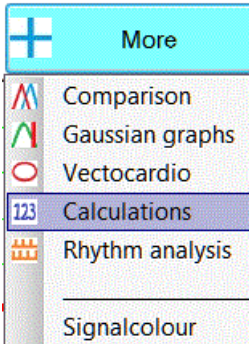


Additions to the manuals for ecg F12 and L12

| Chapter | | page |
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1 Calculated values



View a record and select "More" - "Calculations"

A screenshot of a 'Values' window displaying a table of ECG parameters. The table has 14 columns: P+, P-, Q, Qms, R, S, ST20, ST40, ST60, ST80, T+, T-, and T1/2. The rows represent different leads: I, II, III, AVR, AVL, AVF, V1, V2, V3, V4, V5, and V6. Below the table, there is a field for '% Ayrthmia' with the value 5 and a 'Quit' button.

| | P+ | P- | Q | Qms | R | S | ST20 | ST40 | ST60 | ST80 | T+ | T- | T1/2 |
|-----|----|-----|-----|-----|-----|-----|------|------|------|------|----|-----|------|
| I | 39 | 0 | 0 | 0 | 11 | 225 | 526 | 568 | 534 | 499 | 67 | -68 | -27 |
| II | 42 | 0 | 12 | 23 | -7 | 211 | 524 | 587 | 552 | 519 | 70 | -75 | -30 |
| III | 2 | 0 | 5 | 26 | 60 | 46 | -1 | 19 | 18 | 20 | 3 | -6 | -3 |
| AVR | 37 | -41 | 0 | 0 | 207 | 0 | -525 | -578 | -543 | -509 | 72 | -68 | 28 |
| AVL | 18 | 0 | 0 | 0 | 28 | 130 | 264 | 274 | 257 | 239 | 32 | -31 | -11 |
| AVF | 22 | 0 | 8 | 23 | 15 | 81 | 261 | 303 | 285 | 269 | 36 | -41 | -17 |
| V1 | 36 | 0 | 131 | 46 | -5 | 153 | 560 | 635 | 596 | 560 | 78 | -94 | -47 |
| V2 | 39 | 0 | 117 | 46 | -7 | 150 | 548 | 610 | 573 | 537 | 75 | -85 | -40 |
| V3 | 38 | 0 | 66 | 46 | -5 | 150 | 518 | 578 | 545 | 510 | 70 | -75 | -31 |
| V4 | 39 | 0 | 0 | 0 | 67 | 151 | 529 | 589 | 554 | 518 | 70 | -75 | -31 |
| V5 | 38 | 0 | 0 | 0 | 121 | 150 | 514 | 560 | 529 | 493 | 67 | -68 | -26 |
| V6 | 40 | 0 | 0 | 0 | 93 | 220 | 471 | 532 | 500 | 465 | 70 | -72 | -27 |

% Ayrthmia

The height of the values is in millivolt*100 (10 means 1 mm high)

The columns from left to right are :

- ❖ P+ largest positive deflection of the P wave.
- ❖ P- largest negative deflection of the P wave.
It's possible that P waves and T wave are biphasic.
- ❖ Q , R and S as positive numbers.
- ❖ **Qms duration of the Q waves in milliseconds.**
- ❖ ST20, ST40, ST60 and ST80: the ST segment deviation 40, 60 of 80 milliseconds after the J point.
- ❖ T+ largest positive T wave deviation.
- ❖ T- largest negative T wave deviation
- ❖ T1/2 : value of T wave halfway.

These vales are used in the protocol formulas.

Below left is located “% Arythmia”. Is the maxmost deviation of RR distance to the mean RR distance.

How are all these numbers useful ?

They offer complete transparency for the protocol.
Verification of the amplitudes in use is possible.

2. Setup - Hints of the Ecg protocol.

Hints are tips, all possibilities that require your attention.

The setup of the “Hints” permits the user to enter the limits for the hints.

Often, a full description of all the record properties is not possible in a single line.

Most recording have also additional properties.

Example: an isolated negative T wave lead III should be mentioned, but is not always pathological.

| | I | II | III | AV | AV | AV | V1 | V2 | V3 | V4 | V5 | V6 |
|-----|----|----|-----|----|----|----|----|----|----|----|----|----|
| Q | 30 | 30 | 30 | 30 | 30 | 30 | 25 | 25 | 25 | 25 | 25 | 25 |
| T+ | 66 | 66 | 66 | 66 | 66 | 66 | 66 | 66 | 66 | 66 | 66 | 66 |
| T- | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 |
| ST | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| ST- | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |

Meaning of the percent in the abbreviations – first 3 rows

Q = 30 in I means that a Q wave deeper then 30 percent of the following R wave in lead I is added to the hints list.

T+ = 66 in I means that a T wave higher then 66 percent of the preceding R wave in lead I is added to the hint list.

T- = 14 : a T wave lower then 14 percent of the preceding R wave is added to the hint list as being low.

Meaning of the percent in the abbreviations – last 2 rows in 1/10 mm

ST+ = 10 positive ST60 segment deviation in corresponding lead is max 1 mm.

ST- = 20 negative ST60 segment deviation in corresponding lead is max 2 mm.

Using 10 for ST segment deviation in the precordial leads has as result that the precordial leads are often added to the hints.

Early re polarisation is not an exceptional entity.

Show help

shows the above information.

Default - Standard :

Values as mentioned above.

The user has the possibility to modify the values.

These values are saved in the file \InstallationDirectory\EcgConfig.xml

3 Setup of the Ecg protocol - modify conclusions protocol

The explication that follows is dedicated to the setup of the protocol. It is not for beginning users. Advanced users have the possibility to modify the conclusions of the protocol, even to add a pathology or to use a different configuration.

CAUTION:

Before modifying the protocol, backup the file \EcgProtocol.xml in the installation directory. The use of an invalid formula can stop Ecg.exe from executing. In that case, simply restore the previous EcgProtocol.xml file

In Ecg.exe open "Setup" "Protocol"
Click on a pathology in the listbox at left to select it.
Below "Left ventricular hypertrophy" is selected.

3 4 5

Ecg Protocol

Backup file \Ecgprotocol.xml before editing

1

- Right atrial hypertrophie
- Left ventricular hypertrophy
- Left ventricular hypertrophy
- Right ventricular hypertrophy
- Hypocalcemie
- Hypercalcemie
- Hypopotassemia ? (low T waves)
- Acut anterior infarct

Click on a pathology to edit.

2

N Linker ventikelhypertrofie

D Linksventrikulare Hypertrophia

E Left ventricular hypertrophy

F Hypertrophie ventriculaire gauche

S Hipertrofia ventricular esquerda

| | Min | Max |
|-----------|------|-----|
| Frequency | 40 | 150 |
| P° | -180 | 360 |
| QRS° | -180 | 360 |
| T° | -180 | 360 |
| PP | 0 | 300 |
| PQ | 0 | 300 |
| QRS | 0 | 125 |
| QT | 180 | 720 |
| QTc | 180 | 720 |
| Arythmia% | 0 | 99 |

Save

Save as..

Quit

6

(RRR10>270) OR (RRR11>270) OR (RRR12>270) OR (SSSS7>300) OR (SSSS8>300) OR (SSSS9>300) OR

(RRR10+SSSS7>400) OR (RRR10+SSSS8>400) OR (RRR10+SSSS9>400) OR (RRR11+SSSS7>400) OR (RRR11+SSSS8>400) OR

(RRR11+SSSS9>400) OR (RRR12+SSSS7>400) OR (RRR12+SSSS8>400) OR (RRR12+SSSS9>400) OR (RRRR5>130)

OR (RRRR6>200)) AND (TTT11>11) AND (TTT12>11)|

Verify and edit a diagnosis

We give a practical example: left ventricular hypertrophy, see previous page.

- 1: Click on it in the list on the left side.
- 2: If necessary edit the name of the pathology in your language E = English
- 3 : List of general properties, properties for all the pathologies.
- 4: Minimum of a property (3) in a given pathology.
- 5: Maximum of a property (3) in a given pathology.
- 6: Formula for a certain pathology. Left ventricular hypertrophy (**LVH**) is the largest formula of all. Don't let impress you. The explication follows.

Meaning of the general properties in the formulas.

| | Min | Max |
|---|------------|---------------|
| . Frequency/ minute. | 40 | 150 |
| => LVH is possible for each recording with a frequency between 40 and 150 / minute. | | |
| . Axis of the P wave in degrees. | -180 | 360 degree |
| . Axis of the QRS complex in degrees. | -180 | 360 degree |
| . Axis of the T wave in degrees. | -180 | 360 degree |
| => LVH is possible on any axis of P, QRS and T. | | |
| . PP: time of the P wave in milliseconds. | 0 | 300 ms |
| . PQ: PQ time in milliseconds. | 0 | 300 ms |
| . QRS: QRS time in milliseconds. | 0 | 125 ms |
| . QT: QT time in milliseconds. | 180 | 720 ms |
| . QTC: QT/(square of RR interval) in milliseconds | 180 | 720 ms |
| . Arrhythmia% sensitivity. . | 0 | 99 % |

==> For LVH all the borders where set as large if possible.

The intention is not to exclude recordings on these properties for the diagnoses of LVH
However there is one exception:

QRS time maximal is set to 125 ms : the QRS complex may not be to much enlarged:
LBBB excludes LVH.

Meaning of the abbreviations in the formulas (6) :

Look at the formulas that appear often in up to 5 lines below.

The 5 digit variables in use are :

PPPP1, PPPP2 at PPP12 : maximal P wave in I,II..V6

PPPM1 .. PPM12 maximal negative P wave I..V6

QQQQ1..QQQ12 : Q wave from I at V6.

QTQQ2..QTQ12 : duration of the Q wave

RRRR1..RRR12 : R wave from I at V6.

SSSS1..SSS12 : S wave

ST201..ST212 : ST20 segments.
 ST401..ST412 : ST40 segments.
 ST601..ST612 : ST60 segments.
 ST801..ST812 : ST80 segments.
 TTTT1..TTT12 : maximal positive T wave from I at V6.
 TTTM1..TTM12 : maximal negative T wave from I at V6.

The two logical operators allowed are AND and OR
 The two comparator signs are > and < (highest precedence)
 The four calculations that are possible are +,-,% and *

The possible evaluations in the formulas are:

+ , - , % and < , > , () , OR , AND

Operator precedence from left to right:

% + - < > () OR, AND

For LVH the formula is

(RRR10>270) OR (RRR11>270) OR (RRR12>270) OR (SSSS7>300) OR (SSSS8>300) OR (SSSS9>300)
 OR (RRR10+SSSS7>400) OR (RRR10+SSSS8>400) OR (RRR10+SSSS9>400) OR (RRR11+SSSS7>400)
 OR (RRR11+SSSS8>400) OR (RRR11+SSSS9>400) OR (RRR12+SSSS7>400) OR (RRR12+SSSS8>400)
 OR (RRR12+SSSS9>400) OR (RRRR5>130) OR (RRRR6>200)) AND (TTT11>11) AND (TTT12>11)

This is the largest formula of all pathologies.

Spoken in words, the formula becomes:

The diagnosis of LVH is applicable when

- R wave in V4-V5-V6 is higher then 27 mm
- OR the S wave in V1-V2-V3 is higher then 30 mm
- OR the sum of R+S in any pre cordial leads is higher then 40 mm
- OR the R wave in AVL is higher then 13 mm
- OR the R wave in AVF is higher then 20 mm
- AND the T wave in V5 or V6 higher then 1.1 mm

Some other examples of a formula: (the program has a lot of examples)

Right auricular hypertrophy

(PPPP2>25 OR PPPP3>25 OR PPPP6>25) means that the P wave in II,III or AVF should be higher then 2,5 millivolt.

Inferior infarction

(QQQ2>25%RRRR2) OR (QQQ3>30%RRRR3) AND (QQQ6>30%RRRR6) AND (QTQQ2>30) OR (QTQQ3>30) AND (QTQ6>30)

QQQ2>25%RRRR2: if the Q wave in lead II is deeper then 25% of the R wave means a pathological Q wave in lead II

QTQQ2>30: duration of the Q wave in lead II should be longer then 30 msec in lead II

Formulated in words: for the diagnosis of inferior infarction, at least two Q waves are necessary with a duration more then 30 ms (one in II or III and one in AVF) and the R waves are visible (> 1 mm).

Edit existing pathology

Select the pathology in the list (1).
Modify the properties (4,5) and formula. (6).

After modifying the selected pathology, select **Save** and then Quit.

Example

Some users want a Sokolow index of 35 mm for the diagnosis of left ventricular hypertrophy.

Select in (1) 'Left ventricular hypertrophy'.

Replace in the formula 400 by 350 and save.

Add new pathology

Select a similar pathology in the left column.

Enter next to 'Pathology' the new name after the **E** (English).

Enter the new or modified formula and the limits of P-QRS-ST and T segment.

Select "**Save as**" and then Quit.

