DEVICE SPECIFICATION

VascuDOP

Continuous Wave Doppler

for use in the

Carolina Medical VascuMAP®

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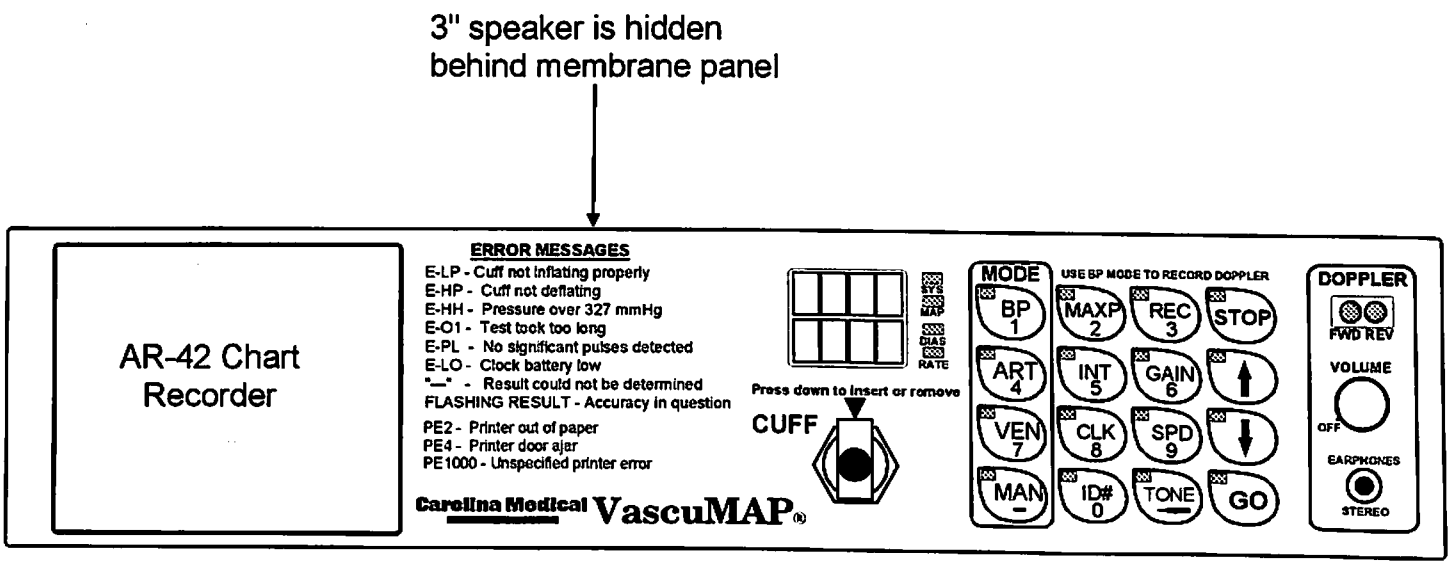


VascuDOP Front Panel Detail

showing all front panel controls

Carolina Medical VascuMAP®

VascuDOP Instrument Specification - REV 10 - 8 Oct. 1996

Description of the Instrument

The Doppler enhancement of the VascuMAP air plethysmograph is known as the "VascuDOP". This instrument adds a 5.0 Mhz Continuous Wave Doppler flow detector for arterial and venous blood velocity and waveform determination and documentation. Performing as an add-on board to the standard VascuMAP, the VascuDOP provides stereo audio output of the detected flow via earphones, or through the built-in speaker on the VascuDOP front panel. Simultaneous bidirectional waveform velocity documentation is provided by the thermal strip recorder in the instrument, with the waveform envelope determined by the standard, clinically proven zero-crossing detector method. Printed waveforms are accompanied by a scale showing axial velocity in cm/sec and by a printed header giving date, time, patient indentification, test parameters and other messages. Axial velocity measurement - the blood velocity component detected along the axis of the ultrasound beam - is independent of ultrasound frequency and is equal to the actual vascular blood velocity *or less* (depending on the angle of insonation) thus providing a minimum flow velocity documentation.

Audio output from the Doppler is available at all times in any VascuMAP operating mode (BP, ART, VEN, and MAN). Frequency response is 130 Hz to 14 KHz via the front panel speaker or 100 Hz to 20 KHz through the front panel stereo earphone jack. To silence the audio output and turn off the Doppler transmitter, an off-on-volume control is provided.

