlight the row and display its variance from the nominal values below the table. For example, row 145 is selected above

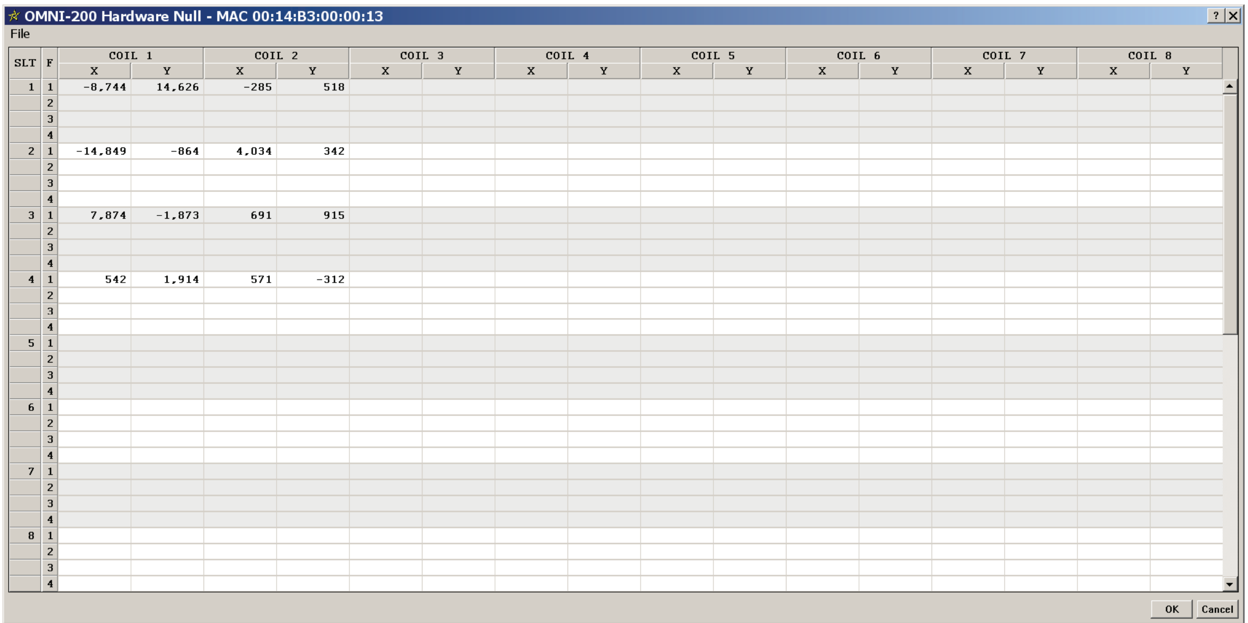


144												
145	1,000,000 Hz	000	-22	0.0794	0.0868	0.0869	0.0877	0.0866	0.0872	0.0869	0.0870	0.0867
146		001	-16	0.1585	0.1719	0.1720	0.1726	0.1724	0.1742	0.1730	0.1732	0.1728
147		010	-10	0.3162	0.3328	0.3334	0.3344	0.3349	0.3358	0.3359	0.3366	0.3357
148		011	-4	0.6310	0.6568	0.6573	0.6599	0.6590	0.6632	0.6610	0.6620	0.6615
149		100	2	1.2589	1.3161	1.3133	1.3090	1.3087	1.3168	1.3126	1.3144	1.3116
150		101	8	2.5119	2.6330	2.6352	2.6414	2.6366	2.6531	2.6466	2.6548	2.6466
151		110	14	5.0119	5.0870	5.0876	5.0720	5.0573	5.0685	5.0640	5.0771	5.0806
152		111	20	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000
Color Code	> 10%	> 20%		% Error	9.329%	9.395%	10.363%	8.989%	9.791%	9.371%	9.509%	9.127%

5 Hardware Null Tool

The **Hardware Null** tool displays a table of digital offsets used to center the eddy current data around zero. These offsets are computed when you click the **HW NULL** button (see **Toolbar Left** on page 43).

To access the tool, choose **Hardware Null** from the **Tools** menu.



5.1 Hardware Null Menu

The **File** menu has the following choices:

Export	Export a text version of the null results to a text editor.

