

PERIPHERAL NEUROPATHY: PERONEAL MOTOR NERVE CONDUCTION**TABLE OF CONTENTS**

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PERIPHERAL NEUROPATHY: PERONEAL MOTOR NERVE CONDUCTION

1. Peripheral neuropathy background and rationale

Decrements in peripheral nerve function are known to increase both with advancing age and in the presence of diabetes mellitus. Since peripheral neuropathy (PN) involves both sensory and motor functions, PN may be associated with decrements in balance, strength and mobility, all disability-related outcomes that are central to the scientific objectives of Health ABC. Supporting a potential association between PN and various aspects of physical function in old age are several small studies in older adults that have suggested these effects. PN may be related both to performance tests and strength measures in the lower extremity, and are of equal scientific importance in older individuals with and without diabetes. Tests of PN in Health ABC are standard tests used in other epidemiologic studies, and involve measurement of both sensory and motor nerve function. PN measurements are divided into three parts:

- Quantitative sensory testing (QST) of the great toe using the Medoc vibration device,
- Nerve conduction (NC) studies using the NeuroMax 8 to measure several parameters associated with the peroneal nerve, and
- Testing of loss of protective sensation using the monofilament.

Electrophysiologic tests provide reliable and reproducible information for the detection and characterization of peripheral nerve disease. These tests of large, myelinated nerves yield important information about nerve function that is often not clinically apparent. Since the function of large nerve fibers declines with age even in the absence of diabetes, these measures provide important information for both diabetic and non-diabetic individuals. Whole nerve electrophysiologic measures afford an objective and reliable measure of the integrity of specific aspects of nerve function. For Health ABC, nerve conduction studies will be performed on the right peroneal nerve. This test is non-invasive, and is conducted with surface electrodes.

General description of nerve conduction studies with electrophysiologic equipment using surface electrodes:

Among other measures, nerve conduction studies generate information on amplitude and velocity following a stimulus to a large myelinated nerve. Amplitude is the strength of the signal needed to achieve maximum stimulation of the nerve. Velocity is the speed at which the signal travels down the nerve. These measurements have been reported to vary with height, body mass index, and diabetes status, and may also vary with lifestyle factors such as smoking and alcohol consumption.

2. Equipment and supplies

- Surface thermistor
- XLTek NeuroMax 8
- Laptop or desktop hook-up for data storage
- Conducting gel
- Disposable surface electrodes
- Paper towels or wipes
- Alcohol wipes
- “Sandpaper tape”
- Electrode tape
- Marker
- Measuring tape

3. Safety issues and exclusions

- Participants are excluded if they are missing both legs (e.g., if both legs have been amputated) or if they have had bilateral knee replacements.
- There are no safety exclusions for nerve conduction studies conducted on the lower extremity.

4. Participant and exam room preparation

Nerve conduction studies can be performed either in a fasting or a non-fasting state. The right peroneal nerve will be evaluated. Examination of this nerve requires that the pant leg of the right leg be rolled up above the knee. Contraindications for testing on the right leg include amputation, ulcer, trauma, knee replacement, and surgery. If the right leg cannot be tested, test the left leg, unless contraindicated.

The participant should be supine on the examining table, with the right leg exposed. The surface electrodes are placed on the right leg with conducting gel according to the protocol. The nerve is stimulated, and the electrophysiologic measures are collected in the computer.

Nerve conduction studies should be performed under standardized temperature conditions using the same equipment and the same brand of disposable electrodes. If the initial limb temperature is below 30°C, the leg should be heated with the heating pad until 30°C is achieved. Temperature measurements are performed with a surface thermistor held approximately four inches from the foot. The temperature is recorded before and after the nerve conduction study, and both values are reported on the data form. Nerve conduction values are reported as the recorded values without

8. Latency Measurements:

Motor Latency: Onset latency from take-off of negative wave; when there is positivity, measure amplitude from base of positive peak to top of negative peak.

9. NCV Calculations: To nearest 0.1 m/s.

Motor: use “long segment” distances.

