DNI NEVADA

Operating and Service Manual

CuffLink

Non-Invasive Blood Pressure Analyzer

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DNI NEVADA
INCORPORATED

To order this manual, use Part Number 9508-0198.

Revision History		
Revision	Description	Date
D	Firmware version 3.20; addendum incorporated.	4/96
E	Format change.	11/97

Copyright

Unpacking and Inspection

Follow standard receiving practices upon receipt of the instrument. Check the shipping carton for damage. If damage is found, stop unpacking the instrument. Notify the carrier and ask for an agent to be present while the instrument is unpacked. There are no special unpacking instructions, but be careful not to damage the instrument when unpacking it. Inspect the instrument for physical damage such as bent or broken parts, dents, or scratches.

Claims

Our routine method of shipment is via common carrier, FOB origin. Upon delivery, if physical damage is found, retain all packing materials in their original condition and contact the carrier immediately to file a claim.

If the instrument is delivered in good physical condition but does not operate within specifications, or if there are any other problems not caused by shipping damage, please contact DNI Nevada or your local sales representative.

Standard Terms and Conditions

Refunds & Credits

Please note that only serialized products (products labeled with a distinct serial number) and accessories are eligible for partial refund and/or credit. Nonserialized parts and accessory items (cables, carrying cases, auxiliary modules, etc.) are not eligible for return or refund. In order to receive a partial refund/credit of a product purchase price on a serialized product, the product must not have been damaged by the customer or by the common carrier chosen by the customer to return the goods, and the product must be returned complete (meaning all manuals, cables, accessories, etc.) within 90 days of original purchase and in "as new" and resellable condition. The *Return Procedure* must be followed to assure prompt refund/credit.

Restocking Charges

Only products returned within 90 days from the date of original purchase are eligible for refund/credit. Products returned within 30 days of original purchase are subject to a minimum restocking fee of 15%. Products returned in excess of 30 days after purchase, but prior to 90 days, are subject to a minimum restocking fee of 20%. Additional charges for damage and/or missing parts and accessories will be applied to all returns. Products not returned within 90 days of purchase, or products which are not in "as new" and resellable condition, are not eligible for credit return and will be returned to the customer.

Return Procedure

Every product returned for refund/credit must be accompanied by a Return Material Authorization (RMA) number, to be obtained from our Order Processing Department. All items being returned must be sent freight prepaid to our factory location.

Certification

This instrument was thoroughly tested and inspected and found to meet DNI Nevada's manufacturing specifications when it was shipped from the factory. Calibration measurements are traceable to the National Institute of Standards and Technology (NIST). Devices for which there are no NIST calibration standards are measured against in-house performance standards using accepted test procedures.

Warranty

Warranty and Product Support

This instrument is warranted by DNI Nevada against defects in materials and workmanship for one full year from the date of original purchase. During the warranty period, we will repair or, at our option, replace at no charge a product that proves to be defective, provided you return the product, shipping prepaid, to DNI Nevada, Inc. This warranty does not apply if the product has been damaged by accident or misuse or as the result of service or modification by other than DNI Nevada. IN NO EVENT SHALL DNI NEVADA BE LIABLE FOR CONSEQUENTIAL DAMAGES.

Only serialized products and their accessory items (those items bearing a distinct serial number tag) are covered under this one–year warranty. PHYSICAL DAMAGE CAUSED BY MISUSE OR PHYSICAL ABUSE IS NOT COVERED UNDER THE WARRANTY. Items such as cables and nonserialized modules are not covered under this warranty.

This warranty gives you specific legal rights, and you may also have other rights which vary from state to state, province to province, or country to country. This warranty is limited to repairing the instrument to DNI Nevada's specifications.

When you return an instrument to DNI Nevada, Inc., for service, repair, or calibration, we recommend using United Parcel Service, Federal Express, or Air Parcel Post. We also recommend that you insure your shipment for its actual replacement cost. DNI Nevada will not be responsible for lost shipments or instruments that are received in damaged condition due to improper packaging or handling. All warranty claim shipments must be made on a freight prepaid basis. Also, in order to expedite your claim, please include a properly completed copy of the Service Return Form. Recalibration of instruments, which have a recommended semiannual calibration frequency, is not covered under the warranty.

Use the original carton and packaging material for shipment. If they are not available, we recommend the following guide for repackaging:

- Use a double–walled carton of sufficient strength for the weight being shipped.
- Use heavy paper or cardboard to protect all instrument surfaces. Use nonabrasive material around all projecting parts.
- Use at least four inches of tightly packed, industrial–approved shock–absorbent material around the instrument.

Warranty Disclaimer

Should you elect to have your instrument serviced and/or calibrated by someone other than DNI Nevada, please be advised that the original warranty covering your product becomes void when the tamper-resistant Quality Seal is removed or broken without proper factory authorization. We strongly recommend, therefore, that you send your instrument to DNI Nevada for factory service and calibration, especially during the original warranty period.

In all cases, breaking the tamper-resistant Quality Seal should be avoided at all cost, as this seal is the key to your original instrument warranty. In the event that the seal must be broken to gain internal access to the instrument (e.g., in the case of a customer-installed firmware upgrade), you must first contact DNI Nevada's technical support department at 702-883-3400. You will be required to provide us with the serial number for your instrument as well as a valid reason for breaking the Quality Seal. You should break this seal only after you have received factory authorization. Do not break the Quality Seal before you have contacted us! Following these steps will help ensure that you will retain the original warranty on your instrument without interruption.

WARNING

Unauthorized user modifications or application beyond the published specifications may result in electrical shock hazards or improper operation. DNI Nevada will not be responsible for any injuries sustained due to unauthorized equipment modifications.

Preface

Chapter 1 - Getting Started

Chapter 2 - NIBP Monitoring

Chapter 3 - Operation

Chapter 4 - Remote Commands

Chapter 5 - Printing

Chapter 6 - Reference

Chapter 7 - Test and Calibration

Chapter 8 - Technical Information

CuffLink Non-Invasive Blood Pressure Analyzer

CuffLink's New Features

The firmware revision 3.0 includes many additions and updates including a set of adult arrhythmias, an internal pump, additions to pressure testing and support for our new Auscultatory Option

Arrhythmias

CuffLink gives you five new arrhythmias to test your NIBP monitors in the presence of typical patient arrhythmias. These clinically-derived simulations are a representation of the peripheral pulse as seen by an oscillometric NIBP monitor.

Each arrhythmia is generated on a random basis throughout the entire pressure curve cycle. The variations in pulse timing and amplitude are relatively small.

Premature Atrial Contraction (PAC)

The first pulse of the PAC cycle is premature and lower in amplitude than a normal sinus pulse. The next pulse would be back in sync with normal sinus and slightly higher in amplitude. All subsequent pulses are normal.

Premature Ventricular Contraction (PVC)

This is a representation of the peripheral pulse similar to PAC

Atrial Fibrillation (AF)

The AF cycle has an irregular R to R interval. Its occurance and properties (early vs late) are random throughout the pressure curve cycle.

Missed Beat (MB)

A complete beat is randomly skipped during the pressure curve cycle. The following beat reverts to normal R to R intervals.

Aberrant Sinus Conduction (AS)

The AS cycle inserts one pulse so low that is is virtually non-existent. This causes CuffLink to skip one diastolic pulse and then return to normal sinus pulses.

Pressure Testing

Internal Pump

CuffLink now has an internal compressor which eliminates the need to manually inflate the cuff for NIBP monitor testing. This automates your static pressure measurements, leak testing, and relief valve testing.

Pop Off Added to Press Menu

Perform over-pressure tests on your NIBP monitors with this addition to the PRESS menu.

Utility Menu Added to Leak Test

Select cuff size, turn printing on or off, and choose a target pressure for leak testing.

Manometer

CuffLink simulates a digital manometer with pump capabilities.

Remote Commands

CuffLink has new RS-232 commands to support its new functions.

Command	Function
DEFLATE	Releases pressure inside CuffLink
INFLATE	Pumps CuffLink to 200 mmHg or specified pressure
KEYTEST	Tests CuffLink's keyboard
MKARR_AF	Simulates atrial fibrillation
MKARR_MB	Simulates a missed beat
MKARR_PAC	Simulates premature atrial contraction
MKARR_PVC	Simulates premature ventricular contraction
MKARR_AS	Simulates aberrant sinus conduction
POPOFF	Tests monitor's overpressure valve
PUMPPCB	Determines if pump PCB is installed in CuffLink

Auscultatory Option Support

CuffLink firmware revisions 3.0 and above will include support for Cufflink's Auscultatory Option (must be purchased separately).

With the Auscultatory Option installed, you can test selected dual-sensor monitors (the oscillometric pressure pulse is simultaneously output at the same time as the auscultatory signal).

You must have at least revision 3.0 to install the Auscultatory Option.

About This Manual

This manual was designed as a reference so you can easily find information you need on any topic.

Chapter 1 covers specifications and familiarizes you with the controls and indicators.

Chapter 2 gives an overview on NIBP monitoring.

Chapter 3 covers operation.

Chapter 4 explains remote, or RS-232 commands, and has an alphabetical list of commands. The end of the chapter includes programming examples.

Chapter 5 covers printing CuffLink documents.

Chapter 6 is a reference chapter that includes a menu map and glossary.

Chapter 7 has information on calibration and performance checks.

Chapter 8 includes schematics and a complete parts listing.

The Auscultatory Option

If you see text surrounded by this type of box, we are referring to the Auscultatory Option. Any text like this relates only to this option and you must have it installed in your CuffLink to access any of the functions listed within the box.

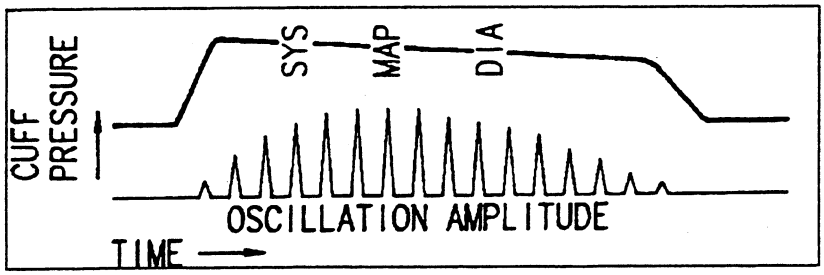
CuffLink NIBP Blood Pressure Analyzer

CuffLink provides accurate and repeatable dynamic blood pressure (BP) waveforms for evaluation of both semi and fully automated oscillometric Non-Invasive Blood Pressure (NIBP) devices. CuffLink also has an option available to simulate waveforms for auscultatory devices. This is done by microprocessor controlled simulation of the patient's response to the BP cuff.

To test a device, wrap the BP cuff around the mandrel (supplied with CuffLink) and insert the cuff adapter in the pressurized line. All tests are conducted with the BP cuff connected to the system.

CuffLink can generate BP waveforms for seven adult (oscillometric and auscultatory), five neonate (oscillometric), and 5 arrhythmias. The different systolic/diastolic pressure gradients simulate a physiological range of normal, hypotensive, and hypertensive adult or neonate patients. Actual patient data was used to design the preprogrammed peripheral pulse waveforms and envelopes.

CuffLink can produce qualitative measurements of BP cuff pressure and inflate/deflate timing.



The cuff pressure waveform during blood pressure measurement

CuffLink also offers automated leak testing of NIBP monitors. An internal pump pressurizes the NIBP system under test. Press a key to initiate a 60 second leak test once the desired pressure is reached.

You can use CuffLink's digital manometer instead of a mercury column for doing pressure measurements. CuffLink facilitates overpressure testing of NIBP monitors by automatically detecting and displaying the overpressure point.

Auscultatory Option

Designed for use with selected dual-sensor NIBP monitors, this option allows you to analyze device performance for both oscillometric and auscultatory measurements. CuffLink will test your entire system, including the patient monitor, cuff, and the auscultatory sensor.

CuffLink has seven adult auscultatory NIBP selections at preset normal sinus heart rates. This auscultatory NIBP simulation has both a mechanical force and an electrical signal format. The mechanical force output is generated by a linear actuator located within the auscultatory mandrel assembly. The electrical signal generated by the CuffLink auscultatory option replaces the microphone pickup and is directly input into the NIBP device under test.

System Requirements

Hardware

The Auscultatory Option consists of a printed circuit board and an auscultatory mandrel assembly that connects to CuffLink's adult mandrel.

Firmware

You need CuffLink firmware version 3.0 or greater to use the Auscultatory Option.

Chapter 1

Getting Started

Specifications

Target Blood Pressure Selections

Select BP	Target Value (MAP) (mmHg)	HR (BPM)	Waveform Type
Adult	60/30 (40) 80/50 (62) 400/65 (75) 120/80 (90) 150/100 (115) 200/150 (165) 255/195 (215)	30 40 60 80 120 160 200 240	Normal Sinus
Neonate	60/30 (40) 80/50 (62) 400/65 (75) 120/80 (90) 150/100 (115)	30 40 60 80 120 160 200 240	Normal Sinus
Arrhythmias	120/80 (90)	80	Premature Atrial Contraction Premature Ventricular Contraction Atrial Fibrillation Missed Beat Aberrant Sinus Conduction

Select BP	Target Value (MAP) (mmHg)	HR (BPM)	Waveform Type
Auscultatory Option	60/30 (40) 80/50 (62) 400/65 (75) 120/80 (90) 150/100 (115) 200/150 (165) 255/195 (215)	30 40 60 80 120 160 200 240	Normal Sinus Mechanical Force Electrical Signal Normal Microphone Reversed Microphone Low Signal Microphone

Preprogrammed Pulse Envelope

Horizontal Axis (cuff pressure)	0 to 300 mmHg in 1.0 mmHg steps
Vertical Axis	2.0 mmHg (nominal) 100% gain with normal adult cuff 0 to 200% selectable
Pulse Amplitude (adult)	2.0 mmHg @ MAP 100% gain
Repeatability	±1% of selected target value

Pulse Waveforms

Pulse ID #	Pulse Width (ms)	Rise Time (ms)
0	800	270
1	500	165
2	250	85
3	720	90
4	230	80
5	280	96
6	350	100
7	480	108
8	980	180
9	1,980	460
10	1,480	330

Digital Manometer

Pressure	Maximum = 499.75 mmHg
Pump	2.0 liters/minute minimum (free flow)

Automated Leak Testing

Start Pressure	Maximum = 499.75 mmHg
Elapsed Time	Fixed at 60 seconds
Leak Rate Range	0.25 to 499.75 mmHg/minute
Pump	2.0 liters/minute minimum (free flow)

Accuracy

Parameter	Value
Mean Arterial Pressure (MAP)	±1.0% of Target Value
Cuff Pressure	±1.0% of reading (±1 mmHg)
Input Overpressure Limit	±1500 mmHg

Display

Parameter	Value
Alphanumeric and Graphic LCD Display	
Alphanumeric Mode	8 lines by 40 characters
Graphics Mode	64 vertical by 240 horizontal dot matrix
Backlight with Viewing Angle Adjustment	

Control Keys

Parameter	Value
Function Keys	F1 to F5 Enter Escape
Cursor	Up Down Left Right

Parameter Selections

Pull Down menus with on screen help
Software defined function keys (F1 to F5)

Ranges for MAKEARM Test Values

Parameter	Range
On Line Cuff Pressure	0.0 to 500 mmHg on display 0.0 to 300 mmHg on graph
Peak Cuff Pressure	500 mmHg peak
Inflate Time	0.1 to 999.9 seconds
Inflate Rate	0.1 to 999.9 mmHg/second
Deflate Time	0.1 to 999.9 seconds
Deflate Rate	0.1 to 999.9 mmHg/second
Total Measurement Time	999.9 seconds maximum
Heart Rate	30 40 60 80 120 160 200 240
Systolic/Diastolic Pressure Target Value	
Mean Arterial Pressure (MAP) Target Value	

Analog Outputs

Cuff Pressure	0 to 499.75 mmHg FS, ±1.0% of reading, ±1.0 mmHg (cuff) 10 mV/mmHg
Pulse Pressure	0 to 5.0 mmHg FS, ±1.0% of reading 1.0 V/mmHg

Auscultatory	0-12 V uncalibrated Typical 2 VDC with 2.4 V signal
Microphone	0-2.2 V uncalibrated Typical 0.36 VDC with 0.36-0.73 V signal

Mandrels

Adult Mandrel
Five interlocking plastic blocks that produce four sizes: Large Adult — use all blocks Adult — use 2 curved end blocks and 2 rectangle blocks Small Adult — use 2 curved end blocks and 1 rectangle block Child — use 2 curved end blocks
Neonate Mandrel
One plastic truncated cylinder that accommodates three different circumferences (14 cm, 10 cm, and 7.6 cm)

Auscultatory Mandrel
Module that contains the solenoid puck assembly Connects to Adult Mandrel for different sizes

Physical Dimensions

Size	Width 12.5 inches Height 5.0 inches Length 15.0 inches
Weight	15 pounds

Power Requirements

Power	115/220 volts AC 50 Watts average 100 Watts peak 50/60 Hz
Input voltage range (AC volts)	For 120 volt operation: 100-130 VAC For 240 volt operation: 200-250 VAC
Fuses	1 ASB, 250 VAC @ 120 V 1/2 ASB, 250 VAC @ 240 V

Cuff Adapters

Adapter	Part Number
Male/Female LUER Locking	9503-0018
Female/Male LUER Non-Locking Taper	9503-0017
5/32" Male/Male Hose Barb	9503-0020
1/4: Male/Male Hose Barb	9503-0023
1/8" Male/Male Hose Barb	9503-0019
Male/Female Clippard (Critikon, Siemens)	9503-0014
Colder/CPC (Marquette, Protocol)	9503-0015
OBAC Quick Release (Hewlett Packard)	9503-0016

Digital Interfaces

RS-232/Serial	
Baud Rates	300 600 1200 2400 4800 9600
Stop Bits	1 2
Parity	Odd Even Off
Handshake	Xon/Xoff RTS/CTS None
Parallel Port (Printer)	Centronics compatible
Pulse Sync	0 to 5 VDC (TTL)

Standard Accessories

1. Soft vinyl accessory pouch
2. Hospital grade power cord set
3. Adult cuff mandrel
4. Neonate cuff mandrel
5. Eight cuff adapters

Standard Auscultatory Option Accessories

1. Auscultatory cuff mandrel

Storage

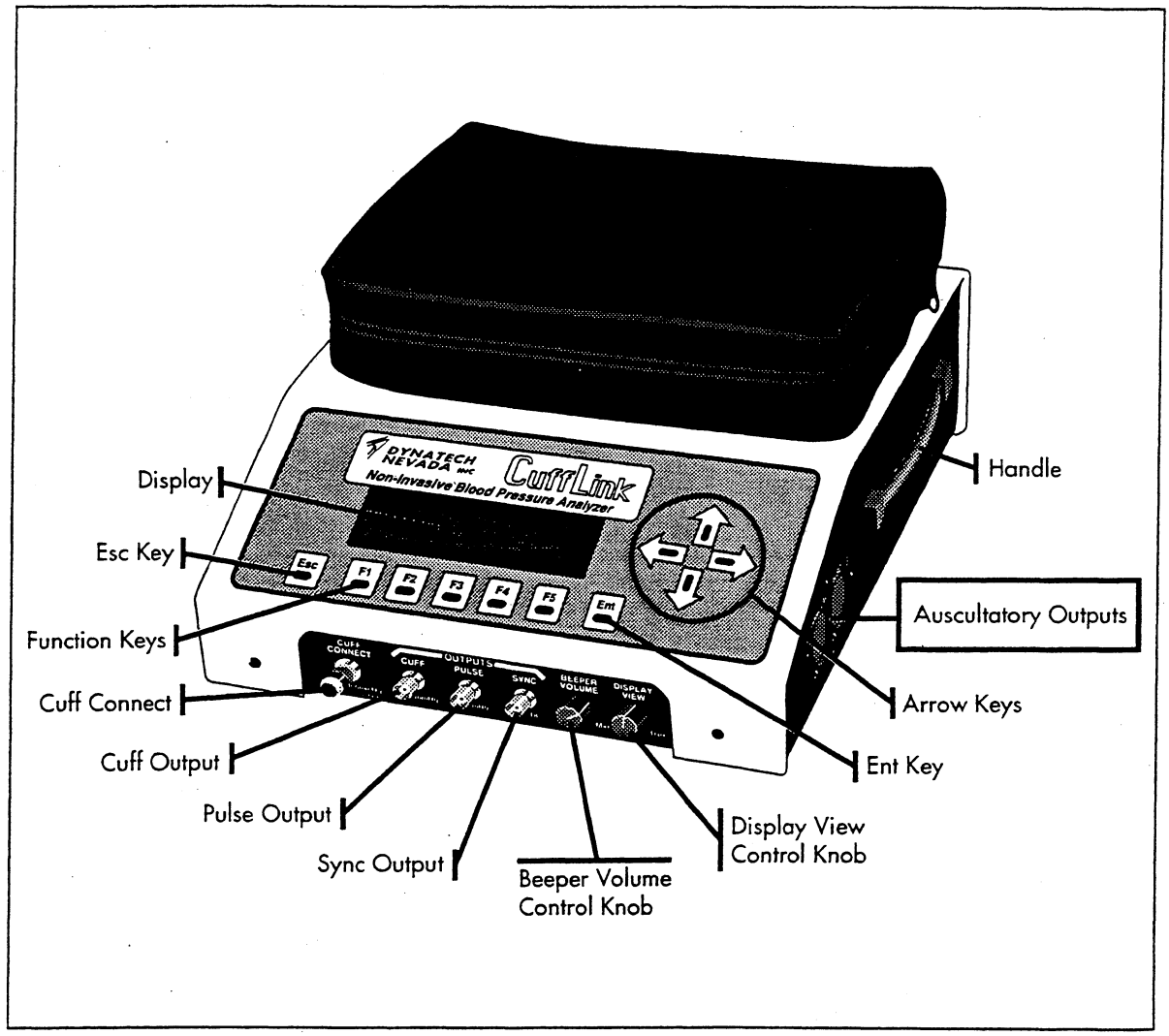
Store in a dry area within the temperature range of 32°F to 122°F. No inspection or maintenance is required during storage.

Miscellaneous

1. Calendar clock with battery backup
2. Internal PCB expansion slot

Front Panel Controls and Indicators

Use the next section to become familiar with CuffLink's front panel controls and indicators.



CuffLink front and side panel controls and indicators

Display

The LCD (Liquid Crystal Display) is a full alphanumeric and graphic display. The maximum number of characters able to be on a single line at any given time is 40, and the number of lines from top to bottom is 8, thereby producing a possible 320 character display. The graphics mode of the display is defined by a grid of 64 vertical pixels by 240 horizontal pixels. This mode enables display of the cuff pressure waveform.

Display viewing angle is adjustable, so if the display appears blank (view angle set too low), or dark (view angle set too high) the view angle may need to be adjusted for optimum visibility (see Display View Control Knob).

"Esc" Key

The Esc (escape) key enables the user to exit any menu, exit without saving new data, or abort any function of CuffLink. Continuously holding down the escape key will return the user to the CuffLink logo display from any menu.

"Ent" Key

Pressing the Ent (enter) key will select a highlighted menu, initiate a CuffLink function, or store data in EEROM. In effect, the enter key is the opposite of the escape key.

Function Keys (Programmable Keys)

The function keys are labeled F1 through F5. Pressing any one of these keys will execute the function, defined by software, that is displayed above that particular key.

Arrow Keys (Up, Down, Left, Right)

The arrow keys are the cursor control keys. Pressing the up arrow key moves the cursor on the display in a upward direction or increases the highlighted value. Pressing the down arrow key moves the cursor on the display in a downward direction or decreases the highlighted value. The down arrow key is also capable of pulling down the submenus of a highlighted main menu. Pressing the left or right arrow keys will produce cursor movement in the corresponding direction. Holding any arrow key down continuously will cause a repeating of the action of that key.

Cuff Connect

A quick disconnect type of port provides the output connection from the pulse producing motor inside CuffLink, to the line connecting the cuff and the BP patient monitor.

Cuff Output

This is a voltage output proportional to cuff pressure (10mv/mmHg). It is always active with a range of -5VDC to +5VDC (-500mmHg to +500mmHg). The accuracy is specified for positive pressures only.

Example:

1.0 volt = 100 mmHg

2.5 volts = 250 mmHg

This signal is also useful when connected to a storage oscilloscope or strip recorder to observe the cuff inflate/deflate cycle.

Output impedance is 100 ohms.

Pulse Output

This is a voltage output proportional to pulse pressure. It is only active when CuffLink is outputting pressure pulses. The output is at 0 volts in the inactive state. The pulse voltage is taken from the pressure transducer and the large static cuff pressure is subtracted. For example, if the cuff is inflated to 150 mmHg and the pulse is 1.2 mmHg in amplitude, only the 1.2 mmHg portion of the signal is presented at this output.

The pulse output voltage is 1 VDC/mmHg and has a range of -5 VDC to +5 VDC (-5 mmHg to +5 mmHg).

Example:

1.0 volt = 1.0 mmHg pulse

0.5 volt = 0.5 mmHg pulse

When CuffLink is simulating blood pressure it removes the static cuff pressure from the pulse output (forcing it to 0 VDC) at the beginning of each heartbeat. During the heartbeat the amplitude of the pulse is output. As the cuff deflates (or inflates) this process is repeated for each heartbeat.

Output impedance is 100 ohms.

Sync Output

This is a logic level (0 to 5VDC) that outputs a pulse at the start of every heartbeat. When CuffLink is not outputting pressure pulses this output is at 0VDC. When CuffLink is outputting pressure pulses the output is high (5VDC) during the pulse and low between the end of one pulse and the start of the next pulse. This output is useful for measuring heart rate and synchronizing a scope trigger for viewing individual pressure pulses on the pulse output.

Output impedance is 100 ohms.

Beeper Volume Control Knob

The amplitude of the CuffLink audible feedback may be adjusted by turning the beeper volume control knob. Turning the knob clockwise (towards the "MAX" label next to the knob) will increase the volume of the beeper, while turning the knob counterclockwise will decrease the beeper volume.

Display View Control Knob

The angle at which the display is most visible is adjustable with the display view control knob. Turning the knob clockwise (towards the "DARK" label next to the knob) will increase the contrast of the display, or make the display darker. Turning the knob counterclockwise will decrease the contrast, making the display lighter.

Side Panel Controls and Indicators

Handle

The handle for transporting CuffLink is located on the right side of the instrument case.

Auscultatory Output

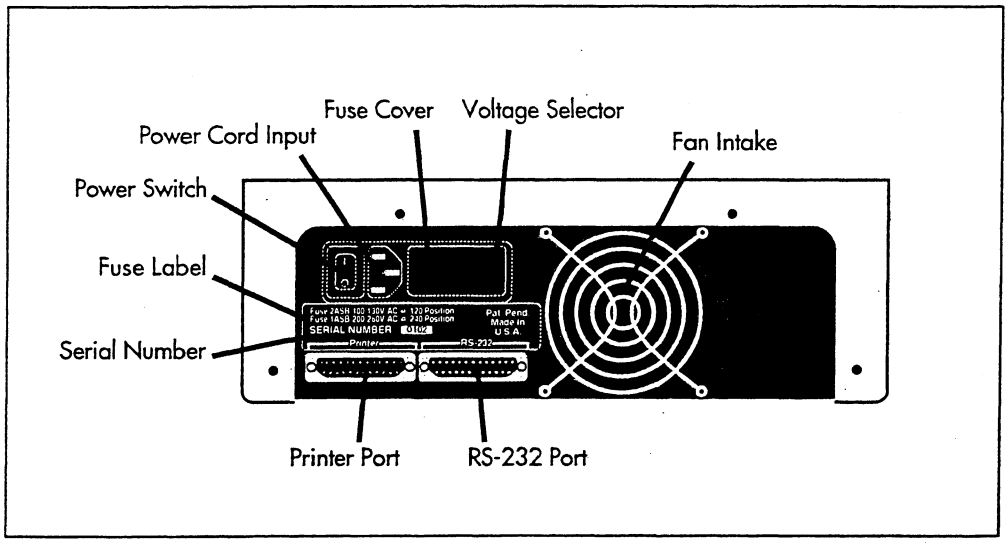
Mandrel

Voltage output is normally 2 to 3 Vdc (steady state) with an output pulse of 2 to 5 Vdc.

Microphone

This is an attenuated signal limited to +0.75 Vdc that you connect to the monitor input.

Rear Panel Controls and Indicators



CuffLink rear panel controls and indicators

Power Switch

The "on" position of the power switch is represented by "1" and the "off" position is labeled "0".

Power Cord Input

The input for the CuffLink power cord is located next to the power switch. This is the connection for the detachable power cord.

Fuse Cover

The fuse(s) are located behind the fuse cover. The fuse cover may be carefully pried open at 3a.

Voltage Selector

CuffLink is able to operate on two different line voltages. The voltage selector indicates the voltage (either 120V or 240V) at which CuffLink will operate. There are an additional two voltages (100V and 220V) listed on the back panel. These do not apply to CuffLink.

Fan Intake

A hole cut in the rear panel of the case provides ventilation for CuffLink from the fan. Care should be exercised not to block the fan intake or to insert anything into the metal protector.

RS-232 Port

This is the connector for the RS-232 serial interface. It is a 25 pin (DB25), male, "D" shell connector (same pinout as PC compatible computer).

Printer Port

The connector for the parallel printer is a 25 pin (DB25), female, "D" shell connector. The printer port is Centronics compatible (same pinout as a PC compatible computer).

Serial Number

The four digit CuffLink serial number is located above the printer port. The serial number should be documented along with the model number whenever CuffLink is shipped to Dynatech Nevada.

Fuse Label and Fuse Replacement

The fuse label documents the type of fuses needed. Use one 1ASB 250 VAC fuse (DNI part no. 1005-0184) if CuffLink is set for 120 volt operation, and two 1/2 Amp 250 VAC fuses (DNI part no. 1005-0185) if CuffLink is set for 240 volt operation.

Replacing Fuses

1. Turn CuffLink's power off and unplug the power cord.
2. Remove the fuse cover with a small blade screwdriver. The plastic fuseholder should pop out of the CuffLink case.
3. Use the screwdriver to pry the old fuse out of the plastic holder.
4. Install the new fuse.
5. Replace the fuseholder by simply pushing the fuseholder back into place.

Before You Begin...

Power-Up

Attach the power cord supplied with CuffLink to the power cord input on the CuffLink back panel. Plug the unit into a properly rated outlet. Turn CuffLink on by pushing the power switch on the back panel to the "On" position (marked "1"). CuffLink performs a self test and system initialization.

The CuffLink logo display is visible for about 5 seconds during the power-up initialization procedure. The current time and date is in the upper right hand corner and the software revision, along with installed options, is directly below the "CuffLink" name.

CuffLink Menu Structure

After the 5 second logo display, CuffLink will then display the main menus, which are listed across the top of the display.

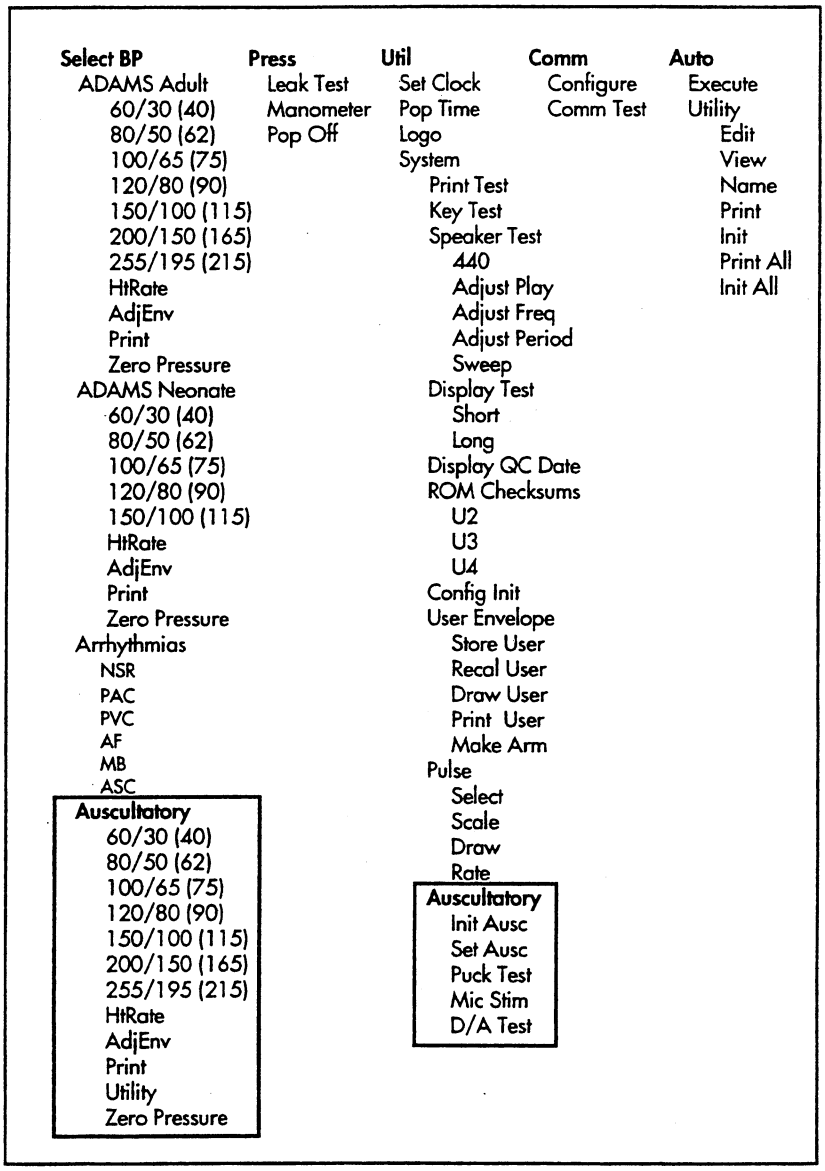
The Main Menus Are:

Select BP	(Select Blood Pressure)
Press	(Pressure Tests)
Util	(Utilities)
Comm	(Communications Ports)
Auto	(Autosequences)

Along the bottom of the display is the menu description, which is a brief description of the contents or purpose of each highlighted menu. If a pulldown menu, or submenu, is visible (the box below main menu titles), the menu description will pertain to what is highlighted in that submenu.

ADAMS Adult (under "Select BP" menu) is automatically highlighted after initialization (pressing the Esc key twice at this point will return CuffLink to the logo display and initialization procedure).

Moving Around the Menu Map



CuffLink Menu Map

Arrow Keys

Select one of the main menus by pressing the left or right arrow keys. When the desired menu is highlighted, press Ent or the down arrow to pull down the submenu. Press either the up or down arrow key to move the dark blue rectangle (hereafter referred to as the "cursor") up or down in the submenu.

"Ent" Key

When the cursor is at the desired location on any menu, press Ent (enter) to select or activate the highlighted parameter.

"Esc" Key

Pressing the Esc (escape) key will return to the menu that was displayed prior to the current menu. An example: Pressing Esc when CuffLink is showing the Set Clock display will return the user back one step to the Util submenu.

Holding the escape key down will eventually return CuffLink from any menu or submenu back to the logo display and initialization procedure.

Holding any of the keys down will result in a repeating action of that key.

Chapter 2

NIBP Monitoring

Non-Invasive Blood Pressure (NIBP) Monitoring

Blood pressure can be measured using a variety of techniques. They can be classified into 2 major categories. They are known as invasive and non-invasive. The invasive approach inserts a catheter into an artery of a test subject. The catheter may contain a pressure transducer at its tip or it may be fluid filled and couple the blood pressure thru the fluid to an external transducer. The change of fluid pressure (i.e. blood pressure) in the subject's artery is said to be measured invasively. This technique is also referred to as a direct measurement since the parameter being measured is directly coupled to the transducer.

The non-invasive technique can be realized several ways. It usually involves the use of an inflatable cuff wrapped around the limb of a test subject. The cuff is inflated and deflated at a controlled rate and physical parameters are observed. The auscultatory and oscillometric techniques are well known non-invasive methods. These methods are indirect because they do not couple directly to the artery.

Auscultatory Technique

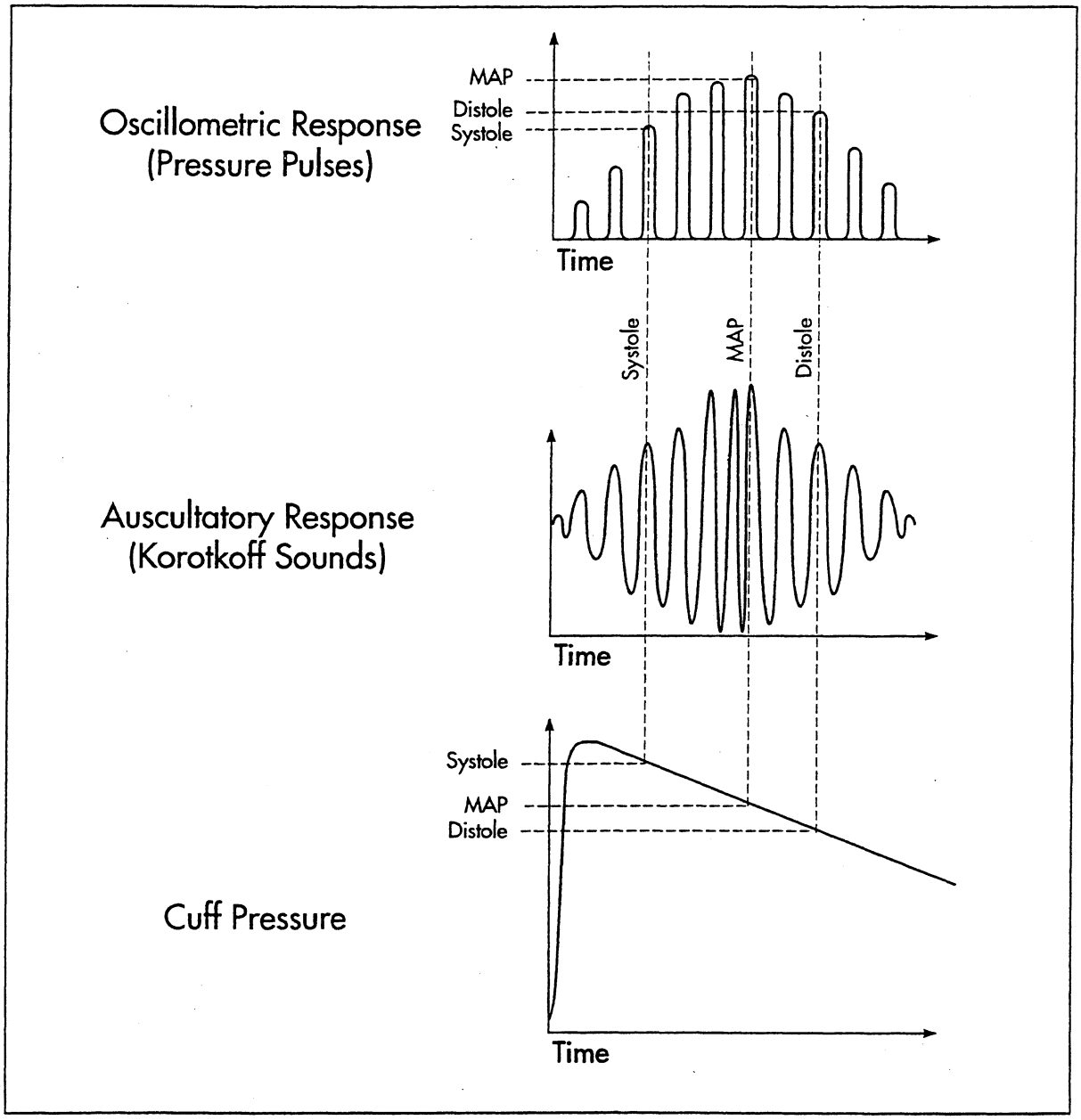
The auscultatory technique is based on the sounds caused by the blood flow through the artery that is surrounded by the cuff. These sounds are known as Korotkoff sounds. In manual blood pressure measurement these sounds are detected by a human observer using a stethoscope. Automated blood pressure monitors use an audio transducer (e.g. microphone) to convert the Korotkoff sounds into electric signals. The cuff is inflated to a point that occludes the artery. The pressure in the cuff is lowered. The cuff pressure at which the Korotkoff sounds are first detected is the systolic pressure. The monitor continues to decrease the cuff pressure until the Korotkoff sounds disappear. The cuff pressure at this point is called diastolic pressure.

Oscillometric Technique

The oscillometric technique does not use Korotkoff sounds to determine blood pressure. The oscillometric technique monitors the changes in cuff pressure caused by the flow of blood thru the artery. The monitor inflates the cuff to a pressure that occludes the artery. Even when the artery is occluded, the pumping of the heart against the artery can cause small pressure pulses in the cuff baseline pressure. The monitor lowers cuff pressure at a controlled rate. As the cuff pressure goes down, blood starts to flow thru the artery. The increasing blood flow causes the amplitude of the pressure pulses in the cuff to increase. These pressure pulses continue to increase in amplitude with decreasing cuff pressure until they reach a maximum amplitude at which point they begin to decrease with decreasing cuff pressure. The cuff pressure at which the pulse amplitude is the greatest is known as Mean Arterial Pressure (MAP). The manner in which the pulse amplitudes vary is often referred to as a pulse envelope. The envelope is an imaginary line that connects the peak of each pressure pulse and forms an outline. The shape of the envelope is observed by the monitor using a variety of techniques to determine the diastolic and systolic blood pressures.

Auscultatory vs. Oscillometric Techniques

The auscultatory response is based on the sounds heard with a microphone. The cuff is inflated to a pressure much higher than systole. As the cuff is deflated the observer (or automated monitor) listens for the onset of K sounds. The cuff pressure at which the K sounds are first detected is treated as systolic pressure. Notice that some smaller K sounds are shown before the systolic point. In many cases there is a threshold point. The point at which the sounds jump from some very low level to a much larger level is more typical with live subjects. The K sound amplitude does not change much as the cuff continues to deflate until the point of diastole is reached. At this point, there is an abrupt drop in K sound amplitude.

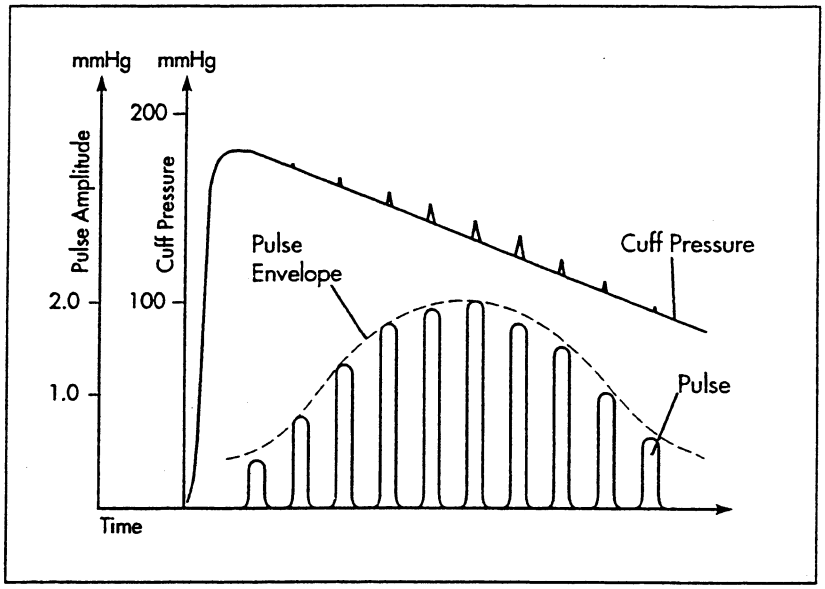


Auscultatory vs. Oscillometric Techniques

The oscillometric response is quite different from the auscultatory response. Note that the oscillometric pulse amplitudes are constantly changing. Also note that there is no point where the pulses abruptly change in amplitude. There is a point where the pulse amplitude reaches a peak. It is generally agreed that the cuff pressure at peak pulse amplitude is the mean arterial pressure (MAP). Note that MAP is not easily identified using the auscultatory method.

Pulse Amplitude

The amplitude of the oscillometric pulses (hereafter referred to as 'pulses') is quite small when compared to the static pressure in the cuff. The pulses are present on the cuff pressure waveform as very small spikes. They are shown in amplified form with the cuff pressure stripped off to reveal the manner in which the amplitude varies as a function of cuff pressure. Notice that the peak pulse amplitude is 2 mmHg at a cuff pressure of 115 mmHg in the example shown.