5.2 Hardware Null Table

The table contains the following fields:

SLT	The time slot.
F	The frequency number (i.e. time slice) in the given slot.

COIL n **X and Y**	For each coil, the offset applied to center the X and Y components for the given time slot and time slice. Only nonzero values are shown.

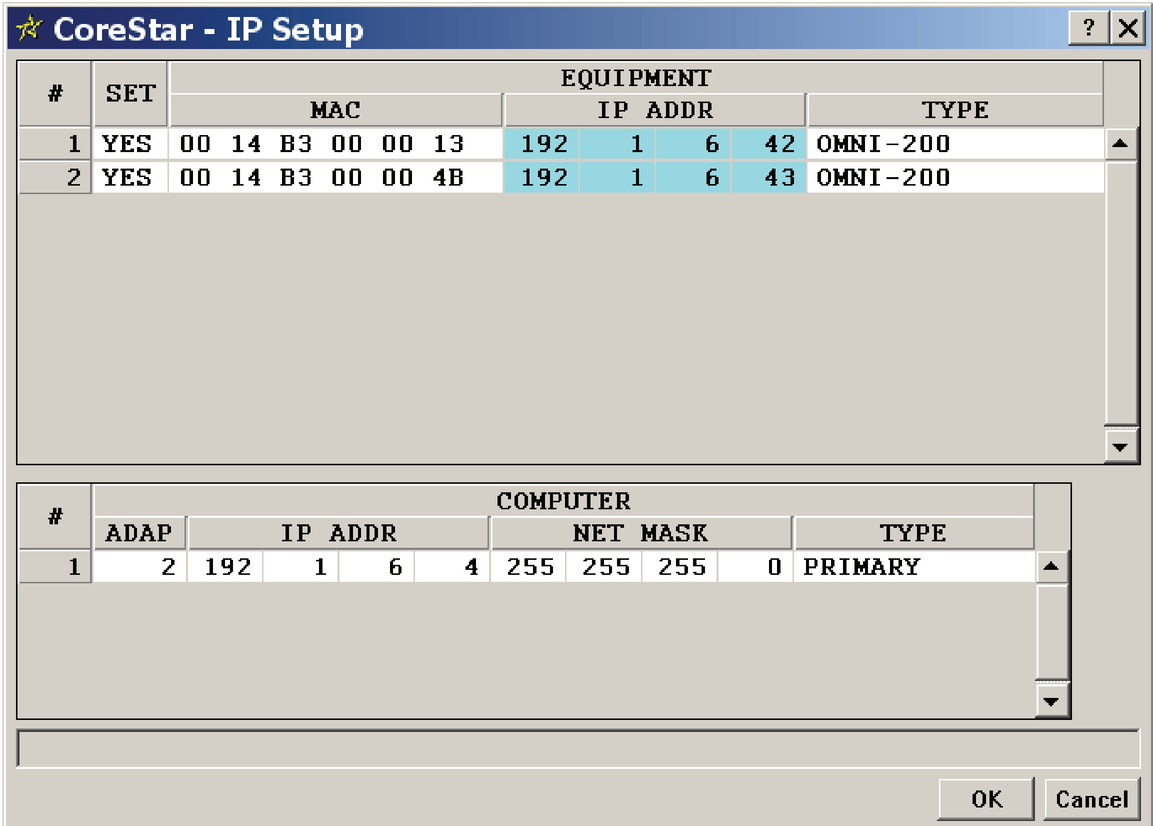
6 IP Setup Utility

The OMNI-200 uses the Internet Protocol (IP) to communicate over the network. The **IP Setup** utility is used to help properly configure the tester to communicate with the acquisition software.

Every piece of equipment (i.e. node) on the network has a unique physical address called its MAC (Media Access Control) address. This is six bytes in length and is assigned by the manufacturer of the equipment. Each vendor is assigned a block of addresses by the IEEE in order to avoid conflicts. All OMNI-200 testers begin with 00:14:B3 and an example MAC address is 00:14:B3:00:00:13 (this is the tester used in t.

Each node also has a four byte logical address (e.g. 192.1.6.4), called its IP address, used by end users to refer to a machine. If the node is on the Internet, it must be a globally unique address. In most cases, eddy current testing is done on a private local network. It is always safe to use IP addresses in the range 192.168.0.0 to 192.168.255.255. These are reserved and will not be used by any node on the Internet.

