

Chapter 4 – Using Line Power Analysis

Line Power Analysis Overview

The Line Power Analysis section of PMA1 provides the user with tools to measure 50 and 60 Hz line voltage (V_{RMS}), line current (I_{RMS}), Apparent Power (VA), Real Power (Watts), and Power Factor ($\cos \theta$), as well as evaluate harmonic currents injected into the power line. Harmonic measurements are made in relationship to the requirements of standard EN60001-3-2.

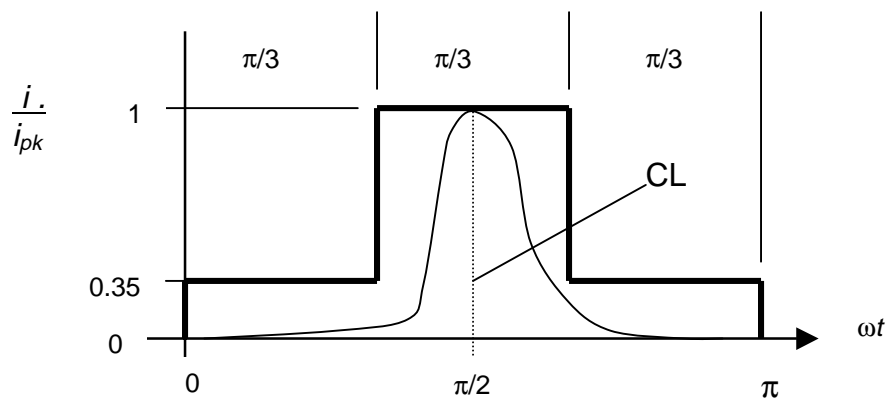
EN61000-3-2

The user is encouraged to refer to the latest version of EN61000-3-2 for full definitions and limits set forth by the standard. The following is provided for convenience.

Classification of Equipment:

For purposes of harmonic current limitation, EN61000-3-2 classifies equipment as follows:

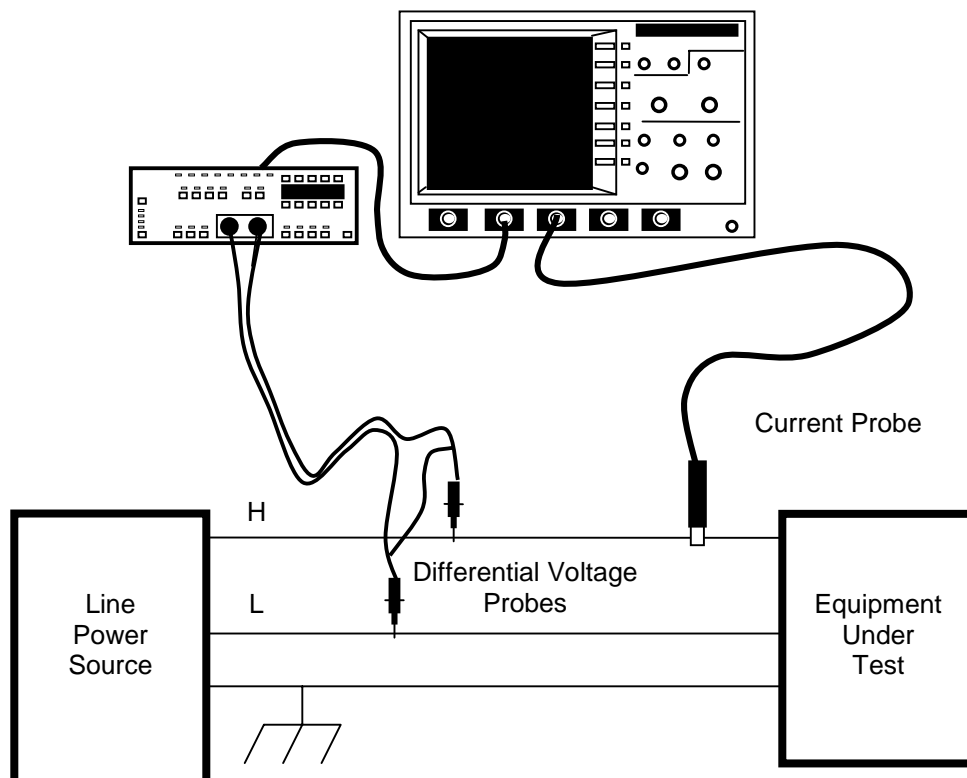
- Class A:** Balanced three-phase equipment and all other equipment, except that stated in one of the following classes.
- Class B:** Portable tools.
- Class C:** Lighting equipment, including dimming devices.
- Class D:** Equipment not in Classes B, C, or motor driven and having an input current with a “special wave shape” as defined in the following figure:



Equipment is deemed to be Class D if the input current wave shape of each half-period is within the figure's envelope for at least 95% of the time. The input current's peak value defines the envelope's centerline, CL.

Configuring for Line Power Analysis

SETUP: To make line power analysis measurements, the equipment should be set up as follows. In the examples below, Channel 2 is used for voltage and Channel 3 is used for current. Any channel can be used for voltage or current. In the case of 3 ϕ systems, multiple voltage and/or current channels can be set up before analysis is started.

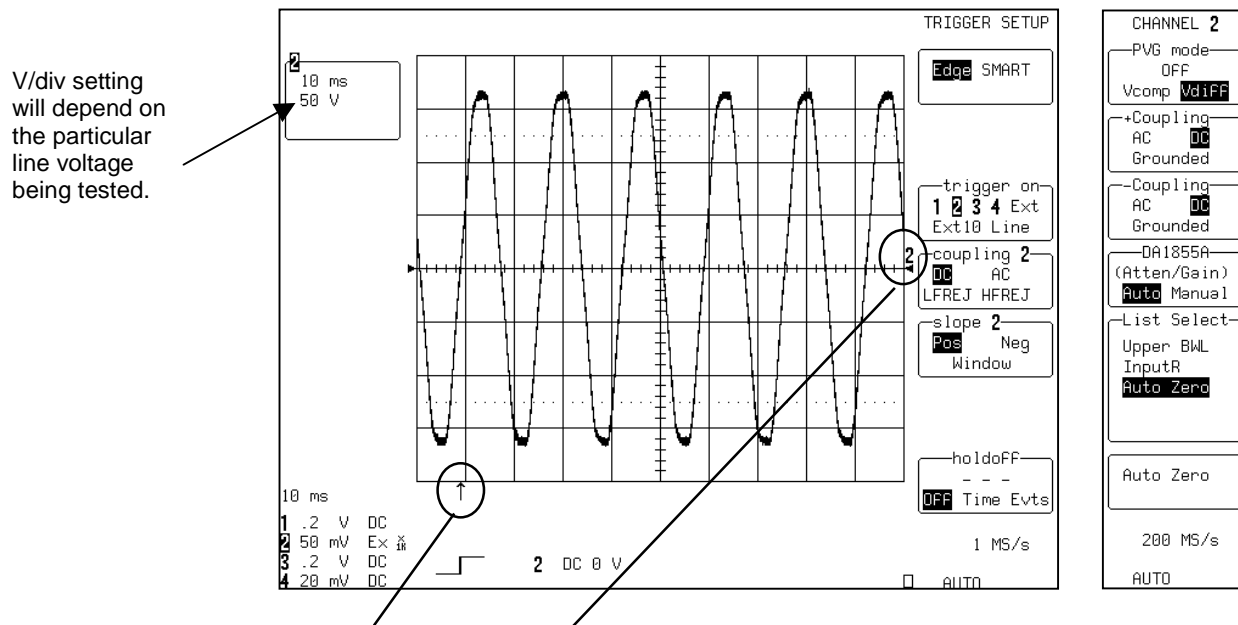


EQUIPMENT UNDER TEST: The equipment being tested for power consumption and line harmonics.

