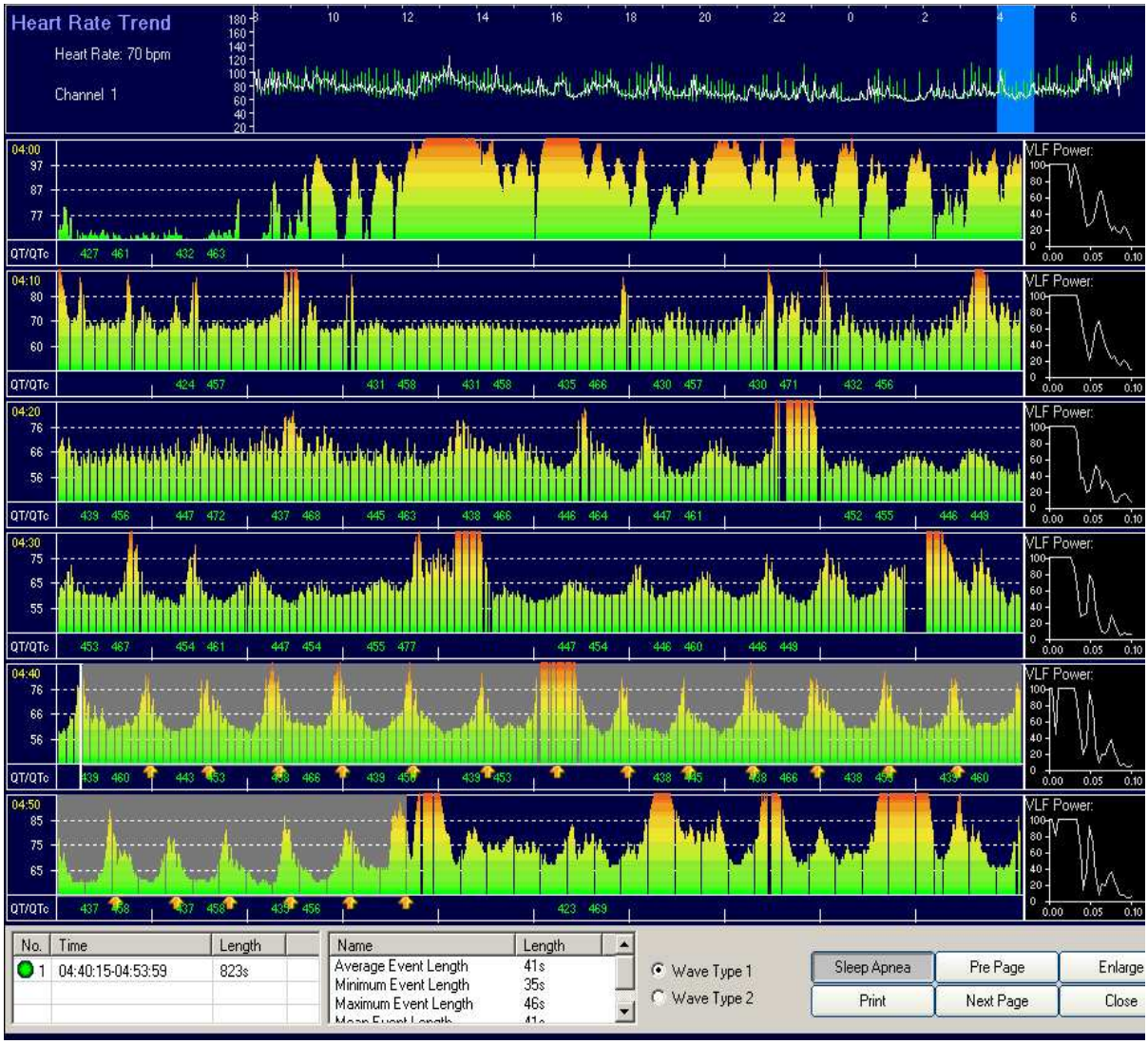
DMSoftware

CardioScan-12 Holter ECG Systems

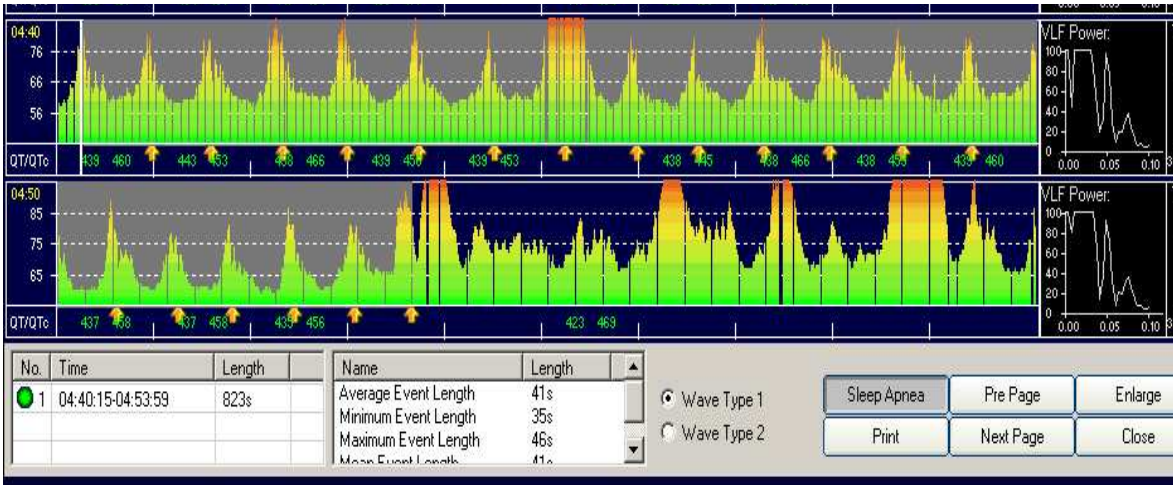
Sleep Apnea



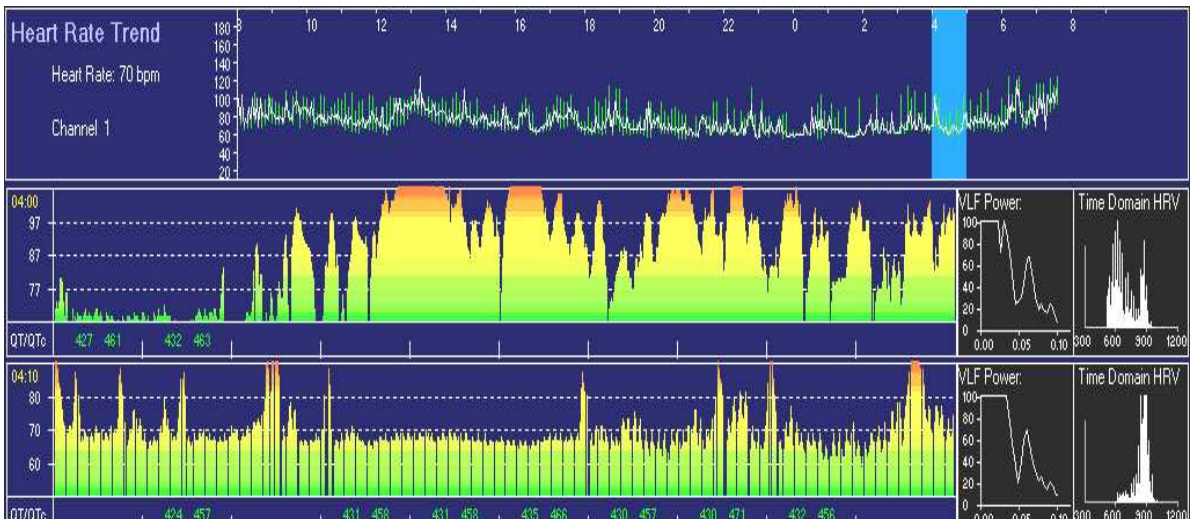
The above display shows a sleep disorder starting at 4:40 AM and ending at 4:53 AM. The sleep disorder episode is shown with the gray background, and each of the individual sleep events are shown with the yellow arrow markers.

Cardiac Sleep Disorders:

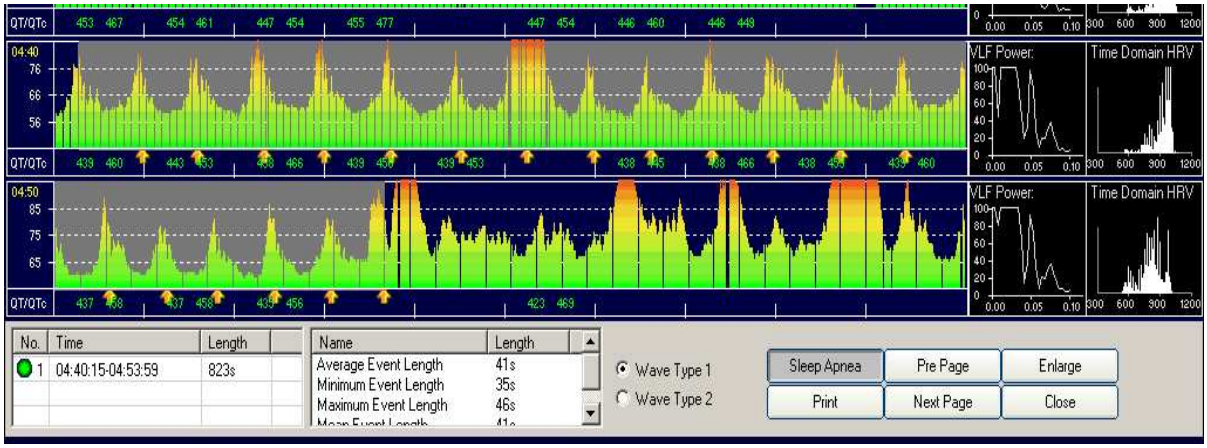
- Over the past 5-years there has been a shift of sleep disorders from pulmonary and neurology problems to cardiac problems.
- The credible medical literature has reported hundreds of studies on the cardiac association with sleep disorders.
- This was prompted by the observation that a high percentage of patients with documented sleep apnea from polysomnography tests evolved into cardiac disease. The source reasons for this evolution are controversial, but it appears to be quite clear that early detection of sleep apnea disorders may be a major factor in early detection and preventive programs for cardiac disease.
- The vast majority of cardiology studies on detecting sleep apnea disorders use Heart Rate Variability (HRV) techniques to detect transient sleep apnea disorders.
- The below display is the premier visual display of HRV activity in detecting these transient sleep disorders.