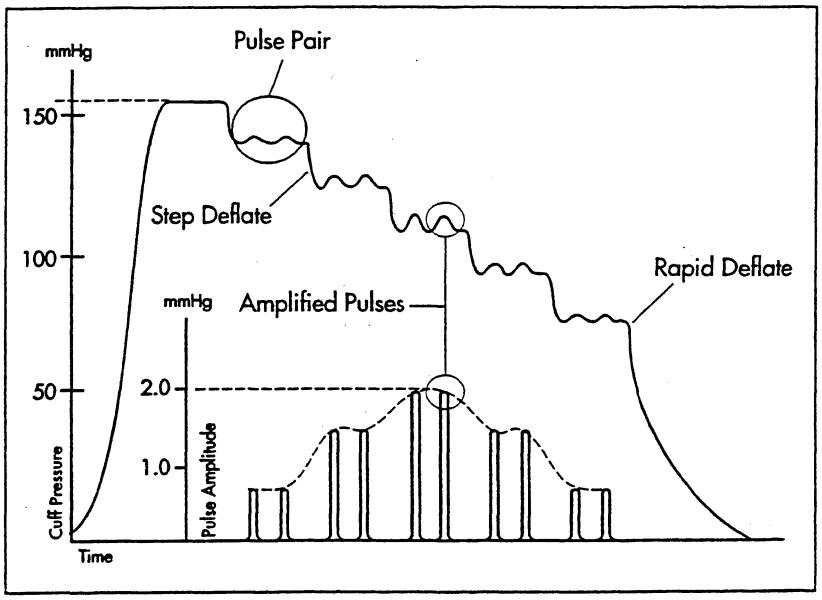
Pulse amplitude and cuff pressure as a function of time during a linear deflate

In general, the peak pulse amplitude is 1-3% of the cuff pressure at which it occurs. Therefore, the monitor must be able to strip off the large static cuff pressure to measure the individual pulse. Since the pulses are so small it is possible for artifact conditions to obscure the pulse. Patient motion and respiration are common artifacts that the monitor must reject. When the cuff pressure is quite high the pulse amplitude is small. As the cuff deflates, the pulse amplitudes increase to a maximum and then begin to decrease to a minimum.

Cuff Deflation

The linear deflate method is also known as continuous bleed. This is the method a nurse normally uses when measuring blood pressure manually. If the deflate is slow, the accuracy is improved. For example, if the bleed rate is 1 mmHg/sec and the heart rate is 60 beats/min, then the cuff pressure changes 1 mmHg per heart beat. Therefore, the error due to change in cuff pressure is limited to 1 mmHg. If the bleed rate is 10 mmHg/sec, then the cuff pressure changes 10 mmHg per heartbeat and the potential error due to change in cuff pressure is 10 mmHg. This error is in addition to the error of the method being used to determine blood pressure. The tradeoff is accuracy versus patient discomfort. The automated monitors employ algorithms to interpret the measurement points to minimize error due to rapid deflate. As an aside, take note the next time someone measures your blood pressure. If they deflate the cuff faster than 3 mmHg/sec they are introducing appreciable error into their ability to measure your blood pressure. For example, if the cuff is inflated to 180 mmHg and then deflated to 60 mmHg, it should take 40 seconds at a deflation rate of 3 mmHg/second.

A typical deflate method used by automated monitors is known as stepwise deflate.

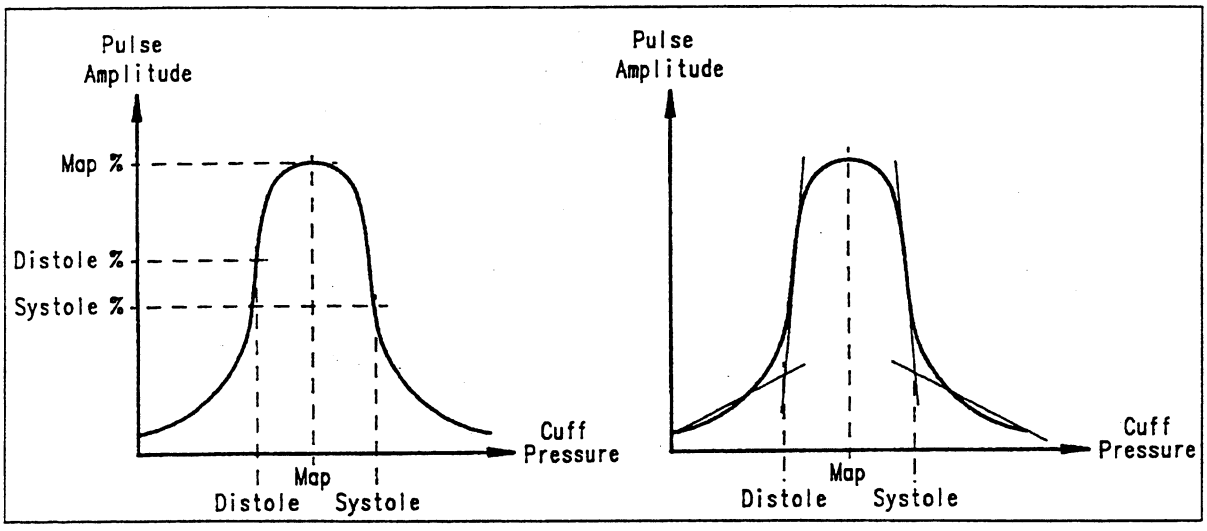


Cuff pressure and pulse amplitude vs. time for a commercial monitor

The cuff is inflated to a pressure much greater than systole and deflated in discrete steps. Typical step deflate size is from 4 to 10 mmHg depending on the monitor and cuff size being used. After the deflate, the monitor measures some number of pulses before deflating again. The number of pulses gathered depends on the monitor software and the algorithm used. In a stat mode, it is common to gather only one pulse per step. In normal mode, it is common to gather pulses until at least 2 pulses are within some tolerance of each other in amplitude for artifact rejection. When a monitor step deflates in large steps it must interpolate the shape of the pulse envelope. The larger the step size the larger the potential for error when interpolating. If the step size is small the potential for error is reduced. Much effort has been spent by manufacturers to maximize step size and minimize error with varying degrees of success. With the introduction of CuffLink it is now possible to compare normal mode to stat mode and observe the repeatability of the monitor as a function of step size and pulse pair matching. The end of the measurement cycle is defined as the point at which diastolic pressure has been determined. At this time the cuff is rapidly deflated to further minimize patient discomfort.

BP Determination

The manner in which oscillometric pulses vary as a function of cuff pressure is open to interpretation. Height based and slope based algorithms are used to determine blood pressure based on pulse amplitudes. The illustration below shows the same pulse envelope and how it may be interpreted by these two different methods.



Height Interpretation ***Slope Interpretation***

Height and Slope Interpretations for determining blood pressure from pulse amplitude data

Height Method

The peak pulse amplitude is treated as MAP and normalized to a value of 100%. The cuff pressure at MAP is the MAP pressure. Systole and diastole are fixed percentages based on MAP. The cuff pressure under diastole is the diastolic pressure and the cuff pressure under systole is the systolic pressure. There is no standard to suggest what the percentages for systole and diastole should be or even that they should be fixed percentages. Every manufacturer using height based algorithms has performed its own clinical trials and drawn its own conclusion as to what the percentages should be and whether they are fixed or not as a function of MAP pressure.

Slope Method

There are many methods employed to determine how many slopes should be drawn and what conclusions can be made about their intersection. As shown in this example, the cuff pressure under the intersection of the slopes is treated as the systolic and diastolic pressures. There is no standard for slope algorithms just as there is no standard for height algorithms.

NIBP Monitor Testing

Manufacturers of non-invasive blood pressure monitors using the oscillometric technique have performed clinical trials to determine the correlation between both auscultatory techniques and invasive (arterial line) methods of measuring blood pressure to the oscillometric technique. Various interpretations have emerged from these manufacturers with varying degrees of agreement. At present, no regulatory agency has put forth a standard as to how pulse amplitudes should be interpreted to determine blood pressure. Therefore, the accuracy and repeatability of these monitors is difficult to determine.

Conclusion

With the introduction of CuffLink, it is now possible to determine the repeatability and agreement of these monitors. CuffLink produces a stable "live subject" response to the cuff during the measurement cycle. Since CuffLink produces the same response independent of the inflate/deflate cycle or the algorithm used by the monitor, we offer the term "Target Value" as an approximation of the patient's actual blood pressure.

Absolute dynamic accuracy cannot be assigned to MAP, diastolic, and systolic target values at this time because no standard exists. Should any public standards emerge, CuffLink may be programmed to implement them and test blood pressure monitor accuracy.

Chapter 3

Operation

SELECT BP

The "Select BP" (Select Blood Pressure) test is simulates a human arm and produces target value blood pressures.

Adult		Neonate		Adult Arrhythmias
Blood Pressure (mmHg)	**Mean Arterial Pressure (mmHg)**	**Blood Pressure (mmHg)**	**Mean Arterial Pressure (mmHg)**	Premature Atrial Contraction Premature Ventricular Contraction Atrial Fibrillation Missed Beat Aberrant Sinus Conduction
60/30 80/50 400/65 120/80 150/100 200/150 255/195	40 62 75 90 115 165 215	60/30 80/50 400/65 120/80 150/100	40 62 75 90 115	
Heart Rate Selections				**Blood Pressure and Heart Rate** Blood Pressure fixed at 120/80 (90) Heart Rate fixed at 80 BPM
30 40 60 80 120 160 200 240				

SELECT BP

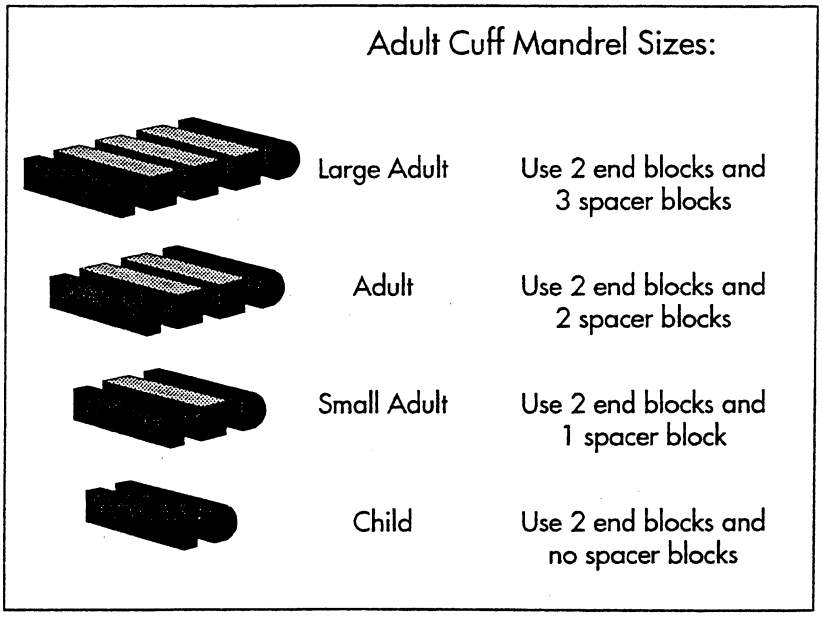
Setup

Equipment

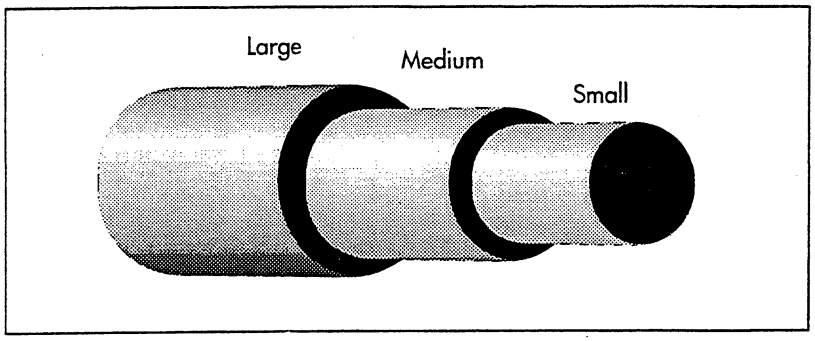
You need the following equipment to test blood pressure readings of an NIBP monitor:

1. NIBP monitor
2. CuffLink*
3. Mandrel*
4. BP cuff
5. Hoses that attach cuff to monitor
6. Cuff Adapter for monitor being tested*

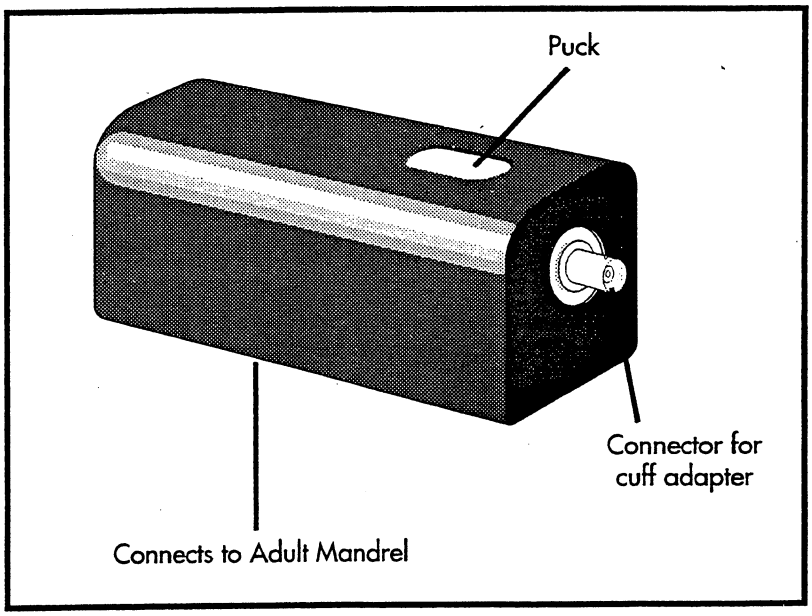
* = Items supplied with CuffLink



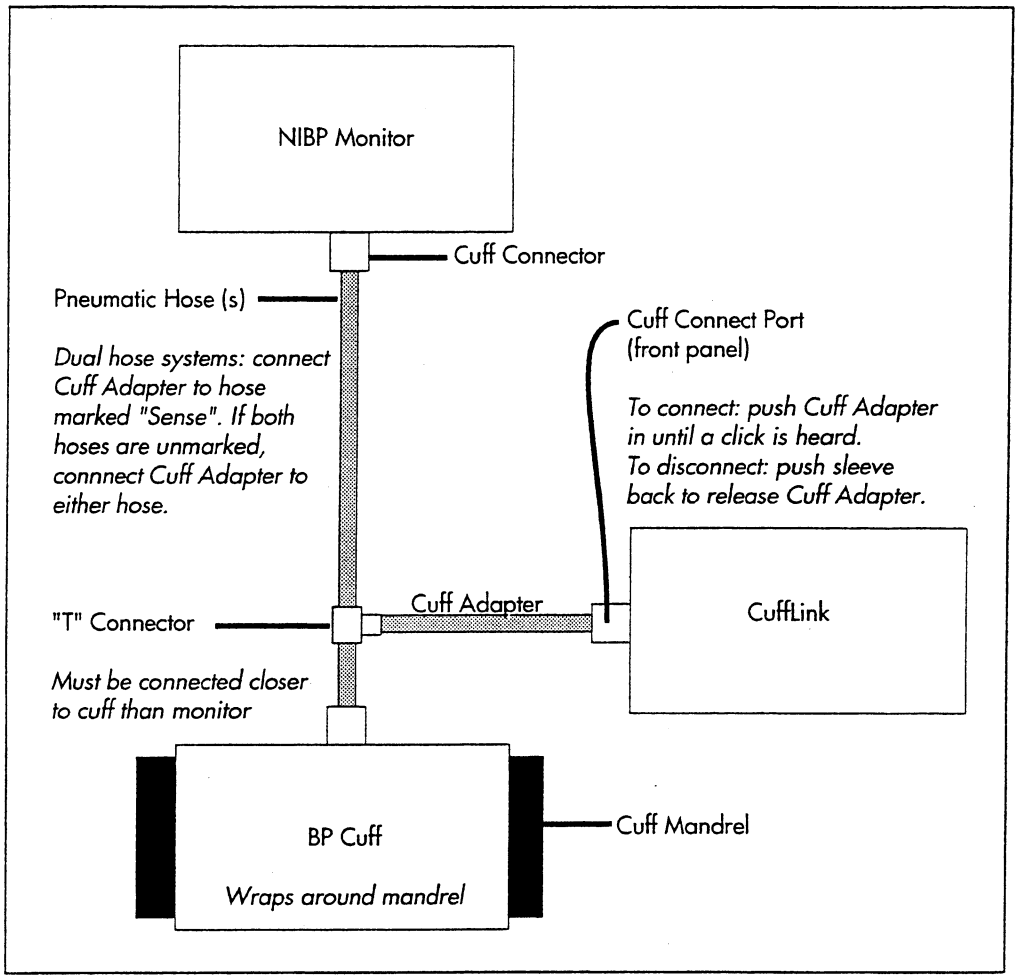
Adult cuff mandrel sizes



CuffLink neonate mandrel



Auscultatory mandrel



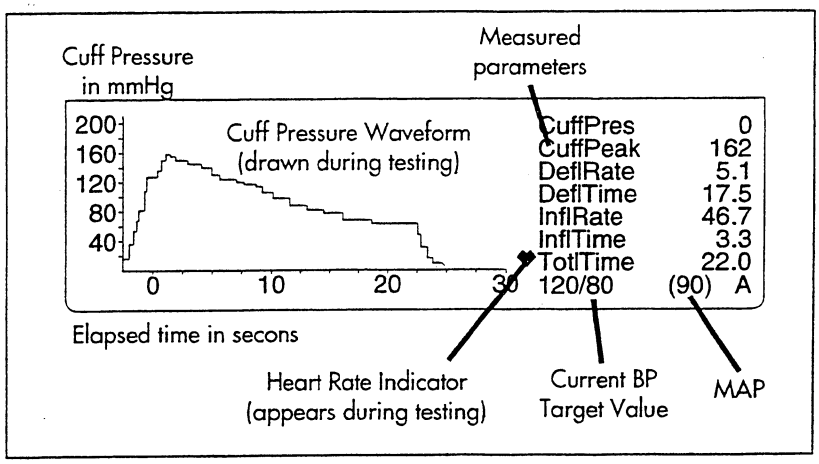
Connecting CuffLink to an NIBP monitor

Connections

1. Attach BP cuff to NIBP monitor as documented in the operator's manual for that monitor.
2. Wrap cuff tightly around the mandrel.
3. Connect the cuff adapter "T" connector into the line nearest the cuff. If the NIBP monitor has 2 pneumatic hoses connected to the cuff, insert the cuff adapter into the hose labeled "Sense". If neither hose is labeled, the cuff adapter may be inserted into either hose.

   Do not connect the cuff adapter to CuffLink at this time, unless CuffLink has been warming up for at least 15 minutes. The reason for this is explained further in the "Zero Pressure" section.
4. Both the NIBP monitor and CuffLink should be powered up at this point. CuffLink is now ready to simulate the human arm in order to reliably evaluate the NIBP monitor.

Make Arm Display



CuffLink "Makearm" display

Graph

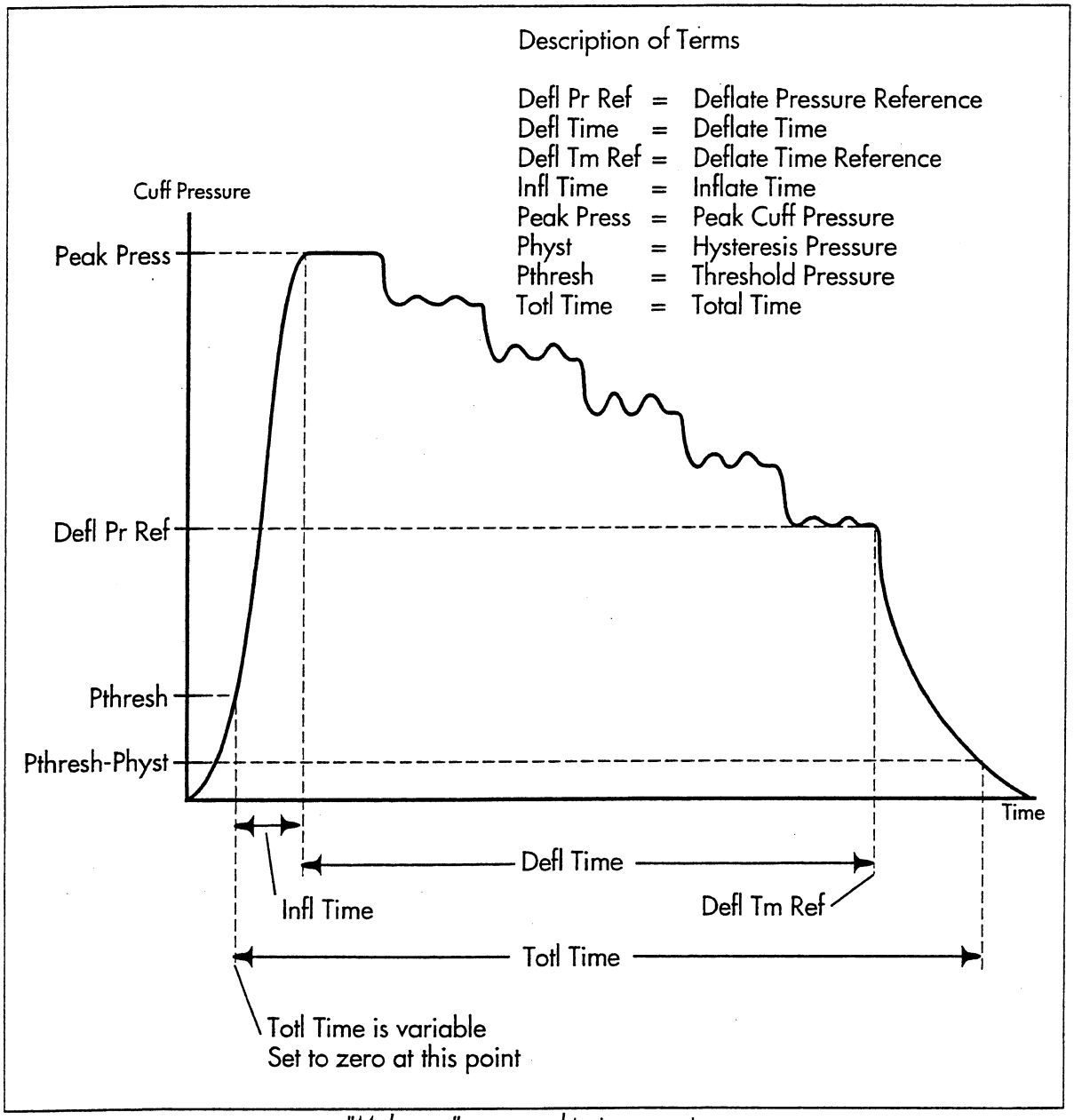
The vertical axis of the graph indicates cuff pressure in millimeters of mercury (mmHg). The horizontal axis indicates elapsed time in seconds.

CuffLink graphs are auto-ranging. If the cuff pressure curve values extend beyond the displayed ranges, the entire graph will be redrawn on the display. The result of this is that the curve will appear more compact. Note that the values along the horizontal and/or vertical axis have adapted to accommodate the modified curve. The values along the curve, therefore, have remained the same.

Description of Measured Test Parameters

The test parameters are listed on the right side of the display. These values are defined as follows:

1. CuffPres: On-Line Cuff Pressure (mmHg)
2. CuffPeak: Peak Cuff Pressure (mmHg)
3. DeflRate: Deflate Rate (mmHg/second)
4. DeflTime: Deflate Time (seconds)
5. InflRate: Inflate Rate (mmHg/second)
6. InflTime: Inflate Time (seconds)
7. TotlTime: Total Measurement Time (seconds)



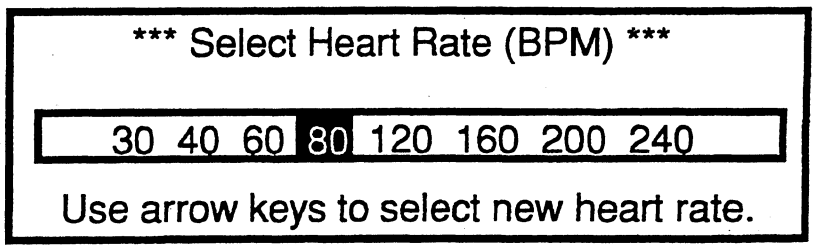
"Makearm" measured test parameters

Current Blood Pressure Target Value Setting

This value is shown just below the list of test parameters on the Makearm display and indicates which BP target value is currently being simulated by CuffLink.

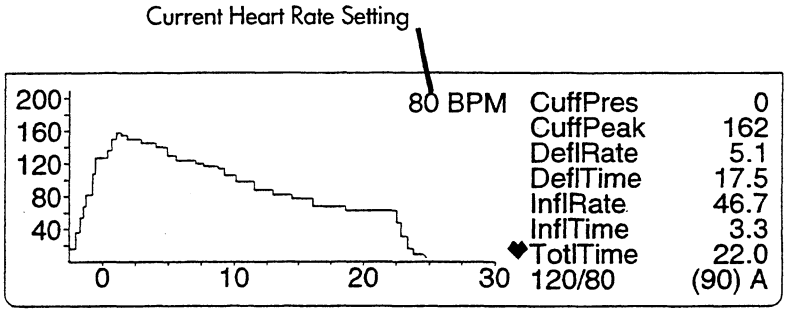
Heart Rates (HtRate)

Choose "ADAMS Adult" or "ADAMS Neonate" under the "Select BP" main menu and press "Enter". Highlight the blood pressure target value you want CuffLink to simulate. Press F1 ("HtRate") on the "ADAMS Family Target value" display and CuffLink will display the heart rates. Use the arrow keys to choose a heart rate and then press "Enter".



CuffLink "Select Heart Rate" display. Use the arrow keys to select the heart rate and press "Enter".

A CuffLink pop up window will confirm which heart rate you have chosen. When the target value display reappears, press "Enter" to display the "makearm" graph. The current heart rate setting is shown in the upper part of the "makearm" graph next to "CuffPres".

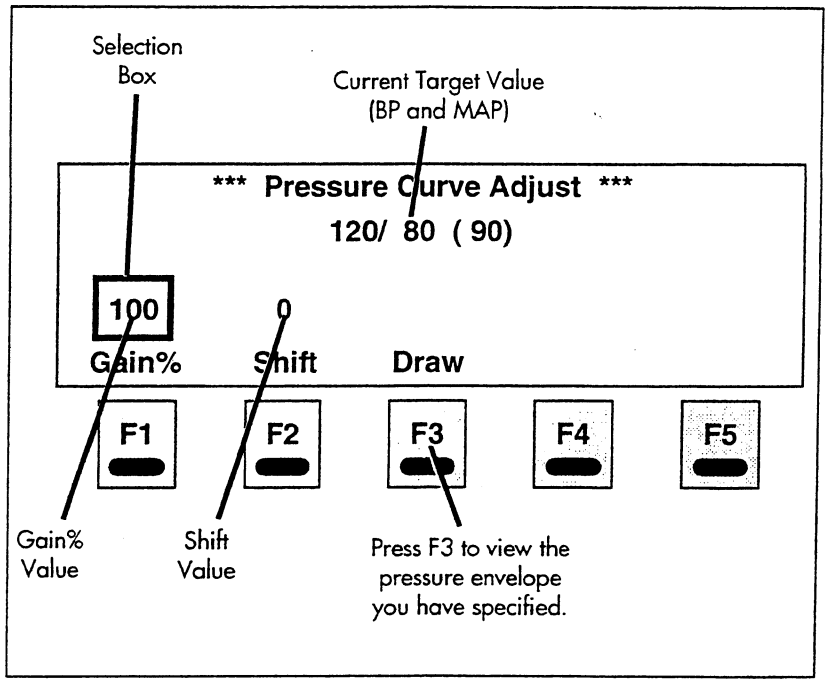


The heart rate setting is shown on the "Makearm" graph.

Pressure Envelope Adjustments (AdjEnv)

With this option you can modify the gain (amplitude) or shift (BP value) of the blood pressure envelope and draw the envelope you have specified.

From the main menu under "Select BP", choose "ADAMS Adult" or "ADAMS Neonate". Highlight the target value you want CuffLink to simulate, then press F2 ("AdjEnv") to make adjustments to the pressure envelope. When you have finished, you can view the pressure envelope by selecting "Draw" (F4).



CuffLink "Pressure Curve Adjust" display

Press "Enter" to save the pressure envelope or "Escape" to undo any changes you've made, and CuffLink returns to the target values display. Press "Enter" and your ready to start the NIBP monitor and simulate the blood pressure.

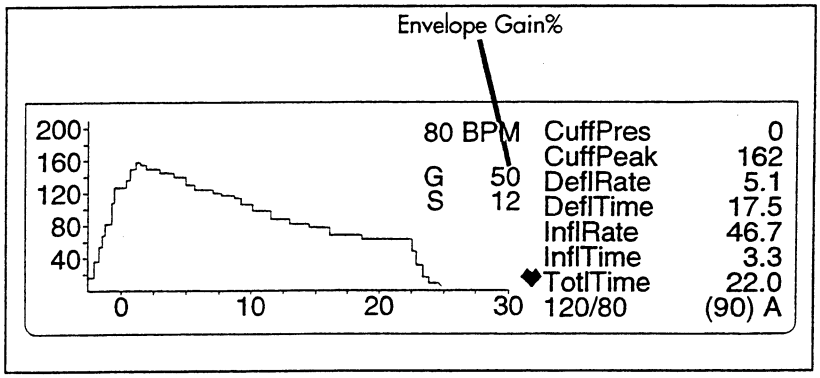
Draw

Press F4 to view the waveform you have specified with the "Pressure Curve Adjust" menu. Pressing "Escape" or "Enter" returns you to the "Pressure Curve Adjust" menu.

Gain%

The percent of gain affects the pressure pulse amplitude. The default value for "Gain%" is 100% and the range is from 1% to 200%.

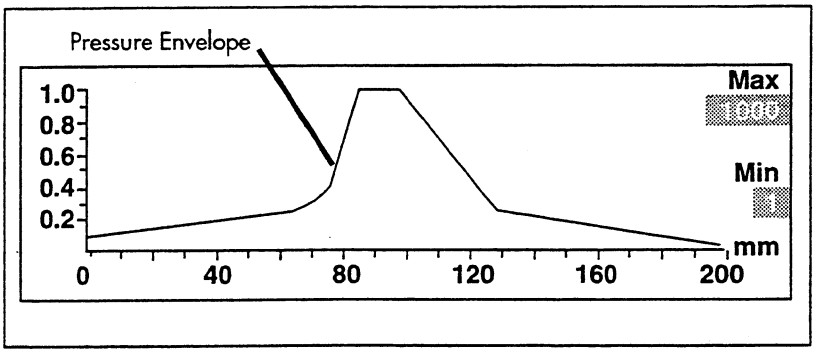
From the "Pressure Curve Adjust" display, press F1 to move the selection box to "Gain%" and use the arrow keys to change the value.



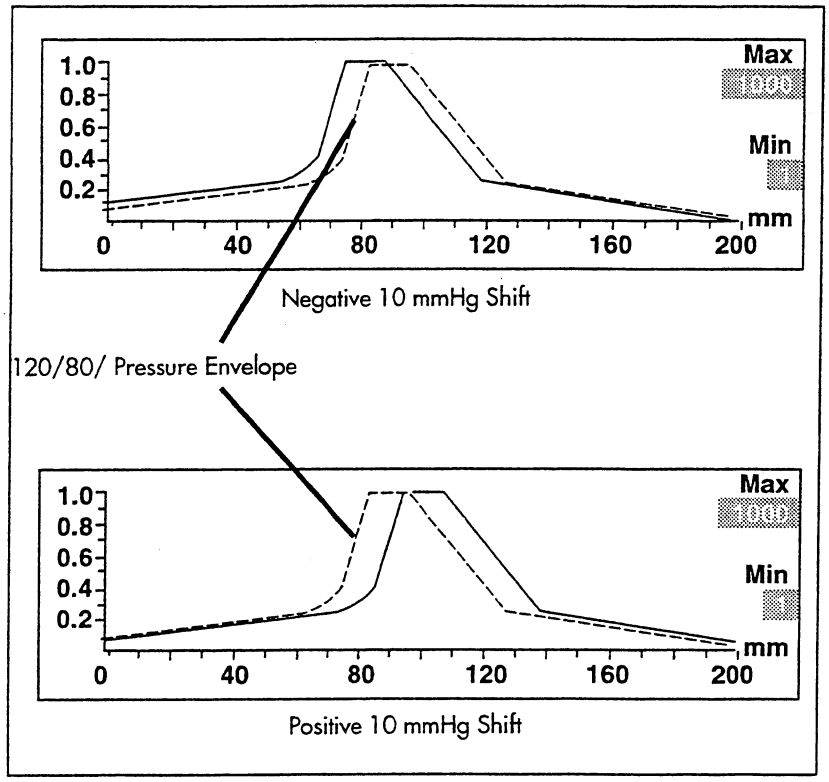
If you change the default value for "Gain%", it appears below heart rate on the "makearm" graph.

Shift

"Shift" increases or decreases the blood pressure value by shifting the entire blood pressure envelope to the left (- shift) or right (+ shift). If you select a target value of 120/80 and add a +10 mmHg shift, the actual blood pressure target value simulated changes to 130/90.

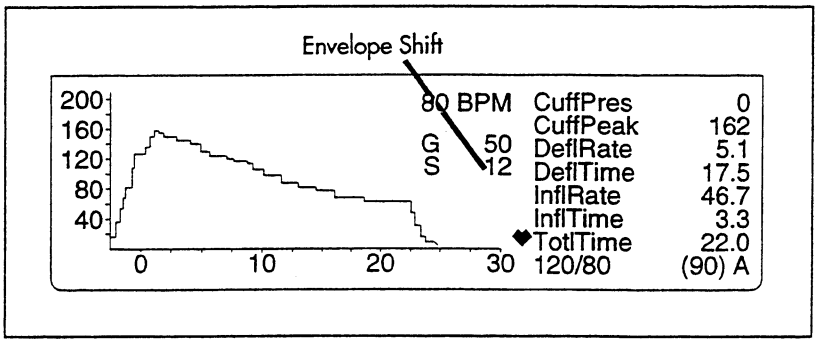


120/80 blood pressure envelope, no shift



Negative and positive pressure envelope shifts. Amplitude remains constant. 120/80 pressure envelope (dotted line) shows reference point.

The default value for shift is 0 mmHg and the range is from -100 mmHg to +100 mmHg. Press F3 on the "Pressure Curve Adjust" display to move the selection box to "Shift" and use the arrow keys to change the value.



If you change the default value for "Shift", it appears below heart rate and "Gain%" on the "makearm" graph.

Simulating Adult Blood Pressure

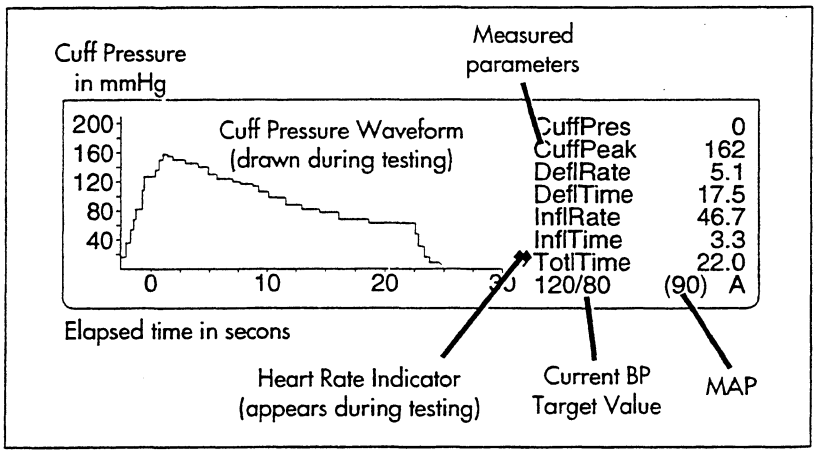
Simulating the "Adams Adult" 120/80 Blood Pressure Target Value

1. **Select Adams Adult 120/80.**

   After power-up and initialization, CuffLink displays the Select BP, ADAMS Family submenu. Press Ent to display the target values or blood pressure selections of ADAMS Family. The cursor will initially be at 120/80. Heart rate is fixed at 80 BPM. Press Ent to enter the "Make Arm" function for 120/80. CuffLink display will briefly show:

   120/80 (90)

   This verifies which parameter was chosen. CuffLink will then draw the Make Arm display.



CuffLink Makearm display

NOTE: CuffLink pop-up windows will not be visible if Pop Time is set to 0.00. See section on "Pop Time" (UTIL).

2. **Zero Pressure**

   The value for cuff pressure (CuffPres), shown in the upper right corner of the "Makearm" display, should read zero pressure (0 mmHg) before you start a test. If the display is not showing a zero, return to previous menu by pressing Esc (escape). Make sure nothing is connected to CuffLink's cuff connect port. Press F5 to zero the pressure. A pop-up message will read:

   ***n.nn* mmHg removed**

   This indicates that CuffPres has been set to match the atmospheric pressure.

You only need to zero pressure during the 15 - 20 minute warmup period. After warmup, the value for CuffPres becomes stable and it is not necessary to continually zero the cuff pressure.

Press Ent to view the Make Arm graph. The value for CuffPres should now be set to zero. If CuffPres is not zero, repeat the above procedure.

3. **Activate NIBP Monitor; Begin Testing**

Connect the cuff adapter to CuffLink once you have set CuffPres to zero.

Initiate the testing sequence of the NIBP monitor (refer to the operator's manual for that monitor). The cuff should begin to inflate around the mandrel. CuffLink will start the peripheral pulse simulation and a curve representing the cuff pressure (Oscillometric Technique, Chapter 3) will be drawn as the test progresses.

CuffLink initiates blood pressure simulation when the inflate pressure has reached 8.0 mmHg and terminates simulation when the pressure upon deflate has arrived at 6.0 mmHg.

A small flashing heart will become visible to the left of Total Test Time (TotlTime, on right side of graph) when simulation begins. This represents the heart rate. Each color change of the heart signifies one heartbeat.

The NIBP monitor will interpret and display the measured blood pressure values and heart rate at the completion of the test. The monitor may have a different reading than the target value displayed on the CuffLink Make Arm display. This is normal. Readings may also be different when the monitor is in the stat mode rather than the normal (automatic) or manual mode. The main thing is that readings are consistent and repeatable. Accuracy for the target values can not be specified because no standard for blood pressure measurements exists.

Simulating Other ADAMS Family Target Values

Simulation of any of the ADAMS Family target values follows the same procedure as that of the 120/80 simulation. From the 120/80 Make Arm display, press Esc to return to the ADAMS Family submenu and choose the desired target value. Press Ent and the Make Arm display will reappear with a new target value displayed below TotlTime.

BP	MAP
60/30	(40)
80/50	(62)
100/65	(75)
120/80	(90)
150/100	(115)
200/150	(165)
255/195	(215)

Adams Adult target values

Simulating Neonatal Blood Pressure

Neonatal blood pressure target values are in the "Select BP" menu. From "Select BP" on the main menu, choose "ADAMS Neonate". This menu looks and functions the same as the "ADAMS Adult Family" blood pressure menu.

You must use the neonate mandrel with a neonate cuff when using these target values.

BP	MAP
60/30	(40)
80/50	(62)
100/65	(75)
120/80	(90)
150/100	(115)

Adams Neonate target values

Simulating Arrhythmias

CuffLink gives you five arrhythmias to test your NIBP monitors in the presence of typical patient arrhythmias. These simulations are a representation of the peripheral pulse as seen by an oscillometric NIBP monitor during arrhythmic activity.

Each arrhythmia is generated on a random basis throughout the entire pressure curve cycle.

See the "Remote Commands" chapter for a description of all RS-232 commands pertaining to arrhythmias.

Arrhythmia Types

1. **Premature Atrial Contraction (PAC)**

   The first pulse of the PAC cycle is premature and lower in amplitude than a normal sinus pulse. The next pulse would be back in sync with normal sinus and slightly higher in amplitude. All subsequent pulses are normal.

2. **Premature Ventricular Contraction (PVC)**

   This is a representation of the peripheral pulse similar to PAC but has a different amplitude.

3. **Atrial Fibrillation (AF)**

   The AF cycle has an irregular R to R interval. Its occurance and properties (early vs late) are random throughout the pressure curve cycle.

4. **Missed Beat (MB)**

   A complete beat is randomly skipped during the pressure curve cycle. The following beat reverts to normal R to R intervals.

5. **Aberrant Sinus Conduction (AS)**

   The AS cycle inserts one pulse so low that is is virtually non-existent. This causes CuffLink to skip one distal pulse and then return to normal sinus pulses.

Testing with Adult Arrhythmias

1. Use the adult mandrel and connect CuffLink to the NIBP monitor.
2. Choose SELECT BP from the main menu.
3. Choose Arrhythmias.
4. Select an arrhythmia and press ENT.
5. Zero pressure if CuffPres does not equal zero.
6. Start the NIBP monitor and begin testing.

Heart Rate

Baseline heart rate for all arrhythmias is set at 80 BPM.

Arrhythmia Utilities

1. **Print**

   Press F3 to print results of your arrhythmia tests.

2. **Draw**

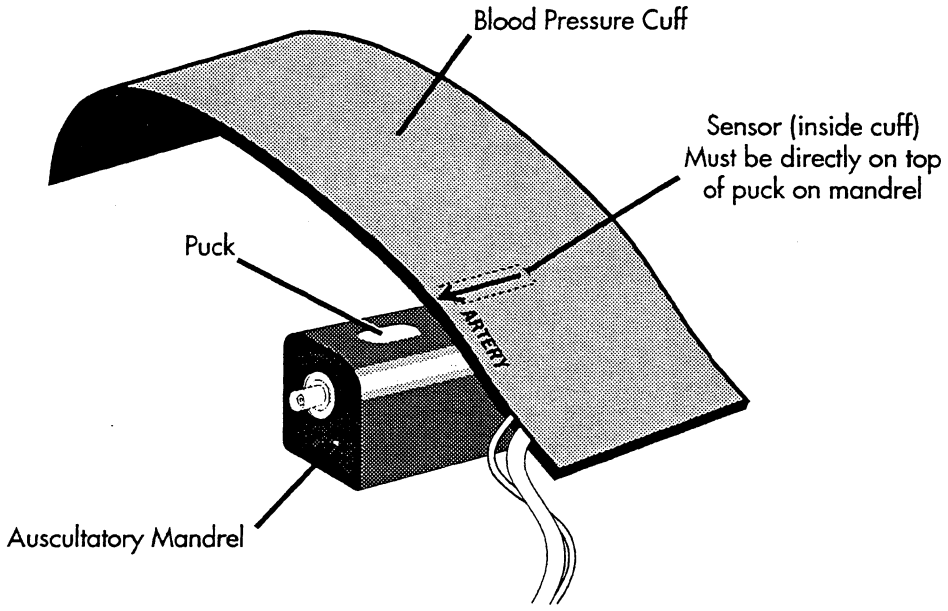
   Press F4 to draw the pressure envelope pulse.

3. **ZeroPres**

   Press F5 to zero pressure before testing.

Simulating Auscultatory Blood Pressure

1. Choose "Ausc. Option" from Select BP on the main menu. The auscultatory menus function the same as the ADAMS Adult Target Values menu.
2. Select a target value and heart rate. Press Ent.
3. Start the NIBP monitor to begin testing.



