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1 Preliminaries

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Definitions

- EPG  Electropalatograph
- SPI  Serial Port Interface unit
- MIT  Medical Isolation Transformer
- D.C.  Direct current

Warranty

Articulate instruments Ltd warrants the Electropalatograph against defects in materials and workmanship for a period of one year from receipt by the user. During that warranty period, Articulate Instruments Ltd will either, at its option, repair or replace products, which prove to be defective. Articulate Instruments Ltd can accept no responsibility if the Electropalatograph is used other than in accordance with the instructions supplied. This warranty applies to the initial purchaser only and is not transferable. Full Terms and Conditions are contained in the Warranty terms and Conditions enclosed with the system.

Inspection

Upon receipt of your WinEPG™ system (or upgrade system), it should be examined immediately for any evidence of damage. Damaged shipments should be reported promptly to the carrier, who is normally liable for such damage. All documentation, airway bills and packing materials should be retained in order to establish claims. After notifying the carrier of shipping damage, please also advise Articulate Instruments so that we may assist in damage claims and supply replacement equipment if necessary.
Computer Recommendations

Safety
The PC used with the WinEPG™ system should be approved to the appropriate safety standard for IT equipment, i.e. IEC 60950, or its national variants, EN 60950, UL 1950...

Sound card
Some PCs are sold with poor quality sound cards built into the motherboard. Such soundcards tend to have inaccurate sample rates and do not have line-level stereo input. Poor sample rate accuracy will result in poor synchronisation with the EPG signal. Without a line-level stereo input it is not possible to record a second channel e.g. Laryngograph. It is therefore recommended that a separate sound card be used for research applications.

USB Port
The WinEPG™ system connects to the PC using USB and uses RS232 serial communication to transfer data. At least two free USB sockets must be available on the PC (one for the WinEPG system and one for the software key).

Video display
The minimum recommended screen resolution is 800 x 600 for satisfactory display of numerous analysis windows with colour depth > 256 bits

Memory
Audio and EPG data are stored in computer memory during recording and so the amount of memory determines the length of recording that can be made. The system will run with 32Mbytes of memory on Windows 95/98. However, 64Mbytes memory or greater is recommended for Windows 95/98/2000/NT and a minimum of 128Mbytes of memory is recommended for Windows XP.

Hard disk
The size of the hard disk simply limits the amount of data that can be stored. One minute of audio (22050Hz mono) and EPG data takes up 2.694Mbytes of disk. A 20Gbyte hard disk will therefore have room for more than 100 hours of audio/EPG data.

Data backup device
It is highly recommended that the computer has a backup/archiving device such as a writeable CDROM drive (CD-RW) or that the computer can be connected to a network with such a device. Data should be backed up on a regular basis in case the computer develops a problem that results in data being lost.

CE Marks on electrical devices
The European Union has introduced directives requiring CE marks on devices.

NOTE: WinEPG upgrade systems and WinEPG systems sold without a Medical Isolation Transformer are NOT compliant with EEC Council Directive 93/42/EEC of 14 June 1993 concerning Medical Devices and may not be used for a therapeutic or diagnostic purpose.

NOTE: The PC used with the WinEPG system should be approved to the appropriate safety standard for IT equipment, i.e. IEC 60950, or its national variants, EN 60950, UL 1950…

**General EMC (Electromagnetic Compatibility) Guidelines**

**Shielded USB cable**

Using the shielded USB cable supplied with the system ensures that you maintain the appropriate EMC classification for the intended environment.

**Electromagnetic Interference**

Electromagnetic interference (EMI) is any signal or emission, radiated in free space or conducted along power or signal leads, that endangers the functioning of a radio navigation or other safety service or seriously degrades, obstructs, or repeatedly interrupts a licensed radio communications service. The WinEPG™ system is designed to comply with applicable regulations regarding EMI. In particular it complies with standards for medical electrical equipment and information technology equipment used in medical electrical application.
Declaration of Conformity

Manufacturer:
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Queen Margaret Campus
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+44 (0)131 474 0000
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Product Designation: Electropalatograph (Models WinEPG and PTU)

The above mentioned products meet the essential requirements of:

2. Canadian Medical Devices Regulations (PC 1998-783, 7 May 1998), classified Class II (CMDR rules 9,10)

Standards to which Conformity is declared:

ISO 9001:2008 Quality management systems: except service & installation
ISO 14971:2009 Application of risk management to medical devices
IEC 980:2008 Symbols for use in the labelling of medical devices
IEC 60601-1-1:2001 Safety requirements for medical electrical systems
IEC 60601-1-2:2007 Electromagnetic compatibility – requirements and tests
IEC 60601-1-4:1996 Safety of programmable electrical medical systems
MDR (PC 1998-783, 7 May 1998) Canadian Medical Devices Regulations
Annex VI & VII MDD 93/42EEC Medical Device Directive

Notified Body:
AMTAC Certification Service Limited
www.intertek-acsl.com
Notified Body Number: 0473

Testing Laboratory:
SGS United Kingdom Ltd
www.uk.sgs.com
UKAS No 1116

Certificate No.: 637CE
I, the undersigned, hereby declare that the equipment specified by this declaration conforms to the listed directives and standards

Signature:  
Name: Alan Wrench
Position: Managing Director

Date: 20 October 2009
Safety Precautions
The WinEPG system is designed and tested in accordance with IEC EN 60601-1.

WARNING: Dangerous Voltage Inside. Do not remove cover. Service by qualified personnel only.