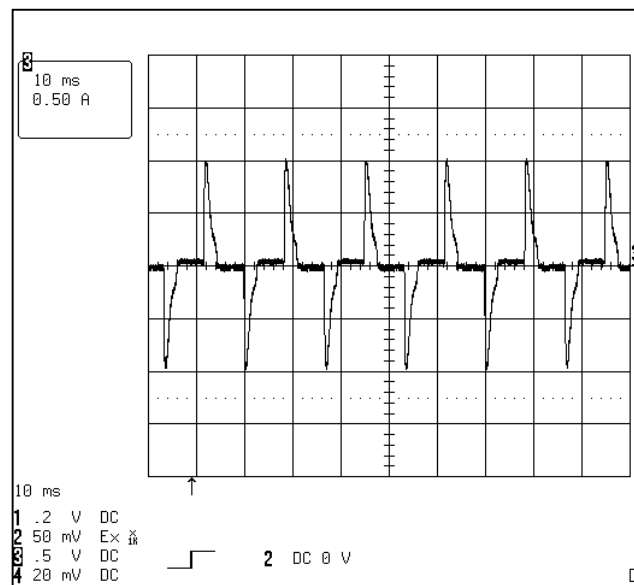
LINE POWER SOURCE: The power source should be low distortion. EN61000-3-2 specifies maximum crest factor and harmonic distortion for the power source while it is connected to the EUT. The test can be run with the available power line, but the distortion in the source will directly affect the quality of the measurements.

Initial Setup – The Line Voltage and Current Signals

Set up a stable display of the line voltage and current signals similar to those shown.



Set the time/div, trigger delay, trigger level, and voltage channel coupling to obtain a display similar to that shown above.



Polarity of the current waveform must match that of the voltage waveform.

Finishing the Setup and Making Line Power Measurements

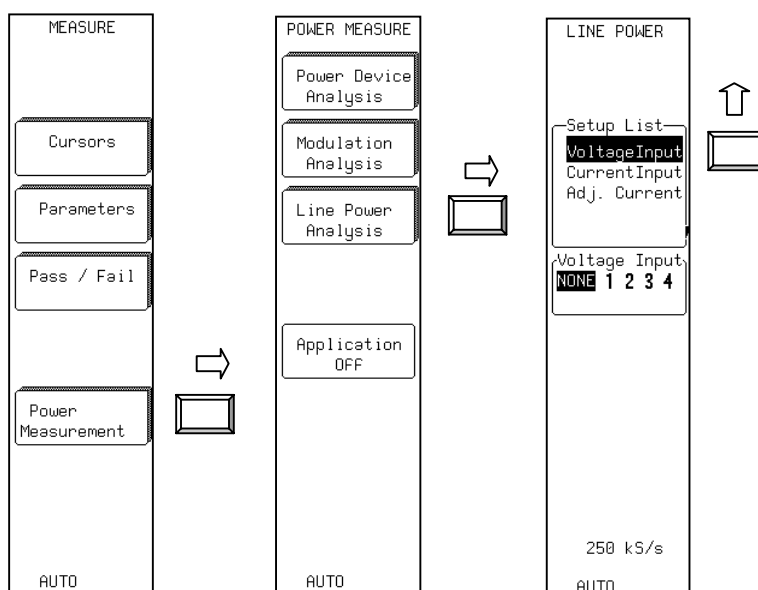
After the measurement is planned and the voltage and current channels are connected and preliminarily set up, use the PMA1 software to finish the setup and make the line power measurements.

Activating the Line Power Analysis Menu

Press the **MEASURE TOOLS** (LT Series) or **CURSORS/MEASURE** (LC Series) button on the DSO front panel to bring up the **MEASURE** menu, which includes the **Power Measurement** selection.