To access the **IP Setup** utility, choose **IP Setup** from the **Util** menu. When the utility starts up, it broadcasts a message on the local network asking all OMNI-200 testers to respond with their IP address. This requires that broadcast packets be allowed on your network (some firewalls will block them).



The **EQUIPMENT** table at the top displays the following information:

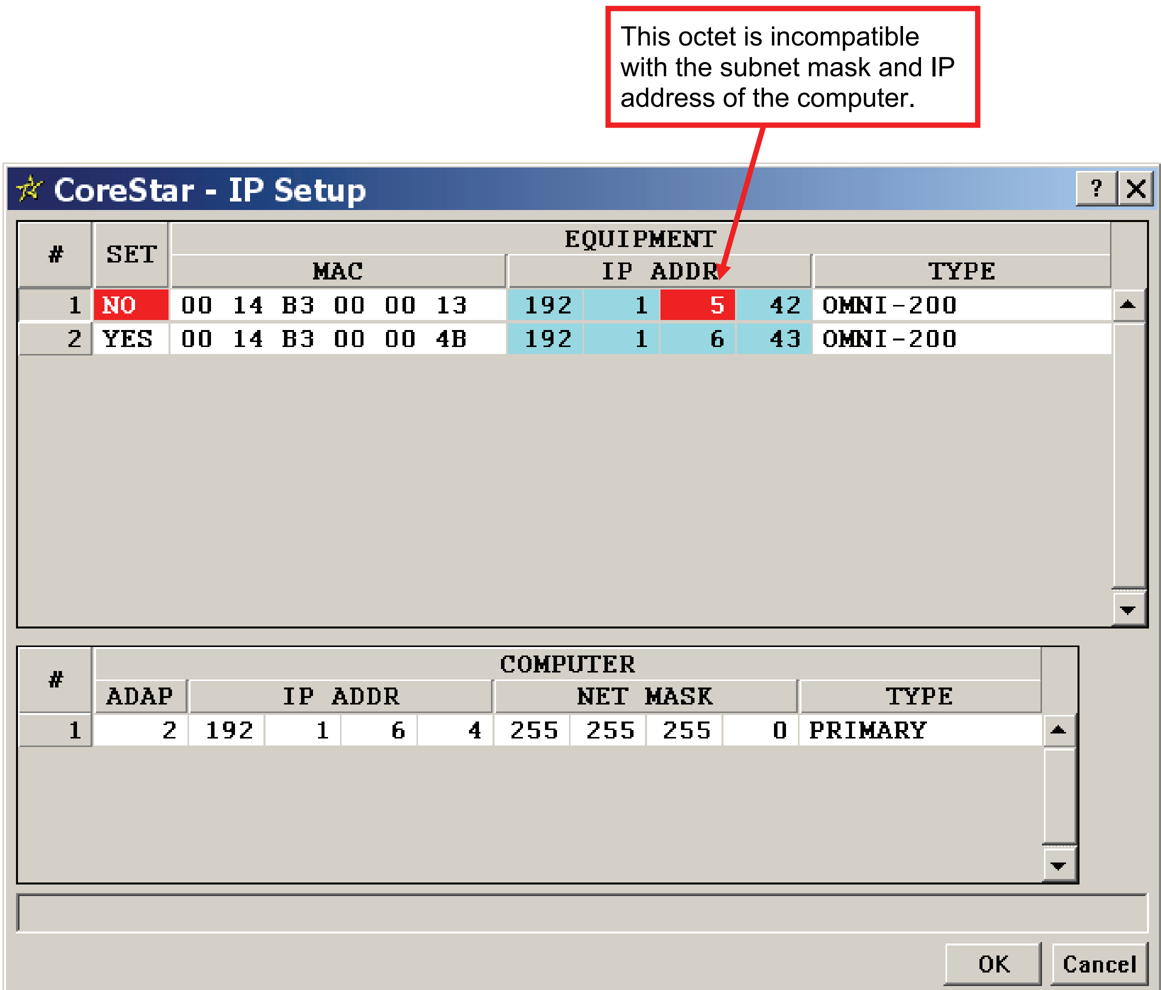
#	The index of this row of the table.
SET	• **YES** if the **IP ADDR** displayed has actually been stored to the tester. • **NO** if the user has modified the IP address but not yet stored it in the tester.
MAC	The MAC address of the given tester. The MAC address of each tester is printed on a label on the front panel.
IP ADDR	The IP address of the tester.
TYPE	The type of equipment. Currently, this will always be OMNI-200.