Correct placement of auscultatory cuff on auscultatory mandrel

Utility

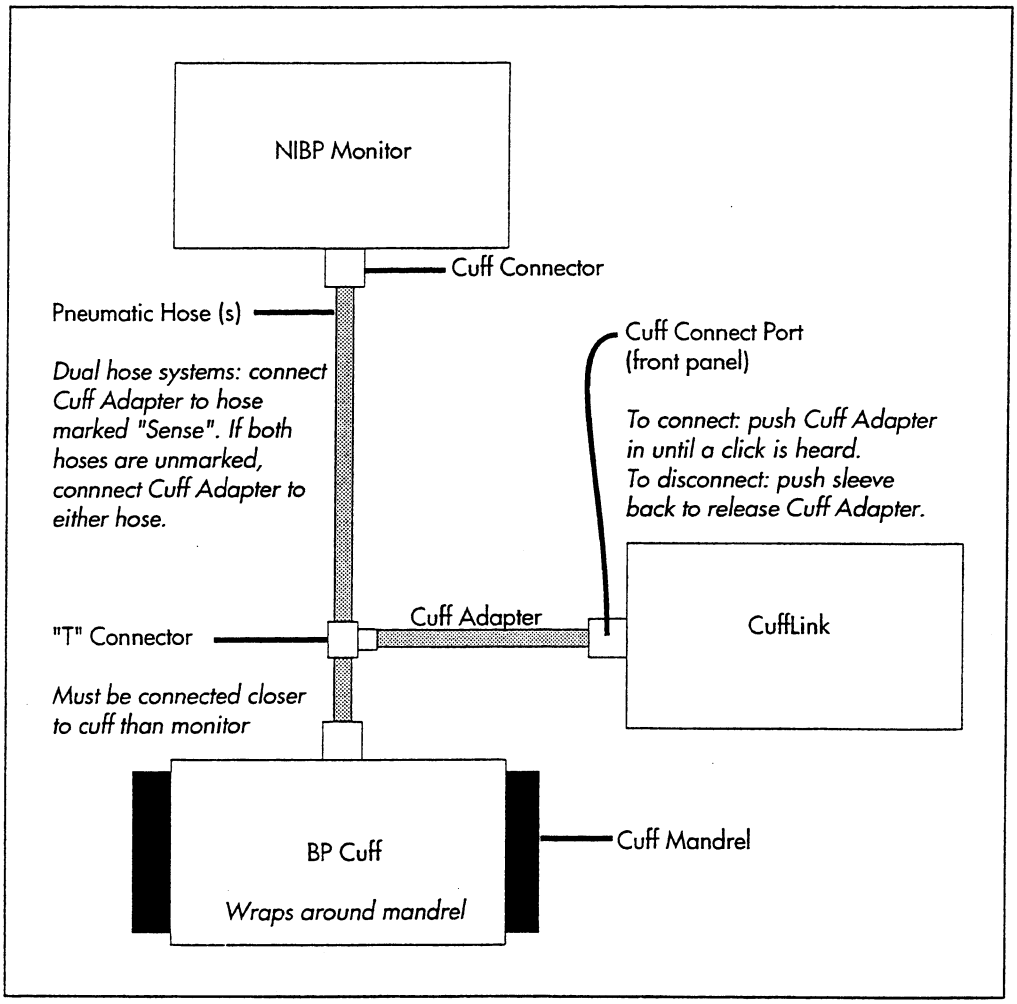
You can set CuffLink to simulate the following conditions:

1. Normal Mandrel
2. Normal Microphone
3. Reverse Microphone
4. Low Signal Microphone

PRESS

If CuffLink is not showing the main menus across the top of the display, press Esc until the list of main menus is available. Use the arrow keys to move the cursor to the Press (Pressure Measurements) main menu. If necessary, press Ent or the down arrow key to pull down the submenu box.

From the Press submenu, the user has access to the Pressure Leak Test, Digital Manometer, and the Pop Off Test.



Connections for pressure testing

Refer to the operator's manual for the NIBP equipment being tested for further information.

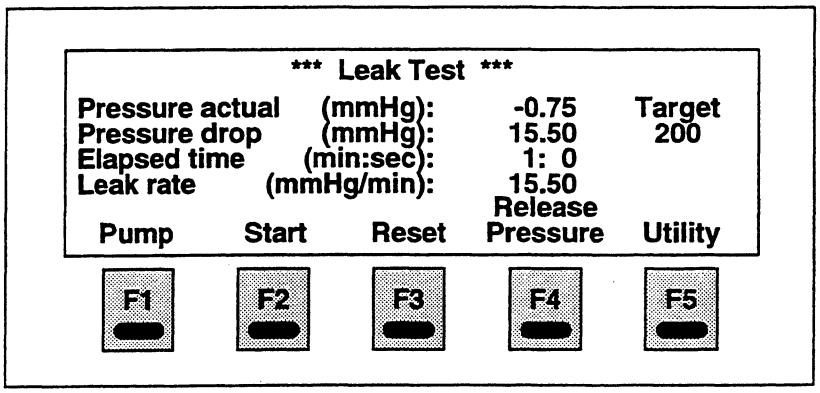
Leak Test

The Leak Test checks NIBP equipment, including cuff and tubing, for air leaks.

Note: If you have an NIBP device that has an internal system leak test or one that vents the cuff inflation pneumatic circuit to atmosphere when idle, do not use CuffLink's leak test. You can use the manometer in CuffLink to monitor internal system leak tests. Refer to your NIBP device's manual for recommended test protocol.

Select Leak Test

Use the arrow keys, if necessary, to move the cursor to the Leak Test option of the Press submenu. Press Ent to select the option and the Leak Test display will appear.



CuffLink Leak Test display

Zero Pressure

The Zero Pressure function should only be necessary during CuffLink's warm up period (first 15 minutes of operation).

If Cuff Pressure is zeroed, the CuffLink display will momentarily read

n.nn mmHg removed

to indicate the amount subtracted.

Utilities

Press F5 for Leak Test Utilities. Use the arrow keys to highlight the utility you want to modify and press Ent. When you are finished, press Esc.

1. **Small Cuff**

   Cuff size, or volume, affects the way CuffLink inflates the cuff for leak testing.

   Select and press Esc to set size to small cuff.

2. **Medium Cuff**

   Select and press Esc to set size to medium cuff.

3. **Large Cuff**

   Select and press Esc to set size to large cuff.

4. **Zero Pressure**

   After you press Ent, CuffLink displays the amount of pressure removed (in mmHg).

5. **Reset**

   Resets Target Value to 200 mmHg.

6. **Set Target**

   Use the arrow keys to change the Target Value. To save the new value, press Ent. Press Esc to cancel and return to the Leak Test menu.

7. **Print On/Off**

   Use this utility to print leak test results.

Inflation and Testing

1. Press F1 to pump up the pressure until Pressure actual is equal to the value documented for this test in your NIBP monitor's manual.
2. Press F2 (Start Test) to begin leakage measurement.

   CuffLink will measure any pressure drop in the system for the duration of one minute. An audible tone will sound at the end of the one minute test and CuffLink will cease measurements.

3. Press F3 (Reset) to return leakage measurements back to zero.
4. Press Esc to exit the Leak Test.

Description of Measured Parameters

The Leak Test parameters are defined as follows:

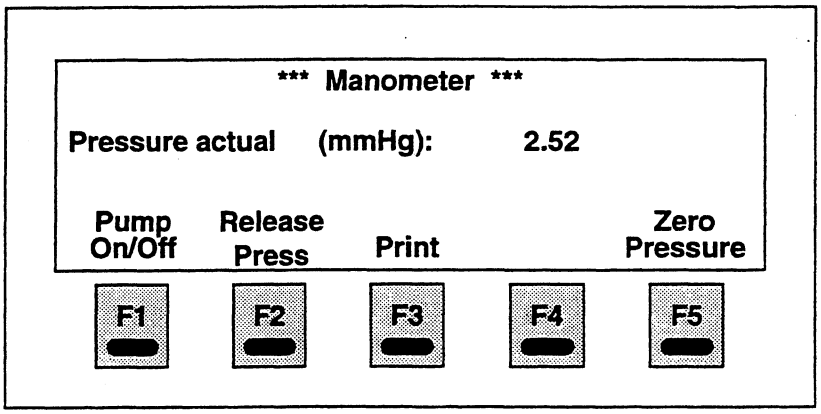
1. **Pressure actual (mmHg):** The pressure of the BP cuff.
2. **Pressure drop (mmHg):** The measured drop in pressure actual as the test progresses.
3. **Elapsed time (min:sec):** Displays how much time the leak test has taken to that point.
4. **Leak rate (mmHg/min):** Displays the rate of air leakage at the end of the one minute test.
5. **Target (mmHg):** Displays the pressure to which CuffLink inflates and begins leak testing.

Manometer

CuffLink has a digital manometer you can use for general pressure measurements.

Select Manometer Function

Use the arrow keys, if necessary, to move the cursor to the Manometer function of the Press submenu. Press Ent to select the option and the manometer display will appear.



CuffLink Manometer display

Zero Pressure

The Zero Pressure function should only be necessary during CuffLink's warm up period (first 15 minutes of operation).

If you zero Cuff Pressure, the CuffLink display will momentarily read

n.nn mmHg removed

to indicate the amount subtracted.

Inflation and Testing

1. Press F5 to zero pressure if Pressure actual is not reading zero.
2. Press F1 to start the pump and inflate the cuff until the NIBP monitor indicates the overpressure point has been reached (consult owner's manual for monitor). Press F1 again to stop the pump. CuffLink will display the pressure in mmHg.
3. Press F2 (Release Pressure) to return Pressure actual to zero.
4. Press Esc to quit Manometer.
5. Press F3 to print test results.

Description of Measured Parameters

The measured parameters of the Manometer option are defined as follows:

1. **Pressure actual (mmHg):** Indicates pressure in the blood pressure cuff.

Pop Off Test

The Pop Off test is an overpressure test that evaluates your monitor's emergency release valve.

Inflation and Testing

1. Press F5 to zero pressure if Pressure Actual does not read zero.
2. Press F1 to begin inflation. CuffLink inflates until the monitor's release valve activates.
3. Press F2 to reset readings to zero.
4. Press F3 to print test results.
5. Press F4 to release all pressure in the system (CuffLink and the monitor).

Description of Measured Parameters

The measured parameters of the Manometer option are defined below:

1. **Pressure Actual (mmHg):** Indicates current pressure in the blood pressure cuff.
2. **Pressure Peak (mmHg):** Indicates the maximum pressure in the system before release of the monitor's emergency valve.

UTIL

The CuffLink Util (Utilities) menu selections enable the user to set the clock, adjust pop time, view the logo display, and perform system tests.

The Util options are CuffLink system tests or adjustments and only affect CuffLink. The NIBP monitor will not be affected by the Util options.

If CuffLink is not showing the main menus across the top of the display, press Esc until the list of main menus is available. Use the arrow keys to move the cursor to the Util main menu. If necessary, press Ent or the down arrow key to pull down the submenu box.

Set Clock

The Set Clock option enables changes to be made to the clock or calendar (date). These are both visible in the upper right corner of the logo display.

Use the arrow keys to move the cursor to the Set Clock option under the Util menu. Press Ent to select this option. The Set Clock display will appear.

The Current line indicates the settings for time, date, day, and mode that are currently stored in Random Access Memory (RAM). The Adjust line is where the cursor marks a value to be modified. This is where any changes are made.

The left and right arrow keys select the time or date value to modify. The up and down arrow keys modify the selected value. The arrow key functions are shown in the lower right corner of the Set Clock display. Holding down any key will result in a repeating of that key's action.

Time

Time is displayed in hours, minutes, and seconds. Move the cursor to the hour position (the first two digits in the Time column of the Adjust row). Using the up arrow key will increase the value of the number and using the down arrow key will decrease the value of the number. Holding the arrow keys down will cause the number to rapidly change value after a pause of about one second.

Adjust the minutes, seconds, and am/pm designator (see Mode, below) in the same manner as described above.

Date

Move the cursor over to the Date column. The date is displayed by month, day, and then year. Date values are set the same way the Time values are (see Time, above).

Day

Move the cursor to the Day column. Use the up/down arrow keys to move through the days of the week.

Mode

Mode describes the Time setting. It can be either in the 12 hour (12hr) mode or the 24 hour (24hr) mode. In the 12 hour mode, the clock will read 12:00:00 at midnight. Most clocks display in the 12 hour mode. In the 24 hour mode, the clock will read 24:00:00 at midnight. The 24 hour mode is sometimes referred to as "military time".

Move the cursor to the Mode column and use the up/down arrow keys to toggle between the 12hr and 24hr modes.

Selecting the 12 hour mode will cause an "a.m." or a "p.m." designator to appear at the end of the Time column. Move the cursor back to the Time column to make any necessary changes.

Saving or Cancelling New Information

If desired changes have been made in the Time, Date, Day, and Mode settings, they are ready to be saved, or written to memory. The only way to retain any new information is to write it to memory. The new information is then stored and is available the next time CuffLink is powered up. If new information is not saved, it will be lost when the power to CuffLink is turned off.

To save the new information (data), press Ent. CuffLink will briefly display

Storing DATA

which confirms the fact that the new data has been saved.

To prevent writing any data modifications to memory, simply press Esc to exit the Set Clock function, and CuffLink will ignore any changes that were made.

Pop Time

When certain functions are chosen from the CuffLink display (example: choosing a blood pressure target value from the Select BP main menu), a message surrounded by a box briefly appears over the information on the CuffLink display. The box containing this information is called the "pop up window".

The Pop Time option enables the user to adjust the pop up window delay time. Adjustment may be necessary if the pop up window flashes on the display too fast to read, or if the window stays on the display too long and produces unwanted delays in testing procedure. The pop up window may also be completely eliminated by setting the Pop Time to 0.00 seconds. This feature may be desired as the user becomes more experienced with the CuffLink system and does not need the reminders that the pop up windows provide.

Move the cursor to the Pop Time option under the Util main menu and press Ent to select this option. The Pop Time display will appear and will show the current value of the Pop Time.

This option has only one adjustment to make. It is labeled as Delay Time. The value is displayed in seconds.

Adjusting Pop Time

Use the up or down arrow keys to change the current value of Pop Time. The cursor is not visible on the Pop Time display.

The range of values for Pop Time is from 0.00 seconds to 5.00 seconds and changes by 0.25 second steps.

Pressing the up arrow key once will increase the value by 0.25 seconds. Holding the key down will quickly increase the displayed value to 5.00 seconds.

Pressing the down arrow key once will decrease the value by 0.25 seconds. Holding the key down will quickly decrease the pop time to 0.00 seconds.

Saving or Cancelling New Data

Once the pop time is set, it is ready to be saved in EEROM.

Press the Ent key to save the modified pop time value, or the Esc key to retain the current pop time setting. If the Ent key is pressed, CuffLink displays

Storing DATA

to confirm that the new value for pop up window delay has been saved, then exits to the Util submenu. If the Esc key is pressed, CuffLink displays

No DATA stored

and will then exit to the Util submenu.

Logo

The Logo function draws the CuffLink logo display that appears during the initialization procedure that occurs at power-up.

The logo shows the CuffLink name, current software revision, time, and date.

To view the logo, move the cursor to the Logo option of the Util submenu. Press Ent to select and the logo will be displayed until the Esc key is pressed. The display will then return to the Util submenu.

No adjustments are possible in the Logo function.

System

This menu lists CuffLink's system tests. These are primarily functional self tests.

Use the arrow keys to move the cursor to the System option of the Util submenu. Press Ent to select, and the System submenu will be displayed.

The system tests for CuffLink are listed below.

Print Test

Key Test

Speaker Test

Display Test

Disp QC date

ROM Checksums

Config Init

Pump Test

Auscultatory Test

Print Test

The Print Test will verify that CuffLink is able to communicate with the connected printer system.

Connect the printer to the CuffLink printer port on the rear CuffLink panel and turn printer power on.

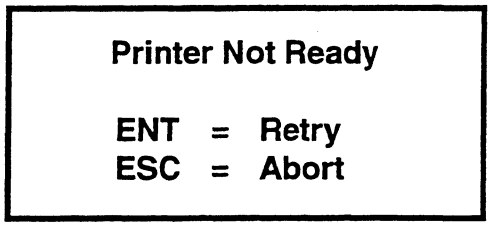
Move the cursor to the Print Test option and press Ent.

CuffLink will send a test string out the printer port to the printer. The printer should print

Printer test message

every time the CuffLink Ent key is pressed.

If this test is attempted without the printer connected properly, or if there is any type of fault anywhere in the printer system, including the cable, CuffLink will display



Press the Ent key to attempt repeating the print test or the Esc key to exit the print test.

Key Test

The Key Test verifies that the CuffLink front panel keyboard is functional.

Move the cursor to the Key Test option and press Ent. CuffLink will show the Key Test display.

Press each key on the CuffLink keyboard one at a time and you will see a description of each key after "Keyboard:". Press the Escape key 4 times to exit the keyboard test.

If CuffLink does not display the description of a key that has been pressed, refer the unit to the Dynatech Nevada Technical Service Department.

Speaker Test

The Speaker Test verifies speaker operation by activating it with signals of various frequencies. Adjustments of frequency (pitch of the sound) and period (length of sound) are also possible.

Move the cursor to the Speaker Test option of the System submenu and press Ent. The Speaker Test display will appear.

To exit the Speaker Test option, press Esc.

The various speaker tests and adjustments are defined as follows:

440 (F1):	Speaker will produce a 440 hertz, 500 millisecond tone when the F1 key is pressed.
Adjust Play (F2):	Speaker will produce a tone determined by the settings displayed by the Adjust Frequency and Adjust Period values (see below for description) shown in the center of the display. Press F2 to activate this function.
Adjust Freq (F3):	Pressing F3 moves the cursor to the Adjust Frequency value. When the cursor is at this position, the frequency of the Adjust Play tone may be modified. Use the up or down arrow keys to change the value. Holding either arrow key down will produce a rapid change in the frequency value. The left and right arrow keys have no effect on this function. Change the value of the frequency and press F2 (Adjust Play) to hear the difference in pitch of the tone. The value of the frequency and the pitch of the tone are directly related. As the value of the frequency increases, so does the pitch.

Adjust Period (F4): Pressing F4 moves the cursor to the Adjust Period value, which is displayed in milliseconds (ms). When the cursor is at this position, the length of the Adjust Play tone may be modified. Use the up or down arrow keys to change the value. Holding either arrow key down will produce a rapid change in the period value. The left and right arrow keys have no effect on this function.

Change the value of the period and press F2 (Adjust Play) to hear the difference in length of the tone. The value of the period and the length of the tone are directly related. As the value of the period increases, so does the length.

Sweep (F5): Pressing F5 causes the speaker to produce a long tone of various frequencies, starting with a low frequency (pitch), gradually increasing to a higher frequency, then back down again to where it began.

Display Test

The Display Test verifies the correct operation of the CuffLink liquid crystal display by writing (displaying) a series of test patterns to the display. Any sections of the display that are not functioning will become apparent during this test.

Select the Display Test by moving the cursor to Display Test and pressing Ent. CuffLink will show the Display Test display.

The Short Test lasts about 15 seconds and displays two patterns: the Text plane - Character test and the Graphic plane - Solid fill test.

The Text plane - Character test shows all the characters or symbols (character set) that CuffLink produces. This includes letters, numbers, and other assorted symbols.

The Graphic plane - Solid fill test will evaluate the display's graphic capabilities. The test fills the entire grid of 240 by 64 pixels (the tiny dark squares visible on the display during this test) with a dark blue color. This demonstrates that all the pixels may be activated correctly.

Press F1 to initiate the Short Test. CuffLink will perform the tests and display

Display test complete
Hit any key...

at the end of the test sequence. Pressing any key will return to the System submenu.

The Long Test requires about 1 minute, 10 seconds to perform display tests. The tests include both character and graphics tests similar to those seen in the Short Test.

Press F2 to initiate the Long Test. CuffLink will perform all the test patterns and display

Display test complete
Hit any key...

at the end of the test sequence. Pressing any key will return to the System submenu.

Disp QC Date

The Display QC (Quality Control) Date function indicates the date on which CuffLink was last calibrated or serviced by the factory. The date is programmed, by use of a special code, into CuffLink at the factory.

QC date information is useful for maintaining a regular calibration schedule.

Select Disp QC date from the Util System submenu by using the arrow and Ent keys. CuffLink will display

```
QC date:
Hit any key...
```

until any key is pressed. The Util System submenu will then reappear.

ROM Checksums

ROM (Read Only Memory) contains the software that operates CuffLink. It is located within an IC, or Integrated Circuit chip. This type of memory may be accessed, or "read" by the CuffLink microprocessor. Read Only Memory normally may never be written to or altered in any way. Information within ROM may occasionally become corrupted (modified) due to various reasons.

ROM Checksums performs an evaluation of the ROMs that have been installed into the CuffLink system to ensure that the integrity of the ROM is intact. A "checksum" is a mathematical sum of the "code" (bytes) in the software program installed in ROM. A hexadecimal value is then displayed which may then be verified by contacting the Dynatech Nevada technical support department.

ROM Checksums currently has the capability to test ROMs U2, U3, and U4, even though U2 and U3 are the only ROMs installed. Performing a checksum test on ROMs that have not yet been installed will result in an erroneous value.

To perform a ROM Checksums test, use the arrow and Ent keys to select the ROM Checksums option from the Util System submenu. The ROM Checksums display will appear.

This display shows the IC to test, the memory range (in hexadecimal) for the IC, and the calculated checksum value. The checksum values are at xxxx when the ROM Checksum display is brought up.

Select U2 by pressing F1. CuffLink will display

Calculating U2

for a short period of time while the checksum is taking place. A value will then be displayed for U2 (example: 3B29).

The Checksum value is going to change with every new CuffLink software revision, so verify this number with the factory.

Press Esc to exit the ROM Checksum test.

Config Init

This option reinstalls factory default values for Pop Time, Comm port, and autosequences.

Parameter	Value
Pop Time	1 second
Comm:	
Baud Rate	9600
Bits/Character	8
Parity	None
Stop Bits	1
Flow Control	Xon/Xoff

Default values for "Pop Time" and "Comm"

BP			HR	Cycles**				
				A1	A2	A3	A4	A5
60/30	(40)	Adult	40	1	2	3	4	5
80/50	(62)	Adult	60	1	2	3	4	5
100/65	(75)	Adult	80	1	2	3	4	5
120/80	(90)	Adult	80	1	2	3	4	5
150/100	(115)	Adult	120	1	2	3	4	5
200/150	(165)	Adult	160	1	2	3	4	5
255/195	(215)	Adult	200	1	2	3	4	5
120/80	(80)	Adult	80	1	2	3	4	5
Utilities								
Pressure Test		YES						
Leak Test		YES						
Pop Off Test		YES						
Print BP Results		YES						

CuffLink autosequence defaults

*** "Cycles" refer to the number of times CuffLink simulates a target value.*

From "Util" on CuffLink's main menu, select "System" then highlight "Config Init". If you want to restore default values, press "Enter". If you decide not to reset CuffLink, press "Escape" and CuffLink will return to "System Utilities".

Auscultatory Test

The Auscultatory Test determines that the auscultatory PCB is working correctly. Press Esc to exit the Auscultatory Tests.

Init Ausc (F1):	Initializes the auscultatory PCB and microprocessor.
Set Ausc (F2):	Sends current data for pulse, curve, gain, shift, and microphone.
Puck Test (F3):	Sends the maximum signal to the auscultatory mandrel puck.
Mic Stim (F4):	Sends maximum signal to the auscultatory microphone output.
DA Test (F5):	Generates test waveforms that evaluate the digital to analog (DA) converter circuitry on the auscultatory PCB.

Comm

The communications menu has the following choices:

1. **Configure:** Modifies RS-232 configuration.
2. **Comm Test:** Tests CuffLinks RS-232 port and connections to your computer.

Configuring CuffLink's RS-232 Communications

1. Select configure from the Comm menu and press Ent.
2. Press the Left and Right arrow keys to select your choice, and use the Up and Down arrow keys to modify the value.
3. Press Ent to save your new data and Esc to exit. If you press Esc before you save your data, CuffLink cancels any modifications you have made.

CuffLink RS-232 Settings

Baud Rate	300
	600
	1200
	2400
	4800
	9600
Bits/Character	7
	8
Parity Mode	Even
	Odd
	None
Stop Bits	1
	2
Flow Control	Xon/Xoff
	RTS/CTS
	None

Testing CuffLink Communications

1. Select Comm Test from the Comm menu and press Ent.
2. At the top of the screen are the current settings you specified for CuffLink's RS-232 port (see "Configuring CuffLink's RS-232 Communications").
3. Press F2 to transmit "CuffLink Test" to whatever you are using as your controller. The phrase "CuffLink Test" should appear on the controller's monitor.
4. Press F4 to clear the receive box on CuffLink's display. When you send CuffLink data from the controller the information should appear in the receive box.
5. Press Esc to exit.

Auto

You can choose from the adult, neonate, arrhythmias, or auscultatory in any combination.You can select up to 8 different blood pressures for each in addition to heart rate and cycle count (number of times CuffLink simulates a specific blood pressure–anywhere from 1 to 99).

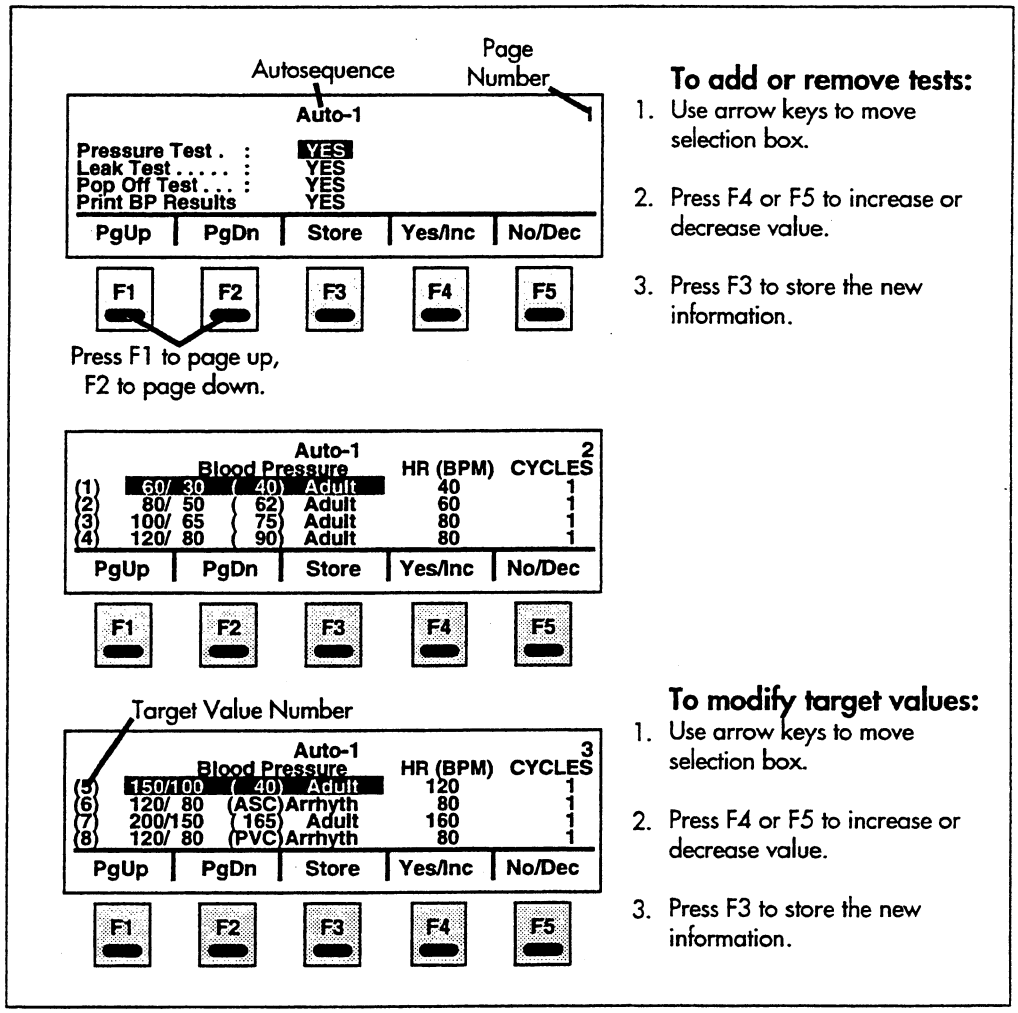
Autosequence Utilities

Use these utilities to edit, view, name, or print autosequences. From CuffLink's main menu under "Auto", select "Utility" and press "Enter" to get the "Autosequence Utilities" menu. Highlight a utility with the arrow keys then choose an autosequence by pressing a function key.

Edit

Use this utility to modify the content of an autosequence. CuffLink is shipped with its autosequences configured by the factory. Highlight "Edit" and select an autosequence with the function keys.

The following illustration shows the three pages CuffLink has for autosequence editing.



CuffLink autosequence "Edit" displays

View

If you want to see the current configuration of an autosequence, use the view utility. These displays allow you only to view the settings. To change them, see the "Edit" section.

Press F1 or F2 to page between the displays and "Escape" to quit.

Name

Use this utility to change the 8 character name of an autosequence. After you highlight "Name" and select an autosequence, a box with the current autosequence name appears. Press the left and right arrow keys to move the blinking cursor to the character you want to change, then use the up and down arrow keys to scroll through the choices. Press "Enter" when you are finished, and the new autosequence name will appear above the function key. If you decide not to save the changes you have made, simply press "Escape".

Print

Use this utility to print the content of the autosequence you select. Highlight the "Print" selection with the arrow keys and choose an autosequence. For example, to print the content of autosequence #3 (AUTO-3), highlight "Print" and press F3. CuffLink displays a "Printing Autosequence" message until the document has printed.

```
                              AUTO-3


                 CuffLink Auto Sequence Test Procedure



04/13/93


Pressure Test ......YES
Leak Test ..........YES
Pop Off Test .......YES
Print Results ......YES


    Blood Pressure          Heart Rate (BPM)        Cycles
---------------------      -----------------       ------
  80/ 50( 62) Adult               40                  3
 100/ 65( 75) Adult               60                  3
 120/ 80( 90) Adult               80                  3
 200/150(165) Adult              120                  3
-------- Off  -------           120                  3
-------- Off  -------           160                  3
-------- Off  -------           200                  3
-------- Off  -------            80                  3
```

Sample printout of CuffLink autosequence content

Init

Use this utility when you want to reset an autosequence to factory default values.

BP			HR	Cycles**				
				A1	A2	A3	A4	A5
60/30	(40)	Adult	40	1	2	3	4	5
80/50	(62)	Adult	60	1	2	3	4	5
100/65	(75)	Adult	80	1	2	3	4	5
120/80	(90)	Adult	80	1	2	3	4	5
150/100	(115)	Adult	120	1	2	3	4	5
200/150	(165)	Adult	160	1	2	3	4	5
255/195	(215)	Adult	200	1	2	3	4	5
120/80	(80)	Adult	80	1	2	3	4	5
Utilities								
Pressure Test		YES						
Leak Test		YES						
Pop Off Test		YES						
Print BP Results		YES						

CuffLink autosequence defaults

***Cycles = number of times CuffLink simulates a blood pressure.*

Print All

Use this utility to print content of all the autosequences. Highlight "Print All" and press "Enter". CuffLink responds with "Printing all Autosequences" while your documents are printing.

Init All

Use this utility to reset all of CuffLink's autosequences to factory defaults. Highlight Init All and press "Enter". CuffLink will warn you that all the autosequences are about to be reset and you can press either "Enter" to reset them all, or Escape and return to the Autosequence Utilities menu. Refer to section on "Init" for a list of autosequence defaults.

Executing Autosequences

From the main menu under "Auto", highlight "Execute" and press "Enter". Start the autosequence you want by pressing the function key below the autosequence name. If you have a pressure test, leak test, or pop off test in the autosequence, you will have to press a CuffLink function key (F4) when these tests are done to advance the autosequence. CuffLink then completes the blood pressure simulations of the autosequence automatically. If you have configured the autosequence to print, it will do so when the cuff deflates after the last blood pressure test, otherwise CuffLink returns to the "Execute Autosequence" display.

Note: If you configure an autosequence to print and try to run it before you have a printer properly connected to CuffLink, you will get a "Printer Not Ready" message. If you don't want a printout of the sequence, go to "Edit" and make sure the "Print BP Results" line says "NO" (see the "Edit" section under "Autosequence Utilities").

Chapter 4

Remote Commands

Remote Commands

You can use two operating modes–local or remote–to control CuffLink. When you turn CuffLink on, it powers up in the local mode. This means that the CuffLink keyboard is enabled and CuffLink is able to understand information you give it from its front panel. The remote mode allows you to communicate with CuffLink using a serial controller (a computer with an RS-232 port or a medTester with medCheck). Connect CuffLink to the controller with a null modem cable (available from Dynatech, part number 3010-0250). As soon as CuffLink receives a remote command from a controller it goes into the remote mode and will only recognize commands from that controller. The CuffLink keyboard will be completely disabled during remote operation (except during some procedures in which you will need to use the "Escape" or function keys). To return CuffLink to the local mode, use the GOTOLOCAL command. Program examples are at the end of this chapter.

There are two types of commands associated with CuffLink; some instruct CuffLink to simply perform a procedure, and others cause CuffLink to perform a procedure and send test results (data) back to the controlling device. If the command instructs CuffLink to do a procedure that generates no data–such as drawing a pressure envelope–CuffLink completes the procedure, then sends an asterisk (*) to the controller. When you see an asterisk on the controller's display, you know that CuffLink has received, understood, and carried out a command.

The following sections on "Remote Commands" include instructions on writing commands, an error message list, a section of detailed command descriptions, and examples of how you can use CuffLink commands in a computer program.

Setting Up the medTester

Before CuffLink can communicate with a medTester, you have to configure the medTester using the following values.

medTester RS-232	Setting
Com1	Off
Com2	On (connect null modem cable from CuffLink to Com2)
Baud Rate	9600
Stop bits	1
Parity	Off
CTS	Off

Remote Command Syntax

You can use either a computer or a medTester with medCheck to control CuffLink. For both controllers you start remote commands with a command verb and add optional parameters (values that further define the remote command). In addition, the remote commands are not case sensitive. This means that you can use either upper or lower case letters anywhere in the command and CuffLink will understand it.

The differences in syntax for each controller is explained below (n represents the parameter value).

Command Syntax for medTester

When you control CuffLink with a medTester, separate the command verb from the parameter list with a colon and separate each parameter with a semicolon. Do not put spaces anywhere in the command line.

CommandVerb:parameter=n;parameter=n

Example: makearm:hr=60,envshift=50

Command Syntax for Computer

When you control CuffLink with a computer, separate the command verb from the parameter list with a space or a colon. Separate the parameters with a comma or semicolon.

CommandVerb parameter=n,parameter=n

Example: makearm hr=60,envshift=50

or

CommandVerb:parameter=n;parameter=n

Example: makearm:hr=60;envshift=50

Command Parameters

Command parameters are values you can specify to further define remote commands. For example, you can specify different heart rates for the "makearm" command.

If you do not specify any command parameters, CuffLink uses current values. Current values are either the default values or the values you used in a previous command.

Parameters for each command are described in the "Command Descriptions" section later in this chapter.

Default Values

Default values are reassigned to all remote commands each time you turn CuffLink on. CuffLink uses default values for the first command you give it if you do not specify any parameters. For example, the command "makearm" has no parameters defining it, so CuffLink will use default values. However, "makearm:hr=30" has a parameter that sets the heart rate at 30 BPM instead of the 80 BPM default value.

You can also use the RESET command to set values to default (see "Command Descriptions").

The following shows how CuffLink retains current parameter values until you assign new values:

1. Enter the command makearm:bp=adams-150/100.

   Simulates blood pressure of 150/100. CuffLink uses default values for all other parameters.

2. Enter the command makearm.

   Blood pressure is still set at 150/100 from the previous command.

3. Enter the command makearm:bp=adams-80/50.

   A new blood pressure of 80/50 replaces the blood pressure of 150/100.

4. Enter the command reset.

   CuffLink is reset to default values. All succeeding commands will have parameters set to default until other values are specified.

Terminating Characters

When you write programs to control CuffLink, a terminating character must be placed after the command line so that CuffLink knows where the end of the command line is.

Terminate commands with any of the following characters.

CR	Carriage Return
LF	Line Feed
CR LF	Carriage Return and Line Feed
LF CR	Line Feed and Carriage Return

If CuffLink receives a terminating character that is not preceded by a remote command, it sends a question mark (?) back to the controller. You can use this feature to do a communication check and verify that CuffLink is properly connected to the controller. After sending the terminating character to CuffLink, wait five seconds for CuffLink to send a "?" back to the controller. If, after the third time, a question mark does not appear on the controller's display, assume that CuffLink is not correctly connected to the controller, a cable wiring error exists, or the setup (baud rate, parity, etc.) is wrong.

Once you have selected a terminating character, you should use the same one to terminate all commands. For example, do not start writing a program using LF as the terminating character and then switch to CR. If you start with LF, use it throughout the entire program.

Error Messages

CuffLink evaluates all remote commands for validity. If a command generates an error, CuffLink will display an error message.

Error #	Description
0	* - Successful command
1	Illegal parameter
2	Unknown command
3	Missing parameter(s)
4	Illegal beep frequency
5	Illegal beep period
6	Illegal time string, must be 22 chars
7	Parallel printer fault
8	Illegal ROM number
9	General failure
10	Illegal heart rate
11	Illegal pulse ID number
12	Pulse width exceeds heart rate period
13	Pulse amplitude too high
14	Pulse amplitude too low
15	Illegal motion command
16	Maximum motor velocity exceeded
17	Pressure engine motion fault
18	Illegal motor direction
19	Illegal motor step count
20	Illegal blood pressure
21	Pressure envelope gain too high
22	Pressure envelope gain too low
23	Pressure envelope shift too high
24	Pressure envelope shift too low
25	Target pressure too high
26	Target pressure too low
27	Illegal cal memory type
28	Illegal cal gain value
29	Illegal microphone value
30	Illegal Pop Time
31	Illegal display test number
32	Illegal peak divide ratio

Command Descriptions

This alphabetized section contains detailed descriptions of CuffLink's remote commands.

Examples for each command show exactly how you would type the command, the results, and the data CuffLink returns to the controller as it appears on the controller's display.

Commands in the "Examples" sections were written in command syntax for computers. For information on medTester syntax, refer to "Command Syntax for medTester".

Important!–Except for asterisks, the "Returned Data" listed in the following examples will be different depending on your CuffLink, and the parameter values you assign to the command. So don't panic if you get values different from those shown in the examples.

AUSC_MIC

Use this command to set the auscultatory option microphone. If you do not have the Auscultatory Option installed in your CuffLink you will get an error message when using this command.

Parameter	Definition	Range	Default
MIC	Microphone Test Setting	0 = Normal Mandrel 1 = Normal Mic 2 = Reversed Mic 3 = Low Signal Mic	Normal Mandrel (0)

AUSC_MIC command parameters

Example

Set the auscultatory microphone to "Reversed Mic".

Command: ausc_mic mic=2

Results: CuffLink simulates a reversed microphone condition.

Returned Data: *

AUSCPUCKTEST

Use this command to perform a mic test. CuffLink makes one auscultatory mandrel pulse at maximum amplitude. If you do not have the Auscultatory Option installed in your CuffLink you will get an error message when using this command.

Example

Perform an auscultatory puck test.

Command: auscpucktest

Results: CuffLink moves auscultatory puck one maximum pulse.

Returned Data: * (Not displayed)

AUSCPCB

Use this command to determine if the CuffLink you are using has the Auscultatory Option board installed in it.

Example

Find out if CuffLink has the Auscultatory Option.

Command:	auscpcb
Results:	CuffLink scans for the Auscultatory Option.
Returned Data:	Ausc PCB installed
or	Ausc PCB not installed

BEEP

Use this command to test CuffLink's speaker. You can modify the frequency (pitch) and period (length of the beep). Since the speaker will be more difficult for you to hear at very low and very high frequencies, be sure the "Beeper Volume" control on the front panel is loud enough.

Parameter	Definition	Range	Default
FREQ	Frequency (Hertz)	76 to 10,000 Hz	440 Hz
PERIOD	Period (milliseconds)	50 to 32,000 ms	500 ms

BEEP command parameters

Examples

1. Beep the speaker using CuffLink's default values.

   Command: beep

   Results: A 440 Hz tone sounds for 500 milliseconds.

   Returned Data: *

2. Beep the speaker at a frequency of 300 Hz for 800 milliseconds.

   Command: beep freq=300,period=800

   Results: A 300 Hz tone sounds for 800 ms (this is lower and longer than the default beep).

   Returned Data: *

CALPUCKPOS

Use this command to calibrate puck position. This procedure positions the puck at a known location or reference point from which subsequent puck movement is calculated. During this procedure, CuffLink moves the puck in a downward direction until it extends to its full range of movement (to the chamber bottom). Then the puck moves up and stops as soon as it is detected by an opto sensor. CuffLink records the number of motor steps necessary to move the puck this distance and stores the number in EEROM.

There are no parameters for this command.

Example

Calibrate the puck position.

Command:	calpuckpos
Results:	CuffLink calibrates the puck. Returned data is the value CuffLink stores in EEROM.
Returned Data:	5681

The "Returned Data" for this command will vary for each CuffLink.

DEFLATE

Use this command to release all pressure inside CuffLink.

There are no parameters for this command.

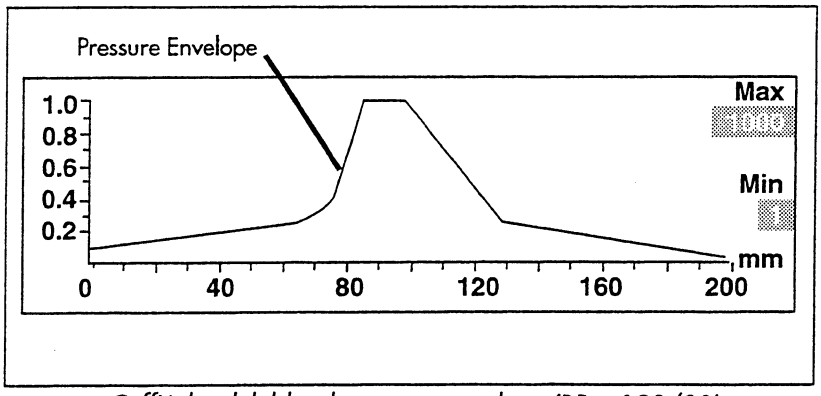
Example

Eliminate the pressure inside CuffLink.

Command:	deflate
Results:	CuffLink releases pressure.
Returned Data:	*

DRAWENV

Use this command to draw an "ADAMS Adult" pressure envelope on CuffLink's display. You can modify envelope gain, shift and pulse width.



CuffLink adult blood pressure envelope (BP = 120/80)

Parameter	Definition	Range	Default	Description
HR	Heart Rate (Beats/Minute)	30 BPM to 240 BPM in 1 BPM Steps	80 BPM	1 BPM resolution
BP	Blood Pressure (mmHg)	ADAMS-60/30 ADAMS-80/50 ADAMS-100/65 ADAMS-120/80 ADAMS-150/100 ADAMS-200/150 ADAMS-255/195	ADAMS-120/80	
PULSEID	Pulse Identification (milliseconds)	ID # WIDTH 0 800 ms 1 500 ms 2 250 ms 3 720 ms 4 230 ms 5 280 ms 6 350 ms 7 480 ms 8 980 ms 9 1980 ms 10 1480 ms	ID #3 (720 ms)	Pulse width affects the rise time of pulse
ENVGAIN	Pressure Envelope Gain	1 to 200% (10 to 2000 RVDUs)	100% is typical value for adult cuffs	Affects pulse strength or amplitude
ENVSHIFT	Pressure Envelope Shift	-100 to +100 mmHg	0 mmHg	Modifies existing pressure envelope to simulate another BP. Example: a +10 mmhg shift will cause 120/80 to read 130/90 on most monitors.

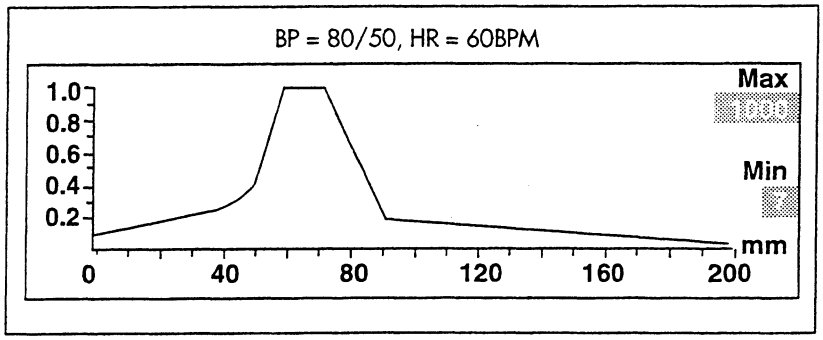
DRAWENV command parameters

Examples

1. Draw a pressure envelope showing a BP of 80/50 with a heart rate of 60 BPM.

   Command: drawenv hr=60,bp=adams-80/50

   Results: The specified pressure envelope is drawn on CuffLink's display.