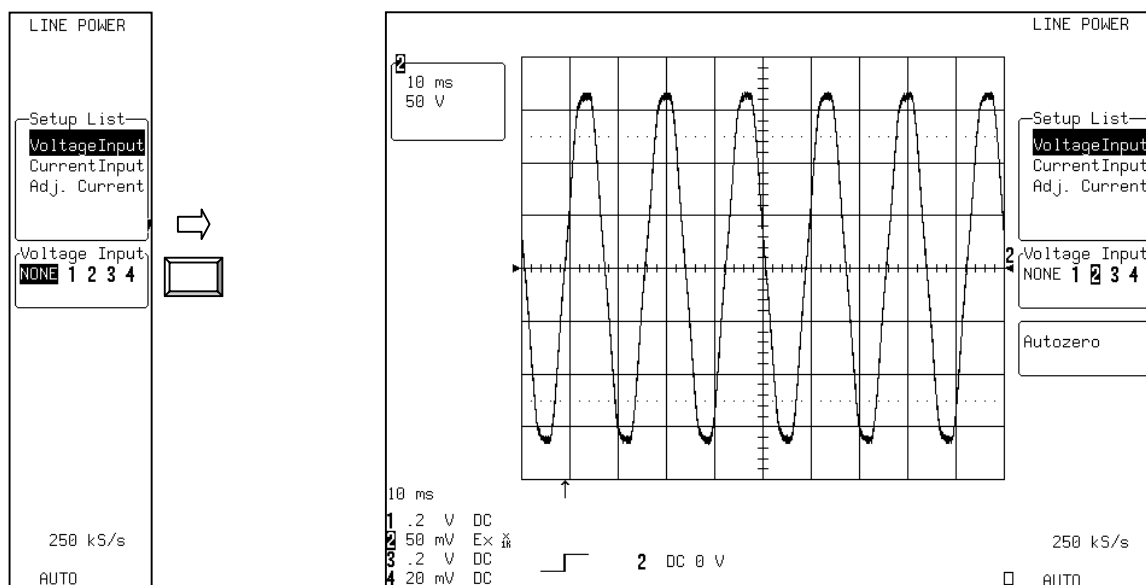



Follow the menu sequence given below:

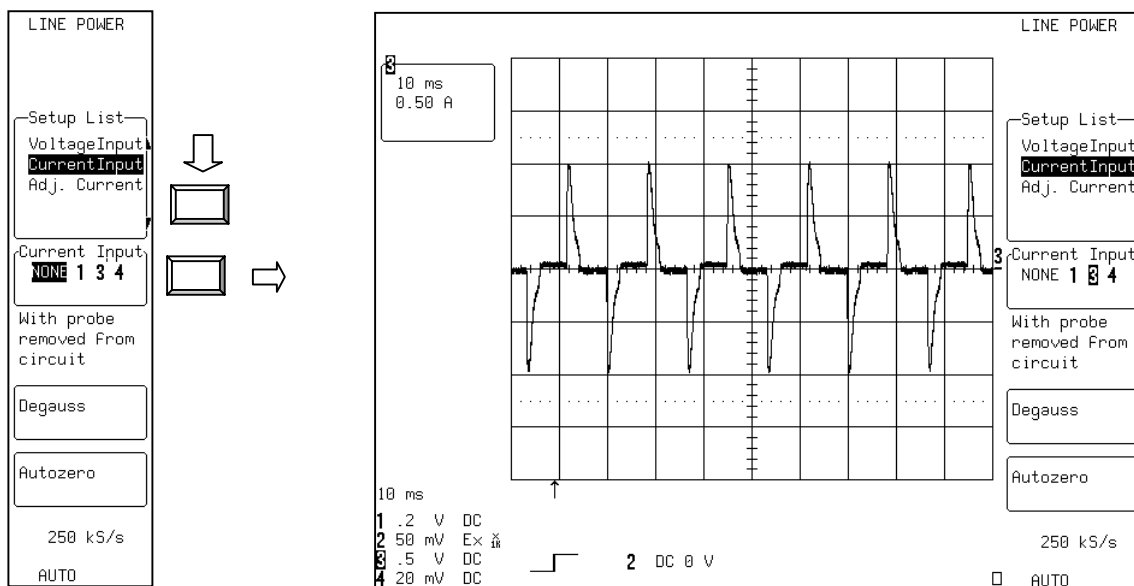


In the **Setup List** menu, select **Voltage Input**.


