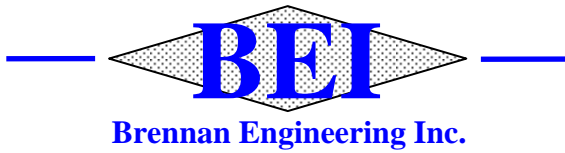


Brennan Engineering Inc.

Filtered Variable Frequency Drives

5700 Antelope Valley Street
Gillette, Wyoming 82718
Tel: (307) 685-2987
Fax: (307) 686-9468



David Brennan Phone: 307-685-2987

Why is a variable frequency pump drive better than an on-off pump controller?

As a wells fluid entry rate decreases over time the on-off controller will cycle more frequently which causes several problems:

- Decreased gas production. Gas production falls off every time the pump shuts down. This is because of the rising fluid level in the casing due to well entry rate and the u-tube effect from the tubing draining back through the pump. A variable frequency pump drive will slow the pump speed to match the well entry rate, therefore, maintaining a consistent fluid level giving the well constant gas production.
- Premature pump failure. Every time the pump restarts, the suction head and the discharge head of the pump are equal. As a result, the pump stages are pushed upward into the outlet of the pump causing premature pump failure. This condition is known as pump up-thrust. A variable frequency pump drive will run continuously, thus maintaining a constant fluid level and avoiding the pump up-thrust condition.
- Premature motor failure. The up-thrust condition during startup can cause the motor rotor to push against the motor end plate causing motor failure.

Variable frequency pump drives have one problem. They produce electrical harmonics which are harmful to other electrical equipment. In the past the only way to correct harmonics was to install a filter at each service location in the field. Brennan Engineering has developed an electrical harmonic filter that fits inside the drive enclosure thus eliminating any external filter requirements. This harmonic filtered drive system has been tested and approved for use by Powder River Energy. Another advantage to our drive system is the customized software for the CBM Industry.

Advantages of using individually filtered drives

- Our filtered drive package is more cost effective than buying a separate filter, plus the added cost of installation.
- Our drive applied filter concept allows the operator to mix linear and nonlinear loads together, with no adverse affects to your total harmonic distortion.
- ABB has worked with us to develop software that is specific to the Coal Bed Methane Industry. Consequently, making the initial start-up and operation of the drive very user friendly.

Disadvantages of using non filtered drives

- Using a non filtered drive requires filtering from a central location; adding or deleting wells will adversely affect the performance of the filter. Thus requiring replacement of the existing filter.
- Adding loads to a filtered service point will require an increase in the size of the filter. All linear loads will have to be separated from the filtered loads at the electrical service point.



15 hp drive with harmonic filter

January 11, 2002

David Brennan
Brennan Engineering & Instrumentation
5700 Antelope Valley St.
Gillette, WY 82718

RE: Harmonic Test

Mr. Brennan,

At your request, Powder River Energy Corporation agreed to field test your Power Quality Solutions (PQS) - Prototype #1 - Harmonic Filter. As you know, non-linear currents caused by variable frequency drives (VFD's) result in harmonic currents that are detrimental to the utility system. Effective filtering is essential in controlling the propagation of this problem.

A site in Sheridan County was selected for the test. A Metrosonic PA-7 Power Quality Monitor was utilized for the data collection. It was programmed to capture one cycle every second, and the test runs were approximately two minutes in duration. Representative waveforms are attached from each of five (5) test runs.

SITE INFORMATION

Fidelity E&P
Rice & Sons 34c-264
SWSE T56N R84W Sec. 2
Sheridan County, WY

The motor is a 10hp submersible located approximately 2,500' from the utility source. The drive is a 20hp ABB unit. Power Factor was not a problem despite the mismatch in the drive and motor horsepower.

TEST DATA

Test #1 – (Page #1) Ambient Condition –Existing voltage waveform at the Point of Common Coupling (PPC) with the motor *not* running. The V_{THD} background is 2.58%.

Test #2 – (Page #2,3,4) Motor running w/o filter –The V_{THD} is 2.50% and the I_{THD} is 43.41%.

Test #3 – (Page #5,6,7) Motor running (60Hz) with filter – The V_{THD} is 2.50% and the I_{THD} is 9.24%.

Test #4 – (Page #8,9,10) Motor running (45Hz) with filter – The V_{THD} is 2.57% and the I_{THD} is 14.25%.

Test #5 – (Page #11,12,13) Motor running (60Hz) with filter plus additional 10hp linear motor running – The V_{THD} is 2.48% and the I_{THD} is 5.70%

Powder River Energy Corporations “Harmonic Distortion Limitation” Policy requires that all customers meet IEEE Standard 519-1992. The I_{SC}/I_L ratio is between 100<1000 and the TDD must fall below 15% to be in compliance. The results of the field-testing show that the subject filter meets the Harmonics criteria and appears to be a viable solution to the harmonics issues.

Please advise if we can provide any additional information on this matter.