- The green vertical lines are all the normal R-R intervals in 10-minutes. These two horizontal sweeps represent 20-minutes of normal R-R intervals.
- The classic HRV activity in sleep disorders is a gradual brady-tachy change in Heart Rate during each abnormal breathing event.
- Each cycle of the ocean-wave-like look of the R-R intervals is an abnormal breathing event.
- It is clear that the R-R interval data pre and post the Sleep episode do not have the smooth brady-tachy R-R transition that matches the elongated abnormal breathing disorder events.

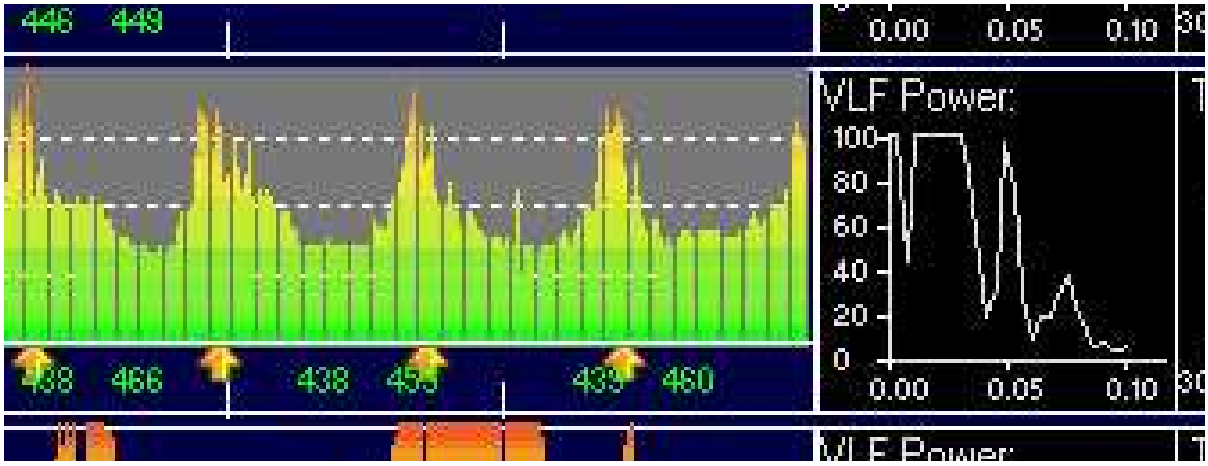


- This display is accessed from Page Scan.
- The top of the display shows the 24-hour heart rate with min, max, & avg. HR.
- With the mouse arrow you can select the desired 1-hour of R-R data. The light blue color shows the selected hour.
- With suspected sleep disorder patients, you would want to view the usual 6 to 8 hours of sleep. These sleep hours are usually the hours of slowest HR.
- By double clicking on the selected hour, the corresponding 1-hour of normal R-R intervals are displayed in 10-minute horizontal sweeps.
- In less than 1-minute all sleep hours are easily reviewed, and sleep disorder episodes are easily recognized.