10. **Filing completed studies:** All studies must be documented. A complete report consists of the following items:

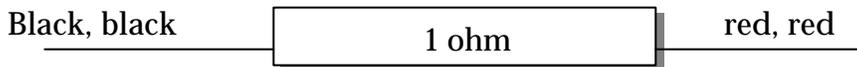
- Nerve conduction worksheet and data collection form
- A picture (printout) of the peroneal motor waveforms

4.2 Calibration:

For most hardware, use the calibration output procedure to generate a motor calibration signal. Then proceed to conduction studies. This applies to section 4.1, item 1. Calibration should be done once per week.

For XLTEK Neuromax ONLY: *Because the Neuromax doesn't have a calibration procedure built in, use the following procedure to generate a motor calibration signal.*

1. First, pull up the previous participant named “Calibration,” and change Examiner ID in the Examiner ID field if necessary.
2. Attach alligator clip electrodes from both the stimulator and recording electrodes across 1 ohm resistor.



3. Go to “Calibration—Motor—No Side” test screen
4. Settings: Notch: Off LFF: 0.5 Hz HFF: 3 kHz
 Gain: 500 ? V/div Timebase: 1 ms/div Sweep delay: -2 ms
5. Set stimulation level to **1.0 mA**
6. Stimulate once or twice until a nice 1 mV square curve appears (Appendix 1).

5. Detailed measurement procedures

5.1 Overview of peroneal nerve conduction test

a) Describe the testing procedure to the participant, and allow them to become familiar with the equipment and provide the opportunity to ask questions.

Script: “This test measures how well a sensation travels down a big nerve in your leg. To do this, I will place small patches on your foot. Then I will use this tool (**show stimulator**) to stimulate your nerve. This test is not painful, but most people say that it feels uncomfortable for just a moment, like when you bump your ‘funny bone.’ Your foot or leg may twitch during the test. If you want to stop the test at anytime, just say so.”

b) Record the surface temperature on the dorsum of the right foot using the surface thermistor. Hold the thermistor approximately 4 inches from the foot. If the right foot cannot be tested, record the temperature of the left foot.

Script: “Before we begin, I need to check the temperature of your foot. If it isn’t warm enough we’ll warm it in a heating pad.”

If the foot temperature is below 30°C, warm the foot and record the temperature again. If, after 5 minutes of warming, the foot does not reach 30°C, record temperature and proceed with testing. Leave the fields for the second temperature measurement (called “Limb temperature following heating”) blank if the participant’s initial limb temperature was at least 30°C.

c) Before beginning the test, say,

Script: “Now I’m going to start the test on your nerve.”

d) Begin testing of the peroneal nerve [see section 5.2]. Data on maximum responses will be recorded in the computer and downloaded later.

e) Conclude the test when maximum responses have been evoked.

f) Record whether or not the peroneal motor nerve conduction test was started. If not, record why not.

g) Record which leg was tested, and if the left leg was tested, record why the right leg was not tested.

h) Answer the data collection form questions regarding:

- whether or not the distal, fibular head, and/or popliteal fossa stimulation were completed (if not completed, indicate why not);
- record the amplitudes and whether or not the amplitudes at each stimulation site were greater than 1 mV (if “No,” flag the waveform for quality control).
- Record the two conduction velocities
 - between the ankle and the fibular head; and
 - between the ankle and popliteal fossa).

If either of these velocities is less than 20 m/s or more than 70 m/s, flag waveform for quality control.

i) Print out a hard copy of the peroneal motor nerve conduction results and waveforms to be placed in the participant’s chart.

5.2 Detailed peroneal nerve testing procedures

1. Test on the right leg unless the right knee was replaced. If a participant has had a knee replacement their other leg should be tested. When answering Question #7b (page 13 in the Year 4 Clinic Visit Workbook), regarding why the right leg wasn’t tested, choose the “Trauma or surgery (including knee replacement)” response option if a participant has had a knee replacement in their right knee. If a participant has had bilateral knee replacements, do not administer the peroneal motor nerve conduction test. Choose the “No” response option when answering Question #6 on page 12: “Was the peroneal motor nerve conduction test started?” and choose “Bilateral knee replacements” to answer “Why wasn’t the test started?”
2. Make sure that **patient info** is entered. Enter the participant’s Health ABC enrollment ID# without the HA or HB, and enter their acrostic (no spaces between numbers and/or letters). For example 1234ASMI.
3. Enter the Staff ID# in the Staff ID# space.
4. For Gender, type M for male or F for female.
5. Choose **Peroneal—Motor—Right**.
6. **Measure limb temperature**,
 - A) Should be $\geq 30^{\circ}\text{C}$
 - B) Warm and repeat as needed.
 - C) Record on study data collection form.
7. **Clean skin.**