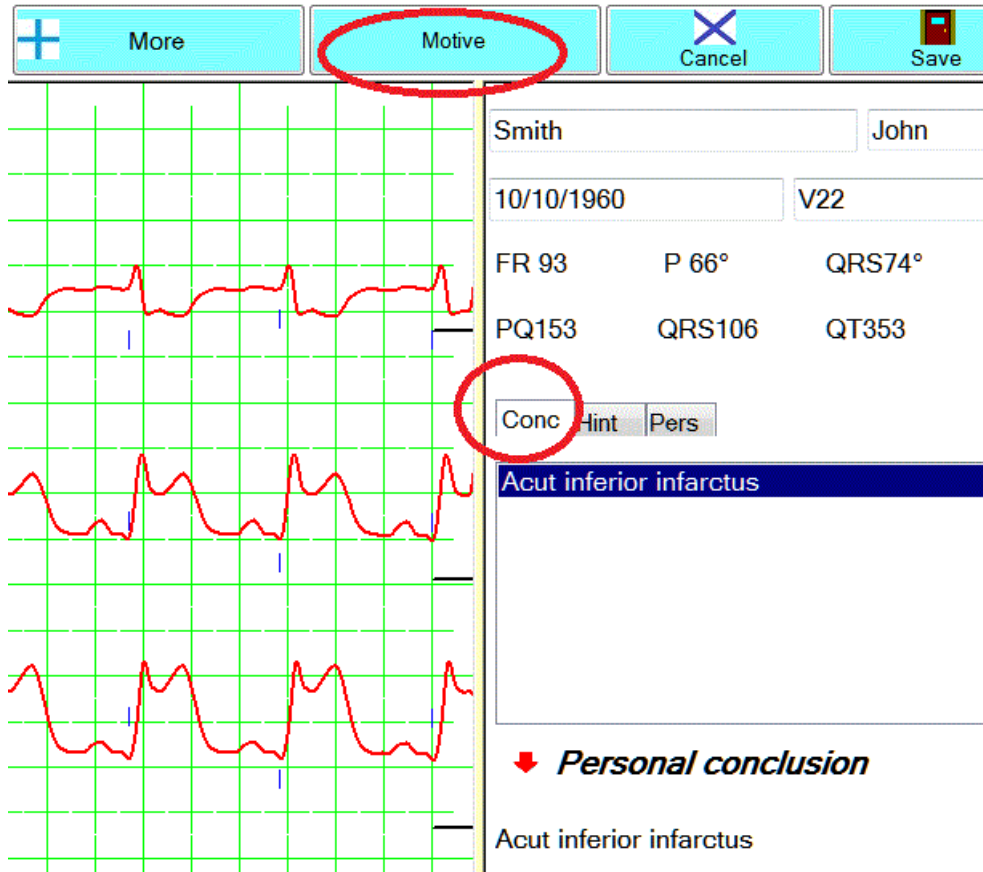
Remark:

Advanced users can edit the file \EcgProtocol.xml with an XML editor.

Examples of a free XML editors are Microsoft sharepoint or XMLMarker.

4 Motivation

When the tab **Conc** is activated, the button '**Motive**' becomes visible.



The screenshot displays a medical software interface. At the top, there are four buttons: 'More' (with a plus sign), 'Motive' (circled in red), 'Cancel' (with an X), and 'Save' (with a floppy disk icon). Below the buttons, the patient's name 'Smith' and 'John' are shown in a text box. The date '10/10/1960' and 'V22' are also visible. The ECG data is presented in three rows on a green grid. The first row shows 'FR 93', 'P 66°', and 'QRS74°'. The second row shows 'PQ153', 'QRS106', and 'QT353'. Below the ECG, there are three tabs: 'Conc' (circled in red), 'Hint', and 'Pers'. The 'Conc' tab is active, showing a blue bar with the text 'Acut inferior infarctus'. Below this, there is a red arrow pointing down to the text '*Personal conclusion*', followed by 'Acut inferior infarctus'.

Click button "**Motive**"

Motivation window

On the left are the list of the pathologies that are examined.
By clicking on a pathology, it's very easy to see why a particular diagnosis is applicable or not.

| Click - select a pathology | | Min | Max | Patient | Result |
|--------------------------------------|----------------------|------|-----|---------|--------|
| WPW type I | Frequency | 50 | 150 | 93 | OK |
| WPW type II | P° | -180 | 360 | 66° | OK |
| Complete left bundle branch block | QRS° | -180 | 360 | 74° | OK |
| Complete right bundle branch block | T° | -180 | 360 | -67° | OK |
| Incomplete right bundle branch block | PP | 0 | 300 | 90 | OK |
| Left anterior hemiblock | PQ | 0 | 300 | 153 | OK |
| Left posterior hemiblock | QRS | 0 | 130 | 106 | OK |
| AV Block first order | QT | 180 | 720 | 353 | OK |
| Left atrial hypertrophy | QTc | 180 | 720 | 439 | OK |
| Right atrial hypertrophie | % Ahythmia | 0 | 99 | 6 | OK |
| Left ventricular hypertrophy | (ST60 in II>20) AND | | | | OK |
| Left ventricular hypertrophy | (ST60 in III>20) AND | | | | OK |
| Right ventricular hypertrophy | (ST60 in AVF>20) AND | | | | OK |
| Hypocalcemie | (ST60 in I<15) AND | | | | OK |
| Hypercalcemie | (ST60 in AVL<15) | | | | OK |
| Hypopotassemia ? (low T waves) | | | | | |
| Acut anterior infarct | | | | | |
| Acut inferior infarctus | | | | | |
| Acut lateral infarctus | | | | | |
| Acut subendocardial infarctus | | | | | |
| Lateral infarctus | | | | | |
| Posterior infarctus | | | | | |
| Slow R progression precordial | | | | | |

In the above example, all conditions for “acute inferior infarctus” are fulfilled.

Every property is marked as 'OK' or 'NOT OK'.
When everything is 'ok', the diagnosis is applicable.

Attention: if some parts of the formulas are coupled with **OR**,
it's ok if one condition from them is ok!

Table with in row 1 + row 2 conditions “ok” or “not ok” and below the result.

| | | | | | | |
|-------------|-------------|-------------|---------|--------------|------------|--------|
| Condition 1 | “Not ok” or | “Not ok” or | “Ok” or | “Not ok” and | Not ok and | Ok and |
| Condition 2 | “Not ok” | “Ok” | “Ok” | “Not ok” | ok | Ok |
| Result | Not ok | Ok | Ok | Not ok | Not ok | Ok |

Example of formula with OR :

| Pathology | Min | Max | Patient | Result |
|--------------------------------------|------|-----|---------|--------|
| WPW type I | 40 | 180 | 74 | OK |
| WPW type II | | | | |
| Complete left bundle branch block | | | | |
| Complete right bundle branch block | | | | |
| Incomplete right bundle branch block | | | | |
| Left anterior hemiblock | | | | |
| Left posterior hemiblock | | | | |
| AV Block first order | | | | |
| Left atrial hypertrophy | | | | |
| Right atrial hypertrophie | | | | |
| Left ventricular hypertrophy | | | | |
| Right ventricular hypertrophy | | | | |
| Hypocalcemie | | | | |
| Hypercalcemie | | | | |
| Hypopotassemia ? (low T waves) | | | | |
| Acut anterior infarct | | | | |
| Acut inferior infarctus | | | | |
| Acut lateral infarctus | | | | |
| Acut subendocardial infarctus | | | | |
| Lateral infarctus | | | | |
| Posterior infarctus | | | | |
| Slow R progression precordial | | | | |
| Frequency | 40 | 180 | 74 | OK |
| P° | -180 | 360 | 35° | OK |
| QRS° | -180 | 360 | 67° | OK |
| T° | -180 | 360 | 65° | OK |
| PP | 0 | 300 | 90 | OK |
| PQ | 0 | 300 | 116 | OK |
| QRS | 0 | 130 | 106 | OK |
| QT | 180 | 720 | 376 | OK |
| QTc | 180 | 720 | 417 | OK |
| % Ayrthmia | 0 | 99 | 7 | OK |
| (R in V4>270) OR | | | | OK |
| (R in V5>270) OR | | | | OK |
| (R in V6>270) OR | | | | NOT OK |
| (S in V1>300) OR | | | | NOT OK |
| (S in V2>300) OR | | | | NOT OK |
| (S in V3>300) OR | | | | NOT OK |
| (R in V5+S9>400) OR | | | | NOT OK |
| (R in V6+S in V1>400) OR | | | | NOT OK |
| (R in V6+S in V2>400) OR | | | | NOT OK |
| (R in V6+S in V3>400) OR | | | | NOT OK |
| (R in AVL>130) OR | | | | NOT OK |

In the above formula the ecg has “Left ventricular hypertrophy”

Some of the **OR** conditions are ok.

Some formulas have both “**AND**” and “**OR**”. **OR** has higher precedence then **AND**.

Example

(R in AVL>130) **OR** (R in AVF>200) **AND** (T in V5<11)

If the R wave in AVL is higher then 13 mm **or** the R wave in AVF is higher then 20 mm and the T wave in V5 is lower then 1.1 mm , the condition is OK.

Even when eg R in AVF >200 is listed as not being OK.

Remember that OR has a higher precedence then AND.

It is important to see why the software proposes a particular diagnosis !

However, even more important is to see why a particular diagnosis is not proposed.

5 Networking, share and security

This chapter is intended for multiple PC users that are connected by means of a network.

When various users want to see each other recording, install the ecg software on every workstation. (the software is **not protected against copying)**

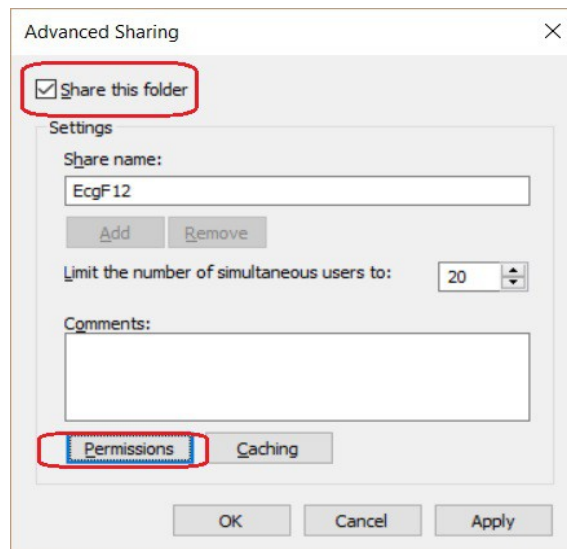
Save all the recordings on a central server in a **shared** directory eg.
//ServerName/Ecg2018

Add and select this directory on every workstation by means of
Setup – Directory - + button

Be aware of the inverted backslashes (most often) // /
Every new record on every PC will then be saved on the server in the shared directory. It is available for all the users.

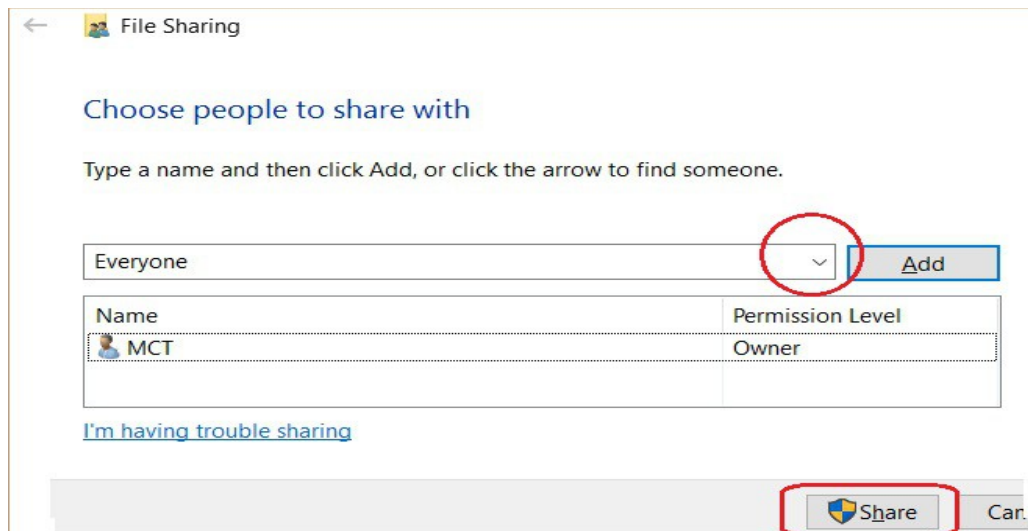
*It's not mandatory to install the ecg software on the server himself.
This is only mandatory if you want to do new recordings also with the server itself.*

Do not forget to share the **directory** on the server.
(in Windows explorer right click on the directory and then share)



Control also the “Permissions” :

Click in the red circle below and select. "Everyone"



Then "Share", below on the page.

In the setup of Ecg.exe, enter the shared directory.

With button +, next to Dir (see further) enter the correct pathname of the shared directory. Be careful with the backslashes, if inverted // / !

All new recordings on each workstation will now be saved in the common shared directory. All allowed users may consult all recordings.

Remarks :

When the number of recordings in a work directory is very high, several thousands, launching of ecg.exe becomes slower.

It is wise to start with a new work directory eg Ecg2018 , Ecg2019 etc

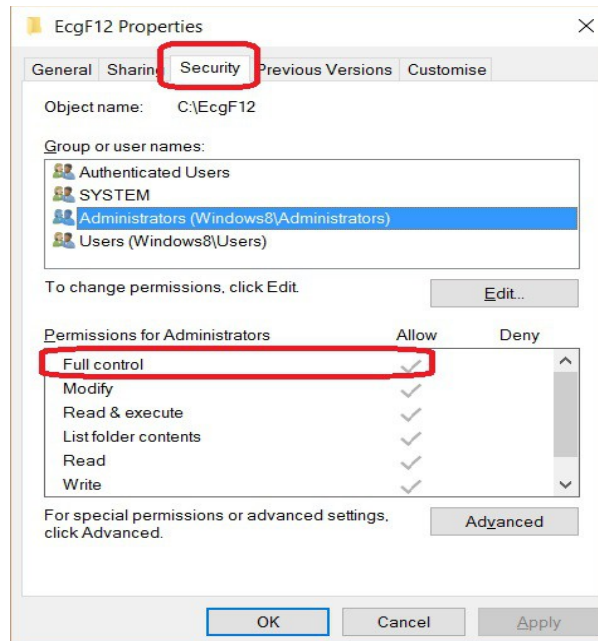
New recordings are possible with every workstation and also with the server, provided that the software has been installed on every workstation and the server.