WARNING: To Prevent Fire or Shock Hazard, Do not expose this system (except the palate) to rain or moisture.

WARNING: The Medical Isolation Transformer must be used to power any mains equipment that a client may touch while using the system. This will normally include the WinEPG™ system itself and the PC. It may also include the monitor and any peripheral equipment such as a printer or external drive.

CAUTION
- When you are not using the WinEPG™ system for a long period of time, it is recommended that you disconnect the power cord from the mains outlet.
- Dangerous Voltage Inside. Refer internal servicing to qualified service personnel.
- If at any time the WinEPG™ system malfunctions or there is some suspicion that the WinEPG™ system is not functioning correctly then, as a precaution, the hand grip, multiplexer and palate should be removed from contact with the client.
- Before use, the Serial Port Interface should be placed on top of the EPG3 scanner which in turn should be placed on a firm, flat surface with enough space for air to circulate around the units.

ATTENTION: Under normal circumstances, the duration of EPG therapy should not be longer than sixty (60) minutes.

WARNING
- Potential EPG users with a heart PACEMAKER should NOT USE EPG until they have discussed the risks with their GP and the manufacturer of the pacemaker.

Some Do’s and Don’ts on the Safe Use of the WinEPG™ System
This equipment has been designed and manufactured to meet international safety standards but, like any electrical equipment, care must be taken if you are to obtain the best results and safety is assured.

DO read the operating instructions before you attempt to use the equipment
DO ensure that all electrical connections (including the mains plug, leads and interconnections between pieces of equipment) are properly made and in
accordance with manufacturer’s instructions. Switch off and withdraw the mains plug when making or changing connections.

**DO** consult the manufacturer if you are ever in doubt about the installation, operation or safety of your system.

**DON’T** continue to operate the equipment if you are in doubt about it working normally, or if it is damaged in any way. Switch off, withdraw the mains plug and consult the manufacturer.

**DON’T** remove any fixed cover as this may expose dangerous voltages.

**DON’T** leave equipment switched on when it is unattended. Switch off using the switch on the SPI unit.

**NEVER** let anyone, especially children, push anything into holes, slots or any other opening in the cases. This could result in a fatal electrical shock.

**NEVER** walk around with the multiplexer around your neck

**ALWAYS** have a responsible adult (preferably a clinician) supervising children or adults with incapacity that are using EPG

**ALWAYS** visually inspect the EPG palate for any signs of damage prior to every use.
Getting Started

Hardware System Features

- **Safety.** No direct connection between client and power source. All connections are capacitance coupled and opto-isolated. Medical grade components are used to ensure safety.

- **Microphone Pre-amplifier.** The Serial Port Interface unit incorporates a pre-amplifier, which boosts a microphone signal to a line-level signal to enhance the signal quality. The line-level signal output can be fed into a line-level input available on better quality computer sound cards.

- **Synchronised Laryngograph Input.** The Serial Port Interface Unit also allows the output of a Laryngograph to be fed into a pre-amplifier. The pre-amplifier is designed to be highly linear which prevents phase distortion of the signal and the line-level signal output is synchronised with the line-level microphone output.

- **Line-level Input.** For convenience, a line-level signal may be fed into the Serial Port Interface unit. This signal is unchanged by the system except for having a synchronisation tone added at the start of each recording.

WinEPG™ System Description

The WinEPG™ system includes the following supplied components:

- Multiplexer with chrome handgrip
- EPG3 scanner unit
- Serial Port Interface (SPI) unit
- Cables and adapters
- Microphone/headphone

To operate the system the following additional items are required:

- Windows 9x/2000/NT/XP computer with sound card and serial port (standard on most PCs)
- A 220-240V or 110V main power supply
- An electropalate, custom made for each client
The EPG palate (Figure 1C) comprises an acrylic palate fitted with 62 silver contacts wired to a multiplexer input connector. EPG palates must be manufactured to fit each individual client. See section 5 for EPG palate manufacturer address. Before use the EPG palate should be inspected for any defects that might put the patient at risk (e.g. breaks, cracks etc).
Multiplexer
The EPG palate plugs into the connector slot on the multiplexer (Figure 1D), which is suspended from a cord around the client’s neck. The lanyard located in the top of the multiplexer should be slipped through the bracket which is also mounted on the top of the multiplexer. The cord will grip without the need to tie a knot and may be adjusted by pulling it through the bracket until the unit rests at a comfortable height. Ideally the multiplexer should be high on the chest so that there is no strain on the palate cables.

WARNING The lanyard should never be tied at the free end, as this would pose a risk of the wearer being strangled by the lanyard if the unit catches on something.

Figure 2 Correct use of the lanyard (neck cord)

The client should hold the chrome handgrip (Figure 1E), which plugs into the side of the multiplexer box to complete the contact circuit.

The palate should always be plugged into the multiplexer BEFORE it is placed in the client’s mouth and DO NOT REMOVE PALATE CONNECTOR WHILST THE CLIENT IS IN CONTACT WITH THE APPARATUS. This is to prevent the possibility that the connector end could come into contact with a surface or piece of equipment that is live or earthed. Likewise the handgrip should always be plugged into the multiplexer before being handed to the client.