8. Place electrodes (see Figure 1):

G1 (recording, black): over base of EDB muscle, 1 cm distal to calcaneus bone

G2 (reference, red): over 5th MTP joint, lateral to long extensor tendons

Ground (smaller rectangle ground): over anterior ankle as shown

9. Measure distance from G1 up 8.5 cm to stimulation site. Mark skin.

10. Filters: LLF = 2.0 Hz, HLF \geq 10.0 kHz

11. Sweep speed: 2 ms/division. May need to be longer.

12. Gain/display: 2 mV/division. May need to be different to achieve waveform \geq 2 divisions.

13. Stimulate Site #1 (Ankle):

A) Cathode (black) at 8.5 cm (85 mm) from G1, which is about 5 cm proximal of malleoli.

B) Nerve runs 5 cm lateral to tendon of tibialis anterior.

C) Start with stimulator transverse or 45° to nerve, then rotate to reduce stim artifact. Start at 20 mA and increase each stimulus by 10 mA.

D) When supramaximal response is obtained, **record single waveform.**

14. Stimulate Site #2 (Fibular Head):

A) Cathode (black) over the nerve where it runs immediately below the fibula [fibular head] and enters the anterior compartment. Mark skin.

B) Start at 20 mA and increase each stimulus by 10 mA. When supramaximal response is obtained, **record single waveform.**

C) Amplitude should be equal or slightly lower than Ankle

Note: If the ankle stimulation results were absent and the fibular head stimulation was satisfactory, repeat the ankle stimulation and place the cathode lateral to its initial placement.

15. Stimulate Site #3 (Popliteal Fossa):

A) Cathode (black) over the nerve in the popliteal fossa approximately 10 cm proximal to the head of the fibula. Mark skin.

B) Start at 20 mA and increase each stimulus by 10 mA. When supramaximal response is obtained, **record single waveform.**

C) Amplitude should be equal or slightly lower than Ankle

16. Check/mark responses with internal cursors.

A) **Onset** latency (from base of positivity if present).

17. Measure and record actual distances (enter into computer).

A) Ankle: from G1 to cathode should be 8.5 cm

- B) Fibular Head: measure actual distance from Ankle cathode (distance between stimulation site #1 and stimulation site #2)
 - C) Popliteal Fossa: measure actual distance from Ankle cathode (distance between stimulation site #1 and stimulation site #3)
18. **Print out waveform** (screen copy) Completed data collection forms should always contain the following information:
- A) Name of nerve
 - B) Side studied
 - C) Date
 - D) Participant ID (participant number)
 - E) Participant acrostic
 - F) Temperature before and after
 - G) Staff ID number

You can find examples of problem waveforms in Appendix 2, 3 and 4.

