811-B ULTRASONIC FLOW DETECTOR

OPERATING MANUAL

CE 0197

TYPE B EQUIPMENT

This device meets or exceeds the international standards listed below:

EN 60601-1-1	Electrical Safety, Labeling, Markings.
EN 60601-1-2	ESD, Radiated Immunity, EFT/Burst Immunity, Fast Surge.
EN 55011 Class B	Conducted Emissions, Radiated Emissions.

Warning: This equipment should not be used with a defibrillator.

This device cannot be used while connected to a charger.

This device is battery operated and uses a **12 V, 1.2 Ah,** sealed lead acid battery for its power source.

811-B ULTRASONIC FLOW DETECTOR

DECLARATION OF CONFORMITY

Product Designation:	Blood Flow Detectors	Blood Flow Meters
Type(s), Model(s)	611-Series	1050-Series
	614-Series	1051-Series
	641-Series	1052-Series
	841-Series	1059-Series
	811-Series	806-Series
	915-Series	
	2100-Series	

Accessories

- Pencil Probes
- Adult Flat Probes
- Infant Probes
- Precordial Probes
- Obstetrical Probes

We hereby declare that the above mentioned products meet the provisions of the EC Directive 93/42/EEC which apply to them, as stated in Annex II of this directive.

This declaration is based on :

Certification of a Quality System:

Certificate # HD 9910392

Issued by TUV Rheinland Product Safety GmbH

Date: 15.03.99

Place: Aloha, OR 97007 Date: December 18, 2002

811-B ULTRASONIC FLOW DETECTOR

SPECIFICATIONS

PROBES

Pencil Probe:	8.2 MHz, Parks part # 832-1820-11.
Skinny Pencil Probe:	Optional - 8.2 MHz, Parks part # 832-2820-11.
Adult Flat Probe:	Optional - 8.2 MHz, Parks part # 832-3820-11.
Infant Flat Probe:	Optional - 8.2 MHz, Parks part # 832-4820-11.

SOUND

Loud Speaker:	Speaker disconnects when headphones are pugged in.
Headphones:	Acquire locally. Low-impedance stereo headphones, rated 8 ohm.

PHYSICAL

Height:	20 cm.
Width:	13.6 cm.
Depth:	8 cm.
Weight:	1.34 kg with battery.

ELECTRICAL

Battery: 12 V, 1.2 Ah, sealed lead acid battery.
PARKS part # 854-0017-01.
POWER-SONIC EUROPE LTD, part # PS-1212.

Fuse:	0.5 A, SLOW fuse, PARKS part # 865-6002-00.
Charger requirements:	Acquire charger locally.
	The external battery charger should supply 16 V ac, 250 mA.
	The battery charger must comply with the relevant national standards. (EN60601-1:1990+A1:1993+A2:1995)

ENVIRONMENTAL CONDITIONS FOR TRANSPORT AND STORAGE (601-1)

Ambient temperature:	Range, -40° C to +70° C.
Relative humidity:	10% to 100%, including condensation.
	Atmospheric Pressure: Range, 500 hPa to 1060 hPa.

OPERATING CONDITIONS

IPXO rating:	Degree of protection against ingress of water ..... none provided.
Temperature range:	10° C to 40° C.

ELECTRICAL WARNING

Misuse of this equipment and inappropriate electrical connections will create a shock hazard.

What appears to be simple connections to other equipment can put the patient and/or the operator at risk of electrical shock. **FOLLOW THE MANUAL INSTRUCTIONS ON THE USE OF THIS EQUIPMENT.** Avoid use involving electrical contact with other equipment. *We assume no responsibility for misuse of our equipment.*

The following is a guide to avoiding common potential hazards, this is NOT comprehensive. Always seek the advice of a qualified Bio-engineer BEFORE making any electrical connections.

1. **WHILE THE BATTERY IS BEING CHARGED IT IS <u>DISCONNECTED</u> FROM THE DOPPLER.** Only the charging circuit is active. The Doppler won't work. This is a safety feature to prevent possible electrical shock to the patient.

   The battery charger must comply with the relevant national requirements (e.g. EN60601-1:1990 +A1:1993+A2:1995). The battery charging input circuitry must not be modified or altered in the field.

   This equipment is not intended to allow operation on a patient while being charged and any modification altering this will no longer comply with the tested requirements.

   Do NOT operate this instrument from other than its own self-contained batteries.

2. **CONNECTING TO A HI-FI OR INTERCOM SYSTEM:** A medical-grade isolation transformer or completely isolated battery operation is the safest means of connecting HI-FI or intercom systems. A qualified technician or Bio-engineer should review all proposed connections.

3. **OPERATION IN THE PRESENCE OF FLAMMABLE MATERIALS OR HIGH OXYGEN CONCENTRATIONS:** The possibility of explosion or fire always exists when this equipment is used in such an environment.

4. **PATIENT BURNS:** In surgery these may occur through the probe when the Doppler is grounded (perhaps through an I.V. pole) and the electrocautery backplate has inadvertently not been connected. To protect against this ensure the cautery ground plate is on and only suspend the Doppler with an insulator.

5. **WARNING:** This equipment <u>should not</u> be used with a defibrillator.

SAFETY IS YOUR RESPONSIBILITY. IF IN DOUBT, SEEK EXPERT ADVICE.

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PANEL DESCRIPTION

OFF/ON

This switch turns the instrument off and on.

BATTERY

The POWER lamp will go on when the unit is turned on. This lamp will blink if the battery needs charging. Although it will operate for a few more hours, it should be recharged as soon as possible.

CHARGER JACK

The external battery charger plugs into this jack. The charger must also be plugged into an appropriate alternating current outlet. The charger should supply 16 V ac, 50-60 cycle at 250 mA.

CHARGING

The battery is charging if the lamp by the charger jack is illuminated. **While the battery is being charged it is disconnected from the Doppler**, which means the Doppler won't work. Only the charging circuit is active. This is a safety feature to prevent possible electrical shock to the patient.

The battery cannot be overcharged.

We recommend you put this unit on charge at the end of every work day. You will get longer, more reliable service from the battery. Leaving the battery discharged for days will shorten the life of the battery. You can expect a life of two to three years for the battery with normal service and care.

If you believe the battery is getting weak, keep the volume low or use headphones to get the maximum Doppler operating time before recharging or replacing it.

VOLUME

This knob controls the volume.

HEADPHONE JACK

When the optional stereo headphones are plugged in the speaker is disconnected, so the sound is heard only through the headphones. You always hear more, especially when you are checking weak flow or veins, through low impedance headphones.

8.2 MHZ PROBE JACKS

The probe is connected to two jacks. It doesn't matter which side of the probe is connected to which jack. The instrument is marked with the frequency number of the Doppler (8.2). The probe you use must match this number. The frequency is engraved on the probe body. When ordering new probes, be sure to order this frequency.

The instrument can be used with the standard 10 mm diameter pencil probe, the skinny pencil probe (6.5 mm), the infant flat and the adult flat probes.

This instrument is designed only for vascular work, not obstetrical service.

THE DOPPLER EFFECT

In vascular testing the Doppler effect describes the change in frequency that occurs when a transmitted energy reflects from a moving object.

This formula describes the Doppler phenomenon:

$$\Delta F = \frac{2F_t V (\cos\theta)}{C}$$

Where:

Δ F = The difference between Doppler probe frequency transmitted and the frequency received.

$2F_t$ = Two times the transmitting frequency of the Doppler probe.

V = Velocity of insonated object (red blood cells).

θ (theta) = The angle of incidence between the ultrasound beam and the blood cells.

C = A constant which is equal to the velocity of ultrasound in tissue (1540 m/sec).

The formula appears intimidating but its principle is easy. It merely states that if you direct a sound beam at a moving object (here the Doppler ultrasound beam points at moving blood cells) that object's movement alters the frequency of the reflected sound beam. Blood cells moving toward the transmitter add their velocity to the signal causing the reflected signal to be a higher frequency than the transmitted frequency. Conversely, blood cells moving away from the transmitter subtract their velocity from the transmitted signal causing the reflected signal to be lower in frequency. The greater the velocity of the blood cells either toward or away from the transmitter the greater the frequency change that occurs. The signal that you listen to during Doppler testing is the difference between the transmitted and the received signal. The Doppler testing device compares the received signal's frequency to the transmission frequency and then outputs the difference between the two signals either to a recording device or to speakers or headphones.

Vascular testing uses two basic Doppler types: continuous wave (C.W.) and pulsed. Most C.W. Dopplers use two piezoelectric crystals (see note below), one continually transmitting and one continually receiving. Pulsed Dopplers use a single crystal which alternates between transmitting and receiving. Each type has unique advantages. C.W. Dopplers provide greater signal resolution and frequency response. Pulsed Dopplers (because of signal timing) allow more accurate determination of vessel depth. Because signal quality is usually more important than vessel depth information in non-invasive vascular testing the Dopplers used on PARKS equipment are continuous wave.

NOTE: Piezoelectric crystals change thickness rapidly when a high frequency electric current passes through them, resulting in the production of sound waves. When they are struck by sound waves reflected from the moving blood cells they convert the sound energy into electric current.

The Doppler unit transmits at a set frequency and "listens" for the returning echo. By comparing the frequency of the "echo" to the transmitted frequency, the Doppler determines forward or reverse flow, flow velocity (angle dependent) and the magnitude of the movement.

There are many elements that interplay to determine some of the values mentioned above but for everyday testing all you need to remember is that if the reflected signal is a higher frequency than the transmitted frequency it is usually associated with forward blood flow (flow towards the probe) and if it is a lower frequency it is reverse flow (flow away from the probe). On a strip chart recorder or on a scope, forward flow usually appears as an upward deflection of the trace while reverse flow appears as a downward deflection.

You can use Dopplers for both arterial and venous examinations. In arterial studies you compare the waveforms to known normals to establish a diagnosis. With venous studies, recording the Doppler signal yields little useful information. Venous Doppler studies rely heavily on the experience of the technologist to listen to and evaluate flow characteristics and they are the most subjective of the non-invasive examinations. In both arterial and venous tests the examination techniques are similar for the upper and lower extremities.

Normally you should use a high frequency Doppler for high flow, relatively shallow vessels. Use a low frequency Doppler for deeper vessels.

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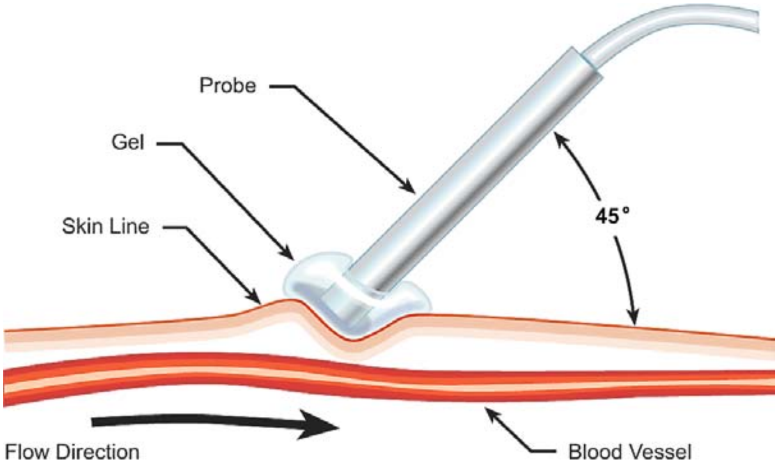
READ THIS!

INFORMATION CONTAINED IN THIS OPERATING MANUAL IS PROVIDED TO HELP THE USER OPERATE THE INSTRUMENT CONTROLS. IN NO WAY MUST A DIAGNOSIS BE MADE ON THE BASIS OF INFORMATION PROVIDED IN THE MANUAL. WE PROVIDE PROCEDURES WHICH WE BELIEVE TO BE IN CURRENT USAGE. HOWEVER, THE PROCEDURE TO BE USED AND THE DIAGNOSIS OF AN INDIVIDUAL PATIENT MUST BE DETERMINED BY THE ATTENDING PHYSICIAN FROM INFORMATION IN THE SCIENTIFIC LITERATURE AND FROM OTHER MEDICAL SOURCES.

PROBE POSITIONING

PROPER PROBE PLACEMENT AND PROPER USE OF GEL ARE VERY IMPORTANT!

In vascular testing the ideal Doppler angle would be to have the probe pointing right down the vessel lumen. Since such a practice is impractical in normal testing a compromise exists. Hold the probe at a **45** to **60 degree** angle from the skin line with the probe tip pointing cephalad (toward the head). As with all guidelines this is not a hard and fast rule. You must still search for the best quality signal.Improper



probe position alters waveform morphology. You cannot make an abnormal signal appear normal by repositioning the probe but you can make a normal signal appear abnormal by incorrect probe angle.

You must be very careful about probe pressure, because a slight amount of pressure against the skin can occlude the artery.

DO NOT point the ultrasonic beam into the retina of the eye.

THE RED PROTECTIVE COVER MUST BE REMOVED FROM THE PROBE BEFORE USE

YOU MUST USE GEL IN FRONT OF THE PROBE

We recommend you use a coupling gel made especially for ultrasonic physical therapy equipment. Gels are available from us, or one of your surgical supply dealers. Acoustical coupling gels are available in bulk, sterile packets and bottles. Gel in a semi-rigid tube with a small extended tip is easier to use than gel in collapsible tubes. Some tubes can be autoclaved.

Do NOT use ECG paste or cream. The probe crystals are covered by a material that is vulnerable to attack by heat, alcohol and ECG paste. Therefore you must not use ECG paste or cream as the contact medium between the skin and the probe.

In an emergency use any surgical jelly or lubricant without excessive bubbles. Don’t use a gel that is too runny. Petroleum jelly or mineral oil can used but they often do not transmit the sound well. Sensitivity may be reduced and bubbles in the gel can make a popping noise. Placing the pencil probe directly on wet tissue will also work.

Remove the gel after use with a soft tissue, **DO NOT scrape off the gel**. You may use alcohol, but wipe probe with water afterwards. If you should find the probe with dried gel on it, wash it off under running water (not hot). The material covering the crystals will soften and come loose if soaked in some liquids, such as alcohol. Therefore we recommend that you use a cleaning procedure that does not require soaking. If a probe is accidentally immersed, soak in plain water and hang to dry with the cable straight down so the probe body drains.

Do NOT autoclave the probe. Temperatures above 60 degrees Celsius destroy the crystal activity and cause the covering over the individual cables and the outer sheath to shrink and crack. With a raised temperature a severe loss of sensitivity will occur. Gas sterilization is OK.

Refer to page **17** for care and cleaning.

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BASIC OPERATING INSTRUCTIONS

USE OF THE PENCIL PROBE IN THE DIAGNOSIS OF ARTERIAL DISEASE IN THE LIMBS

1. **THE PROBE.** The active part of the probe consists of two crystals. One transmits the ultrasonic waves and the other receives them. Each crystal can serve either function so it makes no difference how you plug in the probe to the panel connectors. The crystals are held in place by a material that protects the crystals and the tiny wires soldered to them. This material is vulnerable to attack by heat, alcohol and ECG paste.

2. **POSITION OF THE PROBE:** Invariably, people not accustomed to our probe use it incorrectly. The probe we furnish is different from that of the other manufacturers and is used differently. If you hand someone the probe and say “Here, try it for yourself”, he will almost always put it over his radial artery and put the probe perpendicular to the artery—and perhaps with no coupling gel. Many people have tried to compare our Doppler with other makes by this method. Keep in mind that you are not buying a Doppler for use on the radial artery, but for use on vessels you cannot feel. The best testing ground is therefore in your particular area of interest. We believe our instruments will permit you to find the vessels easier, let you hear the venous sounds easier and follow the vessels better than any other device on the market, regardless of price. But it takes some practice in order to be able to do this. We believe the arm is a good and most convenient limb for you to learn on—to learn how to hold the probe depending on the depth of the artery and vein. The area about 150 mm each side of the elbow is a good place to start.

   First, put some gel on the tip of the probe. The gel squeeze-bottle must be shaken downward and then gently squeezed to get the gel to come out. Pile up about 7 mm of gel on the probe, making certain there are no large air bubbles in the pile because ultrasound does not go readily through air. It needs a continuous conducting medium, and the gel is ideal.

   Turn the VOLUME control fully down (counter clockwise) and turn the instrument on. Gradually turn up the volume. You should hear a rumbling sound if you are holding the probe. This is caused by the vibration of the gel due to tremor in your arm. Now place the probe over an artery in the arm about half way between the elbow and the wrist. Tilt the back of the probe toward the hand at an angle of about 45 degrees, making certain there is gel in the pathway between the probe and the skin. Move the probe and the skin sideways to try to find the center of the artery and the hissing noise at heart rate, which is the Doppler sound for an artery. If the sounds you hear are more or less continuous, that is simply the background noise of the instrument and it means that you are not over the artery. The main energy of the beam is only about as wide as the crystals in the probe, so there isn’t much room for error in aiming the probe. For this reason you must always search the area of the artery and tilt the probe for best Doppler sounds.

When you are looking for deep arteries, or for small or obstructed arteries, you will have to turn the VOLUME control near maximum. This also means that every time you move the head of the probe you are going to get some pretty big thumping noises in the earphones. Therefore you want to avoid moving the head of the probe with respect to the skin as much as possible. That is why you place the probe over the area where you think the artery is and then you search for the exact point by moving the skin with the probe and changing the angle of the probe with respect to the skin. You might wonder why these big transient noises can't be filtered. We do limit their intensity, but we do not filter. The reason is that in the search for low-velocity blood flow, such as in occluded arteries and in the veins, the pitch of the Doppler sounds associated with the blood flow are very low. Any filtering to eliminate or minimize the sounds accompanying movement of the probe would also reduce the response to low-velocity blood flow sounds, and of course this is undesirable.

3. **DIAGNOSIS OF ARTERIAL DISEASE:** The Doppler method of diagnosing arterial disease of the limbs is only one of several good methods. It is probably the most convenient and least expensive of the better methods. It is only qualitative but can be made semi-quantitative by permitting you to make systolic blood pressure measurements along the leg with the aid of a proper cuff and manometer.

   The great sensitivity of the transcutaneous Doppler can cause a doctor or technician to conclude improperly that an arterial pathway is open when it isn't. Collateral flow around an obstruction can be well-developed, especially in the thigh, and cause pulsatile blood to flow in the distal arteries. Or a major artery may be narrowed, causing pulsatile flow distally. These mistakes in diagnosis can be avoided almost entirely by simple means and a little bit of experience. An experienced user of the Doppler can recognize the characteristic sounds of open and obstructed arteries. Remember that Doppler sounds vary in pitch (frequency) with the velocity of blood flow. When you hear the Doppler sound on a normal artery and compare it with a normal arterial pulse-pressure wave, you will recognize the sound of the dicrotic notch, the very fast rise time of the wave and perhaps a third sound just before the onset of a new pulse wave. While the origin of these second and third waves in the descending branch of a pulse wave may be in dispute, their absence in vessels distal to an obstruction is not disputed. So a diagnostic rule is that whenever you hear the second and perhaps third sounds of a pulse wave of a major artery, you can be sure the artery is open proximal to the probe. Plethysmographic studies also show a delayed crest to the wave, associated with a slower rise time to the wave when there is an obstruction proximally. Though the Doppler is permitting you to hear velocity changes rather than true volume changes, the correlation is good enough to be quite valuable diagnostically.

   Now the opposite is not necessarily true—that when you can't hear second and perhaps third sounds the artery is obstructed proximally to the probe. In the digits and smaller vessels the pulse wave is smoothed out more, especially when there is some vasoconstriction. Now of course there are cases that are in doubt. If you cannot clearly hear the second and third sounds (the third sound is frequently missing), compare with the same artery on the other limb. If you find a radical difference in the sound of the Doppler, both in pitch and in amplitude, you are justified in being quite suspicious of the patency of the artery of the first limb you studied provided you are now fairly skilled at optimizing the sounds.

   Another thing you listen for is the relative clarity of the arterial wave. How well it stands out from the background noise of the instrument and perhaps the venous flow adjacent to the artery. Move the probe a little to each side of the artery to make this estimation. In a normal person you will find that you can make the arterial pulse wave almost completely separate from the venous sounds by positioning of the probe.

The way you really come to a final conclusion that the artery is obstructed proximal to the probe is by measuring the systolic pressure at the ankle with an ordinary arm cuff. If you want to measure pressure at other places on the leg you will need a special cuff, the bladder of which encircles the limb. The method is as follows:

> Wrap the cuff around the ankle or slightly above it so you can get the probe on the posterior tibial and hear the arterial sounds adequately. Inflate the cuff to a pressure well above the patient's arm pressure or at least 30 points above the pressure at which the Doppler sounds disappear. Gradually reduce cuff pressure until you hear blood flow, though the sound won't be normal. At that point read the pressure to obtain systolic pressure at the ankle. If you have doubts, center the probe on the artery and inflate the cuff again. You can observe at what cuff pressure the blood flow stops and again where it starts. Where it starts is normally used.

What you are doing is very similar to taking pressure on the arm using a stethoscope. There you are using sounds of turbulence or wall motion. Here we are sensing the flow of blood under the cuff with a much more sensitive device. You can get a clear indication of systolic pressures as low as 30 mm of Hg. The only problem is keeping the probe right on the center of the artery while you are inflating and deflating the cuff. An aneroid manometer mounted on the inflation bulb of the cuff is preferable.

The possibility of misdiagnosing is greatly reduced by this method provided you make two or more measurements and you are skilled at holding the probe in the right place and at the right angle. A low pressure reading is quite reliable. On diabetics you may get readings of 300 mm Hg or more, even though they have ulcers on their toes. These people with end-artery disease studied plethysmographically with the mercury-in-silastic strain gage, which we also make, will have quite large and normal looking pulsations in the toes. Their arterial walls are sclerosed so badly sometimes that they will not compress with cuff pressure.

The normal pressure in the ankles should be about the same as the systolic pressure in the arm, or a little higher. If the arm pressure is 30 mm Hg or higher, an obstruction is almost certainly present. Normally one finds that people with arterial obstructions have pressures of 100 mm Hg or less.

If you have a proper cuff you can take pressures in the same manner (with the probe at the posterior tibial) just below the knee, just above it and at the top of the thigh. By measuring systolic pressure (the pressure measurement is always where the cuff is, not where the probe is) you will find radical differences between measuring sites if the obstruction is between them or you will find that pressures at corresponding points on the two legs are quite different. An exception is bilateral obstruction of the bifurcation of the abdominal aorta which may give you fairly symmetrical pressures on both legs. Unfortunately you cannot use the Doppler above the top of the thigh. The pressure measurements made on the thigh with a narrow cuff will be clinically useful, though not accurate.

Once you have determined that there is an obstruction it is often desirable to determine just where it is. It is permissible to check at certain points provided you are quite familiar with normal sounds, second and perhaps third sounds. Start at the top of the thigh and listen for the normal arterial sounds. A little to one side you should hear venous flow varying with respiration. The adjacent venous flow assures you that you are indeed listening to a major artery. This is important because you can get beautiful sounds from a collateral that is aimed toward your probe and giving a tremendous Doppler effect. But a collateral follows a tortuous path and the venous sounds will not be found adjacent to it. If you have a little problem hearing the vein (and you shouldn't over big veins) give the leg a slight squeeze distal to the probe to increase the velocity of the venous blood and make its pitch higher. As you follow the superficial femoral artery down toward the knee you will lose the sound, even on normals, in some parts of the path because of tendons or other anatomical obstructions between the probe and the artery. You should be able to pick it up again easily in the popliteal region. Your ear and concentration make a filter to extract wanted information from background noise that exceeds anything that can be done electronically. You can follow these small arteries distal to the knee and in some cases they can be followed all the way to the ankle and beyond. Keep in mind that some people don't have a dorsalis pedis artery. If you are working on arteries in the foot, make sure they are dilated by immersing the foot in a bucket of warm water for a few minutes. Some people are vasoconstricted most of the time. They usually will dilate for a while after the immersion and in a few minutes be constricted again. Also they usually do not have arterial disease.

To summarize, if you want to quickly determine the patency of the arterial system in the leg, pick up the posterior tibial and listen for 2nd and perhaps 3rd sounds. If you hear them, and you are sure you know the difference between normal and abnormal, go no further. If they do not sound normal or there is doubt, make a blood pressure measurement and compare it with systolic pressure on the other ankle and on the arm. To find the location of the obstruction you can listen with the Doppler, or using a special cuff you can make blood pressure readings farther up the leg. If the obstruction is in the iliacs you can note it by the Doppler sound distal to the obstruction or by a much lower than normal blood pressure at the top of the thigh as measured with the cuff and the Doppler.

4. **PREOPERATIVE AND POSTOPERATIVE** use of the Doppler is very important. When the patient is on the table, measure systolic pressure at both ankles and record it. After blood is again permitted to flow, measure *both* pressures again. The pressure on the operated leg should be UP compared to the pressure in the other leg, the control. If it isn't, then it is pretty safe to assume something is wrong. On rare occasions a limb will have such a high degree of reactive hyperemia that pressure will not be up and may even be lower, but the leg will be hot. A large percentage of patients are blocked to some degree before they get off the table. Blood-pressure measurements will give you an objective evaluation of the surgery. Some surgeons use the pencil probe directly on the artery (using sterile jelly for coupling) just distal to the repair. The characteristic of the flow sound is important. If the runoff is inadequate an experienced ear can detect it and often correct the cause on the table. You can also use Doppler and pressure measurements for follow up, comparing pressures at both ankles with systolic pressure at the arm, measured either with a Doppler or stethoscope.

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USE OF THE FLAT BLOOD-PRESSURE PROBES

Infant flat blood pressure probe

Adult flat blood pressure probe

We manufacture two different sizes of flat probes meant to be taped to the wrist for repeated blood pressure measurements. One is called the adult flat 15 degree or just adult flat. The other is the infant flat. The 15 degree nomenclature means that the crystals are set into the plastic so that the ultrasound beam goes into the vessel at about 15 degrees from perpendicular. The probes can be used on either adults or infants but the infant probe is definitely more convenient to use on infants because it is smaller.

These probes must be obtained in a frequency corresponding to that marked on your Parks Doppler. Nominal 8.2 MHz is standard.

The beam width of these probes is about 10 mm, the longest length of the crystals. The probe is normally placed over the radial artery, where it is easiest to palpate, with the cord lying across the hand. This makes the crystals point upstream a little bit (15 degrees from perpendicular). There must be a gel contact between the skin and the material covering the crystals visible in the probe. In time, this gel can melt away, especially if the skin is sweaty, so if you lose signal, suspect that the gel is not bridging the gap between the skin and the crystals.

Holding the probe in position can be a problem. Normally tape is used. If you first draw the skin up around the sides of the probe before putting the tape on it may stay in position better. Normally you anchor the cord in at least one place distal to the probe so it will not tug on the probe. A Velcro strap has been used by some.

GENERAL INFORMATION ON MAKING THE MEASUREMENT OF SYSTOLIC PRESSURE

A Doppler is normally used to make accurate systolic pressure measurements. Diastolic pressure can be estimated by other sound changes in some cases, but it is not accurate. The accuracy of the systolic measurement depends on having the proper width cuff for the limb. The Doppler is merely serving as a sensing device to let you know that blood is spurting through the constriction in the artery imposed by the cuff. This corresponds to the first sounds you get through a stethoscope when you deflate the cuff. Since blood flow causes a hissing sound in a Doppler, you will clearly hear the hissing spurt of blood as cuff pressure is slightly lower than arterial pressure. You read the manometer on the cuff when you first hear blood flow sounds from the Doppler. The Doppler probe can be anywhere distal to the cuff. The measurement made is for the pressure at the site of the cuff, not where the Doppler probe is.

USE OF THE FLAT BLOOD-PRESSURE PROBES

TO MEASURE SYSTOLIC PRESSURE

First you put the cuff on the arm in the normal position above the elbow. You position the probe over the radial artery before you inflate the cuff and find where the flow is loudest. Then you anchor the probe with tape by manipulating the skin up the side of the probe before you tape. Next you inflate the cuff quickly to above estimated systolic pressure, letting the pressure down slowly. When you hear the spurt of sound from the Doppler, read the manometer and then deflate the cuff. Your manometer reading is the systolic pressure measurement.

The reason for using the Doppler and not a stethoscope is that the Doppler will allow you to make accurate systolic pressure measurements on patients with very low blood pressure, on legs, on fingers, rat tails, animal legs, dog and cat tails, etc. Again, accuracy depends on having the right width cuff. Systolic pressure measurements as low as 10 mm of mercury have been made on infants in surgery.

DISCUSSION

The measurement is usually quite consistent with some experience. Variations in intrathoracic pressure can cause flow sounds to come and go when you lock the manometer to a specific pressure, such as 145. When you are in doubt about a pressure, lock the manometer at some reading and see if there is a spurt of flow with each cardiac cycle. Increase pressure a bit and see if the spurt stops or only occasionally comes through. Normally when the spurt of flow is there for two cardiac cycles as you lower pressure, that is the measurement you want. Oscillation of the needle on the manometer is not a valid measurement.

Diabetics, whose arteries may be calcified, may give you high systolic pressure readings, especially on the legs. This would happen with a stethoscope too. You cannot make an accurate systolic pressure reading using a cuff when arteries at the wrist or ankle are heavily calcified, regardless of whether you use a stethoscope or a Doppler.

CARDIOPULMONARY BYPASS MEASUREMENTS

When a patient is on cardiopulmonary bypass or there is some type of shunt between the artery and vein, there is no pulse. What you must do is inflate the cuff to above systolic pressure, let pressure fall rather quickly and note the pressure in the cuff when you first hear blood flow sounds from the Doppler.

DIGITAL AND TAIL MEASUREMENTS

Animal and tail vessels can constrict so completely that the blood just oozes, it does not pulsate. Therefore you cannot detect it with the Doppler because the velocity is too low. You must release vasomotor tone by warming or causing tissue anoxia (inflating the cuff to above systolic pressure and leaving it at that pressure for five minutes or so).

DIASTOLIC PRESSURE MEASUREMENTS

The Doppler method is not very suitable for diastolic measurements. The reason is that the diastolic measurement is a cessation of the vibration of the arterial wall. In normals, this is easily heard with a stethoscope. As pressure falls or the limb is small, the stethoscope does not work either.

You can estimate diastolic pressure in two ways. One is to insert the probe under the lower edge of the cuff and listen for the disappearance of the thumping sound as you pass diastolic pressure. The problem with this is that positioning of the probe so it will stay in place is often difficult. Also the distance to the brachial artery on obese or muscular people may be so great you cannot get a good Doppler sound. What some people do is use the probe at the radial artery as above noted, but listen for the return of the dicrotic notch, where flow signal is first heard during the entire cardiac cycle rather than an interrupted sound. These measurements are estimates and we do not claim accurate diastolic readings can be made.

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USING THE DOPPLER ON DIGITS

Standard 8.2 MHz pencil probe

The Doppler comes equipped with a 3/8" nominal 8.2 MHz pencil probe. We also make a 1/4" skinny pencil probe which some people like for digits and supraorbital arteries. The benefit is better separation of artery and vein. Mostly the two lie close together, and you will find supraorbitals much easier to do with the skinny pencil. You will also find that you get a better signal-to-noise ratio in many cases.

Line the length of the probe up with the length of the artery for best separation of arteries and veins at the ankle and best efficiency on the digital arteries. Separation of artery and vein on the digit is not possible with standard or even skinny pencil probes and is not normally necessary.

Whenever you try to pick up arterial flow from the digits you must consider digit temperature. It is often difficult to get a digital pulse when feet are cold or cool. The digits can be so vasoconstricted that blood only oozes through, which is sufficient to nourish but doesn't give a good recording or sound on any device. This occurs in perfectly healthy digits under normal conditions. It also occurs after surgery when severe vasospasm may occur.

In order to get a good sound or blood pressure measurement under these conditions you must cause vasodilatation to take place. One method is to warm the extremity by immersing it in warm water-not hot water. Within a few minutes you will be able to evaluate the condition of the flow when the limb is at heart level or slightly above.

Another method used to dilate peripheral vessels is to occlude all flow at the ankle or forearm with an ordinary arm cuff inflated to well above systolic pressure. This is not normally painful, especially when vascular disease is present in the arterial system. If too much discomfort is apparent, a different procedure could be tried. Five minutes is usually enough time. On release of cuff pressure a reactive hyperemia will take place and last for a short time at least. There should be enough time to make an evaluation of arterial patency. Diabetics may have incompressible arteries so this technique may not work with them.

When there are two sounds to the arterial pulse wave, the first caused by the filling of the vessel with systole and the second being either forward or reverse flow in the diastolic phase, vessels are usually patent. However, blockage of major proximal arteries may be present with good collateral flow around them. When there is only one sound with each cardiac cycle and the sound is not brisk, a proximal stenosis or occlusion may be present.

PROPER PROBE PLACEMENT AND PROPER USE OF GEL ARE VERY IMPORTANT!
The pencil probe body should be in line with the artery, not crossways to it, and should be at about a **45 degree angle**. You must be very careful about probe pressure, because a slight amount of pressure against the skin will occlude the artery. You must use a glob of gel in front of the probe.

You may find it impossible to make blood pressure measurements on the digits with a Doppler, especially the toes. It is better to use our photoplethysmograph for that purpose. Doppler sounds from digital arteries will be very helpful once you become familiar with normal and pathological sounds. Making digital pressure measurements on the toes is not a very popular procedure.

Refer to your medical literature for diagnostic procedures. This information is primarily meant to be a simplified guide to the use of the instruments and the probe.

TECHNIQUE OF EVALUATING CALF VENOUS DISEASE

The assessment of calf venous disease by Doppler ultrasound may be achieved with an accuracy of up to 85% compared to venography when one is experienced with the technique. The status of the calf veins can be assessed by listening with the Doppler at the posterior tibial vein at the ankle, the popliteal vein, the superficial femoral vein, and the common femoral vein. The status of the calf veins is determined by a combination of augmentation maneuvers when listening at these various points.

NORMAL RESPIRATION FLOW SOUNDS

The Doppler is initially placed over the posterior tibial vein at the ankle behind the medial malleolus. Generous amounts of acoustic gel must be used, and one must be careful to avoid undue pressure with the probe which might result in obstruction of venous flow. Initially the posterior tibial artery signal is elicited. The probe is then moved slightly to either side of the arterial signal until the windstorm like venous signal is heard. Normally this signal should wax and wane with respiration. In the presence of calf vein thrombosis, the signal may be more continuous or there may be no audible signal present. If the feet are vasoconstricted, a venous flow signal may not be heard until the venous velocity is increased by gentle compression of the foot.

CHECKING COMPETENCY OF THE VALVES

Once the optimal venous signal is elicited, the calf is then compressed with the hand which is not holding the probe. The fingers should be spread so that much of the calf muscle is compressed. During this procedure, no venous flow should be heard. If venous flow signals are elicited, this is a sign of deep venous valvular incompetence, usually secondary to old deep vein thrombosis.

AUGMENTING VENOUS VELOCITY BY COMPRESSION

Next the calf is released and one should normally hear an augmentation of venous flow as blood enters the previously decompressed calf veins. The magnitude and duration of the augmented signal can be influenced by several factors including the temperature of the foot, the general vasomotor tone of the patient and the presence or absence of venous thrombosis in the calf. It is important to compare the augmentation signals in each foot. In vasoconstricted individuals with cold feet, the posterior tibial venous augmentation may be very minimal but it should be symmetrical. If there is good augmentation in one leg and poor augmentation in the other, the latter leg is usually the site of venous thrombosis. Next, the common femoral and then the superficial femoral veins are examined and the signals assessed for augmentation upon calf compression. Calf-vein thrombosis will result in a decreased augmentation of the venous signals at these sites. Similarly the popliteal vein should be examined. In general, the most sensitive indicator of calf-vein thrombosis is a relative decrease in augmentation upon release of calf compression with the probe positioned over the posterior tibial vein at the ankle. There are certain conditions which will imitate calf-vein thrombosis. Such problems as subfascial hematoma, a ruptured Baker’s cyst, extensive edema, or other conditions which cause increased pressure on the calf veins may result in a decreased augmentation of flow during the aforementioned maneuvers. Such conditions can be best diagnosed by a venogram if the diagnosis is in question.

811-B ULTRASONIC FLOW DETECTOR

CARE OF THE PROBE

The Doppler probes are easily ruined through misunderstanding and neglect. Over 90% of the failures of the Doppler are due to failure of the probe in some way. It will pay you to read what follows and transmit this information to any person using the Doppler.

ABOUT THE PROBE

The active part of the probe consists of two crystals. One transmits the ultrasonic waves and the other receives them. Each crystal can serve either function so it makes no difference how you plug in the probe to the panel connectors. The crystals are held in place by a material that protects the crystals and the tiny wires soldered to them. This material is vulnerable to attack by heat, alcohol and ECG paste.

CLEANING THE PROBE

After use, the probe should be gently wiped clean of acoustical coupling gel with a soft tissue. If the gel has dried on the probe, put it under running tap water (not hot) to soften the gel and permit you to wipe it off. The probe crystals are covered with a material that will soften and come loose if soaked in some liquids, such as alcohol. Therefore we recommend you use a cleaning procedure that does not require soaking. Usually, wiping with a damp cloth is sufficient. You may use alcohol on the cloth, but wipe with a water-dampened cloth afterwards. If a probe is accidentally immersed, soak in plain water and hang to dry with the cable straight down so the probe body drains.

Should someone use a sharp instrument to scrape off dried gel, they may also succeed in scraping off the material covering the tiny wires and crystals as well. We speak from long experience. Such probes cannot be repaired, and in fact any probe with a broken or cracked crystal cannot be repaired.

DO NOT AUTOCLAVE

Temperatures above 60 degrees Celsius destroy the crystal activity and cause the covering over the individual cables and the outer sheath to shrink and crack. With a raised temperature a severe loss of sensitivity will occur.

BE SURE THE PROBE FREQUENCY MATCHES THE TUNING OF THE DOPPLER.

The frequency is marked on the probe and on the instrument. When ordering new probes, be sure to order this frequency. The user should keep a spare probe of the proper frequency on hand if they depend on the Doppler.

<u>The red protective cover must be removed from the probe before use.</u>

DISCONNECTING THE PROBES FROM THE INSTRUMENT SHOULD BE MINIMIZED.

Don’t do it unless you need to, for two reasons. First the connectors wear and make erratic contact causing “static” after many disconnects. Second, people have a tendency to pull on the cable instead of the connectors themselves and they break the soldered connection inside the cable connector.

STRANGE NOISES FROM THE DOPPLER

On occasion there are noises you might not expect from the Doppler when in fact the Doppler is working fine. The following are some common concerns and their causes.

CONCERN:	CAUSE:	REMEDY:
Popping scratchy noises sounds when the probe is first placed on the skin.	Air bubbles in the gel are moving and/or popping. Hair movement can also cause these noises.	Use a new dab of gel that looks clear, push the probe down enough so hair is immobilized, and wait a few seconds for everything to settle. If the noise is not there when the probe is clean (no gel) and suspended in the air, the Doppler and/or probe are probably working fine.
Static when the dry probe is moved through the air.	Loose connectors where the probe connects to the instrument, broken shield wire in the cable either at the connector or as it comes out of the probe.	There is normally some static generated when the cable is flexed, but it isn’t severe. Replace probe or get connectors fixed. If the problem persists contact your sales representative.
High pitched tone and flow indicators (if so equipped) go to the extreme.	Radio interference from a mobile service, police station nearby, even another Doppler working close by. Usually occurs near large open windows, rarely in the center of the building.	Move the Doppler to another location away from windows and toward the center of the building. If the problem persists contact your sales representative.
Buzzing noise that almost obliterates the Doppler signal.	Electrocautery or other sparking device, bad fluorescent light fixture or neon signs nearby.	Move the Doppler to another location away from the interference. If the problem persists contact your sales representative.
Howling noise when probe is held or laid on a table with gel on it.	Probe is acting as a microphone and you are getting acoustic feedback.	Wipe gel from probe, If the noise does not occur without gel on the probe, it is probably working fine.

ADDITIONAL TESTS:

1. Try using headphones if you have a howling noise. If there is no howl using headphones but there is with a speaker, it is acoustic feedback.
2. Try a different probe, even if it is the wrong frequency it will let you know if the problem is noisy connectors in the instrument or frayed shielding near the probe body.

SUMMARY

The problem may simply be a probe or it may be peculiar to the environment in which it is used. If you have tried the tests and remedies mentioned and you still suspect a problem contact your sales representative.

811-B ULTRASONIC FLOW DETECTOR

MAINTENANCE OF THE DOPPLER

NOTES FOR THE SERVICE TECHNICIAN

CLEANING

Clean instrument once a year or as needed. Turn off power and unplug battery charger before cleaning. Loose dust accumulated on the outside of the instrument can be removed with a soft cloth or small paint brush. Dirt which remains can be removed with a soft cloth dampened in a mild solution of detergent and water. Abrasive cleaners should not be used.

CALIBRATION

No user calibration is advised. The technician without Doppler experience cannot know how to test for sensitivity of the total system. Those of us who have tested thousands of Dopplers may have differing opinions at times. That is why it is best to return the instrument to the sales representative if there is a sensitivity problem that replacing a probe does not cure. But don't do so without first calling. Most service problems can be handled over the phone.

INSPECTIONS

PROBE AND PROBE CONNECTORS

Component failure is rare. Failure of the probe accounts for about 90% of all the service problems. It is always best to have a spare probe because if there is a failure of the Doppler and you do not have a spare probe, you will not know whether the problem is the probe or the Doppler and may have to send the Doppler for service. If you have a spare you will know immediately whether the Doppler or the probe is at fault.

Make sure that the frequency of the instrument matches the frequency marked on the probe. The frequency is marked on the probe and on the instrument.

Some probes fail because of the solder joint on the crystal. Sometimes it is visible, sometimes not. You can check for this by using a scope to look at the exciting voltage on the transmitting connector. It should be at least 4 or 5 volts peak-to-peak with a load. If you plug in the probe and the voltage drops, you know the probe is loading it. If it doesn't drop but a small amount (capacitive loading of the cable), then the crystal may be disconnected internally. Compare the two crystals for loading.

The probe may have been damaged by soaking it in a conductive sterilizing solution, or by autoclaving it. Dried gel on the probe may have been scraped off with a sharp instrument, damaging the material covering the crystals.

The red protective cover must be removed from the probe before use.

STATIC PROBLEMS

If probe connectors or jacks are making poor contact and there is "static". The center pin wiping on the panel jack is usually at fault. With no gel on the probe, you can jiggle the connectors and see if you get static. Use an awl or large needle to bend the edge of the wiping sleeve inward (panel jack). When the probe connector is lightly inserted, it should stop before the outer flange engages the probe jack on the panel. This means it is encountering resistance at the tip of the center pin, which is what you want to happen for a wiping action.

Repeated flexing of the cable near the probe body will eventually destroy the cable shielding and cause static.

Always check for static with NO GEL on the probe. Wiggle the wires near the panel and near the probe. Common causes of "static" are hair on the body, air bubbles in the gel popping, and sometimes radio interference (includes diathermy, electrocautery, NMR). All tests for static or interference should be done with no gel on the probe and with pencil probes being held in the hand or on an insulator because in high interference areas, touching the shield of the pencil probe carries RF signals into the box. If that problem exists, we make a special probe to eliminate that possibility. Sometimes a doctor complains about intraoperative use. If you can not make the instrument act up outside the O.R., you either have interference or operator problems.

COMPONENT FAILURE

To replace fuse, open the case by removing the four corner screws and refer to F1 on the Parts Location Diagram. Replace with a **0.5 A SLOW** fuse, PARKS # <u>865-6002-00</u>.

Look for broken resistors around the edge of the circuit board. They may be broken inadvertently during the process of changing the battery.

THE BATTERY

NOTES FOR THE SERVICE TECHNICIAN

KEEP THIS INSTRUMENT ON CHARGE WHEN IT IS NOT IN USE.

It is always best to be sure the battery has been recently charged before you use the instrument. **Overcharging is not possible.** The regulator within the instrument limits the total voltage to 14.5. Allow **12 hours** to completely recharge a low battery.

When the POWER lamp flashes, it means the battery is getting low and should be charged.

The POWER lamp on the panel begins to flash at about 11.3 V. However, there is so much reserve built into the system that normal operation of electronic circuits will be preserved for a few hours. At 10 V or a little above, the instrument ceases to operate. Current drain varies with speaker volume.

BATTERY CHARGER

The battery is charged by means of an external, wall-mount charger which has a cord that connects to the front panel of the instrument. When the charger is working and electrical wall outlet and cable connections are good, the charging lamp will illuminate. While the battery is being **charged it is DISCONNECTED from the Doppler**, which means the Doppler won't work. Only the charging circuit is active.

The battery charging input circuitry must not be modified or altered in the field.

Charger requirements

Acquire charger locally.

The battery charger should supply 16 V ac, 250 mA.

The battery charger must comply with the relevant national standards. (EN60601-1:1990+A1:1993+A2:1995)

BATTERY

This device uses a sealed lead acid battery for its power source. The battery acid is contained in a fibrous material so there is no loose liquid in the battery. Life expectancy, if the battery is kept charged, is two to three years. Life will be seriously shortened if the battery is left in a discharged condition for weeks or months. Car batteries behave similarly.

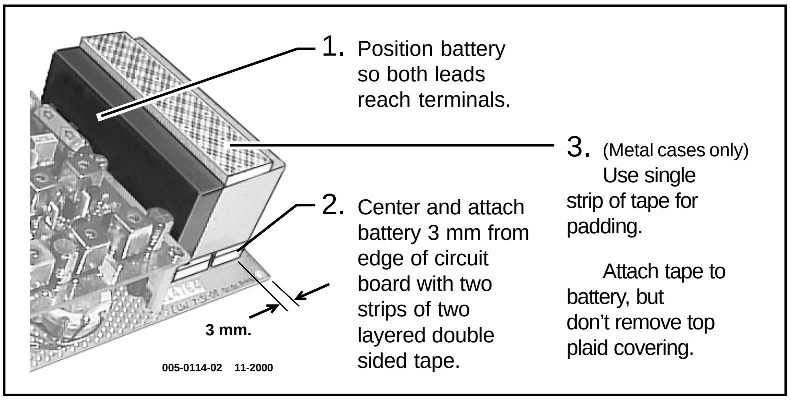
Battery failure

The battery could be either the wrong type or put in backwards. It could have shorted while it was being installed, resulting in diminished life. The battery can fail if the instrument was dropped. Battery brackets can be sprung so that a good end contact is not made. A leaking battery can corrode brackets so that good end contact is not made. Corrosive fluid can penetrated end insulators causing electrical leakage to ground. The wire to battery or connector may be broken (perhaps only internally).

Replacement Battery

12 V, 1.2 Ah, sealed lead acid battery.
Either POWER-SONIC EUROPE LTD, part # PS-1212. or PARKS # 854-0017-01.

To replace the battery:



Open the case by removing the four corner screws and take note on how the battery wires are connected. For safety reasons, disconnect the black battery wire first, then the red. Wiggle and gently pull the connectors, being careful not to break the insulation or short to ground. The battery is mounted with adhesive to the panel. Gently pry or cut it loose . Replace the battery with the positive terminal next to the panel. Otherwise you risk shorting to the ground plane of the circuit board. Replace battery and carefully reconnect the wires, red wire first, black last.

SEALED LEAD ACID BATTERY MUST BE RECYCLED OR DISPOSED OF PROPERLY.