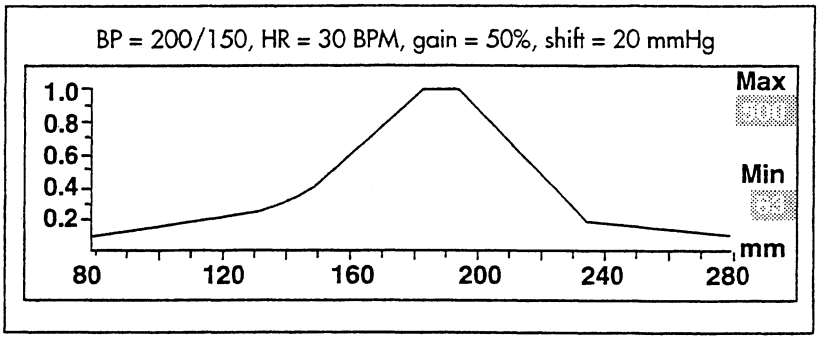


   Returned Data: *

2. Draw a pressure envelope with a heart rate of 30 BPM, a blood pressure of 200/150, a 50% gain, and a shift of 20 mmHg.

   Command: drawenv hr=30,bp=adams-200/150,envgain=50,envshift=20

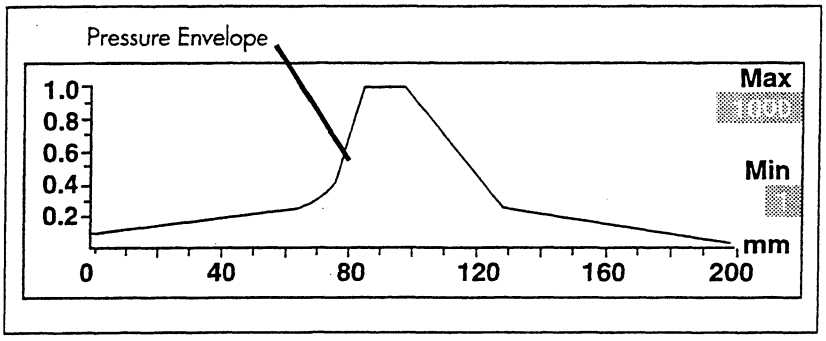
   Results: The specified pressure envelope is drawn on CuffLink's display.



   Returned Data: *

DRAWENVNEO

Use this command to draw an "ADAMS Neonate" pressure envelope on CuffLink's display. You can modify envelope gain, shift and pulse width.



CuffLink neonate blood pressure envelope (BP = 120/80)

Parameter	Definition	Range	Default	Description
HR	Heart Rate (Beats/Minute)	30 BPM to 240 BPM in 1 BPM Steps	80 BPM	1 BPM resolution
BP	Blood Pressure (mmHg)	ADAMSNEO-60/30 ADAMSNEO-80/50 ADAMSNEO-100/65 ADAMSNEO-120/80 ADAMSNEO-150/100	ADAMSNEO-120/80	
PULSEID	Pulse Identification (milliseconds)	ID # WIDTH 0 800 ms 1 500 ms 2 250 ms 3 720 ms 4 230 ms 5 280 ms 6 350 ms 7 480 ms 8 980 ms 9 1980 ms 10 1480 ms	ID #3 (720 ms)	Pulse width affects the rise time of pulse
ENVGAIN	Pressure Envelope Gain	1 to 200% (10 to 2000 RVDUs)	100% is typical value for neonate cuffs	Affects pulse strength or amplitude
ENVSHIFT	Pressure Envelope Shift	-100 to +100 mmHg	0 mmHg	Modifies existing pressure envelope to simulate another BP. Example: a +10 mmhg shift will cause 120/80 to read 130/90 on most monitors.

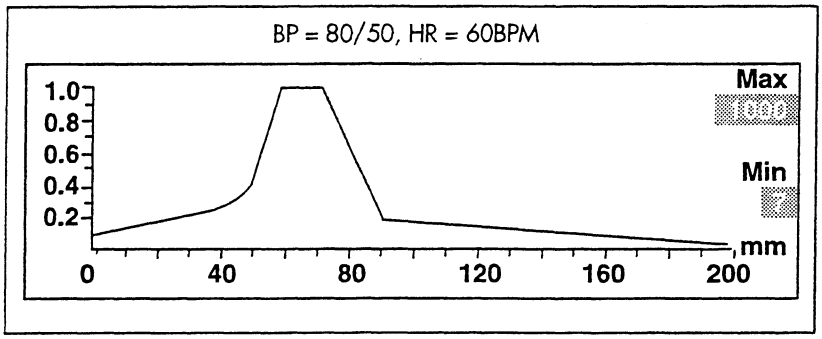
DRAWENVNEO command parameters

Examples

1. Draw a neonatal pressure envelope with a BP of 80/50 with a heart rate of 60 BPM.

   Command: drawenvneo hr=60,bp=adamsneo-80/50

   Results: Specified pressure envelope is drawn on CuffLink's display.

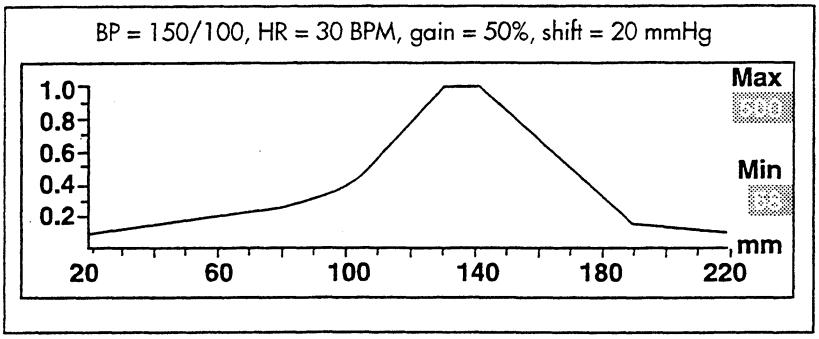


   Returned Data: *

2. Draw a neonatal pressure envelope with a heart rate of 30 BPM, a blood pressure of 150/100, a 50% gain, and a shift of 20 mmHg.

   Command: drawenvneo hr=30,bp=adamsneo-150/100, envgain=50,envshift=20

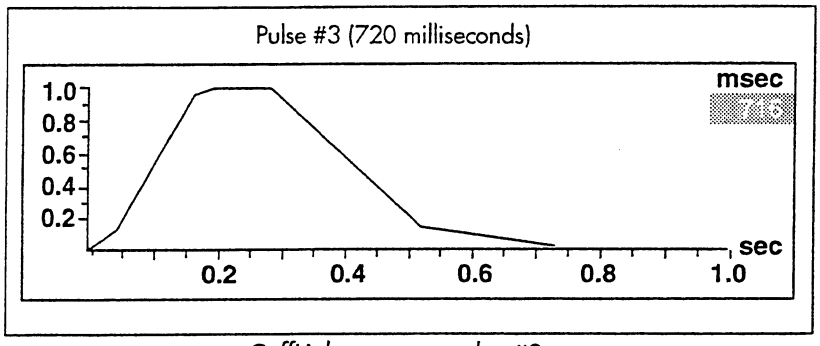
   Results: Specified pressure envelope is drawn on CuffLink display.



   Returned Data: *

DRAWPULSE

Use this command to draw an individual pressure pulse (the CuffLink pressure envelope is comprised of many individual pressure pulses). You can specify different pulse widths for this command.



CuffLink pressure pulse #3

Parameter	Definition	Range	Default	Description
PULSEID	Pulse Identification (milliseconds)	ID # WIDTH 0 800 ms 1 500 ms 2 250 ms 3 720 ms 4 230 ms 5 280 ms 6 350 ms 7 480 ms 8 980 ms 9 1980 ms 10 1480 ms	ID #3 (720 ms)	Pulse width affects the rise time of pulse

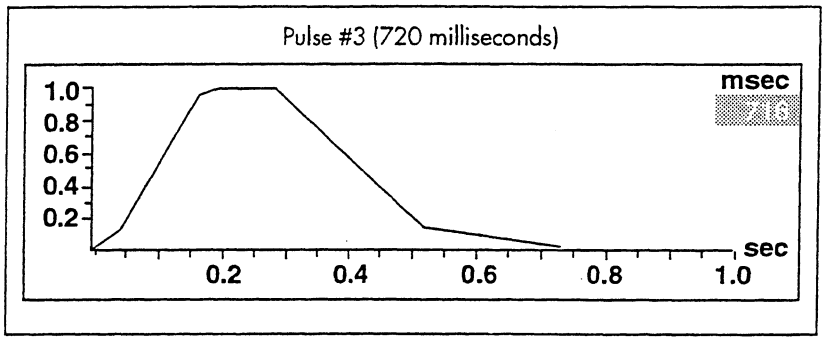
DRAWPULSE command parameters

Examples

1. Draw a 720 millisecond wide pressure pulse.

   Command: drawpulse

   Results: CuffLink draws a 720 millisecond wide pressure pulse (default value).

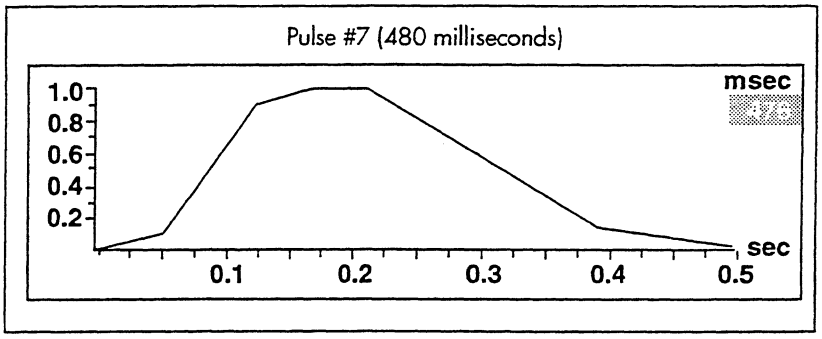


   Returned Data: *

2. Draw a 480 millisecond wide pressure pulse (pulse number 7).

   Command: drawpulse pulseid=7

   Results: The specified pressure pulse is drawn on the CuffLink display.



   Returned Data: *

GLOBALINIT

Use this command (there are no parameters) to reset CuffLink to factory defaults.

BP			HR	Cycles**				
				A1	A2	A3	A4	A5
60/30	(40)	Adult	40	1	2	3	4	5
80/50	(62)	Adult	60	1	2	3	4	5
100/65	(75)	Adult	80	1	2	3	4	5
120/80	(90)	Adult	80	1	2	3	4	5
150/100	(115)	Adult	120	1	2	3	4	5
200/150	(165)	Adult	160	1	2	3	4	5
255/195	(215)	Adult	200	1	2	3	4	5
120/80	(80)	Adult	80	1	2	3	4	5
Utilities								
Pressure Test		YES						
Leak Test		YES						
Pop Off Test		YES						
Print BP Results		YES						

CuffLink autosequence defaults

***"Cycles" refer to the number of times CuffLink simulates a target value.*

Parameter	Value
Pop Time	1 second
Comm:	
Baud Rate	9600
Bits/Character	8
Parity	None
Stop Bits	1
Flow Control	Xon/Xoff

Default values for "Pop Time" and "Comm"

Example

Do a global initialization.

Command: globalinit

Results: All user modifications for Pop Time, RS-232 port, and autosequences are reset to factory defaults.

Returned Data: *

GOTOLOCAL

Use this command to switch control of CuffLink from a serial controller to the CuffLink keyboard.

There are no parameters for this command.

Example

Return CuffLink control to its front panel.

Command:	gotolocal
Results:	The CuffLink logo display appears and CuffLink returns to the local mode. The front panel keyboard is now active.
Returned Data:	*

IDENT

Use this command to show the CuffLink name and firmware version on the controller's display.

There are no parameters for this command.

Example

Identify CuffLink and firmware version.

Command:	ident
Returned Data:	CuffLink, 3.00, Ausc, Pump

The "Returned Data" for this command will vary for each CuffLink, depending on the installed firmware and options.

INFLATE

Use this command to pump up the pressure inside CuffLink.

Parameter	Definition	Range	Default
PRESSURE	Pressure (mmHg)	0 to 499.75 mmHg	200 mmHg

INFLATE command parameters

Examples

1. Pump CuffLink pressure up to 275 mmHg.

   Command: inflate pressure=275

   Results: CuffLink's internal pump increases pressure to 275 mmHg.

   Returned Data: *

2. Pump CuffLink pressure up to 200 mmHg.

   Command: inflate

   Results: CuffLink's internal pump increases pressure to the default value of 200 mmHg.

   Returned Data: *

INITAUSC

Use this command to initialize the Auscultatory Option after you have it installed. CuffLink will search for the installed auscultatory PCB and, if installed, sets a flag in the software that allows you to use the Auscultatory Option.

There are no parameters for this command.

Example

Initialize the auscultatory PCB.

Command:	initausc
Results:	CuffLink initializes the auscultatory PCB.
Returned Data:	*

KEYTEST

Use this command to test CuffLink's keyboard.

There are no parameters for this command.

Example

Test the keyboard

Command:	keytest
Results:	CuffLink echoes the key you press. To exit the keytest, press Esc four times.
Returned Data:	F1

LEAKTEST

Use this command to put CuffLink in the leak test mode. The keys on CuffLink's front panel will become active during this test so you can zero pressure, perform the leak test, do a reset, or print the test results. To exit the leak test mode, simply issue CuffLink another remote command.

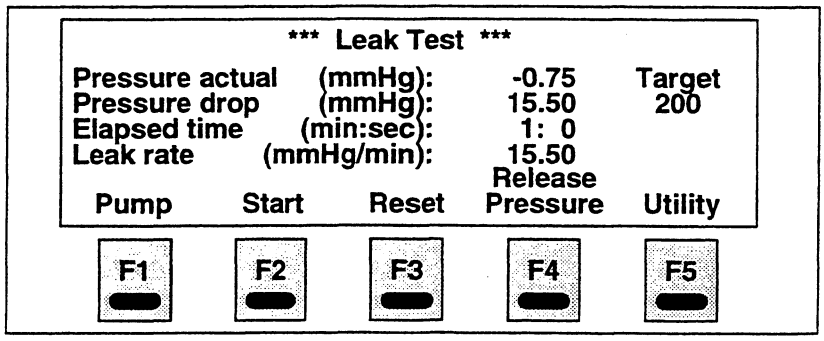
There are no parameters for this command.

Example

Enter the CuffLink leak test mode.

Command: leaktest

Results: CuffLink enters the leak test mode and shows the "Leak Test" display. Press F1 on the CuffLink keyboard to begin the leak test. CuffLink will run the leak test for 1 minute, then display the leak rate in mmHg per minute.



Returned Data: *

MAKEARM

Use this command to simulate blood pressures from the "ADAMS Adult Family" target values. You can change heart rate, BP, and pressure envelope gain and shift.

Parameter	Definition	Range	Default	Description
HR	Heart Rate (Beats/Minute)	30 BPM to 240 BPM in 1 BPM Steps	80 BPM	1 BPM resolution
BP	Blood Pressure (mmHg)	ADAMS-60/30 ADAMS-80/50 ADAMS-100/65 ADAMS-120/80 ADAMS-150/100 ADAMS-200/150 ADAMS-255/195	ADAMS-120/80	
PULSEID	Pulse Identification (milliseconds)	ID # WIDTH 0 800 ms 1 500 ms 2 250 ms 3 720 ms 4 230 ms 5 280 ms 6 350 ms 7 480 ms 8 980 ms 9 1980 ms 10 1480 ms	ID #3 (720 ms)	Pulse width affects the rise time of pulse
ENVGAIN	Pressure Envelope Gain	1 to 200% (10 to 2000 RVDUs)	100% is typical value for adult cuffs	Affects pulse strength or amplitude
ENVSHIFT	Pressure Envelope Shift	-100 to +100 mmHg	0 mmHg	Modifies existing pressure envelope to simulate another BP. Example: a +10 mmhg shift will cause 120/80 to read 130/90 on most monitors.

MAKEARM command parameters

Make all necessary connections from CuffLink to the NIBP monitor before you send a "makearm" command to CuffLink. When CuffLink receives the "makearm" command, it displays a graph where the pressure envelope will be drawn. Start the NIBP monitor and CuffLink will begin BP simulation and draw the pressure envelope. Peak pressure, deflate time, deflate rate, inflate time, inflate rate and total time are displayed on the computer monitor when the blood pressure cycle is complete. The NIBP monitor can run as many times as needed or until you issue a new command to CuffLink.

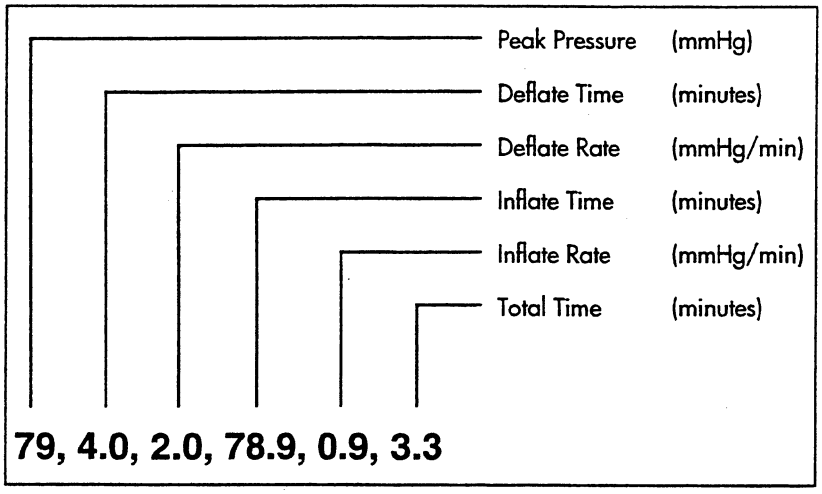
Returned Data

CuffLink sends the "makearm" data (format shown below) to the computer in six different fields separated by commas. If the data is positive it is preceded by a space and if the data is negative it is preceded by a minus sign (-).

Data	Field Number	Field Length	Field Content
peak pressure	1	4 characters	*[sign n n n]*
deflate time	2	6 characters	*[sign n n n .n]*
deflate rate	3	6 characters	*[sign n n n .n]*
inflate time	4	6 characters	*[sign n n n .n]*
inflate rate	5	6 characters	*[sign n n n .n]*
total time	6	6 characters	*[sign n n n .n]*

Returned data format

A sample data string as it might appear on the controller display is explained below.



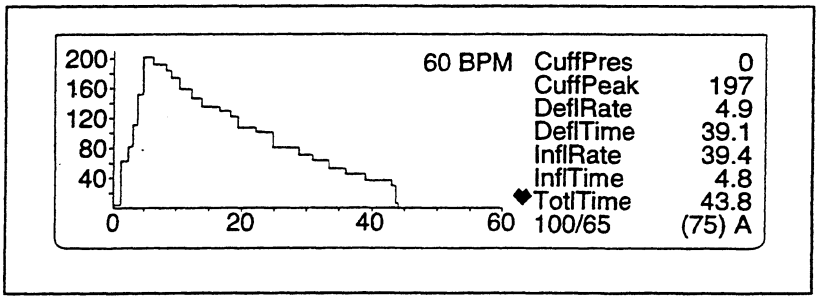
This is a data string of positive values. The peak pressure of 79 mmHg is in field 1 and the total time of 3.3 minutes is in field 6.

Examples

1. Simulate a blood pressure of 100/65 with a heart rate of 60 BPM.

   Command: makearm bp=adams-100/65,hr=60

   Results: CuffLink draws the "makearm" graph and begins arm simulation when the NIBP monitor starts inflating the cuff. Test results are sent to the controller when the cuff deflates.



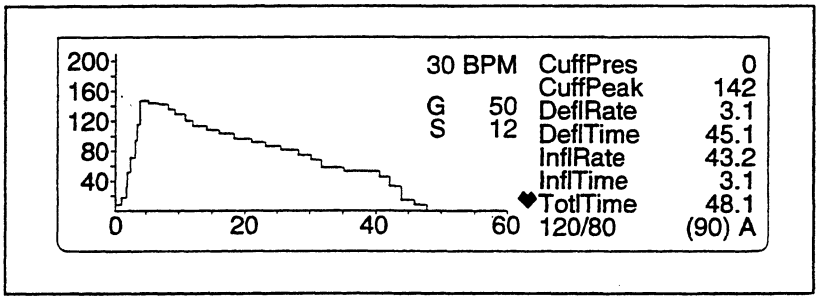
   Returned Data: 197, 4.9, 39.1, 39.4, 4.8, 43.8

The "Returned Data" for this command will vary depending on parameter values.

2. Simulate a blood pressure of 120/80 with a heart rate of 30 BPM, a gain of 50%, and a shift of 12 mmHg.

   Command: makearm bp=adams-120/80,hr=30, envgain=50,envshift=12

   Results: CuffLink draws the "makearm" graph and begins arm simulation when the NIBP monitor starts inflating the cuff. Test results are sent to the controller when the cuff deflates.



   Returned Data: 142, 3.1, 45.1, 43.2, 3.1, 48.1

The "Returned Data" for this command will vary depending on parameter values.

MAKEARMAUS

Use this command to simulate blood pressures from the "Auscultatory" target values. You can change heart rate, BP, microphone setting, pulse width and pressure envelope gain and shift.

Parameter	Definition	Range	Default	Description
HR	Heart Rate (Beats/Minute)	30 BPM to 240 BPM in 1 BPM Steps	80 BPM	1 BPM resolution
BP	Blood Pressure (mmHg)	AUSC-60/30 AUSC-80/50 AUSC-100/65 AUSC-120/80 AUSC-150/100 AUSC-200/150 AUSC-255/195	AUSC-120/80	
PULSEID	Pulse Identification (milliseconds)	ID # WIDTH 0 800 ms 1 500 ms 2 250 ms 3 720 ms 4 230 ms 5 280 ms 6 350 ms 7 480 ms 8 980 ms 9 1980 ms 10 1480 ms	ID #3 (720 ms)	Pulse width affects the rise time of pulse
ENVGAIN	Pressure Envelope Gain	1 to 200% (10 to 2000 RVDUs)	100% typical value for adult cuffs	Affects pulse strength or amplitude
ENVSHIFT	Pressure Envelope Shift	-100 to +100 mmHg	0 mmHg	Modifies existing pressure envelope to simulate another BP. Example: a +10 mmhg shift will cause 120/80 to read 130/90 on most monitors.
MIC	Microphone test setting	0 = Normal Mandrel 1 = Normal Mic 2 = Reversed Mic 3 = Low Signal Mic	Normal Mandrel (0)	Bypasses cuff and directly manipulates NIBP monitor

MAKEARMAUS command parameters

Make all necessary connections from CuffLink to the NIBP monitor before you send a "makearmaus" command to CuffLink. When CuffLink receives the "makearmaus" command, it displays a graph where the pressure envelope will be drawn. Start the NIBP monitor and CuffLink will begin BP simulation and draw the pressure envelope. Peak pressure, deflate time, deflate rate, inflate time, inflate rate and total time are displayed on the computer monitor when the blood pressure cycle is complete. The NIBP monitor can run as many times as needed or until you issue a new command to CuffLink.

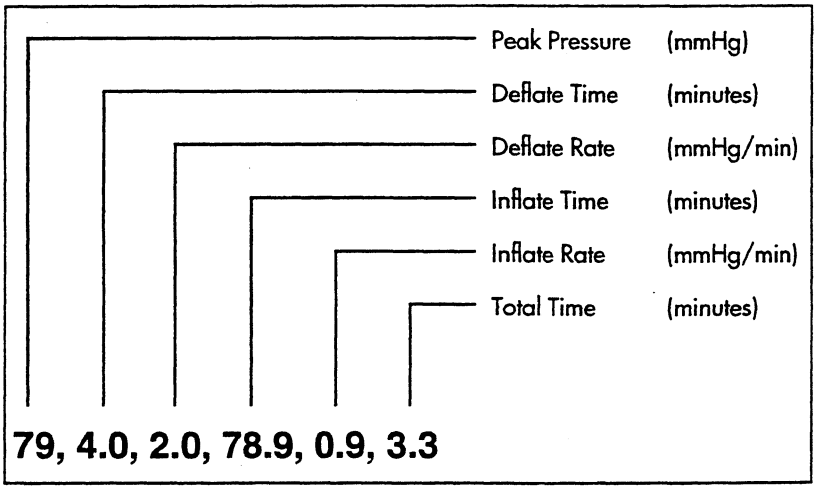
Returned Data

CuffLink sends the "makearmaus" data (format shown below) to the computer in six different fields separated by commas. If the data is positive it is preceded by a space and if the data is negative it is preceded by a minus sign (-).

Data	Field Number	Field Length	Field Content
peak pressure	1	4 characters	*[sign n n n]*
deflate time	2	6 characters	*[sign n n n .n]*
deflate rate	3	6 characters	*[sign n n n .n]*
inflate time	4	6 characters	*[sign n n n .n]*
inflate rate	5	6 characters	*[sign n n n .n]*
total time	6	6 characters	*[sign n n n .n]*

Returned data format

A sample data string as it might appear on the controller display is explained below.



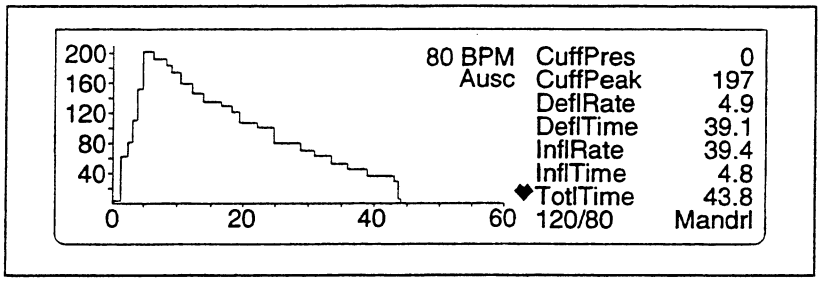
This is a data string of positive values. The peak pressure of 79 mmHg is in field 1 and the total time of 3.3 minutes is in field 6.

Examples

1. Simulate an auscultatory blood pressure of 100/65 with a heart rate of 60 BPM.

   Command: makearmaus bp=adams-100/65,hr=60

   Results: CuffLink draws the "makearmaus" graph and begins arm simulation when the NIBP monitor starts inflating the cuff. Test results are sent to the controller when the cuff deflates.



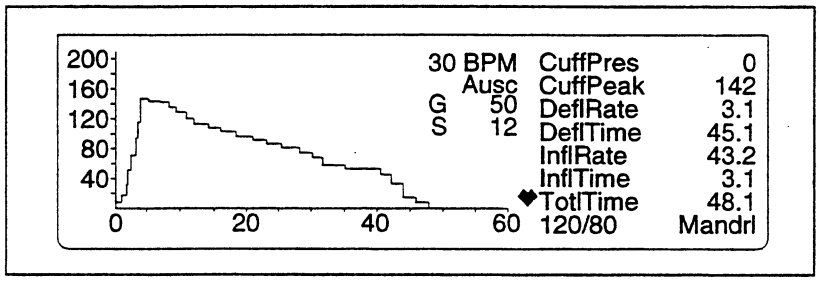
   Returned Data: 197, 4.9, 39.1, 39.4, 4.8, 43.8

The "Returned Data" for this command will vary depending on parameter values.

2. Simulate a blood pressure of 120/80 with a heart rate of 30 BPM, a gain of 50%, and a shift of 12 mmHg.

   Command: makearmaus bp=adams-120/80,hr=30, envgain=50,envshift=12

   Results: CuffLink draws the "makearmaus" graph and begins arm simulation when the NIBP monitor starts inflating the cuff. Test results are sent to the controller when the cuff deflates.



   Returned Data: 142, 3.1, 45.1, 43.2, 3.1, 48.1

The "Returned Data" for this command will vary depending on parameter values.

MAKEARMNEO

Use this command to simulate blood pressures from the "ADAMS Neonate Family" target values. You can change heart rate, BP, and pressure envelope gain and shift.

Parameter	Definition	Range	Default	Description
HR	Heart Rate (Beats/Minute)	30 BPM to 240 BPM in 1 BPM Steps	80 BPM	1 BPM resolution
BP	Blood Pressure (mmHg)	ADAMSNEO-60/30 ADAMSNEO-80/50 ADAMSNEO-100/65 ADAMSNEO-120/80 ADAMSNEO-150/100	ADAMSNEO-120/80	
PULSEID	Pulse Identification (milliseconds)	ID # WIDTH 0 800 ms 1 500 ms 2 250 ms 3 720 ms 4 230 ms 5 280 ms 6 350 ms 7 480 ms 8 980 ms 9 1980 ms 10 1480 ms	ID #3 (720 ms)	Pulse width affects the rise time of pulse
ENVGAIN	Pressure Envelope Gain	1 to 200% (10 to 2000 RVDUs)	100% is typical value for neonate cuffs	Affects pulse strength or amplitude
ENVSHIFT	Pressure Envelope Shift	-100 to +100 mmHg	0 mmHg	Modifies existing pressure envelope to simulate another BP. Example: a +10 mmhg shift will cause 120/80 to read 130/90 on most monitors.

MKARMNEO command parameters

Make all necessary connections from CuffLink to the NIBP monitor before you send a "makearmneo" command to CuffLink. When CuffLink receives the "makearmneo" command, it displays a graph where the pressure envelope will be drawn. Start the NIBP monitor and CuffLink will begin BP simulation and draw the pressure envelope. Peak pressure, deflate time, deflate rate, inflate time, inflate rate and total time are displayed on the computer monitor when the blood pressure cycle is complete. The NIBP monitor can run as many times as needed or until you issue a new command to CuffLink.

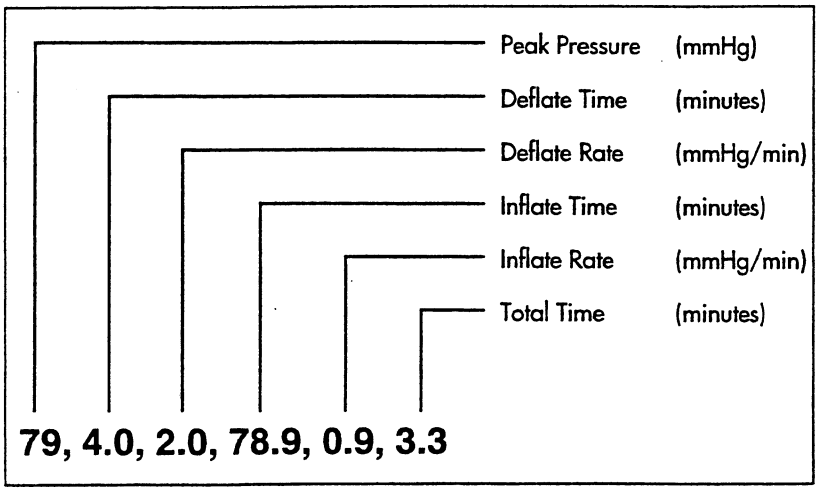
Returned Data

CuffLink sends the "makearmneo" data (format shown below) to the computer in six different fields separated by commas. If the data is positive it is preceded by a space and if the data is negative it is preceded by a minus sign (-).

Data	Field Number	Field Length	Field Content
peak pressure	1	4 characters	*[sign n n n]*
deflate time	2	6 characters	*[sign n n n .n]*
deflate rate	3	6 characters	*[sign n n n .n]*
inflate time	4	6 characters	*[sign n n n .n]*
inflate rate	5	6 characters	*[sign n n n .n]*
total time	6	6 characters	*[sign n n n .n]*

Returned data format

A sample data string as it might appear on the controller display is explained below.



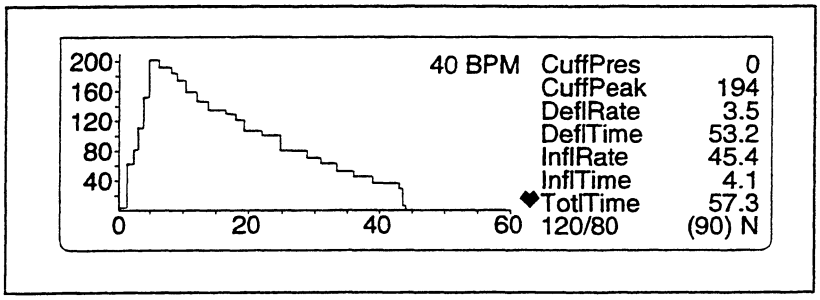
This is a data string of positive values. The peak pressure of 79 mmHg is in field 1 and the total time of 3.3 minutes is in field 6.

Examples

1. Simulate a neonatal arm with a heart rate of 40 BPM.

   Command: makearmneo hr=40

   Results: CuffLink draws the "makearmneo" graph and begins arm simulation when the NIBP monitor starts inflating the cuff. In this case, default values are used for all parameters except heart rate. Test results are sent to the controller when the cuff deflates.



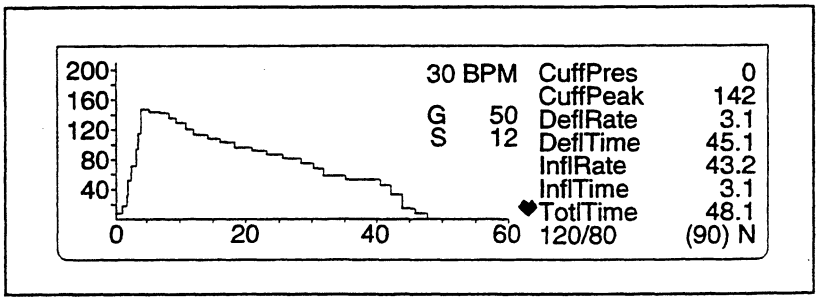
   Returned Data: 194, 3.5, 53.2, 45.4, 4.1, 57.3

The "Returned Data" for this command will vary depending on parameter values

2. Simulate a neonatal arm with a blood pressure of 120/80 , a heart rate of 30 BPM, a gain of 50%, and a +12 mmHg shift.

   Command: makearmneo bp=adamsneo-120/80,hr=160, pulseid=8,envgain=50,envshift=12

   Results: CuffLink draws the "makearmneo" graph and begins arm simulation when the NIBP monitor starts inflating the cuff and results are sent to the controller when the cuff deflates.



Returned Data: 142, 3.1, 45.1, 43.2, 3.1, 48.1

The "Returned Data" for this command will vary depending on parameter values.

MANOMETER

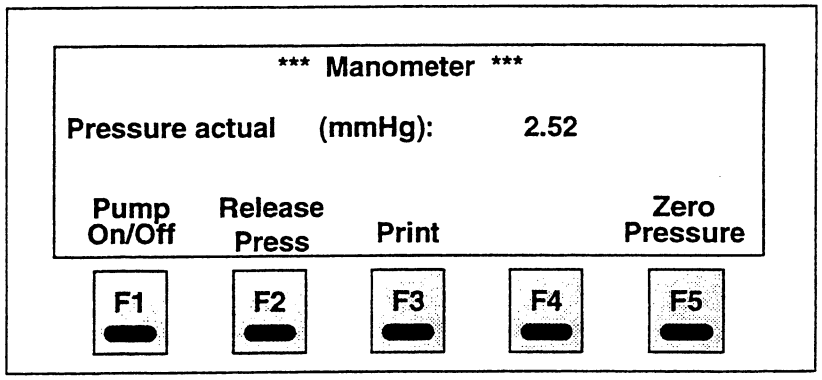
Use this command to put CuffLink into the manometer mode. The keys on CuffLink's front panel become active during this test so you can zero pressure, do a reset, or print test results. Press F1 to start measurements.

See also: "Pop Off Test"

Example
Put CuffLink into the manometer mode.

Command: manometer

Results: CuffLink enters the manometer test mode and shows the "Manometer" display. Press F1 on the CuffLink keyboard to begin.



Returned Data: *

MKARM10

Use this command to set blood pressure simulation to Adams Adult 60/30, with a heart rate of 40 BPM.

There are no parameters for this command.

Example
Simulate a specific adult BP of 60/30 at 40 BPM.

Command: mkarm10

Results: CuffLink runs the Adams Adult 60/30, heart rate is set to 40 BPM.

Returned Data: *

MKARM20

Use this command to set blood pressure simulation to Adams Adult 80/50, with a heart rate of 60 BPM.

There are no parameters for this command.

Example

Simulate a specific adult BP of 80/50 at 60 BPM.

Command:	mkarm20
Results:	CuffLink runs the Adams Adult 80/50, heart rate is set to 60 BPM.
Returned Data:	*

MKARM30

Use this command to set blood pressure simulation to Adams Adult 100/65, with a heart rate of 80 BPM.

There are no parameters for this command.

Example

Simulate a specific adult BP of 100/65 at 80 BPM.

Command:	mkarm30
Results:	CuffLink runs the Adams Adult 100/65, heart rate is set to 80 BPM.
Returned Data:	*

MKARM40

Use this command to set blood pressure simulation to Adams Adult 120/80, with a heart rate of 80 BPM.

There are no parameters for this command.

Example

Simulate a specific adult BP of 120/80 at 80 BPM.

Command:	mkarm40
Results:	CuffLink runs the Adams Adult 120/80, heart rate is set to 80 BPM.
Returned Data:	*

MKARM50

Use this command to set blood pressure simulation to Adams Adult 150/100, with a heart rate of 120 BPM.

There are no parameters for this command.

Example

Simulate a specific adult BP of 150/100 at 120 BPM.

Command:	mkarm50
Results:	CuffLink runs the Adams Adult 150/100, heart rate is set to 120 BPM.
Returned Data:	*

MKARM60

Use this command to set blood pressure simulation to Adams Adult 200/150, with a heart rate of 160 BPM.

There are no parameters for this command.

Example

Simulate a specific adult BP of 200/150 at 160 BPM.

Command:	mkarm60
Results:	CuffLink runs the Adams Adult 200/150, heart rate is set to 160 BPM.
Returned Data:	*

MKARM70

Use this command to set blood pressure simulation to Adams Adult 255/195, with a heart rate of 200 BPM.

There are no parameters for this command.

Example

Simulate a specific adult BP of 255/195 at 200 BPM.

Command:	mkarm70
Results:	CuffLink runs the Adams Adult 255/195, heart rate is set to 200 BPM.
Returned Data:	*

MKARMNEO10

Use this command to set blood pressure simulation to Adams Neonate 60/30, with a heart rate of 40 BPM.

There are no parameters for this command.

Example

Simulate a specific neonate BP of 60/30 at 40 BPM.

Command:	mkarmneo10
Results:	CuffLink runs the Adams Neonate 60/30 with heart rate set to 40 BPM.
Returned Data:	*

MKARMNEO20

Use this command to set blood pressure simulation to Adams Neonate 80/50, with a heart rate of 60 BPM.

There are no parameters for this command.

Example

Simulate a specific neonate BP of 80/50 at 60 BPM.

Command:	mkarmneo20
Results:	CuffLink runs the Adams Neonate 80/50 with heart rate set to 60 BPM.
Returned Data:	*

MKARMNEO30

Use this command to set blood pressure simulation to Adams Neonate 100/65, with a heart rate of 80 BPM.

There are no parameters for this command.

Example

Simulate a specific neonate BP of 100/65 at 80 BPM.

Command:	mkarmneo30
Results:	CuffLink runs the Adams Neonate 100/65 with heart rate set to 80 BPM.
Returned Data:	*

MKARMNEO40

Use this command to set blood pressure simulation to Adams Neonate 120/80, with a heart rate of 80 BPM.

There are no parameters for this command.

Example

Simulate a specific neonate BP of 120/80 at 80 BPM.

Command:	mkarmneo40
Results:	CuffLink runs the Adams Neonate 120/80 with heart rate set to 80 BPM.
Returned Data:	*

MKARMNEO50

Use this command to set blood pressure simulation to Adams Neonate 150/100, with a heart rate of 120 BPM.

There are no parameters for this command.

Example

Simulate a specific neonate BP of 150/100 at 120 BPM.

Command:	mkarmneo50
Results:	CuffLink runs the Adams Neonate 150/100 with heart rate set to 120 BPM.
Returned Data:	*

MKARR_AF

Use this command to set blood pressure simulation to the Atrial Fibrillation Arrhythmia at the fixed BP and heart rate of 120/80 and 80 BPM.

There are no parameters for this command.

Example

Simulate an atrial fibrillation.

Command:	mkarr_af
Results:	CuffLink runs atrial fibrillation at 120/80 with heart rate set to 80 BPM.
Returned Data:	*

MKARR_MB

Use this command to set blood pressure simulation to the Missed Beat Arrhythmia at the fixed BP and heart rate of 120/80 and 80 BPM.

There are no parameters for this command.

Example
Simulate a missed beat.

Command:	mkarr_mb
Results:	CuffLink runs missed beat at 120/80 with heart rate set to 80 BPM.
Returned Data:	*

MKARR_PAC

Use this command to set blood pressure simulation to the Premature Atrial Contraction Arrhythmia at the fixed BP and heart rate of 120/80 and 80 BPM.

There are no parameters for this command.

Example
Simulate a premature atrial contraction.

Command:	mkarr_pac
Results:	CuffLink runs premature atrial contraction at 120/80 with heart rate set to 80 BPM.
Returned Data:	*

MKARR_PVC

Use this command to set blood pressure simulation to the Premature Ventricular Contraction Arrhythmia at the fixed BP and heart rate of 120/80 and 80 BPM.

There are no parameters for this command.

Example

Simulate premature ventricular contraction.

Command:	mkarr_pvc
Results:	CuffLink runs premature ventricular contraction at 120/80 with heart rate set to 80 BPM.
Returned Data:	*

MKARR_AS

Use this command to set blood pressure simulation to the Aberrant Sinus Conduction Arrhythmia at the fixed BP and heart rate of 120/80 and 80 BPM.

There are no parameters for this command.

Example

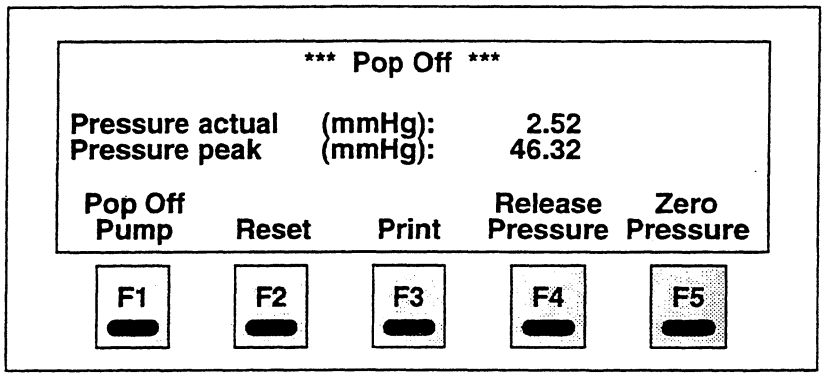
Simulate aberrant sinus conduction.

Command:	mkarr_as
Results:	CuffLink runs premature aberrant sinus conduction at 120/80 with heart rate set to 80 BPM.
Returned Data:	*

POPOFF

Use this command to test your NIBP monitor's emergency release valve. Although the escape key is disabled during this test, you are still able to use the function keys. This is useful if you use CuffLink with the Dynatech Nevada medTester in the checklist mode.

There are no parameters for this command.



POPOFF display

Example

Test the overpressure valve.

Command:	popoff
Results:	CuffLink tests the overpressure valve.
Returned Data:	*

PRINTTEST

Use this command to test your parallel printer. CuffLink sends a data string that says "Printer test message". If this prints, the printer is connected and working properly.

If the printer is not ready to print (is unconnected or is turned off, etc) CuffLink displays a "Printer Not Ready" message. Press "Enter" from the CuffLink keyboard to try again or "Escape" to quit.

Example

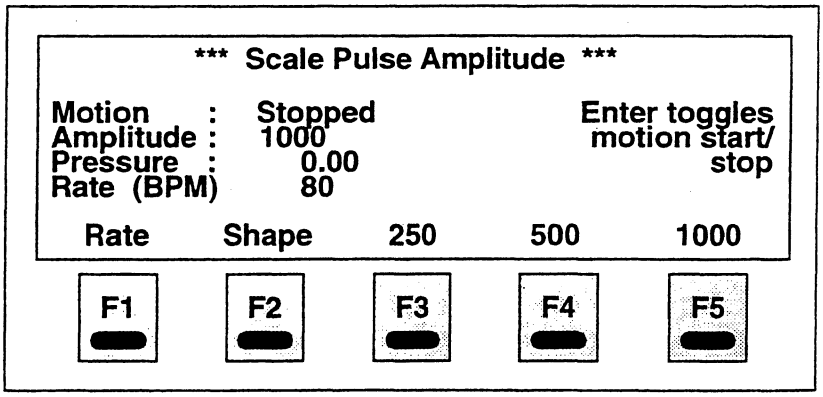
Do a print test.

Command:	printtest
Results:	The printer prints "Printer test message".
Returned Data:	*

PSCALE

Use this command to produce a constant pulse amplitude independent of pressure. This signal is present at all CuffLink front panel outputs and you can monitor the signal at the "PULSE" output. CuffLink's keyboard is enabled during this test.

You can modify heart rate, pulse width, pulse amplitude, and puck motion.



"Scale Pulse Amplitude" display

Parameter	Definition	Range	Default
HR	Heart Rate (Beats/Minute)	30 BPM to 240 BPM in 1 BPM Steps	80 BPM 1 BPM resolution
PULSEAMP	Pulse Amplitude (RVDU*)	1 to 1000 RVDUs	1000 RVDUs
MOTION	Puck Motion	On Off	On
PULSEID	Pulse Identification	ID # WIDTH 0 800 ms 1 500 ms 2 250 ms 3 720 ms 4 230 ms 5 280 ms 6 350 ms 7 480 ms 8 980 ms 9 1980 ms 10 1480 ms	Pulse #3 (720 ms)

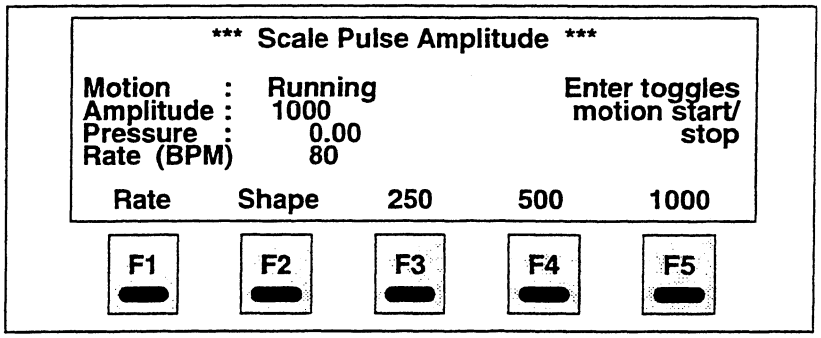
**RVDU = Relative Volume Displacement Unit, or the volume displaced when the pressure engine moves 1 increment (1 microstep).*

Examples

1. Output the default pulse.

   Command: pscale

   Results: Pulse is output at "PULSE" output jack on the CuffLink front panel.

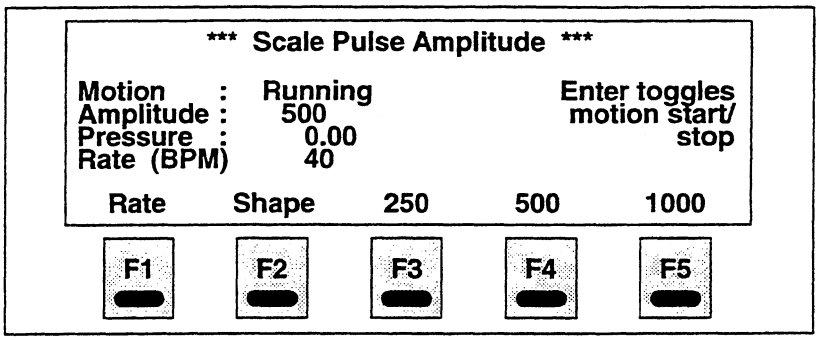


   Returned Data: *

2. Output a 28 millisecond pulse at 40 BPM with an amplitude of 500 RVDUs.

   Command: pscale hr=40,pulseid=5,pulseamp=500

   Results: Pulse is output at "PULSE" output jack on the CuffLink front panel.



   Returned Data: *

PULSE

Use this command to output a single, specific pressure pulse. If you do not specify any parameters, CuffLink will use a current value for pulse width and calculate pulse amplitude. CuffLink calculates pulse amplitude by reading the cuff pressure and applying it to the active pressure envelope.

Parameter	Definition	Range	Default	Description
PULSEAMP	Pulse Amplitude (RVDUs*)	1 to 1000 RVDUs	1000 RVDUs	
PULSEID	Pulse Identification (milliseconds)	ID # WIDTH 0 800 ms 1 500 ms 2 250 ms 3 720 ms 4 230 ms 5 280 ms 6 350 ms 7 480 ms 8 980 ms 9 1980 ms 10 1480 ms	ID #3 (720 ms)	Pulse width affects the rise time of pulse

PULSE command parameters

This command is useful for synchronizing CuffLink pulse output to another device and for custom pressure envelopes with random pulse selection.

Examples

1. Output a pulse using the active pressure envelope and pulse width (ID).

   Command: pulse

   Results: No parameters were specified in this example, so CuffLink determines amplitude by reading cuff pressure and applies it to the active pressure envelope. CuffLink also uses the current pulse width and drives the motor to output a single pulse and then stop. Pulse is output at "PULSE" output jack on the CuffLink front panel.

   Returned Data: *

2. Output a pulse that is 231 steps in amplitude and 23 ms wide.

   Command: pulse pulseamp=231,pulseid=4

   Results: Pulse #4 becomes the active pulse. If you use another pulse command and specify no parameters, CuffLink will use pulseid #4. Pulse is output at the "PULSE" output jack on the CuffLink front panel.

   Returned Data: *

PUMPPCB

Use this command to determine if a pump circuit board is installed in your CuffLink.

There are no parameters for this command.

Example

Check for pump PCB.

Command:	pumppcb
Results:	CuffLink scans for the board.
Returned Data:	Pump PCB installed.
	or Pump PCB not installed.

RCUSERENV

Use this command to copy the user envelope data from EEROM to RAM.

There are no parameters for this command.

Example

Recall user envelope data.

Command:	rcuserenv
Results:	CuffLink writes the user envelope data stored in EEROM to RAM.
Returned Data:	*

RDCLOCK

Use this command to display the current time, day, and date. The data returned to the controller is configured as shown below.

hour:min:sec mo/date/yr day (0 = Sunday, 6 = Saturday)

There are no parameters for this command.

Example

Display the time and date for Monday, December 5th.

Command:	rdclock
Results:	CuffLink reads the clock information.
Returned Data:	13:14:12 12/05/91 1

The "Returned Data" for this command will vary depending on the current date.

RDENVGAIN

Use this command to show the pressure envelope gain value (displayed in %) on the controller's display.

There are no parameters for this command.

Example

Display the envelope gain value.

Command:	rdenvgain
Results:	CuffLink reads the envelope gain value from ROM.
Returned Data:	101

The "Returned Data" for this command will vary depending on the current setting for envelope gain.

RDENVSHIFT

Use this command to show the pressure envelope shift value (in mmHg) on the controller's display. The range for envelope shift is from -100 mmHg to +100 mmHg.

There are no parameters for this command.

Example

Display the pressure envelope shift value.

Command:	rdenvshift
Results:	CuffLink reads the pressure envelope shift value stored in RAM.
Returned Data:	42

The "Returned Data" for this command will vary depending on the current setting for envelope shift.

RDPEAKDIV

Peak divide ratio is the variable CuffLink uses to detect the point of rapid cuff deflate, or when to stop blood pressure simulation, during the "makearm" process. Use this command to display the peak divide ratio on the controller's display.

There are no parameters for this command.

Example

Read the peak divide ratio.

Command:	rdpeakdiv
Results:	CuffLink reads the peak divide ratio stored in EEROM and sends this value to the computer.
Returned Data:	8.8

The "Returned Data" for this command will vary depending on the current setting for peak divide ratio.

RDQCDATE

Use this command to display the last date on which CuffLink was calibrated at the factory.

There are no parameters for this command.

Example

Read the QC (Quality Control) date.

Command:	rdqcdate
Results:	CuffLink reads the QC date stored in EEROM.
Returned Data:	02/04/91

The "Returned Data" for this command will vary depending on the last time CuffLink was at the factory.

RDUSERENV

Use this command to transmit the user pressure envelope array data. The array is a series of values 300 lines long and consists of two fields: one for the line number and one for the pressure envelope data. These are separated by a colon. The end of the array transmission is marked with a star character (*).

CuffLink stores the user envelope array in RAM. This is where CuffLink retrieves the data when you issue a rduserenv command. This data may be different than what is stored in EEROM. When you turn CuffLink on, it writes the user envelope stored in EEROM to RAM. As soon as you send CuffLink new user envelope information via the RS-232 port, then the user envelope in RAM is different than EEROM.

If you would like to read the EEROM user envelope data instead of that stored in RAM, then issue the rcuserenv command followed by a rduserenv command.

There are no parameters for this command.

Example

Read the user envelope

Command:	rduserenv
Results:	CuffLink takes data for the user envelope in RAM and sends it out the RS-232 port.
Returned Data:	1:100 2:100 3:100 4:105 5:110 ↓ 298:150 299:140 300:130 *

READPRESS

Use this command to show a value (in 0.25 mmHg increments) on the controller's display for CuffLink's pressure transducer.

There are no parameters for this command.

Example

Read the pressure transducer value.

Command:	readpress
Results:	CuffLink reads the pressure transducer value stored in EEROM.
Returned Data:	123.25

The "Returned Data" for this command will vary for each CuffLink.

RESET

Use this command to reset CuffLink back to factory default values. This affects the following parameters.

Parameter	Default Value
Pulse ID number	3
Heart Rate	80 BPM
Pressure Curve ID number	A120_80
Pressure Curve Vertical Gain	100%
Pressure Curve Horizontal Shift	0 mmHg

RESET command parameters

Be sure you want these values stored in memory before using this command.

There are no parameters for this command.

Example

Reset CuffLink to default values.

Command: reset

Results: CuffLink resets to factory values.

Returned Data: *

SETAUSC

Use this command to send a specific pressure curve, pulse width, along with the current envelope gain, and shift.

Parameter	Definition	Range	Default	Description
BP	Blood Pressure (mmHg)	AUSC-60/30 AUSC-80/50 AUSC-100/65 AUSC-120/80 AUSC-150/100 AUSC-200/150 AUSC-255/195	AUSC-120/80	
PULSEID	Pulse Identification (milliseconds)	ID # WIDTH 0 800 ms 1 500 ms 2 250 ms 3 720 ms 4 230 ms 5 280 ms 6 350 ms 7 480 ms 8 980 ms 9 1980 ms 10 1480 ms	ID #3 (720 ms)	Pulse width affects the rise time of pulse
ENVGAIN	Pressure Envelope Gain	1 to 200% (10 to 2000 RVDUs)	100% typical value for adult cuffs	Affects pulse strength or amplitude
ENVSHIFT	Pressure Envelope Shift	-100 to +100 mmHg	0 mmHg	Modifies existing pressure envelope to simulate another BP. Example: a +10 mmhg shift will cause 120/80 to read 130/90 on most monitors.
MIC	Microphone test setting	0 = Normal Mandrel 1 = Normal Mic 2 = Reversed Mic 3 = Low Signal Mic	Normal Mandrel (0)	Bypasses the cuff and directly manipulates the NIBP input

SETAUSC command parameters

Example

1. Set the BP curve to 100/65, pulse ID to #4, envelope gain to 105%, and envelope shift to +5 and microphone to reversed microphone.

   Command: setausc BP=ausc-100/65,pulseid=4,envgain=105, envshift=5,mic=2

   Results: CuffLink sets the waveform you've specified.

   Returned Data: *

STUSERENV

Use this command to store the user envelope data from RAM to EEROM. This command is useful for loading new user envelope data into EEROM, where it will be permanently stored until you change it again.

There are no parameters for this command.

Example

Store new user envelope information permanently in EEROM.

Command:	stuserenv
Results:	CuffLink writes your new user envelope (in RAM) to EEROM.
Returned Data:	*

WRCLOCK

Use this command to write data to CuffLink's clock. The data string you send must be complete, as partial strings will cause errors in the clock. You should give CuffLink a rdclock command to verify that the correct information was written to the clock.

Parameter	Description	String Positions
TIME	Time and Date data string	0 hour 10s digit 1 hour 1s digit 2 : 3 minute 10s digit 4 minute 1s digit 5 : 6 seconds 10s digit 7 seconds 1s digit 8 space, a, or p 9 space or m 10 space 11 space 12 month 10s digit 13 month 1s digit 14 / 15 day 10s digit 16 day 1s digit 17 / 18 year 10s digit 19 year 1s digit 20 space 21 day of week (0=Sun, 6=Sat) 22 null (0 x 00)

WRCLOCK command parameters

Format

Use this format when sending a clock information data string to CuffLink:

```
08:23:33pm  12/15/89 6
```

WRPEAKDIV

Peak divide ratio is the variable CuffLink uses to detect the point of rapid cuff deflate, or when to stop blood pressure simulation during the "makearm" process. Use this command to store a new peak divide ratio in EEROM. You need to set a divide ratio factor for this command.

Parameter	Default Value	Range
DIV	Divide Ratio Factor	2.0 to 20.0

WRPEAKDIV command parameters

Example

Set the peak divide ratio to 8.8.

Command: wrpeakdiv div=8.8

Results: CuffLink stores a value of 8.8 in RAM for peak divide ratio.

Returned Data: *

WRUSERENV

Use this command to write new user envelope data from CuffLink's RS-232 port to RAM. This action overwrites user envelope data already in RAM. You can only write information to RAM (not to EEROM) with the wruserenv command. To write data to EEROM, which is permanent, use the stuserenv command.

When you send CuffLink a wruserenv command, it acknowledges that it is ready to receive data by sending a star character (*) back to the controller. The controller can begin sending the data, one line at a time, until all 300 lines have been received by CuffLink. CuffLink marks the end of the transmission with another star character.

Dynatech supplies a PC utility program (PC3CUFF) that will transfer the array text file from a 1PC to CuffLink.

There are no parameters for this command.

Example

Write a new user envelope to RAM.

Command:	wruserenv
Results:	CuffLink writes new user envelope data from its RS-232 port to RAM.
Returned Data:	* 1:100 2:100 3:100 4:105 5:110 ↓ 298:50 299:48 300:46 *

ZEROPRESS

Use this command to zero the pressure transducer. This removes any offset errors during a pressure measurement. To get an idea of how often you should zero pressure, periodically make a pressure measurement with nothing connected to the Cuff Connect output to see if the reading you get is zero. If it is not, you need to issue CuffLink a zeropress command.

There are no parameters for this command.

Example

Zero the pressure transducer.

Command:	zeropress
Results:	CuffLink removes any offset occurring at the pressure transducer and sets it to zero.
Returned Data:	*

NOTE: The following remote commands were added with firmware version 3.20: pumpon, pumpoff, valveopen, and valveclosed. Explanations of these remote commands begin on page 4-72.

Programming with CuffLink Commands

With CuffLink's remote commands, you can create custom programs that automate your calibration and testing protocols.

A Checklist Generated in BASIC

This BASIC program tells CuffLink to display its firmware version, simulate an adult blood pressure, display the test results on the computer's display, and return to local mode.

```
10   REM Demonstration program for CuffLink RS-232 Communications.
20   REM The system used for this demonstration has a mouse on COM1
30   REM so COM2 is used.
40   CLOSE #2                                    'Ensures that #2 file is closed.
50   CLS                                         'Clears the screen.
60   OPEN "COM2:9600,N,8,1,CDO,CSO,DSO,OPO,RS,TB2048,RB2048" FOR RANDOM AS #2
70   REM OPEN "COM2:9600,N,8,1,CDO,CSO,DSO,OPO,RS,TB2048,RB2048"
80                                               'Opens communications channel 2 in
90                                               'random-access mode at speed of
100                                              '9600 baud with no parity bit, 8 data bits,
110                                              'and 1 stop bit. The program can now
120                                              'access channel 2 as file number 2.
130  '-------------------------
140  CUFFOUT$ = "IDENT"                          'Displays the current firmware version.
150  PRINT #2, CUFFOUT$                         'Sends command to the CuffLink.
160  '
170  INDATA$ = INPUT$(13, #2)                    'Gets return data from the CuffLink.
180  REM The return from the CuffLink is "CuffLink, 3.20, Ausc, Pump"
190  REM that is 25 characters for the input string. For shorter strings,
200  REM the number must be smaller and longer strings will carry over to
210  REM the next input string.
211  REM
220  PRINT "Press any key to continue": a$ = INPUT$(1)
230  PRINT INDATA$                               'Prints data on screen.
240  '
250  '-------------------------
260  'The next command shows a MAKEARM command with parameters.
270  '
280  CUFFOUT$ = "MAKEARM HR=60,BP=ADAMS-150/100,PULSEID=3"
290  PRINT #2, CUFFOUT$                          'Sends command to the CuffLink.
300  '
310  CLOSE #2
320  OPEN "COM2:9600,N,8,1,CDO,CSO,DSO,OPO,RS,TB2048,RB2048" FOR RANDOM AS #2
330  REM The two previous lines close and clear the communications buffer
340  REM that is used. This wipes extra characters that list options and
350  REM the "*" returns when CuffLink receives the MAKEARM command.
351  REM
360  PRINT "press any key when test is completed": a$ = INPUT$(1)
370  INDATA$ = INPUT$(39,#2)                     'Gets return data from the CuffLink.
380  REM Again the length of the returned string affects the Input$.
390  REM If the string is longer than the Input$, the system will hang up.
391  REM
400  PRINT INDATA$                               'Prints data on screen.
410  PRINT "Press any key to return CuffLink to LOCAL": a$ = INPUT$(1)
420  CUFFOUT$ = "GOTOLOCAL"
430  PRINT #2, CUFFOUT$
440  CLOSE #2
450  END
```

A BASIC program using CuffLink remote commands.

Adult BP Checklists and Test Results

```
DATE: 06/05/1993                    CHECKLIST CONTENTS                    PAGE: 3
CHECKLIST NUMBER: 18 (start)              CHECKLIST DESCRIPTION: ADULT*NIBP

Ln    Item                          Check Item                            Type
--    -----   ------------------------------------------------------------ --------
 1        1   \p GENERAL CONDITION OF EQUIPMENT                            GEN/PHYS
 2        2   \p LINE CORD/STRAIN RELIEF                                   GEN/MECH
 3       37   \M TRPN (POWER ON)                                           REMOTE
 4        6   \p INDICATORS/DISPLAYS                                       GEN/ELEC
 5        7   \p CONTROLS/SWITCHES                                         GEN/ELEC
 6       13   \p TUBES/HOSES                                               GEN/PLMB
 7       15   \p FITTINGS/CONNECTORS                                       GEN/PHYS
 8       38   \M IDENT                                                     CL
 9       39   \M LEAKTEST                                                  CL
10       40   \P LEAK TEST: APPLY 200 MMHG (<10/MIN)                       CL
11       41   \M MANOMETER                                                 CL
12       42   \P STATIC PRESSURE CHECK: APPLY 200 MMHG                     CL
13       43   \P STATIC PRESSURE CHECK: APPLY 100 MMHG                     CL
14       73   \P POP OFF/RELIEF VALVE: APPLY >250 MMHG                     CL
15       61   \M MAKEARM:HR=100;BP=ADAMS-120/80                            CL
16       62   \P ADULT 120/80 AT 100 BPM                                   CL
17       63   \M MAKEARM:HR=80;BP=ADAMS-150/100                            CL
18       64   \P ADULT 150/100 AT 80 BPM                                   CL
19       65   \M MAKEARM:HR=60;BP=ADAMS-200/150                            CL
20       66   \P ADULT 200/150 AT 60 BPM                                   CL
21       50   \M GOTOLOCAL                                                 CL
22       51   \M GTOL                                                      CL
23      ----->  through line 79 - unused -
80       25   ^A4                                                          AUTO SEQ

                ------------------------------------------------------------
                                --- end of checklist #18 --
```

A medBase checklist

```
MedTester REC # 15

SEQUENCE: 4    DATE: 6/05/93        TIME: 15:38:28

OP CODE: TEO

DEVICE INFORMATION
   TYPE: ADULT*NIBP        MANF:           LOC: DNI
   MODEL:                  SN:             CN:  ADULT*NIBP

PHYSICAL INSPECTION



LINE VOLTAGES
   L1-L2        L1-GND          L2-GND
    120.5          .4            120.5 VOLTS RMS

GROUND RESISTANCE:      .002 OHMS

LEAKAGE TESTS, EQUIPMENT PWR OFF
  CASE EXT LEAD  NORM POL  CLSD GND          .0 µAMPS RMS
  CASE EXT LEAD  NORM POL  OPEN GND          .0 µAMPS RMS
  CASE EXT LEAD  REV POL   OPEN GND          .0 µAMPS RMS

LEAKAGE TESTS, EQUIPMENT PWR ON
  CASE EXT LEAD  REV POL   OPEN GND          .0 µAMPS RMS
  CASE EXT LEAD  NORM POL  OPEN GND          .0 µAMPS RMS
  CASE EXT LEAD  NORM POL  CLSD GND          .0 µAMPS RMS

EUT CURRENT DRAWN:      .5 amps

COMMENTS:
NEXT TEST DUE DATE:
USER TIME:
ELAPSED TEST TIME: 62 SECONDS
```

```
MedTester REC # 16

CHECKLIST: ADULT*NIBP    DATE: 6/05/93    TIME: 15:39:31

OP CODE: TEO

DEVICE INFORMATION
   TYPE: ADULT*NIBP        MANF:           LOC: DNI
   MODEL:                  SN:             CN:  ADULT*NIBP

PHYSICAL INSPECTION


GENERAL CONDITION OF EQUIPMENT ....PASS
LINE CORD/STRAIN RELIEF ..........PASS
TRPN (POWER ON) ..................REMOTE CMD, NO DATA
INDICATORS/DISPLAYS ..............PASS
CONTROLS/SWITCHES ................PASS
TUBES/HOSES ......................PASS
FITTINGS/CONNECTORS ..............PASS
IDENT ............................CUFFLINK,3.00,ADSC,PUMP
LEAKTEST .........................*
LEAK TEST: APPLY 200 MMHG (<10/MIN) ..PASS
MANOMETER ........................*
STATIC PRESSURE CHECK: APPLY 200 MMHG ..PASS
STATIC PRESSURE CHECK: APPLY 100 MMHG ..PASS
POP OFF/RELIEF VALVE: APPLY >250 MMHG ..PASS
MAKEARM:HR=100;BP=ADAMS-120/80 ....*
ADULT 120/80 AT 100 BPM ..........PASS
MAKEARM:HR=80;BP=ADAMS-150/100 ....*
ADULT 150/100 AT 80 BPM ..........PASS
MAKEARM:HR=60;BP=ADAMS-200/150 ....*
ADULT 200/150 AT 60 BPM ..........PASS
GOTOLOCAL ........................*
GTOL .............................REMOTE CMD, NO DATA

COMMENTS:
NEXT TEST DUE DATE:
USER TIME:
ELAPSED TEST TIME: 209 SECS
```

Checklist results. These results are the same from both medBase and Sentinel checklists.

DEMO ROOM

Date: 06/05/93 Relational Checklist Report Page: 1
Time: 12:32 AM Listed In Order Of Relational Procedure

Proc. Name	PM Labor Time
SENT*ADULT	0.00

Description	Type	medTester Control
GENERAL CONDITION OF EQUIPMENT	GEN/PHYS	Pass/Fail
LINE CORD/STRAIN RELIEF	GEN/MECH	Pass/Fail
TRPN (POWER ON)	REMOTE	medTester remote command
INDICATORS/DISPLAYS	GEN/ELEC	Pass/Fail
CONTROLS/SWITCHES	GEN/ELEC	Pass/Fail
TUBES/HOSES	GEN/PLMB	Pass/Fail
FITTINGS/CONNECTORS	GEN/PHYS	Pass/Fail
IDENT	CL	medTester remote command
LEAKTEST	CL	medTester remote command
LEAK TEST: APPLY 200 MMHG (<10/MIN)	CL	Pass/Fail
MANOMETER	CL	medTester remote command
STATIC PRESSURE CHECK: APPLY 200 MMHG	CL	Pass/Fail
STATIC PRESSURE CHECK: APPLY 100 MMHG	CL	Pass/Fail
POP OFF/RELIEF VALVE: APPLY >250 MMHG	CL	Pass/Fail
MAKEARM:HR=100;BP=ADAMS-120/80	CL	medTester remote command
ADULT 120/80 AT 100 BPM	CL	Pass/Fail
MAKEARM:HR=80;BP=ADAMS-150/100	CL	medTester remote command
ADULT 150/100 AT 80 BPM	CL	Pass/Fail
MAKEARM:HR=60;BP=ADAMS-200/150	CL	medTester remote command
ADULT 200/150 AT 60 BPM	CL	Pass/Fail
GOTOLOCAL	CL	medTester remote command
GTOL	CL	medTester remote command
5	AUTO SEQ	medTester autosequence

A Sentinel checklist

Neonate BP Checklists and Test Results

```
DATE: 06/05/1993                    CHECKLIST CONTENTS                    PAGE: 4

CHECKLIST NUMBER: 19 (start)                CHECKLIST DESCRIPTION: NIBP*NEO

Ln    Item                              Check Item                          Type
--    -----   ------------------------------------------------------------  --------
 1        1    \p GENERAL CONDITION OF EQUIPMENT                            GEN/PHYS
 2        2    \p LINE CORD/STRAIN RELIEF                                   GEN/MECH
 3       37    \M TRPN (POWER ON)                                           REMOTE
 4        6    \p INDICATORS/DISPLAYS                                       GEN/ELEC
 5        7    \p CONTROLS/SWITCHES                                         GEN/ELEC
 6       13    \p TUBES/HOSES                                               GEN/PLMB
 7       15    \p FITTINGS/CONNECTORS                                       GEN/PHYS
 8       38    \M IDENT                                                     CL
 9       39    \M LEAKTEST                                                  CL
10       40    \P LEAK TEST: APPLY 200 MMHG (<10/MIN)                       CL
11       41    \M MANOMETER                                                 CL
12       42    \P STATIC PRESSURE CHECK: APPLY 200 MMHG                     CL
13       43    \P STATIC PRESSURE CHECK: APPLY 100 MMHG                     CL
14       73    \P POP OFF/RELIEF VALVE: APPLY >250 MMHG                     CL
15       67    \M MAKEARMNEO:HR=60;BP=ADAMSNEO-150/100                      CL
16       68    \P ADAMS NEONATE 150/100 AT 60 BPM                           CL
17       69    \M MAKEARMNEO:HR=120;BP=ADAMSNEO-100/65                      CL
18       70    \P ADAMS NEONATE 100/65 AT 120 BPM                           CL
19       71    \M MAKEARMNEO:HR=200;BP=ADAMSNEO-60/30                       CL
20       72    \P ADAMS NEONATE 60/30 AT 200 BPM                            CL
21       50    \M GOTOLOCAL                                                 CL
22       51    \M GTOL                                                      CL
23      ----->  through line 79 - unused -
80       25    ~A4                                                          AUTO SEQ

                ------------------------------------------------------------
                                --- end of checklist #19 --
```

A medBase checklist

```
MedTester REC # 17

SEQUENCE: 4     DATE: 6/05/93          TIME: 15:43:29

OP CODE: TEO

DEVICE INFORMATION
   TYPE: NIBP*NEO          MANF:            LOC: DNI
   MODEL:                  SN:              CN:  NIBP*NEO

PHYSICAL INSPECTION



LINE VOLTAGES
   L1-L2          L1-GND          L2-GND
    119.3           .3              120.4 VOLTS RMS

GROUND RESISTANCE:      .002 OHMS

LEAKAGE TESTS, EQUIPMENT PWR OFF
  CASE EXT LEAD   NORM POL  CLSD GND          .0 µAMPS RMS
  CASE EXT LEAD   NORM POL  OPEN GND          .0 µAMPS RMS
  CASE EXT LEAD   REV POL   OPEN GND          .0 µAMPS RMS

LEAKAGE TESTS, EQUIPMENT PWR ON
  CASE EXT LEAD   REV POL   OPEN GND          .0 µAMPS RMS
  CASE EXT LEAD   NORM POL  OPEN GND          .0 µAMPS RMS
  CASE EXT LEAD   NORM POL  CLSD GND          .0 µAMPS RMS

EUT CURRENT DRAWN:      .5 amps

COMMENTS:
NEXT TEST DUE DATE:
USER TIME:
ELAPSED TEST TIME: 49 SECONDS
```

```
MedTester REC # 18

CHECKLIST: NIBP*NEO      DATE: 6/05/93    TIME: 15:44:19

OP CODE: TEO

DEVICE INFORMATION
   TYPE: NIBP*NEO          MANF:            LOC: DNI
   MODEL:                  SN:              CN:  NIBP*NEO

PHYSICAL INSPECTION


GENERAL CONDITION OF EQUIPMENT ....PASS
LINE CORD/STRAIN RELIEF ..........PASS
TRPN (POWER ON) ..................REMOTE CMD, NO DATA
INDICATORS/DISPLAYS ..............PASS
CONTROLS/SWITCHES ................PASS
TUBES/HOSES ......................PASS
FITTINGS/CONNECTORS ..............PASS
IDENT ............................CUFFLINK,3.00,AUSC,PUMP
LEAKTEST .........................*
LEAK TEST: APPLY 200 MMHG (<10/MIN) ..PASS
MANOMETER ........................*
STATIC PRESSURE CHECK: APPLY 200 MMHG ..PASS
STATIC PRESSURE CHECK: APPLY 100 MMHG ..PASS
POP OFF/RELIEF VALVE: APPLY >250 MMHG ..PASS
MAKEARMNEO:HR=60;BP=ADAMSNEO-150/100 *
ADAMS NEONATE 150/100 AT 60 BPM ..PASS
MAKEARMNEO:HR=120;BP=ADAMSNEO-100/65 *
ADAMS NEONATE 100/65 AT 120 BPM ..PASS
MAKEARMNEO:HR=200;BP=ADAMSNEO-60/30 *
ADAMS NEONATE 60/30 AT 200 BPM ....PASS
GOTOLOCAL ........................*
GTOL .............................REMOTE CMD, NO DATA

COMMENTS:
NEXT TEST DUE DATE:
USER TIME:
ELAPSED TEST TIME: 263 SECS
```

Checklist results. These results are the same from both medBase and Sentinel checklists.

DEMO ROOM

Date: 06/05/93 Relational Checklist Report Page: 1
Time: 12:38 AM Listed In Order Of Relational Procedure

Proc. Name	PM Labor Time
SENT*NEO	0.00

Description	Type	medTester Control
GENERAL CONDITION OF EQUIPMENT	GEN/PHYS	Pass/Fail
LINE CORD/STRAIN RELIEF	GEN/MECH	Pass/Fail
TRPN (POWER ON)	REMOTE	medTester remote command
INDICATORS/DISPLAYS	GEN/ELEC	Pass/Fail
CONTROLS/SWITCHES	GEN/ELEC	Pass/Fail
TUBES/HOSES	GEN/PLMB	Pass/Fail
FITTINGS/CONNECTORS	GEN/PHYS	Pass/Fail
IDENT	CL	medTester remote command
LEAKTEST	CL	medTester remote command
LEAK TEST: APPLY 200 MMHG (<10/MIN)	CL	Pass/Fail
MANOMETER	CL	medTester remote command
STATIC PRESSURE CHECK: APPLY 200 MMHG	CL	Pass/Fail
STATIC PRESSURE CHECK: APPLY 100 MMHG	CL	Pass/Fail
POP OFF/RELIEF VALVE: APPLY >250 MMHG	CL	Pass/Fail
MAKEARMNEO:HR=60;BP=ADAMSNEO-150/100	CL	medTester remote command
ADAMS NEONATE 150/100 AT 60 BPM	CL	Pass/Fail
MAKEARMNEO:HR=120;BP=ADAMSNEO-100/65	CL	medTester remote command
ADAMS NEONATE 100/65 AT 120 BPM	CL	Pass/Fail
MAKEARMNEO:HR=200;BP=ADAMSNEO-60/30	CL	medTester remote command
ADAMS NEONATE 60/30 AT 200 BPM	CL	Pass/Fail
GOTOLOCAL	CL	medTester remote command
GTOL	CL	medTester remote command
5	AUTO SEQ	medTester autosequemce

A Sentinel checklist

Adult Arrhythmic BP Checklists and Test Results

```
DATE: 06/05/1993                    CHECKLIST CONTENTS                    PAGE: 2

CHECKLIST NUMBER: 17 (start)              CHECKLIST DESCRIPTION: NIBP*ARR

Ln    Item                              Check Item                          Type
--    -----   ------------------------------------------------------------  --------
 1        1    \p GENERAL CONDITION OF EQUIPMENT                            GEN/PHYS
 2        2    \p LINE CORD/STRAIN RELIEF                                   GEN/MECH
 3       37    \M TRPN (POWER ON)                                           REMOTE
 4        6    \p INDICATORS/DISPLAYS                                       GEN/ELEC
 5        7    \p CONTROLS/SWITCHES                                         GEN/ELEC
 6       13    \p TUBES/HOSES                                               GEN/PLMB
 7       15    \p FITTINGS/CONNECTORS                                       GEN/PHYS
 8       38    \M IDENT                                                     CL
 9       39    \M LEAKTEST                                                  CL
10       40    \P LEAK TEST: APPLY 200 MMHG (<10/MIN)                       CL
11       41    \M MANOMETER                                                 CL
12       42    \P STATIC PRESSURE CHECK: APPLY 200 MMHG                     CL
13       43    \P STATIC PRESSURE CHECK: APPLY 100 MMHG                     CL
14       73    \P POP OFF/RELIEF VALVE: APPLY >250 MMHG                     CL
15       44    \M MKARR_PAC PRE. ATRIAL CONTRACTION                         CL
16       45    \P ARRHYTHMIA PAC 120/80 @ 80 BPM                            CL
17       46    \M MKARR_PVC PRE VENTRICULAR CONTRACTION                     CL
18       47    \P ARRHYTHMIA PVC 120/80 @ 80 BPM                            CL
19       48    \M MKARR_AF ATRIAL FIBRILLATION                              CL
20       49    \P ARRHYTHMIA ATRIAL FIB 120/80 @ 80 BPM                     CL
21       50    \M GOTOLOCAL                                                 CL
22       51    \M GTOL                                                      CL
23      ----->  through line 79 - unused -
80       25    ~A4                                                          AUTO SEQ

                          --- end of checklist #17 --
```

A medBase checklist

```
MedTester REC # 19

SEQUENCE: 4     DATE: 6/05/93          TIME: 15:49:00

OP CODE: TEO

DEVICE INFORMATION
   TYPE: NIBP*ARR          MANF:            LOC: DNI
   MODEL:                  SN:              CN:  NIBP*ARR

PHYSICAL INSPECTION



LINE VOLTAGES
   L1-L2         L1-GND          L2-GND
    120.0           .2             120.5 VOLTS RMS

GROUND RESISTANCE:      .002 OHMS

LEAKAGE TESTS, EQUIPMENT PWR OFF
  CASE EXT LEAD   NORM POL  CLSD GND          .0 µAMPS RMS
  CASE EXT LEAD   NORM POL  OPEN GND          .0 µAMPS RMS
  CASE EXT LEAD   REV POL   OPEN GND          .0 µAMPS RMS

LEAKAGE TESTS, EQUIPMENT PWR ON
  CASE EXT LEAD   REV POL   OPEN GND          .0 µAMPS RMS
  CASE EXT LEAD   NORM POL  OPEN GND          .0 µAMPS RMS
  CASE EXT LEAD   NORM POL  CLSD GND          .0 µAMPS RMS

EUT CURRENT DRAWN:      .5 amps

COMMENTS:
NEXT TEST DUE DATE:
USER TIME:
ELAPSED TEST TIME: 43 SECONDS
```

```
MedTester REC # 20

CHECKLIST: NIBP*ARR      DATE: 6/05/93    TIME: 15:49:44

OP CODE: TEO

DEVICE INFORMATION
   TYPE: NIBP*ARR          MANF:            LOC: DNI
   MODEL:                  SN:              CN:  NIBP*ARR

PHYSICAL INSPECTION


GENERAL CONDITION OF EQUIPMENT ....PASS
LINE CORD/STRAIN RELIEF ..........PASS
TRPN (POWER ON) ..................REMOTE CMD, NO DATA
INDICATORS/DISPLAYS ..............PASS
CONTROLS/SWITCHES ................PASS
TUBES/HOSES ......................PASS
FITTINGS/CONNECTORS ..............PASS
IDENT ............................CUFFLINK,3.00,AUSC,PUMP
LEAKTEST .........................*
LEAK TEST: APPLY 200 MMHG (<10/MIN) ..PASS
MANOMETER ........................*
STATIC PRESSURE CHECK: APPLY 200 MMHG ..PASS
STATIC PRESSURE CHECK: APPLY 100 MMHG ..PASS
POP OFF/RELIEF VALVE: APPLY >250 MMHG ..PASS
MKARR_PAC PRE. ATRIAL CONTRACTION....*
ARRHYTHMIA PAC 120/80 @ 80 BPM......PASS
MKARR_PVC PRE VENTRICULAR CONTRACTION*
ARRHYTHMIA PVC 120/80 @ 80 BPM......PASS
MKARR_AF ATRIAL FIBRILLATION .....*
ARRHYTHMIA ATRIAL FIB 120/80 @ 80 BPM..PASS
GOTOLOCAL ........................REMOTE CMD, NO DATA
GTOL .............................REMOTE CMD, NO DATA

COMMENTS:
NEXT TEST DUE DATE:
USER TIME:
ELAPSED TEST TIME: 208 SECS
```

Checklist results. These results are the same from both medBase and Sentinel checklists.

DEMO ROOM

Date: 06/05/93 Relational Checklist Report Page: 1
Time: 12:34 AM Listed In Order Of Relational Procedure

Proc. Name	PM Labor Time
SENT*ARR	0.00

Description	Type	medTester Control
GENERAL CONDITION OF EQUIPMENT	GEN/PHYS	Pass/Fail
LINE CORD/STRAIN RELIEF	GEN/MECH	Pass/Fail
TRPN (POWER ON)	REMOTE	medTester remote command
INDICATORS/DISPLAYS	GEN/ELEC	Pass/Fail
CONTROLS/SWITCHES	GEN/ELEC	Pass/Fail
TUBES/HOSES	GEN/PLMB	Pass/Fail
FITTINGS/CONNECTORS	GEN/PHYS	Pass/Fail
IDENT	CL	medTester remote command
LEAKTEST	CL	medTester remote command
LEAK TEST: APPLY 200 MMHG (<10/MIN)	CL	Pass/Fail
MANOMETER	CL	medTester remote command
STATIC PRESSURE CHECK: APPLY 200 MMHG	CL	Pass/Fail
STATIC PRESSURE CHECK: APPLY 100 MMHG	CL	Pass/Fail
POP OFF/RELIEF VALVE: APPLY >250 MMHG	CL	Pass/Fail
MKARR_PAC PRE. ATRIAL CONTRACTION	CL	medTester remote command
ARRHYTHMIA PAC 120/80 @ 80 BPM	CL	Pass/Fail
MKARR_PVC PRE VENTRICULAR CONTRACTION	CL	medTester remote command
ARRHYTHMIA PVC 120/80 @ 80 BPM	CL	Pass/Fail
MKARR_AF ATRIAL FIBRILLATION	CL	medTester remote command
ARRHYTHMIA ATRIAL FIB 120/80 @ 80 BPM	CL	Pass/Fail
GOTOLOCAL	CL	medTester remote command
GTOL	CL	medTester remote command
5	AUTO SEQ	medTester autosequemce

A Sentinel checklist

Auscultatory BP Checklists and Test Results

```
DATE: 06/05/1993                    CHECKLIST CONTENTS                    PAGE: 1
CHECKLIST NUMBER: 16 (start)              CHECKLIST DESCRIPTION: NIBP*AUSC

Ln    Item                          Check Item                            Type
--    -----   ------------------------------------------------------------ --------
 1        1   \p GENERAL CONDITION OF EQUIPMENT                            GEN/PHYS
 2        2   \p LINE CORD/STRAIN RELIEF                                   GEN/MECH
 3       37   \M TRPN (POWER ON)                                           REMOTE
 4        6   \p INDICATORS/DISPLAYS                                       GEN/ELEC
 5        7   \p CONTROLS/SWITCHES                                         GEN/ELEC
 6       13   \p TUBES/HOSES                                               GEN/PLMB
 7       15   \p FITTINGS/CONNECTORS                                       GEN/PHYS
 8       38   \M IDENT                                                     CL
 9       39   \M LEAKTEST                                                  CL
10       40   \P LEAK TEST: APPLY 200 MMHG (<10/MIN)                       CL
11       41   \M MANOMETER                                                 CL
12       42   \P STATIC PRESSURE CHECK: APPLY 200 MMHG                     CL
13       43   \P STATIC PRESSURE CHECK: APPLY 100 MMHG                     CL
14       73   \P POP OFF/RELIEF VALVE: APPLY >250 MMHG                     CL
15       52   \M MAKEARMAUS:HR=100;BP=AUSC-120/80                          CL
16       53   \P AUSCULTATORY 120/80                                       CL
17       54   \M MAKEARMAUS:HR=80;BP=AUSC-150/100                          CL
18       55   \P AUSCULTATORY 150/100                                      CL
19       56   \M MAKEARMAUS:HR=60;BP=AUSC-200/150                          CL
20       57   \P AUSCULTATORY 200/150                                      CL
21       50   \M GOTOLOCAL                                                 CL
22       51   \M GTOL                                                      CL
23      ----->  through line 79 - unused -
80       25   ^A4                                                          AUTO SEQ

                ------------------------------------------------------------
                                  --- end of checklist #16 --
```

A medBase checklist

```
MedTester REC # 21

SEQUENCE: 4    DATE: 6/05/93        TIME: 15:53:25

OP CODE: TEO

DEVICE INFORMATION
   TYPE: NIBP*AUSC          MANF:            LOC: DNI
   MODEL:                   SN:              CN:  NIBP*AUSC

PHYSICAL INSPECTION



LINE VOLTAGES
   L1-L2         L1-GND          L2-GND
    120.1           .2            120.5 VOLTS RMS

GROUND RESISTANCE:      .002 OHMS

LEAKAGE TESTS, EQUIPMENT PWR OFF
  CASE EXT LEAD  NORM POL  CLSD GND          .0 µAMPS RMS
  CASE EXT LEAD  NORM POL  OPEN GND          .0 µAMPS RMS
  CASE EXT LEAD  REV POL   OPEN GND          .0 µAMPS RMS

LEAKAGE TESTS, EQUIPMENT PWR ON
  CASE EXT LEAD  REV POL   OPEN GND          .0 µAMPS RMS
  CASE EXT LEAD  NORM POL  OPEN GND          .0 µAMPS RMS
  CASE EXT LEAD  NORM POL  CLSD GND          .0 µAMPS RMS

EUT CURRENT DRAWN:      .5 amps

COMMENTS:
NEXT TEST DUE DATE:
USER TIME:
ELAPSED TEST TIME: 42 SECONDS
```

```
MedTester REC # 22

CHECKLIST: NIBP*AUSC     DATE: 6/05/93    TIME: 15:54:09

OP CODE: TEO

DEVICE INFORMATION
   TYPE: NIBP*AUSC          MANF:            LOC: DNI
   MODEL:                   SN:              CN:  NIBP*AUSC

PHYSICAL INSPECTION


GENERAL CONDITION OF EQUIPMENT ....PASS
LINE CORD/STRAIN RELIEF ..........PASS
TRPN (POWER ON) ..................REMOTE CMD, NO DATA
INDICATORS/DISPLAYS ..............PASS
CONTROLS/SWITCHES ................PASS
TUBES/HOSES ......................PASS
FITTINGS/CONNECTORS ..............PASS
IDENT ............................CUFFLINK,3.00,AUSC,PUMP
LEAKTEST .........................*
LEAK TEST: APPLY 200 MMHG (<10/MIN) ..PASS
MANOMETER ........................*
STATIC PRESSURE CHECK: APPLY 200 MMHG ..PASS
STATIC PRESSURE CHECK: APPLY 100 MMHG ..PASS
POP OFF/RELIEF VALVE: APPLY >250 MMHG ..PASS
MAKEARMAUS:HR=100;BP=AUSC-120/80 ....*
AUSCULTATORY 120/80 ..............PASS
MAKEARMAUS:HR=80;BP=AUSC-150/100 ....*
AUSCULTATORY 150/100 ..............PASS
MAKEARMAUS:HR=60;BP=AUSC-200/150 ....*
AUSCULTATORY 200/150 ..............PASS
GOTOLOCAL ........................*
GTOL .............................REMOTE CMD, NO DATA

COMMENTS:
NEXT TEST DUE DATE:
USER TIME:
ELAPSED TEST TIME: 215 SECS
```

Checklist results. These results are the same from both medBase and Sentinel checklists.

DEMO ROOM

Date: 06/05/93 Relational Checklist Report Page: 1
Time: 12:36 AM Listed In Order Of Relational Procedure

Proc. Name	PM Labor Time
SENT*AUSC	0.00

Description	Type	medTester Control
GENERAL CONDITION OF EQUIPMENT	GEN/PHYS	Pass/Fail
LINE CORD/STRAIN RELIEF	GEN/MECH	Pass/Fail
TRPN (POWER ON)	REMOTE	medTester remote command
INDICATORS/DISPLAYS	GEN/ELEC	Pass/Fail
CONTROLS/SWITCHES	GEN/ELEC	Pass/Fail
TUBES/HOSES	GEN/PLMB	Pass/Fail
FITTINGS/CONNECTORS	GEN/PHYS	Pass/Fail
IDENT	CL	medTester remote command
LEAKTEST	CL	medTester remote command
LEAK TEST: APPLY 200 MMHG (<10/MIN)	CL	Pass/Fail
MANOMETER	CL	medTester remote command
STATIC PRESSURE CHECK: APPLY 200 MMHG	CL	Pass/Fail
STATIC PRESSURE CHECK: APPLY 100 MMHG	CL	Pass/Fail
POP OFF/RELIEF VALVE: APPLY >250 MMHG	CL	Pass/Fail
MAKEARMAUS:HR=100;BP=AUSC-120/80	CL	medTester remote command
AUSCULTATORY 120/80	CL	Pass/Fail
MAKEARMAUS:HR=80;BP=AUSC-150/100	CL	medTester remote command
AUSCULTATORY 150/100	CL	Pass/Fail
MAKEARMAUS:HR=60;BP=AUSC-200/150	CL	medTester remote command
AUSCULTATORY 200/150	CL	Pass/Fail
GOTOLOCAL	CL	medTester remote command
GTOL	CL	medTester remote command
5	AUTO SEQ	medTester autosequemce

A Sentinel checklist

Additional Command Descriptions (Firmware Version 3.20)

The following remote commands are available when firmware version 3.20 is installed in the CuffLink.

PUMPON

Use this command to turn the pump on and close the release valve. The pump runs until it is turned off or the default parameters are reached.

Parameter	Definition	Range	Default	Description
TIME	On time for the pump.	1 to 900 seconds	900 seconds	The time that the pump is on.
PRESSURE	Target pressure for pump operation.	0 to 499 mmHg	200 mmHg	The pump runs when pressure is below this point.

Example

1. Send a command for the pump to run for 2 minutes or a pressure of 50 mmHg.

   Command: pumpon time=120,pressure=50

   Results: XXXX.XX, YY:YY

   "XXXX.XX" is the CuffLink system pressure.

   "YY:YY" is the time the pump was running.

   Returned Data: *

PUMPOFF

Use this command to turn the pump off.

There are no parameters for this command.

Example
Turn the pump off.

Command:	pumpoff
Results:	CuffLink turns the pump off.
Returned Data:	*

VALVEOPEN

Use this command to turn the pump off and open the release valve.

There are no parameters for this command.

Example
Turn the pump off and open the release valve.

Command:	valveopen
Results:	CuffLink turns the pump off and opens the release valve.
Returned Data:	*

VALVECLOSED

Use this command to close the release valve.

There are no parameters for this command.

Example

Close the release valve.

Command:	valveclosed
Results:	CuffLink closes the release valve.
Returned Data:	*

Chapter 5

Printing

Printing CuffLink Documents

You can print test results from CuffLink to any parallel printer used with a PC compatible computer. Connect the printer cable to the port labeled "Printer" on CuffLink's rear panel.

CuffLink will show an error message stating "Printer not ready" if you try to print something when the printer is the wrong type, out of paper, not on line, or is not properly connected.

Printing Blood Pressure Test Results

Use the arrow keys to choose one of the selections under "Select BP" on CuffLink's main menu and press "Enter". When you press F3 to enable printing, CuffLink responds with a "Printing enabled" message.

Choose the blood pressure value you want to simulate, press the "Enter" key, and start the NIBP monitor to begin the test. CuffLink sends the test results to the printer when the cuff has completely deflated.

```
-----------------------------------------------------------------
            ***** Make Arm Results *****

            Heart   Peak   Deflate    Deflate  Inflate    Inflate  Total
Blood       Rate    Press  Rate       Time     Rate       Time     Time
Pressure    (BPM)   (mmHg) (mmHg/s)   (sec)    (mmHg/s)   (sec)    (sec)
----------- ------  -----  --------   ------   --------   ------   -----

___/___ (___)  ___    179     7.0      17.9       59.0      2.9    21.5
120/80  ( 90)A  80  Gain=100  Shift=0

___/___ (___)  ___    159     6.9      15.6       68.6      2.2    18.5
120/80  ( 90)A  80  Gain=100  Shift=0
```

Sample printout of CuffLink "ADAMS Adult Family 120/80" test results

To discontinue printing blood pressure test results, press escape and return to the Target Values display and press the F3 key again. CuffLink will respond with a "Printing disabled" message. You can then continue with blood pressure simulations and CuffLink will not print any of the results.

Printing Manometer, Leak Test, and Overpressure Test Results

After you perform a manometer measurement or a leak test, you can print the test results by pressing F3.

```
        *****  Pressure Test  *****


Pressure :    108.00  mmHg
```

Sample printout of CuffLink manometer test results

```
          *****  Leak Test  *****


Leak Start: 200.00mmHg; Leak Rate:8.75mmHg/m
```

Sample printout of CuffLink leak test results

```
      *****  Over Pressure Test  *****


Pop Off:    289.00 mmHg
```

Sample printout of CuffLink overpressure test results

Printing Autosequences

You can print autosequence content (the tests and their order) or autosequence test results.

AUTO-3

CuffLink Auto Sequence Test Procedure

04/13/93

Pressure Test .....YES
Leak Test .....YES
Pop Off Test .....YES
Print Results .....YES

Blood Pressure	Heart Rate (BPM)	Cycles
80/ 50(62) Adult	40	3
100/ 65(75) Adult	60	3
120/ 80(90) Adult	80	3
200/150(165) Adult	120	3
-------- Off -------	120	3
-------- Off -------	160	3
-------- Off -------	200	3
-------- Off -------	80	3

Sample printout of CuffLink adult autosequence content

Date:09/25/93 ADULT3 Page 1
Time: 08:00 CuffLink Auto Sequence

Manufacturer: ABC Co Model: XXX Ser: 101

Control#: A200 Dept: CCU Loc: BED 5

Software Rev: 3.0 Notes:

***** Pressure Test *****

Pressure: 287.75 mmHg UUT Indicates: 287 mmHg

***** Leak Test *****

Leak Start: 322.75 mmHg; Leak Rate: 0.75 mmHg/m

***** Over Pressure Test *****

Pop Off: 294.00 mmHg

***** Make Arm Results *****

Blood Pressure	Heart Rate (BPM)	Peak Press (mmHg)	Deflate Rate (mmHg/s)	Deflate Time (sec)	Inflate Rate (mmHg/s)	Inflate Time (sec)	Total Time (sec)
80/50 (62)	**40**	161	5.5	27.5	58.8	2.6	30.1
80/50 (62)A	40	Gain=100	Shift=0				
79/50 (60)	**40**	97	3.2	27.6	63.6	1.4	29.0
80/50 (62)A	40	Gain=100	Shift=0				
80/48 (61)	**40**	95	3.1	27.1	79.1	1.1	28.2
80/50 (62)A	40	Gain=100	Shift=0				
98/61 (79)	**60**	180	6.6	22.0	61.4	2.8	24.8
100/65 (75)A	60	Gain=100	Shift=0				
99/62 (73)	**60**	143	6.7	17.6	64.3	2.1	19.7
100/65 (75)A	60	Gain=100	Shift=0				
100/63 (73)	**60**	142	6.8	17.9	78.8	1.7	19.6
100/65 (75)A	60	Gain=100	Shift=0				
116/79 (89)	**80**	145	6.7	14.0	59.6	2.3	16.8
120/80 (90)A	80	Gain=100	Shift=0				
116/77 (90)	**80**	161	7.0	15.5	66.5	2.3	18.3
120/80 (90)A	80	Gain=100	Shift=0				
116/79 (91)	**80**	165	7.0	16.1	65.4	2.4	19.1
120/80 (90)A	80	Gain=100	Shift=0				
200/155 (172)	**205**	163	7.8	11.6	62.0	2.5	15.2
200/150 (165)A	200	Gain=100	Shift=0				
202/148 (165)	**205**	216	8.5	11.6	69.3	3.0	16.0
200/150 (165)A	200	Gain=100	Shift=0				
200/149 (166)	**205**	223	8.4	12.5	69.4	3.1	17.0
200/150 (165)A	200	Gain=100	Shift=0				

NOTE: Bold type represents data hand-entered by user.

Sample printout of CuffLink adult autosequence test results

AUTO-1

CuffLink Auto Sequence Test Procedure

03/24/93

Pressure Test .....YES
Leak Test .....YES
Pop Off Test .....NO
Print Results .....YES

Blood Pressure	Heart Rate (BPM)	Cycles
60/ 30(40) Adult	40	1
80/ 50(62) Adult	60	1
120/ 80(PAC) Arrhyth	80	1
120/ 80(PVC) Arrhyth	80	1
-------- Off -------	120	1
-------- Off -------	160	1
-------- Off -------	80	1
-------- Off -------	80	1

Sample printout of CuffLink adult BP with arrhythmia autosequence content

Date:09/25/93 AUTO-1 Page 1
Time: 08:41 CuffLink Auto Sequence

Manufacturer: ABC Co Model: XXX Ser: 00102

Control#: A100 Dept: CCU Loc: BED 5

Software Rev: 3.0 Notes:

***** Make Arm Results *****

Blood Pressure	Heart Rate (BPM)	Peak Press (mmHg)	Deflate Rate (mmHg/s)	Deflate Time (sec)	Inflate Rate (mmHg/s)	Inflate Time (sec)	Total Time (sec)
66/27 (35)	**39**	145	2.9	47.8	44.2	3.1	50.9
60/30 (40)A	40	Gain=100	Shift=0				
77/46 (62)	**60**	97	3.7	16.3	35.6	2.5	19.5
80/50 (62)A	60	Gain=100	Shift=0				
113/76 (89)	**80**	174	4.9	21.2	19.1	8.7	31.3
120/80 (PAC)AR	80	Gain=100	Shift=0				
119/80 (88)	**80**	158	5.2	16.6	53.6	2.8	20.8
120/80 (PVC)AR	80	Gain=100	Shift=0				

NOTE: Bold type represents data hand-entered by user.

Sample printout of CuffLink adult BP with arrhythmia autosequence test results

NEO-2

CuffLink Auto Sequence Test Procedure

04/13/93

Pressure Test .....YES
Leak Test .....YES
Pop Off Test .....NO
Print Results .....YES

Blood Pressure	Heart Rate (BPM)	Cycles
100/ 65(75) Neonate	**120**	**1**
80/ 50(62) Neonate	**120**	**1**
60/ 30(40) Neonate	**160**	**1**
100/ 65(75) Neonate	**200**	**1**
-------- Off -------	**40**	**1**
-------- Off -------	**40**	**1**
-------- Off -------	**40**	**1**
-------- Off -------	**40**	**1**

Sample printout of CuffLink neonate autosequence content

Date:09/25/93 NEO-2 Page 1
Time: 08:23 CuffLink Auto Sequence

Manufacturer: ABC Co Model: YYY Ser: 00104

Control#: N200 Dept: PICU Loc: BED 2

Software Rev: 3.0 Notes:

***** Leak Test *****

Leak Start: 337.00 mmHg; Leak Rate: 5.25 mmHg/m

***** Over Pressure Test *****

Pop Off: 263.25 mmHg

***** Make Arm Results *****

Blood Pressure	Heart Rate (BPM)	Peak Press (mmHg)	Deflate Rate (mmHg/s)	Deflate Time (sec)	Inflate Rate (mmHg/s)	Inflate Time (sec)	Total Time (sec)
100/63 (**77**)	**120**	195	6.0	31.1	49.2	3.8	34.9
100/65 (75)A	120	Gain=100	Shift=0				
98/63 (**76**)	**122**	137	5.2	18.7	61.4	2.1	22.0
100/65 (75)A	120	Gain=100	Shift=0				
99/63 (**79**)	**122**	138	5.9	16.7	65.0	2.0	19.9
100/65 (75)A	120	Gain=100	Shift=0				
79/48 (**59**)	**120**	135	5.8	22.1	45.4	2.8	24.9
80/50 (62)A	120	Gain=100	Shift=0				
80/49 (**61**)	**122**	121	6.6	17.4	56.5	2.0	19.4
80/50 (62)A	120	Gain=100	Shift=0				
79/49 (**62**)	**120**	122	5.3	16.7	54.3	2.1	19.5
80/50 (62)A	120	Gain=100	Shift=0				
59/29 (**39**)	**163**	122	6.5	17.5	42.2	2.7	20.2
60/30 (40)A	160	Gain=100	Shift=0				
59/29 (**39**)	**163**	94	6.1	14.1	53.8	1.6	15.7
60/30 (40)A	160	Gain=100	Shift=0				
59/28 (**43**)	**160**	97	6.7	13.1	38.7	2.3	15.4
60/30 (40)A	160	Gain=100	Shift=0				
99/65 (**75**)	**205**	149	10.6	13.2	23.9	5.9	19.1
100/65 (75)A	200	Gain=100	Shift=0				
100/64 (**78**)	**205**	140	8.1	10.9	45.5	2.9	15.1
100/65 (75)A	200	Gain=100	Shift=0				
98/64 (**76**)	**205**	141	10.1	13.2	51.2	2.6	15.8
100/65 (75)A	200	Gain=100	Shift=0				

NOTE: Bold type represents data hand-entered by user.

Sample printout of CuffLink neonate autosequence test results

AUTO-2

CuffLink Auto Sequence Test Procedure

03/25/93

Pressure Test .....NO
Leak Test .....NO
Pop Off Test .....NO
Print Results .....YES

Blood Pressure		Heart Rate (BPM)	Cycles
200/150(165)	Adult	200	1
150/100(115)	Adult	160	1
120/ 80	Ausc	120	1
100/ 65	Ausc	80	1
--------	Off -------	30	1
--------	Off -------	30	1
--------	Off -------	30	1
--------	Off -------	30	1

Sample printout of CuffLink auscultatory autosequence content

Date:09/25/93 AUTO-2 Page 1
Time: 08:44 CuffLink Auto Sequence

Manufacturer: ABC Co Model: XXX Ser: 00103

Control#: A300 Dept: CCU Loc: BED 5

Software Rev: 3.0 Notes:

***** Make Arm Results *****

Blood Pressure	Heart Rate (BPM)	Peak Press (mmHg)	Deflate Rate (mmHg/s)	Deflate Time (sec)	Inflate Rate (mmHg/s)	Inflate Time (sec)	Total Time (sec)
200/141(168)	**120**	231	6.3	20.7	9.4	23.8	46.3
200/150(165)A	120	Gain=100	Shift=0				
150/95(114)	**159**	241	6.3	27.4	44.8	5.2	34.1
150/100(115)A	160	Gain=100	Shift=0				
120/79(97)	**120**	186	5.2	25.7	52.4	3.4	31.0
120/ 80)	AU 120	Gain=100	Shift=0	Ausc.	Mandrel		
101/64(72)	**80**	162	4.2	24.6	53.1	2.9	29.1
100/ 65	AU 80	Gain=100	Shift=0	Ausc.	Mandrel		

NOTE: Bold type represents data hand-entered by user.

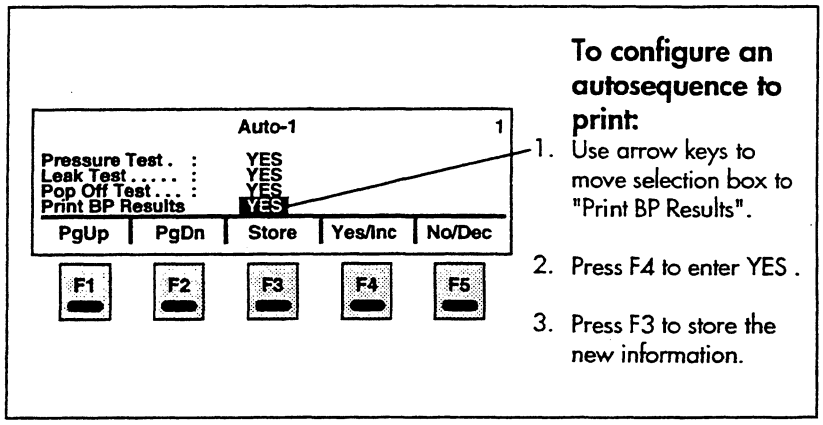
Sample printout of CuffLink auscultatory autosequence test results

Printing Autosequence Content

Go to "Auto" on CuffLink's main menu, use the arrow keys to choose "Utility" and press "Enter". Highlight the "Print" selection with the arrow keys and press the function key below the autosequence you want printed. For example, to print the content of autosequence #3, highlight "Print" and press F3. To print content of all the autosequences, select "Print All" and press "Enter".

Printing Autosequence Test Results

Go "Auto" on CuffLink's main menu, use the arrow keys to choose "Utility" and press "Enter". Highlight "Edit" and press the function key below the autosequence you want printed.



Editing an autosequence to print test results

Use the arrow keys to move to the "Print BP Results:" line. Press F4 to enter a "YES" and F3 to store the change.

If you decide you don't want an autosequence to print, press F5 to enter a "NO" on this line. Press F3 to store the change.

Note: Before starting an autosequence that will print, make sure the printer is ready or you will get a "Printer not ready" message and the autosequence will not run.

Chapter 6

Reference

CuffLink Menu Map, Firmware Version 3.20

Select BP
- ADAMS Adult
  - 60/30 (40)
  - 80/50 (62)
  - 100/65 (75)
  - 120/80 (90)
  - 150/100 (115)
  - 200/150 (165)
  - 255/195 (215)
  - HtRate
  - AdjEnv
  - Print
  - Zero Pressure
- ADAMS Neonate
  - 60/30 (40)
  - 80/50 (62)
  - 100/65 (75)
  - 120/80 (90)
  - 150/100 (115)
  - HtRate
  - AdjEnv
  - Print
  - Zero Pressure
- Arrhythmias
  - NSR
  - PAC
  - PVC
  - AF
  - MB
  - ASC
- **Auscultatory**
  - 60/30 (40)
  - 80/50 (62)
  - 100/65 (75)
  - 120/80 (90)
  - 150/100 (115)
  - 200/150 (165)
  - 255/195 (215)
  - HtRate
  - AdjEnv
  - Print
  - Utility
  - Zero Pressure

Press
- Leak Test
- Manometer
- Pop Off

Util
- Set Clock
- Pop Time
- Logo
- System
  - Print Test
  - Key Test
  - Speaker Test
    - 440
    - Adjust Play
    - Adjust Freq
    - Adjust Period
    - Sweep
  - Display Test
    - Short
    - Long
  - Display QC Date
  - ROM Checksums
    - U2
    - U3
    - U4
  - Config Init
  - User Envelope
    - Store User
    - Recal User
    - Draw User
    - Print User
    - Make Arm
  - Pulse
    - Select
    - Scale
    - Draw
    - Rate
- **Auscultatory**
  - Init Ausc
  - Set Ausc
  - Puck Test
  - Mic Stim
  - D/A Test

Comm
- Configure
- Comm Test

Auto
- Execute
- Utility
  - Edit
  - View
  - Name
  - Print
  - Init
  - Print All
  - Init All

Glossary

ADAMS Adult Family

Set of CuffLink target values designed to simulate adult blood pressure.

ADAMS Neonate Family

Set of CuffLink target values designed to simulate neonatal blood pressure.

AdjEnv

Adjust Envelope. Selection on CuffLink's ADAMS Adult or ADAMS Neonate menus from which you can adjust envelope gain and shift or draw the pressure envelope.

A to D (or A/D) converter

Analog to Digital Converter. Electronic device or circuit that converts analog input voltage to a number of equivalent digital output levels.

arrhythmia

Alteration in time or force of the normal heartbeat rhythm.

auscultatory blood pressure measurement

Blood pressure measurement done by interpreting sounds of blood flow (Korotkoff sounds) through an artery that is surrounded by the cuff.

baud rate

Rate of serial transmission measured in bits per second.

bits/character

The number of bits needed to define one keyboard character.

blood pressure

Pressure in the brachial artery at heart level.

blood pressure cycle

One CuffLink blood pressure simulation, completed by deflation of the BP cuff.

checklist

A set of instructions performed on a piece of equipment. Checklists are generated by the Sentinel or medBase1 programs and can include any medTester remote commands for CuffLink (see Chapter 4, "Commands for medTester").

controller

A device capable of controlling CuffLink operations. A medTester with Checklist or a computer with a serial port.

cuff adapter

Specialized connecting hose (consists of "T" connector, plastic tubing, and quick release connector) that provides the link from CuffLink to the NIBP system. There are several different types of cuff adapters available to accommodate many different types of NIBP monitors.

CuffPeak

Cuff Peak. Value on the "makearm" display that indicates peak cuff pressure reached during the blood pressure cycle.

CuffPress

Cuff Pressure. Value on the "makearm" display that indicates current cuff pressure during the blood pressure cycle.

cuff pressure

Pressure inside the sphygmomanometer cuff.

cursor

Dark blue rectangle on CuffLink's display that indicates a current selection.

cycle

See "blood pressure cycle".

data string

A serial data transmission. In this case, the data is values CuffLink sends to the controller.

default values

Values assigned to remote commands each time you turn CuffLink on.

DeflRate

Deflate Rate. Value on the "makearm" display that indicates the rate of cuff deflation (in mmHg/sec) at the end of the blood pressure cycle.

DeflTime

Deflate Time. Value on the "makearm" display that indicates how long (in seconds) it took for the cuff to deflate at the end of the blood pressure cycle.

diastole

Relaxation of the heart during the cardiac cycle.

diastolic blood pressure

The blood pressure that occurs during the relaxation period of the cardiac cycle.

display test

A CuffLink self test. A series of patterns are shown on the display to verify correct display operation.

EEROM

Electrically Erasable Read Only Memory. A memory device that is programmed with high voltage signals and erased electrically. In CuffLink, all user modifications are stored in EEROM.

flow control

"Handshaking". The method used by peripherals and microprocessors to inform each other when data is available to be sent or received. This is useful when the microprocessor is faster than the peripheral device (printer, etc.). CuffLink's microprocessor can fill the output buffer, go on to other tasks, and resume sending data to the peripheral when it needs more data.

gain

Amplitude, voltage. Gain affects CuffLink pressure pulse amplitude.

HtRate

Heart Rate. Adjustable from CuffLink's "Target Values" menu for both "ADAMS Adult" and "ADAMS Neonate".

impedance

Resistance or opposition to AC (sinusoidal) current that is expressed in "ohms" (W).

InflRate

Inflate Rate. Value on the "makearm" display that indicates the rate of cuff inflation (in mmHg/second) during the blood pressure cycle.

InflTime

Inflate Time. Value on the "makearm" display that indicates how long (in seconds) it took for the cuff to inflate during the blood pressure cycle.

Korotkoff sounds

Refers to the sounds blood creates when moving through vessels partially occluded by a sphygmomanometer cuff. For blood pressure determination, systolic pressure is at the point where Korotkoff sounds are first heard as the cuff begins to deflate. Diastolic pressure is at the point where the Korotkoff sounds become muffled.

K sounds

Korotkoff sounds.

leak test

Test in which an NIBP device is evaluated for leaks in the cuff or hose connections caused by incorrect or broken connections, cracks in the cuff, "O" ring deterioration, etc. Maximum leak rates are documented in the manual for each NIBP device.

local mode

CuffLink operating mode in which you control it with the keys on its front panel.

makearm

Name for the CuffLink blood pressure simulation process.

mandrel

Adjustable plastic form (supplied with CuffLink) that replaces the human arm inside the sphygmomanometer cuff. The complete adult mandrel assembly consists of 2 end blocks and 3 spacer blocks. The optional auscultatory mandrel assembly contains the auscultatory puck and connects to the adult mandrel. The neonate mandrel is a single plastic cylinder that has 3 different diameters (mandrel size is determined by cuff position).

manometer

Device for measuring pressure.

MAP

Mean Arterial Pressure. The minimum cuff pressure at which pulse amplitude is the greatest. The maximum perfusion (transfer) of oxygen from the arterial blood supply to the surrounding tissue also occurs at MAP.

millisecond

One thousandth of a second.

mmHg

Millimeters of mercury. Standard unit of pressure measurement.

neonatal

Of or relating to a newborn.

NIBP

Non-invasive Blood Pressure. A blood pressure measurement that involves no direct contact with the artery.

opto sensor

Electronic device that acts as a switch. When the CuffLink puck moves down far enough to break the light beam of this device, the switch turns off. When the light beam is not broken, the switch is on.

oscillometric blood pressure measurement

A measurement of blood pressure by monitoring changes in cuff pressure caused by the flow of blood through the artery.

overpressure test

Test in which you evaluate an NIBP device's overpressure point, or the point at which cuff pressure is great enough to cause emergency deflation.

parallel communications

Data transmission in which all bits are received or transmitted at the same time.

parallel printer port

Connection for a parallel, Centronics compatible printer.

parameter

Additional values that further define CuffLink remote commands. You can specify many different parameters for remote commands.

parity

The number of (binary) ones in a serial data stream. Even parity means the data stream has an even number of ones. Odd parity means the data stream has an odd number of ones. Different peripheral devices may need different types of parity. You need to configure CuffLink to be compatible with whatever parity the peripheral device requires (Odd, Even, or Off).

peak divide ratio

The value CuffLink uses to calculate the point of rapid cuff deflate at the end of the blood pressure cycle.

peak pressure

Maximum cuff pressure attained during the blood pressure cycle.

pixel

When referring to monitors or displays, the small elements (seen as small squares on CuffLink's display) that comprise the display. Pixels are arranged in a horizontal and vertical grid pixel number is directly related to display resolution. The greater the number of pixels in the display, the greater the resolution will be.

pop off test

See "overpressure test".

PopTime

The amount of time CuffLink displays pop-up windows. Adjustable from 0 to 5 seconds.

Pop-Up Window

Informational boxes that appear momentarily on CuffLink's display. Pop-up windows appear to confirm a choice you have made or an action CuffLink has performed.

pressure cycle

See "blood pressure cycle".

pressure envelope

Graphic representation of cuff pressure as a function of time during a blood pressure cycle.

pressure envelope gain

Increase or decrease in pressure envelope amplitude.

pressure envelope shift

Change of blood pressure envelope position along the pressure axis.

pressure pulse

Pulse, or temporary increase in blood pressure caused by the intermittent rush of blood in the arteries due to the heart's pumping action.

pressure transducer

Electronic device that converts pressure to a proportional voltage signal.

print test

Test CuffLink performs to check printer operation.

puck

Small, moveable disk that creates positive and negative pressures inside a chamber when moved by the CuffLink pressure engine. The action of the puck moving up and down within the puck chamber produces CuffLink's oscillometric blood pressure simulations. The puck inside the auscultatory mandrel simulates auscultatory blood pressure.

pulse amplitude

Height of the peripheral pulse.

pulse envelope

Imaginary line that connects the peak of each pressure pulse to form an outline. NIBP monitors use pulse envelope shape to determine diastolic and systolic blood pressures.

RAM

Random Access Memory.

remote mode

CuffLink operating mode in which you operate it with a controller (a medTester with Checklist or a PC with an RS-232 port).

returned data

Information (values) sent to a controller from CuffLink as a result of a remote command. These values can be test results, information stored in CuffLink's memory, or, if the remote command does not generate data, an asterisk.

ROM

Read Only Memory. The software program that operates CuffLink is located in ROM.

ROM checksum

The mathematical sum of the software program code (in bytes) stored in ROM. The code in ROM should never change once programmed at the factory, and a ROM checksum value indicates the integrity of the code when analyzed by a qualified service technician.

RS-232

Electronics industry standard for serial communications.

RTS/CTS

Request To Send/Clear To Send. Handshaking protocol in which an RTS signal generated by CuffLink indicates there is data to send and a CTS signal generated by the peripheral device indicates it is ready to receive data from CuffLink.

RVDU

Relative Volume Displacement Unit. The volume displaced inside the puck chamber when CuffLink's pressure engine moves one increment (one microstep).

Sentinel

Equipment management system (available from Dynatech Nevada) that tracks items such as preventative maintenance and plant operations.

serial communication

Transmission or reception of data in a bit stream, one bit at a time.

shift

See "pressure envelope shift".

stop bit

The last bit added to the bit stream by the transmitting hardware that indicates the end of the bit stream to the receiving hardware. You can specify either 1 or 2 stop bits for CuffLink.

systole

Contraction of the heart during the cardiac cycle.

systolic blood pressure

The blood pressure that occurs during the cardiac cycle when the heart contracts.

target value

A blood pressure defined by specific systolic, diastolic, and MAP values that can be simulated by CuffLink.

terminating character

Character, entered from a controller's keyboard, that informs CuffLink where the end of a serial transmission (remote command) is.

TotlTime

Total Time. Value on the "makearm" display that indicates how long (in seconds) it took for the complete blood pressure cycle.

Xon/Xoff

Transmit On/Transmit Off. It is a handshaking protocol in which a transmit on signal generated indicates data may be received.

zero pressure

CuffLink feature that allows you to zero the pressure transducer and remove any offset errors during pressure measurements.

Chapter 7

Test and Calibration

Cufflink Calibration Procedure

This procedure defines the testing of CuffLink to ensure proper operation and calibration. Section 1 defines the overall parameters of this procedure. Section 2 outlines visual inspection of PCBs, sub-assemblies and the assembled CuffLink unit as a system. Section 3 outlines voltage and clock tests. Section 4 outlines calibration checks.

EPROM and EPLD Firmware Checksum History

Version	Description	Check Sum	Date
1.00	U2 (Standard Production Firmware)	3B29	9/21/90
1.00	U2 (Manufacturer's Firmware)	3B28	9/21/90
1.00	U32 (EPLD) LOGIC DE-CODE	26EC	8/13/90
1.00	U7 (EPLD) STATE MACHINED	89A	8/13/90
1.01	U2 (Standard Production Firmware)	96B2	10/21/90
1.01	U2 (Manufacturer's Firmware)	9700	10/21/90
2.00	U2 (Standard Production Firmware)	A855	10/23/91
2.00	U3 (Standard Production Firmware)	C90F	10/23/91
3.00	U2 (Standard Production Firmware)	E7E1	4/28/93
3.00	U3 (Standard Production Firmware)	1E5D	4/28/93
3.20	U2 (Standard Production Firmware)	9C0B	2/8/94
3.20	U3 (Standard Production Firmware)	B1AB	2/8/94

Electrical Specifications

Specifications	Published Tolerance	Test Tolerances
Functional Tests		
Dynamic flow rate into approximately 300 cc volume over 10 seconds	2.00 liters/min free flow	> 1.25 liters/min dynamic flow
Arrhythmia timing		±10 ms (milliseconds)
Measurement Accuracies		
Pressure measurements (in mmHg gage)		± 1% of reading +1 count
Arrhythmia (Normal sinus) (premature) (late) (Atrial Fib - range)		750 ms ± 10 ms 638 ms ± 10 ms 862 ms ± 10 ms 630 - 870 ms
Auscultatory D/A output (Use normal mandrel output) Level 0 - OFF 3.0 VDC Level 1 2 VDC Level 2 4 VDC Level 3 6 VDC Level 4 NOT USED (0 VDC)		 ±100 mVdc ±100 mVdc ±100 mVdc ±100 mVdc ±100 mVdc

Equipment Required

You will need the following equipment for this procedure:

1. Digital MultiMeter (DMM) - 5 1/2 digit - with TRUE RMS AC
2. Oscilloscope Tektronix 2211 or equivalent with probes
3. Precision voltage source
4. Printer with Centronics parallel interface
5. Basic hand and soldering tools
6. Large tub like container for leak test
7. 300 to 500 cc reservoir
8. Distilled water
9. Universal Frequency Counter HP model 5315A or equivalent
10. Pressure Meter - 0 to 500 mmHg, 0.08 % minimum accuracy
11. NIBP monitor

Visual Inspection

CuffLink System

1. Place CuffLink on a work surface.
2. Remove ten (10) screws holding top cover to unit.
3. Lift top cover and rotate it to the right.
4. Leave cables attached and place top cover vertically along side of the unit.
5. Inspect transformer connections for proper shrink tubing fit over all soldered connections.
6. Inspect power entry module connections for proper fit of shrink tubing over all soldered connections except ground wire on EMI filter.
7. All connections to PCB are to be correct and secure.
8. Correct jumper settings:
   a. W1 - INSTALLED in 'TEST' position
   b. W4 - through W8 – NOT installed
9. Check for correct versions of EPROMs U2 & U3. They should be installed properly (correct direction, no pins sticking out, etc.) and each ZIF should be closed securely.
10. Ensure PLDs (U7 & U32) are correct version and installed properly.
11. Ensure PLCCs (U1 & U14) are installed properly.
12. Ensure ground wire is attached to PCB and keyboard.
13. Check for correct attachment of plumbing to:
    a. pressure engine assembly
    b. front panel connector
    c. pressure transducer
    d. pump
    e. check valve
    f. release valve
14. Ensure that silicon tubing is secured with hose clamps.

Battery Test

1. Ensure jumper W1 is in the 'NORM' position.
2. Set meter to Volts DC in the 20 millivolt (mV) range.
3. Connect the DMM test probes between TP29 and TP30 and record the voltage.
4. Calculate the current drain on the battery by dividing the resistance of R62 (10 Ω) by the voltage drop across TP29 and TP30.
5. Maximum voltage drop across TP29 & TP30 = 0.5 mV dc.

   Maximum current drain is 50 uA (0.05 mA).
6. Test VBAC by attaching negative test probe to TP47 and positive probe to TP7.
7. Voltage reading should be 2.8 volts or greater.

Board Tests

Raw DC Voltage Checks

1. Connect CuffLink to a VARIAC.
2. Turn VARIAC output control CCW (zero output).
3. Turn VARIAC on and adjust CW output control until output is approximately 30 Vac.
4. Test regulator inputs as follows:

   a. Turn VARIAC to 30 Vac and perform the following voltage readings:

Connect Negative Probe to TP33 **Connect Positive Probe to:**	**Signal Description**	**Voltage Should Be:**
TP51	Digital Raw (U17)	4.5 V ± 1 V
TP52	+ Analog Raw (U18)	10 V ± 1 V
TP53	- Analog Raw (U19)	-10 V ± 1 V
TP50	Raw (U35 and U36)	26 V ± 2 V

   b Turn VARIAC to 60 Vac and perform the following voltage readings:

Connect Negative Probe to TP33 **Connect Positive Probe to:**	**Signal Description**	**Voltage Should Be:**
TP51	Digital Raw (U17)	10.5 V ± 1 V
TP52	+ Analog Raw (U18)	21 V ± 2 V
TP53	- Analog Raw (U19)	-21 V ± 1 V
TP50	Raw (U35 and U36)	54 V ± 5 V

c. Turn VARIAC to 120 Vac and perform the following voltage readings:

Connect Negative Probe to TP33 Connect Positive Probe to:	Signal Description	Voltage Should Be:
TP51	Digital Raw (U17)	2.2 V ± 0.5 V
TP52	+ Analog Raw (U18)	5 V ± 1 V
TP53	- Analog Raw (U19)	-5 V ± 1 V
TP50	Raw (U35 and U36)	12.5 V ± 2 V

DC Voltage Checks

1. Connect CuffLink to 120 Vac.
2. Test regulator inputs as follows:

   Turn VARIAC to 120 Vac and perform the following voltage readings:

Connect Negative Probe to TP33 Connect Positive Probe to:	Signal Description	Voltage Should Be:
TP9	+ 35 V Phase A	35 V ± 1 V
TP52	+ 35 V Phase B	35 V ± 1 V
TP53	+ 5 V Digital	5 V ± 0.25 V
TP50	+ 12 V Analog	12 V ± 0.5 V
TP50	- 12 V Analog	-12 V ± 0.5 V

3. Feel the heat sink - it should be slightly above room temperature.

System Clock Test

1. Set the scope sweep time to 0.1 µsec/div.
2. Set the scope channel 1 (A) to 1 volt per division.
3. Attach scope probe to TP1 (SYS CLK) and Gnd.
4. One pulse per 2 divisions.
5. Set frequency counter to 'FREQ A'.
6. Set frequency counter gate delay near 'MIN'.
7. Set frequency counter trigger level about midway between '-' and '+'.
8. Set frequency counter Channel A to 'DC'.
9. Set frequency counter to positive slope.
10. Attach scope probe BNC connector to Channel A of frequency counter.
11. Adjust frequency counter trigger level and gate time until you obtain a stable reading.
12. Frequency must be 4.9152 MHz ± 500 Hz. (4,914,700 to 4,915,700).

1 ms Interrupt

1. Set scope sweep time to 0.5 msec/div.
2. Set scope Channel 1 (A) to 1 volt per division.
3. Attach scope probe to TP2 (1ms INT) and Gnd.
4. Pulse frequency should be 1000 Hz (± 1 Hz 1 msec apart or 999 Hz to 1001 Hz).

System Clock / 2

1. Set scope sweep time to .2 µsec/div.
2. Set scope channel 1 (A) to 1 volt per division.
3. Attach scope probe to U32 pin 7 and Gnd.
4. One pulse per 2 divisions.
5. Set frequency counter to 'FREQ_A'.
6. Set frequency counter gate delay near 'MIN'.
7. Set frequency counter trigger level about midway between '-' and '+'.
8. Set frequency counter Channel A to 'DC'.
9. Set frequency counter to positive.
10. Attach scope probe BNC connector to Channel A of frequency counter.
11. Adjust frequency Counter trigger level and gate time until stable reading is obtained.
12. Frequency must be 2.4576 MHz ± 250 Hz. (2,457,350 to 2,457,850).

Test 1Hz clock

1. Set scope sweep time to .5 sec/div.
2. Set scope Channel 1 (A) to 1 volt per division.
3. Attach scope probe to TP8 (1HZ CLK) and Gnd.
4. Pulse frequency should be 1 Hz (1 sec apart or one pulse per 2 divisions).
5. Set frequency counter to 'FREQ_A'.
6. Set frequency counter gate delay near 'MIN'.
7. Set frequency counter trigger level about midway between '-' and '+'.
8. Set frequency counter channel A to 'DC'.
9. Set frequency counter to positive.
10. Attach scope probe BNC connector to Channel A of frequency counter.
11. Adjust frequency Counter trigger level and gate time until stable reading is obtained.
12. Frequency must be 1 Hz ± 0.00001 Hz. (.99999 to 1.00001).

Analog Circuit Reference Voltages

1. Set DMM to DC Volts, 20 Volt range.
2. Attach NEG probe to Gnd.
3. Attach POS probe to TP14 (10V A/D REF).
4. Reading must be 10.0 VDC ± .25 V.
5. Move 'POS' probe to TP19 (10V REF).
6. Reading must be 10.0 VDC ± .25 V.

Pressure Sensor Circuitry Tests

1. Set pressure in system to zero by ensuring that nothing is attached to 'CUFF CONNECT' on CuffLink's front panel.
2. Set DMM to DC Volts, 20 Volt range.
3. Attach NEG probe to Gnd.
4. Attach POS probe to TP37 (PR LOW).
5. Reading should be 5.00 Vdc ± .10 Vdc.
6. Attach POS probe to TP38 (PR HI).
7. Reading should be 5.00 Vdc ± .10 Vdc.
8. Attach POS probe to TP16 (FILT CUFF).
9. Reading should be 0.00 Vdc.
10. Slowly rotate R64 trim pot CW and CCW. Note the changes (Range -.12 to +.12 Vdc).
11. Adjust to zero (0) ± .001 Vdc.

Systems Test and Final Calibration Procedure

Clock

1. Select 'UTIL' in MAIN MENU and then press 'Ent'.
2. Select 'SET CLOCK' and press 'Ent'.
3. Check the time - it should be accurate within two (2) minutes.
4. Check date and day for accuracy.
5. Press enter to 'SAVE' data.
6. Exit this menu.

Printer

1. Connect printer cable from printer to J3 of CuffLink.
2. Select 'System' and press 'Ent'.
3. Select 'Print Test' and press 'Ent'.
4. Printout should read 'Printer test message'.
5. Exit this menu.

Speaker

1. Select 'Util' in Main Menu and press 'Ent'.
2. Select 'System' and press 'Ent'.
3. Select 'Speaker Test' and press 'Ent'.
4. Adjust volume for maximum.
5. Press 'F5' and rotate volume control to ensure volume decreases and increases.
6. Exit this menu.

Pressure Leak Test

1. Release all pressure in CuffLink.
2. Verify reading on a calibrated meter.
3. Connect 1/4' Tygon tubing from CuffLink to reservoir and calibrated meter.
4. Pressurize system to 300 mmHg ± 20 mmHg.
5. Verify reading on Calibrated meter.
6. Allow 2 minutes for pressure in system to stabilize.
7. Leak rate of system must be less than 5 mmHg in 1 (one) minute.
8. Exit this menu.

Pressure Calibration

1. Select 'System' and press 'Ent'.
2. Press 'F6' internal 'Cal' switch.
3. Select "Cal Press' and press 'Ent'.
4. Set DMM to DC Volts, 20 Volt range.
5. Connect one end of coaxial cable to 'CUFF' on front of CuffLink.
6. Connect other end of coaxial cable to DMM.
7. Ensure nothing is connected to 'CUFF' connector on CuffLink.
8. Adjust R64 (Offset) to .0000 Vdc ± 1 mV on DMM.
9. Press F2 ('Offset') on CuffLink to display Offset factor.
   a. Adjust Offset factor until Offset factor equals Raw A/D VIA 'UP' and 'DOWN' arrow keys.
10. Connect 1/4' Tygon tubing from CuffLink to reservoir and meter.
    a. Pressurize CuffLink to 300 mmHg ± 20 mmHg.
    b. Wait approximately 2.00 minutes for pressure to stabilize.
    c. Adjust R54 (Gain) until DMM reading equals pressure meter reading ± .5 mV.
    d. Press F3 ('Gain') on CuffLink to display 'GAIN' factor.
    e. Verify reading on CuffLink display and adjust Gain factor until CuffLink pressure reading equals calibrated meter pressure reading VIA 'UP' and 'DOWN' arrow keys.
    f. When readings are correct, press 'Ent' and then press 'Ent' again to save values to EEPROM.
11. Release all pressure from system.
12. Exit this menu.

State Machine Step Count

1. Universal Counter method (HP model 5315A):
   a. Press blue button IN.
   b. Press 'TOT START/TOT STOP' button IN.
   c. Press 'RESET' on Counter before each count.
   d. Set counter to DC coupling.
   e. Set counter to X1 attenuation.
   f. Set counter 100 KHz 'IN'.
   g. Set counter to '+ slope'.
   h. Adjust trigger level CCW from full CW position until LED begins to light.
   j. Attach probe to TP34 (STEP CNT) and Gnd.
   k. Attach probe to Channel A input.
   l. Select 'System' under 'Util" in MAIN MENU and then press 'Ent', then press internal; 'F6' key.
   m. Select 'Move Motor' and press 'Ent'.
   n. Press 'F4' to start motor in POSitive direction.
   p. Press 'F1' to move motor 10 steps.
   r. Read count on counter.
   s. Count must be 10 ± 0.
2. Exit this menu.

Calibrate Motor Drivers

1. Set DMM to DC Volts and 20 Volt range.
2. Attach 'POS' probe to TP35 (VREF-A) and 'NEG' probe to TP36 (VREF-B).
3. Select 'Motor Balance' and press 'Ent' on CuffLink.
4. Press 'F3' key and adjust R38 (BAL) to 0.0000 Vdc ± .5 mV.
5. Move 'NEG' probe to TP46 (DCOM Ground).
6. Press 'F1' key and adjust R47 (LEV) to 7.20 Vdc ± .05 Vdc (50 mV).
7. Repeat steps 5 through 8 to verify test results.
8. RMS voltage check for balance:
   a. Set DMM to RMS AC Volts, 2 Volt range.
   b. Attach 'NEG' probe to TP44 (IBLO).
   c. Attach 'POS probe to TP41 (IAHI).
   d. Note reading on meter.
   e. Move 'POS' probe to TP43 (IBHI).
   f. Adjust R38 (BAL) to mean of TP41 and TP43 readings.
9. Exit this menu.

Puck Position Test

1. Select 'Util' Menu and press 'Ent' on CuffLink.
2. Select 'System' Menu and press 'Ent' on CuffLink.
3. Select 'Sys Config' press 'Ent' then press 'F6' Cal switch.
4. Select 'Puck Position' and press 'Ent'.
5. 'NEW DATA' should be within 500 of 'OLD DATA'.
6. Execute this test until Step 5 is satisfied but no more than five (5) times. If item Step 5 still is not satisfied, troubleshoot the opto-coupler circuitry.
7. Exit this menu.