Figure 1

Peroneal Nerve

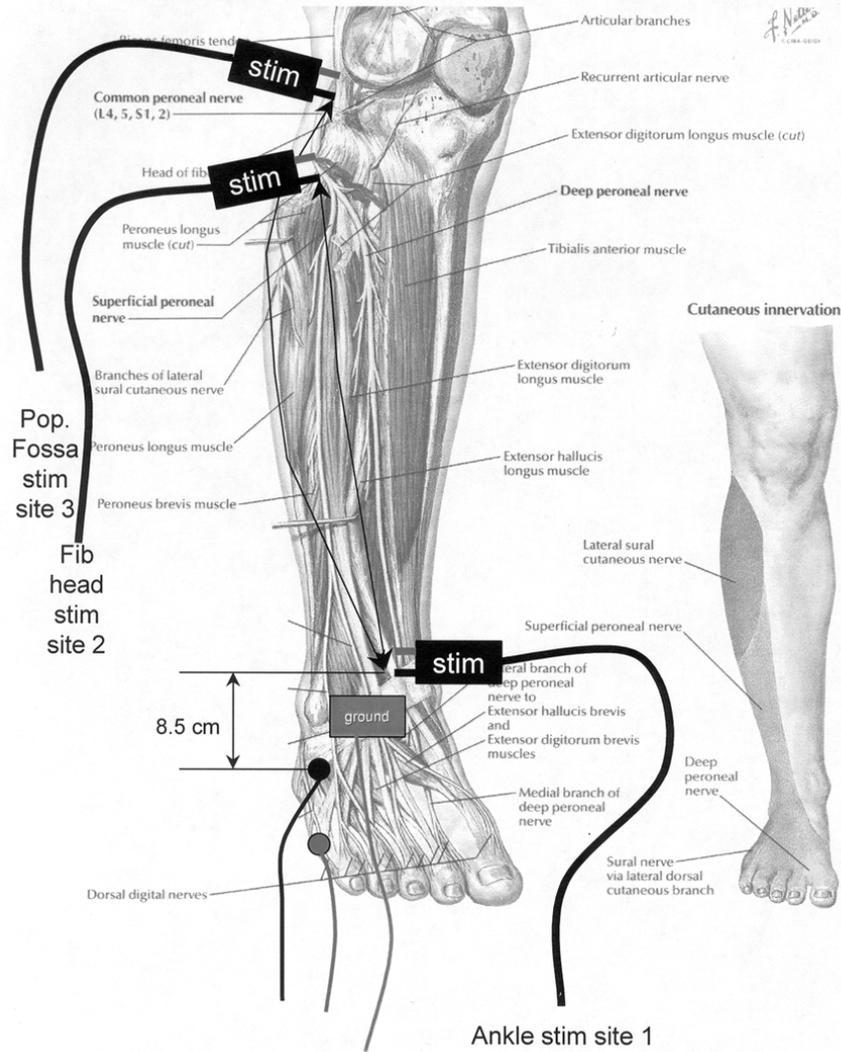
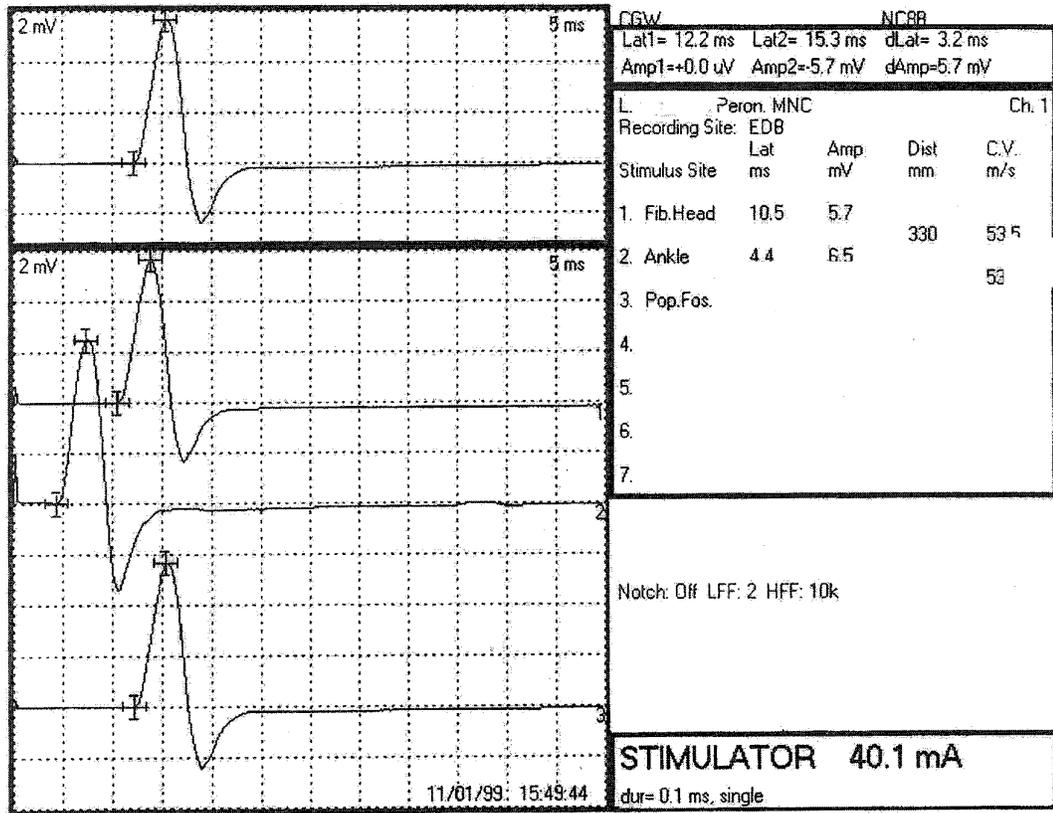