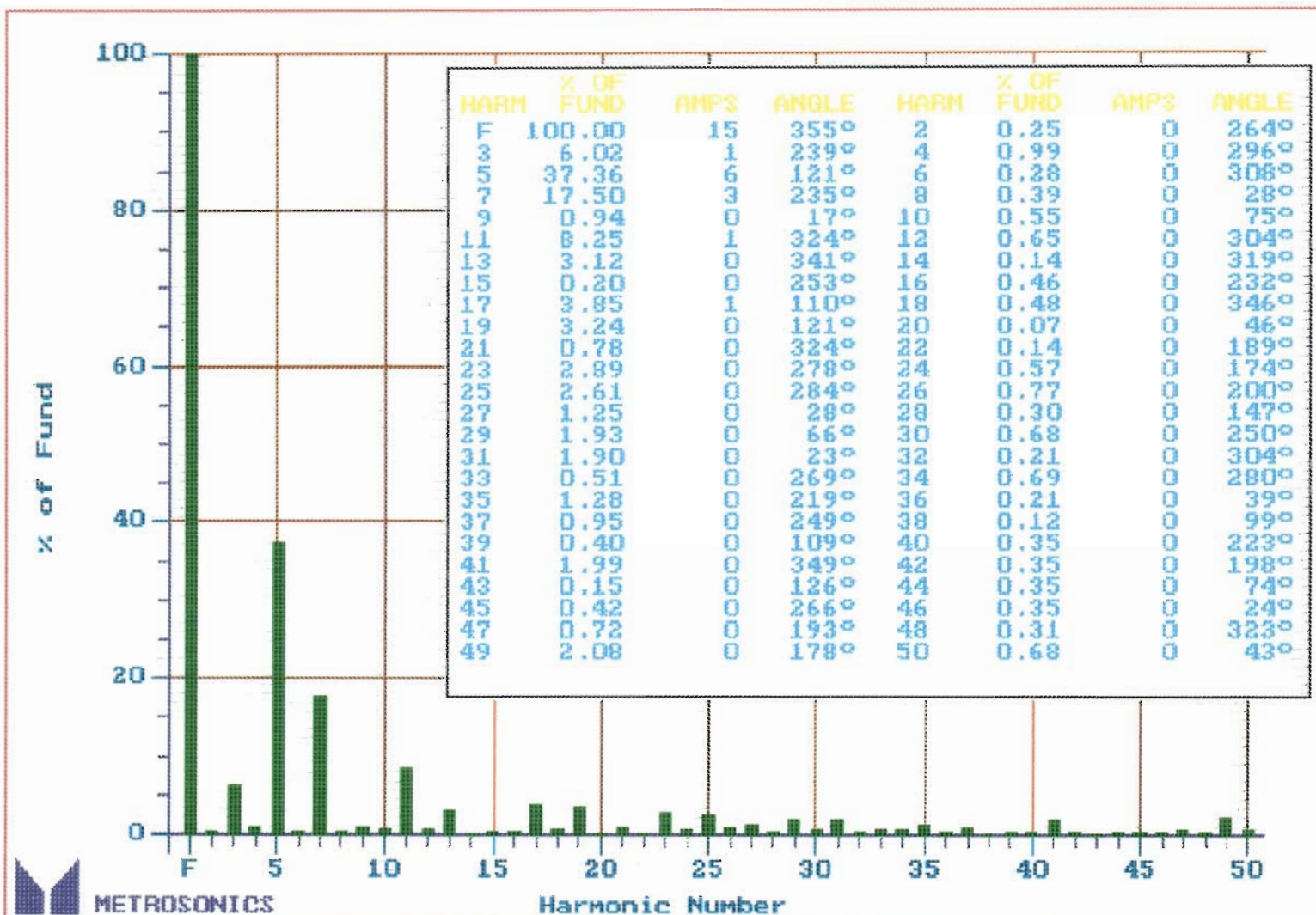
Respectfully,



Rick Browne
Sheridan Division Engineer

Cc: Steve Taylor, Sundance

Filename.....PQS-2
 Customer Name...
 Account/Meter #.
 Address One.....
 Address Two.....
 City,State,Zip..
 Phone Number....
 Comment 1.....@ meter # R1010
 Comment 2.....

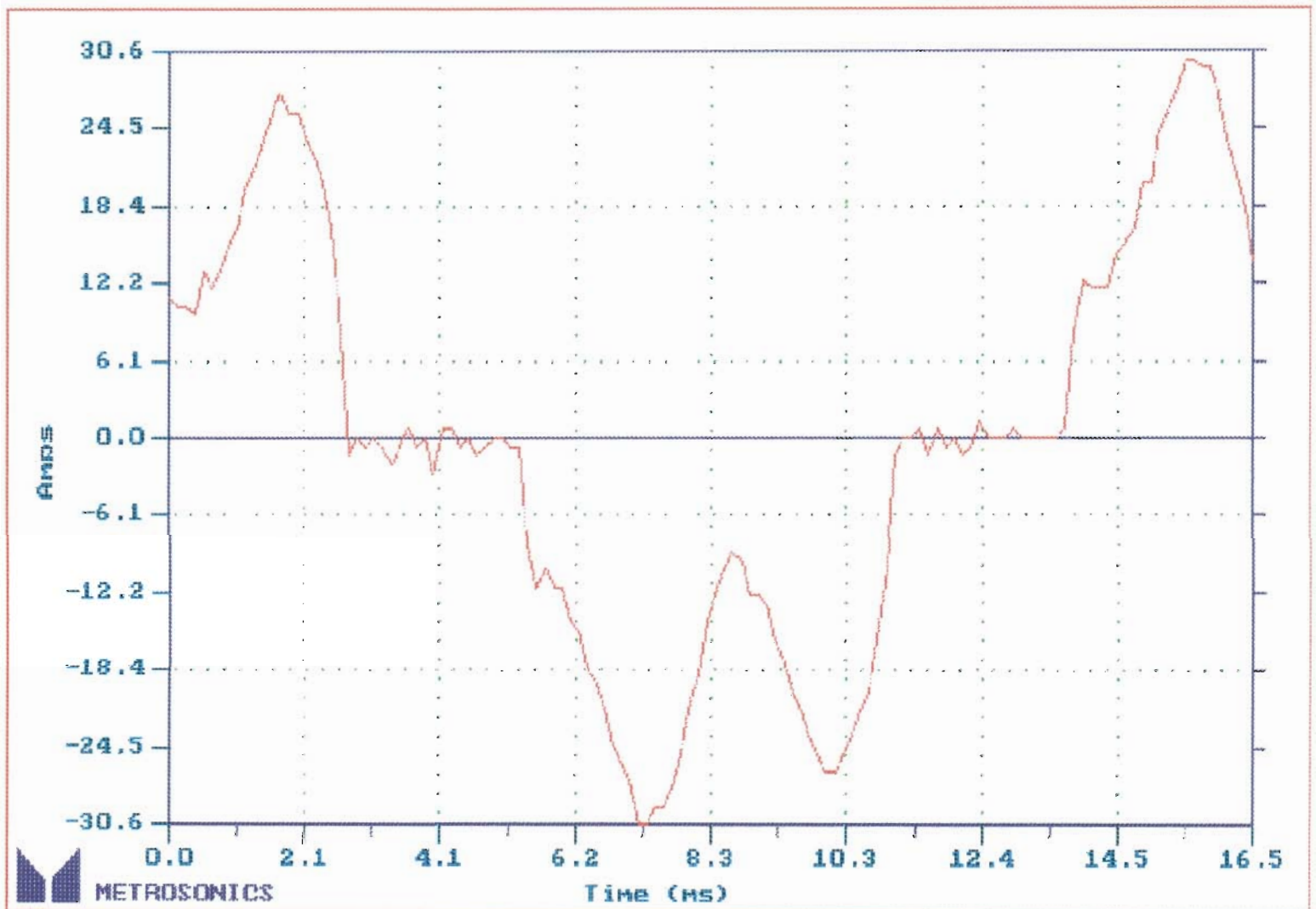


Event 20 of 95 For Ch 2 (PH A) Trigger occurred on cycle 1

Cycle 1 of 1 on 12/19/101 at 11:27:19.00

Total Harmonic Distortion...	43.41%	RMS of Fundamental.....	15A
Odd Contribution.....	43.35%	RMS of Fund+Harmonics...	17A
Even Contribution.....	2.36%	K Factor.....	10.23

Filename.....PQS-2
Customer Name...
Account/Meter #.
Address One.....
Address Two.....
City,State,Zip..
Phone Number....
Comment 1.....@ meter # R1010
Comment 2.....