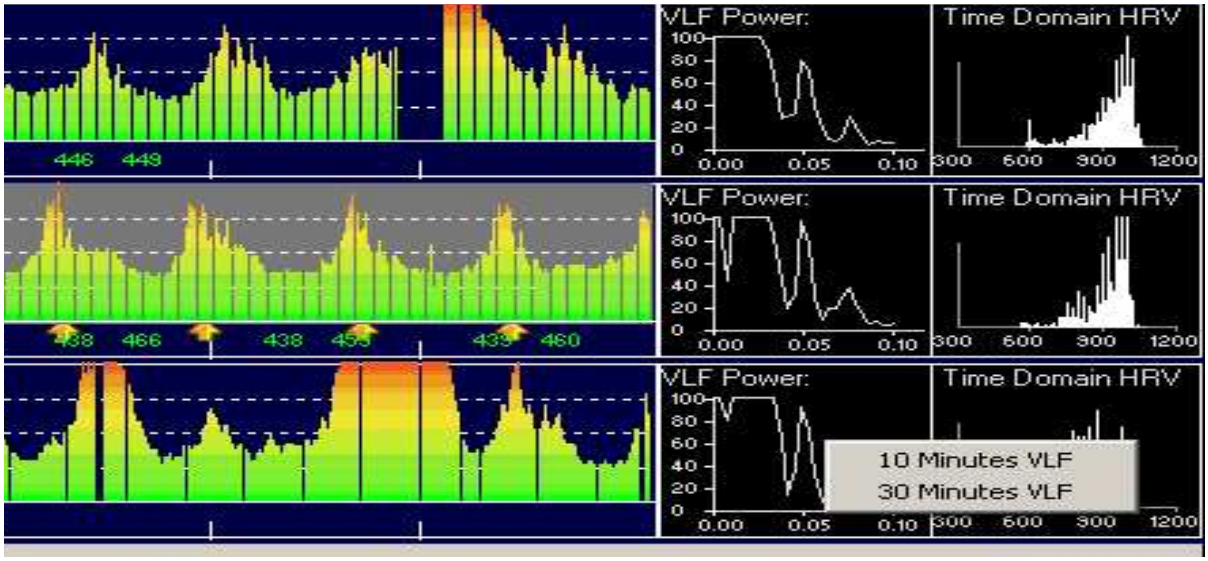


- The directly above data shows that the Sleep Disorder episode lasted for 823 seconds; with the Average Sleep Event at 41 seconds, the Minimum Sleep Event at 35 seconds, and the Maximum Sleep Event at 46 seconds.
- To the right of the wave-like R-R intervals is a Frequency graph of Heart Rate Variability that is spotlighted on the VLF (Very Low Frequency). A sudden drop in VLF power is clearly depicted, and many cardiology studies have associated this type of VLF function with Sleep Apnea Disorders.

- Thus, you have two independent confirmations of a Sleep Disorder episode.



- The VLF Power graph clearly shows a sudden drop in power at the far left side of the Frequency graph.
- Each 10-minute time period is subject to HRV analysis.
- The physician can choose to show the VLF Power for only those beats in the 10-minute time period, or you can choose a 30-minute time period that includes 10 minutes pre and 10 minutes post this 10 minute time period.



- You can select the 10 or 30 minute HRV analysis for each 10-minute horizontal sweep by placing the mouse arrow in the VLF Power area, and then doing a right mouse click.
- This VLF Power graph shows that there was no indication of a Sleep Disorder during the top 10-minute time period. The middle time period (which had the wave like display of R-R intervals throughout the 10-minute time period) has a significant drop in VLF Power. The next 10-minutes of R-R intervals shows

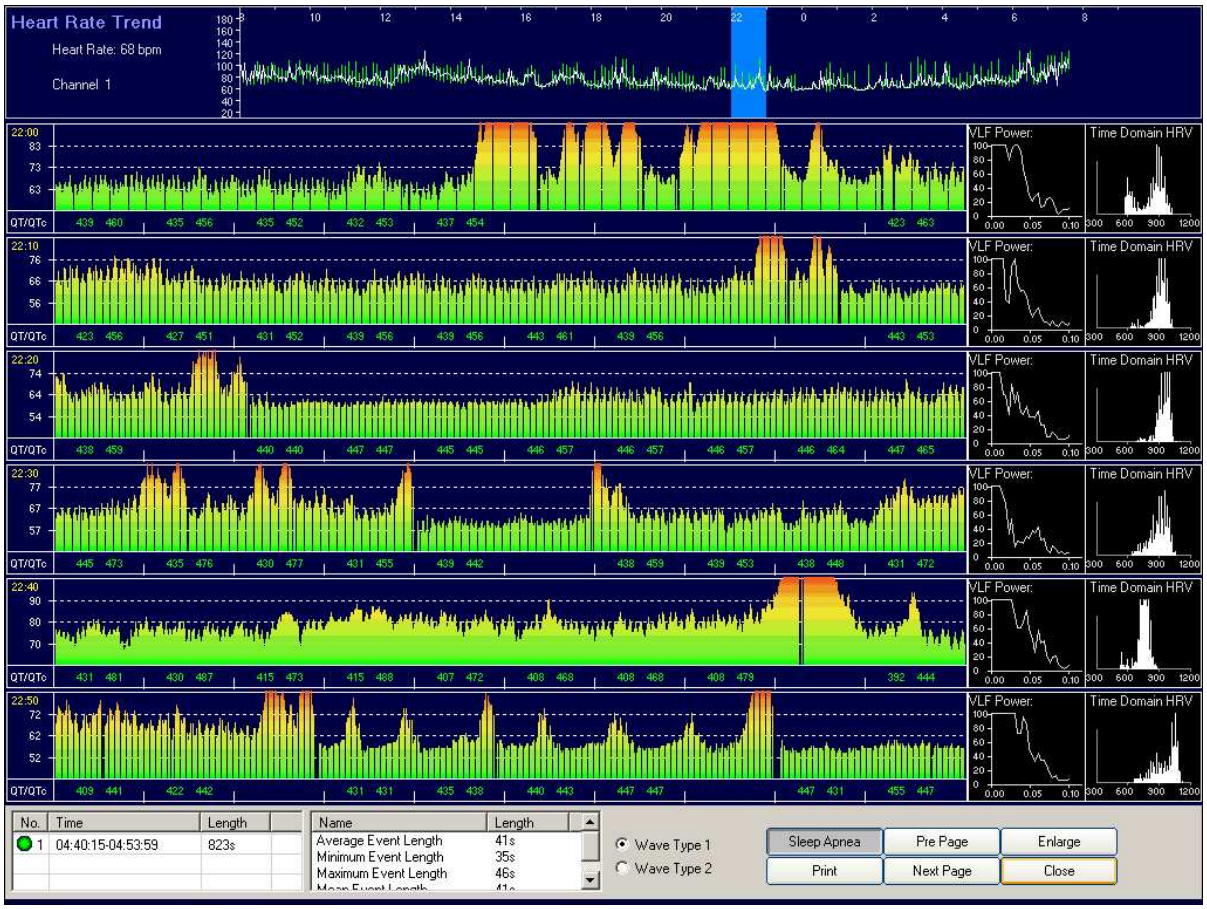
a small VLF Power drop, which matches the wave-like R-R intervals during the first half of the 10-minute time period.