Selecting the Voltage and Current Channels




Press the **Voltage Input**  to select the previously set up line voltage signal channel.

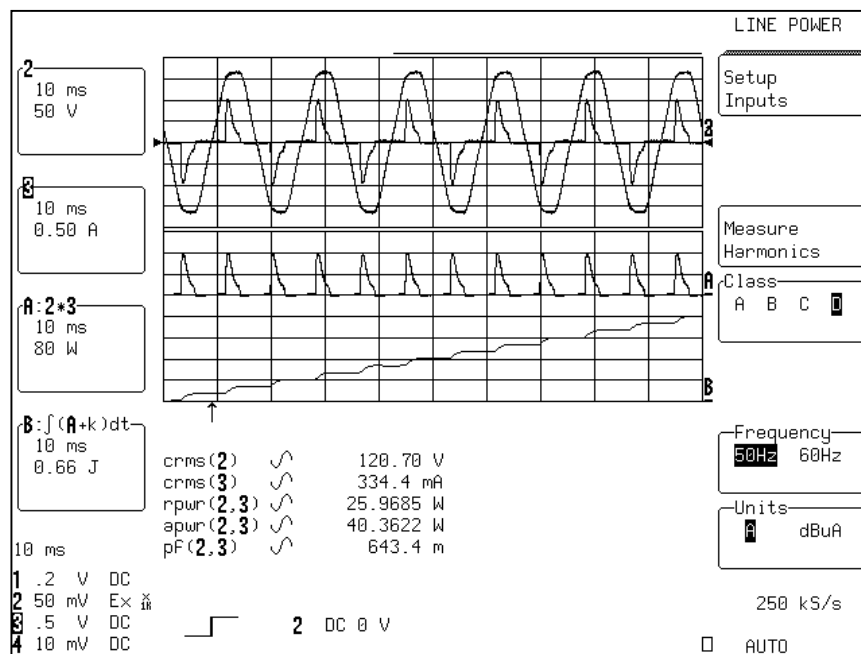


In the **Setup List** menu, select **Current Input**.

Press the **Current Input**  to select the previously set up line current signal channel. The channel selected as the **Current Input** channel will be assigned Ampere units even if a voltage or nonProBus-compatible current probe is used. Remove and degauss the current probe. Polarity of the current probe should match the voltage waveform.

Line Power Measurement

After the Voltage Input and Current Input selections have been made, press the **RETURN**  on the DSO front panel to bring up the following display:



This display screen shows the line voltage and current waveform, as well as the power and energy waveforms.

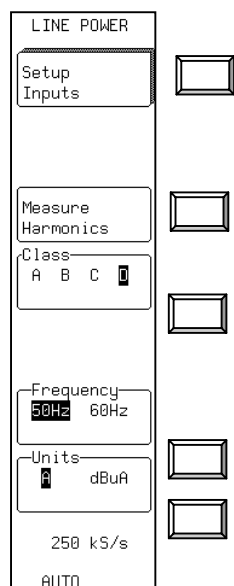
Parameters displayed are:


- Line Voltage {crms (2)}**
- Line Current {crms (3)}**
- Real Power {rpwr (2,3)}**
- Apparent Power {apwr (2,3)}**
- Power Factor {pf (2,3)}** (readout is in milli-units)


Menu selections are provided for the user to select the class of the equipment under test (EN61000 A, B, C, or D classification) and the line frequency at which it is operating (50 or 60 Hz).