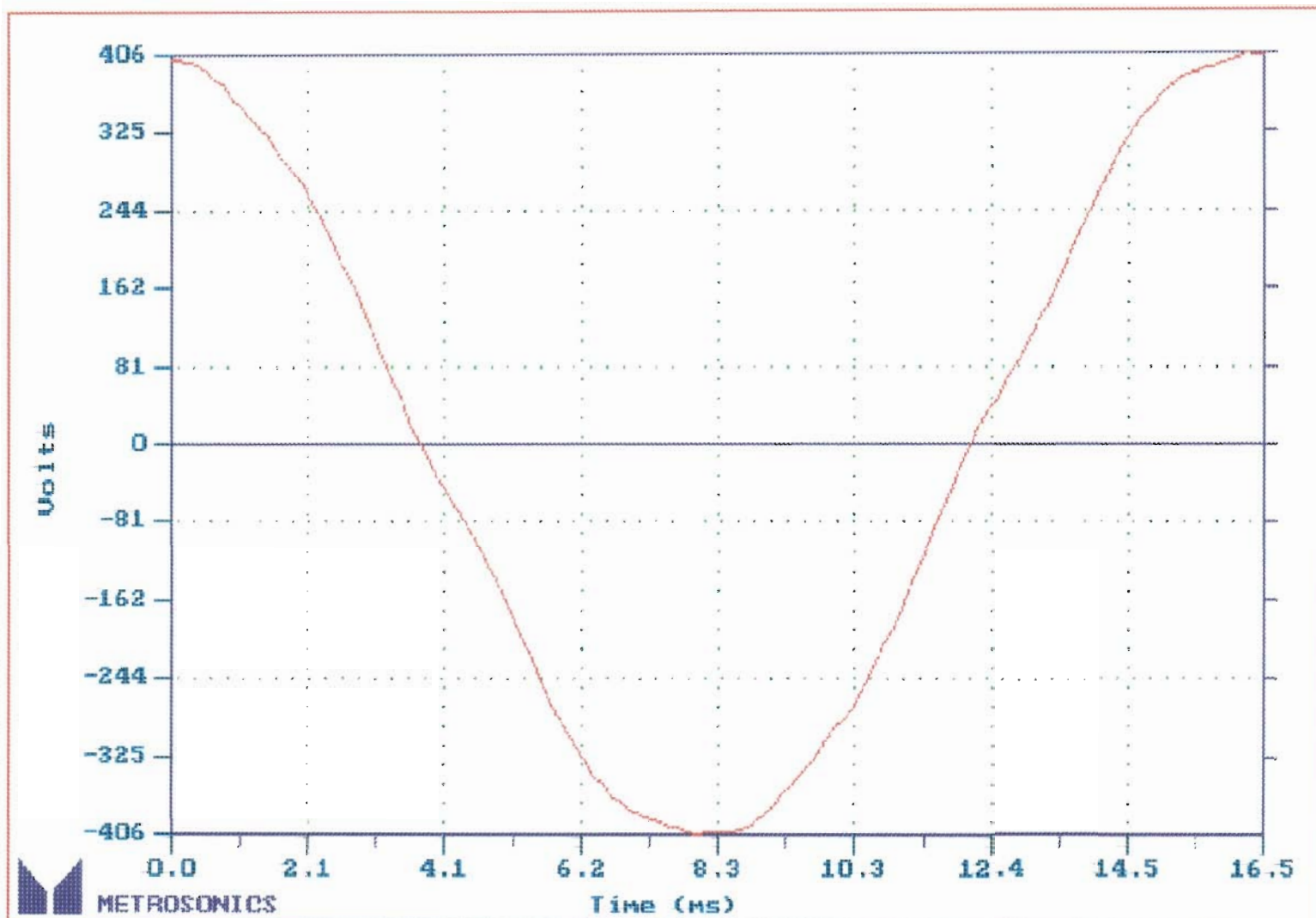


Event 20 of 95 For Ch 2 (PH A) Trigger occurred on cycle 1

Cycle 1 of 1 on 12/19/101 at 11:27:19.00

Total Harmonic Distortion...	43.41%	RMS of Fundamental.....	15A
Odd Contribution.....	43.35%	RMS of Fund+Harmonics...	17A
Even Contribution.....	2.36%	K Factor.....	10.23

Filename.....PQS-2
Customer Name...
Account/Meter #.
Address One.....
Address Two.....
City,State,Zip..
Phone Number....
Comment 1.....@ meter # R1010
Comment 2.....