The purpose of this test is to provide the physician with a simple and low cost procedure that can be a good indication for a Polysomnography overnight sleep study.

1. Accessing the internet for HRV Sleep Apnea studies will reveal a very large number of cardiology studies using Holter recorders and Heart Rate Variability for an efficient and economical method for the early detection of Sleep Apnea Disorders.
2. The general patient indications are males, over 40 years old, overweight, and snore. For females it is post-menopause, overweight, and snore.
3. This represents a huge quantity of patients presenting with these above indications.
4. The CardioScan 12 includes this Sleep Disorder analysis for each processing of a Holter recording.
5. There is no charge for this capability.
6. The data can be used as an early detection of a significant Sleep Disorder. However, a positive test should only be considered an indication for more traditional sleep disorder testing.
7. This capability can also be used as a follow-up to drug therapy or C-Pap therapy.
8. Since the time for viewing and verifying apparent sleep disorder events only takes about 1-minute of time and there is no additional cost, the CardioScan is the best choice for a quick and economical procedure for finding a transient and positive indication.
9. The basic Holter ECG function of reporting on heart rate changes has been found by the cardiology research community to be the key to the early detection of this very serious patient abnormality.

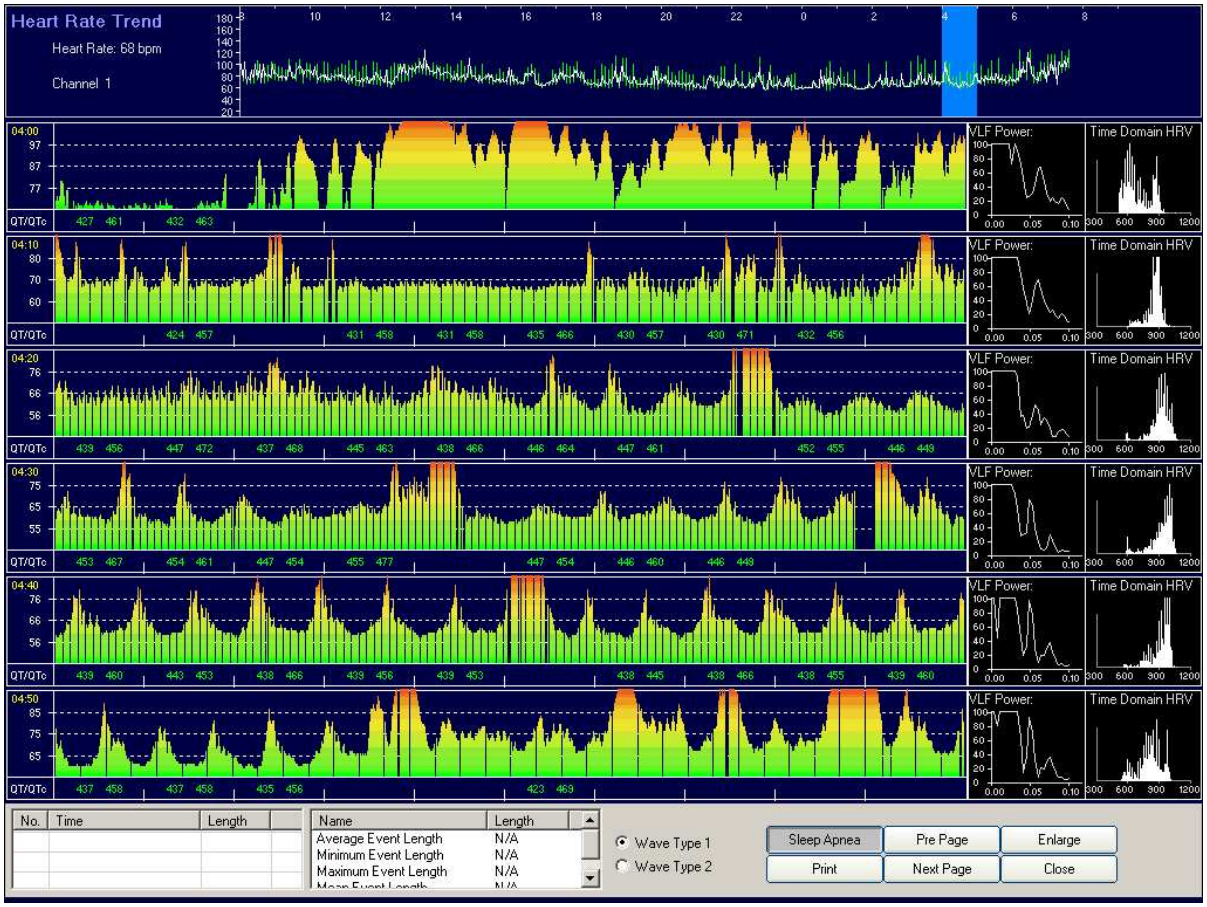
You access this Sleep Apnea Disorder data by clicking on Page Scan, and then clicking on Page Scan Sleep Apnea. Then click on each hour during the patient sleep hours. Within 1-minute you will know if there are any wave-like R-R events.