However, when you launch the server software, starting from a workstation, it's not possible to do a record with the workstation !

Security management.

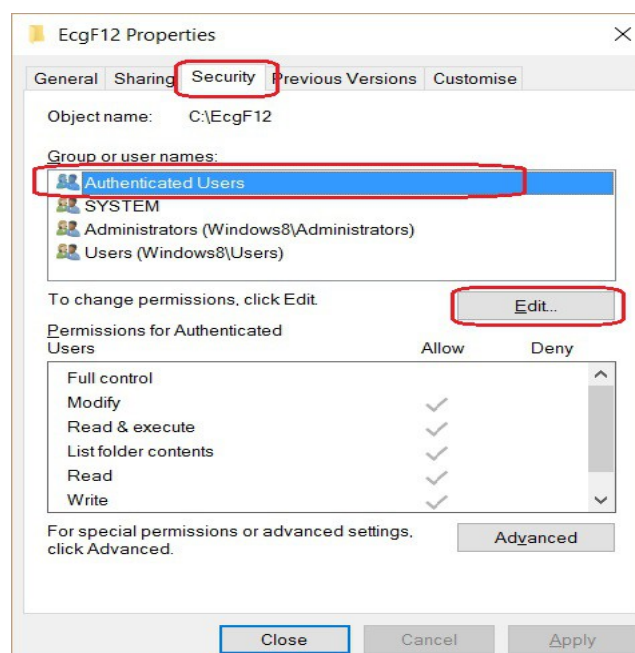
Single user

The user has Administrator rights. Verify this in Windows explorer, rightclick on the installation directory (C:\EcgF12) and then 'Tab' **"Security"**. **"Full control"** is checked:



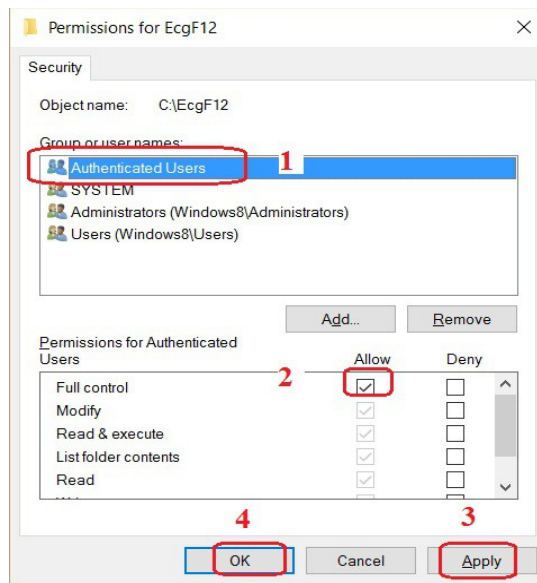
Several verified users of Ecg.exe on the same Windows PC:

Some recent versions of Windows doesn't allow "Full control" for all "Authenticated Users" after installation with an installation program.



Click then button “**Edit**”.

Select again “Authenticated Users (1) , Full control – Allow (2) , Apply (3) and OK.(4)



Repeat the same procedure for directory C:\Ecgbibnew.

New account on PC.

To allow a new user full control of ecg.exe the security settings to “Full control” are necessary. Some recent Windows versions with a strong security management by the system manager, “Administrator” doesn’t allow change to “Full control.

This happens only after installation by means of an installation program.

In that case installation without the installation program is possible and very easy, see next chapter.










6 Structure of the ecg program.

The directory and file structure of the ecg program are very simple. After a new default installation two directories are created:

C:\Ecgbibnew contains the *.F12 ecg recordings of the library.

C:\EcgF12 contains all the rest, data for protocol, pdf, setup, Ecg.exe and a few recordings. New recordings are stored in the same dir.

Minimal content of dir \EcgF12 after a new installation :

| | | | |
|---|------------------|----------------------|----------|
|  2012_02_01_21_24_08.F12 | 24/11/2014 13:25 | F12 File | 59 KB |
|  2014_01_05_20_15_13.F12 | 03/12/2014 18:11 | F12 File | 293 KB |
|  CDM20824_Setup.exe | 13/01/2013 18:11 | Application | 1,703 KB |
|  dbAutoTrack.PDFWriter.dll | 10/09/2010 11:39 | Application extens.. | 464 KB |
|  DONOTDEL.txt | 02/01/2012 18:50 | Text Document | 4 KB |
|  Ecg.exe | 20/05/2016 12:05 | Application | 1,232 KB |
|  ecg.ico | 25/07/2010 01:11 | Icon File | 1 KB |
|  EcgProtocol.xml | 24/04/2014 16:11 | XML File | 24 KB |
|  Personal.txt | 22/05/2014 20:27 | Text Document | 1 KB |

*.F12 files are ecg recordings. 59KB for a 10 sec record.

CDM... exe is for reinstallation of driver usb serial converter.

DbAutoTrack.PDFWriter.dll is a library for PDF generation.

DONOTDEL.txt: data for Gauss curbs. Do not delete it.

Ecg.exe the exe.

EcgProtocol.xml: data for ecg protocol.

Protocol.txt Text with your own protocol conclusions.

Where are the settings of Ecg.exe ?

Also local in C:\EcgF12\EcgConfig.xml. This file is created after setup of ecg.exe

No files are installed in the Windows directory.

Also no files in other directories like Program Files, Program Files (x86), Program Data, Users, Documents etc.

The only exception is the driver for the USB serial converter. After installation of a new Windows version reinstallation of the USB converter is sometimes necessary: Execute C:\EcgF12\CDM...exe once, plug the converter in an USB port and wait before selection of the comportnumber in the setup of ecg.exe See the core manual.

What is the importance of the program structure for the System manager, Security manager, Administrator, Network administrator ?

Allow all users full control to C:\EcgF12 and C:\Ecgbibnew is enough.

When after a new installation, the security settings are not ok, install without the installation program.

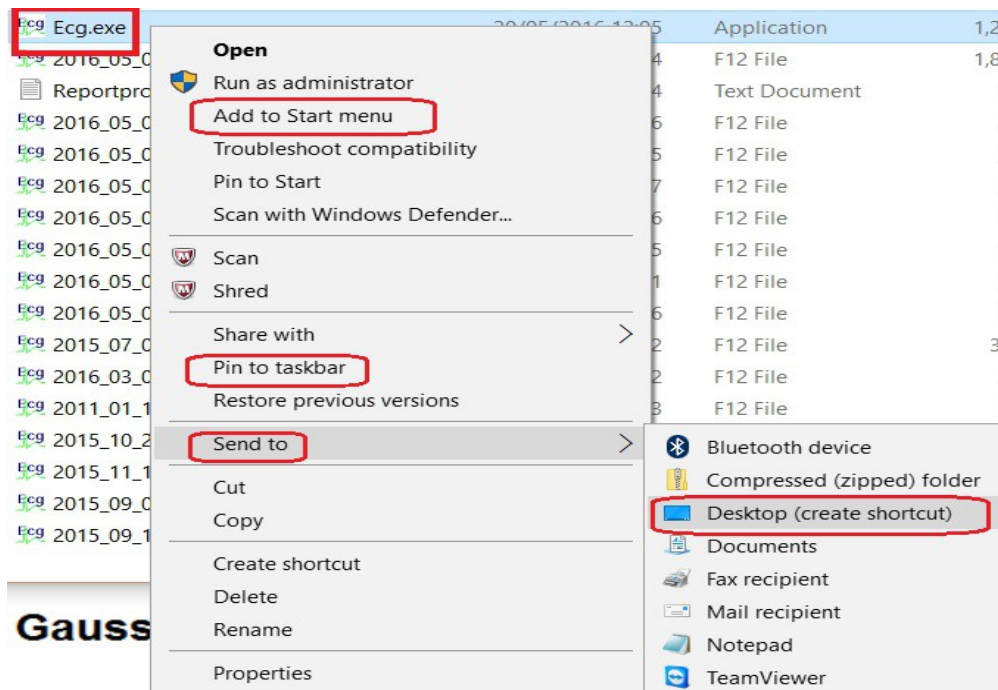
Installation without the installation program is very easy:

Download Ecg.zip and Ecgbibnew on our site and unzip, extract them in dirs C:\EcgF12 and C:\Ecgbibnew

==> A full backup of the program is nothing more then make a copy of C:\Ecgbibnew en C:\EcgF12 and their content.

After installation without installation program, no shortcut is on the desktop.

Rightclick in Windows explorer on \Ecg.exe makes this possible :

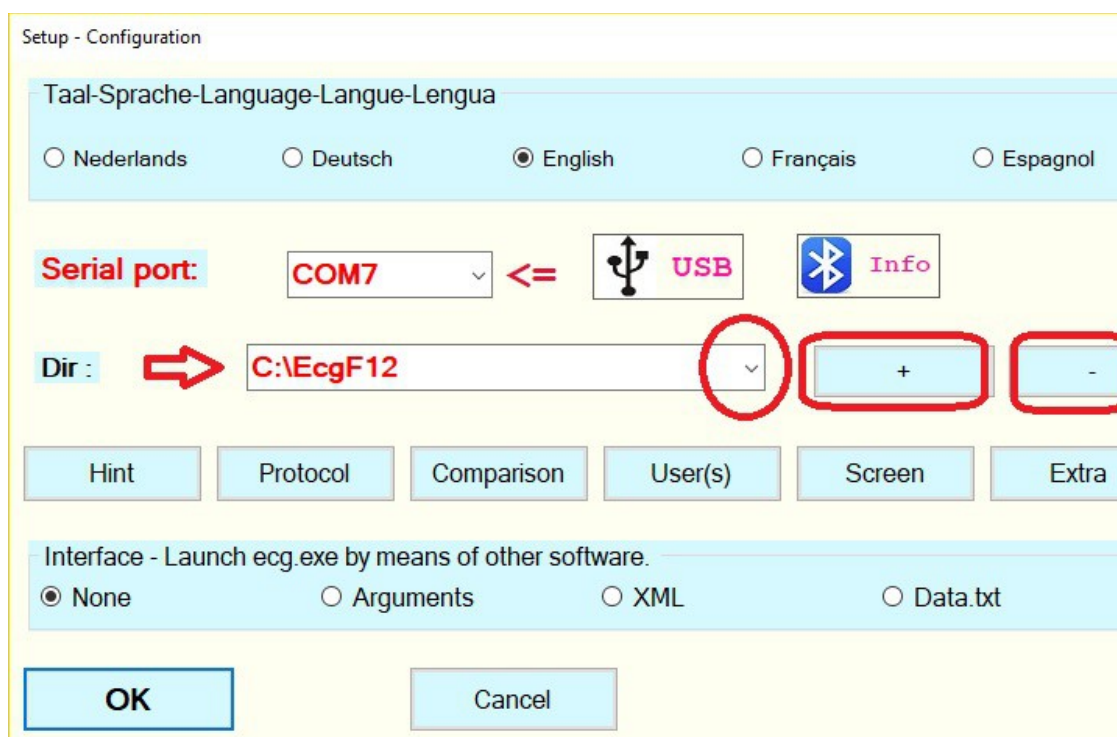


7 Directory management

Installation of the ecg program in any directory, with allowed access is possible.
Recordings may be stored in any work directory, with allowed access.
Installation directory and work directory may be different.

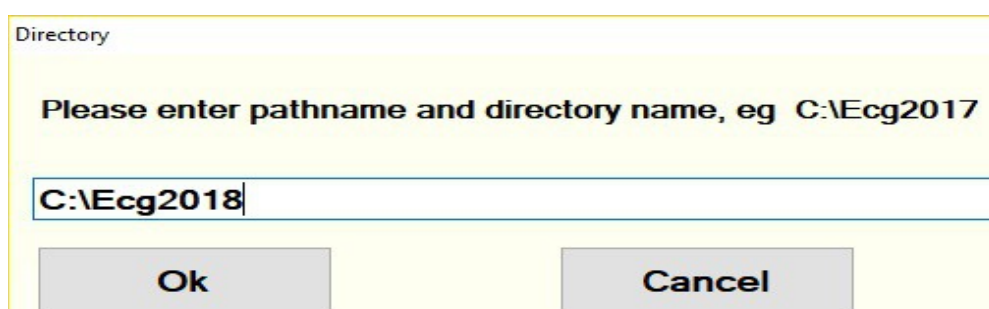
Many thousands of recordings in the selected work directory slow down the startup of the ecg program. The solution is then to start with a new work directory.

In the setup after “Dir” and the red arrow is the actual active work directory :



At right of “Dir” are the buttons “+” and “-”.