EPG 3 Scanner
Two input connectors marked ‘PALATE’ (Figure 4C, Figure 4H) (or A and B on the old EPG 3) are provided to enable a therapist to alternately view the client and the therapist’s own palate for demonstration purposes. The white switch (Figure 4F) is used to select either input A or input B. A second multiplexer is required to support this mode of operation. The palate threshold adjustment control (Figure 4E) allows the sensitivity of the EPG3 scanner to be adjusted. A microphone input socket (Figure 4K) is provided (See following SPI section for more details). An indicator above the microphone socket lights up when the EPG3 scanner is properly connected and receiving power from the SPI unit.
Serial Port Interface (SPI)
The Serial Port Interface (SPI) powers the EPG3 scanner and controls its operation in response to instructions from the host computer. The SPI sits on top of the EPG 3 scanner and is connected to the EPG 3 scanner by a short cable from the 25-way D connector on the rear panel of the EPG3 scanner (Figure 3K), marked ‘EPG CONTROL’, to the connector on the rear panel of the SPI marked ‘EPG3 CONTROL’. NB. A different cable is required to connect the old DOS EPG 3 unit. See upgrade section. The SPI is connected to the computer USB port using the 2m USB cable (Figure 4C) plugged into the connector on the rear panel of the SPI marked ‘Host USB. The SPI unit provides pre-amplification for a microphone plugged into the EPG 3 scanner.

Important: Do not use the ‘Mic In’ socket on the front of the SPI unit as it is disabled in this model. USE THE MICROPHONE INPUT ON THE EPG3 SCANNER.

The line-level preamplifier output is taken from the phono socket on the rear panel of the SPI marked ‘AUDIO OUT’ (Figure 3G). The SPI is designed to take the input from a Laryngograph and pre-amplify it. The Laryngograph can be connected to the phono socket marked ‘LX IN’ (Figure 3I) and the line-level Lx output is taken from the phono socket marked ‘LX OUT’ (Figure 3F), both on the rear panel of the SPI. For convenience a fourth phono socket marked ‘LINE IN’ allows any line level signal to be connected to the SPI. Note that this signal will be fed to the ‘AUDIO OUT’ connector and should not be used when a microphone is plugged into the EPG 3 scanner.

Figure 3 Rear Panel of SPI unit and EPG3 Scanner
There are three gain controls on the front panel of the SPI marked ‘MICROPHONE’, ‘LINE’ and ‘LX’ with the following functions:

- **Microphone.** (Figure 4B) Gain control for the microphone plugged into the EPG3 scanner.
- **Line.** (Figure 4A) Gain control for the line-level input to the SPI
- **Lx.** (Figure 4D) Gain control for the Laryngograph plugged into the SPI.

There are two meters on the front panel marked ‘AUDIO’ (Figure 4G) and ‘LX’ (Figure 4I), which indicate the signal levels for the microphone and Laryngograph respectively.

**Figure 4 Front Panel of SPI unit and EPG3 Scanner**

**Installation**

Please read through these steps carefully and completely before you assemble the system. At the end of the process if you can record and playback speech and record and display EPG patterns on the computer, the system is correctly installed and configured.

**WinEPG™ Hardware**

1. Place SPI on top of the EPG 3 scanner
2. Connect the SHORT 25-way ribbon cable (Figure 5A) between the connector marked ‘COMPUTER’ on the rear of the EPG 3 scanner and the connector marked ‘EPG CONTROL’ on the rear of the SPI.

   IMPORTANT: Only the short 10cm 25-way cable supplied should be used. Any other cable may cause serious damage to the system.
below if you are upgrading from the old DOS EPG system as a different cable is used.

![Cable Diagram](image)

**Figure 5 Cables and Accessories**

3. Connect the 2m USB cable (Figure 5C) between the connector marked ‘HOST USB’ on the rear of the SPI (Figure 3L) to a USB socket on the host PC.

4. Plug the main power lead into the rear of the SPI then plug the lead into a suitable power supply and switch on the power.

**Important:** See following section regarding the use of a Medical Isolation Transformer.

5. Switch on the green power switch on the rear panel of the SPI (Figure 3B). After 7 seconds you should hear a beep. If not check that green light on the front panel of the SPI marked ‘POWER’ is illuminated. If the switch is not illuminated there is no power reaching the SPI.

6. Plug the multiplexer cable into one of the sockets marked ‘PALATE’ on the front of the EPG 3 scanner and make sure that the white palate selector switch (Figure 4F) is pointing towards this socket.

7. Plug the chrome handgrip (Figure 5D) into the multiplexer.

8. Plug an EPG palate into the multiplexer (Figure 1D).

9. Hang the multiplexer around the subject’s neck, pulling the cord through the hole in the bracket to ensure the multiplexer rests at a comfortable height and so that there is no strain on the EPG palate when it is in the subject’s mouth.

10. If your computer soundcard does not have a line-in then connect the microphone to the microphone input on your computer’s sound card otherwise follow the following recommended procedure.
**Recommended Audio Setup:**
If your sound card has a line-level input, you have two options that will provide more reliable synchronisation.

**First option:** You may plug your microphone into the socket on the front of the EPG3 (Figure 4K) scanner unit. A Power Supply Adapter is supplied with the system to provide phantom power for the supplied condenser headset microphone.

The adapter is NOT required if the microphone is plugged directly into a modern PC sound card as the PC supplies power to the microphone.

The adapter IS required if the supplied condenser headset microphone is plugged into the EPG3 unit as this unit does not supply phantom power.

Also, it is possible that some old soundcards may not supply phantom power.