Figure 2: Peroneal Nerve Waveforms / Motor



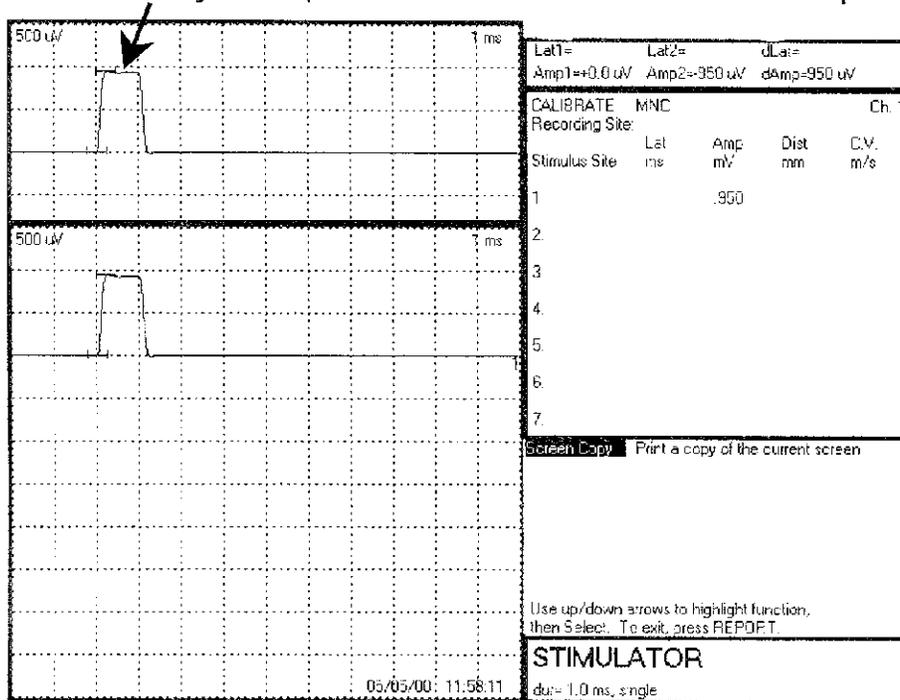
9.3 Quality assurance checklist

- Main points of script correctly and clearly delivered
- Correctly warms leg, if necessary, before administration of protocol
- Correctly describes testing procedure
- Cleans skin
- Correctly places electrodes (over base of EDB muscle, over 5th MTP joint, lateral to long extensor tendons, and over anterior ankle.
- Measures distance from G1 (over base of EDB muscle, 1 cm distal to calcaneus bone) up 8.5 cm to stimulation site; marks skin
- Correctly stimulates site #1
- Records data for site #1
- Correctly stimulates site #2
- Records data for site #2
- Correctly stimulates site #3
- Records data for site #3
- Measures and records distances (into computer)
 - ankle to G1 cathode (should be 8.5 cm)
 - fibular head to ankle (distance between stimulation site #2 and stimulation site #1)
 - popliteal fossa to ankle (distance between stimulation site #3 and stimulation site #1)
- Records which leg was tested or why test was not done on data collection form
- Reviews form for completeness following completion of test
- Prints out hard copy of nerve conduction data and waveforms
- “Repeatability studies” satisfactorily completed