For recording the Doppler waveform, the VascuDOP is placed in BP mode (the chart recorder is used for plethysmographic waveforms in the other modes.) Zero-velocity baseline is fixed 15mm above the bottom of the 40 mm high recording strip, with trace inversion switchable via the UP and DOWN arrows of the VascuDOP keypad. Chart Gain and Speed may be manually preset, and are adjustable while the recorder is running. When the record strip is turned off, the inversion-corrected velocity scale is printed along with the printed header. Flow *toward* the Doppler Probe is always shown as a positive velocity value on the output scale. Chart gain is adjustable to accommodate the low flow rates found in veins as well as the fast flow jets of arterial occlusion.

Two ultrasound probes are available for the VascuDOP. For routine work, a 2.0 cm focal depth pencil probe is standard, and for deeper vessels a high-gain probe is available as an option. Other specialty probes may be designed for specific clinical or research purposes. Electrical safety is provided by 2500 Vrms RF transformer isolation in both transmit and receive connections to the Doppler probe. Leakage current at the probe connector is less than 50 microamps. An additional 2500Vrms isolation is also built in to the VascuDOP power supply, giving a full 5000Vrms isolation from the wall power connections.

The VascuDOP addition takes all its signals and power from the VascuMAP motherboard. A control panel daughterboard holds an off-on-volume control, a stereo earphone jack, and two brightness-modulated LED lamps to show forward and reverse velocities detected by the Doppler. A separate isolated audio output allows easy connection to a PC sound board (or other 600 Ohm line) for real-time FFT waveform display and analysis.

With the addition of a full-function, velocity-calibrated CW Doppler to the basic VascuMAP plethysmograph, clinicians of diverse specialties can have an instrument for their practice that provides standard blood pressures, peripheral vascular pressures, arterial and venous plethysmography, and arterial and venous flow velocity documentation all in one compact, convenient unit.

VascuDOP Electrical and Mechanical Specifications

ULTRASOUND OUTPUT
- 5.00 MHz continuous wave
- 50 Ohms, nominal
- output power fixed to meet FDA guidelines for diagnostic ultrasound, not adjustable.

AUTOMATIC GAIN CONTROL (AGC)
- 40 dB (10,000x) AGC provided at mixer outputs
- AGC attack and release time 100 ms and 2 sec, nominal, respectively

THUMP (HIGH PASS) FILTER
- 9-pole Butterworth fixed at 100 Hz
- limits low frequency response to chart recorder and audio outputs

AUDIO OUTPUT CHARACTERISTICS
- 100 to 20,000 Hz bandwidth at earphone jacks, stereophonic
- 100 to 20,000 Hz +/- 1 dB, 1 Vrms, nom., at audio line output (Rload >600 ohms)
- 130 to 15,000 Hz +/- 3 dB, 1 Watt, max, output via concealed front panel speaker