To connect the supplied headset condenser microphone to the EPG3 scanner (see Figure 6), first plug the white microphone minijack into the EMA-20 power supply adapter then plug the EMA-20 into the SPI. The EMA-20 requires an AAA size 1.5V battery and has an off/on/volume switch.

Connect the twin phono to minijack lead (Figure 5F) from the red and black phono connectors marked ‘AUDIO OUT’ and ‘LX OUT’ on the rear panel of the SPI to the line level input socket on your sound card. Be careful to match the red and black plugs to the red and black sockets.

**Superior Option 2:** This option generally gives a superior audio quality as the first option can pick up electrical noise as the weak microphone signal passes through the EPG3 unit. You may connect the supplied microphone or your own microphone into your own line-level amplifier and then connect the output of your amplifier into the ‘LINE IN’ phono socket on the rear of the SPI unit. Make sure the microphone gain control is turned completely anti-clockwise (off) and the line input gain control is turned up so that the amplified microphone signal registers on the line level meter on the front panel.

11. Run ‘Articulate Assistant™’ software on the PC.

**Note:** The WinEPG system should be left switched on for 10 minutes to warm up after transit or storage in a cold or humid area.
Medical Isolation Transformer

If the WinEPG system is to be used by patients for speech therapy/pathology or any other medical purpose, it is necessary to use an isolated medical power supply with EN60601-1 approval. Patient safety may be compromised if a medical isolation transformer is not used as indicated in this section.

An isolation transformer is used as a means of complying with several of the electrical requirements of IEC 60601-1, which governs the manufacture and use of medical devices. It allows the use of equipment which form part of the WinEPG system which otherwise would not comply with IEC 60601-1, e.g. PC, monitor, printer.

Its function is to isolate the neutral line from earth and it can be simply set up to handle 110V or 230V power systems.

**Note:** Make sure that the Voltage Selection Switches (Figure 7C) for the Input and Output are appropriately set for the mains supply. The default setting will be 240 Volts for both the input and the output to suit European mains supplies. Fuse ratings for different settings are marked on the case next to the switches. The fuses should be changed if necessary to match the selected voltage settings. See the Technical section at the end of this manual for more details on selecting voltages.

When using the Medical Isolation Transformer, Step 4. in the previous section should instead read:

4. Plug the mains power lead into the Medical Isolation Transformer (Figure 7B) then plug an output power lead (Figure 8) into one of 4 outputs on the medical isolation transformer unit and connect the other end of the output power lead to the rear of the SPI. The PC to which the WinEPG system is connected, the PC monitor and any other peripheral devices connected to the PC that require a power supply should also be powered via the remaining medical isolation transformer.
outputs. The medical isolation transformer input should then be connected to a mains power socket and the power switched on.

Figure 7 Medical Isolation Transformer (MIT)

Figure 8 Output Power Cable

Upgrade from DOS EPG 3 system
The installation procedure is the same as for the WinEPG system with one important exception. The cable connecting an old EPG3 scanner (Figure 9) is wired differently to the new EPG3 scanner (green panels). The upgrade cable (Figure 5E) is also longer to account for the different position of the ‘COMPUTER’ connector on the rear of the old EPG3 scanner.
Software Installation

Close any program you have running on your computer.
Insert the ‘Articulate Assistant™’ CDROM

Use ‘Windows Explorer’ or similar to find the setup.exe file on your CDROM Drive and double click. The software will load automatically. Read the license agreement and proceed to install only if you agree with the terms.

System Setup

Installing Articulate Assistant™ Software

Notice: For convenience, be sure to install the Articulate Assistant™ software before connecting the USB key.

To install the software, place the Setup CD in the CD player of your PC and run ‘Setup.exe’ from your CDROM drive. This will install the Articulate Assistant™ software in the ‘ArticAsst’ folder. The program can be run from the Windows Taskbar Start Menu (‘Start:Programs:ArticAsst:ArticAsst’).

Registering Articulate Assistant™ Software

Versions of Articulate Assistant™ software 1.17 and above do not need to be registered. Older versions must be registered before it can be used. Please download the latest version of the software from our website.

To register older versions, run ‘ArticAsst.exe’ and click on the ‘Help:Registration...’ menu to show the following dialogue box.
Then, if you agree to the license terms, click on the Register button to bring up the Registration Dialogue box (Figure 10).

Figure 10 Registration Dialogue Box
Type into the ‘Name’ box the name of the individual, company or institution to which this copy of the program will be registered. Then contact the manufacturer at the email address given at the end of this manual to obtain the registration ‘Number’. Note: The Name and Number must typed in exactly as provided by the manufacturer.

Buzzer frequency
IT IS NO LONGER RECOMMENDED TO USE THE BUZZER (EXTERNAL BEEP) FOR SYNCHRONISATION. It is less reliable than other methods and so the following is retained only for historical reference.

The buzzer inside the SPI unit provides an audible beep at a frequency in the range 2900-3400Hz. When the microphone is connected directly into the PC, the synchronisation of the audio and EPG inputs depends on the automatic identification of the start time of this beep. The system should operate satisfactorily with the default setting. However, it is possible to adjust the synchronisation setting in the following manner.

1. Look on the SPI unit and find the label that specifies the Buzzer Frequency. It should be near the serial number on the back or the underside of the unit. Take a note of this number.
2. Open Articulate Assistant™ and select the menu item Options|Sync...
3. Click on the ‘Advanced’ checkbox in the bottom right corner
4. Change the ‘Beep Frequency’ to the buzzer frequency you noted in step 1
5. Click on the ‘Advanced’ checkbox
6. Click on OK in the top right of the dialogue box to close and save the new setting.

