

Power Quality
Engineering, Inc.

**Linear U91-3k
UPS Evaluation**

**PQE File 22099
June 10, 2002**



Linear Model U91-3K UPS Testing

BACKGROUND

Power Quality Engineering performed a review of a Linear, Model U91-3K UPS system. An eight channel BMI Model 8800 disturbance analyzer was used for the purpose of this testing. All threshold levels were set to the lowest values possible. The objective was to record any disturbance activity associated with the various modes of UPS operation.

Ed Weiss performed the testing on June 10, 2002.

CONCLUSIONS

Based on our review of the specifications and testing results, we are confident that this is a high quality UPS system that will meet or exceed the needs of our Medical Clients.

Specifics:

- No transition related voltage impulses.
- No significant high frequency noise associated with electronic tap switching.
- No significant voltage THD.
- Excellent waveshape quality with and without the inverter in operation.
- Computer Grade isolation transformer as a standard feature.
- TVSS protection as standard feature.
- The cabinet has an appropriate medical equipment appearance.

RECOMMENDATIONS

- Improve specification literature (colors, content, graphics, etc.)

MONITORING

Initially, the UPS was plugged into the line source with no load applied to the output. **Figure 1** is a status report graph illustrating good voltage level, stable frequency and high frequency noise levels that are very low (0.2 Vpp). **Figure 2** illustrates good voltage waveshape quality and **Figure 3** illustrates an excellent relationship between neutral and ground. **Figure 4** is a harmonic snapshot graph illustrating that Total Voltage Harmonic Distortion is only 2.5%.

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LINEAR 1                               Jun 10, 2002
STATUS REPORT                           10:41 AM

CHANNEL 3 (Voltage Channel 3)
Voltage: 119.2 Urms
Frequency: 60.0 Hz
High freq noise: 0.2 Vpp

NEUT-GND (Voltage Channel 4)
Voltage: 0.0 Urms
High freq noise: 0.1 Vpp
    
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Figure 1

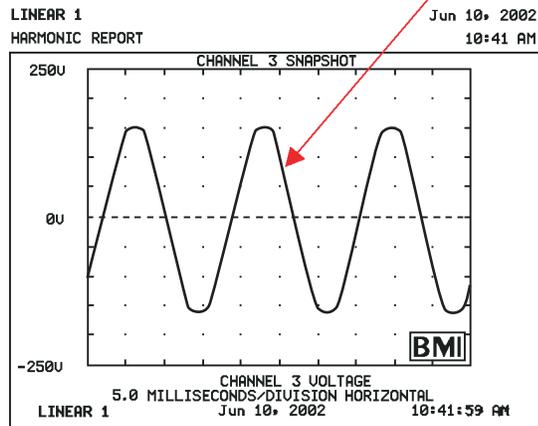


Figure 2

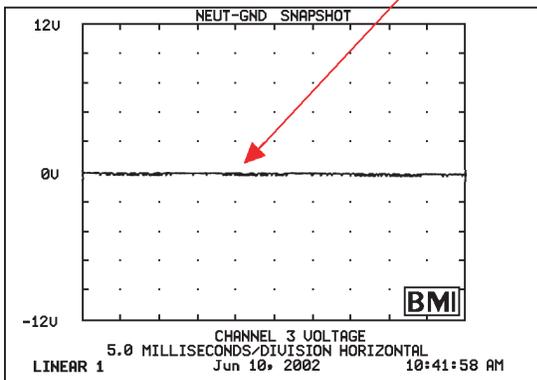


Figure 3

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LINEAR 1                               Jun 10, 2002
CHANNEL 3 VOLTAGE SPECTRUM             10:41:58.99 AM
Fundamental frequency: 60.0 Hz

Harmonic Percent Phase                 Harmonic Percent Phase
Fund 100.0% 0                          2nd
3rd 1.2% 72                             4th
5th 1.9% 175                             6th
7th 0.8% 7                               8th
9th 0.5% 91                              10th
11th 0.2% 285

Odd: 2.5%                               Even: 0.0%
Thd: 2.5%
    
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Figure 4

Next, the UPS was loaded to 47% of full load capacity and the input plug was disconnected. No disturbances were recorded during the transition. **Figure 5** illustrates a small increase in normal mode high frequency noise. **Figure 6** illustrates good waveshape quality being produced by the inverter. **Figure 7** illustrates no change in the neutral-ground relationship. **Figure 8** illustrates no change in Voltage THD.