Button “+” allows to add a directory to the list of directories :



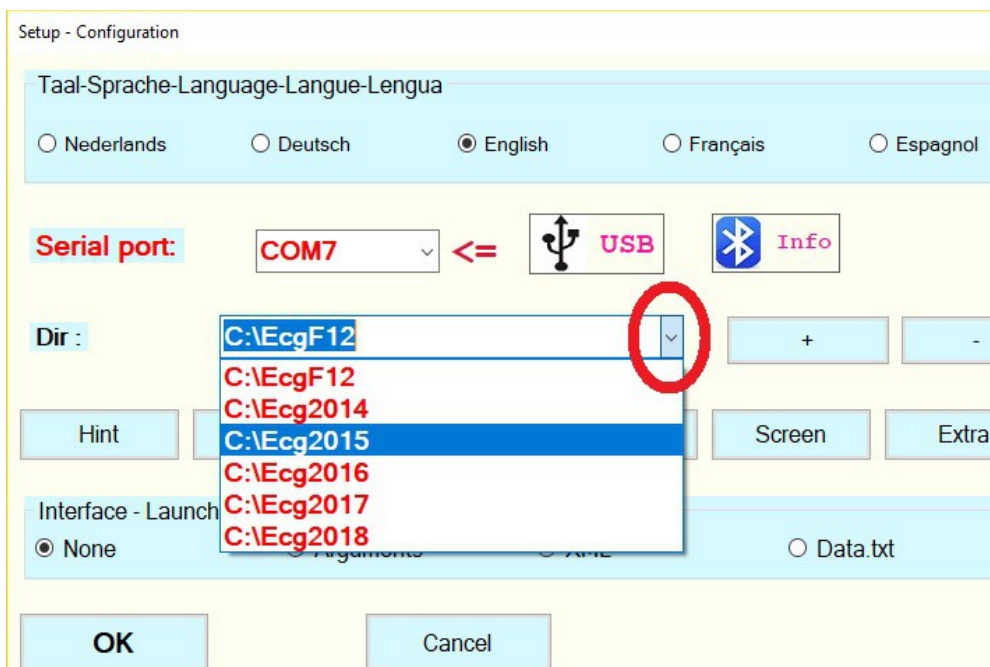
The new directory may be a shared network directory on a server.

Button “-” allow removal of a directory from list.

Don't be afraid, directory and content are **not deleted**.

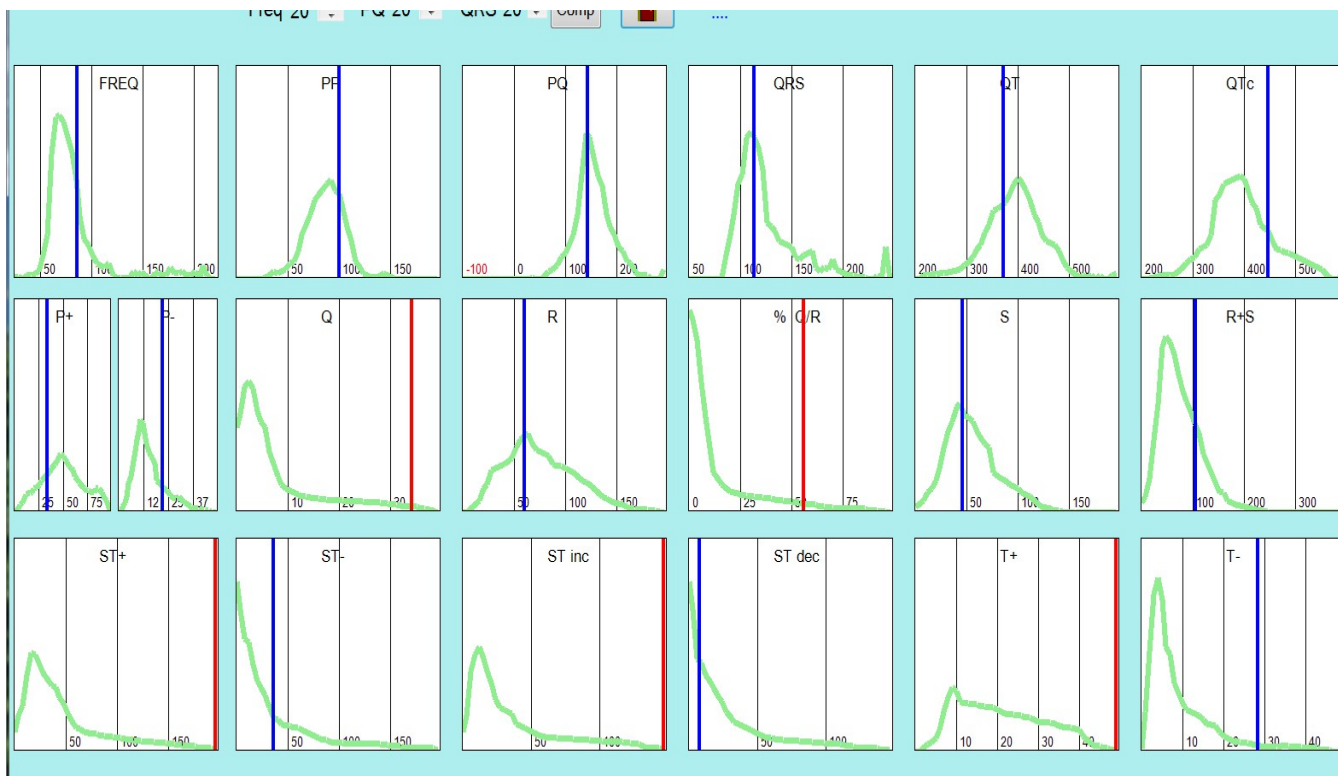
Changing of work directory:

Click in the red circle, select the new directory in the dropdown list and quit setup with button “Ok”.



8 Gaussian curbs.

Button "More" "Gaussian curb" shows:



The following graphs are displayed as a Gaussian or semi-gaussian curb:

Row above : Frequency , PP (P wave duration), PQ, QRS, QT and QTc time.

Middle row: Positive and negative P waves, Q, R, QR in%, S and RS waves.

Row below: Sum of positive and negative ST segments (ST40).

ST inclination between ST20 and ST60. A light elevation of the ST segment with a positive inclination is often normal.

ST declination is the same for ST segment depression.

Sum of the positive and negative T waves. The graph of normal positive T waves is much more wider than the graph of the negative T waves.

The curbs above were generated by means of the ecg's in C:\Ecgbibnew

The vertical line indicates the position of the selected ecg. If the position of the vertical is out of "normal" borders it is drawn in red.

*The image above shows an **infarctus**. The red vertical lines indicate increased Q waves, % Q/R , ST segment, ST increment and T wave deviations.*

Load some pathological traces. Study the position of the vertical lines.

When will the position of a patient, the vertical line become red ?

Setup – comparator allows adjustment of limits:

Section A : see next chapter.

A

Comparator

Freq % 20

PQ % 20

QRS % 20

B

| | Min | Max |
|------|-----|-----|
| Freq | 60 | 100 |
| PP | 20 | 100 |
| PQ | 120 | 200 |
| QRS | 60 | 120 |
| QT | 320 | 420 |
| QTc | 320 | 440 |

C

| | Min | Max |
|--------|-----|------|
| P pos | 10 | 80 |
| P neg | 3 | 40 |
| Q | 4 | 300 |
| R | 200 | 1500 |
| Q/R % | 0 | 25 |
| S | 200 | 1500 |
| R+S | 400 | 3000 |
| ST60+ | 0 | 150 |
| ST60- | 0 | 150 |
| ST inc | 0 | 100 |
| ST dec | 0 | 100 |
| T pos | 0 | 500 |
| T neg | 20 | 500 |

Section B

Contains common limits.

Frequency limits for normal are between 60 and 100/minut .

The other values are in msec.

Section C

Contains minimal and maximal values, that are not yet common.

% QR is a percent. The vertical becomes red when the Q waves are more then 25% of the R waves.

For the limits of the other graphs, we used standard deviations.

P pos = sum of all positive P waves in the 12 leads. (10 = 1 mm)

P neg = sum of all negative P waves in the 12 leads. (100 = 1 millivolt)

Q = sum of Q waves in the 12 leads.

R = sum of R waves in the 12 leads.

Q/R% = Q at R in percent. More then 25% is often pathological.

S = sum of S waves in the 12 leads.

RS = sum of R+S waves in the 12 leads.

ST60+ = sum of ST60 elevation in the 12 leads.

ST60- = sum of ST60 depression in all 12 leads.

ST inc = sum of elevation between ST20 and ST60 in all 12 leads.

ST dec = sum of decrement between ST20 and ST60 in all 12 leads.

(Descending ST depression is more often pathological than ascending depression,
cfr early repolarisation)

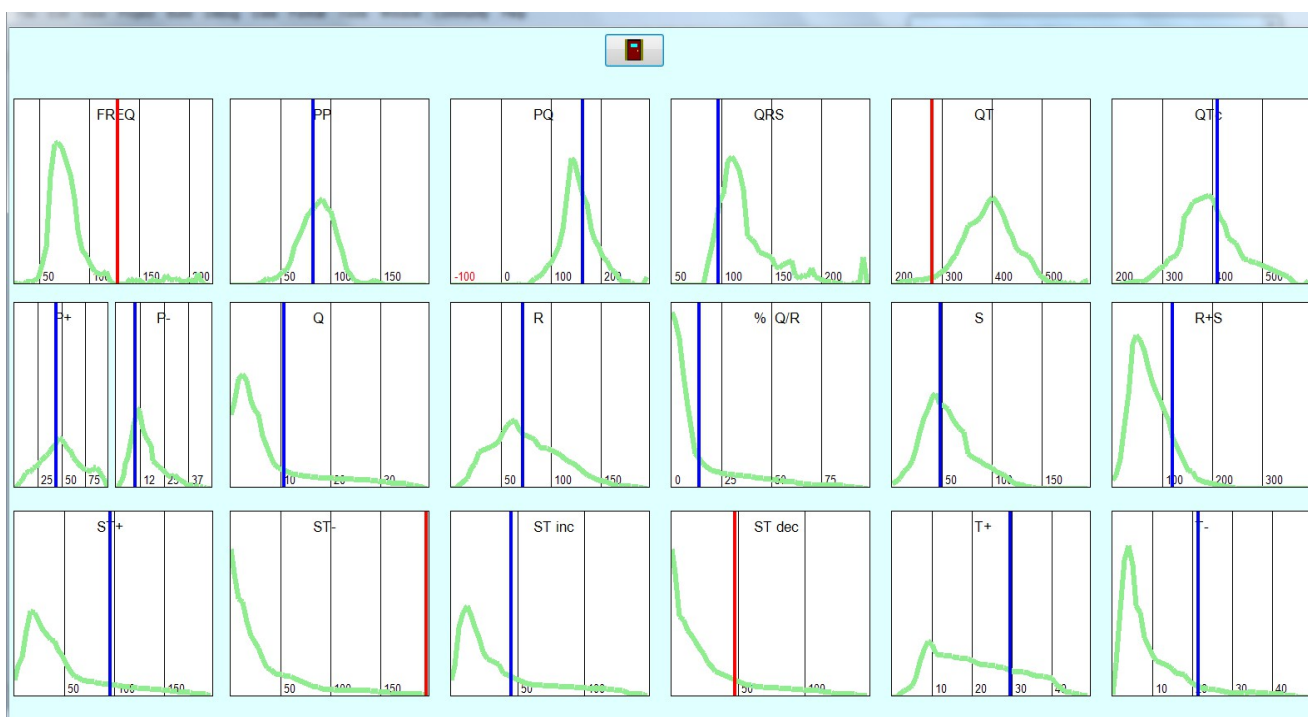
T pos = sum of positiv T waves in all 12 leads.

T neg = sum of negativ T waves in all 12 leads.

The value of the record is displayed as a blue vertical line.

When the value of record is outside minima or maxima of **Section B and C**, it is displayed as a red vertical line.

Graphs of a patient with angor pectoris :

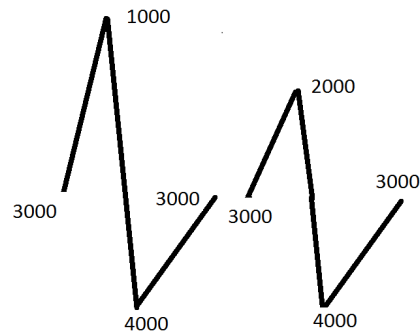


The graphs indicate :

- tachycardia.
- extreme ST segment depression.
- the ST segment depression is descending.

6 Ecg - comparator

Principle of the comparator



Simplified example of 2 QRS complexes

Every point of the ECG is stored in the computer memory as a number between 0 and 4096 (12 bits).

This number depends on the amplitude of the signal.

Every second 600 numbers are stored of every lead.

On the figure above the difference between this two traces is 1000.

The less the sum of the differences, the more resembling two traces are.

Setup comparator (see also p 23)

Above left it's possible to adjust the percent of three general parameters: Frequency, PQ time and QRS time.

| Comparator | | |
|------------|--|----|
| Freq % | <input type="button" value="▲"/> <input type="button" value="▼"/> | 20 |
| PQ % | <input type="button" value="▲"/> <input type="button" value="▼"/> | 20 |
| QRS % | <input type="button" value="▲"/> <input type="button" value="▼"/> | 20 |

Freq % 20

All recordings of the library with a frequency deviation up to 20 percent are included in the comparison.

Example, frequency 100 / minute :

All recordings with a frequency between 80 and 120 / minute are included in the comparison.

By doing so a severe tachycardia will not be compared to a bradycardia.

PQ % 20

PQ duration should not differ more than 20%.