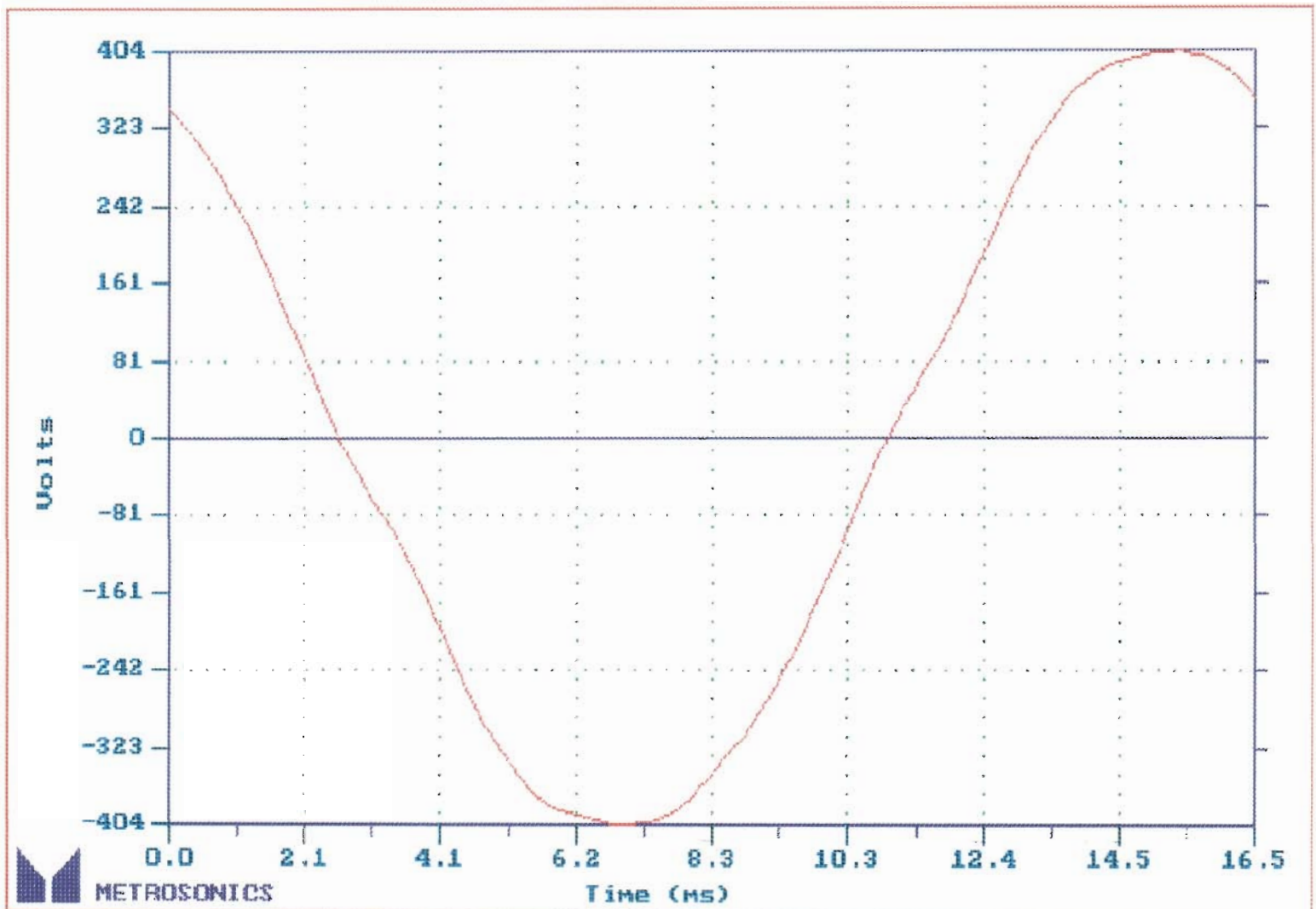


Event 20 of 95 For Ch 1 (PH A) Trigger occurred on cycle 1

Cycle 1 of 1 on 12/19/101 at 11:27:19.00

Total Harmonic Distortion...	2.50%	RMS of Fundamental.....	288.3V
Odd Contribution.....	2.49%	RMS of Fund+Harmonics...	288.4V
Even Contribution.....	0.21%		

Filename.....PQS-1
Customer Name...
Account/Meter #.
Address One.....
Address Two.....
City,State,Zip..
Phone Number....
Comment 1.....@ meter # R1010
Comment 2.....

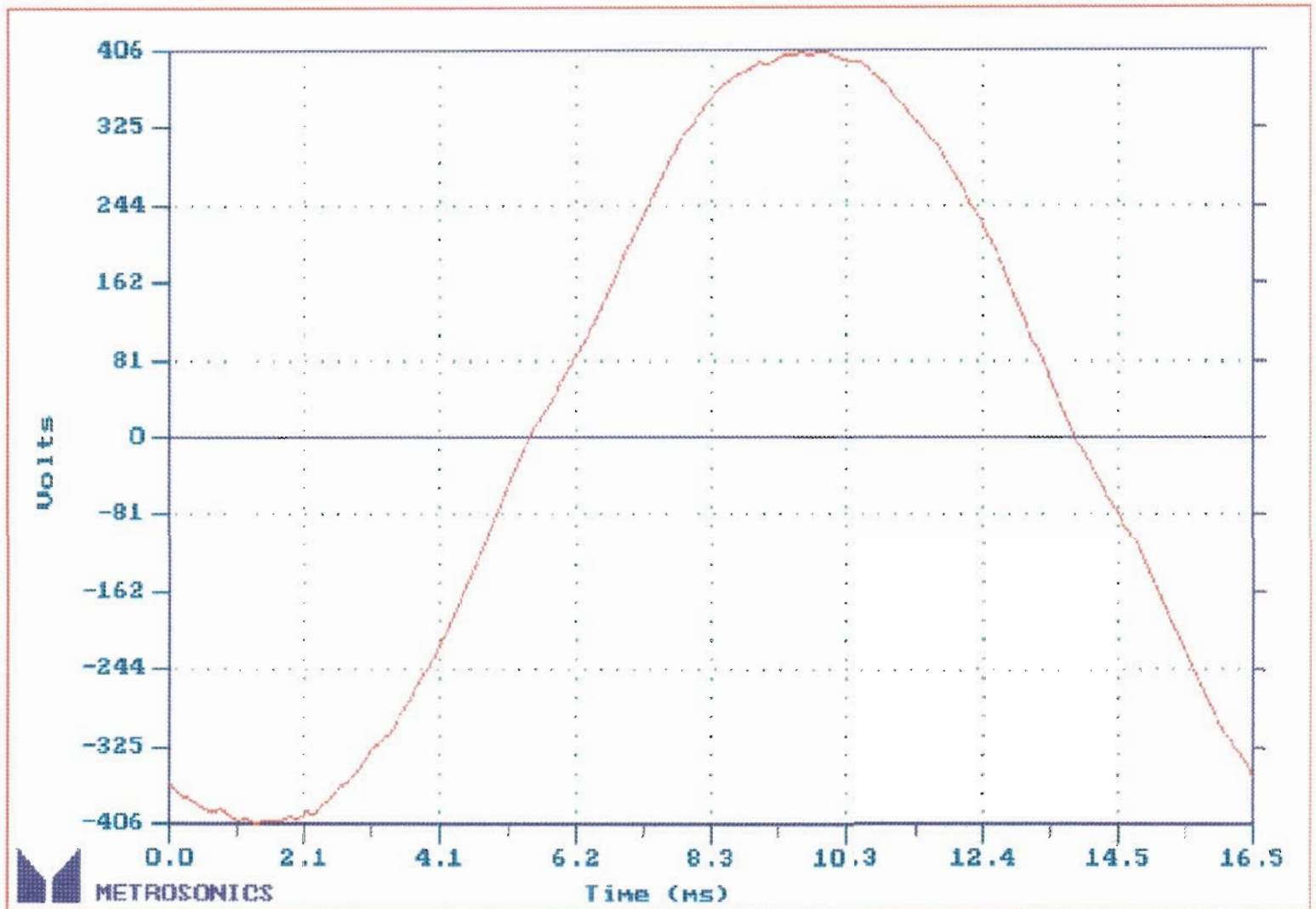


Event 20 of 122 For Ch 1 (PH A) Trigger occurred on cycle 1

Cycle 1 of 1 on 12/19/101 at 11:04:19.01

Total Harmonic Distortion...	2.58%	RMS of Fundamental.....	288.1V
Odd Contribution.....	2.58%	RMS of Fund+Harmonics...	288.2V
Even Contribution.....	0.12%		

Filename.....PQS-3
 Customer Name...
 Account/Meter #.
 Address One.....
 Address Two.....
 City,State,Zip..
 Phone Number....
 Comment 1.....@ meter # R1010
 Comment 2.....



Event 20 of 136 For Ch 1 (PH A) Trigger occurred on cycle 1

Cycle 1 of 1 on 12/19/101 at 11:38:19.00

Total Harmonic Distortion...	2.50%	RMS of Fundamental.....	289.2V
Odd Contribution.....	2.49%	RMS of Fund+Harmonics...	289.3V
Even Contribution.....	0.19%		

Filename.....PQS-3
 Customer Name...
 Account/Meter #.
 Address One.....
 Address Two.....
 City,State,Zip..
 Phone Number....
 Comment 1.....@ meter # R1010
 Comment 2.....