Line Harmonics Measurement


Before evoking the **Measure Harmonics** menu selection:




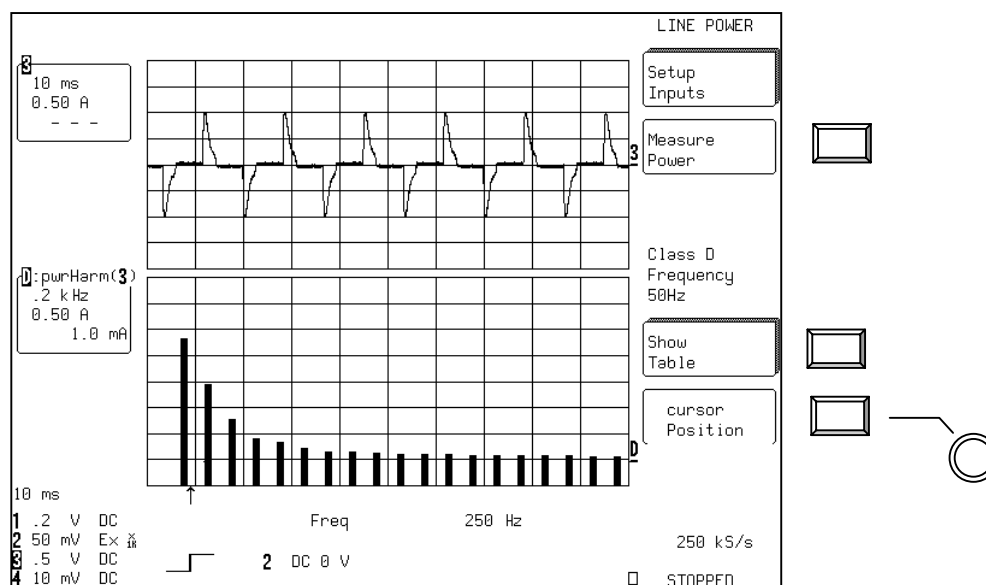
Press the **Class**  to select the proper EN61000-3-2 equipment class.


Press the **Frequency**  to select the line frequency (50 Hz or 60 Hz) upon which the equipment under test is operating.

Press the **Units**  to select Amps or dBuA units for the harmonic displays.


If changes are needed in the voltage or current input setups, pressing the **Setup Inputs**  will return to the previous menu where the selections can be changed.

After the above selections are made, press the **Measure Harmonics**  to bring up the following display:

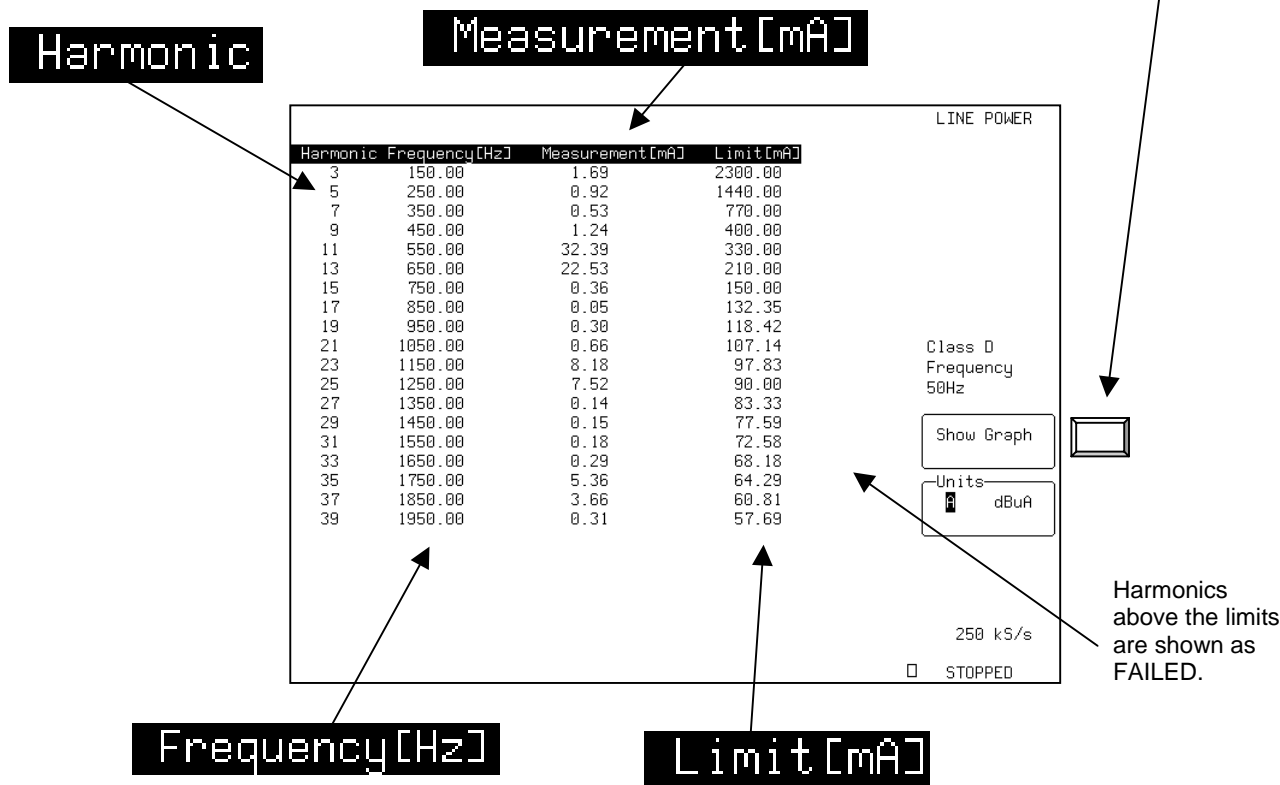
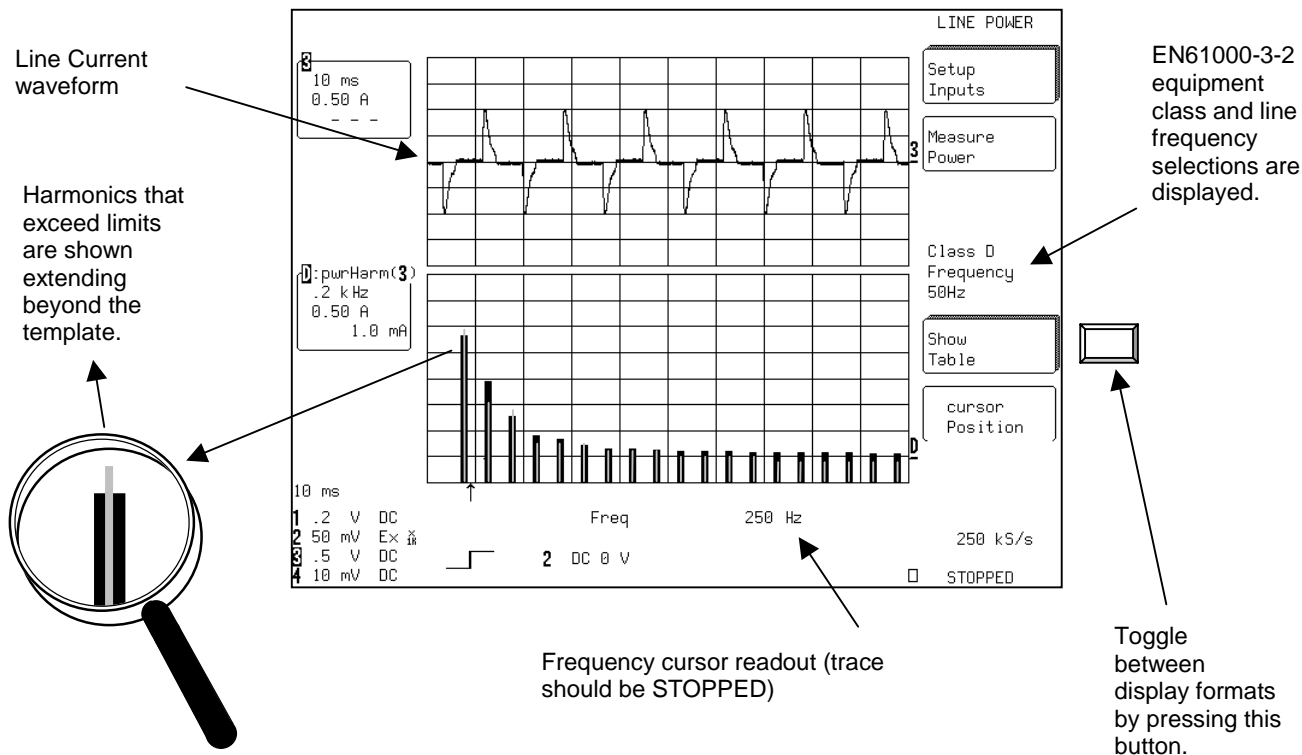