A WPW syndrome may never resemble to a record with short PQ time.

QRS 20%

QRS time should not differ more than 20%.

A left bundle branch block will not be compared to a record with small QRS complex.

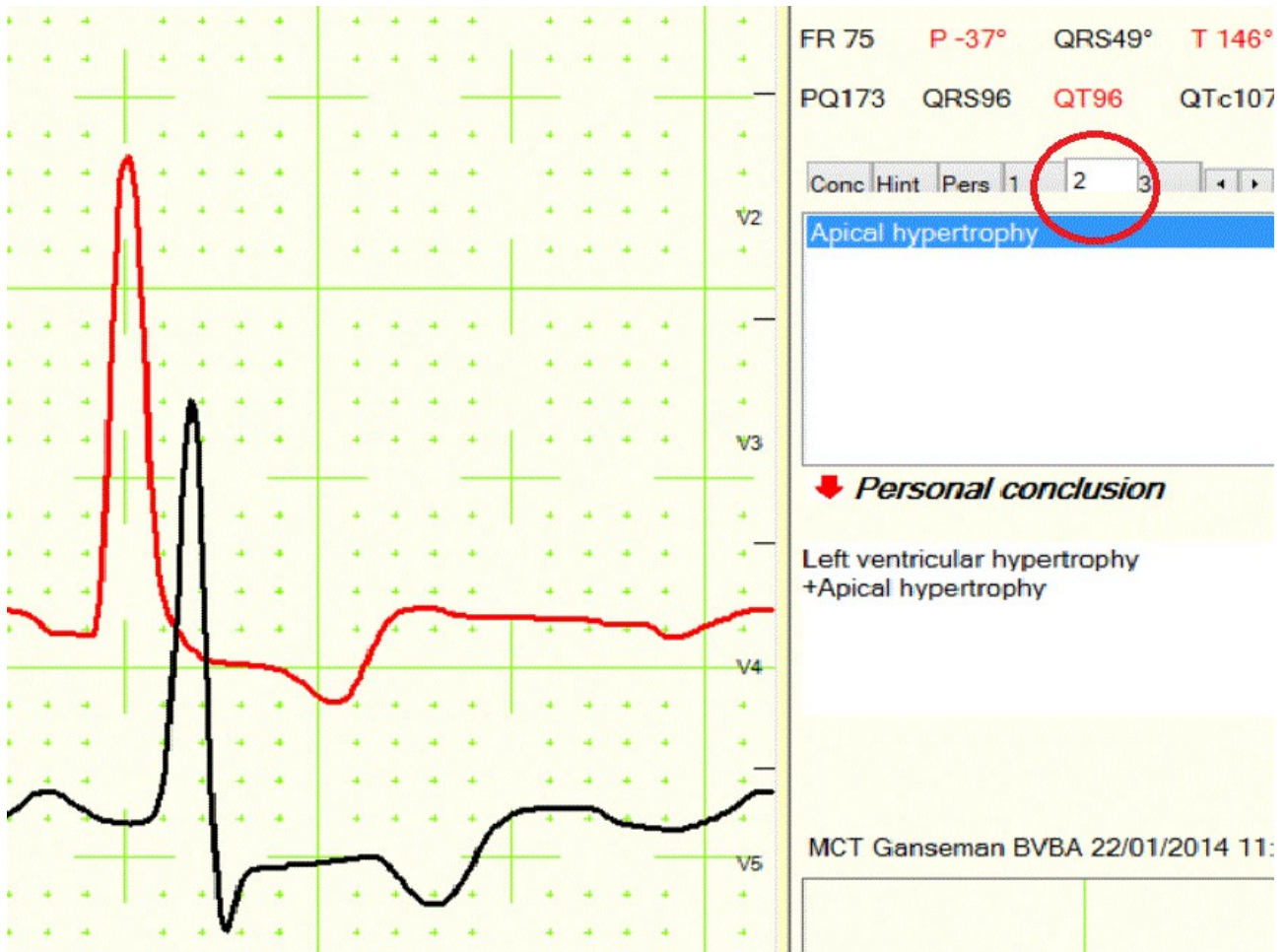
20 % is for this 3 parameters mostly ok.

Making the 20% higher includes to much recordings in the comparison.

Making the 20% lower includes to less recordings in the comparison.

Selection of the 10 most resembling ecg's.

When comparator is launched from the 'View' screen with the button **More - Comparison**, the software selects the 10 most resembling traces of the library.



After a few seconds, the 10 most resembling ecg's are added to Tab with Conc-Hint (red circle above)

With the red arrow the conclusion of a resembling recording may be added to personal conclusion.

The comparator gives very good results for (P)QRST complex abnormalities, but is less effective for rhythmic abnormalities.

This method offers the possibility to reach a scientific level of ECG interpretation, not influenced by the formulas in the software !

10 Integration

Starting from a patient program it is possible to launch the ECG software.

The advantages are:

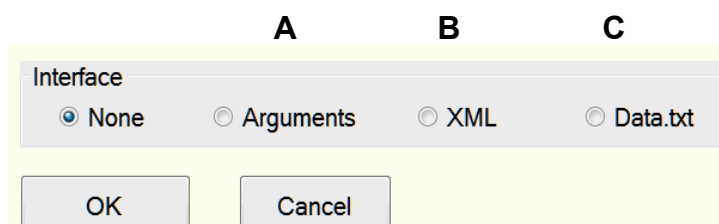
- it is not necessary to retype the name, first name, birth date and ID of the patient.
- when the patient has already some recordings, the software selects the most recent ecg.

We give support to **tree different mechanism**.

With setup – interface in the ecg program the user can select one of this three options.

A B or C

However if the ecg program is not launched from another program, select '**None**' !



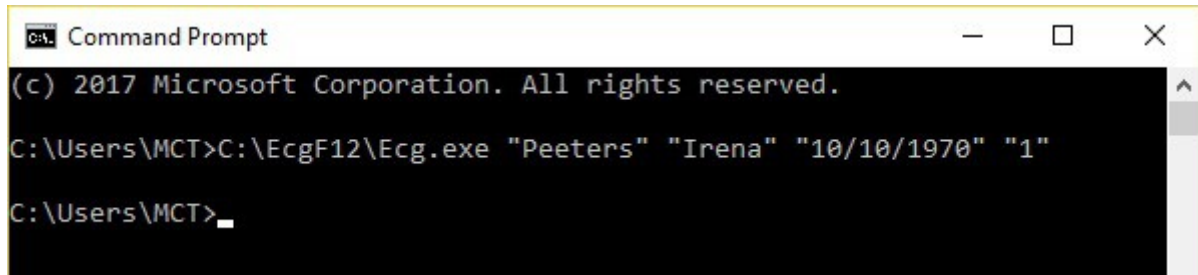
A/ Start our software with arguments.

Select in the Ecg program setup – interface – arguments , OK and quit the program.

Start Ecg.exe with parameters name, first name, birth date, ID and sex (M = male or F=female).

Name and first name can be in different parts and must be putted between quotes ' '

Testing of the arguments in Windows is possible from the 'Command' prompt.



```

Command Prompt
(c) 2017 Microsoft Corporation. All rights reserved.
C:\Users\MCT>C:\EcgF12\Ecg.exe "Peeters" "Irena" "10/10/1970" "1"
C:\Users\MCT>_

```

C:\EcgF12\Ecg.exe" Name" "FirstName" "20/08/1951" "123" "M" <Enter>

Click then the leftmost icon "Record".

Arguments "Name" etc.. are displayed.

Even without an ecg apparatus complete testing is possible !

.

Software of the ecg launching program :

Ask your software developer to write in its code one single line like this:

```
Process.Start("C:\EcgF12\Ecg.exe 'SMITH' 'JOHN JOE' 20/08/1951 123 M");
```

The ecg program is started and jumps to SMITH JOHN JOE. If this patient is not yet there, he will be added after recording a new ECG (click immediately on the most left icon after starting the program)

Path to the ecg program:

After a default installation the installation directory is C:\EcgF12
The complete path to program is then C:\EcgF12\Ecg.exe

B/ Interface by means of xml file.

Is a less used option.

Select in the Ecg program setup – interface - XML

Some software has the possibility to make a file XML in the Ecg installation directory. This file must have the name ident.xml or careconnectxxx.xml

Example of a file ident.xml:

```
<DateTimeBegin>19/06/2010 23:22:32</DateTimeBegin>
<Patient>
<Name>
<FirstName>JOHN JOE</FirstName>
<LastName>SMITH</LastName>
</Name>
<DateOfBirth>18/11/1955</DateOfBirth>
<Sex>M</Sex>
</Patient>
```

When you start C:\EcgF12\Ecg.exe then it will place himself on SMITH JOHN JOE or he will be there when you start immediately a new recording.

Default path to program is C:\EcgF12\Ecg.exe

B/ Interface by means of tekstfile 'Data.txt'.

Select in the Ecg program setup – interface -Data.txt

If it is possible for your patient software to generate a text file 'Data.txt' in the installation directory with the following 5 lines as content.

After launching, the Ecg software will retrieve the data from it.

Name patient

First Name patient

Birth date

ID number

M or F (male or female)

Example of a Data.txt file

SMITH

JOHN JOE

20/08/1951

123

M

When you start Ecg.exe then it will place himself on SMITH JOHN JOE or he will be there when you start immediately a new recording.

With this option you can also launch Ecg.exe with a provided short cut.

If your patient program has the possibility to generate a Data.txt file, then you don't even need the help of your software developer.

Reverse integration

This means that data coming from the ecg program are incorporated into a patient program.

Every time the user looks at an ecg recording, two files are generated in the working directory, protocol.txt and protocol.xml

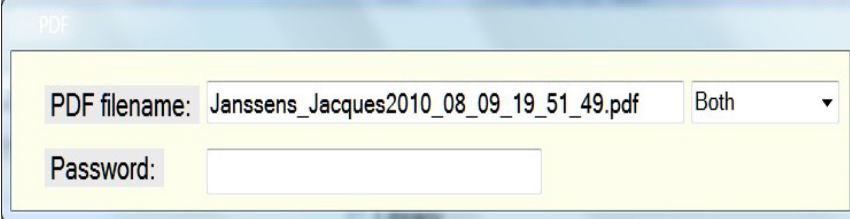
One of both can also be incorporated in the patient program.

However, then you have only the text protocol, no graphs.

Many patient programs have also the possibility to incorporate a PDF file or an image file (png and tiff are the most compact).

Reverse integration of a PDF file

A



With **A** three choices are possible as file name for the PDF output:
 Date.pdf, name_firstname.pdf and Name_firstname_date.pdf
 Also a proprietary name and directory are possible.

A password is possible and mandatory if you send the file by means of internet and it contains the personal data of the patient.

If the user leaves the box after 'Password' empty, the pdf file is not protected with a password.

Reversed integration with the “Windows clipboard”

FR 61 P 43° QRS41° T 28°
 PQ156 QRS110 QT426 QTc430

| Conc | Hint | Pers |
|-------------------------------|------|------|
| Slow R progression precordial | | |
| Microvoltage precordial | | |
| Personal conclusion | | |

Slow R progression precordial
 Microvoltage precordial
 No other apparent abnormalities

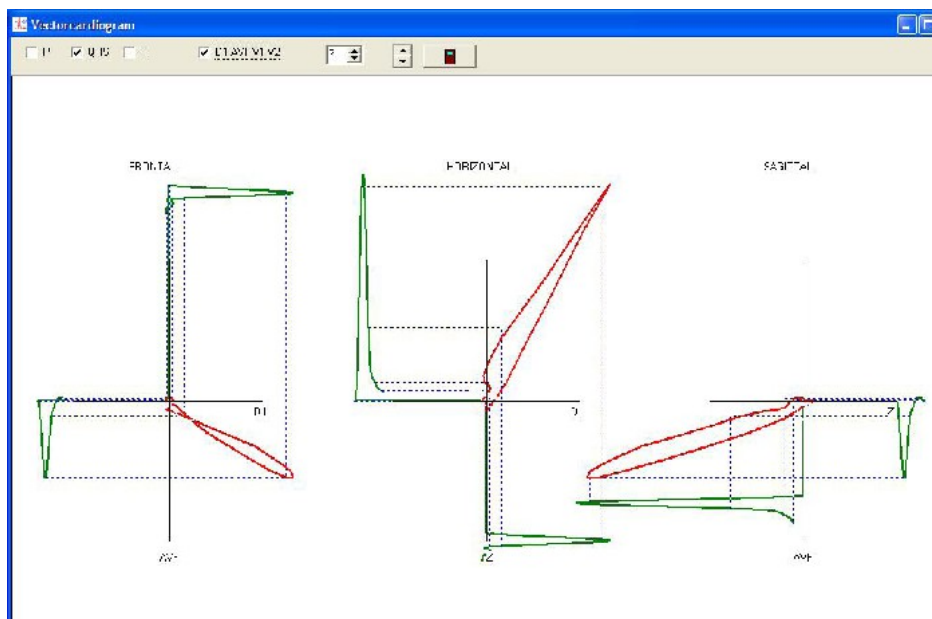
Click on label 'Personal conclusion' to add the protocol data to the Windows clipboard.

With shift – insert or Ctrl-V the data will be copied into the text of another program.

11 Vectocardiography

For interested users.

- . I is used as X axis.
- . AVF is used as Y axis.
- . The intermediate of V1 and V2 is used as Z axis.