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LINEAR 1                               Jun 10, 2002
STATUS REPORT                            10:43 AM

CHANNEL 3 (Voltage Channel 3)
Voltage:      120.7 Urms
Frequency:    60.1 Hz
High freq noise: 0.7 Upp

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NEUT-GND (Voltage Channel 4)
Voltage:      0.0 Urms
High freq noise: 0.1 Upp

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Figure 5

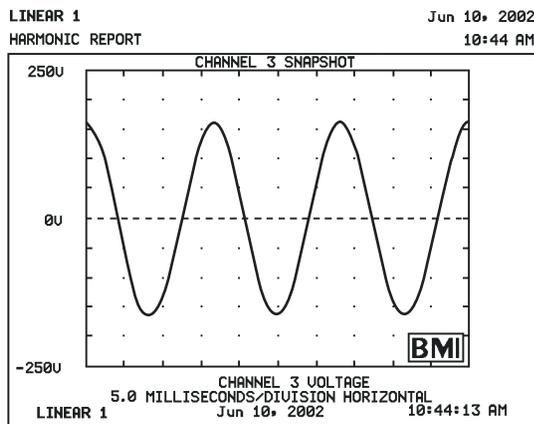


Figure 6

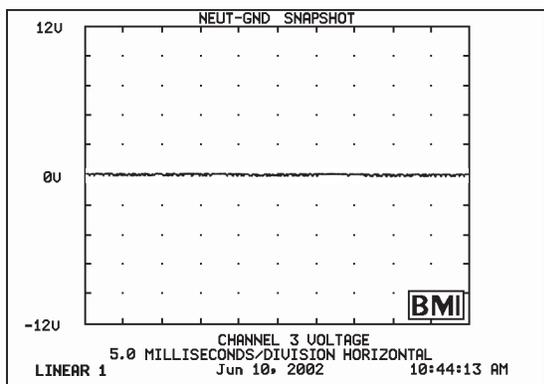


Figure 7

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LINEAR 1                               Jun 10, 2002
CHANNEL 3 VOLTAGE SPECTRUM              10:44:13.98 AM
Fundamental frequency: 60.1 Hz

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Harmonic	Percent	Sine Phase	Harmonic	Percent	Sine Phase
Fund	100.0%	0	2nd		
3rd	1.4%	348	4th		
5th	1.5%	36	6th		
7th	1.1%	21	8th		
9th	0.7%	312	10th		
11th	0.3%	320			
Odd: 2.5%			Even: 0.0%		
Thd: 2.4%					

Figure 8

Figure 9 is a one-hour strip chart report. Voltage noise and frequency remain unchanged and no voltage impulses were recorded. The line cord was disconnected and reconnected several times during this test. No disturbances were recorded.

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LINEAR 1                               Jun 10, 2002
STRIP CHART REPORT                       10:47 AM
From 10:00 AM To 11:00 AM

CHANNEL 3 (Channel 3)
Voltage:      120.7 Urms min, 120.7 Urms max
Noise:        0.7 Upp min, 0.7 Upp max
Frequency:    60.1 Hz min, 60.1 Hz max
Impulses:     0 counted

NEUT-GND (Channel 4)
Voltage:      0.0 Urms min, 0.0 Urms max
Noise:        0.1 Upp min, 0.2 Upp max
Impulses:     0 counted

```

Figure 9