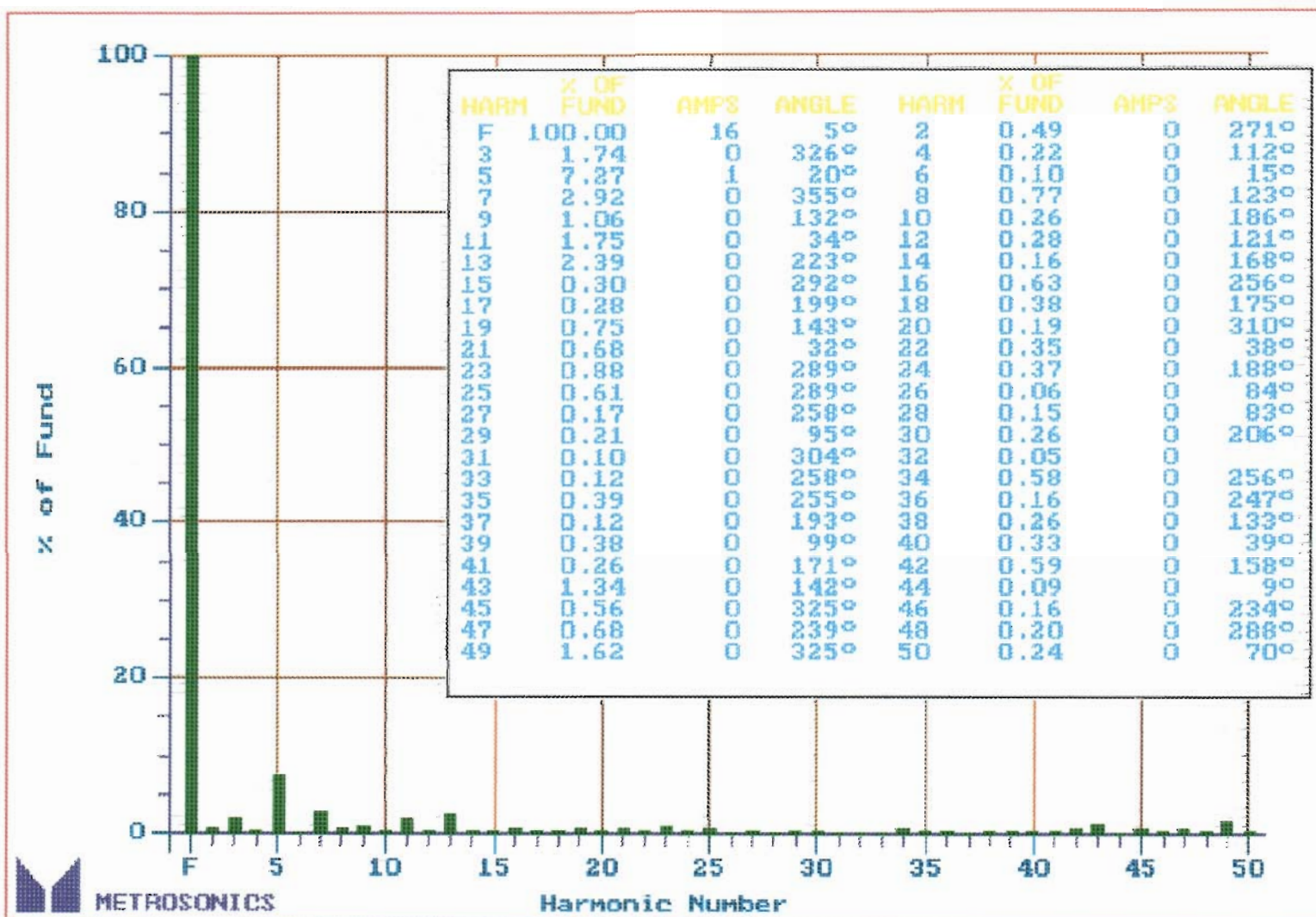


Event 20 of 136 For Ch 2 (PH A) Trigger occurred on cycle 1

Cycle 1 of 1 on 12/19/101 at 11:38:19.00

Total Harmonic Distortion...	9.24%	RMS of Fundamental.....	16A
Odd Contribution.....	9.07%	RMS of Fund+Harmonics...	16A
Even Contribution.....	1.73%	K Factor.....	2.79

Filename.....PQS-3
 Customer Name...
 Account/Meter #.
 Address One.....
 Address Two.....
 City,State,Zip..
 Phone Number....
 Comment 1.....@ meter # R1010
 Comment 2.....