With the check boxes P,QRS and T above, you can display the vector cardiogram of the P wave, QRS complex or T wave.

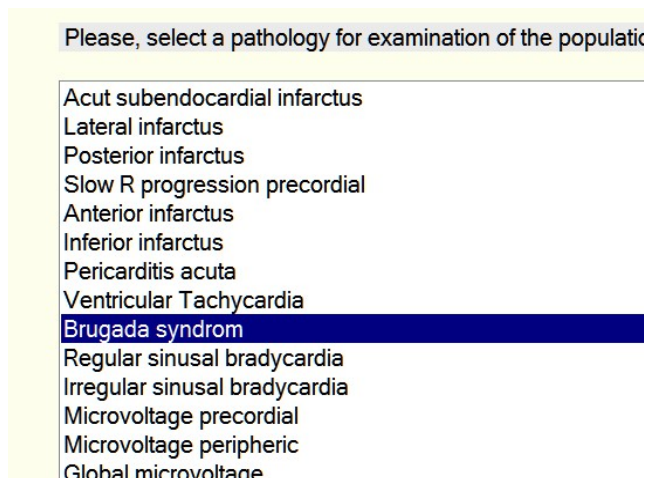
On the leftmost figure, the frontal vector cardiogram, the main axis of the QRS complex and of the T wave are apparent.

Normally, the frontal axis of the QRS complex and T wave may not differ more than 45 degrees.

By means of the library traces, you can study the vector cardiogram of bundle block branches.

12 Population examination

In the main menu “**More**” - “**Population**” pops up a list box



Afterwards all records that match the selection are displayed.
The number of matching recordings is displayed at right. (2 in this case)
On the selection a new sub selection is possible.

| Name | Firstname | Birthdate | Id number | File | Fr | PQ | QRS | QT | QTc | Sec |
|---------|-----------|------------|-----------|--------------------------------------|-----|-----|-----|-----|-----|-----|
| Brugada | I | 1/1/1955 | M59 | C:\Ecgbibnew\2007_03_01 17_29_37.F12 | 074 | 150 | 116 | 356 | 395 | 10 |
| Brugada | I | 21/07/1956 | 72 | C:\Ecgbibnew\2010_12_01 11_08_48.F12 | 080 | 186 | 120 | 353 | 408 | 10 |

To display again all the recordings, toggle, check and uncheck 'Library',
even when you did the population examination in another directory.

13 About long time recording and stress tests.

Often, patient and cable movements are responsible for important perturbations.

Some hints for possible improvement are:

Locate the 4 peripheral leads dorsal thoracic in a square with a size of only about 12 cm. As a result, the peripheral leads become somewhat distorted, but the precordial leads stay the same!

A large jersey stocking (diameter of 30 cm), with as much of the patient cable as possible fixated inside.

Patch electrodes, for some it takes several minutes before the skin-electrode resistance becomes stable.

Skin preparation: abrade with sand paper (theoretical..)

Better is patch electrodes+some gel or spray+fixation with hypo allergenic tape.

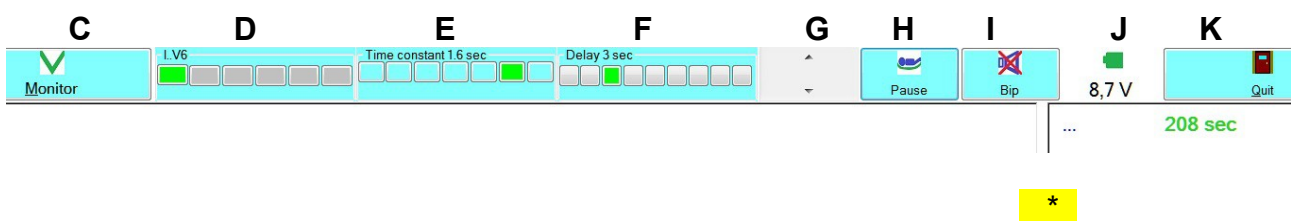
Disadvantage is the time of patient preparation.

Even better is a **suction system**. However this is expensive.

Start a new record with the leftmost icon of the main menu "Record"

Main menu of long time recording

After selection of '**Monitor**' (C) several options become visible :



At right a separation between recording screen and average signals becomes visible. Click on the separation line with the left mouse button and adjust the location *

After selection of '**Monitor**'(C) some extra options become visible.

Lead selection (D)

Even when not all leads are displayed, they will all be recorded.

Time constant (E)

The necessary time to return to the baseline(= sec* 5) from saturation.

For rest ecg the time constant is always 3.2 seconds.

The complete ecg spectrum is then displayed from 0.005 Hertz at 105 Hertz -3dB.

The signal is displayed real time on screen.

For stress test a 3.2 second time constant is not ok.

It would take up to $3.2 * 5 = 16$ seconds for the baseline to become stable.

Selection of 3.2, 1.6, 1.2, 0.8, 0.6, 0.4 and 0.2 seconds as time constant (**E**) is possible.

The lesser the time constant, the more the baseline stays stable.

A to small time constant gives following deformations of the ecg :

Quick signal components, like a sharp QRS complex, stay the same.

Slower elements return quicker to the baseline.

A mono phase T wave becomes flatter and even a little biphasic.

For a stress test, a time constant of 0.6 or 0.8 seconds is often ok.

When you selected a time constant less then 3.2 seconds, the software will display, the corrected signal with a delay.

The baseline correction is calculated by the PC in the mean time.

With (F) select delay between original and corrected signal.

When the time constant is 3.2 seconds the original and the corrected signal are the same: the signal is always real time.

Important

The signal is always saved as being recorded with a time constant of 3.2 seconds.

G Enlargement or diminution of the signal amplitude.

J Tension of the battery of wireless equipment (down to +- 6.8 Volt is ok)

H Pause (when an electrode is no longer attached). Uncheck to continue.

Frequency / minute and Elapsed time in seconds are displayed at right.

K : stop the recording.

At right of screen frequency / minute and recording time in secs are shown.

Average signals :

At right of screen average complexes are displayed.

The complexes are calculates from 4 best PQRST complexes of the last 10 seconds recording.

Some contra indications for a stress test

Recent infarctus, less then 10 days.

Unstable angor pectoris.

Important ventricular arhythmia.

Auricular fibrillation with tachycardia.

Cardial decompensation, endocarditis, pericarditis acuta.

Important aortic valve stenosis.

Antecedent of syncope during efforts.

Pulmonar embolism or possibility.

Poor general condition.

Severe hypertension.

Absence of reanimation knowledge and materials like oxygen, defibrillator, intubation possibility and cardiovascular emergency medication.

Observation of the patient afterwards is also necessary.

Up to to 15 minutes after a test, clinical and electrocardiographic signs of ischaemia may become apparent.

A formulas for calculation of maximal frequency :

Maximal frequency = 220 – age in years.

Submaximal frequency = 200 – age in years.

The list above is unlimited, depending on clinical examination of the practitioner.

Protocol of a stress test.

Record a 12 channel standard ecg recording before the test.

Explain then the patient the course of the test.

Start with a charge of 25 or 50 Watt.

Man : add 30 Watt every 3 minutes.

Women : add 20 Watt every 3 minutes.

The patient should try to reach the sub maximal or even the maximal cardiac frequency.

During the test, measure the blood pressure at regular intervals, eg every 3 minutes.

The maximal cardiac frequency is reached after 10 to 25 minutes on a cyclo ergometer.

Entering of **watt**, systolic en diastolic **blood pressure** (mm Hg) right below of screen is possible. Watt and blood pressure will be saves together with the recording.

| | |
|----------|-----|
| Watt/sec | 100 |
| RR S | 155 |
| RR D | 95 |

Time of a stress test :

On a cycloergometer the effective time to reach maximal frequency is mostly 10 to 25 minutes.

Emergency stop of a stress test (unlimited list)

- Angor pectoris.
- Severe dyspnoea.
- Acute hypertension >240 mm systolic.
- Hypotension, blood pressure fall.
- Rhythm disturbances.
 - Ventricular arhythmia like bigeminia, multiple ventricular extrasystoles, ventricular tachycardia.
 - Auricular flutter or fibrillation.
- Conduction disturbances
 - AV block II of III
 - New left or right bundle branch block.
- ST segment deviations :
 - ST80 sinking of more then 0.15 millivolt (1.5 mm) in one or more leads.
 - Acute ST80 elevation of more then 1 mm.
 - Pathological ST segment deviations should be horizontal or decreasing.

Option on ecg apparatus F12 or L12 : 4 leads monitor cable.

Attachment and fixation of 10 electrodes is a time consuming task.

As option we have a cable with 4 leads.

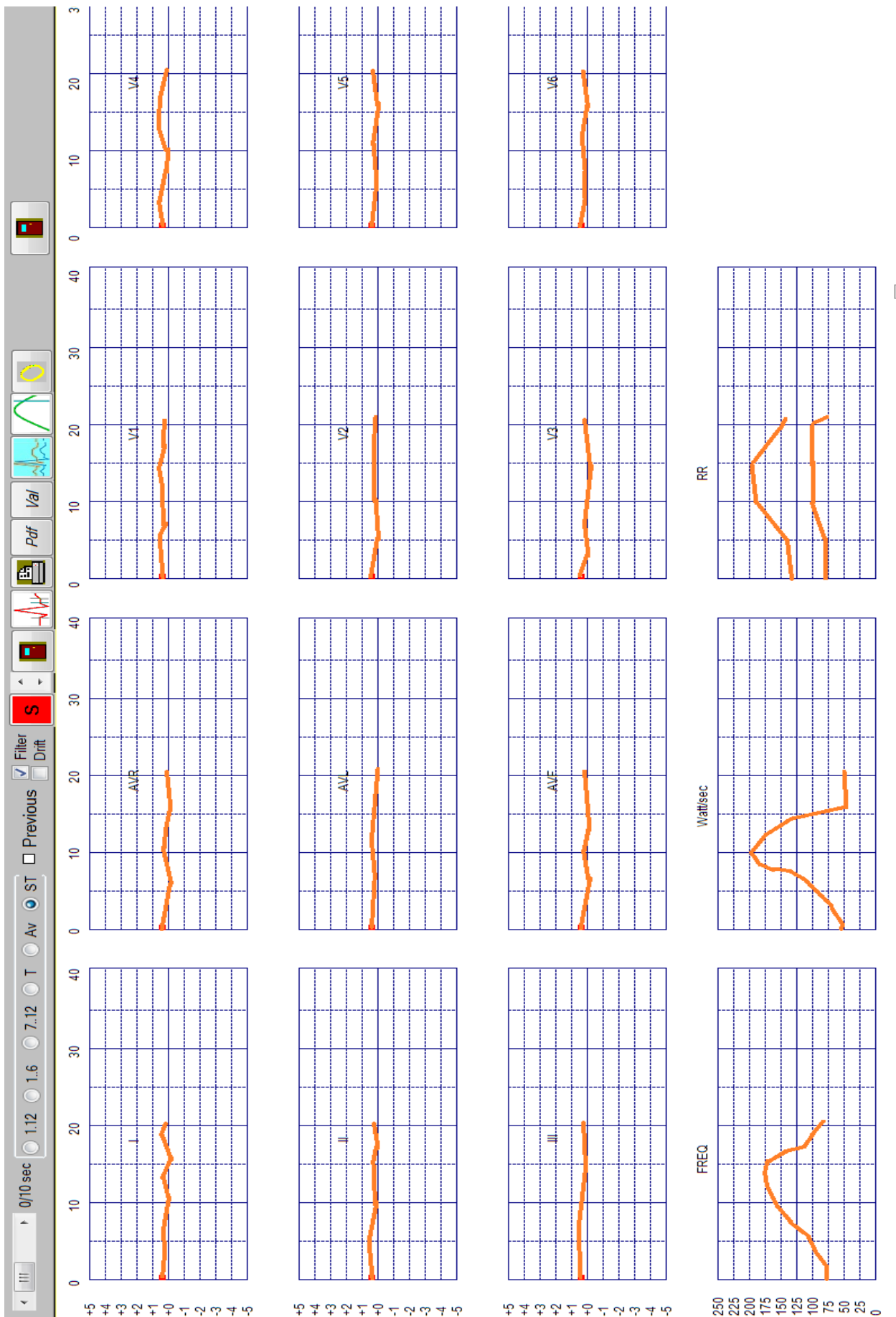
The 6 peripheral leads are recorded with it.

We have also dedicated monitoring software for Windows and Android.

A minute software recording storage needs only 90 kb (360 kb for 12 leads ecg)

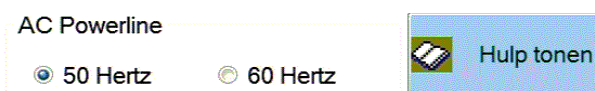
You find more information on the end of this file and on our site.

Example of a stress test with iso-electric STT segments on next page:



14 Filters

Verify with **Setup – Extra** that the correct power line frequency is selected.



Most countries have 50 Hertz. Button “Help” will show you a list of countries with 60 Hertz. The power line frequency is important for correct function of filters.

The unfiltered signal is always saved.

Afterwards the user may select the appropriate software filter.

The same filter will then be used not only for rendering but also for printing, pdf and image generation.

The selected filter is displayed **left below at screen** and in the **hints**. The hint text is the text that will be displayed by moving the mouse cursor over the button “Filter”.

Button '**View**' '**Filter**' offers **four** possibilities.