![Articulate Assistant - Synchronisation](image)

**Figure 11 Synchronisation Dialogue**

The external beep setting is no longer recommended as the synchronisation is not accurate. If the PC you are using does not have a line-in option, it is possible to use a special cable that steps down the line-level output from the SPI unit to microphone level. However, this is not ideal and every effort should be made to use a soundcard with line-level input.

If the microphone is plugged into the EPG3 scanner and the audio lead is connected from the back of the SPI to the line-input of the PC soundcard then the ‘External beep + internal tone’ setting may be used. We would however, recommend using the ‘**Internal tone only**’. Version 1.17 and above provide an option for the screen to turn green and/or the PC to generate a beep as a signal when to start speaking.

**Checking the EPG display function and accuracy**

Switch on the SPI by operating the switch on its rear panel. Observe the front panel LED (Figure 4J) marked ‘POWER’ to confirm that the SPI is powered. Observe the similar LED on the front panel of the EPG3 scanner to confirm that the EPG3 scanner is powered.

Run ‘Articulate Assistant™’ software. The display should look similar to Figure 12.
Figure 12 Record Task Window

The contact area should provide live feedback of contact between the tongue and the EPG palate. If the display does not respond, check that the handgrip is plugged in and being gripped by the client. Try pressing the BLACK RESET button on the rear of the SPI. You should hear a beep after 6 seconds and the palate display should go live. If there is still no response it may be that the communication port parameters supplied with the software are incorrect and need to be changed.

To change the communication port setting:
The COM port needs to be set to the same value as determined shown in Windows Device manager for the ‘Prolific USB-to-Serial Comm Port’.
Figure 13 Windows Device Manager showing COM4 is active.

Select the menu option ‘Options’ then select the submenu option ‘Comms…’. Set the ‘COM port’ to the same setting as found in the device manager e.g. For the example in Figure 13 ‘COM4’. Alternatively, try setting the ‘COM port’ to COM4. If it reads ‘No port’ then try ‘COM5’. If it still reads ‘No port’ then try ‘COM6’, ‘COM7’ and ‘COM8’.

Figure 14 Com port selection dialogue

TIP: If an EPG palate is not available it is possible to check that the system is working by stroking the multiplexer socket with a coin whilst holding the chrome handgrip.
If the EPG display is unresponsive check the advanced settings (Figure 15). For an SPI V2.0 unit with USB lead the value ‘Bits per sec’ should be 57600. [For older SPIV1.0 systems ‘Bits per sec should be 19200]. When the system is operating correctly there will be data continually streaming in the ‘Receive’ box on the bottom right of the dialogue.

Figure 15 Advanced Comms Dialogue

If the EPG display remains unresponsive after following the instructions above then please contact Articulate Instruments for advice.

Once the EPG display is configured and responds to tongue contact, observe the display when in use by an EPG palate wearer. The contacts should switch on and off cleanly as the tongue makes and breaks contact. If the contacts appear to flicker or stay on after the tongue is removed from the palate then follow the instructions for an on-site calibration check in the Technical Details section 3 of this manual.

Checking Audio Function
Next, check the audio signal level.

If using line-level input (see WinEPG hardware setup 10. above), then check that the audio meter (Figure 4Q) is responding to the microphone signal. Adjust the control knob marked ‘Microphone’ until the needle on the meter rises above 8 but below 0 while speaking into the microphone. If line input is not available on you computer then the microphone should be connected directly to the PC soundcard microphone input.

Now talk into the microphone and the audio display should be similar to the one below. If there is no signal (a flat line in the display) then the audio software setup needs to be changed.
In Articulate Assistant™, select the menu option ‘Options: Audio…’ Then click on the dialogue button marked ‘Recording Control’.

If line-in is being used then make sure the ‘line-in’ checkbox marked ‘enabled’ is checked and the ‘microphone’ checkbox marked ‘enabled’ is unchecked. If Laryngograph is not being used then the checkbox marked ‘mono’ should also be checked.

If microphone is plugged directly into the PC soundcard ‘microphone’ input then the dialogue should appear as below.

![Audio Mixer Dialogue](image)

Figure 16 Wave display showing audio signal at correct level

Figure 17 Audio recording setup for use with direct microphone input to sound card. Note. The appearance of this dialogue is liable to change depending on the sound card that is installed

Now adjust the slider control on the ‘microphone’ or ‘line-in’ (as appropriate) until the waveform display responds to speech input to the microphone. Then close the dialogue box by clicking the X at the top right corner.

Congratulations. You are now ready to record audio and EPG data with Articulate Assistant™.
## 2 Technical Details

The SPI incorporates its own microprocessor to control the EPG3 scanner under the instruction of the host computer via the RS232 57,600 Baud serial link. This method eliminates the need for any special hardware or drivers within the host computer.


### Specifications

**SPI V1.0**

- **Power Supply**: 240v AC 50/60 Hz. Internally switchable to 110v 50/60Hz
- **Transformer**: Double Wound Toroidal 5kV isolation.
- **Power consumption**: 120 Watts
- **Power to EPG3**: +12v 200m/a
- **Line Input**: 100mV rms 20-20kHz + and – 1dB
- **Lx Input**: 100mV rms 0-20kHz + and – 1 dB
- **Mic Input via EPG3**: 1mV into 600 ohms 20-4.5kHz opto-isolated.
- **Chan A o/p**: 2v pp to suit host computer line input A RED 10kHz 16 bit
- **Chan B o/p**: 2v pp to suit host computer line input B BLACK 10kHz 16 bit
- **USB**: B type socket.
- **Palate Sample Rate**: 100 per second.
- **Real Time Display Rate**: VDU refresh rate.
- **Data and Control I/O**: Filtered to reduce EMC
- **Approvals**: FCC and European RFI tested.
- **Case Dimensions**: 284 x 278 x 85
- **Weight**: 2.445kg
- **Buzzer frequency**: ________Hz
- **Serial Number**: ________

**EPG3 Scanner**

- **Power from SPI**: +12v 200m/a
Approvals
FCC and European RFI tested.

Case Dimensions
265 x 278 x 60
Weight
1.186kg

Serial Number
________

Multiplexer
Power Supply
+/- 5Vdc

Case Dimensions
94 x 158 x 32mm
Weight
0.288kg

Serial Number
________

Medical Isolation Transformer
Power Supply
240v AC 50/60 Hz. Switchable to 110v 50/60Hz

Transformer
Toroidal isolation transformer rated 260VA.
Transformer Approval
EN60601-1

Typical Leakage Current
0.095mA

Case Dimensions
280 x 155 x 90
Weight
4kg

Serial Number
________

General Environmental
Temperature (Operation)
+10 to +40°C

Temperature
(Storage/Transport)
-15 to +60 °C

Humidity
No Condensation 30 to 70%

Meaning of symbols on rear panels

Fuse symbol with accompanying voltage and current specifications and whether a time-delay or fast acting type fuse is required.
Eg. 240V T200mAL = 240 Volt Time delay 200 milliamp fuse
Attention, consult accompanying documentation (this manual)

Type BF: Equipment providing a particular degree of protection against electric shock. In particular
- allowable leakage currents
- reliability of the protective earth connection (if present)

and having an F-type non-cardiac applied part isolated from all other parts of the equipment to such a degree that the patient leakage current allowable in a single fault condition is not exceeded when a voltage of 1.1 x the highest rated mains voltage is applied between the applied part and earth.

**Electrical Safety**

The electrical safety of WinEPG has been a major consideration during design of the system hardware. The design includes fully floating opto-isolation of the multiplexer and EPG palate with medical grade components used throughout. To comply with CE class IIa medical device safety requirements it is also necessary to use a medical isolation transformer (which can be supplied if not already available) approved to EN60601-1. All electrical equipment connected to the EPG system must be supplied and earthed via the medical isolation transformer.

**Warning**

Safety of the EPG palate wearer depends upon isolation of the components in contact with the subject from ground and from the main power supply. Nothing should be attached to the patient or to components connected to the patient, which might compromise the isolation provided. If in any doubt over this requirement, consult a competent electrician.
Changing the operating supply voltage setting

Mains voltage setting for U.S. 110V 60 Hz supplies may be used to power the EPG3/SPI system.

SPI
Selection may be achieved by setting an internal switch under the safety cover of the power supply unit within the SPI.

To alter the setting:

1. Switch off the power supply and disconnect the power cable.
2. Remove the SPI case lid by unscrewing the four screws retaining the case feet.
3. Select the desired 115v or 230v position using SW1, which can be accessed, through the window in the aluminium enclosure, which guards the high voltage cables and components.
4. Replace the cover and close case.

MIT
Selection may be achieved by setting the switches accessible through the small windows on the rear of the MIT case next to the fuse holders. Both the input and output voltages should be set to the mains voltage for the country in which the system is used.

To alter the setting:

1. Switch off the power supply and disconnect the power cable.
2. Use a screwdriver inserted through the window to slide the red voltage selection switch up or down so that the text on the switch shows the desired voltage.
3. Make sure that the fuses are correctly rated for the selected voltage.

MIT Fuses:
230V - 1.6A
115V - 3.15A

N.B. Applying the incorrect mains voltage may damage the equipment. Consult with a competent electrician if you have any doubts as to your supply voltage.
Serial Port Interface

Figure 7. Serial Port Interface Block Diagram

The Serial Port Interface (SPI) enables a host computer to control the EPG3 palate scanner using a USB connection and an RS232 communications channel, normally the com4, com5 or com 6 port by means of single byte character codes. Each palate frame is returned via the serial link to the host computer in 9 bytes.

SPI response to ASCII character codes sent by the host computer:

<table>
<thead>
<tr>
<th>Character</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>'A'</td>
<td>The scanner scans a single frame and returns the 9 bytes of information to the computer for real time display.</td>
</tr>
<tr>
<td>'B'</td>
<td>Requests a number of frames to be collected and then proceeds to collect the specified number of frames.</td>
</tr>
<tr>
<td>'C'</td>
<td>Starts continuous scan preceded by 1 sec tone - stopped by 'D'.</td>
</tr>
<tr>
<td>'D'</td>
<td>Stops a running routine and closes down any hardware timers.</td>
</tr>
<tr>
<td>'E'</td>
<td>Starts continuous palate scan - stopped by 'D'.</td>
</tr>
<tr>
<td>-----</td>
<td>--------------------------------------------------</td>
</tr>
<tr>
<td>'F'</td>
<td>Starts continuous tone for analogue channel test.</td>
</tr>
<tr>
<td>'T'</td>
<td>Inserts 100mS tone burst after completion of frame whilst running 'E' then the scan continues until 'D'.</td>
</tr>
</tbody>
</table>

These are stored in the SPI until the scan is complete and then to whole sequence is returned to the host computer for storage as a '.EPG' file. Communication is at 19,200 Baud, 8 data bits, no parity, 1 stop bit and hardware flow control.

**EPG Scanner Control**

The main component of the SPI is a single board computer (SBC) which runs a program retained in flash memory. This program is very similar to that run in the earlier DOS versions of EPG except that it runs entirely independent of the host computer resources so that timing accuracy can be maintained in spite of the pre-emptive multitasking Windows operating system. Full use may therefore be used of the multi-media, data processing and display features of the host computer. No EPG specific drivers are required. No adapter cards are required to be plugged into the internal computer bus.

At switch on, the SBC automatically boots the program software and commences to run. The SBC polls the serial port and responds if either an ‘A’ or ‘B’ character is received.

Upon detection of an ‘A’, an output port is assigned to the EPG3 trigger input, line 6 of the EPG3 control socket. A negative transition initiates a scan of the palate from rear to front as 16 nibbles of data, which appear on lines 1-4 of the EPG3 control socket. These are converted to 9 bytes; the first byte is for error checking (hex AA); each following byte represents a single row of palate contacts. A 9-byte array accumulates the frame contacts. This array is uploaded to the host computer at the end of each scan. The software to control palate data flow scans a handshaking ‘Data Ready’ line. The scan period is 3mS which may be repeated every 10mS to achieve a frame rate of 100 per second.

**Analogue Channel Recording**

Three analogue channels are provided.

**Microphone**

The microphone feed comes from the EPG3 microphone pre-amplifier which is opto-isolated (NB. On old EPG3 units the microphone input is band limited to 4.5kHz).

**Line**
A line input is provided to enable a high quality microphone and pre-amplifier to be connected. This channel contains no bandwidth limiting so enables use of the full bandwidth of the host computer soundcard at the selected sample rate. This facility is provided since the spectrogram in the Analyse program will soon be extended to 11kHz to enable fricatives to be better analysed.

**Laryngograph**
A D.C. coupled Laryngograph channel ensures absence of phase distortion. There is internal provision for inverting the signal should the user require a specific polarisation of signal to be displayed from a chosen Laryngograph.

**On-site Calibration Check**
The WinEPG™ system is calibrated at the time of manufacture and should not need to be adjusted. However, a simple on-site calibration check can be performed in the following manner.

Connect an EPG palate to the system that is known to be fully functioning. Run the WinEPG™ system in feedback mode and have the wearer of the palate press their tongue firmly against the palate until all the contacts are ON. If any of the contacts flicker then threshold adjustment may be required. Use a small 1.2-2.4mm flat-headed screwdriver (a suitable one is supplied with the system) to turn the threshold adjustment screw clockwise until the contacts stop flickering. Now, have the wearer of the EPG palate remove their tongue from contact with the EPG palate. If any of the contacts stick ON (even for a moment) after release then threshold adjustment may be required. Use the above-mentioned screwdriver to turn the threshold adjustment screw anticlockwise until the contacts no longer stick ON.

**WinEPG Maintenance**
Regular maintenance of a technical nature is not required for Electropalatograph systems. If contact patterns on the display are flickering or sticking ON then this can be adjusted using the threshold adjustment. See On-site Calibration Check section above.

If the system does not work or appears to be malfunctioning please contact customer support services for advice, or, if necessary, to arrange the return of the unit to Articulate Instruments Ltd for repair or replacement.

Under normal circumstances the unit should not be disassembled or repairs attempted on site. If done, then this action may invalidate the warranty terms.

The Articulate Instruments website should be regularly monitored for updated manuals.

**End of Life Disposal**
Units may include components containing traces of lead. Units should be disposed of accordingly or returned to the manufacturer for disposal.
EPG Palate Assembly

The essential component of the EPG system is an artificial palate custom built to fit the subject's mouth. This is made from acrylic, moulded to fit the upper palate and teeth, and carries 62 miniature silver contacts exposed to the lingual surface.

**Palate Layout**

These are arranged according to a predetermined scheme based upon anatomical landmarks. This ensures adequate coverage of the entire palate including such phonetically important areas such as the region near the junction between the hard and soft palates and the lateral margins close to the teeth. The procedure involves first marking the positions for the contacts on a plaster model of the subject's upper palate and teeth. Three reference lines are then traced out on the surface:

- A line drawn horizontally across the top of the model through the palatal junctures of the upper front incisors.
- A line drawn horizontally through the mid-point of the juncture between the hard and soft palates.
- A line drawn vertically down the centre of the palate.

The 62 contact positions are arranged in eight horizontal rows with eight contacts in each row, except the first (the most anterior), which has six (see Figure).

The most anterior and most positive rows constitute the two horizontal reference lines ([i] and [ii] above). Along these lines the contact positions are marked out at equidistant intervals with the most lateral ones just inside the teeth. The remaining rows are arranged so that the spacing between the front four row contacts is half of that of the back four row contacts. As with the first (most anterior) and eighth (most posterior) rows, the contact positions are equally spaced across the rows. The contact positions are marked out on the plaster cast and used as a guide for placing the contact during the palate manufacturing process.

The contacts themselves are thin silver discs, 1.4mm in diameter, each connected to a 46cm length of 41 standard wire gauge enamelled copper...
wire. The bundles of wires are brought to the posterior corner of the palate, usually behind the wisdom teeth (in adults) and are fed out of the mouth via the buccal surfaces of the maxillary dentition. The wires are protected by soft heat-shrink tubing.

The choice of anatomically-based reference lines and the proportional spacing of the contacts ensure that different palate sizes can be compared with reference to specific rows and contact positions during articulation analysis. Thus for example, row number three (third from the edge of the alveolar ridge) will stand in more or less the same relationship to the palate and teeth in different subjects.

**Preparation for use of EPG palate**

A number of requirements must be met before the acrylic palate is satisfactory.

It is obviously important that the palate interferes as little as possible with normal speech production. It should be as thin as possible, but at the same time robust enough to tolerate frequent use and thick enough to keep its shape accurately. An exact fit is essential and the palate should not move even when considerable pressure is exerted on the posterior edge, as may happen for example during the closure for a velar stop. It is a routine procedure to issue users with a ‘practice palate’. This is a duplicate palate but without contacts and wires, which can be taken home and worn for increasing periods of time prior to clinical sessions. When the palate is worn for the first time, increased salivation normally occurs, but this effect subsides after wearing the palate for a few hours. Occasionally a user is sensitive to the presence of the palate in the mouth. This is usually overcome after it has been worn a few times. The age of the user does not appear to be a significant factor in tolerating the palate. Some, as young as four years old, have found the palate quite comfortable to wear.

Audio recordings can be made with and without the palate being worn in order to estimate the effect that the presence of the palate is having upon speech.

If a user wears a denture, then it is a straightforward procedure to make a duplicate denture with contacts embedded in it. This has the added advantage of not requiring an adaptation period, since the user will already be used to wearing the denture. Children’s teeth can move slightly over a period of time, or they may lose teeth. This may happen, for example, if the child requires EPG treatment, which extends over a considerable length of time. In these circumstances, it is advisable for a dentist to adjust the wire retention clasps.

**Wiring Connections for the EPG Palate**

Figure below shows the correspondence between the contacts and the actual contacts on the connector plug.
Care of the EPG Palate

To clean the palate after use, rinse in warm water, and if necessary clean with a soft toothbrush and mild detergent (keep the multiplexer connector dry). Wipe dry with tissues. Always place the palate back on the plaster cast when not in use. Try not to subject the wires to any undue tension, or coil them excessively.

Guidelines for preparing plaster models

- In order to obtain an EPG artificial palate for a client, a model (plaster cast) of the client’s upper palate and teeth is required (figure 1). A qualified dentist should take an impression using high quality alginate to obtain an accurate record of the client’s upper palate and teeth.
- The requirements for an EPG palate are somewhat different from those of general dental plates. Specifically, the impression should include the gum area immediately behind the posterior molars. This is to accommodate the passage of leadout wires from the EPG artificial palate.
- Also the impression should be taken as far back as is comfortable for the patient; at least as far back as the posterior tuberosity.
- The stone model may be left untrimmed. If it is trimmed then the posterior edge should leave the posterior tuberosity and the gum area behind the rear molars.
Figure 5 Lefthand model is over-trimmed. Righthand model is suitable and leaves room for positioning leadouts of wires exiting behind the rear molars.

Figure 6 a) “Reading” palate made from acrylic resin and hand soldered wires. b) “Articulate” palate made from pre-formed flexible circuit and pressure formed acrylic sheet. Both palates are compatible with the PTU and WinEPG.

Plaster models (see figure 5) should be packaged securely and sent to the palate manufacturer.

Manufacturers of EPG palates
The process of manufacturing the palates is a skilled process and is currently carried out by two firms of dental technicians in the U.K.

Incidental, (John Broughton)
Suite 14, Building 169,
Greenham Park,
Newbury, Berkshire.
RG19 6HW
U.K.
Tel. +44 (0)1635 521807
Email: (Bertha Bates) berthab@btinternet.com
Troubleshooting

**Frequently Asked Questions**

Q. After I’ve recorded a sentence, the prompt moves on to the next sentence. I want to record several repetitions of the same sentence. How do I get it to stop doing this?
A. Find the checkbox marked ‘Auto Advance’ in the panel at the bottom of the Record Task Window and click on it so that the tick disappears.

Q. What is the clipboard.
A. The clipboard is a bit of memory used by the Windows operating system to store images and text. The images and text are then available for ‘pasting’ into any application running on the PC.

Q. I get messages saying “Error in CalcVolume” or “Error in Calibrate”. What can I do about them?
A. These messages sometimes occur when the computer is low on resources. In windows 95 and 98 resources can be depleted by repeated cutting and pasting of large objects such as pictures. The only way to resolve this is to close down all applications and restart the computer.
Contact
If you are experiencing problems with the hardware or software which are not covered in this manual, you can contact

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WWW: articulateinstruments.com

The website provides downloads, a discussion board, details on a range of products and a customer support section (for which you need to use the password “WinEPGuser”) with updated manuals.

We are always pleased to receive suggestions for improving the WinEPG system and the Articulate Assistant™ software.

<table>
<thead>
<tr>
<th>Revision</th>
<th>Date</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.16</td>
<td>22/12/08</td>
<td>Multiplexer and setup instructions improved. Disposal information.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Supervision of children and adults with incapacity required.</td>
</tr>
<tr>
<td>1.17</td>
<td>20/10/09</td>
<td>Revised the declaration of conformity</td>
</tr>
<tr>
<td>1.18</td>
<td>24/09/10</td>
<td>Grove email address changed</td>
</tr>
</tbody>
</table>