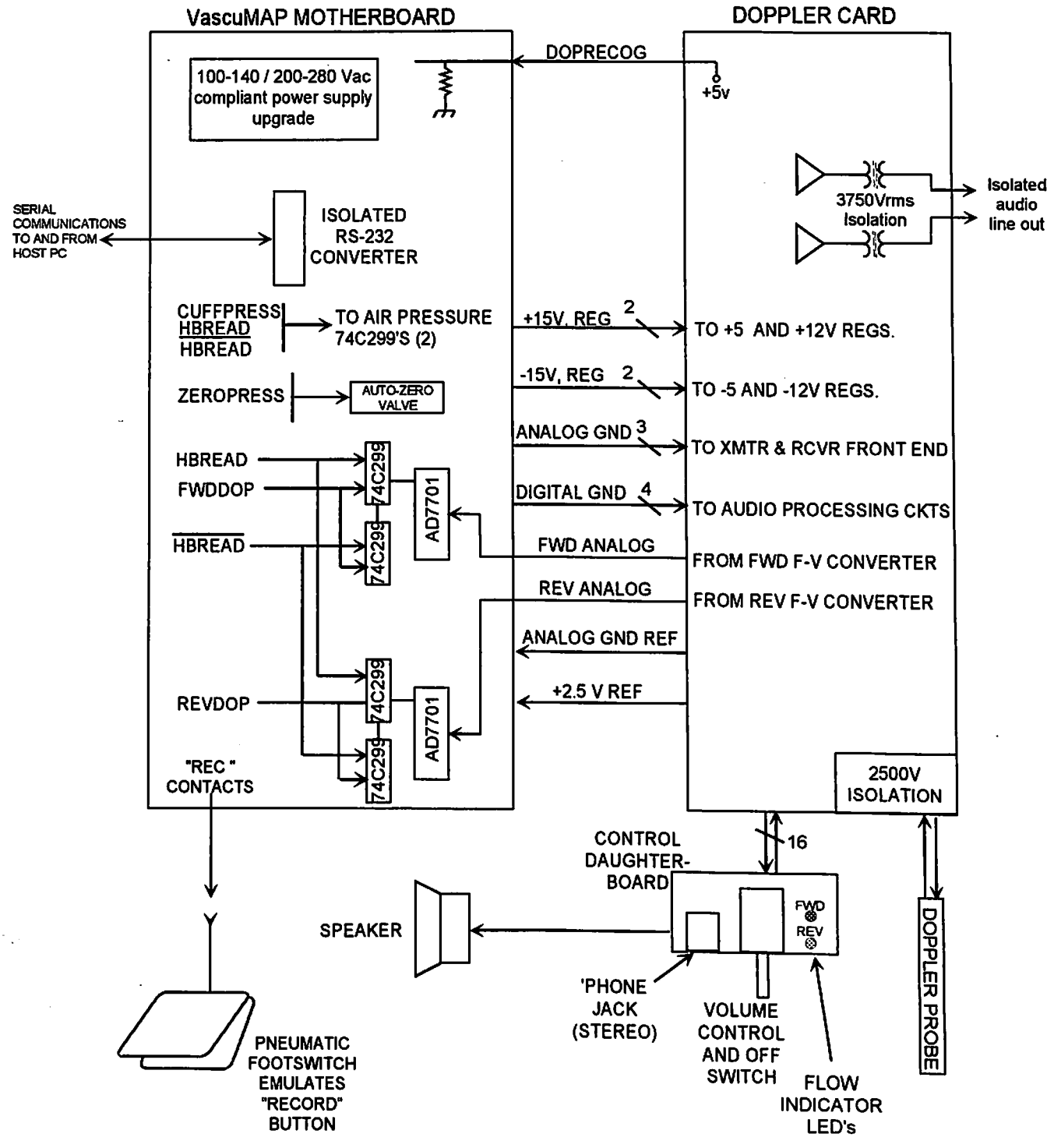
CHART RECORDER OUTPUT (via AR-42 Recorder in VascuMAP environment)
- thermal strip recorder with 40 mm of waveform display
- tracing speeds: 1, 2, 5, 10, 25, and 50 cm/sec.
- waveform envelope bandwidth: 0 to 25 Hz.
- zero-velocity baseline fixed at 15 mm position of 40 mm waveform display area
- tracing polarity invertable
- full-scale recorder gain settings available:
  - 5, 10, 20, 30, 50, 100, 200, and 300 cm/sec
  - (corresponds to 333, 665, 1330, 2000, 3325, 6650, 13,300 and 20,000 Hz Doppler shift)

CONTROLS AND CONNECTIONS
- off-on-volume control
- FWD (green) and REV (red) LEDs indicate velocities detected
- stereo 1/8" earphone jack
- Doppler probe connector
- Isolated stereo audio line out (optional)

DOPPLER PROBES
- pencil probe with 2.0 cm focal length - standard
- High Gain probe with 2.5 cm focal length (optional)

ELECTRICAL SAFETY SPECIFICATIONS (measured via UL-544)
- probe connector to protective ground isolation: 2500Vrms
- probe connector to power mains isolation: 5000 Vrms
- probe connector leakage current (all leads connected): under 50 microamps @ 60 Hz.
- Audio line output isolation from Doppler board: 3750 Vrms

MECHANICAL SPECIFICATIONS
- Case size: 16.5"W x 14.5"D x 5.25"H
- Weight: TBD
- Operating temperature: +10 to +38 Degrees, C, when calibrated at 23C.
- Operating and storage humidity: 20% to 90% RH, noncondensing
- Shock and vibration: Withstands normal shipping stresses and clinical hospital use
- Case materials: Aluminum and high-density plastic, rated UL94 V-0



TOLERANCES: (UNLESS OTHERWISE NOTED) ALL .XXX DECIMAL: ^..005 ALL .XX DECIMAL: ^..03 ALL FRACTIONAL: ^.1/16 ALL ANGULAR: ^..5°	Carolina Medical VascuMAP®	MEDICAL DESIGN	James S. Campbell, EE, MD. 3705 Sapona Trail, Pfafftown, NC 27040
MATERIAL:	DR. BY: JC,MD.	TITLE	VascuMAP DOPPLER INTERCONNECTION DIAGRAM
FINISH:	CHKD BY:	A	DATE 7 Oct 96 / DRAWING NO. DEVICE SPECIFICATION
	APPD.	SCALE	ECS / SHEET

ADDRESS MAP
FOR
VascuMAP & DOPPLER MOTHERBOARD
Carolina Medical, Inc.