- | | |
|--|------------|
| No filter 0.005 – 105 Hertz -3dB are used | (A) |
| 0.005 – 105 Hertz -3dB. Software filter | (B) |
| 0.016 – 105 Hertz -3dB Time constant 1.6 sec | (C) |
| 0.016 – 40 Hertz -3dB Time constant 1.6 sec | (D) |

B is best for power line disturbances, like those coming from an a electric examination table.

This filter has no influence on width and height of the QRS complex.

The spectral frequency stays 0.05 – 105 Hertz -3dB.

C Same filter as B but a time constant of 1.6 sec is used. The baseline becomes more stable.

D 0.016 – 40 Hertz -3dB.

The effect of this filter becomes visible on quick transients of the ecg.

The amplitude of small QRS complexes and Q waves diminishes up to 12 percent.

Which filter to use in the practice ?

The best filter is ..none.

The complete signal spectrum of 0.05 Hertz at 105 Hertz -3db is then equally present in the signal.

It depends of much if it's possible to use no filter:

- Skin preparation, skin resistance of the patient.
- Attachment of the patient cable.
- Electric installation in the examination room.

See manual.

The computer saves only the unfiltered signal.

The user has the possibility to use the filters afterwards as necessary.

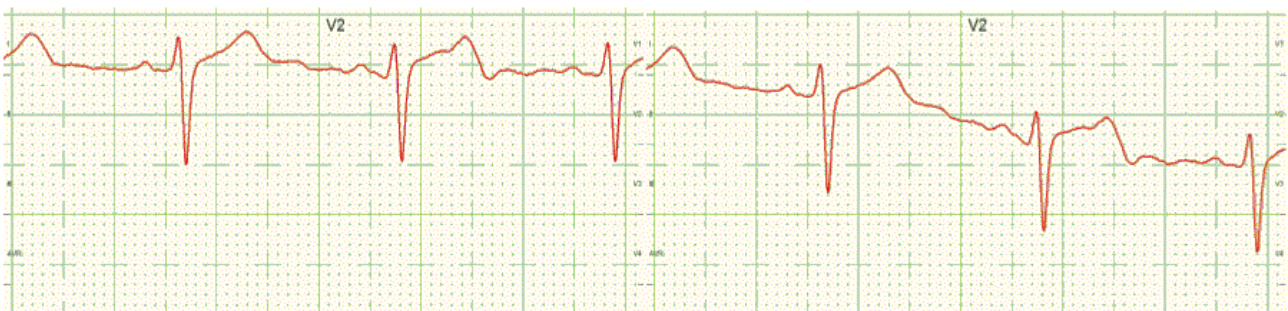
However, in general day practise, most ecg's are displayed and printed with a low pass filter.

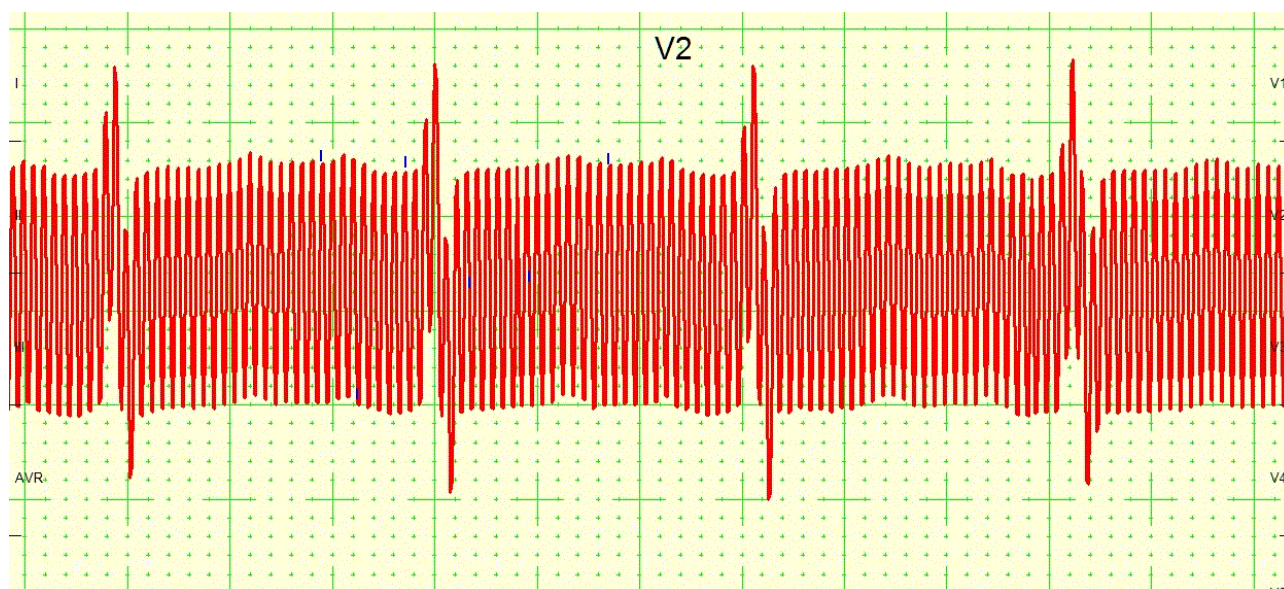
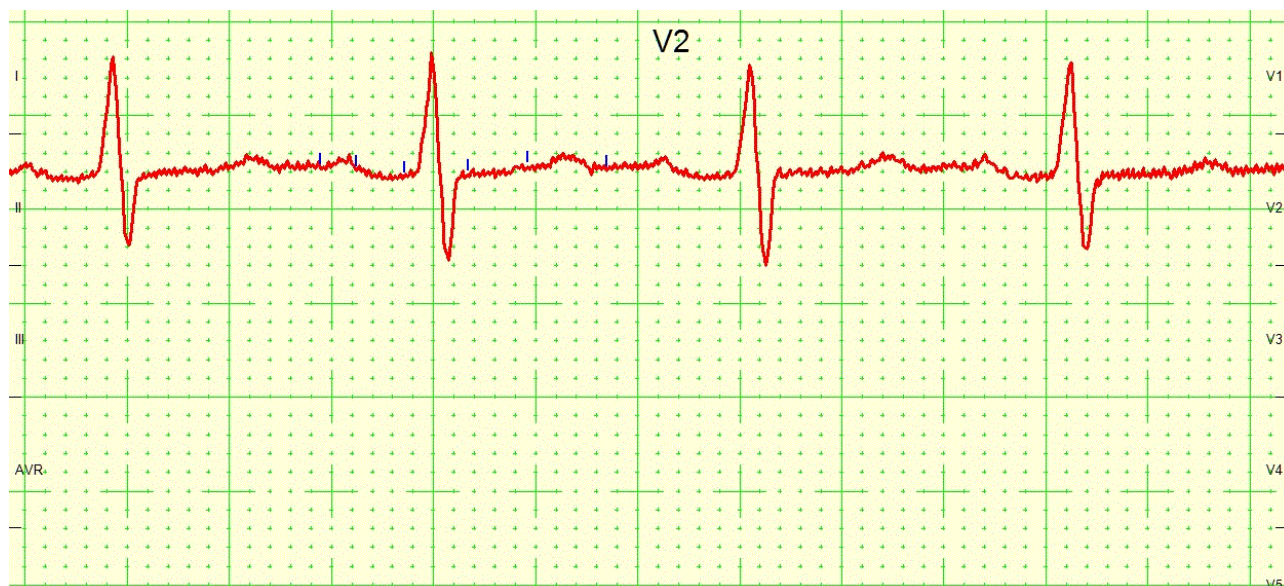
Hereafter we give some examples of the influence filtering.

Some examples :

Right : curve with shift of the baseline. Filter **B**.

Left : same curve with shorter time constant. Filter **C**.



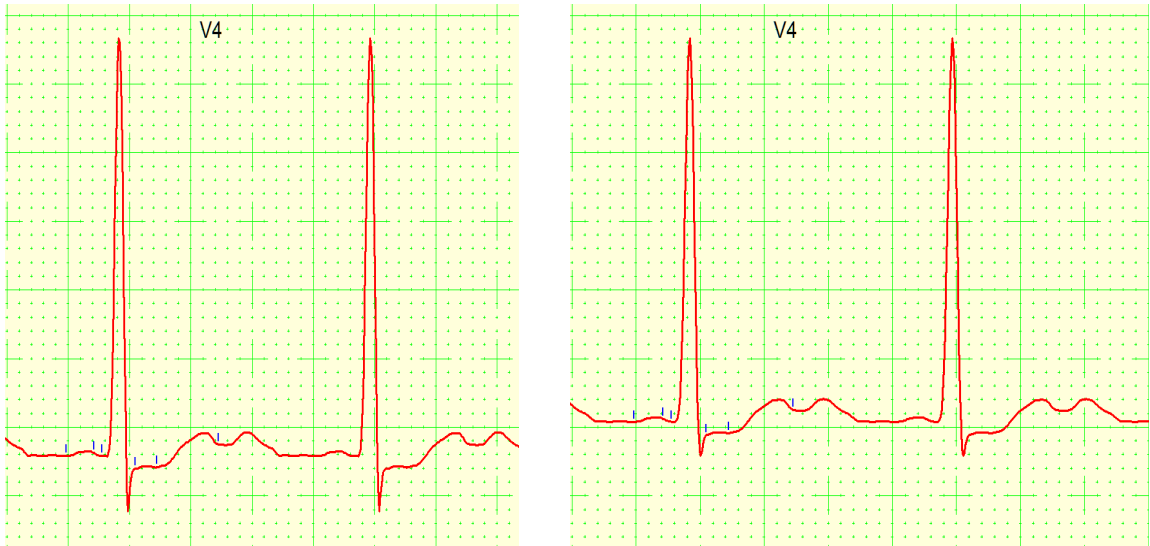
Recording with heavy 50 Hertz disturbance – no filter A.**The same record with filter B.**

For those who see yet a little bit of disturbance :

If the lead above would be printed with a classic resolution of 25 mm / sec and 10 mm/millivolt, no disturbance would be visible.

Influence of filter D:

left without filter (A) – right with filter (D)



Remark the lesser amplitude. In this particular case, a filter was not necessary...

15 Fourier analyse

Button "More" . Fourier shows a Fourier analysis of the selected ecg.
Like most continuous signals an ecg signal is formed from the sum of a number of sinusoid curbs.

The graphs below show in the horizontal X-axis the frequency from 0 at 100 Hertz and in the Y axis the amount of sinusoid signal for the corresponding frequency.

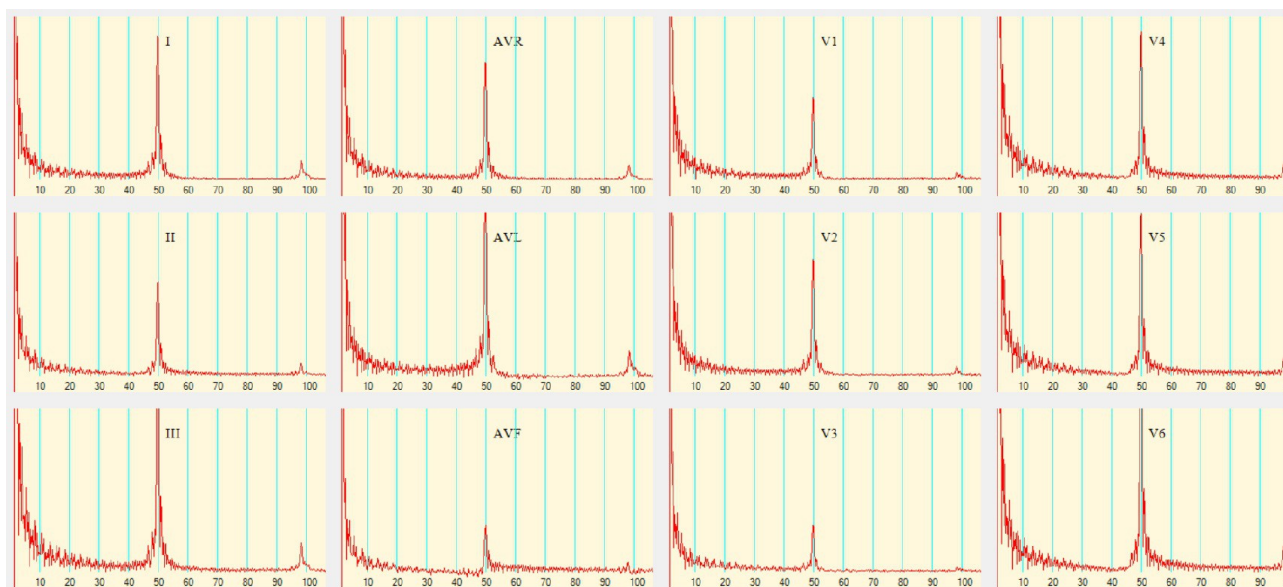
An ecg signal has mainly low frequency components.

The graphs will aid to determine the origin of disturbances.

The example below is from a record with a lot of 50 Hertz noise.

All leads have a peak on 50 Hertz.

A less prominent peak at 100 Hertz originates from the first 50 Hertz harmonic.



16 Rhythm analysis

Automatic analysis of the rhythm give not always good results.

The main reason for failure of automatic detection are the P waves.

P waves are maybe absent, irregular, low and even retrograde.

Better results are possible when the doctor is able to judge about occurrence and aspect of the P waves.

How to proceed :

Select a trace in the library with abnormal rhythm.

In view screen select menu – **More – Rhythm analysis**.

