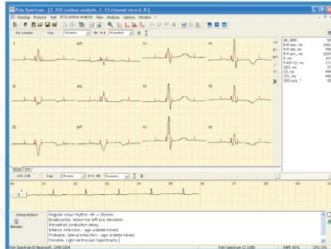# Poly-Spectrum

Additional Software Modules for Digital ECG Systems
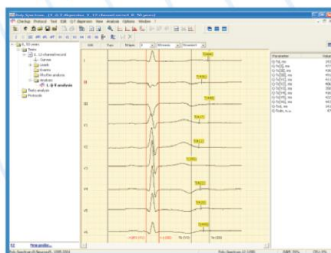

Poly-Spectrum-Analysis
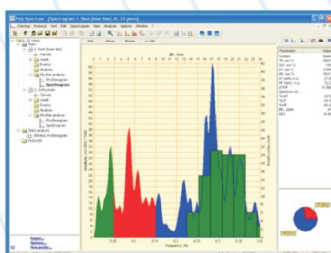
Poly-Spectrum-Analysis – ECG automatic measurement and interpretation software.

Poly-Spectrum-Ergo

Poly-Spectrum-Ergo – exercise testing software.

CAD diagnostics, risk stratification and prognosis in patients with established CAD, evaluation of perioperative risk for noncardiac surgery, determination of the degree of disability in subjects with various forms of heart disease, estimation of quality and quantity of exercise needed for a beneficial effect, assessment of maximal work capacity in normal individuals (sportsmen, army recruits, rescuers, policemen, firemen).

Poly-Spectrum-VLP

Poly-Spectrum-VLP – ventricular late potentials registration and analysis software. Registration of high resolution ECG in Frank orthogonal lead system.

Poly-Spectrum-QT

Poly-Spectrum-QT – Q-T interval dispersion analysis software.

Automatic analysis of Q-T interval dispersion according to the method used in «Rotterdam Study», the international population research, which was finished in 1998.

Poly-Spectrum-Rhythm

Poly-Spectrum-Rhythm – heart rate variability analysis software.

Vegetative tonus examination by HRV analysis (time-domain and frequency-domain) in accordance with the International Standard (1996).

Responses to standardized stimuli – cardiovascular reflex tests (standard battery of tests according to D. Ewing) analysis with automatic calculation of vegetative reactivity standardized indices.

Diabetic and alcoholic autonomic neuropathy diagnostics with the use of cardiovascular reflex tests.

Vegetative balance and psychoemotional strain examination by breath rhythm and heart rate variability cross-analysis (RF patent 2195163).

NEUROSOFT

Medical Diagnostic Equipment Development and Manufacture

Poly-Spectrum-Ergo

Exercise Testing Software for **Poly-Spectrum** Digital ECG Systems

1. A sample of elements arrangement on the PC screen. The main part of the screen is occupied by the curves area. The patient ECG recorded in the real-time operation mode is represented here. The lead system (standard, Frank or Nehb's system), number of displayed leads, ECG sweep speed and sensitivity are software switchable. The averaged cardiocomplex field is to the right of the curves area. Averaging is done by several last complexes. The averaged complex is represented as superimposed with displacement on the complex, which is averaged through the rest ECG recordings. HR (or R-R duration), workload and blood pressure time variation curves are given under the curves area.

2. Time variation curves of the ST displacement through all leads may also be shown under the curves area. To the right of the curves the numerical information is shown, these are test elapsed time, current stage elapsed time, current HR, current workload, cycling speed for cycle ergometry or speed and grade for treadmill. A switch to the next stage can be done manually (by keystroke) or automatically (by the software set time interval). The former way makes the checkup faster.
As for the automatic initial, it makes possible to execute test by a medical staff.

Poly-Spectrum-Ergo software allows executing exercise testing by different cycle ergometers and treadmills. It can operate with **Poly-Spectrum-12/E, Poly-Spectrum-8/E** or **Poly-Spectrum-8/EX** ECG systems.

Poly-Spectrum-Ergo module provides all the necessary software tools for exercise testing including special mode of exercise ECG imaging, the execution of the necessary on-line estimates, and the summary protocol generation.