29 June 1996
James S. Campbell, MD., Medical Design

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PORT ADDRESSES ON 80C31 MICROPROCESSOR (PLCC PIN NUMBERING SHOWN)

PORT NUMBER	PIN NUMBER	READ/ WRITE	FUNCTION	MNEMONIC
P1.0	2	W	TURN ON AIR PUMP	PUMPON
P1.1	3	W	CLOSE DUMP VALVE	DUMPOUT
P1.2	4	W	READ HIGH BYTE OF A/D CNVTR	HBREAD
P1.3	5	R/W	VOLUME CALIBRATOR PIN	VOLCAL
P1.4	6	W	AR-42 CHART RECORDER RESET	!ARRST
P1.5	7	W	START A/D CNVTR CALIBRATION	CALADC
P1.6	8	W	OPEN AUTOZERO VALVE TO ATMOS	ZEROPRESS
P1.7	9	W	WRITE NUMBER TO 7-SEG DISPL	!WRTNUM
P3.0	11	R	SERIAL PORT RECEIVE	RXD
P3.1	13	W	SERIAL PORT TRANSMIT	TXD
P3.2	14	I	AR-42 RECORDER INTERRUPT	!SYNC
P3.3	15	I	TIME CLOCK INTERRUPT	!INT1
P3.4	16	W	OPEN INFLATE VALVE	INFLT
P3.5	17	W	OPEN DEFLATE VALVE	DFLT
P3.6	18	W	WRITE TO ADDRESS SPACE	!WRT
P3.7	19	W	READ FROM ADDRESS SPACE	!RD

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NOTE: "!" = ACTIVE LOW

THE VascuMAP / DOPPLER ADDRESS SPACE IS MAPPED AS FOLLOWS:

ADDRESS (HEX)	R / W	FUNCTION	MNEMONIC
0000-7FFF	R	READ 32 KBYTES OF SRAM	!RAMSEL
and !ALE	W	WRITE 32 KBYTES OF SRAM	!RAMSEL
8000-87FF	R	READ 32 BYTES IN AR-42 RECORDER	!ARRD
	W	WRITE 32 BYTES IN AR-42 RECORDER	!ARWR
8800-88FF	W	WRITE LOW BYTE OF KEY LIGHTS	LOLITE
9000-97FF	W	WRITE HIGH BYTE OF KEY LIGHTS	HILITE
9800-98FF	W	START ANALOG-DIGITAL CONVERSION	!CNVT
A000-A7FF	R	READ CUFF PRESSURE REGISTERS	!CUFFPRESS
A800-A8FF	W	LOAD 7-SEG NUMERIC DISPLAY LATCH	LDNUM
B000-B7FF	R	READ AR-42 RECORDER STATUS LINES	ARSTAT
B800-B8FF	W	SOUND AUDIO BEEP	!BEEP
C000-C7FF	R	READ KEYPAD DECODER	!RDKEY
C800-C8FF	R	READ 64 BYTES IN TIME CLOCK	!RTCSEL
and !ALE	W	WRITE 64 BYTES IN TIME CLOCK	!RTCSEL
D000-D7FF	R	READ FORWARD DOPPLER REGISTERS	!FWDDOP
D800-D8FF	R	READ REVERSE DOPPLER REGISTERS	!REVDOP
E000-E7FF	X	RESERVED FOR FUTURE USE	
E800-E8FF	X	RESERVED FOR FUTURE USE	
F000-F7FF	X	RESERVED FOR FUTURE USE	