Procedure for Marking the length of time for the Sleep episode, plus each individual abnormal breathing event.

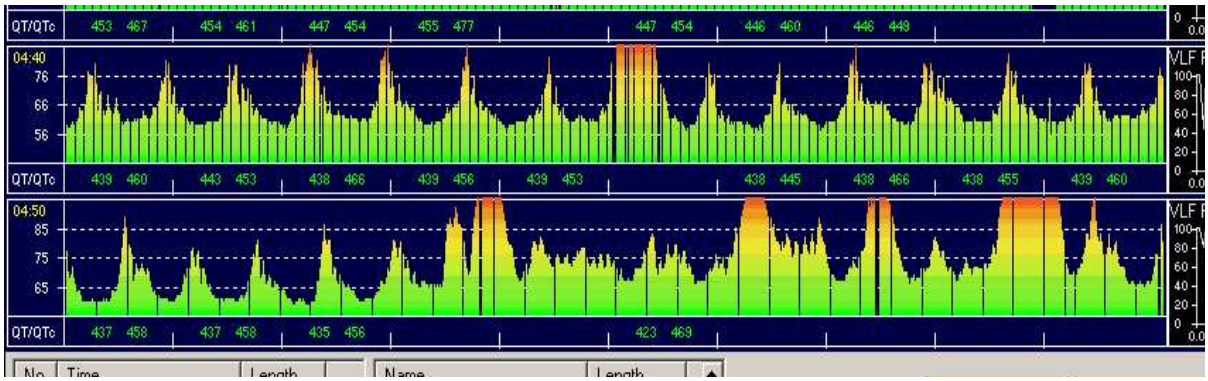


1. Click on the Sleep Apnea icon at bottom right of display.
2. The 24-hour heart rate graph is at the top of the display.
3. Assuming the sleep hours are usually from 10:00 PM to 6:00 AM, move the mouse arrow to the first sleep hour, and left click.
4. If the sleep hours are unknown, the time period of lowest heart rate probably represents the sleep hours.
5. When you click on the 10:00 PM hour in the heart rate graph will make that hour a light blue color in the 24-hour heart rate graph.
6. There appears to be a short period of breathing disorders on the bottom 10-minute display of normal R-R intervals.
7. Move from hour to hour with the mouse clicks until you find an hour of wave-like R-R intervals.
8. This will take less than 1-minute.

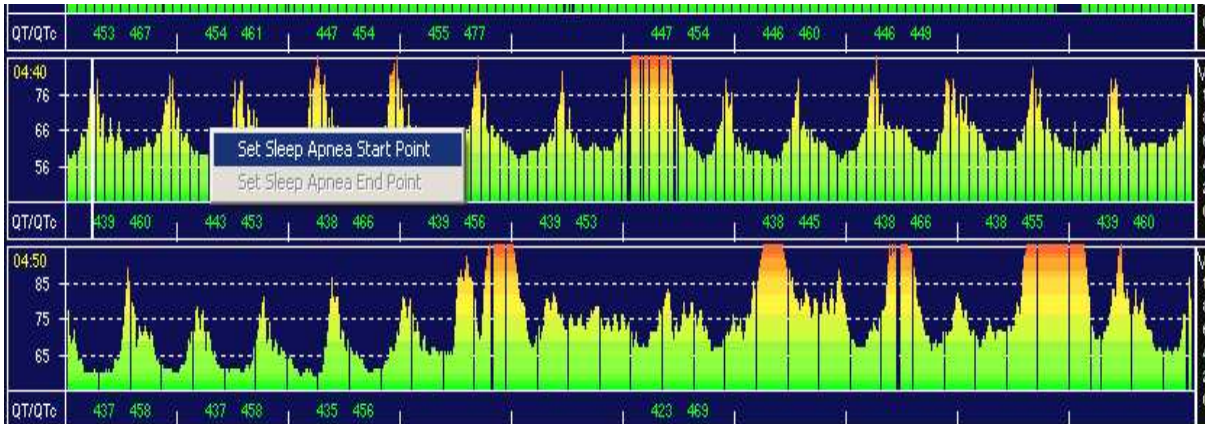
9. The 4:00 AM hour has the classic brady-tachy wave like display of R-R intervals.
10. Now use the mouse to mark the abnormal episode and events.