To establish communication between your computer and the tester, their IP addresses must be compatible. This is determined by what is called the subnet mask. The default subnet mask on Microsoft Windows systems is 255.255.255.0.

A simplified explanation is that if an octet of the subnet mask is 255, that octet of the IP address must be the same for all nodes on the network. The remaining octets of the IP address must be different for each node on the network.

The subnet mask of the computer is shown in the lower table, and in this case is 255.255.255.0. Thus the first three octets of each IP address must be the same for all nodes, and in this case, they are all 192.1.6. The fourth octet must uniquely identify each node. In this case, the first tester is at 42, the second at 43, and the computer itself is at 4.

If a testers IP address is not compatible with the computer's IP address and subnet mask, the conflict will be shown in red:



The third octet is red because the computers subnet mask has a 255 in the third octet and the third octet of its IP is 6, so the third octet of the tester must be 6 as well. If the computers subnet mask were 255.255.0.0, this IP address would not be in conflict.

6.1 Choosing a Tester from the List

To connect to a tester:

1. Choose a tester from the list based on its MAC.
2. Click in the # column of that tester.
3. Click **OK.**

The **IP Setup** utility closes and the IP address of the tester you selected will be shown in the **IP Address** field in the OMNI-200 configuration dialog.

6.2 Changing a Testers IP Address

You may need to modify a testers IP address in order to make it compatible with your PC or to make sure it is unique.

To change the IP address:

1. Click on the parts of the address you wish to change. Make sure no parts are shown in red. This will cause the **SET** column of that tester to change to **NO**.
2. Click on the **NO**. This will send the new IP address to the tester where it will be stored in the FLASH and change the **SET** column back to **YES**.
3. Click **OK** to close the **IP Setup** utility and use the new IP Address.