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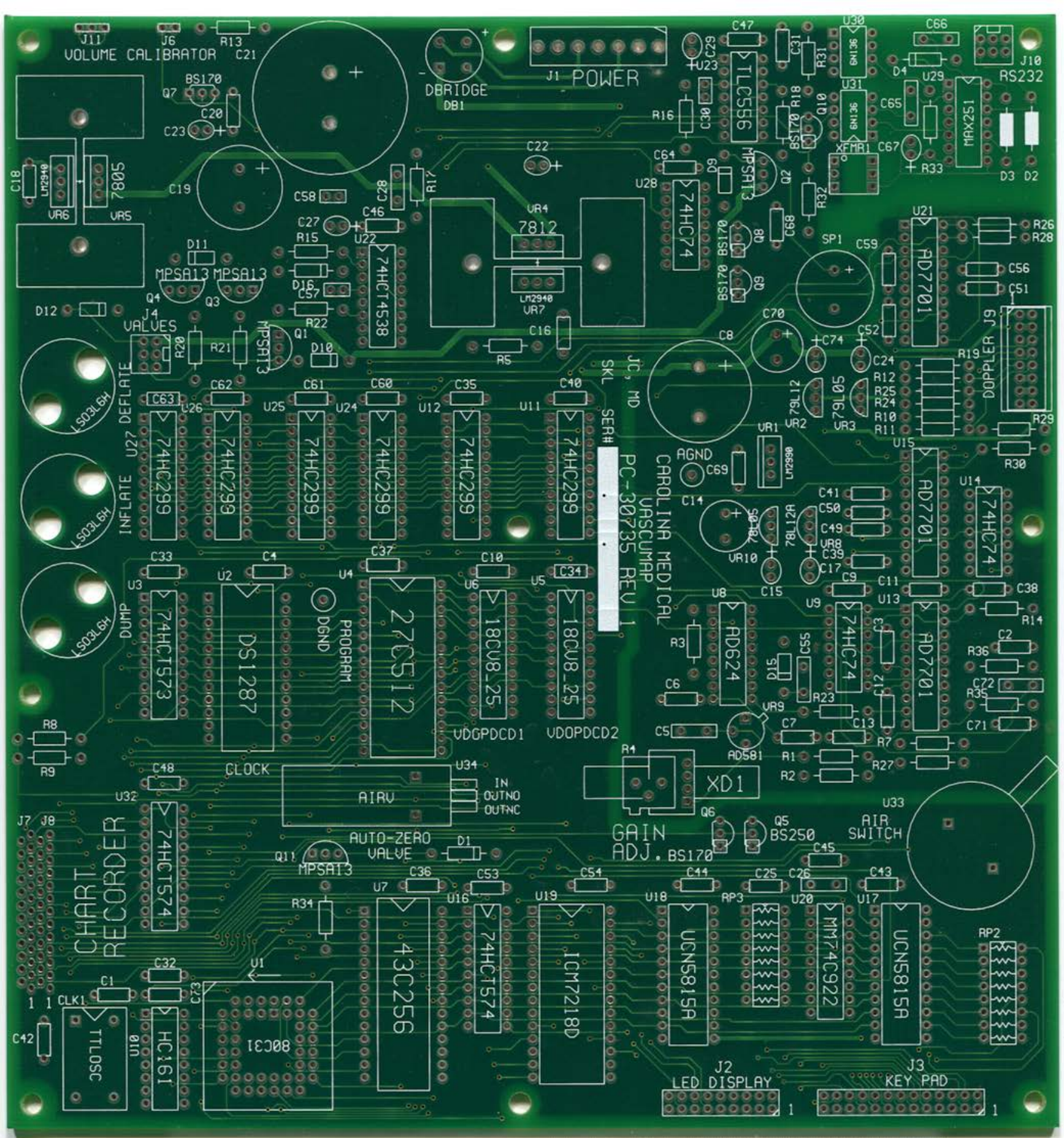
NOTES:

BIT 6 OF THE AR-42 STATUS REGISTER (ARSTAT) IS THE DOPPLER RECOGNITION BIT (DOPRECOG). HI = DOPPLER CARD INSTALLED. POLL THIS BIT AT STARTUP AND INITIATE DOPPLER ROUTINES IF HIGH.

BIT 7 OF THE AR-42 STATUS REGISTER (ARSTAT) IS THE KEYBOARD DATA READY BIT (KDA). HI = KEYBOARD DATA AVAILABLE (BUTTON HAS BEEN PUSHED). POLL THIS BIT IN THE MAIN SOFTWARE CONTROL LOOP AND PERFORM KEYPAD SERVICE ROUTINE IF HIGH.



VascuMAP II
Motherboard
JSCMD 1996