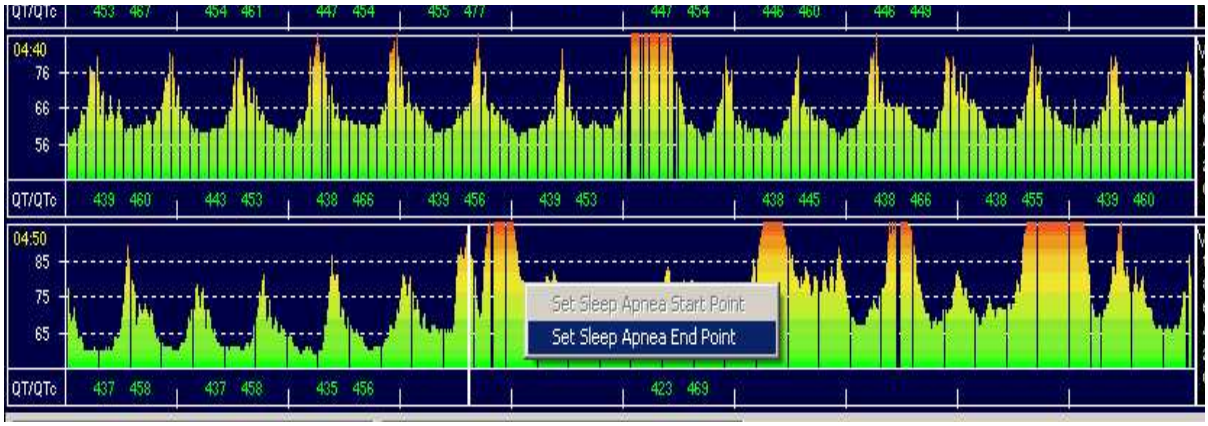
1. At the 4:00 AM hour, you can see the wave-like R-R intervals. The vertical length of each green line equals the width of an R-R interval. Only normal R-R intervals are displayed.
2. The fifth sweep shows the wave-shape, and the first part of the sixth sweep shows the same.



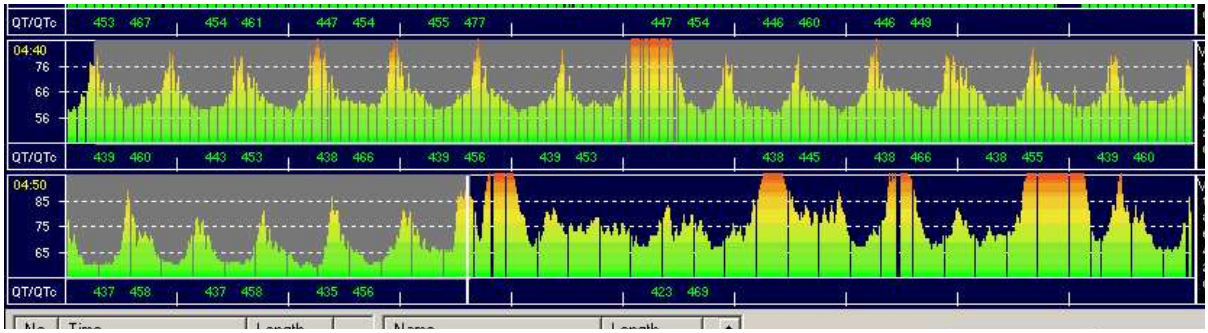
The mouse arrow will now be used to mark the Sleep Disorder episode, and the individual breathing events.



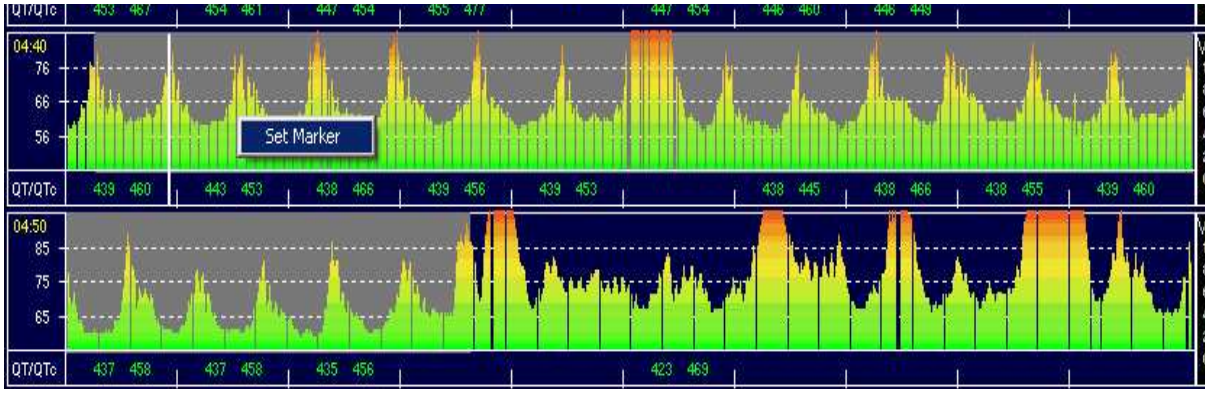
1. Place the mouse arrow at the beginning of the Sleep Apnea episode and do a left mouse click.
2. Then do a right mouse click, and do a left mouse click on “Set Sleep Apnea Start Point.”