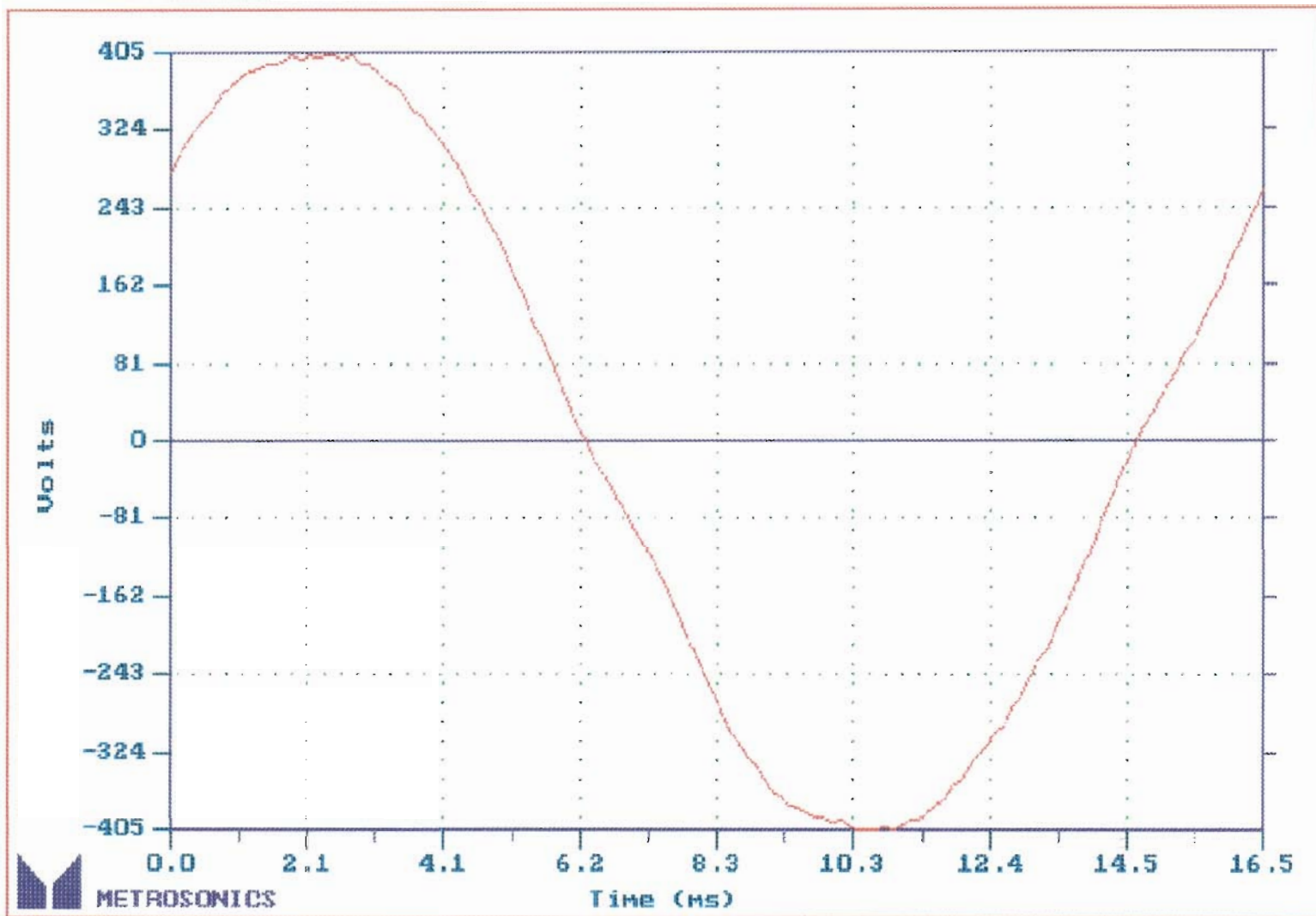


Event 20 of 136 For Ch 2 (PH A) Trigger occurred on cycle 1

Cycle 1 of 1 on 12/19/101 at 11:38:19.00

Total Harmonic Distortion...	9.24%	RMS of Fundamental.....	16A
Odd Contribution.....	9.07%	RMS of Fund+Harmonics...	16A
Even Contribution.....	1.73%	K Factor.....	2.79

Filename.....PQS-4
 Customer Name...
 Account/Meter #.
 Address One.....
 Address Two.....
 City,State,Zip..
 Phone Number....
 Comment 1.....@ meter # R1010
 Comment 2.....

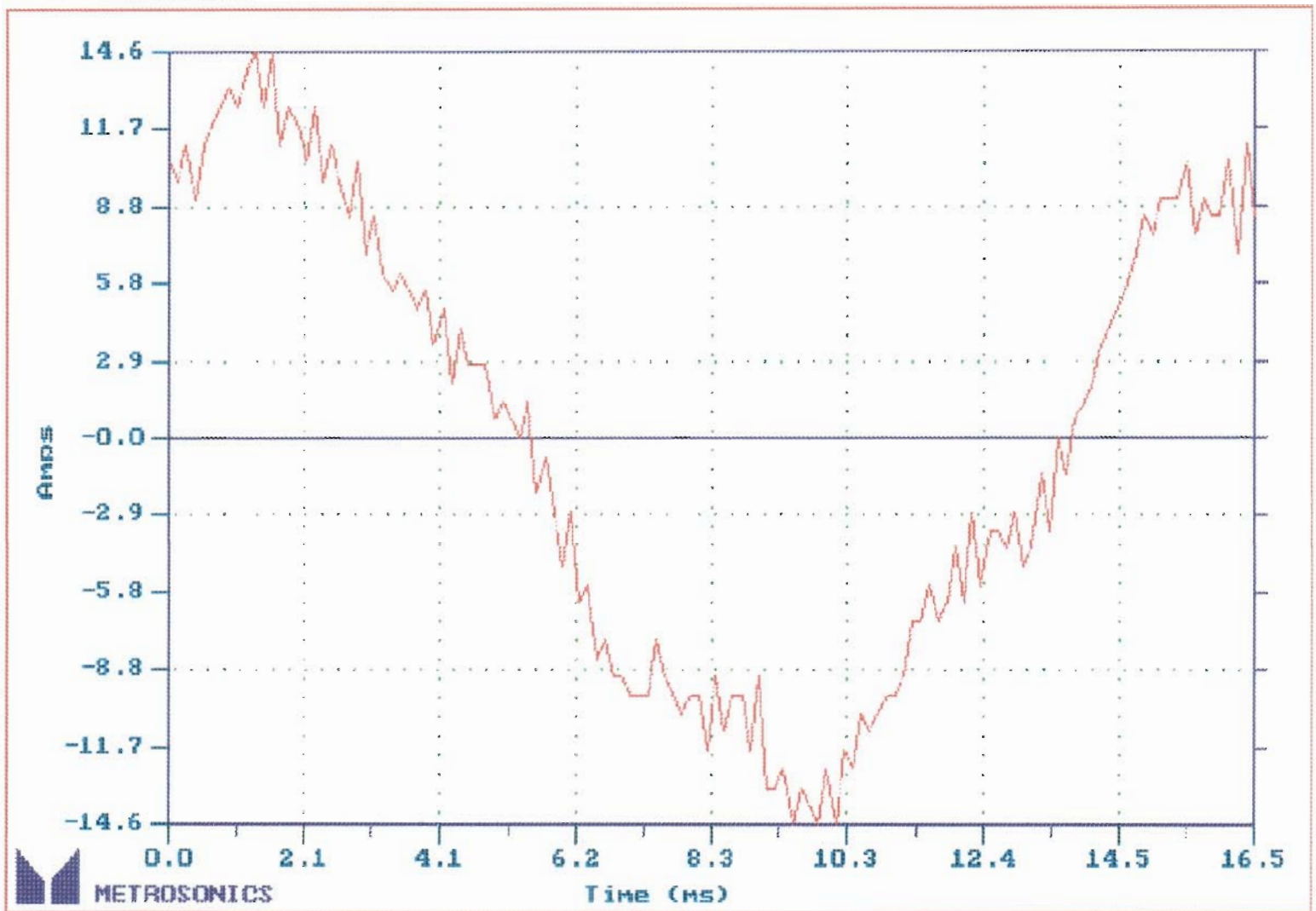


Event 20 of 119 For Ch 1 (PH A) Trigger occurred on cycle 1

Cycle 1 of 1 on 12/19/101 at 11:57:19.00

Total Harmonic Distortion...	2.57%	RMS of Fundamental.....	289.0V
Odd Contribution.....	2.55%	RMS of Fund+Harmonics...	289.1V
Even Contribution.....	0.30%		

Filename.....PQS-4
 Customer Name...
 Account/Meter #.
 Address One.....
 Address Two.....
 City,State,Zip..
 Phone Number....
 Comment 1.....@ meter # R1010
 Comment 2.....

