SERVICE MANUAL

Avotec, Inc.

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BrainWave – Functional Brain Mapping Option

GE Catalog Part Number: M1033BN

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All packages should be closely examined at time of delivery. If damage is apparent, have notation **"damage in shipment"** written on **all** copies of the freight or express bill **before** delivery is accepted or "signed for" by a General Electric representative or a hospital receiving agent. Whether noted or concealed, damage **MUST** be reported to the carrier **immediately** upon discovery, or in any event, within **14** days after receipt, and the contents and containers held for inspection by the carrier. A transportation company will not pay a claim for damage if an inspection is not requested within this **14** day period.

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MS Exchange Path:

Outlook/Public Folder/All Public Folders/Medical Systems/!Global Initiatives/Information Management/Forms/Common Forms/DAMAGE LOSS CLAIM FORM.

Send the completed form to the email address listed in the form.

For more information about the Transportation Claim Procedure, access the GE Medical Systems Intranet and enter the following URL address (case sensitive):

ftp://3.87.40.2/globepro/qualsys/Docs/190016MF.PDF

Rev. 11/15/2000

Language Policy For Service Documentation (Dir. 2128126)

W A R N I N G

- **THIS SERVICE MANUAL IS AVAILABLE IN ENGLISH ONLY.**
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- **DO NOT ATTEMPT TO SERVICE THE EQUIPMENT UNLESS THIS SERVICE MANUAL HAS BEEN CONSULTED AND IS UNDERSTOOD.**
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- **NE PAS TENTER D'INTERVENTION SUR LES EQUIPEMENTS TANT QUE LE MANUEL SERVICE N'A PAS ETE CONSULTE ET COMPRIS.**
- **LE NON–RESPECT DE CET AVERTISSEMENT PEUT ENTRAINER CHEZ LE TECHNICIEN, L'OPERATEUR OU LE PATIENT DES BLESSURES DUES A DES DANGERS ELECTRIQUES, MECANIQUES OU AUTRES.**

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- **FALLS EIN FREMDER KUNDENDIENST EINE ANDERE SPRACHE BENÖTIGT, IST ES AUFGABE DES KUNDEN FÜR EINE ENTSPRECHENDE ÜBERSETZUNG ZU SORGEN.**
- **VERSUCHEN SIE NICHT, DAS GERÄT ZU REPARIEREN, BEVOR DIESES KUNDENDIENST-HANDBUCH NICHT ZU RATE GEZOGEN UND VERSTANDEN WURDE.**
- **WIRD DIESE WARNUNG NICHT BEACHTET, SO KANN ES ZU VERLETZUNGEN DES KUNDENDIENSTTECHNIKERS, DES BEDIENERS ODER DES PATIENTEN DURCH ELEKTRISCHE SCHLÄGE, MECHANISCHE ODER SONSTIGE GEFAHREN KOMMEN.**

AVISO

- **ESTE MANUAL DE SERVICIO SÓLO EXISTE EN INGLÉS**
- **SI ALGÚN PROVEEDOR DE SERVICIOS AJENO A GEMS SOLICITA UN IDIOMA QUE NO SEA EL INGLÉS, ES RESPONSABILIDAD DEL CLIENTE OFRECER UN SERVICIO DE TRADUCCIÓN.**
- **NO SE DEBERÁ DAR SERVICIO TÉCNICO AL EQUIPO, SIN HABER CONSULTADO Y COMPRENDIDO ESTE MANUAL DE SERVICIO.**

- **LA NO OBSERVANCIA DEL PRESENTE AVISO PUEDE DAR LUGAR A QUE EL PROVEEDOR DE SERVICIOS, EL OPERADOR O EL PACIENTE SUFRAN LESIONES PROVOCADAS POR CAUSAS ELÉCTRICAS, MECÁNICAS O DE OTRA NATURALEZA.**

ATENÇAO

- **ESTE MANUAL DE ASSISTÊNCIA TÉCNICA SÓ SE ENCONTRA DISPONÍVEL EM INGLÊS.**
- **SE QUALQUER OUTRO SERVIÇO DE ASSISTÊNCIA TÉCNICA, QUE NÃO A GEMS, SOLICITAR ESTES MANUAIS NOUTRO IDIOMA, É DA RESPONSABILIDADE DO CLIENTE FORNECER OS SERVIÇOS DE TRADUÇÃO.**
- **NÃO TENTE REPARAR O EQUIPAMENTO SEM TER CONSULTADO E COMPREENDIDO ESTE MANUAL DE ASSISTÊNCIA TÉCNICA.**
- **O NÃO CUMPRIMENTO DESTE AVISO PODE POR EM PERIGO A SEGURANÇA DO TÉCNICO, OPERADOR OU PACIENTE DEVIDO A' CHOQUES ELÉTRICOS, MECÂNICOS OU OUTROS.**

AVVERTENZA

- **IL PRESENTE MANUALE DI MANUTENZIONE È DISPONIBILE SOLTANTO IN INGLESE.**
- **SE UN ADDETTO ALLA MANUTENZIONE ESTERNO ALLA GEMS RICHIEDE IL MANUALE IN UNA LINGUA DIVERSA, IL CLIENTE È TENUTO A PROVVEDERE DIRETTAMENTE ALLA TRADUZIONE.**
- **SI PROCEDA ALLA MANUTENZIONE DELL'APPARECCHIATURA SOLO DOPO AVER CONSULTATO IL PRESENTE MANUALE ED AVERNE COMPRESO IL CONTENUTO.**
- **NON TENERE CONTO DELLA PRESENTE AVVERTENZA POTREBBE FAR COMPIERE OPERAZIONI DA CUI DERIVINO LESIONI ALL'ADDETTO ALLA MANUTENZIONE, ALL'UTILIZZATORE ED AL PAZIENTE PER FOLGORAZIONE ELETTRICA, PER URTI MECCANICI OD ALTRI RISCHI.**

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・このサービスマニュアルを熟読し、理解せずに装置のサービスを行わないでください。

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注意:

- 本维修手册仅存有英文本。
- 非 GEMS 公司的维修员要求非英文本的维修手册时，客户需自行负责翻译。
- 未详细阅读和完全了解本手册之前，不得进行维修。
- 忽略本注意事项会对维修员，操作员或病人造成触电，机械伤害或其他伤害。

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SECTION 1 - INTRODUCTION

1-1 Product Identification and Shipping List

This manual is for the servicing of the visual, audio, and patient response hardware components used for the GE BrainWave Option.