Below on screen are 10 seconds of lead I, II and V1.

This are the three leads with the most visible P waves.

The screenshot shows a software interface for rhythm analysis. It is divided into five main sections labeled A through E. Section A (Patient) displays: Pat 67, Freq >100, QRS <120, RR 18%. Section B (Selection) has a dropdown menu for 'P=>' with options: 'No apparent P waves visible', 'Any position or occurrence of P waves is ok.', 'No apparent P waves visible', 'One P wave before each QRS complex', 'Two P waves before each QRS complex', 'Three P waves before each QRS complex', 'Four P waves before each QRS complex', 'Some P waves have fixed relation with a QRS complex', 'P waves without fixed relation with QRS complex', 'P waves are probably located in the QRS complex', 'P waves are located retrograde after the QRS complex', and 'P waves have different morphology'. Section C (Show all) displays a list of 31 possible rhythm types, with 'Auricular fibrillation' selected. Section D (Navigation) has a blue arrow button. Section E (Personal conclusion) displays 'Auricular fibrillation'. The bottom part of the screen shows three ECG traces (Lead I, II, and V1) with vertical blue lines marking the QRS complexes.

The button '**Show all**' - (C) displays more then 30 possible rhythm's.

At left **A** frequency, QRS width and % irregularity of the patient are already displayed.

Below **Selection B** the appropriate selection has been made, but you can modify it.

With the 4 items below '**Selection – B** ' the 31 possibilities below **C** will be narrowed.

1 Frequency : >100/minute <60/minute all.


2 QRS ms width: <120msec >120msec all.

3 RR irregularity: Regular Irregular all. (irregularity = > 10 % difference)

4 Below after P: the most important selection.

Selection of the properties of the P wave gives a further reduction of the possibilities

Rhythm analysis



| Pat | Selection | |
|-----|--|---|
| 48 | Freq <input type="radio"/> >100 <input checked="" type="radio"/> <60 <input type="radio"/> All | 1 |
| 110 | QRS <input checked="" type="radio"/> <120 <input type="radio"/> >120 <input type="radio"/> All | 2 |
| 12% | RR <input type="radio"/> Reg <input checked="" type="radio"/> Irreg <input type="radio"/> All | 3 |
| P=> | <input type="text" value="One P wave before each QRS complex"/> | 4 |

Any position or occurency of P waves is ok.
 No apparent P waves visible

 Two P waves before each QRS complex
 Three P waves before each QRS complex
 Four P waves before each QRS complex
 Some P waves have fixed relation with a QRS complex
 P waves without fixed relation with QRS complex
 P waves are propably located in the QRS complex
 P waves are located retrograde after the QRS complex
 P waves have different morphology

The user selects in the combobox (4, above) the P wave.

All possibilities that fulfil 1,2,3 and 4 are displayed in **C** (previous page)

Red arrow **D** (previous page) allows to add the conclusions in **C** to the personal conclusions.(**E**).

17 Alternative look on the peripheral leads:

Most doctors know that when any two leads of the six peripheral leads are known, calculation of the remaining four is possible.

Suppose that lead I and lead II are known. The formulas are then:

$$III = II - I$$

$$AVR = -(I + II) / 2$$

$$AVL = (I - III) / 2 = (I - (II - I)) / 2 = (2 * I - II) / 2$$

$$AVF = (II + III) / 2 = (II + II - I) / 2 = (2 * II - I) / 2$$

Has this knowledge any practical use ?

View a trace and select the 10 seconds view of I...AVF

Double click then on the label with your name, above the frontal vectocardiography (something you would never do) Select 'Yes' to continue. The original trace will not be modified.

The following screen with an extra horizontal scrollbar appears. ==>>



With the horizontal scrollbar, it's possible to scroll lead I a little bit to right or left. Click a few times to left. The other leads III, AVR, AVL and AVF will be calculated again with the formulas above.

Very soon a pathological Q wave in III and AVF will appear...

Same record after moving lead I a little bit to left:



Try also the inverse: load an old inferior infarction from the library. With the scrollbar, move lead I to the right: the pathological Q waves in III and AVF will disappear...

Conclusion

Electrically spoken, an inferior infarction is only a delayed activation in lead II, compared to lead I. When the R wave in I is much higher than in II, deeper Q waves in III and AVF are possible.

Possible general conclusions

The study of the peripheral leads can be limited to the study of two leads and their difference in phase.

Difference in phase should be measured very well.

It would be logical to take two leads that are rectangular to each, like I and AVF.

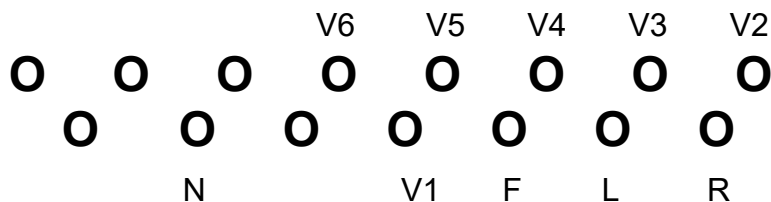
The difficult study of the 6 leads came by historical reasons.

During tens of years it was not possible to compare the phase of two leads.

Multichannel digital apparatus and PC's were not available.

18 Another patient cable or suction system.

Front view of the 15 pole female connector on the apparatus.
The connections are as this:



N= right leg, F=left leg, L=left arm and R=right arm

Today, this connector is widely spread and compatible with some other patient cables.

a Tapuz belt. Some belts have a 15 pole male sub-D connector. The advantage of the belt is that the precordial electrodes stay fixed during recording. However, this belt is costly. Exact positioning of the precordial electrodes is not always possible, especially on women.

Some suction systems can be acquired with a so called 15 pole male sub-D connector.

Remark:

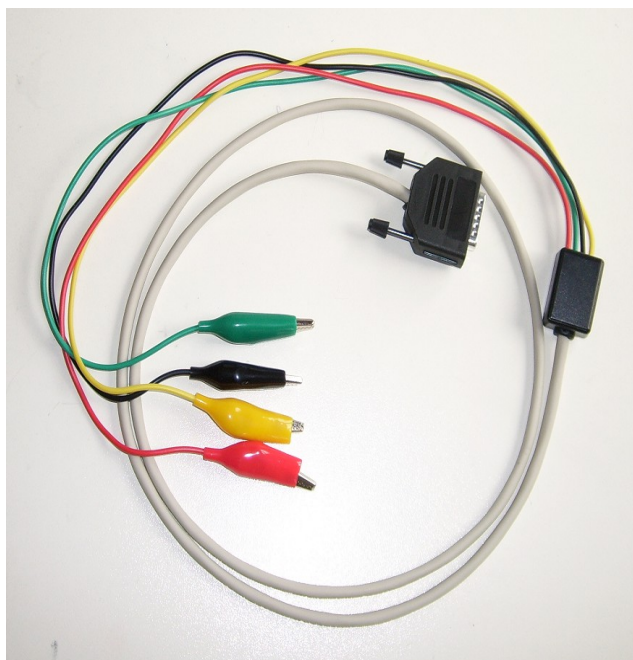
Some "15 pole" cables have only 10 or 11 exposed pins.

Usually they are also ok.

19 Patient monitoring

An interesting option for both F12 and L12 apparatus is the monitoring cable and the monitoring software.

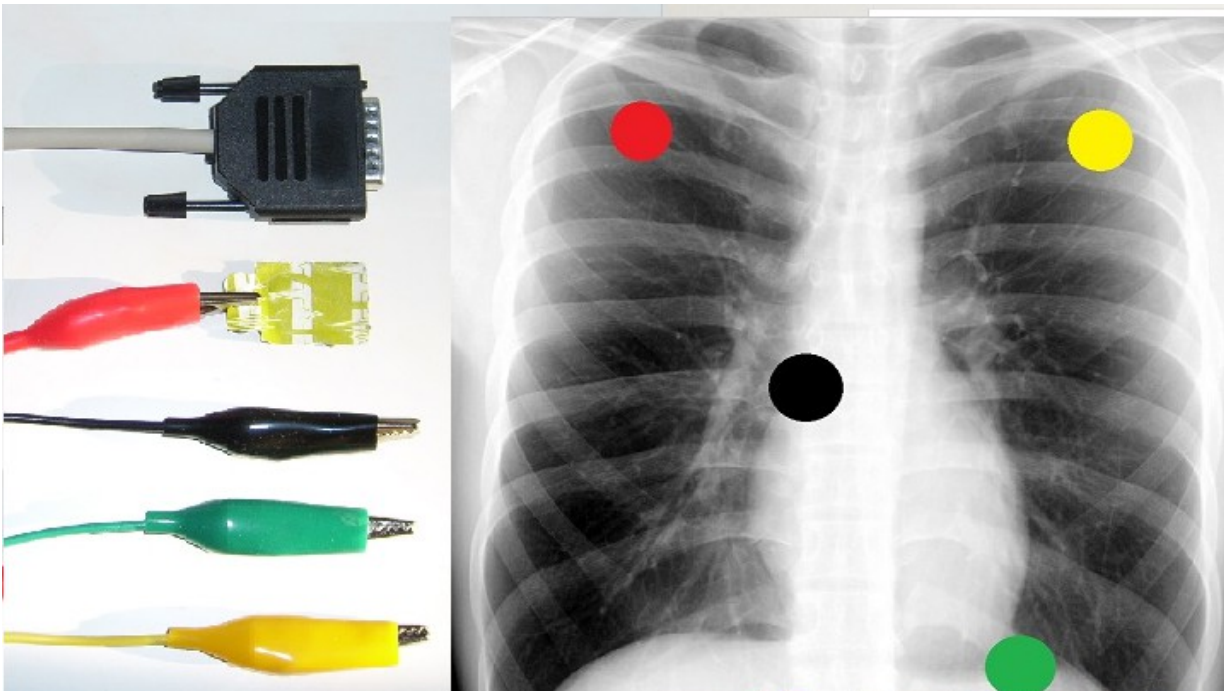
A quick documentation of rhythm disturbances is possible.



Only 4 connection to the patient are necessary. Default location of the electrodes is

- red : below right collar bone.
- yellow : below left collar bone.
- green : below apex cordis
- black : neutral reference electrode.

The location of the black reference electrode it is not critical. Place it somewhere between the 3 others.



With this cable not only lead I,II and III are recorded.
AVR, AVL and AVF are also real time calculated and displayed.

Through displacing of the electrodes it's possible to emulate other leads.
Example: to emulate V1, place the red electrode on the back and the yellow
at the usual V1 location. Lead I becomes then quite similar to V1.

Another advantage of the monitoring soft is that a long time records needs
lesser hard disk space.

For one minute only 90 kb in stead of 360 kb for ecg are needed.

Installation of the monitoring software :

- From CD execute \Monitor\Setupmonitor.exe.
- From our site: download setupmonitor.zip and save it somewhere on your hard disk eg in C:\Temp. Unzip then C:\Temp\Setupmonitor.zip and execute Setupmonitor.exe.

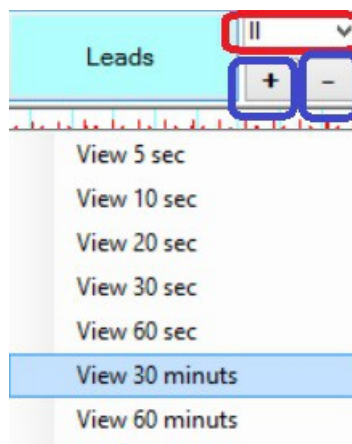
After the installation as proposed C:\Monitor\Mon.exe is located on your PC.

At first open the setup and select the same comport number as is working in ecg.exe.

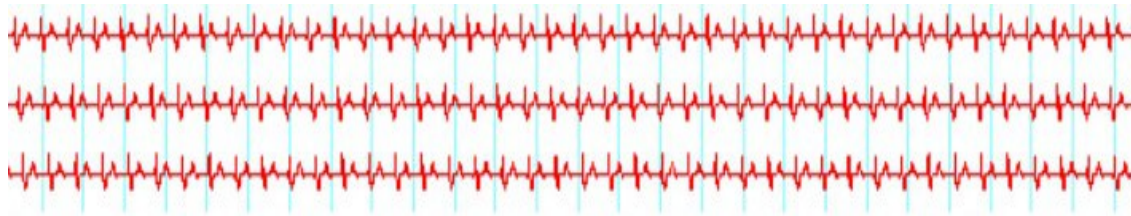
Using of Mon.exe is very similar to Ecg.exe.

However, viewing, printing, PDF and image generation have some extra possibilities for condensed output: 20, 30, 60 sec, 30 and 60 minuts on a single screen.

When 30 minuts or 1 hour are chosen only one of the six leads I, II, III, AVR, AVL or AVF are displayed. In the red rectangle below, selection of the lead is possible. Two buttons '+' and '-' are located in the blue circles. With this buttons regulation of the amplitude of the selected lead in the condensed view is possible. This has also importance for the amplitude of the condensed signal in print, pdf, image.



Below you see a part of a 30 minutes screen with selection of lead II.



Summary

The monitoring soft with the 4 leads cable has this advantages :

Only 90 kb hard disk space for 60 sec recordings (360 kb for 60 sec ecg)

Since no attachment of leads to the limbs of the patient are necessary, the patient may sit on a shear or on a bicycle.

Attachment and fixation of 4 thoracic leads is easier then 10 leads.

With the 4 leads cable the six peripheral leads are recorded.

By replacing of the electrodes, it's possible to emulate nearly each lead.