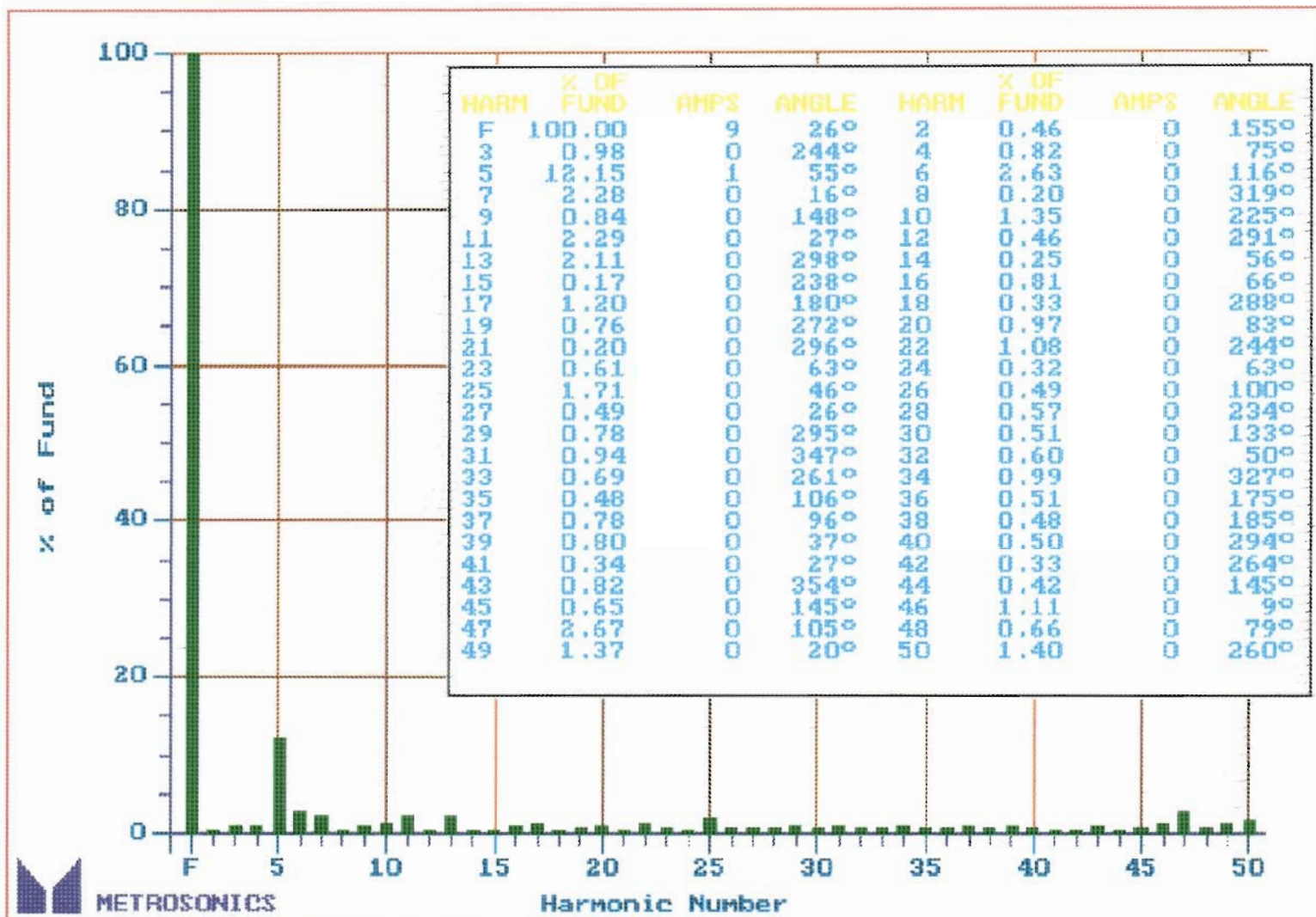


Event 20 of 119 For Ch 2 (PH A) Trigger occurred on cycle 1

Cycle 1 of 1 on 12/19/101 at 11:57:19.00

Total Harmonic Distortion...	14.25%	RMS of Fundamental.....	9A
Odd Contribution.....	13.54%	RMS of Fund+Harmonics...	9A
Even Contribution.....	4.45%	K Factor.....	5.76

Filename.....PQS-4
 Customer Name...
 Account/Meter #.
 Address One.....
 Address Two.....
 City,State,Zip..
 Phone Number....
 Comment 1.....@ meter # R1010
 Comment 2.....