Exercise Testing Protocols:

* Multistage test (on cycle ergometer or treadmill)
* One-stage test based on BEE value (on cycle ergometer)
* Astrand-Test (on cycle ergometer)
* PWC 170 (on cycle ergometer)
* Three-stage Swedish protocol by Sjostrand (on cycle ergometer)
* R. Bruce protocol (on treadmill)
* J. Naughton protocol (on treadmill)
* Any protocol constructed by the user (on cycle ergometer or treadmill).

3. At any time you can «freeze» ECG by keystroke. Then you can send it in ECG measurement and interpretation window (Fig. 4) or print it. All ECG including rest, exercise and recovery periods are stored in PC memory. The number of blood pressure measurements and their savings is unlimited.
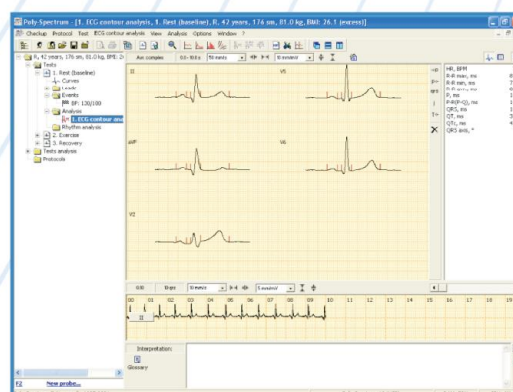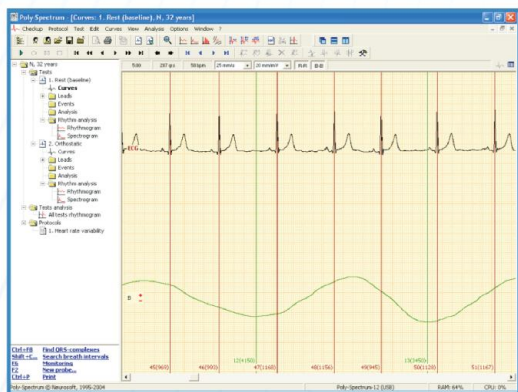

4. At the end of the test each ECG fragment can be analyzed in the ECG measurement and interpretation window.
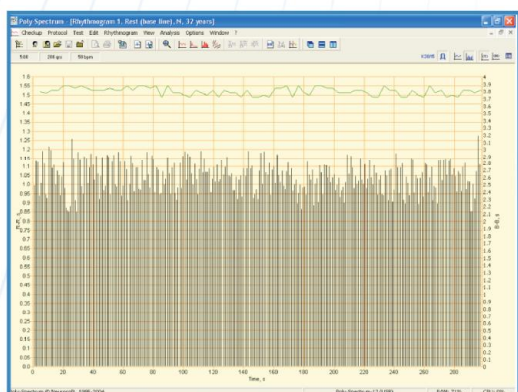
Poly-Spectrum-Rhythm

Heart Rate Variability (HRV) Analysis Software for **Poly-Spectrum** Digital ECG Systems

1. Electrocardiogram with QRS markers and calculated R-R intervals; pneumogram with markers at the start of each breath cycle and calculated «breath-breath» intervals.


2. Rhythmogram is a graphic chart that shows the dependence of R-R interval duration on time. Rhythmogram oscillations are the result of the regulation systems influence on heart (autonomic nervous system in particular). The green line is the breath rhythmogram. Its changes are determined by work of breath rate regulation systems.
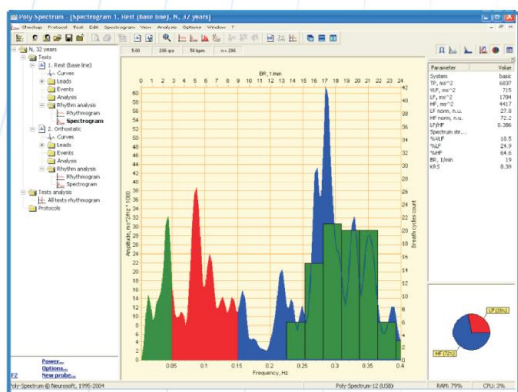

3. Spectrogram is a graphic chart that shows the dependence of rhythmogram oscillations amplitude on their frequency. Frequency ranges are differently colored: the dark blue area is proportional to the parasympathetic regulation power; the red one is proportional to the sympathetic regulation power.