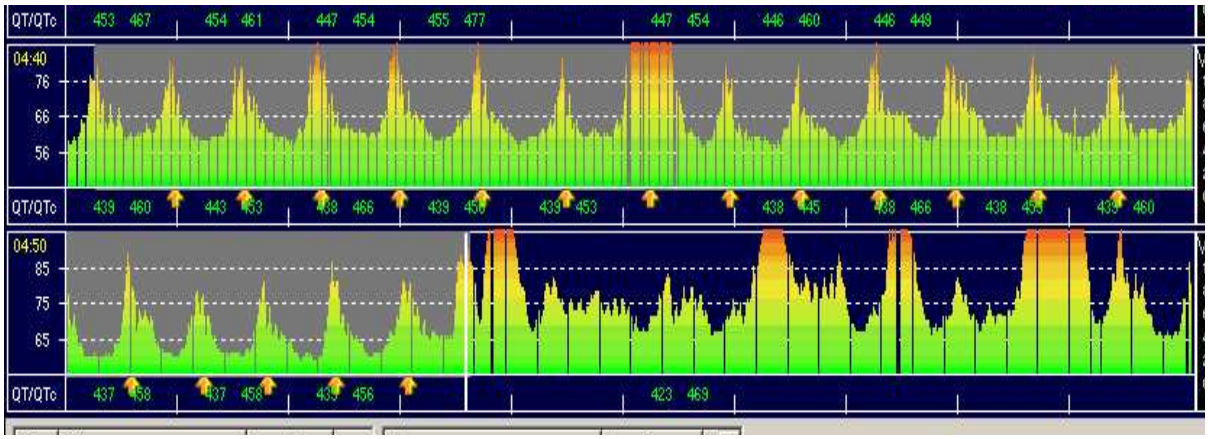
1. Place the mouse arrow at the end of the Sleep Apnea episode and do a left mouse click.
2. Then do a right mouse click, and do a left mouse click on “Set Sleep Apnea End Point.”



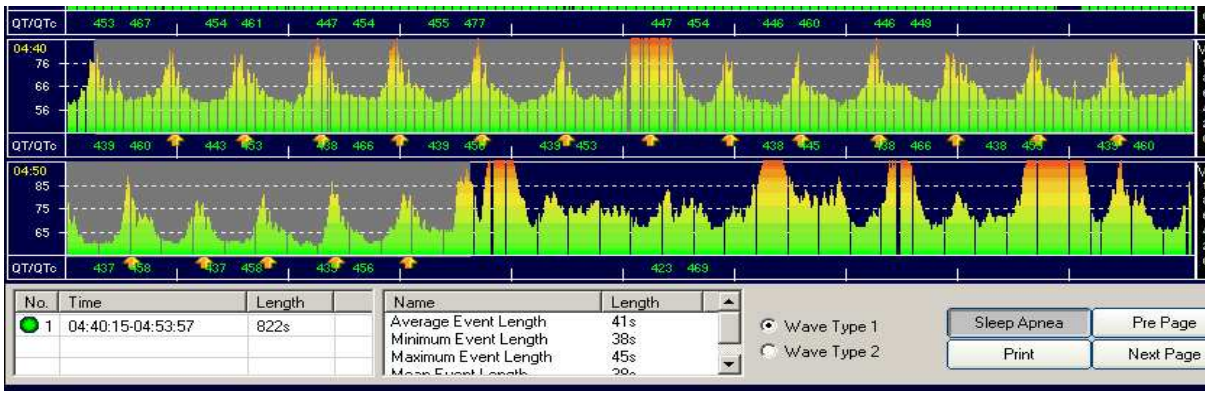
- The gray background area represents the Sleep Apnea episode.



1. To measure the length of the individual breathing events within the Sleep Apnea episode, place the mouse arrow on the peak of the first wave-like display, then do a left louse click, then a right mouse click, and then do a left mouse click on “Set Marker.”
2. Repeat this process on the following peaks.



1. When doing the “Set Marker” for each peak, you will see the yellow marker arrow inserted for each Event.



After setting the markers, the ST Episode length is shown above at 822 seconds. And the average, minimum, and maximum Event lengths are also displayed above. A right mouse click on the above green dot will erase the ST Episode. After completing the marker process, click on the Print icon to print the report.