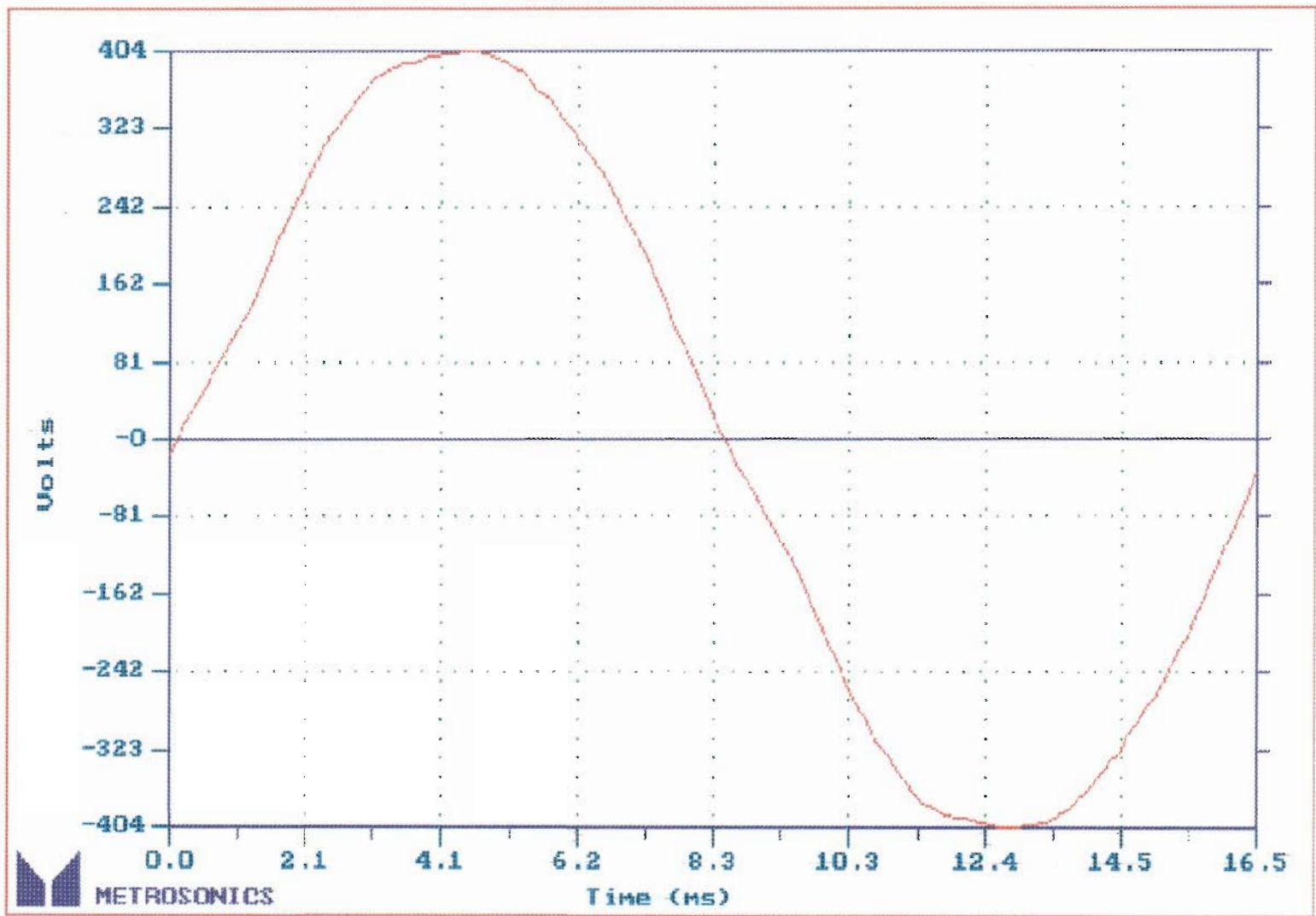


Event 20 of 119 For Ch 2 (PH A) Trigger occurred on cycle 1

Cycle 1 of 1 on 12/19/101 at 11:57:19.00

Total Harmonic Distortion...	14.25%	RMS of Fundamental.....	9A
Odd Contribution.....	13.54%	RMS of Fund+Harmonics...	9A
Even Contribution.....	4.45%	K Factor.....	5.76

Filename.....PQS-5
 Customer Name...
 Account/Meter #.
 Address One.....
 Address Two.....
 City,State,Zip..
 Phone Number....
 Comment 1.....@ meter # R1010
 Comment 2.....with additional 10 hp linear load

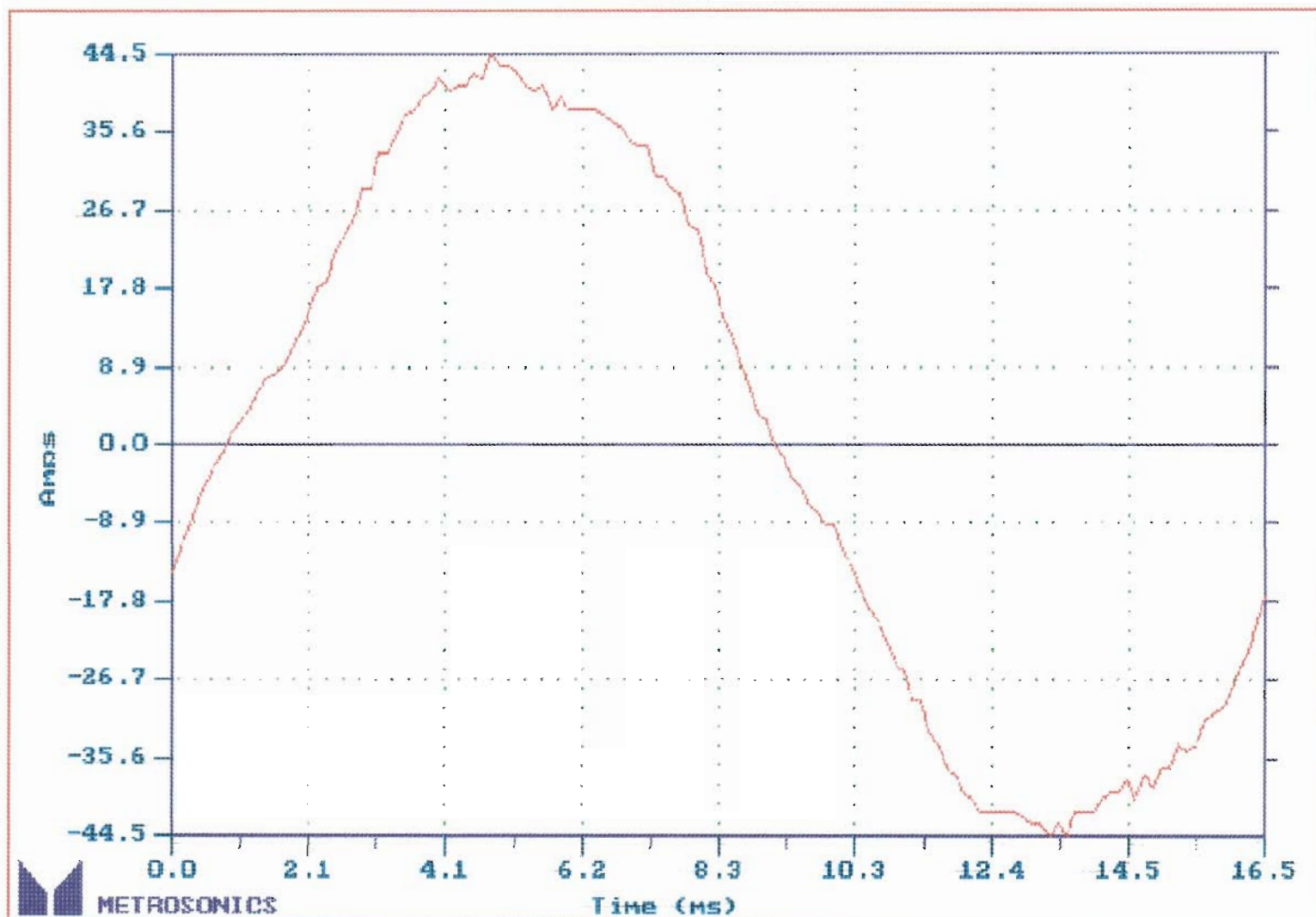


Event 20 of 86 For Ch 1 (PH A) Trigger occurred on cycle 1

Cycle 1 of 1 on 12/19/101 at 12:05:19.00

Total Harmonic Distortion...	2.48%	RMS of Fundamental.....	289.1V
Odd Contribution.....	2.48%	RMS of Fund+Harmonics...	289.2V
Even Contribution.....	0.21%		

Filename.....PQS-5
 Customer Name...
 Account/Meter #.
 Address One.....
 Address Two.....
 City,State,Zip..
 Phone Number....
 Comment 1.....@ meter # R1010
 Comment 2.....with additional 10 hp linear load



Event 20 of 86 For Ch 2 (PH A) Trigger occurred on cycle 1

Cycle 1 of 1 on 12/19/101 at 12:05:19.00

Total Harmonic Distortion...	5.70%	RMS of Fundamental.....	31A
Odd Contribution.....	5.64%	RMS of Fund+Harmonics...	31A
Even Contribution.....	0.83%	K Factor.....	1.36

Filename.....PQS-5
 Customer Name...
 Account/Meter #.
 Address One.....
 Address Two.....
 City,State,Zip..
 Phone Number....
 Comment 1.....@ meter # R1010
 Comment 2.....with additional 10 hp linear load