The last two decades have witnessed the recognition of a significant relationship between the autonomic nervous system and cardiovascular mortality, including sudden cardiac death. Experimental evidence for an association between propensity for lethal arrhythmias and signs of either increased sympathetic or reduced vagal activity has spurred efforts for the development of quantitative markers of autonomic activity. HRV represents one of the most promising markers.

In 1996 the European Society of Cardiology and the North American Society of Pacing and Electrophysiology constituted a Task Force which developed and published «Heart Rate Variability Standards of Measurement, Physiological Interpretation, and Clinical Use».
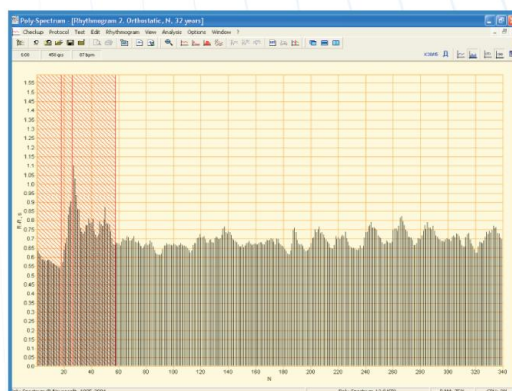
4. Orthostatic test rhythmogram. The wave appearing in the first 30 sec. is the vagus reaction.
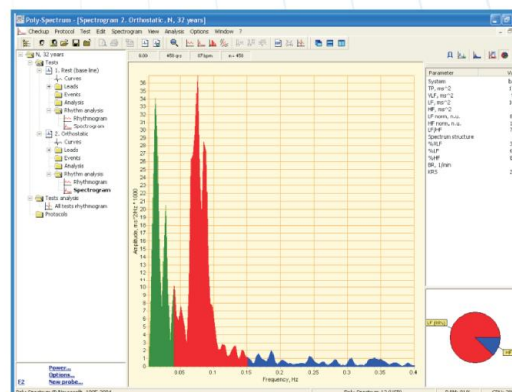
5. Orthostatic test spectrogram. Here one may clearly observe sympathetic response – the red area increase.

There are three HRV measurement approaches: time-domain analysis, frequency-domain analysis and the responses to standardized stimuli – cardiovascular reflex tests (standard battery of tests according to D. Ewing). The first two of above listed approaches are described in the Standard 1996, and the last is given in details in D. Ewing's publications. Ewing proposed using the standard battery of cardiovascular reflex tests.

These simple noninvasive cardiovascular reflex tests have now become the gold standard by which an autonomic neuropathy is diagnosed objectively, and by which other tests are judged. Their use was pioneered in the assessment of diabetes, but they are being used increasingly in a number of other conditions in which autonomic damage is suspected.

A perfect implementation of the described methods is HRV analysis software **Poly-Spectrum-Rhythm**. Nowadays many cardiologists and medical specialists all over the world successfully use this software in their daily clinical work. You can also get such a splendid opportunity.

Poly-Spectrum-Rhythm General Properties:

- Vegetative tonus examination by HRV analysis (time-domain and frequency-domain) in accordance with the International Standard (1996).
- Responses to standardized stimuli – cardiovascular reflex tests (standard battery of tests according to D. Ewing) analysis with automatic calculation of vegetative reactivity standardized indices.
- Diabetic and alcoholic autonomic neuropathy diagnostics with the use of cardiovascular reflex tests.
- Vegetative balance and psychoemotional strain examination by breath rhythm and heart rate variability cross-analysis (RF patent 2195163).
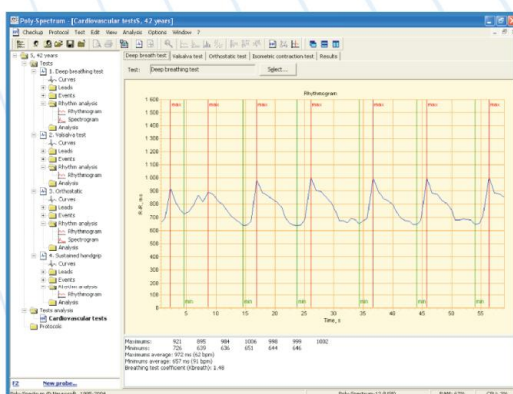
Poly-Spectrum-Rhythm software allows analyzing electrocardiograms recorded by different units: **Poly-Spectrum, Rheo-Spectrum, VNS-Micro, Neuron-Spectrum, Neuro-MEP** produced by **Neurosoft** Company.
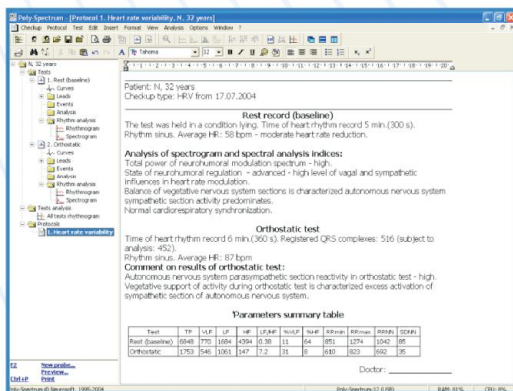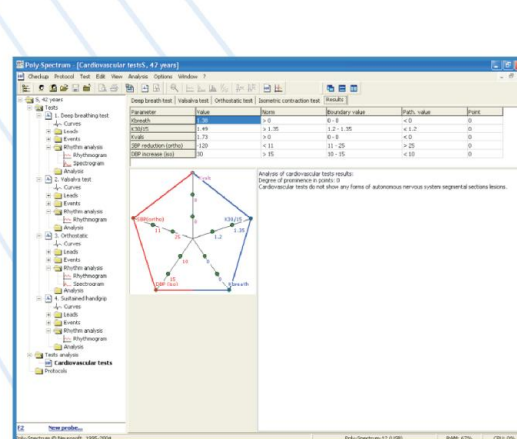

6. Checkup report of the HRV analysis by orthostatic test results.
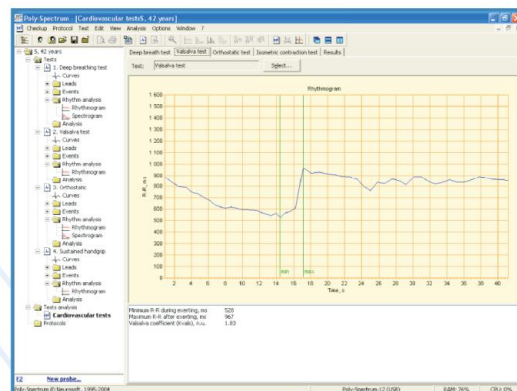
8. Valsalva maneuver rhythmogram.

7. Rhythmogram of deep breath testing. The heart rate modulation by breath is clearly seen. The leading role in this process belongs to the vagus.
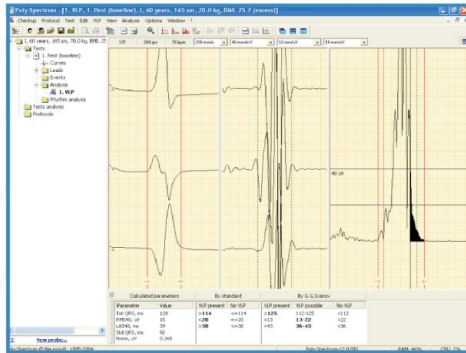

9. Interpretation of the cardiovascular tests results.

Poly-Spectrum-VLP

Ventricular Late Potentials Registration and Analysis Software for **Poly-Spectrum** Digital ECG Systems

1. Results of automatic VLP analysis.

A significant percent of world population die suddenly each year from sustained ventricular tachycardia or ventricular fibrillation. Most have coronary artery disease and left ventricular dysfunction. Essential to reducing the incidence of sudden cardiac death is the accurate identification of patients at high risk. Results of laboratory and clinical studies implicate reentrant mechanisms, at least in part, in the genesis of sustained ventricular tachycardia complicating ischemic heart disease.

Driven by the need to improve the noninvasive identification of patients susceptible to reentrant ventricular tachycardia, signal-processing technique for interrogating the terminal QRS complex and ST segment of the electrocardiogram (ECG) have been developed. The goal of this signal-averaged ECG technique is to detect occult derangements of ventricular activation, or late potentials, present during sinus rhythm that appear to be a hallmark for sustained ventricular arrhythmias.

In ACC Expert Consensus Document «Signal-Averaged Electrocardiography» published in 1996, the following recommendations on the use of this technique were given:

Established Value:

- Stratification of risk of development of sustained ventricular arrhythmias in patients recovering from myocardial infarction who are in sinus rhythm without electrocardiographic evidence of bundle branch block or intraventricular conduction delay (QRS complex >120 ms)
- Identification of patients with ischemic heart disease and unexplained syncope who are likely to have inducible sustained ventricular tachycardia

Valuable in Clinical Care, Further Supportive Evidence Desirable:

- Stratification of risk of development of sustained ventricular arrhythmias in patients with nonischemic cardiomyopathy
- Assessment of success of operation for sustained ventricular tachycardia

Promising but Currently Unproved:

- Detection of acute rejection of heart transplants
- Assessment of efficacy or proarrhythmic effects of antiarrhythmic drug therapy in patients with ventricular arrhythmias
- Assessment of success of pharmacologic, mechanical or surgical interventions to restore coronary artery blood flow

We would like to propose you including this brilliant method in your diagnostic arsenal. **Poly-Spectrum-VLP** applies this method and can operate with **Poly-Spectrum-12/E, Poly-Spectrum-8/E** and **Poly-Spectrum-8/EX** ECG systems, also produced by our company.

Poly-Spectrum-QT

Q-T Interval Dispersion Analysis Software for **Poly-Spectrum** Digital ECG Systems
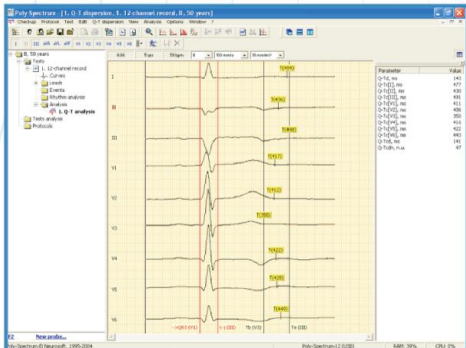
2. Results of automatic Q-T dispersion analysis.

Recent clinical studies have suggested that the interlead variability of the QT interval in the standard ECG, defined as QT dispersion, reflects regional differences in ventricular repolarization. Increased dispersion of recovery time is believed to increase the risk for serious ventricular arrhythmias. The results of population-based Rotterdam Study completed in 1998 showed that the increased QT dispersion, established by computer analysis, was associated with a higher risk for total mortality, cardiac death, sudden cardiac death, and nonfatal cardiac disease in a large nonhospitalized population of older adults. In this study the population consisted of 2358 men and 3454 women. The degree of QT dispersion was categorized into tertiles. In particular, the study results demonstrated that for QT dispersion in 8 leads, those in the highest tertile relative to the lowest tertile had a twofold risk for cardiac death and sudden cardiac death and a 40% increased risk for total mortality.

Nowadays the study of the Q-T interval dispersion analysis is used for examination of patients with cardiovascular diseases by physicians all over the word. We would like to offer you such a splendid opportunity too. **Poly-Spectrum-QT** is an excellent instrumental implementation. It can operate with **Poly-Spectrum-12/E, Poly-Spectrum-8/E** and **Poly-Spectrum-8/EX** ECG systems, also produced by our company.

The software can be used during exercise testing in the following cases: CAD diagnostics, risk stratification and prognosis in patients with established CAD, evaluation of perioperative risk for noncardiac surgery, determination of the degree of disability in subjects with various forms of heart disease, estimation of quality and quantity of exercise needed for a beneficial effect, assessment of maximal work capacity in normal individuals (sportsmen, army recruits, rescuers, policemen, firemen).
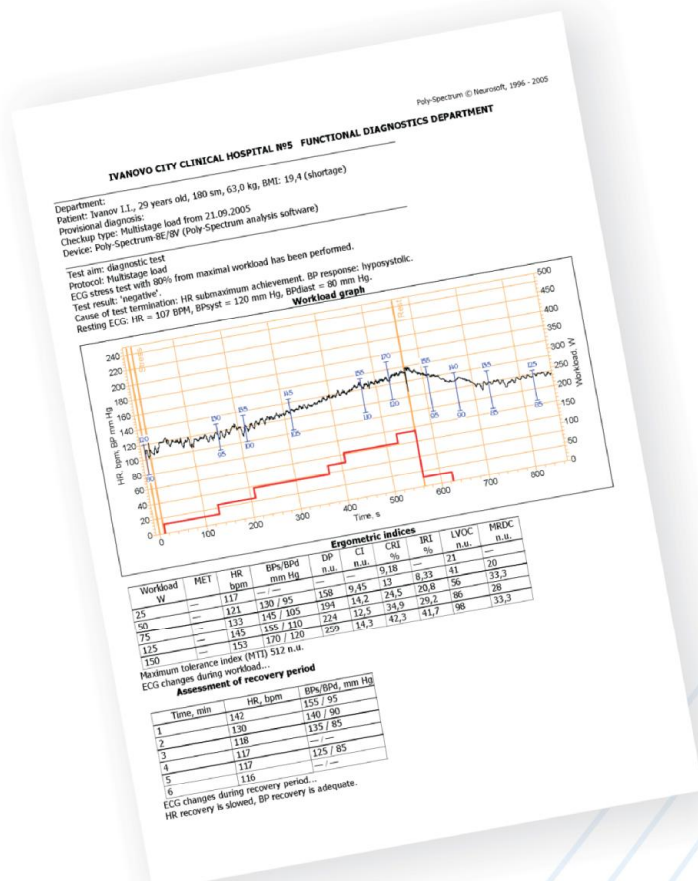

At the end of the test the software automatically generates the checkup report. It consists of test description; table with workload, MET, HR, BP and double product (rate-pressure product) values for each minute of exercise; ergometric parameters table; automatically defined functional class value and degree of disability; quality and quantity of exercise needed for a beneficial effect.
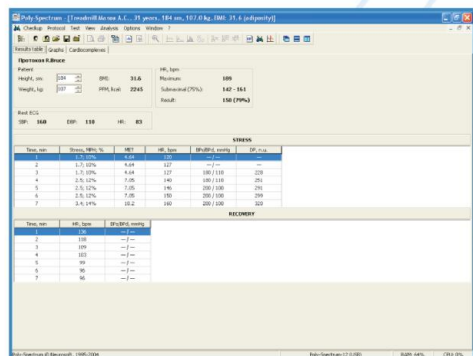

5. In addition to ECG contour analysis a number of ergometric parameters can be analyzed after exercise testing. Some of them are represented in the «Ergometry» window.
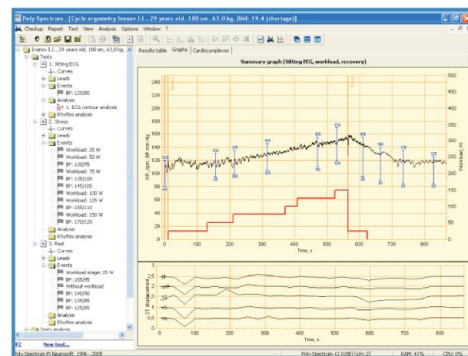
6. Moreover, the combined HR, BP and workload graphs are shown in «Ergometry» window.
The ST displacement curve is also represented here.
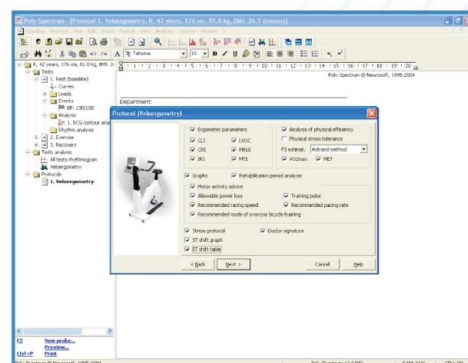
7. You may choose the elements you would like to include in the report. The most representative ECG fragments (at user's option) with the QRS complex amplitude-time parameters tables can also be included in the report. You may also print the whole ECG record.
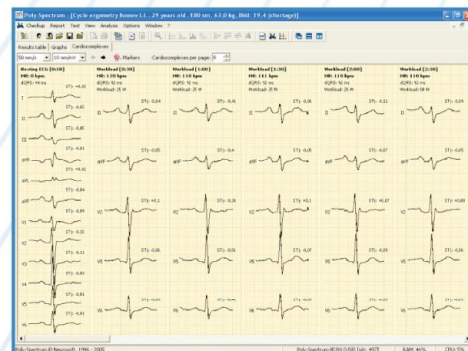
8. Every 30 seconds the program makes the automatic averaging of ECG fragment. The averaged fragment is stored in PC memory. After finishing of the testing all the averaged fragments are displayed in the separate window.