Low Battery Detection Circuitry

1. Place W1 in 'TEST' position.
2. Select 'Bat Threshold' and press 'Ent' on CuffLink.
3. Set Precision Power Source to + 3.0 Vdc.
4. Connect 'POS' source to TP6 (VBATT), 'NEG' to TP46 (DCOM).
5. Assure CuffLink display reads 'BATTERY LO' when voltage is less than 2.40 Vdc and 'BATTERY OK' when voltage is above 2.7 Vdc.
6. Trip point should be at 2.6 Vdc ± 0.25 V. (2.35 to 2.85 Vdc).
7. Return W1 to 'NORM' position.
8. Exit this menu.

Pressure Output Tests

1. Low Pressure check:
   a. Set scope sweep time to .2 sec/div.
   b. Set scope Channel 1 (A) to 1 Vdc per division.
   c. Set scope Channel 2 (B) to 10mV per division.
   d. Set scope TRIG to External input.
   e. Adjust Channel 1 (A) and 2 (B) ground traces to third graticule down from center of screen.
   f. Set both channel inputs to DC.
   g. Attach coax cable from 'CUFF' output to Channel 2 (B).
   h. Attach coax cable from 'PULSE' output to Channel 1 (A).
   i. Attach coax cable from 'SYNC' to EXT TRIG.
   j. Select 'Pulse Scale' in Sys Config menu and press 'Ent'.
   k. Connect reservoir and calibrated meter to CuffLink.
   l. Pressurize the system to 20 mmHg ± 5 mmHg.
   m. Press 'Ent' to start motor.
   n. Channels 1 & 2 should be within 1 minor division of each other in amplitude.
2. Exit this menu.

MAKEARM Functional Test

1. Select 'Select BP' in MAIN MENU and press 'Ent'.
2. Press 'Ent' to select pressure curve.
3. Connect coax cable from "SYNC" output on CuffLink to Universal frequency counter.
4. Connect Non-Invasive Blood Pressure (NIBP) Monitor to CuffLink.
5. Start NIBP Monitor.
6. Check curves as follows:

200/150	(165)	If selectable, use 200 BPM Heart rate
120/80	(90)	If selectable, use 120 BPM Heart rate
80/50	(62)	If selectable, use 60 BPM Heart rate

7. Ensure Heart rate displayed on Counter is as follows:

   NOTE: Heart rate menu is activated by pressing 'F1' key in pressure menu.

200 BPM	=	300 msec	± 2 msec sync pulse frequency
120 BPM	=	500 msec	± 2 msec sync pulse frequency
80 BPM	=	750 msec	± 2 msec sync pulse frequency
60 BPM	=	1000 msec	± 2 msec sync pulse frequency

Pump Test

1. "Pump Test" is in the "Factory Utilities" menu.
2. Use a 300cc reservoir for dynamic flow test.
3. Ensure all pressure is released from system before starting this test. Flow rate (in liters per minute) should be 1.25 or greater.

Arrhythmia Tests

1. On CuffLink's main menu, move to "Select BP", choose "Arrhythmias", and press "Ent".
2. Select "PAC" and press "Ent".
3. Connect a liter reservoir to CuffLink.
4. Pressurize CuffLink to 90 mmHg ±5 mmHg (MAP for 120/80 curve).
5. Allow CuffLink to run until at least one Arrhythmia is centered on the scope. Make sure there are normal pulses before and after the arrhythmia.
6. Using the time base cursors on the scope confirm that the normal pulses are 750 ms ± 5ms. The time base from the last normal pulse to the first aberrant pulse should be 640ms ± 10ms. The time base to the next pulse should be 860ms ± 10ms. The time base to the next normal pulse should be 750 ms. The amplitude of the first aberrant pulse should be lower than previous normal pulses. The amplitude of the pulse at time base of 860 ms should be greater than normal pulses.

Auscultatory Option Tests

1. On CuffLink's main menu, go to "Select BP", select "Auscultatory" and press "Ent".
2. Select "120/80" and press "Ent".
3. Connect a 300cc reservoir to CuffLink.
4. Pressurize CuffLink to 120 mmHg ±5 mmHg (Systole for the 120/80 curve).
5. At Systole the auscultatory pulse leading edge coincides with the peak of the oscillometric pulse.
6. Pressurize CuffLink to 80 mmHg ±5 mmHg (Diastole for the 120/80 curve).
7. At Diastole the auscultatory pulse leading edge coincides with the beginning of the oscillometric pulse.
8. Pressurize CuffLink to 90 mmHg ±5 mmHg (MAP for 120/80 curve).
9. At MAP the auscultatory pulse leading edge occurs midway between the beginning and the peak of the oscillometric pulse.
10. To test the microphone output, go to "Util", select "System", then select "Auscultatory". Use "Test" to check amplitude of the microphone output. Use "D/A Test" to test the two dual D/A outputs. By pressing the F5 key the first level is output. Press the F5 key once to advance to the second level. Press the F5 key once to advance to the third level. Press the F5 key once to advance to the fourth level (not active for version 1.0 of Ausc software). Press the F5 key once to return to the active menu.

Chapter 8

Technical Information

Reference	Part Number	Description	Qty.
CuffLink Analog Output Cable Assembly			
201562			
P010	2710-0018	CONN 6 PIN BODY ONLY - MOLEX	1
ZZ01	2716-0027	TERM CRIMP	6
ZZ02	3006-0001	WIRE COAX RG174A\U 12"	1
ZZ03	3006-0001	WIRE COAX RG174A\U 11"	1
ZZ04	3006-0001	WIRE COAX RG174A\U 10"	1
ZZ05	3012-0001	CABLE TIE NYLON	1
ZZ06	3040-0042	TUBE #14 TEFLON .75 LG	3
ZZ07	5001-0326	TYTON TABTAGS 1 x .5 x 1.437	2
ZZ08	5001-0326	TYTON TABTAGS 1 x .5 x 1.437	2
ZZ09	5001-0326	TYTON TABTAGS 1 x .5 x 1.437	2
CuffLink Auscultatory Option PCB Assembly			
205110			
C011	0401-0007	CAP DIP 1MF 35V	1
C012	0418-0008	CAP CERA 0.1MF 50V	1
C013	0415-0086	CAP MICA 30PF 5% 500V	1
C014	0415-0086	CAP MICA 30PF 5% 500V	1
C015	0401-0016	CAP DIP 47MF 25V	1
C041	0401-0007	CAP DIP 1MF 35V	1
C042	0418-0008	CAP CERA 0.1MF 50V	1
C051	0401-0007	CAP DIP 1MF 35V	1
C052	0418-0016	CAP CERA .001 UF 50V	1
C071	0401-0007	CAP DIP 1MF 35V	1
C072	0418-0016	CAP CERA .001 UF 50V	1
C081	0418-0008	CAP CERA 0.1MF 50V	1
C091	0418-0008	CAP CERA 0.1MF 50V	1
C092	0418-0008	CAP CERA 0.1MF 50V	1
C101	0418-0008	CAP CERA 0.1MF 50V	1
C111	0418-0008	CAP CERA 0.1MF 50V	1
C112	0418-0008	CAP CERA 0.1MF 50V	1
C121	0415-0100	CAP MICA 100PF 500V	1
C122	0418-0008	CAP CERA 0.1MF 50V	1
C123	0418-0008	CAP CERA 0.1MF 50V	1
C124	0401-0015	CAP DIP 10MF 25V	1
C125	0415-0012	CAP MICA 18PF 300V	1
C126	0418-0008	CAP CERA 0.1 MF 50V	1
C131	0418-0009	CAP 1MF 50 V CERAMIC	1
C141	0403-0052	CAP DIP 6.8MF 50V	1

Reference	Part Number	Description	Qty.
CuffLink Auscultatory Option PCB Assembly, continued			
C142	0401-0015	CAP DIP 10MF 25V	1
D121	2102-0039	LM385Z-1.2 VOLTAGE REF TO-92	1
D141	2101-0005	DIODE 1N4005	1
D142	2101-0005	DIODE 1N4005	1
J010	2710-0288	CONN, FLAT CBL 50 PIN BOX HDR	1
J040	2710-0008	CONN 3PIN BRD MOUNT	1
J050	2710-0007	CONN 2PIN PCB MOUNT	1
J060	2710-0187	2 PIN PCB MT .1 SPC	1
R011	0307-1014	RES MF 1/8W 1% 10K	1
R012	0307-1014	RES MF 1/8W 1% 10K	1
R013	0307-1014	RES MF 1/8W 1% 10K	1
R014	0307-1014	RES MF 1/8W 1% 10K	1
R091	0307-1184	RES MF 1/8W 1% 15K	1
R121	0307-1324	RES MF 1/8W 1% 21K	1
R122	0307-1324	RES MF 1/8W 1% 21K	1
R123	0307-1514	RES MF 1/8W 1% 33.2K	1
R125	0307-1014	RES MF 1/8W 1% 10K	1
R126	0307-1014	RES MF 1/8W 1% 10K	1
R127	0307-1884	RES MF 1/8W 1% 80.6K	1
R131	0303-1560	RES CC 1W 5% 5.6	1
R132	0303-1560	RES CC 1W 5% 5.6	1
R133	0307-1014	RES MF 1/8W 1% 10K	1
R134	0307-1935	RES MF 1/8W 1% 909K	1
R135	0307-1315	RES MF 1/8W 1% 205K	1
R141	0303-1560	RES CC 1W 5% 5.6	1
R142	0303-1560	RES CC 1W 5% 5.6	1
R143	0307-1493	RES MF 1/8W 1% 3.16K	1
R144	0307-1382	RES MF 1/8W 1% 243	1
RN11	0317-0006	RES NET SIP 10K	1
RN41	0317-0006	RES NET SIP 10K	1
TB01	2710-0296	CONN, 6 PIN SIP .200 CENTERS	1
TB02	2710-0294	CONN, 4 PIN SIP .200 CENTERS	1
TB03	2710-0294	CONN, 4 PIN SIP .200 CENTERS	1
U010	2122-0115	MPU NEC V25,5MHZ UPD70320L/332	1
U040	2122-0137	IC PROG'D EPLD CUFFLINK U32	1
U050	2122-0238	IC EPROM CUFF AUSC U50 ASSY	1
U070	2122-0131	IC 128KX8 STATIC RAM 581000P	1
U080	2122-0143	I.C. DAC PM7528	1
U090	2118-0116	IC LF442CN	1
U100	2122-0143	I.C. DAC PM7528	1

Reference	Part Number	Description	Qty.
CuffLink Auscultatory Option PCB Assembly, continued			
U110	2118-0116	IC LF442CN	1
U120	2118-0116	IC LF442CN	1
U130	2118-0161	IC POWER TRANSISTOR LM395T	1
U140	2118-0050	IC LM 317T VOLT REG	1
Y001	1220-0021	CRYSTRL 9.8304 MHZ PARA RESON	1
ZZ01	2712-0046	SCKT IC 84 PIN PLCC	1
ZZ02	2712-0048	SCKT IC 44 PIN PLCC	1
ZZ03	2712-0052	SCKT IC 32PIN DIP	2
ZZ04	2712-0017	SCKT IC 20PW DIP	2
ZZ05	2712-0003	SCKT IC 8 PIN DIP	3
ZZ06	4906-0009	SIL PAD TO 220 SING	2
ZZ07	4402-0018	HEATSINK 6070 W/6071	2
ZZ08	4704-2435	SCREW PPH 6-32 X 3/8	2
ZZ09	4711-9720	NUT KEP 6-32 X 1/4	2
ZZ10	5201-0326	CUFFLINK AUSCULT PCB BASIC	1

CuffLink Display Electrical Assembly
201555

P007	2710-0014	CONN 2 PIN BODY ONLY	1
ZZ02	2410-0018	LCD DSPY 240 X 64 W/BCKLITE	1
ZZ03	2716-0027	TERM CRIMP 18-24 AWG	2
ZZ04	3004-0806	WIRE #22 19/34S BLU 14" LONG	2
ZZ05	3010-0297	CUFFLINK DISPLAY CABLE ASSY	1
ZZ06	3012-0001	CABLE TIE NYLON	3

Reference	Part Number	Description	Qty.
CuffLink External Adjust Electrical Assembly			
201558			
P006	2710-0019	CONN 8 PIN BODY ONLY	1
R014	0327-0073	RES VAR 10K LINEAR TAPER	1
R073	0327-0073	RES VAR 10K LINEAR TAPER	1
SP01	0801-0026	SPEAKER 2 INCH	1
ZZ01	2716-0027	TERM CRIMP 18-24 AWG	8
ZZ02	3004-0800	WIRE #22 19/34S BLK 15.0"	1
ZZ03	3004-0801	WIRE #22 19/34S BRN 7.0"	1
ZZ04	3004-0802	WIRE #22 19/34S RED 7.0"	1
ZZ05	3004-0803	WIRE #22 19/34S ORG 16.0"	1
ZZ06	3004-0804	WIRE #22 19/34S YLW 7.0"	1
ZZ07	3004-0805	WIRE #22 19/34S GRN 7.0"	1
ZZ08	3004-0806	WIRE #22 19/34S BLU 7.0"	1
ZZ09	3012-0001	CABLE TIE	4
ZZ10	3004-0807	WIRE #22 19/34S VIO 7.0"	1
CuffLink Fan Electrical Assembly			
201557			
P013	2710-0014	CONN 2 PIN BODY ONLY	1
ZZ01	2716-0027	TERM CRIMP 18-24 AWG	2
ZZ02	4102-0011	24 VDC FAN	1
ZZ03	4713-0014	PCB PRESS NUT 6-32 THD	4

Reference	Part Number	Description	Qty.
CuffLink Keyboard Assembly			
201512			
D001	2102-0034	1N6267 TRAN SUP	1
D002	2102-0034	1N6267 TRAN SUP	1
D003	2102-0034	1N6267 TRAN SUP	1
D004	2102-0034	1N6267 TRAN SUP	1
D005	2102-0034	1N6267 TRAN SUP	1
D006	2102-0034	1N6267 TRAN SUP	1
D007	2102-0034	1N6267 TRAN SUP	1
D008	2102-0034	1N6267 TRAN SUP	1
R001	0307-1013	RES MF 1/8 W 1% 1K	1
R002	0307-1013	RES MF 1/8 W 1% 1K	1
R003	0307-1013	RES MF 1/8 W 1% 1K	1
R004	0307-1013	RES MF 1/8 W 1% 1K	1
R005	0307-1013	RES MF 1/8 W 1% 1K	1
R006	0307-1013	RES MF 1/8 W 1% 1K	1
R007	0307-1013	RES MF 1/8 W 1% 1K	1
R008	0307-1013	RES MF 1/8 W 1% 1K	1
SW01	2505-0028	SWITCH OBROUND BUTTON BLK	1
SW02	2505-0028	SWITCH OBROUND BUTTON BLK	1
SW03	2505-0028	SWITCH OBROUND BUTTON BLK	1
SW04	2505-0028	SWITCH OBROUND BUTTON BLK	1
SW05	2505-0028	SWITCH OBROUND BUTTON BLK	1
SW06	2505-0028	SWITCH OBROUND BUTTON BLK	1
SW07	2505-0028	SWITCH OBROUND BUTTON BLK	1
SW08	2505-0028	SWITCH OBROUND BUTTON BLK	1
SW09	2505-0028	SWITCH OBROUND BUTTON BLK	1
SW10	2505-0028	SWITCH OBROUND BUTTON BLK	1
SW11	2505-0028	SWITCH OBROUND BUTTON BLK	1
ZZ01	3010-0298	CUFFLINK KBRD CABLE ASSY	1
ZZ02	5201-0259	CUFFLINK KBRD PCB - BASIC	1

Reference	Part Number	Description	Qty.
CuffLink Main PCB Assembly			
201508			
B001	1001-5001	BATTERY 2/3 A 3V LITHIUM	1
C001	0415-0086	CAP MICA 30PF 5% 500V	1
C002	0415-0086	CAP MICA 30PF 5% 500V	1
C004	0418-0008	CAP CERA 0.1MF 50V	1
C005	0401-0007	CAP DIP 1MF 35V	1
C007	0418-0008	CAP CERA 0.1MF 50V	1
C008	0401-0010	CAP DIP 10MF 20V	1
C009	0418-0085	CAP CERM .0022UF 50V	1
C010	0418-0085	CAP CERM .0022UF 50V	1
C011	0418-0085	CAP CERM .0022UF 50V	1
C012	0418-0085	CAP CERM .0022UF 50V	1
C013	0418-0085	CAP CERM .0022UF 50V	1
C014	0418-0085	CAP CERM .0022UF 50V	1
C015	0418-0085	CAP CERM .0022UF 50V	1
C016	0418-0085	CAP CERM .0022UF 50V	1
C017	0418-0085	CAP CERM .0022UF 50V	1
C018	0403-0065	CAP ELECT 3300 UF 80V	1
C019	0403-0063	CAP ELECT 6800UF 25V	1
C021	0403-0052	CAP ELECT 6.8MF 50V	1
C022	0403-0064	CAP ELEC 2200UF 50V	1
C023	0403-0064	CAP ELEC 2200UF 50V	1
C024	0403-0052	CAP ELECT 6.8MF 50V	1
C025	0403-0052	CAP ELECT 6.8MF 50V	1
C026	0418-0014	CAP,CERA .01UF 50V	1
C027	0401-0007	CAP DIP 1MF 35V	1
C028	0418-0014	CAP,CERA .01UF 50V	1
C029	0401-0007	CAP DIP 1MF 35V	1
C030	0418-0014	CAP,CERA .01UF 50V	1
C031	0401-0007	CAP DIP 1MF 35V	1
C032	0410-0011	CAP METAL POLY O.1 MF	1
C033	0410-0011	CAP METAL POLY O.1 MF	1
C034	0401-0007	CAP DIP 1MF 35V	1
C035	0401-0007	CAP DIP 1MF 35V	1
C036	0418-0008	CAP CERA 0.1MF 50V	1
C037	0418-0008	CAP CERA 0.1MF 50V	1
C039	0401-0007	CAP DIP 1MF 35V	1
C040	0401-0007	CAP DIP 1MF 35V	1
C041	0410-0011	CAP METAL POLY O.1 MF	1
C042	0410-0011	CAP METAL POLY O.1 MF	1
C043	0415-0091	CAP MICA 47PF 500V	1

Reference	Part Number	Description	Qty.
CuffLink Main PCB Assembly, continued			
C044	0418-0008	CAP CERA 0.1MF 50V	1
C045	0415-0124	CAP MICA 820PF 300V	1
C046	0415-0124	CAP MICA 820PF 300V	1
C047	0418-0008	CAP CERA 0.1MF 50V	1
C048	0415-0124	CAP MICA 820PF 300V	1
C049	0415-0124	CAP MICA 820PF 300V	1
C050	0415-0009	CAP 10PF 100V M	1
C051	0415-0009	CAP 10PF 100V M	1
C052	0410-0011	CAP METAL POLY O.1 MF	1
C053	0410-0011	CAP METAL POLY O.1 MF	1
C054	0410-0007	CAP POLYCARB .47MF 250V	1
C055	0418-0008	CAP CERA 0.1MF 50V	1
C056	0418-0008	CAP CERA 0.1MF 50V	1
C057	0418-0008	CAP CERA 0.1MF 50V	1
C061	0418-0008	CAP CERA 0.1MF 50V	1
C063	0401-0007	CAP DIP 1MF 35V	1
C064	0403-0062	CAP ELECT 1000MF 50V	1
C065	0403-0062	CAP ELECT 1000MF 50V	1
C066	0403-0003	CAP ELECT 1000MF 10V	1
C067	0401-0007	CAP DIP 1MF 35V	1
C068	0418-0016	CAP CERA .001UF 50V	1
C069	0418-0016	CAP CERA .001UF 50V	1
C070	----------	NOT INSTALLED	0
C071	----------	NOT INSTALLED	0
C072	0418-0076	CAP CERM 100PF 50V	1
C073	0418-0076	CAP CERM 100PF 50V	1
C074		CAP SELECT	1
C075		CAP SELECT	1
C076		CAP SELECT	1
C077		CAP SELECT	1
C078		CAP SELECT	1
C079		CAP SELECT	1
C080		CAP SELECT	1
C081		CAP SELECT	1
C082		CAP SELECT	1
D001	2101-0010	DIODE 1N914 / 1N4148	1
D002	2101-0010	DIODE 1N914 / 1N4148	1
D003	2103-0008	DIODE BRIDGE MDA970A1	1
D004	2101-0005	DIODE IN4005	1
D005	2101-0005	DIODE IN4005	1

Reference	Part Number	Description	Qty.
CuffLink Main PCB Assembly, continued			
D006	2103-0005	DIODE VM 18	1
D007	2101-0005	DIODE IN4005	1
D008	2101-0005	DIODE IN4005	1
D009	2101-0005	DIODE IN4005	1
D010	2101-0005	DIODE IN4005	1
D012	2101-0029	DIODE ULTRA-FAST UF 4001	1
D013	2101-0029	DIODE ULTRA-FAST UF 4001	1
D014	2101-0029	DIODE ULTRA-FAST UF 4001	1
D015	2101-0029	DIODE ULTRA-FAST UF 4001	1
D017	2101-0005	DIODE IN4005	1
D018	2101-0005	DIODE IN4005	1
D019	2101-0005	DIODE IN4005	1
D020	2101-0005	DIODE IN4005	1
D021	2101-0010	DIODE 1N914 / 1N4148	1
D022	2101-0010	DIODE 1N914 / 1N4148	1
F001	1005-0186	FUSE 3A SLO-BLO	1
F002	1005-0185	FUSE 1/2A SLO-BLO	1
F003	1005-0185	FUSE 1/2A SLO-BLO	1
J002	2710-0280	25 PIN D-SHELL MALE	1
J003	2710-0279	25 PIN D-SHELL FEMALE	1
J004	2710-0283	14 PIN RIBBON HEADER ENCL	1
J005	2710-0281	20 PIN RIBBON HEADER	1
J006	2710-0012	CONN 8PIN PCB MOUNT	1
J007	2710-0007	CONN 2PIN PCB MOUNT	1
J008	2710-0011	CONN 6PIN BRD MOUNT	1
J009	2710-0288	CONN, FLAT CBL 50 PIN BOX HDR	1
J010	2710-0011	CONN 6PIN BRD MOUNT	1
J011	2710-0008	3 PIN MOLEX PCB MOUNT	1
J012	2710-0012	CONN 8PIN PCB MOUNT	1
J013	2710-0007	CONN 2PIN PCB MOUNT	1
J016	2710-0008	CONN 3PIN BRD MOUNT	1
Q003	2111-0007	TRANS NPN 2N4123	1
Q004	2112-0003	TRANS PNP 2N4125	1
R001	0307-1014	RES MF 1/8W 1% 10K	1
R002	0307-1014	RES MF 1/8W 1% 10K	1
R003	0307-1013	RES MF 1/8W 1% 1K	1
R004	0307-1017	RES MF 1/8W 1% 10M	1
R005	0307-1017	RES MF 1/8W 1% 10M	1
R006	0307-1304	RES MF 1/8W 1% 20K	1
R007	0307-1014	RES MF 1/8W 1% 10K	1

Reference	Part Number	Description	Qty.
CuffLink Main PCB Assembly, continued			
R008	0307-1014	RES MF 1/8W 1% 10K	1
R009	0300-1473	RES CC 1/4W 5% 4.7K	1
R010	0300-1473	RES CC 1/4W 5% 4.7K	1
R011	0300-1473	RES CC 1/4W 5% 4.7K	1
R012	0300-1473	RES CC 1/4W 5% 4.7K	1
R013	0307-1184	RES MF 1/8W 1% 15K	1
R015	0303-1162	RES CC 1W 5% 160 OHMS	1
R016	0303-1162	RES CC 1W 5% 160 OHMS	1
R017	0307-1013	RES MF 1/8W 1% 1K	1
R018	0300-1473	RES CC 1/4W 5% 4.7K	1
R019	0300-1473	RES CC 1/4W 5% 4.7K	1
R020	0307-1681	RES MF 1/8W 1% 49.9	1
R021	0307-1681	RES MF 1/8W 1% 49.9	1
R022	0307-1014	RES MF 1/8W 1% 10K	1
R023	0307-1014	RES MF 1/8W 1% 10K	1
R024	0307-1012	RES MF 1/8W 1% 100	1
R025	0307-1012	RES MF 1/8W 1% 100	1
R026	0307-1014	RES MF 1/8W 1% 10K	1
R027	0307-1065	RES MF 1/8W 1% 113K	1
R028	0307-1065	RES MF 1/8W 1% 113K	1
R029	0307-1015	RES MF 1/8W 1% 100K	1
R030	0307-1065	RES MF 1/8W 1% 113K	1
R031	0307-1065	RES MF 1/8W 1% 113K	1
R032	0307-1015	RES MF 1/8W 1% 100K	1
R033	0307-1012	RES MF 1/8W 1% 100	1
R034	0307-1014	RES MF 1/8W 1% 10K	1
R035	0307-1014	RES MF 1/8W 1% 10K	1
R038	0326-0122	RES VAR 1/2 10% 1K	1
R039	0320-0051	RES WW 2W 0.5 OHMS NON-INDUCT	1
R040	0300-1564	RES CC 1/4W 5% 56K	1
R041	0320-0051	RES WW 2W 0.5 OHMS NON-INDUCT	1
R042	0300-1564	RES CC 1/4W 5% 56K	1
R043	0307-1013	RES MF 1/8W 1% 1K	1
R044	0307-1013	RES MF 1/8W 1% 1K	1
R045	0307-1182	RES MF 1/8W 1% 150	1
R046	0307-1012	RES MF 1/8W 1% 100	1
R047	0326-0125	TRIMPOT 10K 25T	1
R048	0307-1013	RES MF 1/8W 1% 1K	1
R049	0307-1613	RES MF 1/8W 1% 4.22K	1
R050	0307-1014	RES MF 1/8W 1% 10K	1

Reference	Part Number	Description	Qty.
CuffLink Main PCB Assembly, continued			
R051	0316-0212	RES MF 1/8W .1% 5K	1
R052	0316-0212	RES MF 1/8W .1% 5K	1
R053	0316-0219	RES MF 1/8W .1% 50PPM 95.3 OHM	1
R054	0326-0202	RES VAR 1/2W 10% 10 OHMS	1
R055	0307-1012	RES MF 1/8W 1% 100	1
R056	0307-1014	RES MF 1/8W 1% 10K	1
R058	0307-1793	RES MF 1/8W 1% 6.49K	1
R059	0307-1382	RES MF 1/8W 1% 243	1
R060	0307-1793	RES MF 1/8W 1% 6.49K	1
R061	0307-1382	RES MF 1/8W 1% 243	1
R062	0307-1011	RES MF 1/8W 1% 10	1
R064	0326-0114	RES VAR 100K 25T	1
R065	0307-1013	RES MF 1/8W 1% 1K	1
R066	0307-1014	RES MF 1/8W 1% 10K	1
R067	0307-1013	RES MF 1/8W 1% 1K	1
R068	0307-1013	RES MF 1/8W 1% 1K	1
R069	0307-1014	RES MF 1/8W 1% 10K	1
R070	0307-1014	RES MF 1/8W 1% 10K	1
R071	0307-1014	RES MF 1/8W 1% 10K	1
R072	0307-1014	RES MF 1/8W 1% 10K	1
R073	0307-1300	RES MF 1/8W 1% 2 OHMS	1
R080	0307-1014	RES MF 1/8W 1% 10K	1
R081	0307-1014	RES MF 1/8W 1% 10K	1
R082	0307-1014	RES MF 1/8W 1% 10K	1
RN01	0317-0006	RES NET SIP 10K	1
RN02	0317-0006	RES NET SIP 10K	1
S001	2505-0052	SWITCH P.B.	1
S002	2505-0052	SWITCH P.B.	1
T003	1201-0083	+5VDC TO AC INVERTER	1
TB01	2710-0295	CONN, 5 PIN SIP .200 CENTERS	1
TB02	2710-0294	CONN, 4 PIN SIP .200 CENTERS	1
TB03	2710-0296	CONN, 6 PIN SIP .200 CENTERS	1
TB04	2710-0292	CONN, 2 PIN SIP .200 CENTERS	1
TB05	2710-0292	CONN, 2 PIN SIP .200 CENTERS	1
TB06	2710-0294	CONN, 4 PIN SIP .200 CENTERS	1
TB07	2710-0296	CONN, 6 PIN SIP .200 CENTERS	1
TB08	2710-0294	CONN, 4 PIN SIP .200 CENTERS	1
TB09	2710-0295	CONN, 5 PIN SIP .200 CENTERS	1
TB10	2710-0294	CONN, 4 PIN SIP .200 CENTERS	1
TB11	2710-0293	CONN, 3 PIN SIP .200 CENTERS	1

Reference	Part Number	Description	Qty.
CuffLink Main PCB Assembly, continued			
TB12	2710-0297	CONN, 1 PIN	1
U001	2122-0115	MPU NEC V25,5MHZ UPD70320L/332	1
U002	2122-0135	IC PROG'D EPROM CUFFLINK U2	1
U003	2122-0174	IC PROG'D EPROM CUFFLINK U3	1
U005	2122-0131	IC 128KX8 STATIC RAM 581000P	1
U006	2122-0083	IC 82C54 TIMER	1
U007	2122-0136	IC PROG'D EPLD CUFFLINK U7	1
U008	2122-0143	IC DUAL DAC PM7528	1
U009	2122-0089	IC X2864P EEPROM 8K X 8	1
U010	2122-0110	TIMER, WATCH DOG MAX 690	1
U011	2122-0079	IC RTC72421 CLK/CAL W/XTL	1
U013	2118-0105	IC 1489PC UA	1
U014	2122-0117	IC SER/PAR 68PLCC VL16C452	1
U015	2118-0105	IC 1489PC UA	1
U016	2118-0104	IC UA1488PC	1
U017	2118-0036	IC 7805	1
U018	2118-0125	IC LM7812CT VREG +12V	1
U019	2118-0126	IC LM7912CT VREG -12V	1
U020	2122-0118	IC A-D CONVERTER ADC574AJP	1
U021	2118-0116	IC LF442CN	1
U022	2118-0116	IC LF442CN	1
U023	2118-0123	INA 110AG INST AMP	1
U025	2118-0123	INA 110AG INST AMP	1
U026	2118-0054	IC LF 13202 4 N/O ANAL SW	1
U027	5210-0199	MOTOR DRIVER ELEC. ASSEMBLY	1
U028	5210-0199	MOTOR DRIVER ELEC. ASSEMBLY	1
U029	2118-0160	IC HI-SPEED DUAL OP/AMP AD712	1
U030	2118-0132	IC OPA27P	1
U031	2118-0132	IC OPA27P	1
U032	2122-0137	IC PROG'D EPLD CUFFLINK U32	1
U033	2121-0048	3 OF 8 DECODER MM74HC138	1
U035	2118-0050	IC LM 317T VOLT REG	1
U036	2118-0050	IC LM 317T VOLT REG	1
U037	2118-0132	IC OPA27P	1
U038	2118-0116	IC LF442CN	1
U039	2118-0161	IC POWER TRANSISTOR LM395T	1
W001	2710-0224	3 PIN SIP HEADER ST	1
Y001	1220-0021	CRYSTRL 9.8304 MHZ PARA RESON	1
ZU01	2712-0046	SCKT IC 84 PIN PLCC	1
ZU02	2712-0052	SCKT IC 32 PIN DIP	1

Reference	Part Number	Description	Qty.
CuffLink Main PCB Assembly, continued			
ZU03	2712-0052	SCKT IC 32 PIN DIP	1
ZU04	2712-0052	SCKT IC 32 PIN DIP	1
ZU05	2712-0052	SCKT IC 32 PIN DIP	1
ZU06	2712-0016	SCKT IC 24 PIN DIP	1
ZU07	2712-0051	SCKT IC 28 PIN SKINNY DIP	1
ZU08	2712-0017	SCKT IC 20 PIN DIP	1
ZU09	2712-0023	SCKT IC 28 PIN DIP LP	1
ZU10	2712-0003	SCKT IC 8 PIN DIP	1
ZU11	2712-0024	SCKT IC 18 PIN DIP	1
ZU13	2712-0015	SCKT IC 14 PIN DIP	1
ZU14	2712-0047	SCKT IC 68 PIN PLCC	1
ZU15	2712-0015	SCKT IC 14 PIN DIP	1
ZU16	2712-0015	SCKT IC 14 PIN DIP	1
ZU20	2712-0023	SCKT IC 28 PIN DIP LP	1
ZU21	2712-0003	SCKT IC 8 PIN DIP	1
ZU22	2712-0003	SCKT IC 8 PIN DIP	1
ZU23	2712-0018	SOCKET IC 16 PIN DIP	1
ZU25	2712-0018	SOCKET IC 16 PIN DIP	1
ZU26	2712-0018	SOCKET IC 16 PIN DIP	1
ZU29	2712-0003	SCKT IC 8 PIN DIP	1
ZU32	2712-0048	SCKT IC 44 PIN PLCC	1
ZU33	2712-0018	SOCKET IC 16 PIN DIP	1
ZU37	2712-0003	SCKT IC 8 PIN DIP	1
ZU38	2712-0003	SCKT IC 8 PIN DIP	1
ZZ39	5201-0258	CUFFLINK MAIN PCB BASIC	1
ZZ40	4713-0026	STUD S/C PCB	7
ZZ41	5215-0273	REGULATOR HEAT SINK ASSY	1
ZZ42	2710-0166	2 PIN SHORTING PLUG	1
ZZ44	4906-0009	SIL PAD TO 220 SING	5
ZZ45	4715-0013	S/C STUD 4/40 X 1/2 PCB	2
ZZ46	4711-6008	WSHR SHDL #4 NYLON SHORT	5
ZZ47	4704-2234	SCRW PPH 4-40 X 5/16 LG	5
ZZ48	3012-0001	CABLE TIE NYLON	1
ZZ49	8006-0012	FOAM TAPE DOUBLE BACK	AR
ZZ50	5001-0372	BARCODE TAG SERIAL NUMBER	1
ZZ51	4711-9721	NUT KEP 4-40 X 1/4	2
ZZ52	4711-6207	WSHR FLAT FIBER 2161 #4	2
ZZ53	1006-0019	FUSE CLIP, PCB MTG	6
ZZ54	8006-0012	FOAM TAPE 1" X 1 1/2"	1

Reference	Part Number	Description	Qty.
CuffLink Motor Driver Electrical Assembly			
201559			
ZZ01	2122-0121	IC MOTOR DRIVER PBL-3770A	2
ZZ02	4402-0033	HEAT SINK LARGE BATWING	2
CuffLink Optical PCB Assembly			
201564			
D001	2116-0023	OPTO MICRO–SENSOR	1
P016	2710-0015	CONN 3 PIN BODY ONLY	1
ZZ01	2716-0027	TERM. CRIMP. 18-24 AWG	3
ZZ02	3003-0800	WIRE #22 UL PVC BLACK 12.0"	1
ZZ03	3003-0803	WIRE #22 UL PVC ORANGE 12.0"	1
ZZ04	3003-0806	WIRE #22 UL PVC BLUE 12.0"	1
ZZ05	5201-0269	CUFFLINK OPTICAL PCB BASIC	1
ZZ06	3012-0001	CABLE TIE NYLON	3

Reference	Part Number	Description	Qty.
CuffLink Pressure Engine Assembly			
201560			
ZZ01	5215-0277	CUFFLINK PISTON ASSY	1
ZZ02	5205-0269	CUFFLINK OPTICAL PCB ASSEMBLY	1
ZZ03	5210-0200	STEPPER INTERN SCREW ELEC ASSY	1
ZZ04	5215-0266	CUFFLINK ENGINE PLATE ASSEMBLY	1
ZZ05	5215-0270	CUFFLINK ENGINE BASE ASSEMBLY	1
ZZ06	5015-0227	MOTOR SPACER .65 LG	4
ZZ07	4919-0081	O-RING AS146 2.612IDx.103W	1
ZZ08	4704-2234	SCREW PPH 4-40 x 5/16"	2
ZZ09	4711-4019	WSHR FLAT TYPA #6	4
ZZ10	4711-0119	WSHR INT/TH TYPA #6	4
ZZ12	4711-0115	WSHR INT/TH TYPA #4	2
ZZ13	4704-2435	SCREW PPH 6-32 x 3/8	4
ZZ14	5027-0170	CUFFLINK LATEX DIAPHRAGM	1
ZZ16	4711-9720	NUT KEP 6-32 X 1/4	4
ZZ18	8010-0024	LUBRICANT WHITE LITHIUM GREASE	A/R
ZZ21	8006-0001	ADHESIVE CA-9	A/R
ZZ22	4919-0084	O-RING STOCK BUNA-N 2.25" LG	2
ZZ23	5027-0235	SHIM STOCK .003 GREEN	A/R
ZZ24	5027-0236	SHIM STOCK .004 TAN	A/R
ZZ25	5027-0237	SHIM STOCK .005 BLUE	A/R

Reference	Part Number	Description	Qty.
CuffLink Pump PCB Assembly			
205206			
C011	0403-0052	CAP ELECT 6.8MF 50V	1
C012	0403-0052	CAP ELECT 6.8MF 50V	1
D002	2101-0005	DIODE 1N4005	1
D003	2101-0005	DIODE 1N4005	1
J010	2710-0126	HEADER RT ANGLE 50 PIN	1
J030	2710-0008	CONN 3PIN BRD MOUNT	1
J040	2710-0008	CONN 3PIN BRD MOUNT	1
J050	2710-0007	CONN 2PIN PCB MOUNT	1
J060	2710-0187	2 PIN PCB MT .1 SPC	1
R002	0303-1560	RES CC 1W 5% 5.6	1
R003	0303-1560	RES CC 1W 5% 5.6	1
TP01	2710-0297	CONN, 1 PIN	1
U010	2118-0069	IC 7824	1
U020	2120-0094	IC ULN2003A	1
ZZ01	3010-0414	CUFFLINK UPPER PCB RIBBON C/A	1
ZZ02	3010-0415	CUFFLINK 35V INTERCONNECT C/A	1
ZZ03	4402-0038	HEATSINK RT PC TO-220	2
ZZ04	4704-2434	SCREW PPH 6-32 X 5/16	3
ZZ05	4709-0017	SCREW PBH #6-1/4 SELF TAP	4
ZZ06	4711-9720	NUT KEP 6-32 X 1/4	5
ZZ07	4906-0009	SIL PAD TO 220 SING	1
ZZ08	5201-0325	CUFFLINK AIR PUMP PCB - BASIC	1
ZZ09	5210-0249	CUFFLINK AIR PUMP ELEC ASSY	1
ZZ10	5210-0250	CUFFLINK RELIEF VALVE ELEC ASY	1
ZZ11	5001-0372	LABEL BARCODE SERIALIZED	1

CuffLink Regulator Heat Sink Assembly			
201570			
ZZ01	5008-0398	REGULATOR HEAT SINK - BASIC	1
ZZ02	4713-0010	NUT PRESS #5-440-12C	5

Reference	Part Number	Description	Qty.
CuffLink Relief Valve Electrical Assembly			
205212			
ZZ01	2710-0331	2 PIN CONN 0.1 IN SPACE	1
ZZ02	2716-0036	TERM WIRE 08-50-0114	2
ZZ03	2724-0005	VALVE, SOLENOID, 25PSI, 24VDC	1
ZZ04	3040-0045	1/8 ID TYGON TUBING 4" [102]	2
ZZ05	3040-0045	1/8 ID TYGON TUBING 1.5" [38]	1
ZZ06	3040-0045	1/8 ID TYGON TUBING 1.6" [41]	1
ZZ07	3040-0045	1/8 ID TYGON TUBING 1.25" [32]	1
ZZ08	3040-0071	TUBING SILICONE 1/8 ID 2" [51]	1
ZZ09	4919-0036	BARB FITTING 10-32 X 1/8	3
ZZ10	4919-0082	HOSE CLAMP, PLASTIC 1/4 I.D.	1
ZZ11	4920-0022	AIR CHECK VALVE	1
ZZ12	4920-0023	"T" FITTING 3 BARB 1/8" POLY	2
ZZ13	8006-0031	PNEUMATIC/HYDRALIC SEALANT	A/R

Reference	Part Number	Description	Qty.
CuffLink Shipping System			
201500			
ZZ01	3010-0055	404A POWER CORD ASSY	1
ZZ02	5027-0203	NEONATE MANDREL ASSEMBLY	1
ZZ03	5215-0268	MANDREL END BLOCK ASSY	2
ZZ04	5215-0269	MANDREL SPACER BLOCK ASSY	3
ZZ06	9503-0014	CUFFLINK CLIPPARD ADAPTER ASSY	1
ZZ07	9503-0015	CUFFLINK COLDER ADAPTER ASSY	1
ZZ08	9503-0016	CUFFLINK OBAC ADAPTER ASSY	1
ZZ09	9503-0017	CUFFLINK LUER ADAPTER ASSY	1
ZZ10	9503-0018	CUFFLINK LUER-LOCK ADAPT ASSY	1
ZZ11	9503-0019	CUFFLINK 1/8 BARB ADAPTER ASSY	1
ZZ12	9503-0020	CUFFLINK 5/32 BARB ADAPT ASSY	1
ZZ14	9503-0023	CUFFLINK 1/4 BARB ADAPT ASSY	1
ZZ15	9508-0198	CUFFLINK MANUAL	1
ZZ16	9519-0176	CUFFLINK NIBP SIMULATOR	1
ZZ17	9530-0030	CUFFLINK VINYL CASE	1

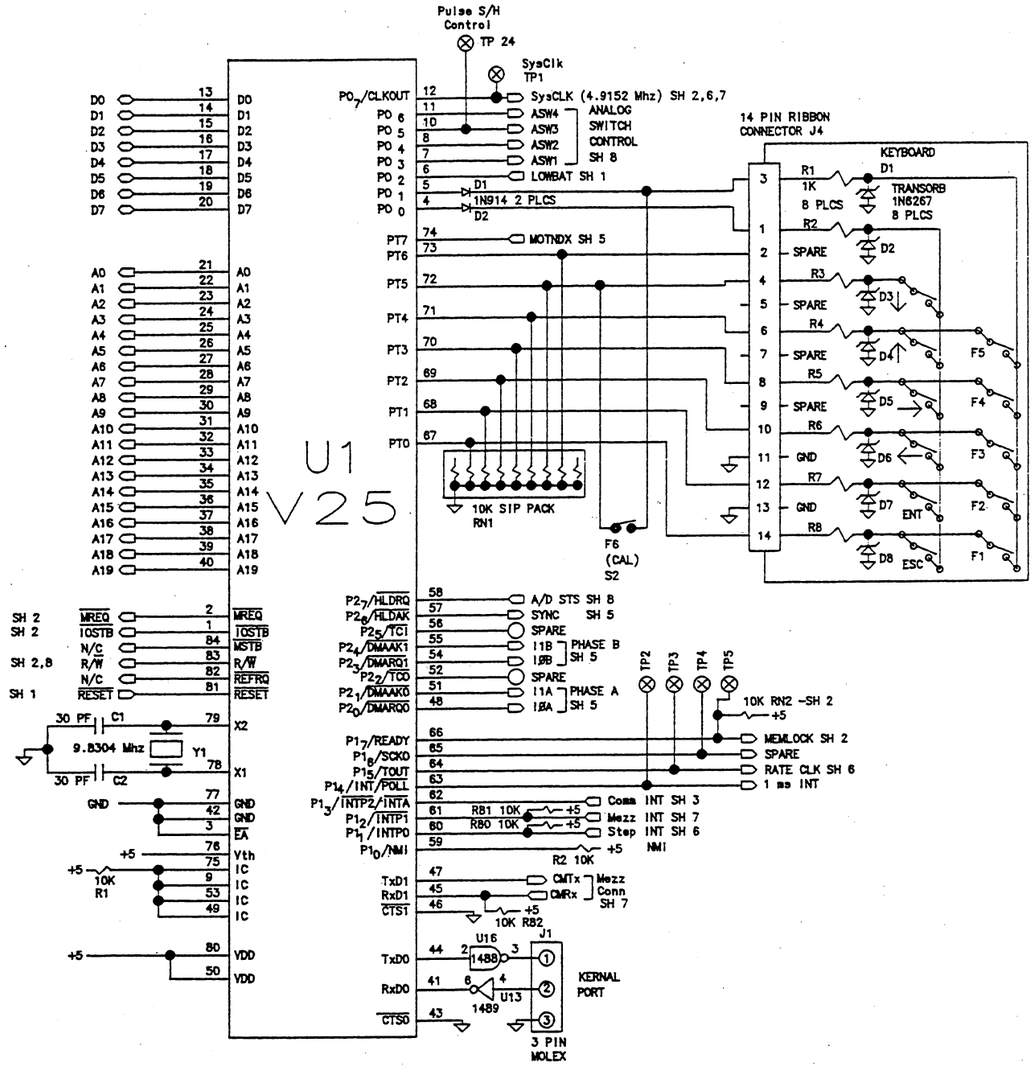
CuffLink Stepper Internal Screw Electrical Assembly			
201571			
M001	4101-0004	MOTOR LINEAR ACTUATOR	1
P008	2710-0018	CONN 6 PIN BODY ONLY	1
ZZ01	2716-0027	TERM. CRIMP. 18-24AWG	6
ZZ02	3012-0001	CABLE TIE NYLON	1