Press the **Measure Power**  to return to the Measure Power Display (changes in class and line frequency can be made there).



Press the **Show Table**  to change to the tabular display.

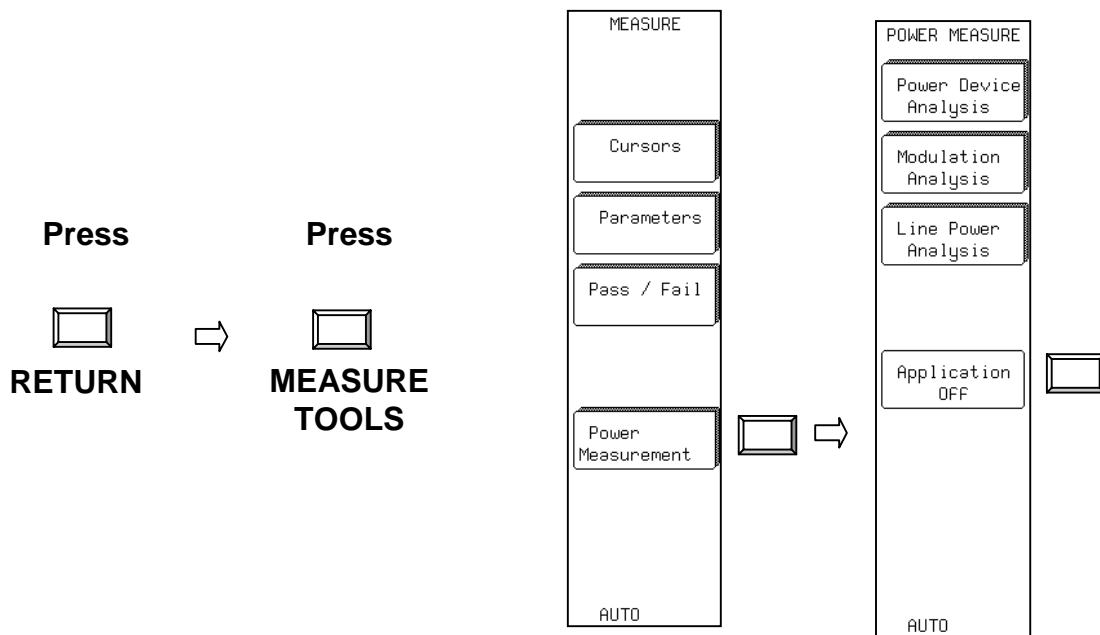
Turn the **cursor Position**  to move the cursor along the harmonics (trace should be stopped before using the cursor).

The Measure Harmonics Displays



Clearing the Line Power Analysis Setup

After using the Modulation Analysis section of PMA1, it is important to clear the channel assignments and other alterations that were made while making line power measurements. Press the **RETURN**  until the on-screen menu is cleared. Then press the **MEASURE/TOOLS**  to bring up the **MEASURE** menu.



Selecting **Application OFF** in the Power Measure menu changes the **Voltage Input** and **Current Input** assignments to **NONE**. The assignment of Ampere units to the channel selected as the **Current Input** channel will also be removed.