Appendix 1 Calibration Waveform

Calibration Waveform

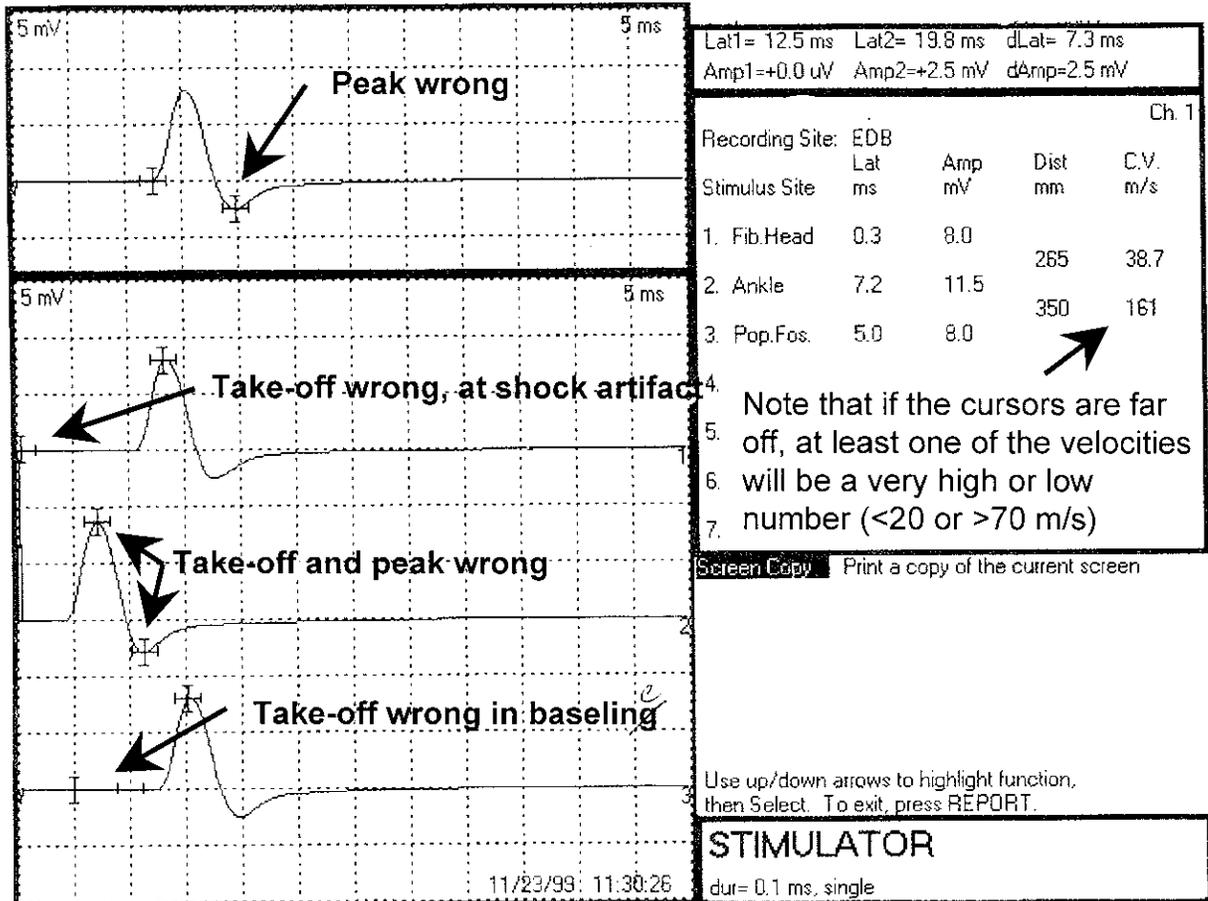
Note that the waveform should be essentially square and around 1 mV every time (between .700 and 1.3 mV is acceptable).



Be sure to store the waveform as number 1 before printing or exiting this screen.