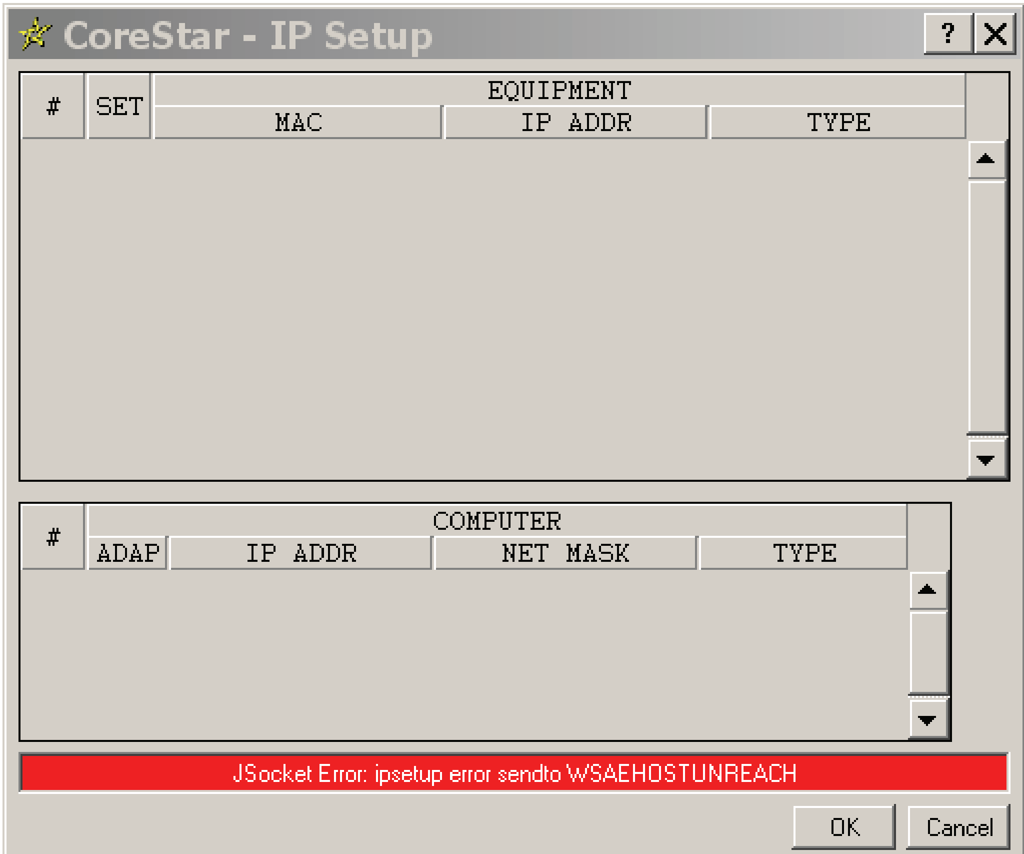
6.3 DHCP and BOOTP

The OMNI-200 supports an alternative to explicitly setting the IP address of each tester, namely to use BOOTP (Bootstrap Protocol) or DHCP (Dynamic Host Configuration Protocol). This requires a BOOTP or DHCP server on your network. The administrator of the server will need to put the MAC address of each OMNI-200, along with the desired IP address into the list of nodes. Whenever the OMNI-200 is powered on, it sends out a BOOTP packet (which is compatible with DHCP as well). If a server sends a BOOTP response, which will contain the desired IP address, the OMNI-200 will use that instead of the one stored in its FLASH.

6.3.1 Disabling DHCP on Your Computer

Sometimes a users computer is mistakenly setup in DHCP mode when there is no DHCP server on the network. In this case, neither the computer or OMNI-200 will be configured properly. This often occurs if a user puts his laptop into DHCP mode in order to connect to a wired network in a hotel, and forgets to disable DHCP when returning to site.

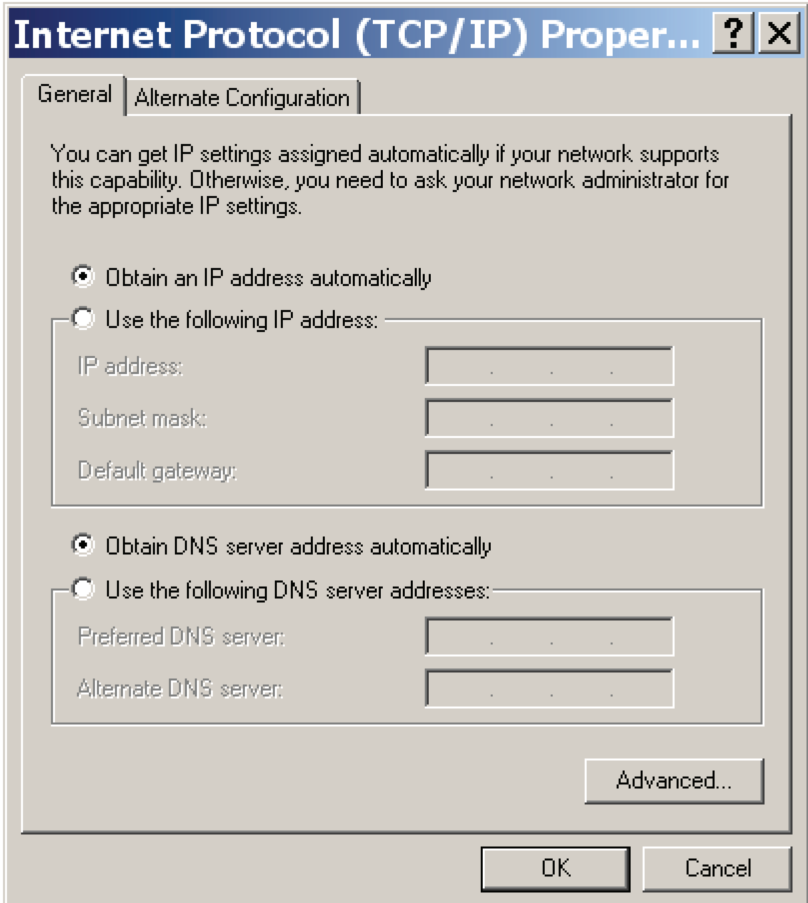
If the computer is in DHCP mode, the **IP Setup** utility will not show an information for testers or the computer:



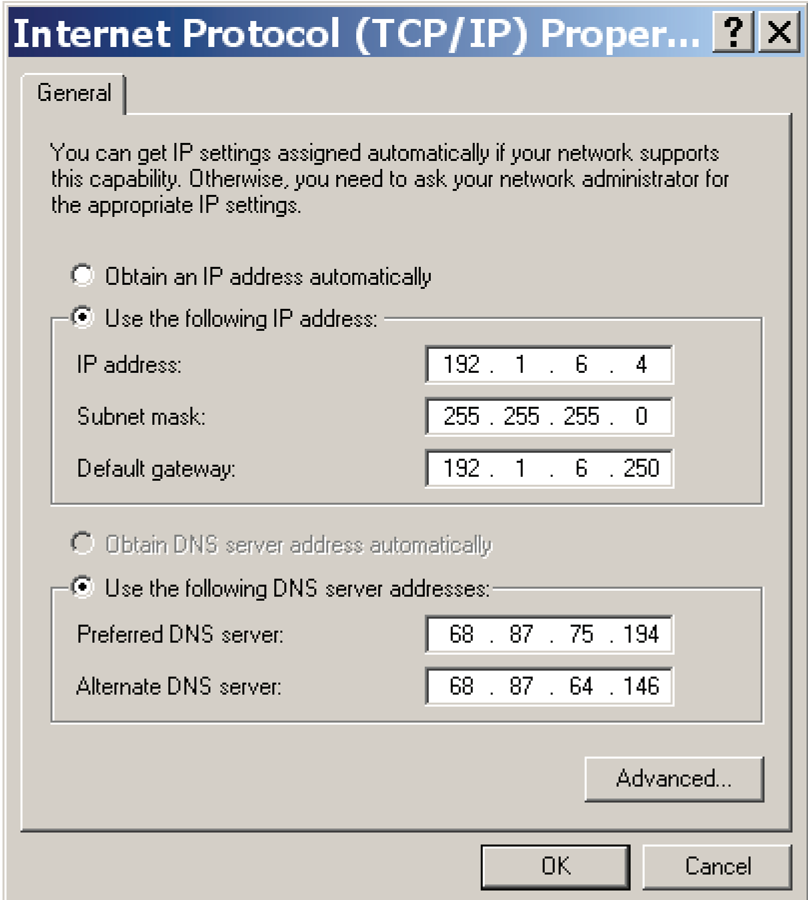
To disable DHCP on a computer running Windows XP:

1. Open **Network Connections** in the **Control Panel**.
2. Select **Local Area Connection** form the list of **Network Connections**.
3. In the **Local Area Connections Status** dialog, click **Properties**.
4. Select **Internet Protocol (TCP/IP)** in the table of protocols.
5. Click **Properties**.

In DHCP mode, the **Internet Protocol (TCP/IP) Properties** dialog will have **Obtain an IP address automatically** selected:



6. Select **Use the following IP address** to disable DHCP:



7. Set the **IP address:** and **Subnet mask:** of the computer to a value compatible with the rest of your network. These are the values for you computer.

8. Click **OK** to close the **Internet Protocol (TCP/IP) Properties** dialog.

9. Click **OK** in the **Local Area Connections Properties** dialog.

10. Click **Disable** in the **Local Area Connection Status** dialog. This will disable the network and close the dialog returning you to the **Network Connections** dialog.

11. Double-click on **Local Area Connection** in the **Network Connections** dialog to re-enable the network.

12. Click **Close** in the **Local Area Connections Status** and close the rest of the dialogs. Your computer should now have the new network settings in effect.

NOTES:	• The actual values displayed on your system will likely differ from this example. • The values for the **Default Gateway** and **DNS** servers are usually not relevant to communicating with the OMNI-200. They are typically for communicating with nodes outside the local network (e.g. the Internet). • If you wish to enable DHCP instead of disabling it, simply modify the above steps by checking the **Obtain an IP address automatically** and **Obtain DNS server address automatically**.

7 Hardware Reference