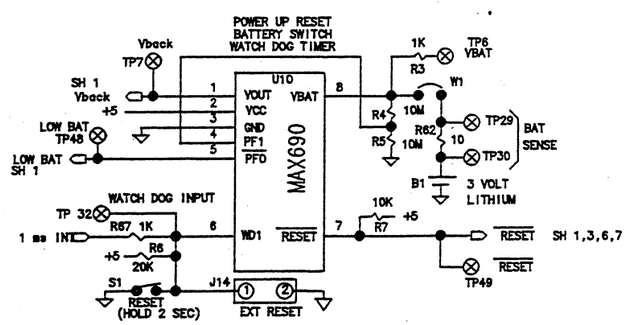
Reference	Part Number	Description	Qty.
CuffLink Transformer Electrical Assembly			
201556			
P012	2710-0019	CONN 8PIN PLUG BODY ONLY	1
T001	1201-0084	XFMR DUAL PRI 36V CT @ 2A	1
T002	1201-0085	XFMR DMT-6-12,(+5V,+12V,-12V)	1
ZZ01	1202-0003	AC INPUT MODULE W/2 VOLT EMI	1
ZZ02	2716-0001	TERM INS RING #6 16-14	1
ZZ03	2716-0027	TERM CRIMP 18-24 AWG	7
ZZ04		BLANK	0
ZZ05		BLANK	0
ZZ06		BLANK	0
ZZ07		BLANK	0
ZZ08	3003-0800	WIRE #22 UL BLACK 4.5"	1
ZZ09	3003-0811	WIRE #22 UL WHT/BLK 11.25"	1
ZZ10	3003-0800	WIRE #22 UL BLACK 12.5"	1
ZZ11	3003-0801	WIRE #22 UL BROWN 3.5"	1
ZZ12	3003-0802	WIRE #22 UL RED 4.5"	1
ZZ13	3003-0802	WIRE #22 UL RED 5.75"	1
ZZ14	3003-0803	WIRE #22 UL ORANGE 5.5"	1
ZZ16	3003-0808	WIRE #22 UL GREY 4"	1
ZZ17	3003-0809	WIRE #22 UL WHITE 4.5"	1
ZZ18	3003-0818	WIRE #22 UL WHT/GRY 11.25"	1
ZZ19	3003-0809	WIRE #22 UL WHITE 12.5"	1
ZZ20	3007-0079	WIRE #16 UL GRN/YEL 5"	1
ZZ21	3012-0001	CABLE TIE NYLON	A/R
ZZ22	3040-0013	SHRINK TUBE 1/8 BLACK .5"	4
ZZ23	3040-0014	SHRINK TUBE 3/16 BLACK .5"	17
ZZ24	3004-0801	WIRE #22 UL BROWN 4.5"	1
ZZ25	3003-0811	WIRE #22 UL WHT/BLK 4.5"	1
ZZ26	3003-0818	WIRE #22 UL WHT/GRY 4.5"	1
ZZ27	1005-0043	FUSE 3AG 1A SB	1
ZZ28	3003-0803	WIRE #22 UL ORANGE 5"	1

Reference	Part Number	Description	Qty.
CuffLink Final Assembly			
201501			
ZZ01	0801-0025	XDCR LOW PRESSURE +/- 300MMHG	1
ZZ02	2706-0001	CONN BNC UG-1094	3
ZZ03	2716-0073	LUG GROUND	3
ZZ04	3010-0299	CUFFLINK ANALOG OUTPUT CBL ASSY	1
ZZ05	3010-0404	MEDTESTER GROUND CABLE ASSEMBLY	1
ZZ06	3012-0001	CABLE TIE NYLON	4
ZZ07	3012-0007	ADHESIVE BACKED PANEL	3
ZZ08	3040-0045	1/8 ID TYGON TUBING 4.25" LG	1
ZZ09	4102-0012	FINGER GUARD 3 IN FAN	1
ZZ10	4704-2235	SCRW PPH 4-40 X 3/8	2
ZZ11	4704-2433	SCRW PPH 6-32 X 1/4	8
ZZ12	4704-2434	SCRW PPH 6-32 X 5/16	4
ZZ13	4704-2435	SCRW PPH 6-32 X 3/8	4
ZZ14	4704-2444	SCRW PPH 6-32 X 1.25	4
ZZ15	4709-0021	SCRW 4-40 X 3/8 BLACK OXIDE	4
ZZ16	4709-0028	SCRW PPH 6-32 X 3/8 BLACK	17
ZZ17	4711-0119	WSHR INT/TH TYPA #6	12
ZZ18	4711-4019	WSHR FLAT TYPA #6	2
ZZ19	4711-6414	WASHER FLAT STEEL .26 OD	12
ZZ20	4711-9302	NUT NYLON 4-40	8
ZZ21	4711-9720	NUT KEP 6-32 X 1/4	11
ZZ22	4711-9721	NUT KEP 4-40 X 1/4	2
ZZ23	4711-9722	NUT KEP 8-32 X 3/8	3
ZZ24	4715-0017	SNAP TOP COVER	4
ZZ25	4715-0023	SCRW PPH #4 3/8 PLASTIFAST	2
ZZ26	4902-0030	HANDLE BLACK	1
ZZ27	4902-0074	KNOB ALCO KLN-500B-1/4	2
ZZ28	4904-0001	BUMPER RUBB 2135	7
ZZ29	4910-0132	SPACER 6-32 X 5/16 1/4 HEX BR	4
ZZ30	4910-0156	SPACER, M/F 6-32 X 1 HEX SS	4
ZZ31	4919-0082	HOSE CLAMP, PLASTIC 1/4 I.D.	1
ZZ32	4920-0003	COUPLER PNL MNT QUICK DISC	1
ZZ33	5001-0282	INSTALLED OPTIONS LABEL	1
ZZ34	5001-0300	CUFFLINK DISPLAY LABEL	1
ZZ35	5001-0301	CUFFLINK FR PANEL LABEL	1
ZZ36	5001-0302	CUFFLINK SERIAL/FUSE LABEL	1
ZZ37	5001-0303	CUFFLINK SERIAL NUMBER TAG	1
ZZ38	5001-0431	CUFFLINK CSA LABEL	1
ZZ39	5001-0530	CUFFLINK OPTIONS SLIP	1

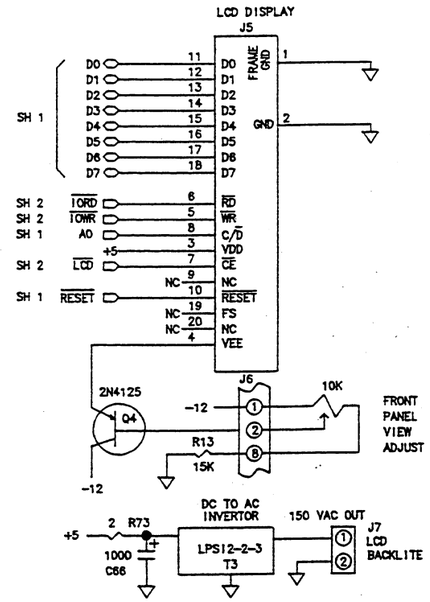
Reference	Part Number	Description	Qty.
CuffLink Final Assembly, continued			
ZZ40	5023-0099	PLASTIC BARBED "T" W/10-32 THD	1
ZZ41	5023-0101	CUFFLINK SPEAKER MOUNT	1
ZZ42	5205-0258	CUFFLINK MAIN PCB ASSY	1
ZZ43	5205-0259	CUFFLINK KEY PCB ASSY	1
ZZ44	5205-0325	CUFFLINK PUMP PCB ASSEMBLY	1
ZZ45	5210-0195	CUFFLINK LCD DISPLAY ELEC ASSY	1
ZZ46	5210-0196	CUFFLINK TRANSFORMER ELEC ASSY	1
ZZ47	5210-0197	CUFFLINK FAN ELEC ASSY	1
ZZ48	5210-0198	CUFFLINK CONTROL ELEC ASSY	1
ZZ49	5210-0204	CUFFLINK PRESSURE ENGINE ASSY	1
ZZ50	5215-0261	CUFFLINK ENCLOSURE - TOP ASSY	1
ZZ51	5215-0262	CUFFLINK ENCLOSURE - BOT ASSY	1
ZZ52	5215-0263	OPTION PLATE ASSEMBLY	1
ZZ53	8007-0001	SILICONE RUBB RTV-103	A/R
ZZ54	8006-0031	PNEUMATIC/HYDRAULIC SEALANT	A/R

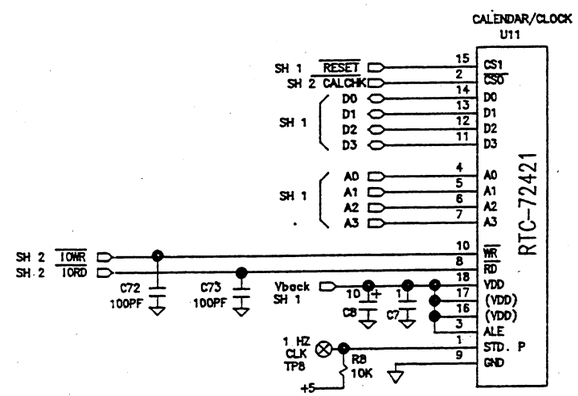
REVISIONS			
LTR	DESCRIPTION	DATE	REV BY
C	ECO 679 – FUSE SECONDARIES	03/15/91	
D	ECO 1473 – ADDED CAPS C68 – C71	09/29/94	JTW
E	ECO 1653 – ADDED CAPS C72 – C82	04/21/95	JTW





	+5	Vback	GND
V25	80,50		77,42
MAX690	2	1	3
RTC-72421		18,17,16	9

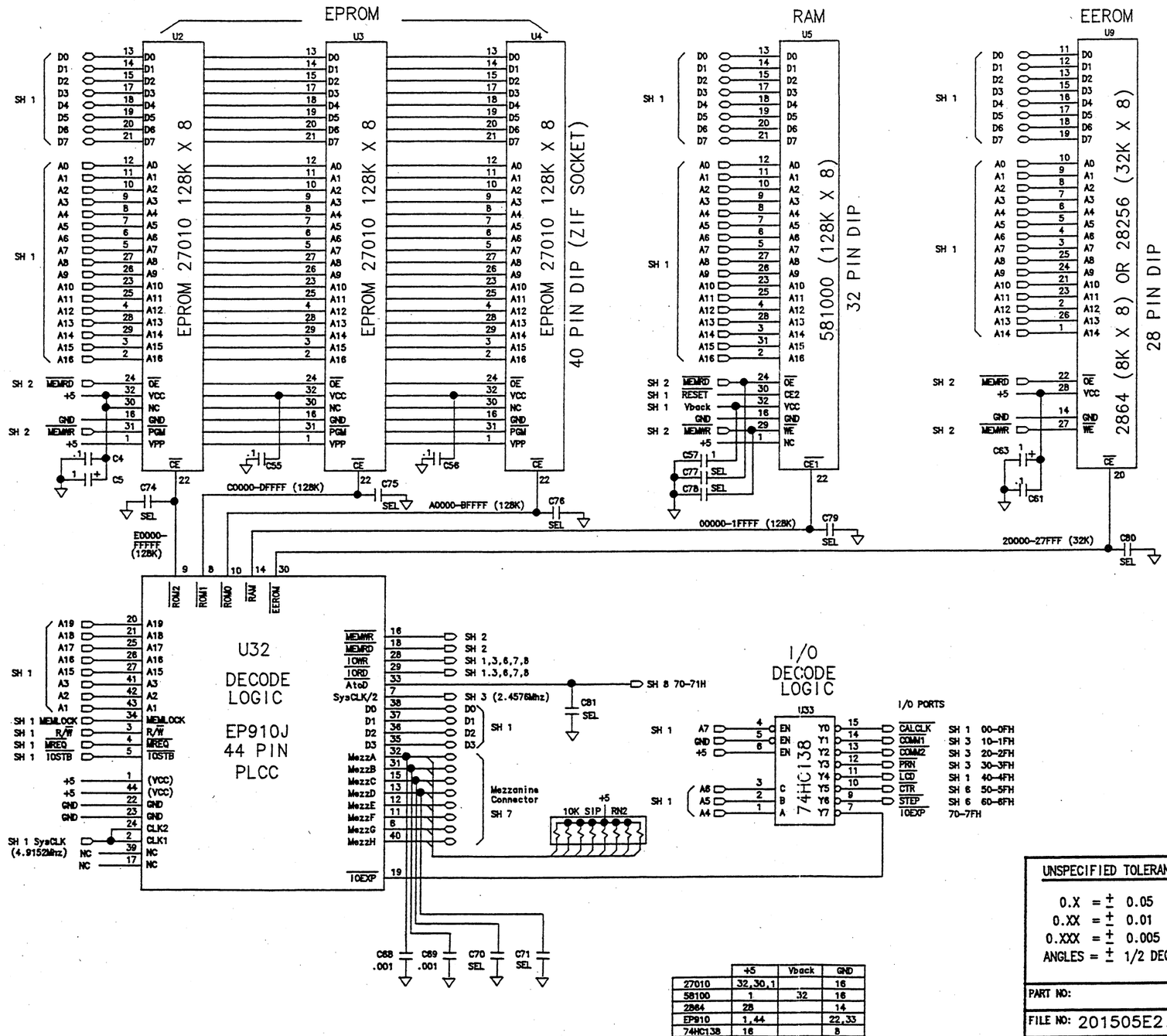




1

UNSPECIFIED TOLERANCE	APPROVALS		
0.X = ± 0.05	DRAWN BY	DATE	TITLE: CUFFLINK SCHEMATIC CPU/KEYBD/LCD/CLOCK
0.XX = ± 0.01	AC	3/8/91	
0.XXX = ± 0.005	ENG MANAGER	DATE	
ANGLES = ± 1/2 DEGREE	JB	4/27/95	
PART NO:	PROJECT ENG	DATE	SIZE: B DWG NO: 201505 REV: E
FILE NO: 201505E1.2D		4/27/95	SCALE: NONE SHEET 1 OF 8

REVISIONS			
LTR	DESCRIPTION	DATE	REV BY
–	FOR REVISION SEE SHEET 1		

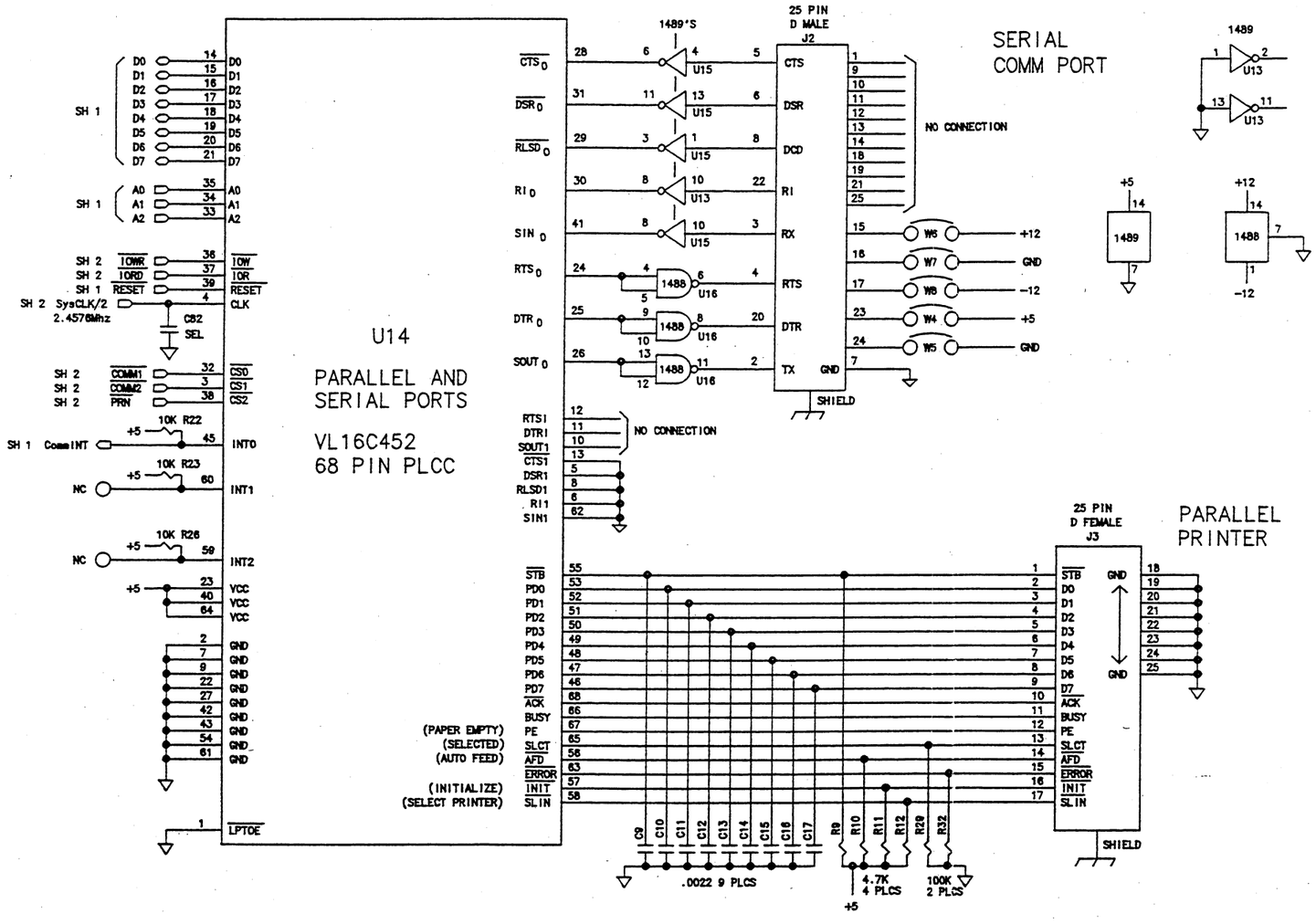


	+5	Vback	GND
27010	32,30,1		16
58100	1	32	16
2864	28		14
EP910	1,44		22,33
74HC138	16		8

2

UNSPECIFIED TOLERANCE	APPROVALS		
0.X = ± 0.05	DRAWN BY	DATE	TITLE: CUFFLINK SCHEMATIC MEMORY AND DECODE LOGIC
0.XX = ± 0.01	AC	3/8/91	
0.XXX = ± 0.005	ENG MANAGER	DATE	
ANGLES = ± 1/2 DEGREE			SIZE B DWG NO: 201505 REV. E
PART NO:	PROJECT ENG	DATE	SCALE: NONE SHEET 2 OF 8
FILE NO: 201505E2.2D			

REVISIONS			
LTR	DESCRIPTION	DATE	REV BY
–	FOR REVISION SEE SHEET 1		

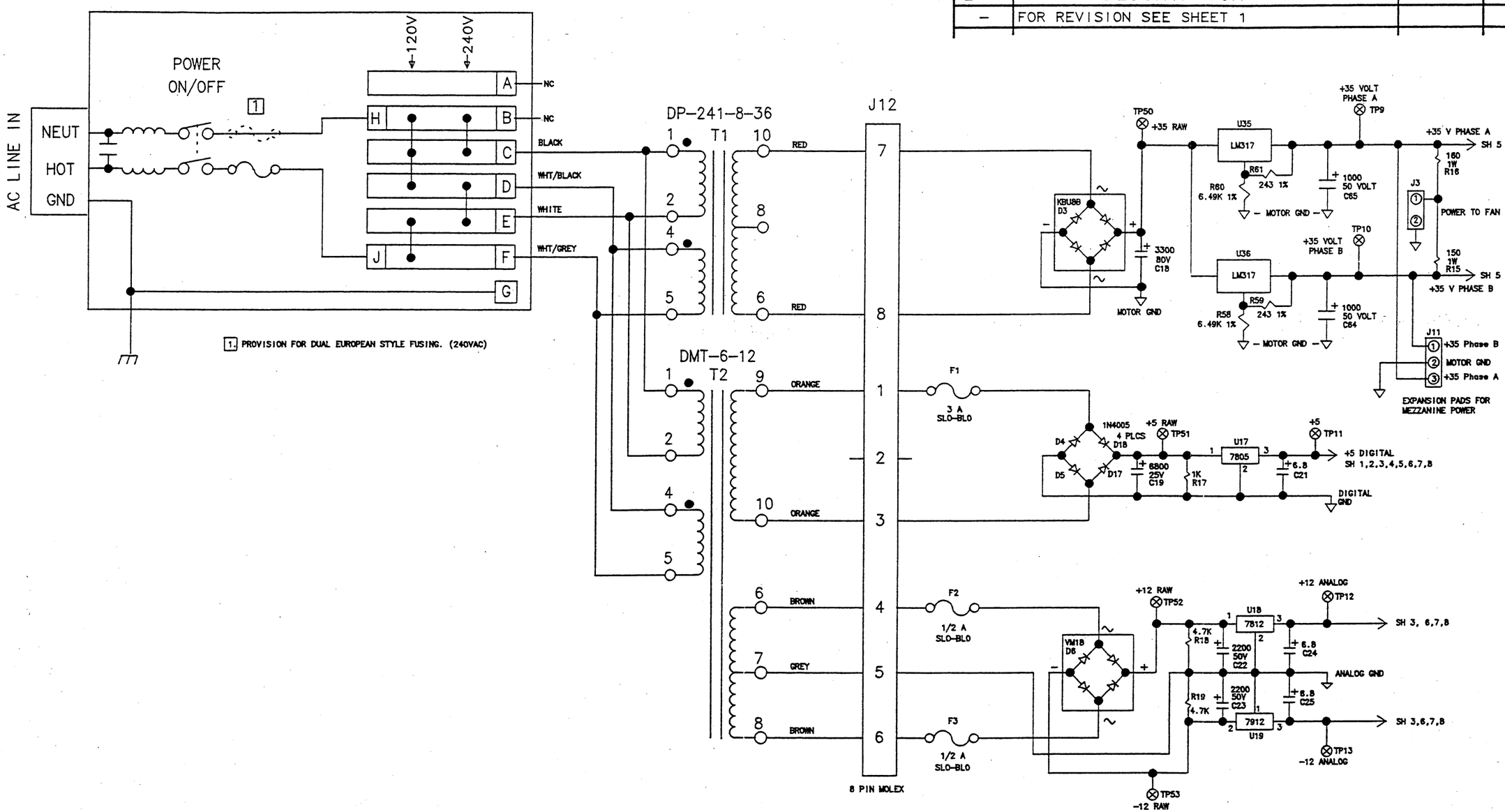


	+5	+12	-12	GND
VL16C452	23,40,64			2,7,9,22,27,42,43,54,61
1489	14			7
1488		14	1	7

3

UNSPECIFIED TOLERANCE	APPROVALS		
0.X = ± 0.05	DRAWN BY	DATE	TITLE: CUFFLINK SCHEMATIC PRINTER AND COMM PORTS
0.XX = ± 0.01	AC	3/8/91	
0.XXX = ± 0.005	ENG MANAGER	DATE	
ANGLES = ± 1/2 DEGREE			SIZE B DWG NO: 201505 REV. E
PART NO:	PROJECT ENG	DATE	
FILE NO: 201505E3.2D			SCALE: NONE SHEET 3 OF 8

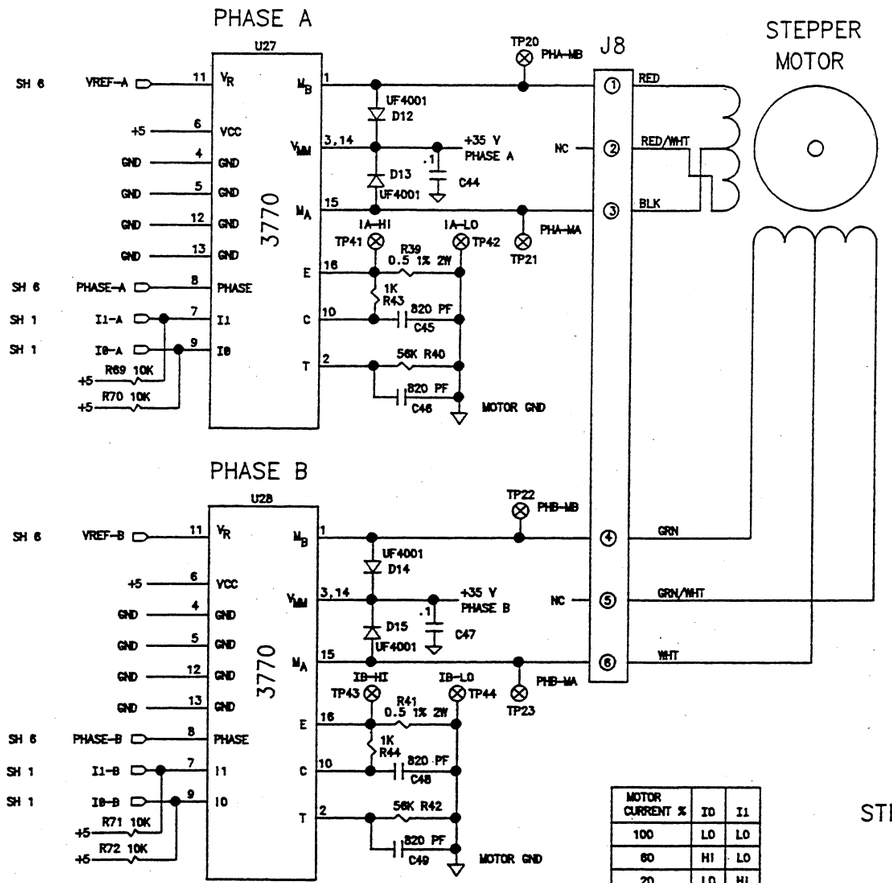
REVISIONS			
LTR	DESCRIPTION	DATE	REV BY
–	FOR REVISION SEE SHEET 1		

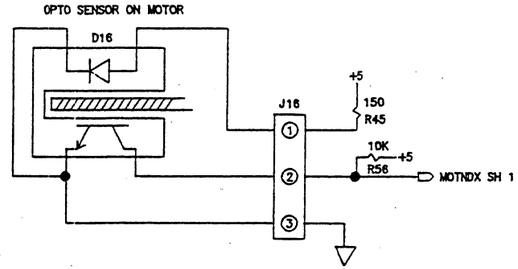


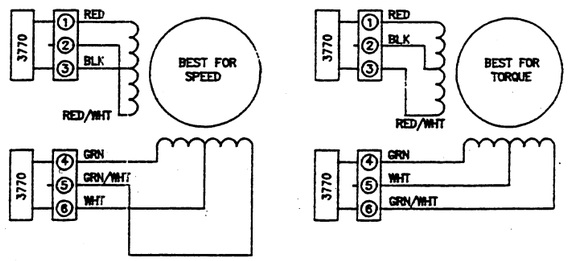
4

UNSPECIFIED TOLERANCE	APPROVALS		
0.X = ± 0.05	DRAWN BY: AC	DATE: 3/8/91	TITLE: CUFFLINK SCHEMATIC POWER SUPPLY
0.XX = ± 0.01	ENG MANAGER	DATE	
0.XXX = ± 0.005			
ANGLES = ± 1/2 DEGREE	PROJECT ENG	DATE	
PART NO:			SIZE: B DWG NO: 201505 REV: E
FILE NO: 201505E4.2D			SCALE: NONE SHEET 4 OF 8

REVISIONS			
LTR	DESCRIPTION	DATE	REV BY
–	FOR REVISION SEE SHEET 1		

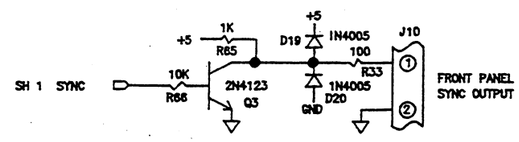






MOTOR CURRENT %	I0	I1
100	LO	LO
80	HI	LO
20	LO	HI
0	HI	HI

STEPPER MOTOR POWER DRIVERS

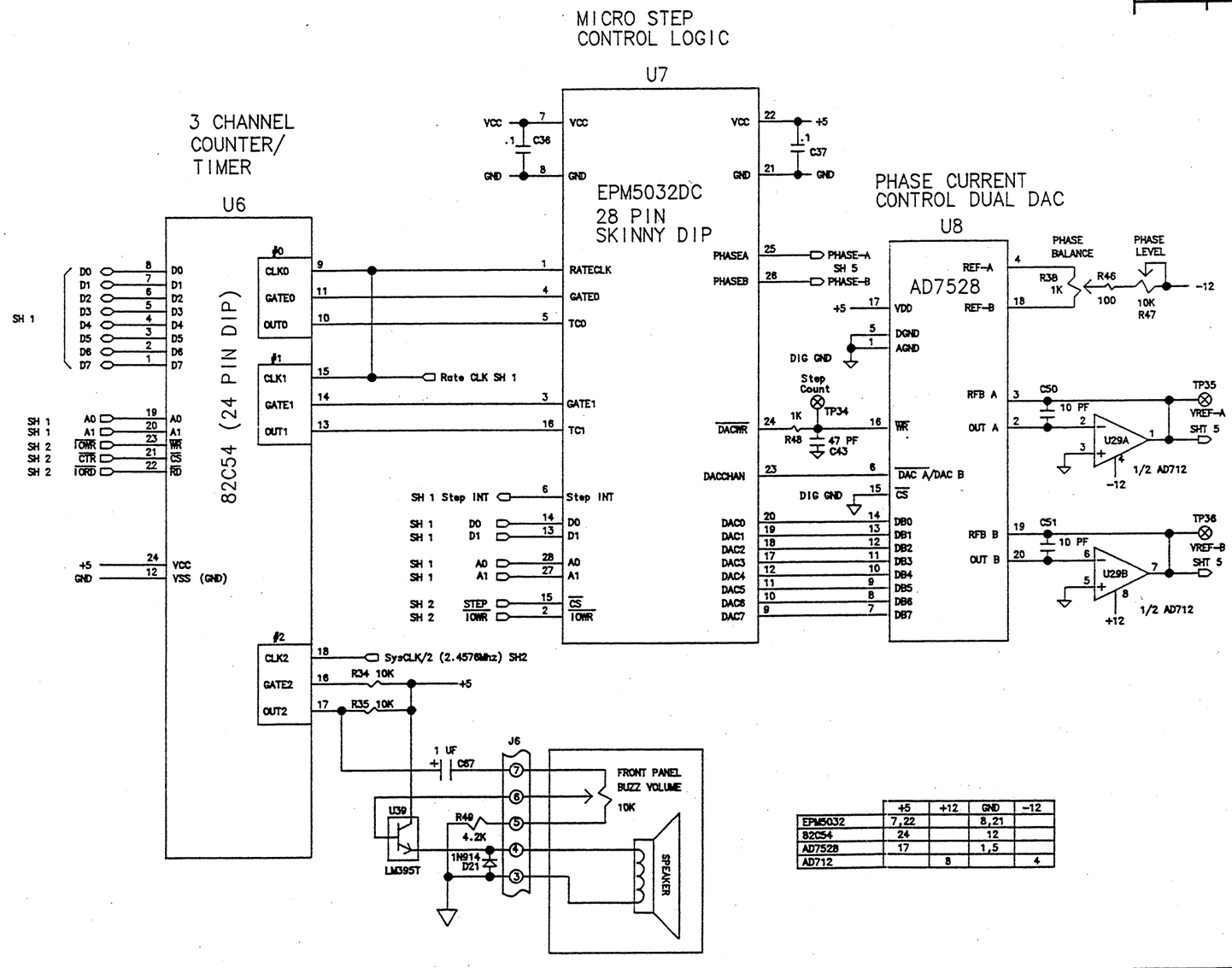


	+5	+35	GND
3770	6	3,14	4,5,12,13

5

UNSPECIFIED TOLERANCE	APPROVALS		
0.X = ± 0.05 0.XX = ± 0.01 0.XXX = ± 0.005 ANGLES = ± 1/2 DEGREE	DRAWN BY: AC	DATE: 3/8/91	TITLE: CUFFLINK SCHEMATIC MOTOR DRIVERS
PART NO:	ENG MANAGER	DATE	SIZE: B — DWG NO: 201505 — REV: E
FILE NO: 201505E5.2D	PROJECT ENG	DATE	SCALE: NONE — SHEET 5 OF 8

REVISIONS			
LTR	DESCRIPTION	DATE	REV BY
–	FOR REVISION SEE SHEET 1		



	+5	+12	GND	-12
EPM5032	7,22		8,21	
82C54	24		12	
AD7528	17		1,5	
AD712		8		4

6

UNSPECIFIED TOLERANCE	APPROVALS		
0.X = ± 0.05	DRAWN BY: AC	DATE: 3/8/91	TITLE: CUFFLINK SCHEMATIC STEP CONTROL LOGIC
0.XX = ± 0.01	ENG MANAGER	DATE	
0.XXX = ± 0.005			
ANGLES = ± 1/2 DEGREE	PROJECT ENG	DATE	
PART NO:			SIZE: B DWG NO: 201505 REV: E
FILE NO: 201505E6.2D			SCALE: NONE SHEET 6 OF 8

REVISIONS			
LTR	DESCRIPTION	DATE	REV BY
–	FOR REVISION SEE SHEET 1		

50 PIN BOX RIBBON CONNECTOR

J9

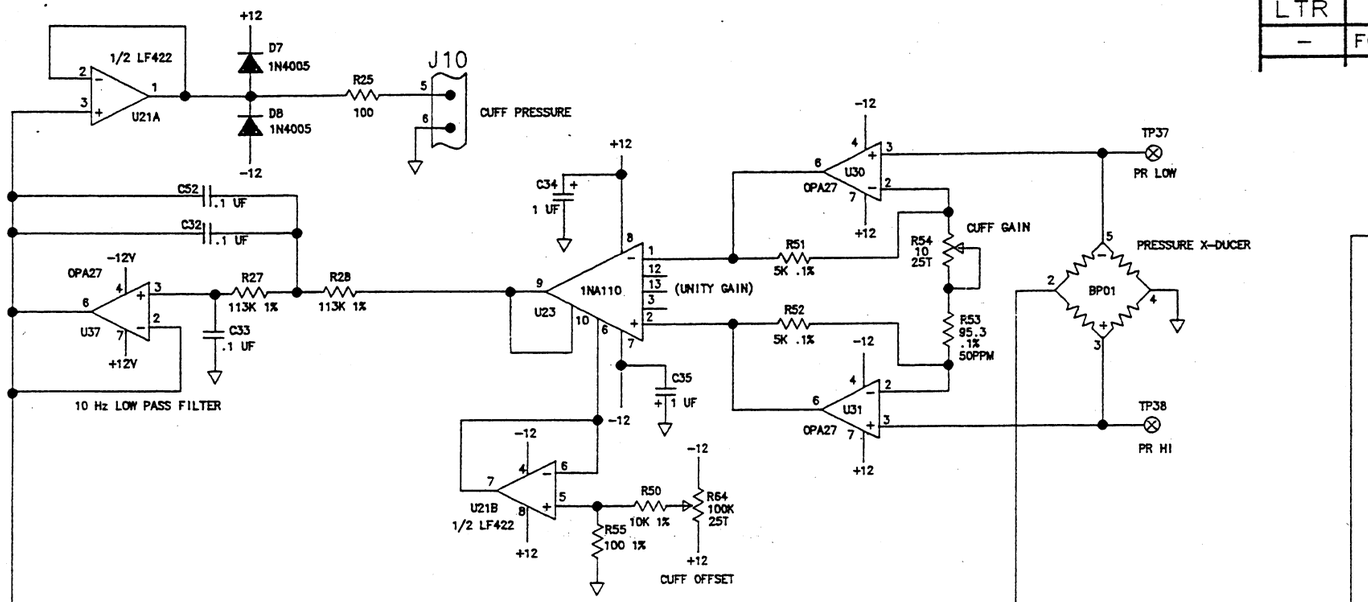
	A0	42
	A1	40
	A2	37
	A3	35
	A4	33
	A5	31
	A6	29
	A7	27
	A8	30
SH 1	A9	32
	A10	38
	A11	34
	A12	25
	A13	28
	A14	26
	A15	23
	A16	24
	A17	22
	A18	19
	A19	20
	D0	44
	D1	46
	D2	48
SH 1	D3	47
	D4	45
	D5	43
	D6	41
	D7	39
SH 2	$\overline{\text{IORD}}$	18
SH 2	$\overline{\text{IOWR}}$	17
SH 2	$\overline{\text{MEMRD}}$	36
SH 2	$\overline{\text{MEMWR}}$	21
SH 1	SysCLK	16
SH 1	CMTx	14
SH 1	$\overline{\text{CMRx}}$	13
SH 1	$\overline{\text{RESET}}$	15
SH 1	Vback	11
	MezzA	3
	MezzB	4
	MezzC	6
SH 2	MezzD	5
	MezzE	8
	MezzF	7
	MezzG	10
	MezzH	9
SH 1	Mezz INT	12
	+5	49
SH 4	+12	1
	-12	2
	DIG GND	50

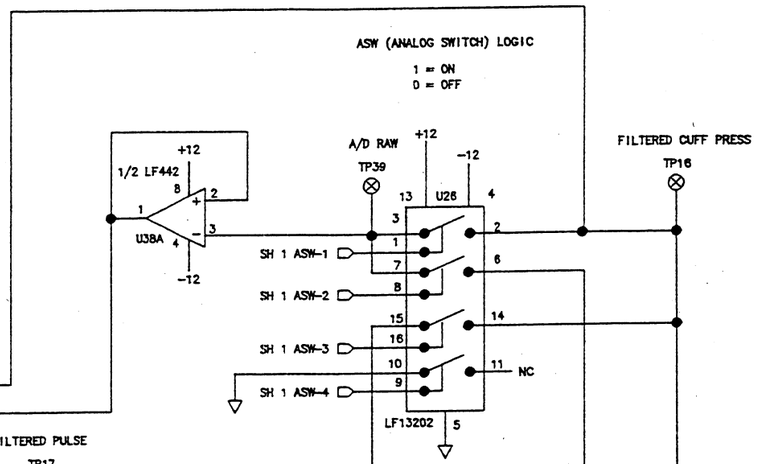
MEZZANINE CONNECTOR

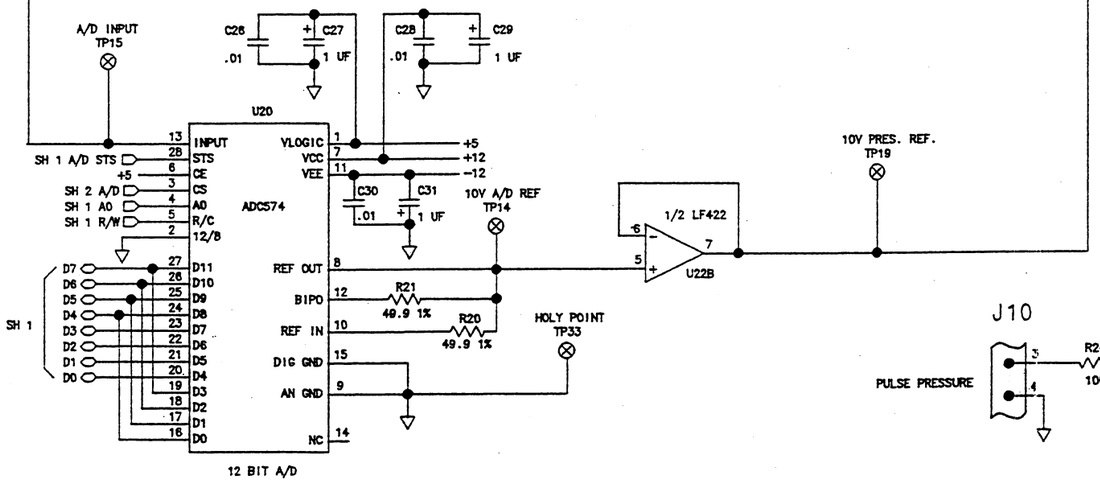
7

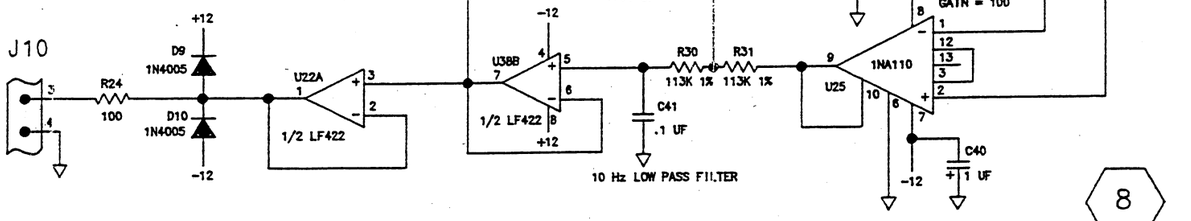
UNSPECIFIED TOLERANCE 0.X = ± 0.05 0.XX = ± 0.01 0.XXX = ± 0.005 ANGLES = ± 1/2 DEGREE	APPROVALS DRAWN BY: AC — DATE: 3/8/91 ENG MANAGER — DATE PROJECT ENG — DATE	TITLE: CUFFLINK SCHEMATIC MEZZANINE EXPANSION
PART NO:		SIZE: B — DWG NO: 201505 — REV: E
FILE NO: 201505E7.2D		SCALE: NONE — SHEET 7 OF 8

REVISIONS			
LTR	DESCRIPTION	DATE	REV BY
–	FOR REVISION SEE SHEET 1		









8

IC REF DES	+5VDC	+12VDC	-12VDC	GND
U20	1	7	11	15
U21,22,38		8	4	
U30,31,37		7	4	
U23		8	7	
U26		13	4	5
U25		8	7	6

UNSPECIFIED TOLERANCE

0.X = ± 0.05
0.XX = ± 0.01
0.XXX = ± 0.005
ANGLES = ± 1/2 DEGREE

APPROVALS	
DRAWN BY	DATE
AC	3/8/91
ENG MANAGER	DATE
PROJECT ENG	DATE

PART NO:

FILE NO: 201505E8.2D

TITLE: CUFFLINK SCHEMATIC ANALOG

SIZE	DWG NO:	REV.
B	201505	E

SCALE: NONE | SHEET 8 OF 8

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED
A	ECO 1025 – ADD PUMP PCB	04/93	
B	ECO 1124 – ADDED D2 & D3	09/93	JTW

TO CUFFLINK MAIN PCB

J10

+12V 1
-12V 2
MezzA 3
MezzB 4
5
6
MezzF 7
MezzE 8
9
10
11
12
CMRx 13
CMTx 14
15
16
17
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31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
+5V 50

J9 (7)

D

U20F 6 11
U20G 7 10
U20E 5 12
U20D 4 13
U20C 3 14
U20B 2 15
U20A 1 16 9
8

W1

VENT

RELEASE VALVE ASSEMBLY

J60 1 2
L1 (− +)

J70 1 2
NOT USED

CHECK VALVE

TO CUFFLINK TRANSDUCER AND PRESSURE ENGINE

PUMP ASSEMBLY

J50 1 2
B1 (− +)
PUMP
OUT
IN

ATMOSPHERE

D3 1N4005
R3 5.6 1W
D2 1N4005
R2 5.6 1W

U10 7824 +24V REG
VIN 1
GND 2
VOUT 3

C11 6.8 UF
C12 6.8 UF

ACOM
TB1 1

J11 (4)

J30
1 +35 PHASE B
2
3 +35 PHASE A

J40
1
2
3

J40 TO AUSC. OPTION (11)

9

UNSPECIFIED TOLERANCE	APPROVALS		
0.X = ± 0.05	DWN EWH	DATE 04/93	
0.XX = ± 0.01	PE	DATE 9-93	
0.XXX = ± 0.005	QC	DATE	
ANGLES = ± 1/2 DEGREE	CE	DATE	
STOCK NO: 5201-0325	PM	DATE	
FILE NO: 205205B.SCH			

TITLE: CUFFLINK PUMP AND VALVE

SIZE	DWG. NO.	REV
B	205205	B

SCALE: NONE SHEET 1 OF 1