Appendix 2 Cursor Placement

Cursor Placement

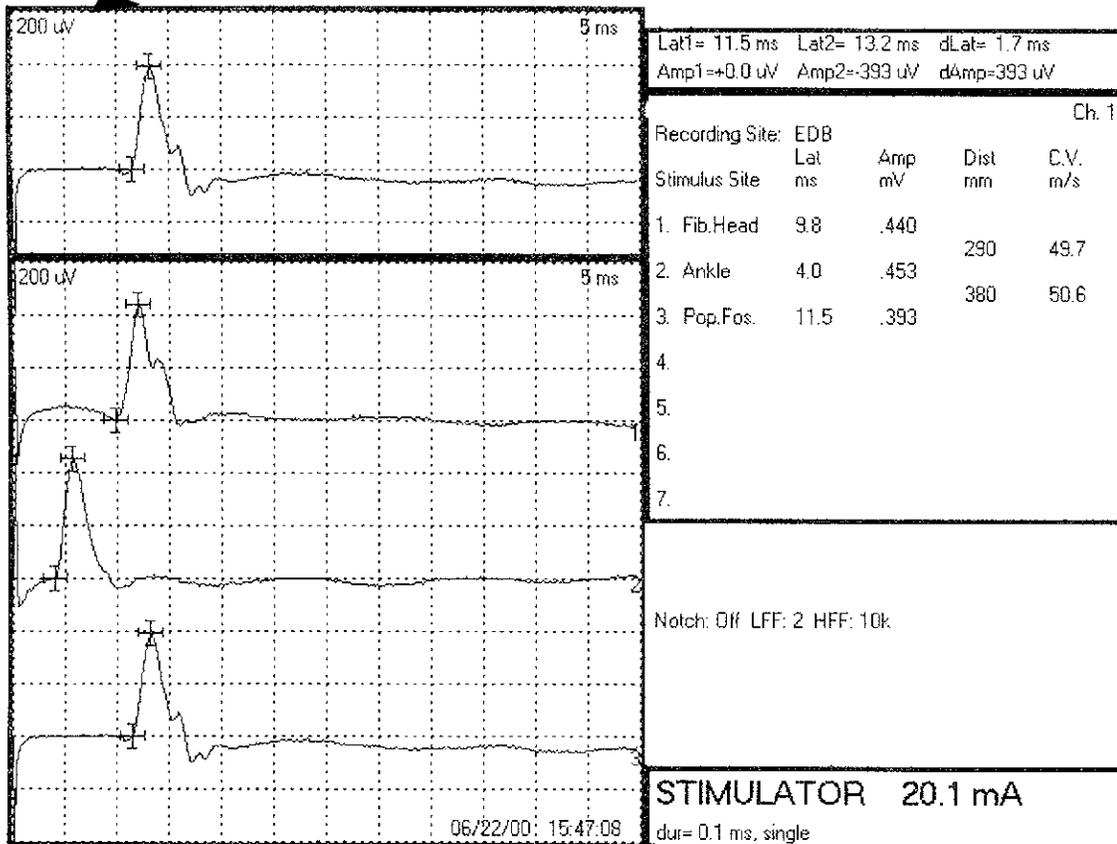


These waveforms are good but the computer placed the cursors in the wrong places...they need to be flagged for QC.