These following components are shipped as part of the product:

BrainWave Rack

Component	Qty	Avotec P/N	GE P/N
Response System Electronics	1	979101	2301428-9
Response System power supply	1	979103	
Response System serial cable to computer	1	979104	
Trigger Converter	1	749002	2301428-10
BNC cable, trigger converter to response system	1	520421	
Stimulus Computer (PC)	1	NA	2303343-2
AC power cord	1	NA	
VGA cable, computer to Video Interface	1	522004	
Video Interface	1	741022	
AC power cord	1	529910	
Graphic Equalizer	1	990355	2301428-24
1/4" to phono converter	4	560202	
1/8" to phono cable	2	560201	
Power strip	1		

Box 1 Cable box

Component	Qty	Avotec P/N	GE P/N
Cable, DC power, Video Interface	1	758617	
Cable, DC power, projector	1	758618	
Cable, fiber optic, visual system	1	758615	
Custom ramp port panel	1	749986	
Y-cable	1	749003	
sub-D M/F cable	1	520422	
Screw lock connector	2	197113	
Monitor mounting kit	1	980262	

Box 2 Silent Scan (audio system) master carton

Component	Qty	Avotec P/N	GE P/N
Audio Console	1	721102	2301428-22
AC power cord	1	529910	
Stereo Interface cable	1	721500	
Audio Transducer	1	722102	2301428-20
Tubing assembly	1	723100	2301428-18
Tubing assembly, research	1	723101	2301428-19
Full Coverage Headset	1	723200	2301428-16
Stethoscopic Headset	1	723300	2301428-14
Covers, Full Coverage Headset	50	962050	
Eartips, Stethoscopic Headset	50	961100	
Silent Scan manual	1	975154	

Box 2A Silent Scan cable box (inside Box 2)

Component	Qty	Avotec P/N	GE P/N
cable, DC power, console	1	758620	
Cable, DC power, magnet	1	758619	
Cable, stereo extension	1	560213	

Box 3 BrainWave Cart

Component	Qty	Avotec P/N	GE P/N
BrainWave Cart	1	980160	
Split tubing (cable wrap)	1	536010	

Box 4 SV projector/IG/glasses

Component	Qty	Avotec P/N	GE P/N
SV projector / IG / glasses	1	745113	2301428-31
Silent Vision Manual	1	975321	

Box 5 SV glasses mount

Component	Qty	Avotec P/N	GE P/N
SV glasses mount	1	745403	2301428-11

Box 6 Patient response system

Component	Qty	Avotec P/N	GE P/N
Response Pad assembly	1	979102	2301428-8
Fiber optic cable	1	979106	

1-2 Compatibility

This hardware is compatible with the following hardware:

- Signa NV/i 1.5T

1-3 Related Documentation

Avotec, Inc.: BrainWave Option, Installation Manual (975156)

Avotec, Inc.: Manual, Series 4000 Silent Vision Fiber optic visual system (975321)

Avotec, Inc: Instruction Sheet, Three-Axis GE Head Coil Mount (975800)

Avotec, Inc: Manual, Silent Scan Hearing Protection and Communication System (975154)

Cedrus: Lumina Operation and Maintenance Manual

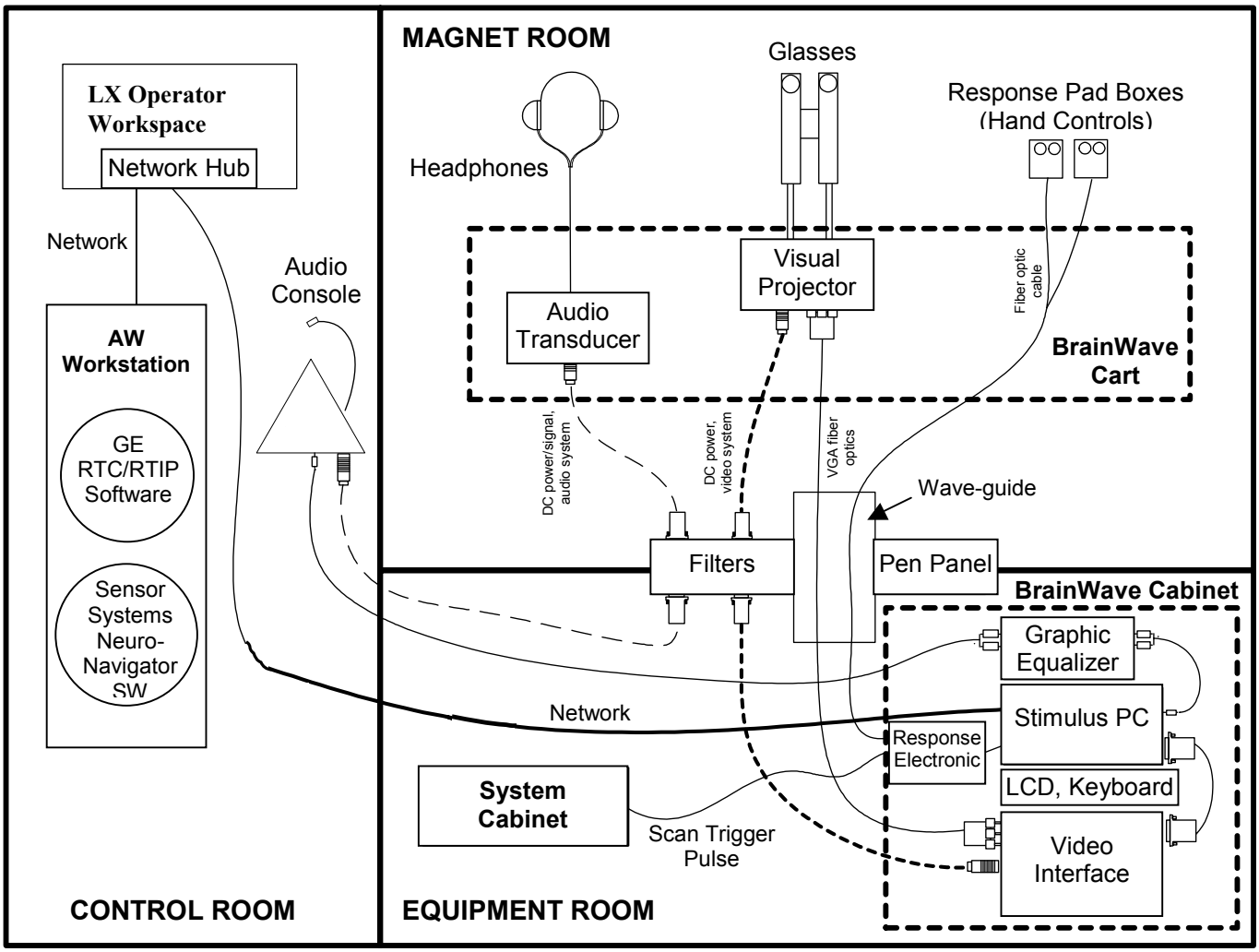
Sensor Systems: BrainWave Installation Manual, ENI 0101

Sensor Systems: BrainWave Troubleshooting Manual, ENR 0101

Sensor Systems: BrainWave User's Manual, ENU 0101

1-4 Theory of Operation

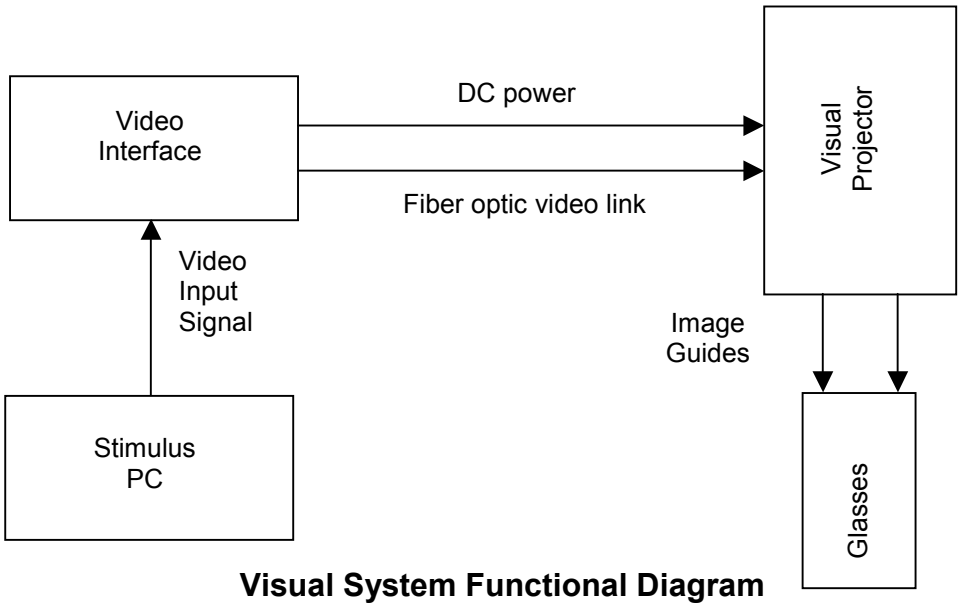
The GE BrainWave Option consists of the necessary hardware and software to present fMRI patient stimuli synchronized with MR scanning (Illustration 1-1). The Silent Vision™ fiber optic visual system is used for visual stimulation. The Silent Scan™ audio system is used for auditory stimulation. The Stimulus PC supplies the input signals for the stimulation system. The software control of the stimulation signals, and the link to the GE MR system, is supplied by the NeuroNavigator™software. Patient response is supplied by the Lumina™ fiber optic patient response system. A trigger signal is supplied by the MR System Cabinet to establish a common time base.



BrainWave Block Diagram
Illustration 1-1

1-4-1 Visual System

The Silent Vision fiber optic visual system (see Silent Vision manual 975321) consists of a Video Interface located in the BrainWave Cabinet, a projector located on the BrainWave Cart, and glasses with glasses mount (3-Axis instructions 975800) installed on the Head Coil. (See Ilustration 2-1.) The projector and glasses are coupled by a pair of fiber optic image guides.



Visual System Functional Diagram
Illustration 1-2

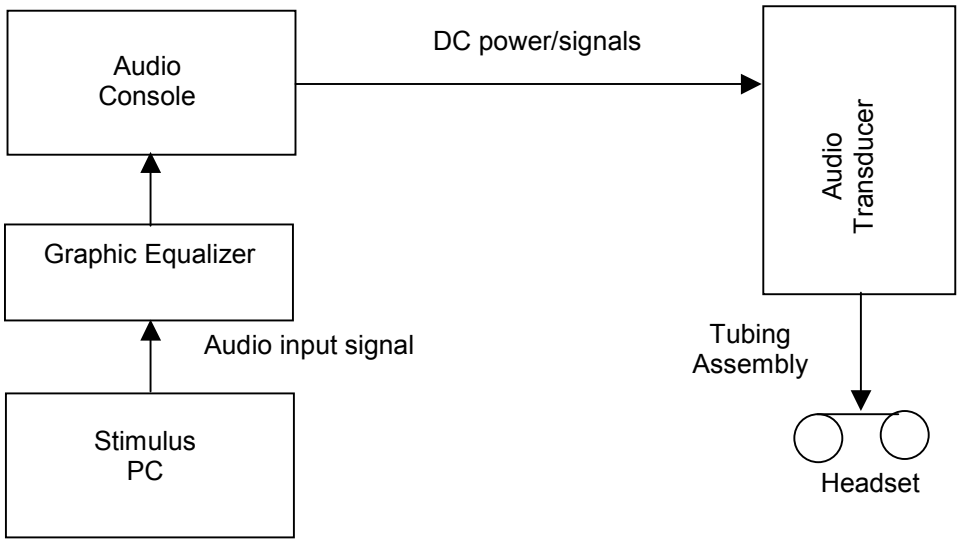
Functionally, a video input signal generated by the Stimulus PC (under control of the NeuroNavigator software) is input to the Video Interface. The Video Interface converts the video input signal to an optical signal, which is then fed by a fiber optic link to the Visual Projector. The projector converts the optical signal, which is then used to drive a pair of transmissive color LCD panels. The color LCD panels are backlit by a pair of halogen lamps. The images of the LCD panels are optically coupled to a pair of fiber optic image guides. The fiber optic image guides transfer the LCD images to the glasses. The glasses mount provides a convenient means of attaching the glasses to the head coil, as well as providing a means for correctly positioning the eyepieces for each patient. DC power to the projector is provided by a wire cable passing through a filtered sub-D connector mounted on a custom ramp port panel. A waveguide in the ramp port panel is used to feed the fiber optic video link into the RF shielded Magnet Room.

The Video Interface has no field serviceable parts (apart from fuses). The projector, glasses and image guides are a complete optical system (Visual Display Assembly) that cannot be separated; they contain no field serviceable parts. The glasses mount has no field serviceable parts.

The troubleshooting approach is to first confirm that the halogen backlights are lit at the projector (which also confirms DC power). Next, the presence of an image matching the Stimulus PC monitor is confirmed.

1-4-2 Audio System

The Silent Scan pneumatic audio system (Silent Scan manual 975154) consists of an Audio Console located at the MR Operator Console, an Audio Transducer located on the BrainWave Cart, and a pair of headphones worn by the patient. The Transducer and the headset are coupled together by a pneumatic tubing assembly (Illustration 1-3).



Audio System Functional Diagram
Illustration 1-3

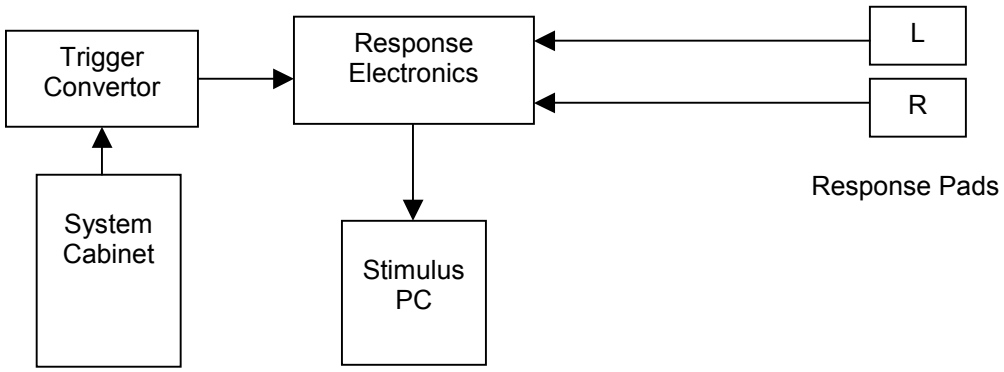
Functionally, an audio input signal generated by the Stimulus PC (under control of the NeuroNavigator software) is input to the equalizer (filter), which pre-emphasizes the audio signal to compensate for the filter characteristics of the Transducer and the tubing assembly. The audio signal is then fed to the Audio Console, and then to the Audio Transducer. The patient headset is linked to the Transducer by a pneumatic tubing assembly. The Audio Console additionally provides a two-way communication link between the operator and the patient. DC power and signal lines to the Transducer are provided by a wire cable passing through a filtered sub-D connector mounted on a custom ramp port panel.

The audio system has two modes of operation, as determined by the mode switches on the back of the Audio Console (Silent Scan manual). In the clinical mode (both switches up), the audio signal is output to the patient when the PTT switch is in the up (on) position; the audio volume is controlled by the music volume control; and the operator microphone is activated by the PTT in the down (momentary) position. In the functional mode (both mode switches down), the audio input is still controlled by the PTT switch, but the volume control is inactive (volume controlled by PC setting), and the operator microphone is inactive.

The Audio Console has no field serviceable parts (apart from fuses). The Audio Transducer and tubing assembly contain no field serviceable parts. The headsets have disposable covers/eartips. There is also a replacement cushion set for the Full Coverage Headset.

1-4-3 Patient Response System

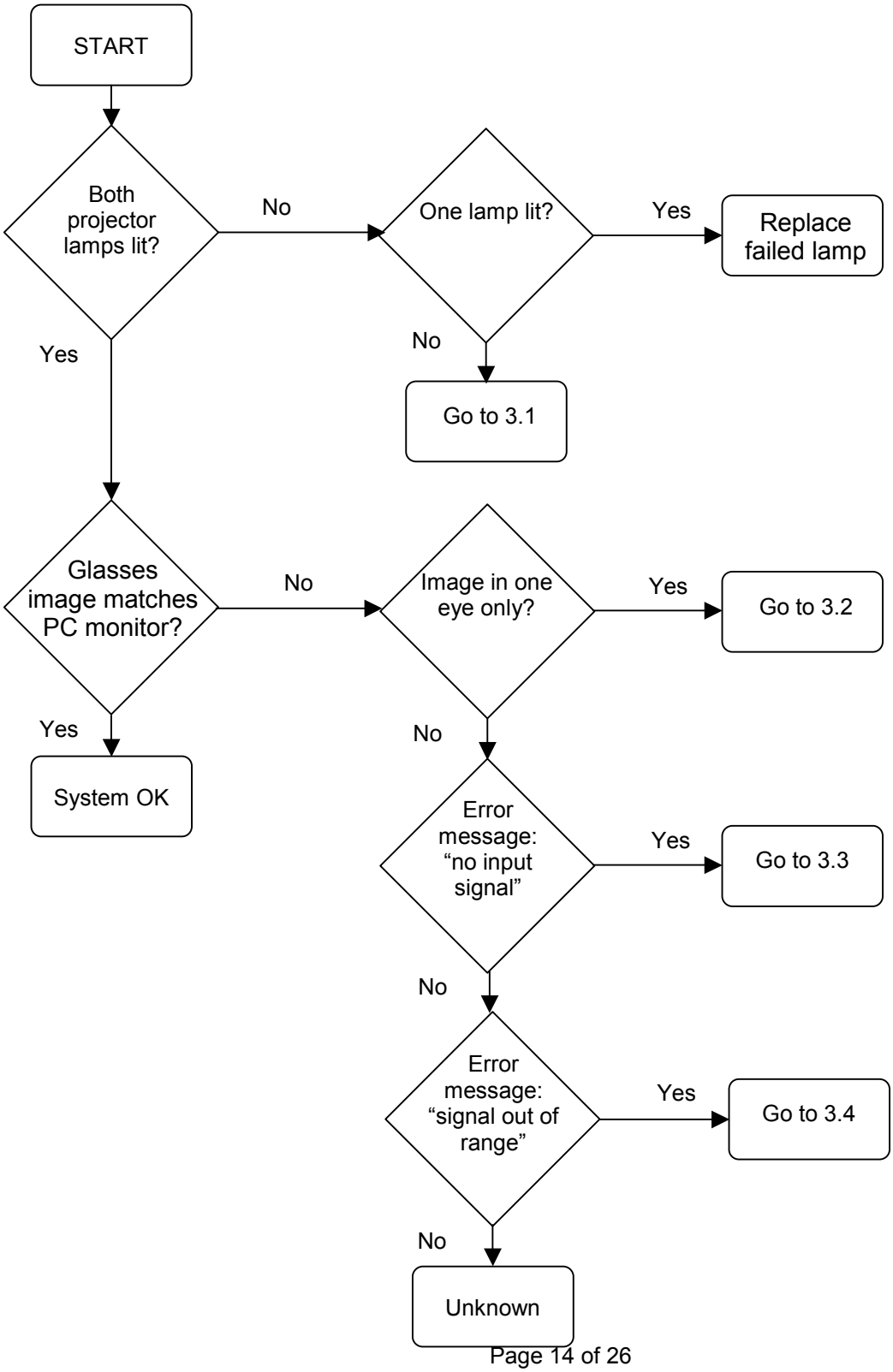
The patient response system (Illustration 1-4) is comprised of two, two-button Response Pads that are held in each of the patient's hands. The pads are connected by a fiber optic link that passes through a waveguide in the Pen Panel to the Response System Electronics in the BrainWave Cabinet. A scan trigger signal from the MR System Cabinet is also input to the Response System Electronics via the Trigger Convertor. An ASCII encoded patient response signal, as well as the trigger signal, are output from the Response System Electronics to the Stimulus PC.



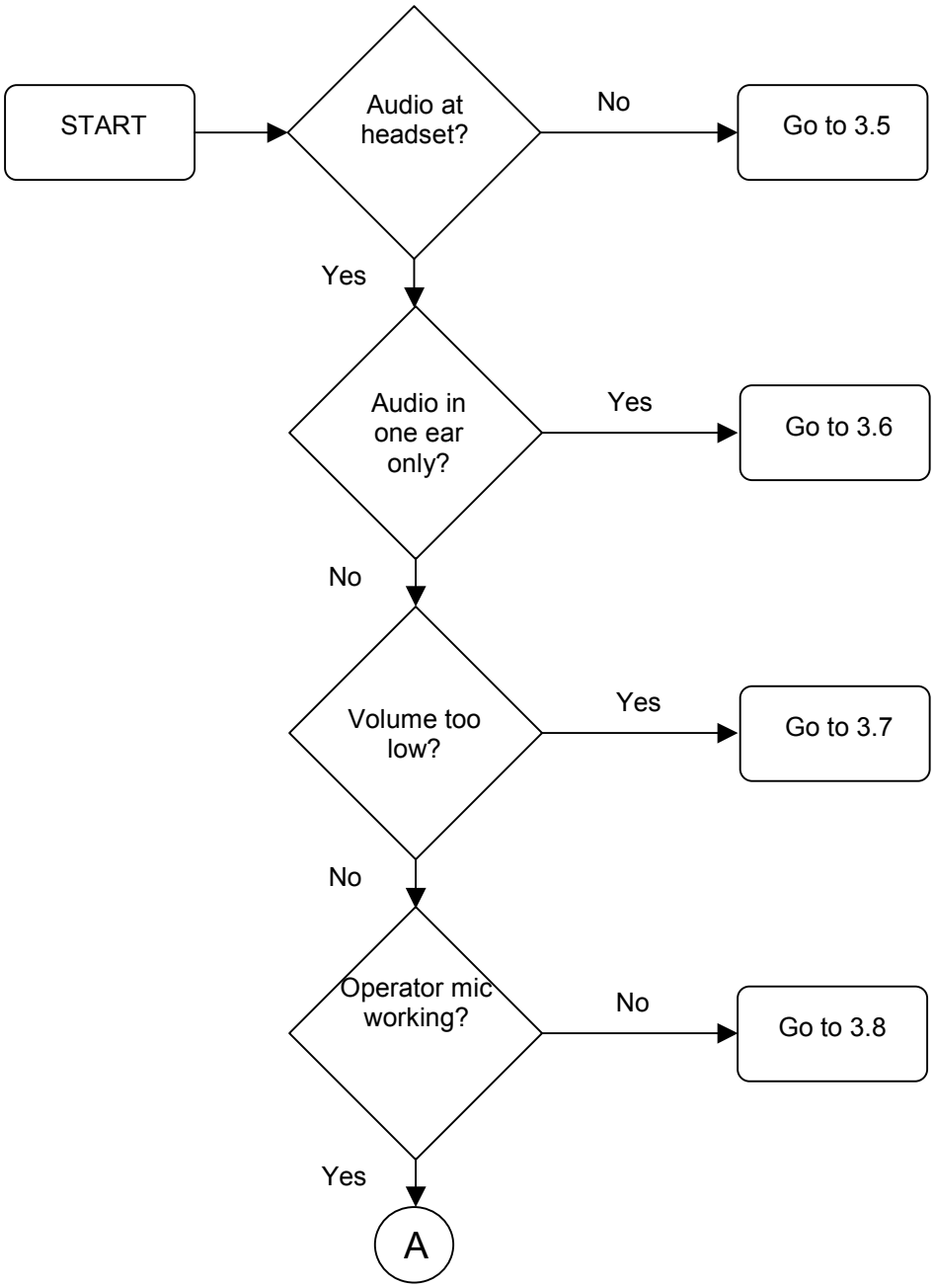
Patient Response System Functional Diagram
Illustration 1-4

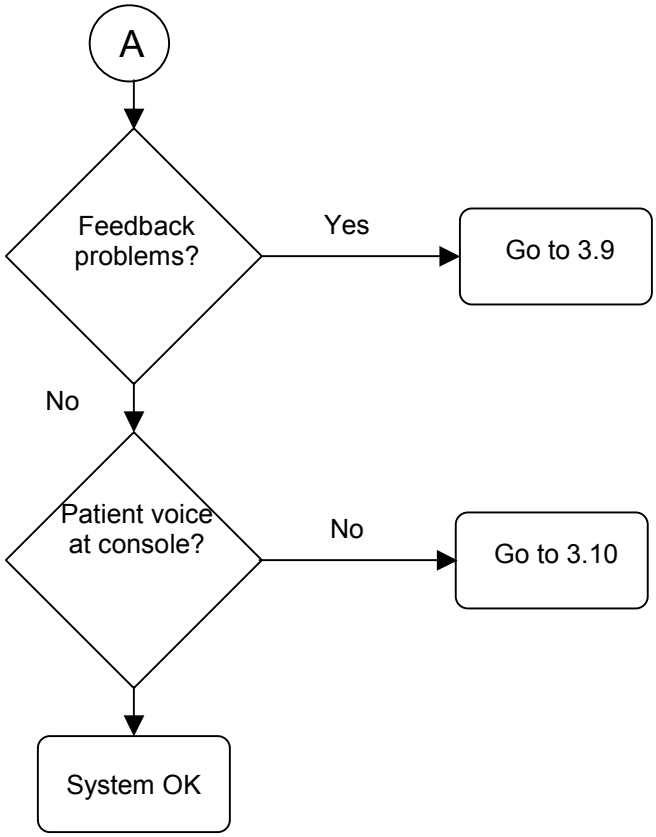
SECTION 2 - TROUBLESHOOTING

2-1 Vision System Flow Chart

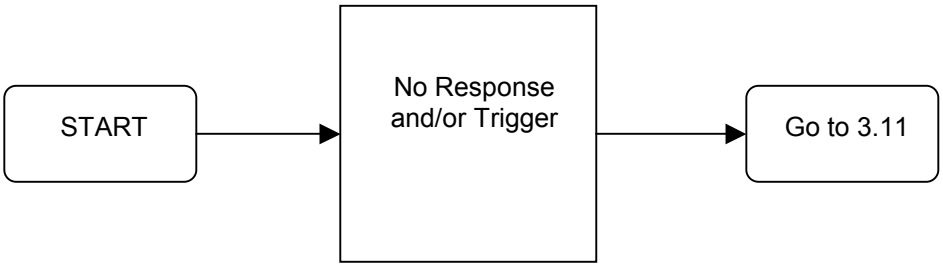


2-2 Audio System Flow Chart





2-3 Patient Response System Flow Chart



2-4 Phone Support

For hardware support call Avotec at (561) 692-0794. Hours of operation are 8:00-5:00 Eastern US Time.

SECTION 3 - RESOLUTIONS AND REPLACEMENTS

3-1 Projector Lamps are not Lit

If both projector bulbs are not lit, it is unlikely that both lamps have burnt out simultaneously. Thus, the DC power connection to the projector should be confirmed (Installation Manual).

1. Check that the Video Interface (located in the BrainWave Cabinet) is powered on. The power indicator light on the power switch should be lit green. If not, check the fuses in the Video Interface (see Silent Vision manual).
2. Confirm that the Video Interface DC power cable is connected at both the Video Interface and at the correct sub-D filter on the custom ramp port panel. Check the physical integrity of the DC power cable.
3. Confirm that the Visual Projector DC power cable is connected at both the projector and at the correct sub-D filter on the custom ramp port panel. Check the physical integrity of the DC power cable.
4. If both lamps are still not lit, try replacing both lamps (see Silent Vision manual).
5. If both lamps are not lit, then there is a failure in either the Video Interface's power supply, the projector, or DC cable. Run a continuity test of the DC cable from the equipment room side by shorting the pins together on the magnet room side. The Video Interface and projector are not field repairable, and must be returned for further servicing.

3-2 Image in One Eye Only

If the correct image (same as seen on the Stimulus PC monitor) is visible in only one eyepiece of the glasses, and both projector lamps are lit, then there is a fault in the projector/image guide/glasses (Visual Display) system. The Visual Display system is not field repairable.

3-3 Error Message: "no input signal"

If the "no input signal" message is visible in the glasses, then a video input signal is not reaching the projector.

1. Check that the video fiber optic connections are made correctly at the projector (refer to the Installation manual).
2. Check that the video fiber optic connections are made correctly at the Video Interface.
3. Check that the (3) green LEDs are lit on the front panel of the Video Interface (refer to the Silent Vision manual).
    a. If the LEDs are not lit green, check that the VGA cable is connected between the Stimulus PC and the Video Interface.
    b. If the LEDs are not lit green, check that the expected image is visible on the Stimulus PC monitor screen.
    c. If the monitor screen has an image, and the LEDs are still not lit, check that the PC video card has the correct video settings (SVGA, 800 x 600, 60 Hz).

d. If the LEDs are still not lit green, then there is a fault in the Video Interface. The Video Interface is not field repairable.

4. If the Video Interface LEDs are lit green, and "no input signal" is still visible in the glasses, then there is a fault in the Video Interface, the fiber optic video link, or the Visual Projector.

   a. On the Video Interface, remove each fiber optic cable (Blue, Green, and Red) and verify a red light can be seen on each fiber optic output connector.

      If a light is not present in any one of the output connectors, there is a fault in the Video Interface. The Video Interface is not field repairable.

      If a light is present on each output, the Video Interface is OK. Go to step b.

   b. Three spare fiber optic cables are provided for the video link. Swap each fiber optic cable with a spare cable on each end.

      If the proper image is seen in the glasses, there is a fault in the fiber optic video link. Label the bad fiber optic cable(s) so they are not used in the future.

      If the error message is still present, then there is a fault in the projector. The Visual Projector is not field repairable. The entire Visual Display (Visual Projector / Image Guides / Glasses) must be replaced.

3-4 Error Message: "signal out of range"

This message indicates that the projector is receiving an incorrect video input signal. At the Stimulus PC, check that the video card is configured for: SVGA, 800 x 600, 60 Hz.

3-5 No Audio Output at Headset

1. Play audio from the Stimulus PC by either running the test calibration paradigm (it is not continuous), play a CD, or run a wave file continuously.
2. Check that the Audio Console power switch is on.
3. Verify the Audio Console has power by cycling the power switch and listen for continuous beeping (press push-to-talk button to "Mic" to stop beeping). If the console does not beep after cycling power, the console is not getting power or the console is defective.
4. Check that the push-to-talk switch on the Audio Console front panel is in the "Music" (up) position.
5. Check that the correct source selection has been made (selector switch is located on the front of the Audio Console). The symbol on the console selection switch should match the symbol of the input on the Stereo Interface box (refer to Install manual).
6. Confirm that the Stereo Interface box is connected to the console. Also, confirm that the stereo extension cable is connected to Stereo Interface box (pn: 721500) (refer to the interconnect diagram in the Appendix of this manual).
7. Ensure both mode switches (back of Audio Console) are in the Clinical (up) position.
8. Check if LEDs light on front of Audio Console, above the volume knob. As volume is turned up more LEDs should light. If LEDs come on, goto step 14.

9. Press push-to-talk switch to “Mic” position and speak into microphone while someone else listens to patient headset. Operator voice should be heard on audio headset. If voice is not heard, then console push-to-talk switch may be defective or console is defective. **Note**: return push-to-talk switch to “Music” position.
10. If sound can be heard through the microphone, but still no sound at the headsets, plug the PC test headphones into the back of the PC and verify sound. If no sound, verify sound is still being generated and adjust volume on PC using the software controls.
11. Check that the Graphic Equalizer (in the BrainWave cabinet) is powered on.
12. Check that both channels of the Graphic Equalizer (located in the BrainWave cabinet) are not in the by-pass mode.
13. Check all wiring connections between PC, Graphic Equalizer, and Audio Console. Equalizer may be defective.
14. If console indicates the sound is being sent to headphones, then confirm that the audio DC power cable is connected at the console, at the correct sub-D filter on the custom ramp port panel in the equipment room, at the correct sub-D panel on the magnet side, and is connected at the Transducer (mounted on the consolidation cart).
15. Confirm that the audio tubing assembly is connected to headset. If voice is still not heard at patient headset, then either Transducer is defective or cable link is defective.

3-6 Audio Input in One Ear Only

1. Confirm that problem is not due to fitting of headset. With audio source present, make sure that (full coverage) headset is adjusted so that each pneumatic tube is placed over ear canal.
2. Examine headset and tubing assembly to confirm that there is no mechanical damage that would reduce or eliminate sound passage.
3. For the full coverage headset, check that the yellow conformal foam inside the headset earcup has not slid over the end of the tubing opening. If it has, simply reach in and pull tubing flush with the outside of the foam piece.
4. Check that both channels of the Graphic Equalizer (located in the BrainWave cabinet) are not in the by-pass mode.
5. At Audio Console, select the Clinical mode (both mode switches in “up” position). If equal volume is heard at each ear, then problem lies with audio input signal.
6. Check computer generated audio input signal with PC test headphones. If audio signal is bad, troubleshoot PC (check balance settings).
7. Use the push-to-talk switch in the Mic (momentary) position to introduce the operator voice as an input signal. Have a second person listen at the headset while the operator speaks. If there is equal volume at each ear, then there is a problem with input section of the Audio Console. If audio input is still present at only one ear, then problem lies with the Transducer.

3-7 Volume Too Low

1. At Audio Console, select the Clinical mode (both mode switches in “up” position). The audio volume control only works in the Clinical mode. Adjust the volume using the volume control. Note: sound in Clinical mode is Mono, sound in Functional mode is Stereo.
2. Select the Functional mode (both mode switches in “down” position). In this mode the audio input volume control is disabled and there is a fixed audio gain through the audio system. Adjust the volume using the Stimulus PC software controls.
3. Check the PC audio out with the PC headset. If audio signal is low, adjust the volume using the PC software controls.

3.8 Operator microphone not working

1. Verify the computer generated audio signal works properly, if not go to the “No audio output” section.
2. The console must be in the Clinical mode for the operator microphone to operate. Select the Clinical mode by putting both mode switches in “up” position.
3. Push the push-to-talk switch down to the “Mic” position and verify the row of LEDs light when speaking into the operator microphone in a normal voice (mouth should be approximately two inches from the microphone).

   If the LEDs do not light, then the console and/or microphone is defective.

   If the LEDs light, but the operator voice is not present in the patient headsets, then the console is defective.

3.9 Feedback problems

1. If there is a feedback problem while trying to speak to the patient (with the audio system in the clinical mode), it will be necessary to reseat the tubing assembly connector in the Transducer receptacle.
2. Power the audio system down.
3. Locate the audio Transducer on the consolidation cart (Installation manual). Unplug the tubing assembly connector from the receptacle in the Transducer. Confirm that the black O-ring is present and not damaged.
4. Plug the tubing assembly connector back into the Transducer receptacle, ensuring that the connector is completely seated.
5. Power the audio system up, and confirm that feedback is no longer present. If problem persists, please contact the factory.

3-10 No patient voice at console

The patient voice channel is completely independent of the operator and/or audio input channel. The audio system thus has a full duplex communication channel. The only override on the patient voice is the voice volume control located on the front panel of the Audio Console.

Functionally, there is an additional tube in the audio tubing assembly that is open at one end where the tubing assembly connects to the headset. The other end of this tube is coupled to a microphone at the Transducer, essentially forming a speaking tube.

1. Confirm that the patient voice volume control is turned up on the Audio Console. This volume control is typically turned down during scanning to avoid hearing the gradient noise.
2. Confirm that the open end of the microphone tube (the visible hole in the headset connectors) is not blocked.
3. If the patient voice still cannot be heard, there is a defect in the Transducer or the console.

3-11 No Response or Trigger

The outputs from the Response Pads and the system trigger from the Systems Cabinet are routed through the Response System Electronics and then to the serial port of the Stimulus PC.

If the BrainWave hardware does not receive the trigger from the Systems Cabinet, the paradigms will not go past the ready state.

1. Run the Serial Port Test (commtest.exe) on the Stimulus PC and check the inputs from the Response Pads (have someone push the buttons) and the system trigger (run a test BrainWave acquisition from the AW to start the trigger).

   Signals from Response Pads will be numbers 49-52.

   Signal from the system trigger will be number 53.
2. The Response Electronics may get hung up, try cycling the power.
3. If response or trigger signals are not present, trace the signals using the interconnect diagram back through the Response Electronics and Signal Converter.

Helpful Hints:

- To stop the NeuroActivator and keep the screen from constantly displaying the 4 color boxes, right click on the NeuroActivator icon on the Start bar and select Exit. To re-start NeuroActivator, click on Start, Programs, NeuroActivator, NeuroActivator – Clinical.
- The signals are sent through pins 4 and 9 of the DB-9 connector on J31 of the Tyme II bd.
- The Signal Converter converts the Tyme II differential trigger signal to a TTL signal.

SECTION 4 - RENEWAL PARTS

4-1 Field Replaceable Units

FIELD REPLACEABLE UNITS LIST – TABLE 4-1

GEMS Part #	Supplier Part #	Description of FRU
2301428-11	745403	Glasses Mount
2301428-12	741022	Video Interface Box
2301428-13	749913	Video maintenance kit, 120V. (Includes four self adhesive image guide holders, two replacement lamps, four image guide protective caps, four protective plugs for goggles assembly, thirteen fiber optic cable protective caps, thirteen fiber optic transmitter/receiver protective caps and two 110VAC 5A fuses.)
2301428-26	758701	Visual Cable Kit (758615 + 522004 + 758617 + 758618)
2301428-31	745113	Visual Display (projector + image guides + glasses assembly)
2301428-14	723300	Stethoscopic headset
2301428-16	723200	Full coverage headset
2301428-18	723100	Audio tubing assembly
2301428-19	723101	Research audio tubing assembly
2301428-20	722102	Audio Transducer
2301428-22	721102	Audio Console
2301428-24	721501	Graphic Equalizer with cables
2301428-27	758702	Audio Cable Kit (758619 + 758620 + 560213 + Qty 2 of 560201 + Qty 4 of 560202 + 721500)
2295515	749986	GEMS Penetration Panel Kit
2301428-8	979102	Response Pad assembly, left & right hand units with two buttons for each hand, includes fiber optic cable, 10 feet.
2301428-9	979101	Response Systems Electronics module
2301428-10	749002	Signal Converter box, DB-9 male Input connector and electrically isolated BNC output connector.
2301428-25	758700	Base Cable Kit (979106, 979104, 520421, Qty 2 197113, 749003, 979105)
2308743	na	Brainmap for PC & AW CD
2303343-2	ZGGEM-21940	Stimulus PC (Preloaded)
2303343-3	KEBKE-001A	Keyboard
2303343-4	MOUMI-008A	Mouse
2303343-6	na	Stimulus PC Base Software CD
2303343-8	570VTFT	LCD Monitor

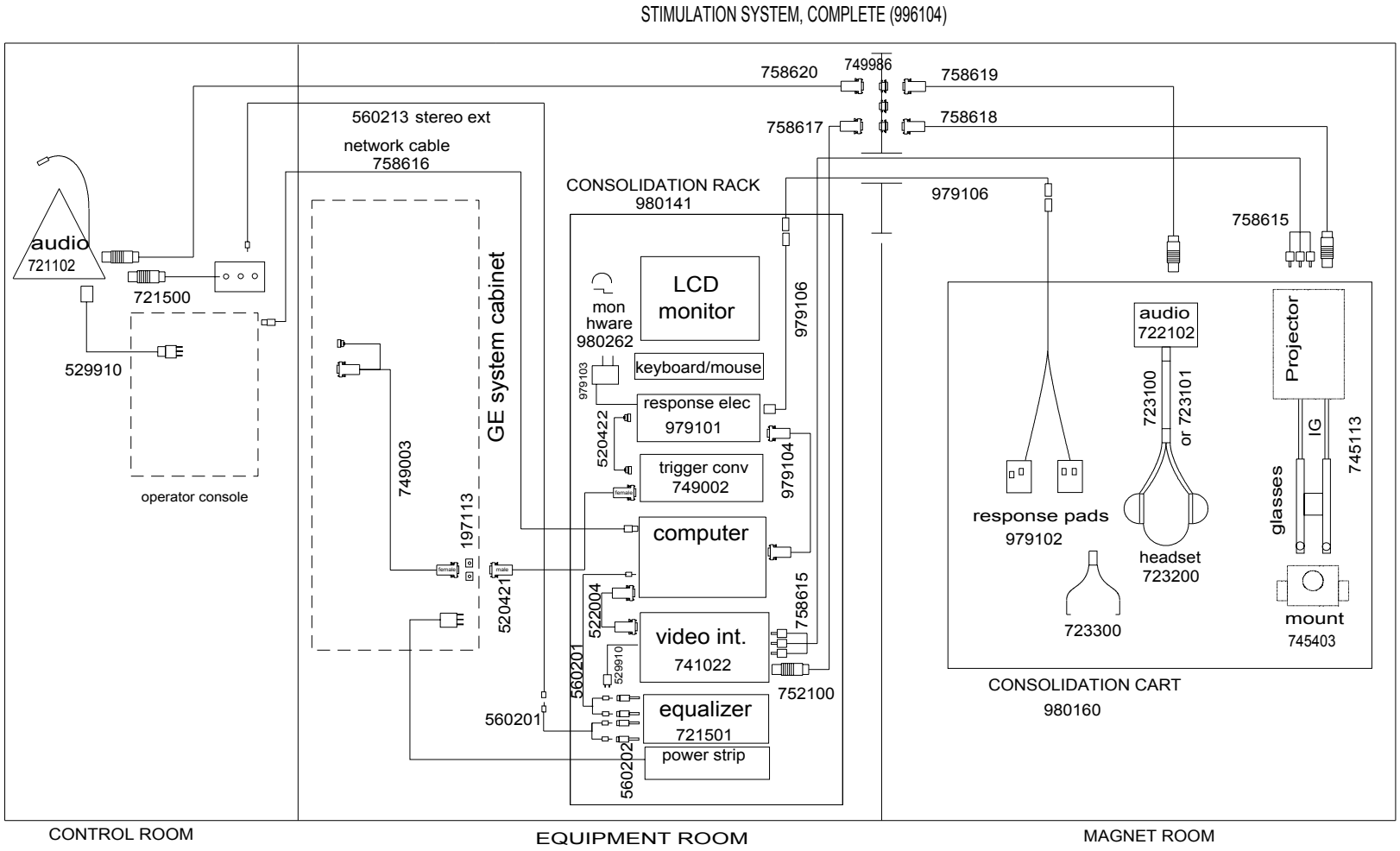
4-2 Other Replaceable Accessories

OTHER REPLACEABLE ACCESSORIES LIST – TABLE 4-2

GEMS Part #	Supplier Part #	Description
Ennnnxx	961100	Eartips for stethoscopic headset (large replacement quantity)
Ennnnxx	962100	Replaceable full headset covers (large replacement quantity)

SECTION 5 - APPENDIX

Interconnect Diagram



REVISION HISTORY

Rev	Date	Author	Primary Reason for Change
A	10/12/01	LaBarge	Updated styles, etc.
B	10/12/01	LaBarge	Added flow charts
C	10/12/01	Keber	Corrected hardware names, updated functional diagrams, theory, and visual troubleshooting sections.
D		LaBarge	Updated T/S sections on page 19 and 20.
E	10/16/01	LaBarge	Combined Revs C & D.
F	10/17/01	LaBarge	Updated Trigger t/s section, added non-Avotec FRUs and other minor style changes.
0	10/22/01	Kopp	Release