Appendix 3 Low Amplitude

Low Amplitude

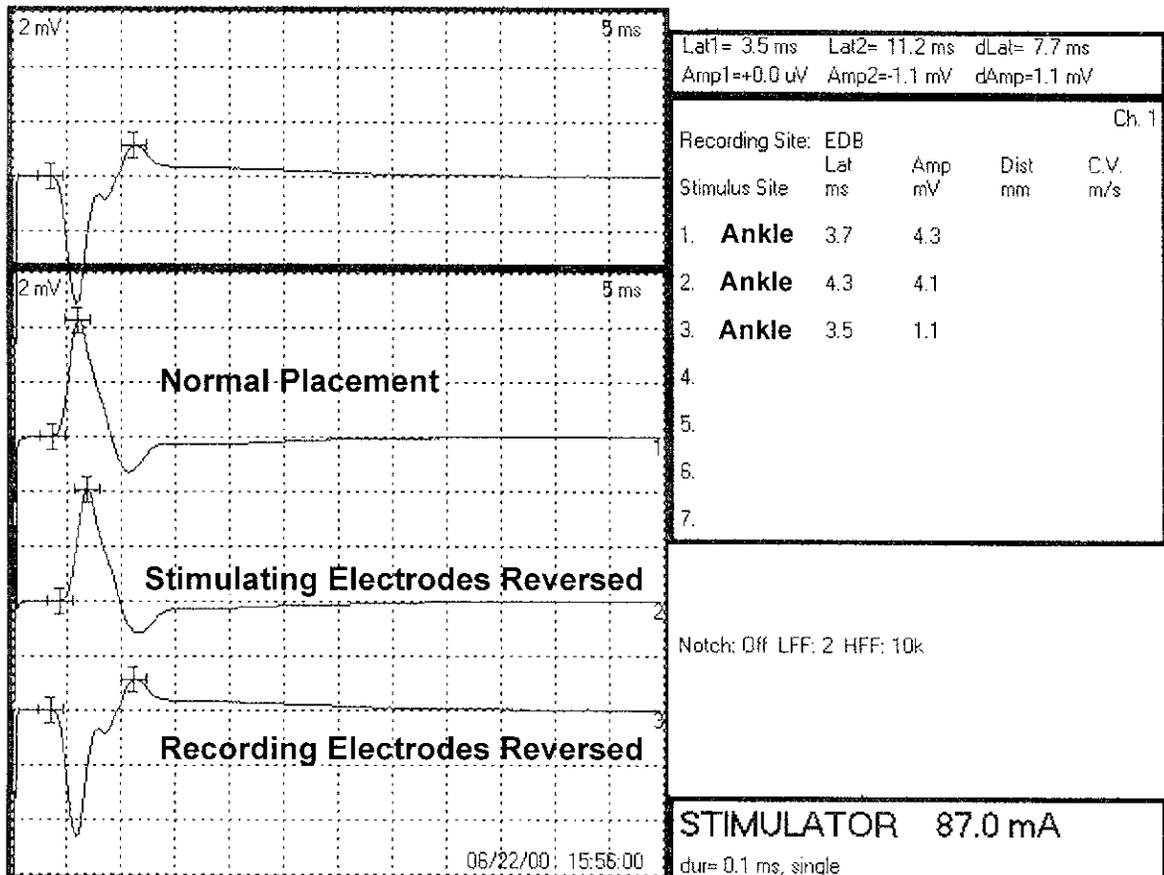
Note y-axis is less than 1 mV (millivolt)



This tracing is acceptable but does still get flagged for QC according to the data collection forms because the amplitude is less than 1 mV.

Appendix 4 Electrodes Reversed

Electrodes Reversed



These, especially number 3, would be unacceptable. Note that number 2 (stimulating electrodes reversed) is difficult to spot from the tracing, so please be careful when choosing the red/black **stimulator** direction.

Appendix 5 Peroneal Motor Nerve Conduction Shipping and Tracking Log

Appendix 6 Peripheral Neuropathy Review Fax Cover Page

Health ABC Peripheral Neuropathy Review Fax Cover Page

FAX

Date: _____

Number of pages including cover sheet: _____

To: Kevin B. Stansberry

Diabetes Institutes

Clinical Research

855 W. Brambleton Avenue

Norfolk, VA 23510

Phone: (757) 446-5912

Fax: (757) 446-5975

E-mail: stansbkb@evms.edu

From:

Phone:

Fax:

Examiner ID:

REMARKS: Urgent For your review Reply ASAP Please comment

This fax contains (check one):

- Non-participant Data for Examiner Certification Visit 1
- Non-participant Data for Examiner Certification Visit 2
- Study participant data from first 150 participants
- Study participant data for other QC review

Tests performed and sent for review (check all that apply):

- Peroneal Motor Nerve Conduction
 - Printout of waveforms from Neuromax
 - Data collection pages 12-14 completed
- Vibration Perception Threshold
 - Data collection pages 9-11 completed

Comments to the reviewer: