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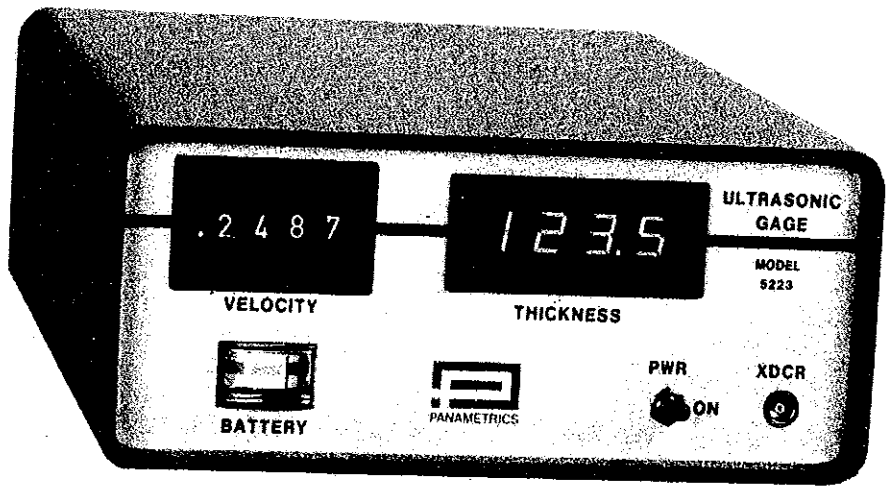
APPLICATIONS LAB

INSTRUCTION MANUAL

ULTRASONIC GAGE

MODEL 5223

SER. NO. _____



PANAMETRICS, INC.
221 Crescent Street
Waltham, MA 02254
Tel: (617) 899-2719

REV. D 6/86

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WARRANTY

Damage in transit - The gage should be thoroughly examined immediately upon receipt for evidences of external or internal damage. The carrier making the delivery should be notified immediately of any such damage, since the carrier is normally liable for damage in shipment. Packing materials, waybills, and other shipping documentation should be preserved in order to establish damage claims. After notification to the carrier, notify Panametrics of the circumstances so that we may assist in the damage claims, and in providing replacement equipment, if necessary.

Warranty - This Ultrasonic Gage is guaranteed by Panametrics to be free from defects in materials and workmanship for a period of two years (twenty-four months) from date of shipment, provided that the equipment has been used in the manner described in this instruction manual. The transducer, transducer cable, charger, and battery are not included under the terms of this warranty. Repairs or replacements, at Panametrics' option, will be made without charge at it's plant during the warranty period. Shipping expense to the Panametrics plant site is to be paid by the customer; shipping expense for return of the repaired equipment will be paid by Panametrics.

Panametrics reserves the right to modify all products without incurring the responsibility for modifying previously manufactured products. Panametrics does not assume any liability for the results of particular installations, as these circumstances are not within our control.

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SECTION 1

GENERAL DESCRIPTION

The Model 5223 Ultrasonic Gage is a simple to operate, solid state, drift free, portable ultrasonic instrument. It can be used to measure thickness, sound velocity, and/or pulse transit time in most solids and liquids. Ultrasonic techniques permit measurements where access to both sides of the solids or liquids is difficult or not possible.

The Model 5223 Gage features direct digital calibration in either English or Metric sound-velocity-units (in./usec or cm/usec) with visual readouts in inches or millimeters. The gage is capable of performing over a nominal measurement of 0.0050 to 0.999 inches (0.120 to 9.999mm) depending on material and transducer type with a calibrated accuracy of ±0.0001 inch (0.001mm). Additional features include: rechargeable battery, small size, rugged light weight case, and plug-in printed circuit cards for serviceability. Also, a wide selection of broadband transducers is available to permit optimum application of the gage under conditions which could otherwise be considered difficult or not possible.

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SECTION 2

UNPACKING AND INSPECTION

The Model 5223 Ultrasonic Gage has been designed and manufactured as a precision instrument, and under normal working conditions will provide long, trouble-free service. Please note, however, that the instrument should be inspected immediately upon receipt for damage incurred during shipment.

2-1 Unpack the electronic unit and visually inspect for physical damage.

2-2 Make sure that all other items are included, i.e., transducer of the type indicated on the packing slip and on cover of manual, transducer cable, battery charger, manual, couplant and test block.

CAUTION

DO NOT ATTEMPT TO USE ANY TRANSDUCER OTHER THAN THE ONE PROVIDED WITH THE INSTRUMENT.

2-3 Each gage is carefully inspected and fully checked out before shipment. Notify the carrier if any concealed physical damage is found and notify Panametrics to arrange for return and repair.

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SECTION 3

THEORY OF OPERATION

The Model 5223 Ultrasonic Gage operates on the "pulse-echo" principle. A piezoelectric transducer is excited by a short duration electrical pulse. The transducer converts the electrical energy into mechanical vibrations, or sound waves. These sound waves are coupled from a short delay medium in front of the transducer into a test material by a coupling liquid such as propylene glycol, glycerin, water, oil etc. Sound waves travel through the medium and are reflected back from the opposite surface. The same transducer receives the reflected sound waves and converts them to electrical pulses. The elapsed time t, (see Fig. 1) between two successive echoes from the surface of interest is related to the thickness x, and velocity V, at which sound waves travel through the material. The result is expressed by the relationship:

$$x = \frac{Vt}{2} \qquad (3\text{-}1)$$

where x = the thickness of the material
V = the velocity of ultrasonic sound in the material
t = the measured round trip transit time.

IDEALIZED WAVEFORM

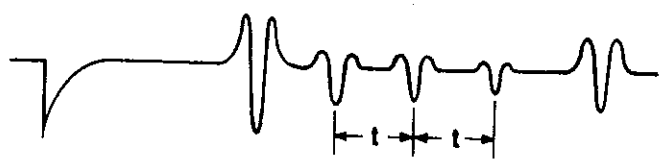
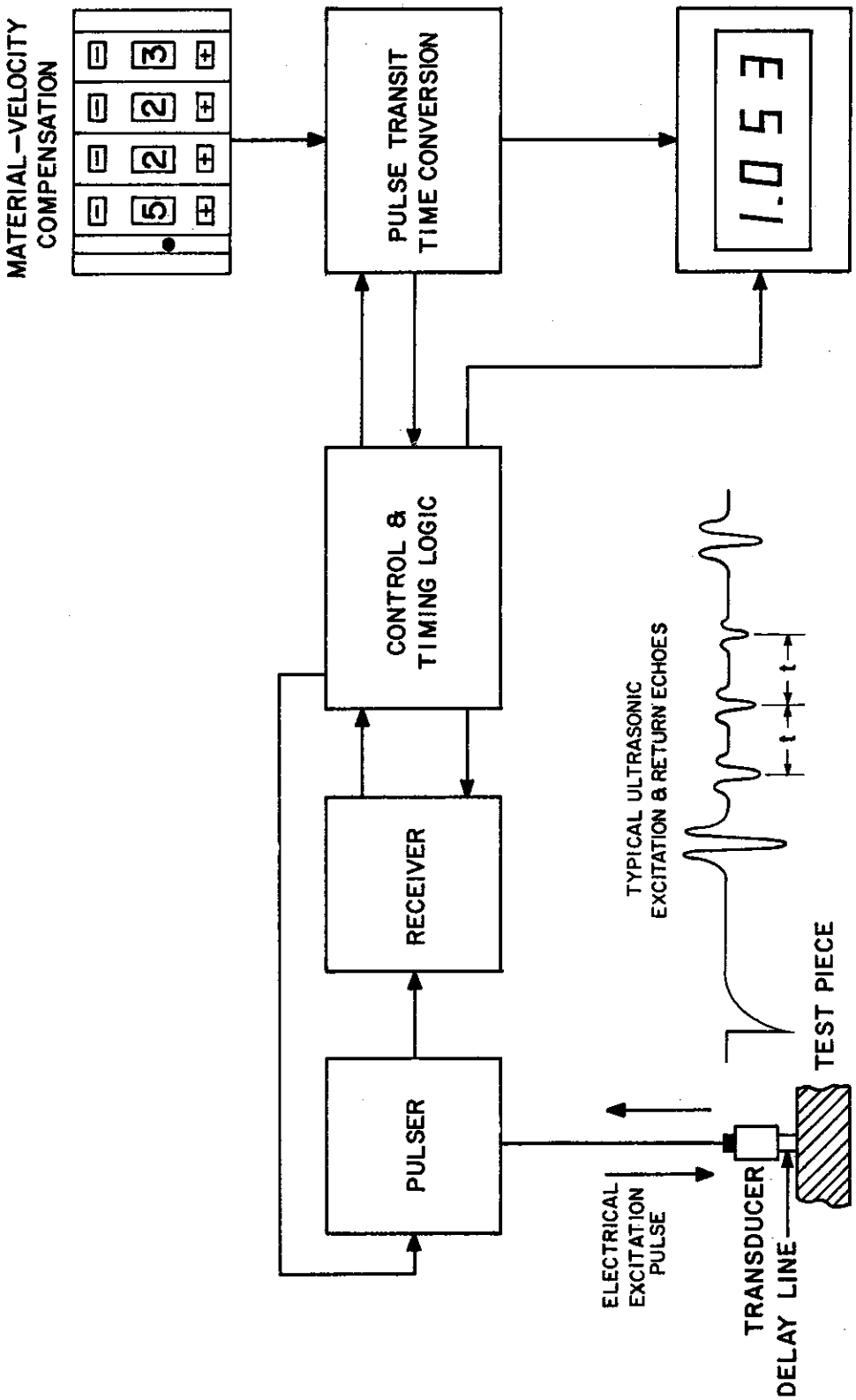


Fig. 1 Idealized Waveform for Pulse-Echo Thickness Measurements using Delay Line Transducers.

Figure 2 illustrates a generalized block diagram of the ultrasonic gage. Referring to Figure 2, the pulser provides a unidirectional broadband voltage impulse to a heavily damped broadband ultrasonic transducer. The broadband ultrasonic pulse generated by the transducer is coupled to the test piece by means of a liquid couplant. Echoes returning from the back or inside surface of the test piece are received by the transducer, converted to the electrical signals and, in turn, fed to the receiver preamplifier. The control and timing logic circuits both synchronize the pulser and select the appropriate echo signals that will be used in the time-interval measurement.

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FIG. 2 BLOCK DIAGRAM OF MODEL 5223 PRECISION DIGITAL ULTRASONIC THICKNESS GAGE SYSTEM



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When the proper signals have been identified by the control logic, the time interval is accurately measured and transmitted to the transit time conversion circuitry. The time interval is then electronically multiplied by the appropriate material velocity which has been set into the material velocity compensation system and then digitally displayed as thickness.

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SECTION 4

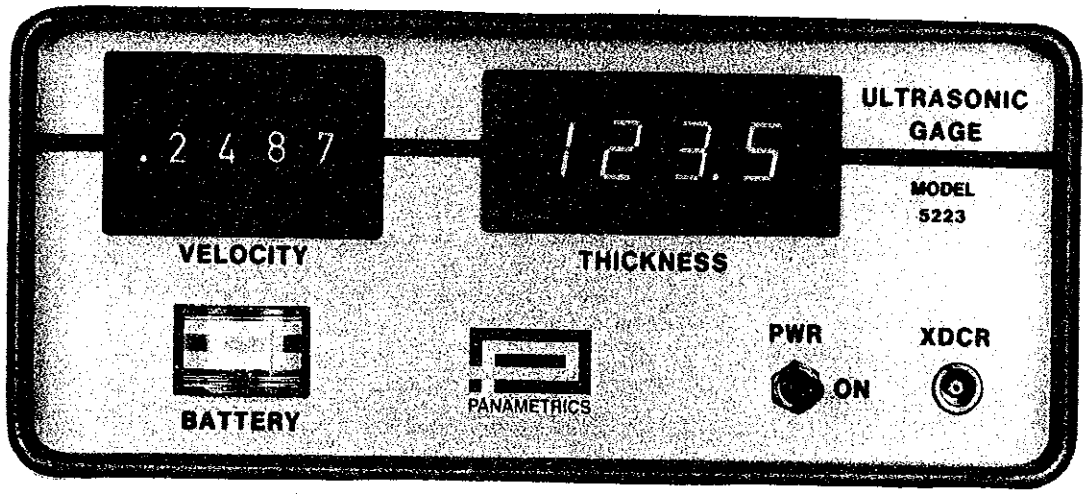
DESCRIPTION OF OPERATING CONTROLS AND INDICATORS (See Fig. 3)

FRONT PANEL

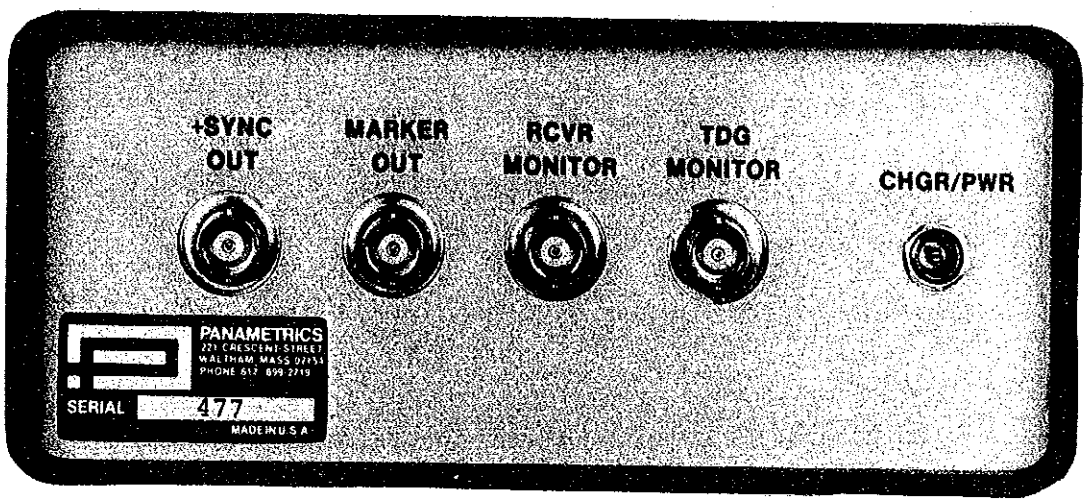
DIGITAL THICKNESS READOUT	Displays thickness measurements in either inches or millimeters, depending upon which unit the operator uses for sound velocity calibration (e.g., in./usec or cm/usec). Decimal point is factory set for readout in either inches or mils, centimeters, or millimeters.
MATERIAL VELOCITY CALIBRATION (MVC)	The Material Velocity Calibration (MVC) control is a four digit bidirectional switch that is used to dial in the sound velocity of the material (if known) in order to read the proper thickness. If the sound velocity of the material to be measured is not known, the thickness must be known and the MVC control is adjusted until the exact thickness of the part appears on the digital display. If sound velocities of inches/usec are used, readings will be in inches or mils. If sound velocities of cm/usec are used, readings will be in millimeters or centimeters.
XDCR CONNECTOR	Transducer connector for contact transducers.
PWR SWITCH	Controls power to the instrument.
BATTERY INDICATOR	Provides the operator with an indication or warning when the batteries need to be recharged. When operating from an AC source (using the CHARGER/AC ADAPTER) the BATTERY indicator provides an indication that the PWR switch is on. For full details on the color code of the indicator see Section 7 and Fig. 4.

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FIG. 3 FRONT AND REAR PANEL OF THE MODEL 5223 ULTRASONIC THICKNESS GAGE



FRONT PANEL



REAR PANEL

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POWER ON LIGHT	Red pilot light indicates that unit is switched on.

REAR PANEL

CHGR/PWR	Connector for the CHARGER/AC ADAPTER power cord.
SYNC OUT	BNC connector output that provides a positive sync pulse of 1-5V, t_r <30ns, Z_{out} approximately 50 ohms, for oscilloscope triggering.
MARKER OUT	BNC connector output that provides an oscilloscope signal that shows the time interval being measured and the position of the "Main Bang" blank.
RCVR MONITOR	BNC connector output that provides a monitor for oscilloscope display of the rf pulses at the output of the receiver. Signal amplitude 0 to 0.8V, Z_{out} approximately 50 ohms.
TDG MONITOR	BNC connector output that provides a monitor for oscilloscope display for setting up the TDG (Time Dependent Gain) adjustments.

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SECTION 5

TECHNICAL SPECIFICATIONS

THICKNESS MEASUREMENT RANGE	0.0050 to 0.9999 inches or 0.127 to 9.999mm (depending on material and transducer type).
VELOCITY CALIBRATION RANGE	0.05 to .07999 in./usec or cm/usec.
DISPLAY	Four digit light emitting diode (LED) display. (Fixed Decimal Point.)
RESOLUTION	0.0001 inch or 0.001mm.
CALIBRATED ACCURACY	± one count of least significant digit.
STABILITY	± one count for 8 hours after allowing one minute warm-up.
RECEIVER BANDWIDTH	1-20 MHz.
TEST MODE	Delay Line or Immersion Transducers.
OPERATING TEMPERATURE RANGE	0°C to 50°C.
POWER REQUIREMENTS	115/230VAC, 50-60Hz supplied from external CHARGER/AC ADAPTER or 6V DC (internal batteries).
BATTERY	6V rechargeable solid gel battery.
BATTERY LIFE	Approximately 8 hours between charges.
CHARGER	External CHARGER/AC ADAPTER connects to CHGR/PWR socket on rear panel of gage. 16 hour maximum charging period (required for fully discharged batteries).
FUSE	Internal fuse located on the POWER SUPPLY BOARD - ampere 3AG type.

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SIZE	2-3/4" High x 6-1/2" Wide x 9-9/16" Long. (70mm High x 165mm Wide x 240mm long).
WEIGHT	4-1/4lbs. (1.9Kg) including battery.
+ SYNC OUTPUT	Positive going 1-5V pulse t_r <30ns, Z_{out} approximately 50 ohms.
RCVR MONITOR	0 to 0.8V output amplitude.
MARKER OUTPUT	4V TTL logic pulse with Main Bang Blank Marker superimposed.
TDG MONITOR	0-10V analog voltage to aid in setting up the Time Dependent Gain (TDG). See Section 9 for further information.

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SECTION 6

OPERATION

6-1 OPERATION USING INTERNAL BATTERY POWER

a. Connect the broadband delay line transducer via the coaxial cable to the XDCR connector located on the front panel. **NOTE:** MAKE SURE THERE IS ADEQUATE COUPLANT BETWEEN THE PLASTIC DELAY-LINE AND THE TRANSDUCER. DO NOT USE THE DELAY-LINE TRANSDUCER WITHOUT THE PLASTIC BUFFER ELEMENT.

b. Place the PWR switch on the front panel of the gage to the ON position. **NOTE:** DISPLAY IS NORMALLY BLANKED UNLESS MEASUREMENTS ARE MADE.

c. If the sound velocity of the material to be measured is known set the VELOCITY calibration switches to the proper velocity (see Table 1, Appendix I).

d. Apply a light coating of the coupling fluid (supplied) to the surface of the specific material under test and couple the transducer, using moderate pressure. The correct thickness will be displayed on the digital panel meter if the proper sound velocity is set in the MVC control.

NOTE: IT MAY BE FOUND THAT VARIATIONS IN COUPLING TECHNIQUE CAUSE THE DISPLAY READING TO CHANGE BY TWO OR THREE COUNTS. IN GENERAL, A STEADY, MODERATE COUPLING PRESSURE IS REQUIRED IN ORDER TO OBTAIN CONSISTENTLY ACCURATE THICKNESS READINGS. HOWEVER, THE SURFACES OF THE PART SHOULD BE AS CLEAN AND AS SMOOTH AS POSSIBLE. IF THE TEMPERATURE OF THE STANDARD SAMPLE IS SIGNIFICANTLY DIFFERENT FROM ROOM (AMBIENT) TEMPERATURE, THE ACTUAL ULTRASONIC VELOCITY VALUE WILL CHANGE ENOUGH TO CAUSE SIGNIFICANT ERROR. VARIATIONS OF THIS SORT MAY BE CORRECTED BY ADJUSTING THE VELOCITY SETTING TO COMPENSATE FOR TEMPERATURE DIFFERENTIALS. FOR ADDITIONAL GUIDANCE PLEASE SEE SECTION 10 (APPLICATIONS NOTES).

e. If the sound velocity of the material is not known use a test block of the material of interest to set up the VELOCITY switches. Always calibrate the VELOCITY bi-directions switches for each set of materials on the thickest material in its respective range. For example, using the test block (supplied),

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apply a light coating of the coupling fluid (also supplied) to the surface of the thickest test block sample and couple the transducer, using moderate pressure, to the material. A thickness will be displayed on the digital panel meter. Adjust the VELOCITY bi-directional switches so the visual reading is exactly the actual thickness of the test sample. At this point the gage is operational, and ready to be used for thickness measurements on materials of identical velocity.

f. Battery life is approximately 8 hours of continuous operation. **CAUTION:** TO AVOID PERMANENT BATTERY DAMAGE RECHARGE BATTERY WHEN INDICATOR REACHES THE "RED" ZONE (SEE FIG. 4). NEVER LEAVE THE POWER SWITCH ON WHEN NOT USING THE GAGE. See Section 7 for further instructions on battery maintenance.

6-2 OPERATION USING EXTERNAL CHARGER/AC ADAPTER

a. Make sure that the CHARGER/AC ADAPTER is compatible with the "line" or "mains" power. Place the slide switch on the back side of the CHARGER/AC ADAPTER module (Model 5200) to the correct voltage (115 or 230VAC whichever is applicable).

b. Connect the output plug of the CHARGER/AC ADAPTER into the CHGR/PWR connector on the rear of the Model 5223 Gage.

c. Plug the CHARGER/AC ADAPTER unit into the proper AC outlet.

d. Place the PWR switch on the front panel of the gage to the ON position.

e. Repeat Section 6-1

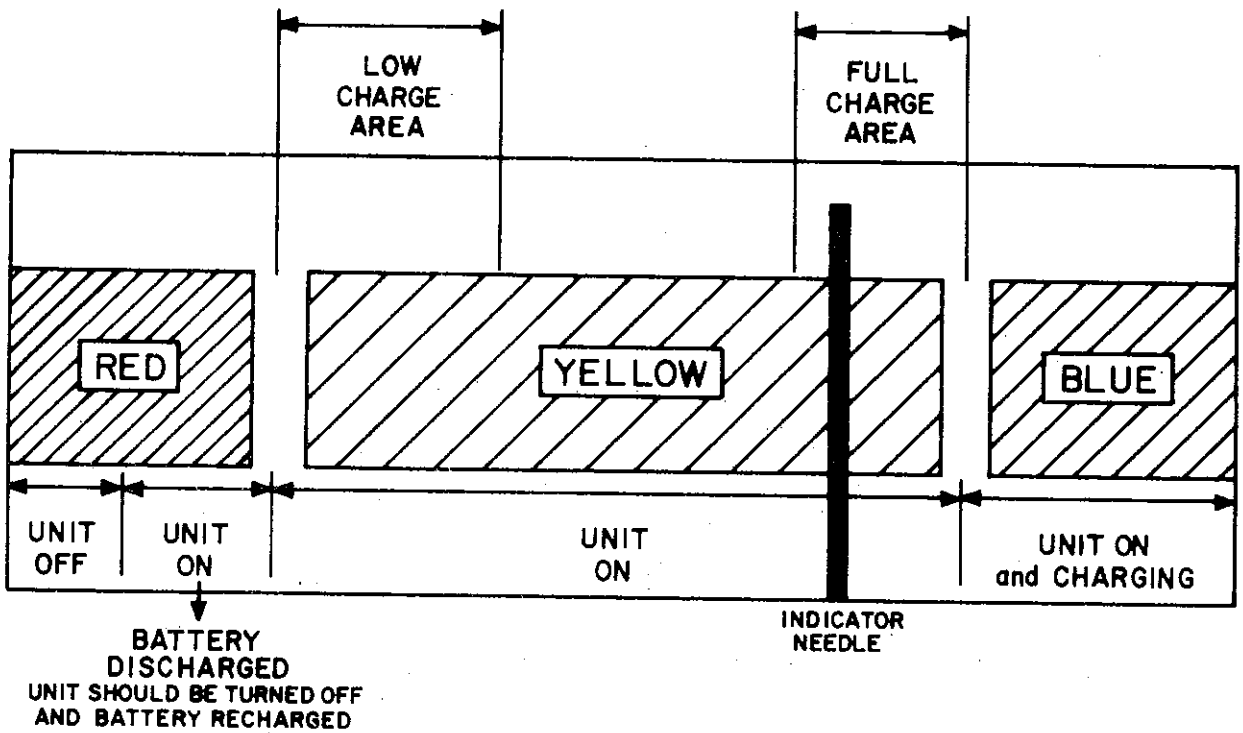
6-3 OPERATION USING EXTERNAL CHARGER/AC ADAPTER WITHOUT INTERNAL BATTERIES

a. The Model 5223 Gage is capable of operating without internal batteries by using power supplied by the CHARGER/AC ADAPTER only.

b. Repeat Section 6-2.

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FIG. 4 BATTERY INDICATOR



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SECTION 7

BATTERY RECHARGING AND MAINTENANCE

Batteries for the Panametrics portable instrument are especially designed for long, trouble-free service. Sealed construction permits them to be operated, stored, or charged in any position either within or outside of the equipment.

The following operating tips will help you obtain the maximum amount of satisfaction from battery use:

7-1 The batteries are fully charged when shipped, but for longest operating time, they should be recharged before using.

7-2 Recharge only with charger supplied with equipment in which the batteries are to be used. Other chargers may reduce battery life.

7-3 Recharge as soon as possible after each use.

NOTE: WHEN BATTERY INDICATOR REACHES THE "RED" ZONE (SEE FIG. 4 BATTERY INDICATOR INTERPRETATION) THE GAGE SHOULD BE SHUT OFF IMMEDIATELY AND THE BATTERY RECHARGED AS SOON AS POSSIBLE. FAILURE TO SHUT DOWN THE EQUIPMENT AND RECHARGE THE BATTERY AT THIS POINT, MAY DECREASE THE BATTERY LIFE.

7-4 To recharge battery attach the CHARGER/AC ADAPTER plug to the CHGR/PWR receptacle on the rear panel and plug the unit into a proper AC power source. Battery will automatically recharge. For a fully discharged battery allow approximately 16 hours to fully recharge.

NOTE: FOR MINIMUM RECHARGE TIME, BATTERIES SHOULD BE RECHARGED WITH THE UNIT TURNED OFF. HOWEVER, THE GAGE MAY BE OPERATED NORMALLY WHILE RECHARGING.

7-5 Preferred storage temperature is 70°F (21°C) or below. The battery should be stored fully charged and recharged at six-month intervals. Higher temperatures require more frequent charging. Storage at temperatures above 100°F (38°C) should be avoided.

7-6 Eventually the battery will gradually lose its capacity to fully recharge. When the operating time after a full charge is no longer satisfactory, it is time to replace the battery.

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SECTION 8

CALIBRATION

8-1 EQUIPMENT REQUIRED

The following test equipment or its equivalent is required for this procedure:

a. Digital voltmeter with a minimum range of 100V

b. Multi-channel 50MHz oscilloscope - Tektronix Model 465 or equivalent

c. Small adjustment screwdriver

d. Sample materials of known velocity and/or thickness

e. BNC/BNC cables or probes to connect gage to scope

8-2 PRELIMINARY ADJUSTMENTS

Each card is calibrated within its respective system.

a. Place "PWR" switch to the "ON" position.

b. Monitor TP1 (inverter oscillator output) on the power supply board with the oscilloscope and adjust the waveform using the OSC BAL potentiometer (see Fig. 5) for the best symmetry and minimum audible noise. Internal scope triggering should be used for this adjustment.

c. Monitor the +5V terminal and the +12V terminal on the power supply card with a voltmeter.

d. Adjust for +5.00 ±01V and +12.00 ±.05V, respectively, using the +5V and +12V adjustment potentiometers (see Fig. 5).

e. Measure the DC voltages at the -5V terminal and the +HV terminal. They should be -5.00 ±0.2V and +100 ±20V, respectively.

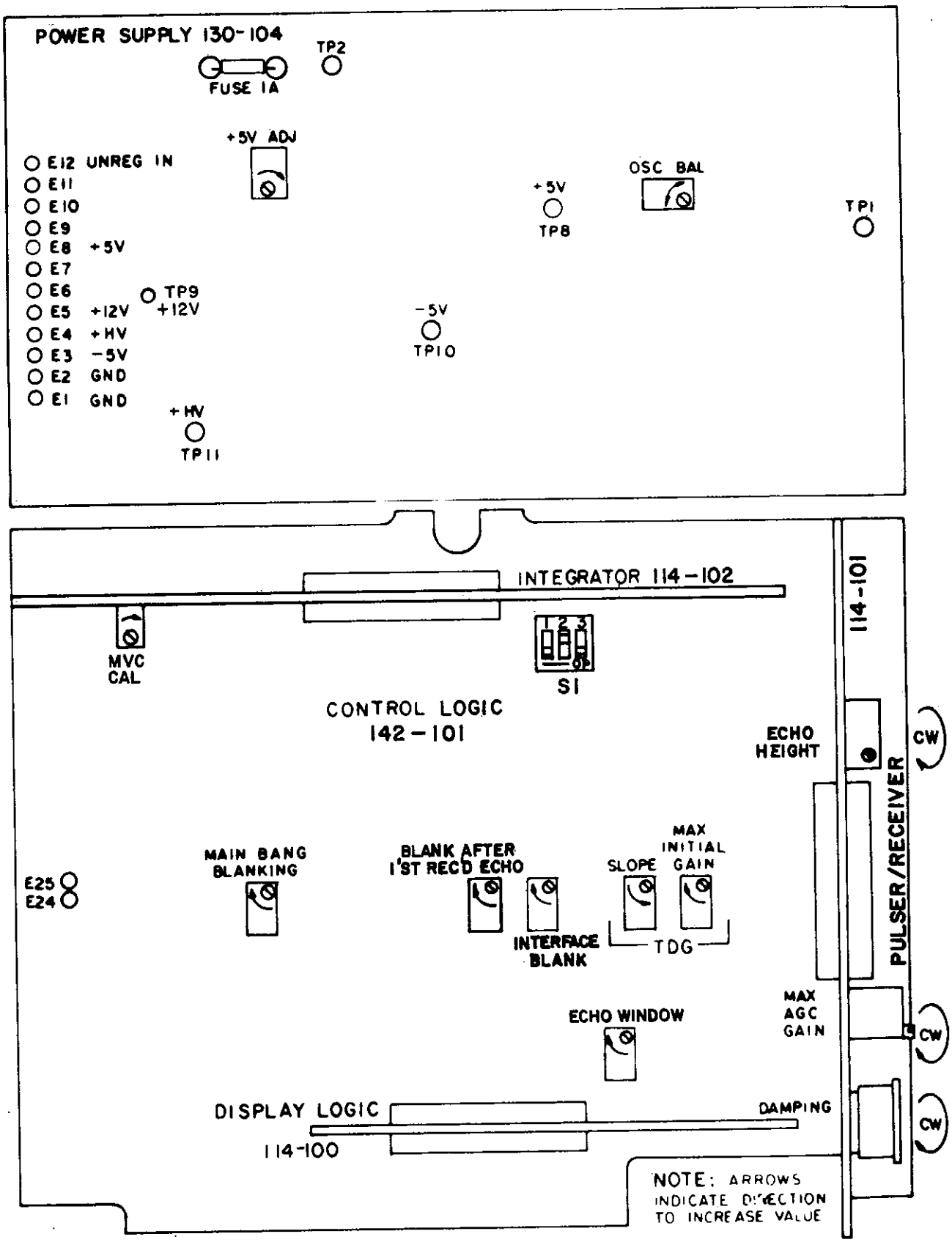
8-3 CALIBRATION

Calibration of the Model 5223 Ultrasonic Gage falls into two categories:

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FIG. 5 LOCATION AND ADJUSTMENTS OF CIRCUIT BOARDS (TOP VIEW)

REAR



FRONT

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TYPE I - ABSOLUTE (THICKNESS-VELOCITY-TIME) CALIBRATION

TYPE II - THICKNESS CALIBRATION

a. TYPE I -ABSOLUTE CALIBRATION

Absolute Calibration involves adjustment of the internal MVC CAL potentiometer. This type of calibration is a factory adjustment and seldom needs to be changed. Altering the MVC CAL potentiometer destroys the absolute accuracy of the VELOCITY switches. This is of paramount importance if the unit is to be used for velocity or time measurements.

UNLESS THERE ARE CALIBRATION STANDARDS AVAILABLE, WHOSE SOUND VELOCITY AND THICKNESS ARE BOTH KNOWN, THIS TYPE OF CALIBRATION SHOULD NOTE BE ATTEMPTED.

The procedure is as follows:

1. Set the VELOCITY switches located on the front panel to the velocity of the calibration standards.

2. Using the standard closest to full scale, apply a light coating of the coupling fluid to the surface of the standard and couple the delay line transducer to the material using moderate to firm pressure. Thickness will be displayed on the thickness display.

3. Adjust the MVC CAL potentiometer on the Integrator Card (see Fig. 5) to read the proper thickness on the display.

4. At this point, the gage is calibrated and thickness, sound velocity and/or pulse transit time measurements can be made.

NOTE: ABSOLUTE ACCURACY OF THE GAGE IS ONLY AS GOOD AS THIS CALIBRATION. IT SHOULD BE PERFORMED CAREFULLY.

b. TYPE II - THICKNESS CALIBRATION

1. Using the thickest standard within the transducer and gage measurement capability apply a light coating of the coupling fluid to the surface of the material and couple the delay line transducer using moderate pressure. Thickness will be displayed on the THICKNESS display.

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2. Adjust the VELOCITY switches on the front panel to read the correct thickness on the display.

3. At this point, the gage is calibrated.

NOTE: ACCURACY OF THE GAGE IS ONLY AS GOOD AS THIS CALIBRATION. IT SHOULD BE PERFORMED CAREFULLY.

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SECTION 9

ADJUSTMENTS

9-1 MAIN BANG BLANKING ADJUSTMENT

This blank or dead zone adjustment prevents spurious signals or reverberations, immediately following the transducer excitation or main bang pulse, from being registered as thickness readings. The normal setting of this blank duration is just prior to the first echo (Interface echo) off the delay line of the transducer or off the first surface in an immersion test. Under some conditions it may be desirable to change the duration of this blank. It is strongly recommended that no attempt be made to adjust the blanking or other internal controls without the aid of an oscilloscope (see also Section 10-6) and such adjustments should only be made by qualified technicians.

The control that regulates the duration of the MAIN BANG BLANK is located on the CONTROL LOGIC CARD (see Fig. 5). Clockwise adjustments increases the duration of the dead zone.

NOTE: UNTIL ONE IS FAMILIAR WITH MAKING SUCH ADJUSTMENTS, IT MAY BE HELPFUL TO NOTE THE AMOUNT OF ADJUSTMENT MADE ON EACH CONTROL SO THAT THE GAGE CAN BE READILY RETURNED TO ITS ORIGINAL CONDITION.

9-2 ECHO WINDOW ADJUSTMENT

The gage will not detect any echoes that occur after a certain period of time from the first interface echo. This time period is controlled by the ECHO WINDOW adjustment on the Control Logic Board, see Fig. 5. This enable period prevents the gage from detecting multiple interface echoes as measurable back echoes and at the same time allows the window to track the varying water path length in immersion type setups.

To adjust this window, observe the RCVR MONITOR and MARKER OUT waveforms on an oscilloscope. If a delay line transducer is being used, couple it to the thickest expected material sample. If an immersion or bubbler setup is being used, adjust the fixture to the minimum expected water path between the transducer and the material being gaged using the thickest expected material. Now adjust the ECHO WINDOW control so that the second falling edge of the MARKER OUT waveform

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occurs just before the second interface echo. The edge should also occur after second measured echo. See Fig. 6. This adjustment will allow the widest ranges of water/delay line length and material thickness.

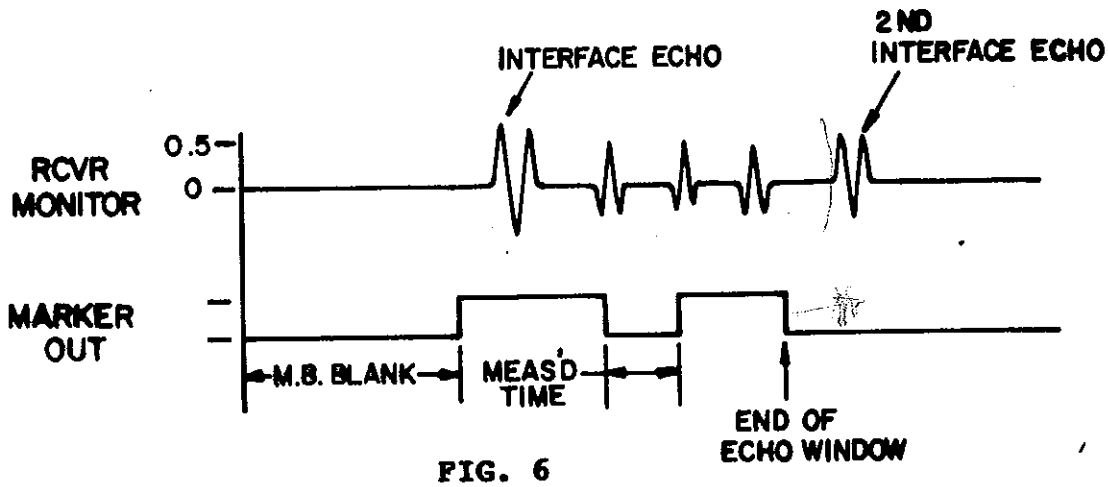


FIG. 6

9-3 INTERFACE BLANKING ADJUSTMENT

The Interface Blanking adjustment controls the length of the dead zone following the leading edge of the interface echo. This dead zone prevents any ringing cycles or noise following the interface echo from being interpreted as back echoes from the measured material. Normally an INTERFACE BLANKING setting of 200 to 300nS provides an optimum safety from false readings and resolution of thin materials. This adjustment should not be attempted without an oscilloscope and the concurrent adjustment of MAXIMUM AGC, DAMPING, and TDG controls.

The control that regulates the duration of INTERFACE BLANKING is located on the CONTROL LOGIC CARD (see Fig. 5). Clockwise rotation increases the duration of the dead zone.

9-4 BLANKING AFTER 1ST MEASURED ECHO ADJUSTMENT

This control adjusts the length of a dead zone after the first measured back echo. The dead zone prevents any ringing from being measured as a back echo. Normally this control is switched to the minimum setting (about 50nS) in order to maximize resolution for very thin materials. However, to obtain extra penetration of a material 20 mils thick and over, transducer characteristics may require use of this blank and sacrifice in thin resolution, and the adjustable delay can be switched in. For no blanking S1-2 is closed and S1-3 is open (OP). For adjustable blanking, S1-2 is open (OP) and S1-3 is closed. This adjustment should be made only with an oscilloscope. Clockwise rotation of the blank after 1st received echo control increases the duration of the dead zone.

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9-5 TIME DEPENDENT GAIN (TDG) SLOPE, AND INITIAL GAIN ADJUSTMENTS

The Model 5223 has independent adjustment potentiometers for the maximum receiver gain immediately following the MAIN BANG BLANK, the slope of the gain as a function of time curve immediately following the MAIN BANG BLANK, and for the maximum final AGC gain (see Fig. 5). Normally these controls are factory set and should not be adjusted by the user unless he is completely familiar with all of the acoustic considerations that go into their proper adjustment. It is almost impossible to properly adjust these controls without the use of an oscilloscope.

The time dependent gain feature of the 5223 is designed to provide maximum near surface resolution without degrading the penetrating capability of the instrument. The initial gain adjustment can be used to reduce the amplifier gain at the INTERFACE ECHO while the slope adjustment compensates for material attenuation, scattering, and/or beam spreading of the sound energy. The controls are particularly valuable when thickness measurements must be made on materials that cause rapid loss of sound energy as a function of thickness.

It is recommended that before any attempt is made to adjust these controls, that the user consult Panametrics for advice. In general, the procedure for setting up the time dependent gain adjustment is as follows:

Two or more samples of the material to be measured are required that represent the extremes in the range over which thickness measurements are to be made. Using the thicker piece of material, a transducer is selected that will give the required penetration. The damping and maximum AGC adjustments are made to give a clear and readable back echo from this piece of material. Then the transducer is coupled to the sample representing the minimum thickness that must be measured. The initial gain control should then be adjusted so that the initial gain is adequate to give readable back echoes but not so great that the interface echo or scattering from the sample is a problem. This, again, can only be done properly with the aid of an oscilloscope monitor. After the initial gain adjustment has been set, the transducer is again coupled to the thick sample. If no reading is obtained, the slope control must be adjusted by increasing the slope to obtain sufficient gain at the time the back echoes are returned from the thick sample to produce a readable signal. After the slope adjustment has been made to achieve a readable back echo from the thick piece, the transducer is again coupled to the thin piece to insure that a reliable reading is obtained. It is advisable to have one or two samples of a thickness intermediate between the minimum and maximum thickness.

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In the event such samples are not available, readings of thickness can be made but must be interpreted with care.

If any problems are encountered in making these adjustments, Panametrics should be consulted for assistance.

9-6 MAXIMUM AGC GAIN ADJUSTMENT

This control is located on the PULSER/RECEIVER card (see Fig. 5) and is used to adjust the maximum gain of the Automatic Gain Control (AGC) circuit beyond the period over which the TDG acts. The initial factory setting of this control is determined by the requirement that the Gage measures reliably over the specified thickness range. The control may be adjusted to give an increase or decrease in gain for special applications. This adjustment should only be made with the aid of an oscilloscope. Clockwise rotation of the Maximum AGC Gain Adjustment increases the maximum available gain.

9-7 ECHO HEIGHT

This control is located on the PULSER/RECEIVER card (see Fig. 5) and is used to set the height at which the AGC will maintain the selected echo of interest. The detection thresholds are about 0.25V, so that the echo height is normally set to about 0.5V at the factory to allow for optimum discrimination between echoes and noise. Clockwise rotation of the Echo Height potentiometer causes an increase in the echo amplitude.

9-8 DAMPING CONTROL ADJUSTMENT

The primary function of the Damping Control is to match the electrical impedance characteristics of the transducers and achieve the optimum pulse-echo waveform. This control is located on the PULSER/RECEIVER card (see Fig. 5). The control is factory set and should rarely need any adjustment. Any adjustment should be made with the aid of an oscilloscope. Fully counterclockwise rotation of the potentiometer results in minimum damping (high resistance) and fully clockwise rotation results in maximum damping (low resistance).

In general, counterclockwise rotation of the damping control (toward high resistance) will increase the penetration capability at the expense of resolution (the minimum thickness that can be measured). Clockwise rotation will improve resolution at the expense of penetration. Proper adjustment of the damping control can be considered a compromise between penetration and resolution.

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9-9 PROGRAMMING SWITCH

S1 on the Control Logic Board (see Fig. 5) allows the user to select the adjustable blank after the first measurement echo.

		SW1		
		1	2	3
BLANK AFTER	NONE	X	0	X
1ST BACK ECHO (1)	YES (2)	X	X	0

NOTES: X INDICATES CLOSED SWITCH SECTION.

0 INDICATES OPEN SWITCH SECTION.

(1) See Section 9-3.

(2) Adjust R32 Control Logic Board.

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SECTION 10

APPLICATION NOTES

The Model 5223 Ultrasonic Gage is a simple to use, precise instrument which will give accurate, reproducible thickness readings when proper technique is employed. Several points are discussed here in order to assist the operator in achieving the full capability of the Gage as delivered from the factory. Further, directions for making some minor adjustments are given that will enhance the Gage performance in certain difficult applications.

10-1 DELAY LINE AND IMMERSION TRANSDUCER MEASUREMENTS

Thickness measurements utilizing the Model 5223 involve the measurement of time intervals between successive back echoes following an interface echo. This measurement technique is normally reserved for thin sections and measurements involving the use of delay-type or immersion-type transducers. This type of measurement technique is best applied to engineering materials having an acoustic impedance that is greater than 1 x 10^6gm/cm^2sec. In materials of this type, successive reverberation echo signals are all the same polarity and the relative amplitude of successive echoes is determined by the transmission coefficient of the sound energy out of the material into either polystyrene or water. Since both of these delay materials are of relatively low acoustic impedance, the ratio of successive echo-signal amplitudes is usually greater than .5 or 6dB. If materials of widely different acoustic impedance are to be tested in this manner, compensation for the variation in successive echo-signal amplitudes must be provided in order to obtain the maximum accuracy from this measurement technique. However, errors do not become too great until the acoustic impedance drops below 3 x 10^6gm/cm^2sec.

If accurate thickness measurements are required on rough machined surfaces having a surface finish of approximately 3 microns RMS, a delay line transducer will give more repeatable readings than a contract type transducer measurement. This is due to the fact that successive echo reverberations tend to subtract out the variable thickness of the couplant layer that adds to the time interval measured using a contact type transducer. Even though delay line measurements can improve the accuracy on relatively rough machined surfaces, this does not mean that delay line measurements in general are useful on very rough or corroded surfaces. Because two

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successive reverberations are required in order to make the time interval measurements, severe surface roughness produces so much scattering that the second reverberations is often obliterated.

In utilizing immersion transducers, it is usually necessary to set up the measurement using an oscilloscope. Often spurious or unwanted signals can interfere with the thickness measurement and these must be observed on an oscilloscope so that the operator can make adjustments to minimize or eliminate them. Two possible situations are illustrated in Fig. 7. Figure 7a shows a thickness measurement utilizing a focussed transducer properly set up with the correct water path. In Figure 7b the time interval measurement is being erroneously made between the first and second cycle of the first back echo. This condition can often exist in measurements involving immersion transducers and sometimes can occur with delay type transducers. Figure 7c illustrates a mode converted shear echo which can result when a focussed immersion transducer is utilized and the water path between the transducer and the test piece is too long. In order to obtain clean multiple echoes for the purpose of thickness gaging measurements, a focussed immersion transducer must be operating considerably short of the focal length. If it is operated at or near the focal length, intermediate shear mode echoes will usually occur. The advantage of focussed immersion transducers is that they often permit more angulation and misalignment with respect to the test piece than is possible with a flat transducer of the same size and frequency.

The Model 5223 is equipped with a blank or dead zone after the first back echo being used on the time interval measurements (see Section 9-3). If the minimum thickness to be measured in a given application is is greater than the time interval in which spurious or unwanted signals occur, the blank can be adjusted to prohibit measurements of unwanted signals. Figure 7d illustrates schematically that such a blank would eliminate such a possibility of the erroneous measurements shown in Fig. 7b and 7c.

For material at elevated temperatures (less than 300°C) delay line transducers can be equipped with a high temperature delay line. Silicone grease can be used as a couplant to obtain thickness readings on materials with relatively good surfaces. The transducer itself must be protected from temperatures in excess of 100°C.

10-2 FACTORS AFFECTING PERFORMANCE AND ACCURACY

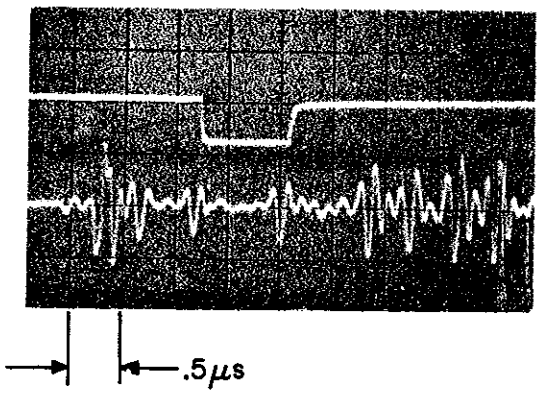
a. **Calibration** - The accuracy of measurement are only as good as the accuracy and care with which the gage has been calibrated. The Model 5223 Ultrasonic Gage has been carefully calibrated before it leaves

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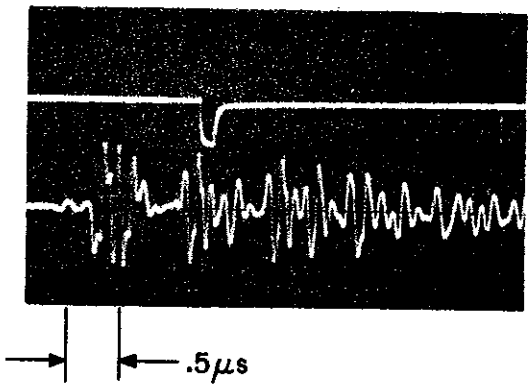
the factory and will seldom require recalibration. However, periodic checks with samples of known thickness should be made to insure the gage is performing correctly (see Section 8).

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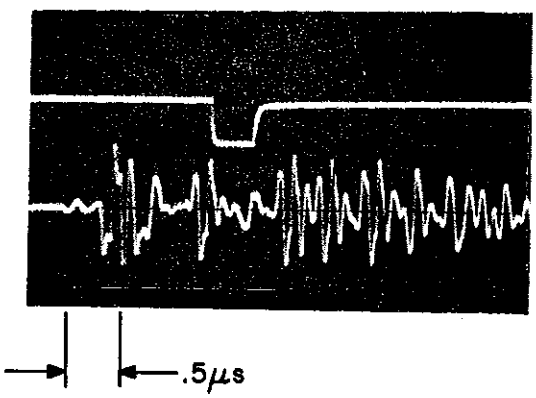
FIG. 7 OSCILLOGRAMS ILLUSTRATING ECHO-SIGNAL WAVEFORMS ENCOUNTERED IN MEASUREMENTS WITH IMMERSION TRANSDUCERS.



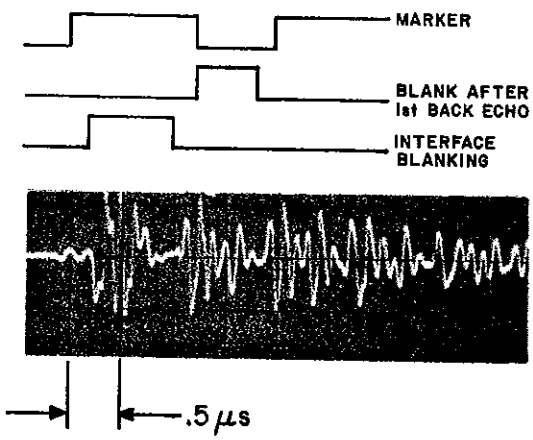
a. PROPER SETUP
WATER PATH= 0.6 in (15mm)



b. ERRONEOUS THICKNESS MEASUREMENT. EXTRA CYCLES CAUSED BY OPERATING AT WATER PATH NEARLY EQUAL TO THE FOCAL LENGTH OF THE TRANSDUCER.
WATER PATH=1.5 in (38mm)



c. ERRONEOUS THICKNESS MEASUREMENT CAUSED BY MODE CONVERTED SHEAR RESULTING WHEN SECOND BACK ECHO IS NEAR FOCAL LENGTH OF TRANSDUCER.
WATER PATH=1.2 in (30mm)



d. SCHEMATIC OF BLANK THAT CAN BE USED TO MAKE MEASUREMENTS MORE RELIABLE OVER LIMITED THICKNESS RANGE.

ALL OSCILLOGRAMS WERE MADE USING THE SAME 5MHz, 0.5in(13mm) DIA. TRANSDUCER FOCUSED AT 2in(50mm) IN WATER, TEST PIECE- STEEL 0.1in(2.5mm) THICK.

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b. **The Surface Roughness of the Test Piece** - The greatest accuracy of measurement is obtained where both the contact surface and the back surface of the test piece are smooth. If the contact surface is rough, the minimum thickness that can be measured will be increased because of sound reverberating in the increased thickness of the couplant layer. Alternately, if the back echo will become distorted and scattered and inaccuracies will result in the thickness measurement. It is also important that the reflecting (back) side of the material be free of couplant, grease, paint or any other contaminant for maximum accuracy.

c. **Tubing Measurements** - Tubing wall-thickness measurements represent a major applications of the 5223 combined with either delay line or immersion type transducers. If measurements are to be made manually an appropriate delay-type transducer with a spring-loaded holder is recommended. If a spring-loaded holder is not used, the operator should exercise care in positioning the transducer to insure that it is centered on the tube. Couplant should be used sparingly. Excessive couplant may degraded the reliability of readings particularly on small diameter tubing.

Immersion transducers are often used for on-line measurements to monitor wall thickness. Focussed immersion transducers are generally recommended because tolerance to misalignment and angulation is greater than for flat transducers. However, the water path should be such that the second measurement echo in the material occurs well short of the focal point. Table II may be used as a guide to the selection of appropriate transducers for tube wall measurement applications. However, it is suggested that Panametrics technical staff be consulted prior to purchase of special transducers.

d. **Curvature of the Test Piece** - When using delay line transducers on curved surfaces it is important that the transducer be placed approximately on a the centerline of the part and that it be held as nearly normal to the surface as possible. In general, as the radius of curvature decreases, the size of the transducer should be reduced. In most cases, the technique for making reliable measurements will be quickly established. If difficulty is encountered, reference to the oscilloscope display can be useful in identifying the problem.

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e. **Taper or Eccentricity** - If the contact surface and the back surface are tapered or eccentric with respect to each other, the return echo again becomes distorted and the accuracy of measurement is diminished. A certain amount of non-parallelism reduces the measurement accuracy.

f. **Acoustic Properties of the Material** - There are several conditions found in engineering materials that can severely limit the accuracy and thickness range that can be measured.

1. SOUND SCATTERING

In some materials, notable certain types of cast stainless steel, cast irons, and composites, the sound energy is scattered from individual crystallites in the casting or from dissimilar materials within the composite. This effect reduces the ability to discriminate a valid return echo from the back side of the materials and limits the ability to gage the material ultrasonically.

2. VELOCITY VARIATIONS

A number of materials exhibit significant variations in sound velocity from point to point within the material. Again, certain types of cast stainless steels, and brass, exhibit this effect due to a relatively large grain size and the anisotropy of sound velocity with respect to grain orientation. Other materials show a rapid change is sound velocity with temperature. This is characteristic of plastic materials where temperature must be controlled in order to obtain maximum accuracy in the measurement.

3. SOUND ATTENUATION OR ABSORBTION

In some materials, sound is attenuated very rapidly at the frequencies used in normal ultrasonic thickness gaging. Therefore, the maximum thickness that can be measured in these materials is often limited by sound attenuation.

10-3 SOUND VELOCITY AND TRANSIT TIME MEASUREMENTS

a. **Sound Velocity** - If the ultrasonic velocity of the material is of interest either as a material property per se, or as a requirement for measuring thickness, it can be measured directly on a sample of the material of known thickness. Material velocity can be measured to an absolute accuracy of

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±0.5%, or better, by adjusting the MVC to make the THICKNESS readout correspond to the actual sample thickness. By this same procedure the instrument may be adjusted to a calibrated accuracy of ±1 count in the thickness range of interest.

b. **Transit Time** - Transit time measurements can also be made by simply dialing in 0.2000 on the VELOCITY switches and coupling the transducer to the material of interest. The resulting reading on the THICKNESS display is the ROUND TRIP TRANSIT TIME IN uSEC DIVIDED BY TEN (i.e. .2363 on the display would be 2.363 usec).

10-4 TRANSDUCER SELECTION

Selection of the appropriate transducer is based on a number of considerations including the acoustic properties of test material and the geometry of the test piece. In general, the highest frequency and smallest diameter transducer that will give adequate performance over the range of thickness that is to be measured will give the most reliable and repeatable results. Small diameter transducers are more easily coupled to the test material. Further, high frequency transducers produce echo signals of faster rise time and thereby enhance the thickness accuracy. The acoustic properties or surfaces condition of the test material may dictate that the transducer frequency be lowered in order to overcome poor coupling and sound attenuation or scattering within the material.

In making thickness measurements on curved surfaces, the active element size of the transducer should normally be reduced as the radius of curvature is reduced.

Although a variety of couplant materials may be used with delay line transducers, we have found that propylene glycol is a suitable couplant for many applications. In difficult applications where a maximum sound energy transfer is desired, glycerin is preferred. However, glycerin promotes corrosion by means of water absorption and may be undesirable in some applications. Other couplants which may be used include petroleum oil, grease, water, and silicone fluids.

For best results, only Panametrics Microscan series transducers should be used. The reason for this is that, in order to function properly, the gage must be used with the transducers of suitable electrical impedance, bandwidth, sensitivity, and main-bang recovery characteristics. Although transducers made by other manufacturers may work, we can only guarantee performance within specifications when the gage is used with Panametrics transducers. Transducers should be maintained in good condition. Table II (see Apendix II) may be used as a guide to selection of transducers. However,

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it is recommended that Panametrics technical staff be consulted prior to purchase of special transducers.

10-5 CABLE LENGTHS

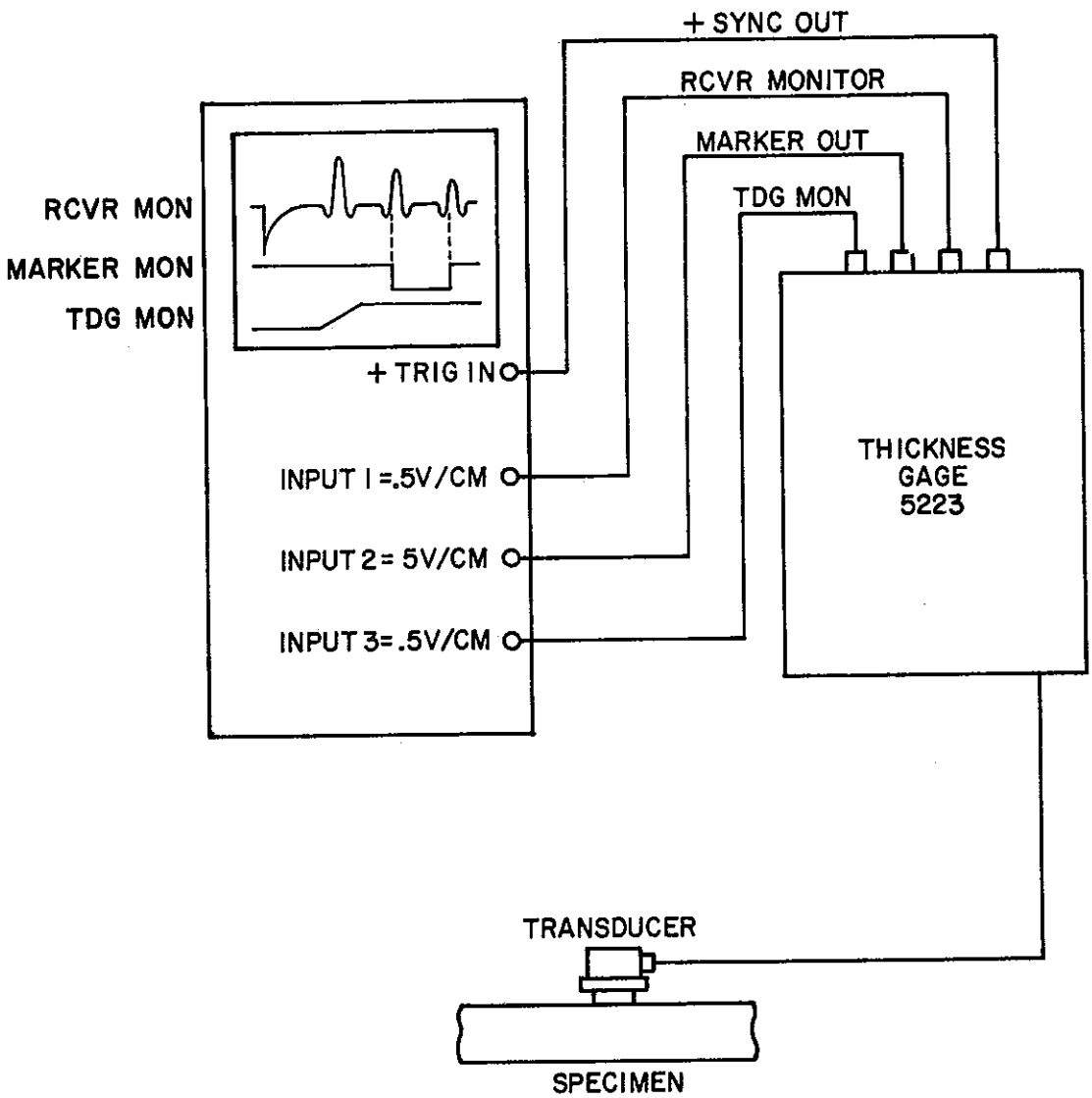
The maximum length of cable that can be used will depend on the type of transducer and minimum thickness range. Generally, long cables are not recommended. However, often it is considered desirable, particularly in industrial applications and underwater measurement applications, to utilize a long cable between the test instrument and the transducer. Cable lengths of up to 400 feet (130 meters) can be utilized in some cases. However, if longer cables are required, particular attention must be given to the problems of matching the transducer to the cable and accounting for the attenuation of the signal in the cable and compensating for delay caused by the propagation time of the pulse in the cable itself. Although cables of 200 feet (50 meters) have been used successfully, they can generally not be used without instrument adjustment and special matching networks in the transducer. **If long cables are required, Panametrics should be consulted.**

10-6 USE OF THE MODEL 5223 WITH AN OSCILLOSCOPE

An oscilloscope may be used with the Model 5223 Ultrasonic Gage either as an aid to setting up the unit for thickness readings or for verifying thickness or time readings shown on the digital display. Generally, however, an oscilloscope is not required to obtain reliable thickness readings. The cable connections and suggested oscilloscope settings are shown in Fig. 8.

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FIG. 8 DIAGRAM SHOWING CABLE CONNECTIONS FOR USING THE MODEL 5223 ULTRASONIC GAGE WITH AN OSCILLOSCOPE



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APPENDIX I

The following is a tabulation of the ultrasonic velocity in a variety of common materials. It is provided only as a guide. The actual velocity in these materials may vary significantly due to a variety of causes, i.e., composition, preferred crystallographic orientation, porosity, and temperature. Therefore, for maximum accuracy, a sample of the actual material to be tested should be used to establish the sound velocity.

Table 1

Sound Velocities of Various Materials

	Longitudinal Wave Velocity		
Material	V in./ sec	V cm/ sec	Ref.
Aluminum, rolled	0.253	0.6420	1
Aluminum, 6061-T6	0.251	0.6383	2
Beryllium	0.5073	1.289	1
Brass, yellow 70 Cu, 30 Zn	0.1850	0.4700	1
Brass, yellow 70 Cu, 30 Zn	0.1726	0.4385	2
Copper, rolled	0.1972	0.5010	1
Duraluminum, 17S	0.2487	0.6320	1
Iron, Armco	0.2345	0.5960	1
Lead, rolled	0.0771	0.1960	1
Magnesium, drawn annealed	0.2270	0.5770	1
Molybdenum	0.247	0.625	3
Monel	0.2105	0.5350	1
Nickel	0.2377	0.6040	1
Steel, mild	0.241	0.610	3
Steel, low alloy	0.2259	0.5734	2
Stainless Steel #347	0.2278	0.5790	1
Titanium	0.237	0.599	3

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Table 1 (cont'd)

Material	Longitudinal Wave Velocity V in./ sec	V cm/ sec	Ref.
Tungsten, drawn	0.2129	0.5410	1
Uranium	0.133	0.337	3
Zinc, rolled	0.1657	0.4210	1
Zinc, extruded	0.1756	0.4460	2
Alumina, Al_2O_3, 99.5%	0.4013	1.019	2
Fused Silica	0.2349	0.5968	1
Pyrex Glass	0.2220	0.5640	1
Lucite	0.1055	0.2680	1
Lucite	0.1077	0.2735	2
Nylon	0.1031	0.2620	1
Polyethylene	0.0705	0.1950	1
Polystyrene	0.0925	0.2350	1
Silicon Rubber RTV	0.0373	0.0948	4

References

1. W. P. Mason, Physical Acoustics and the Properties of Solids, D. Van Nostrand Co., New York, 1958.

2. E. P. Papadakis, Panametrics - unpublished notes, 1972.

3. J. R. Fredericks, Ultrasonic Engineering, John Wiley & Sons, Inc., New York, 1965.

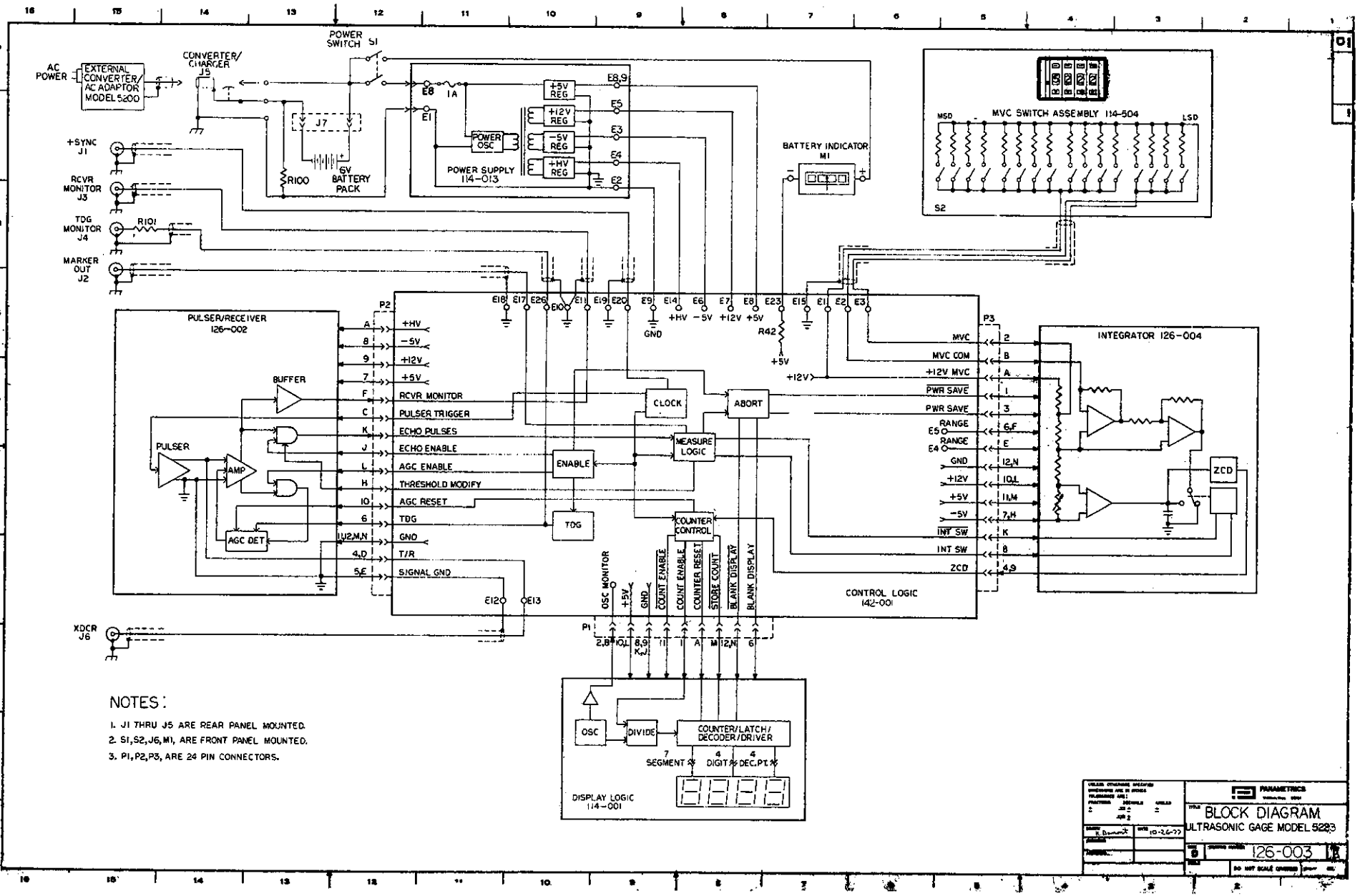
4. D. L. Folds, "Experimental Determination of Ultrasonic Wave Velocities in Plastics, Elastomers, and Syntactic Foam as a Function of Temperature," Naval Research and Development Laboratory, Panama City, Florida, 1971.

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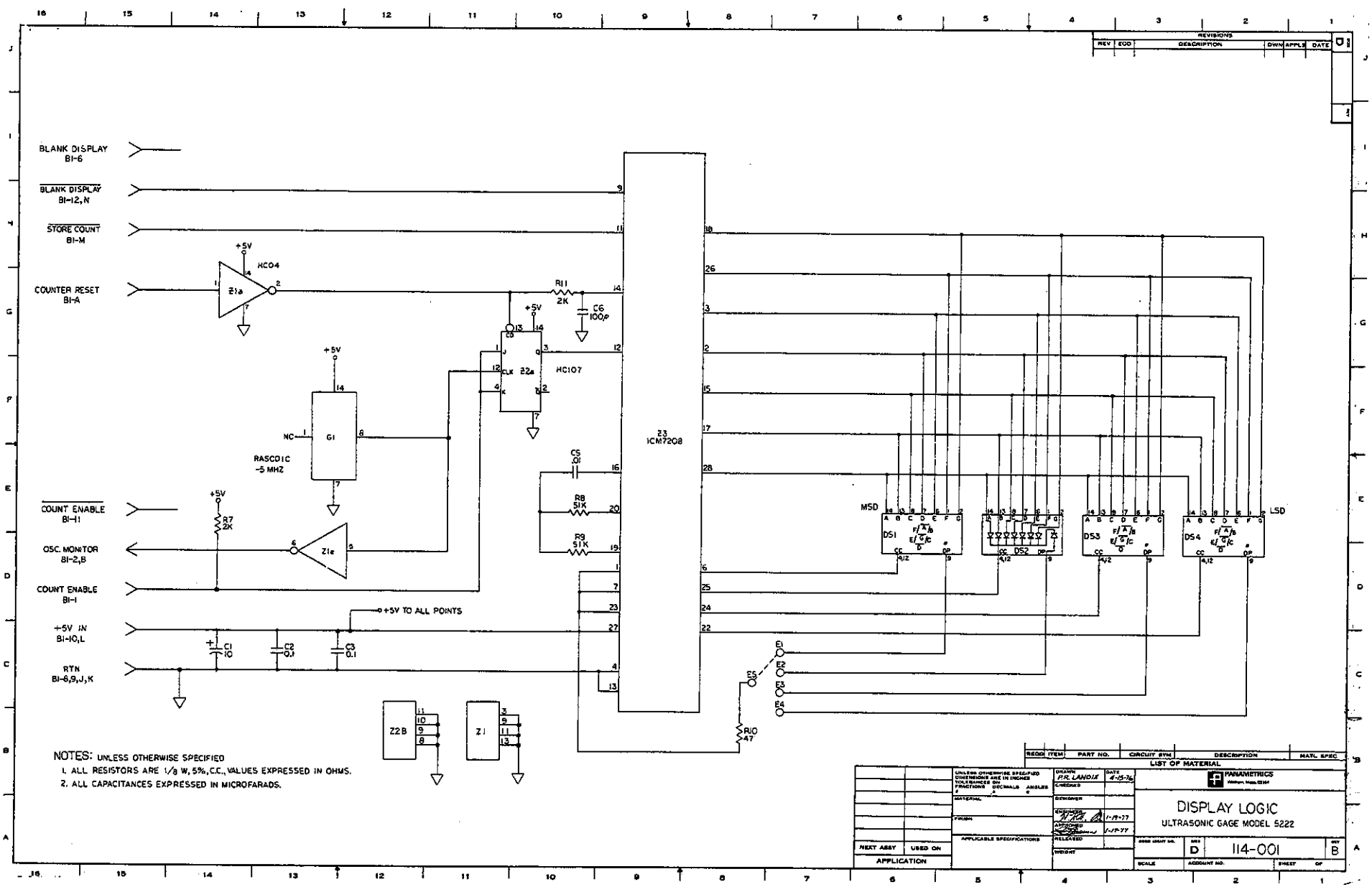
APPENDIX II

SCHEMATICS

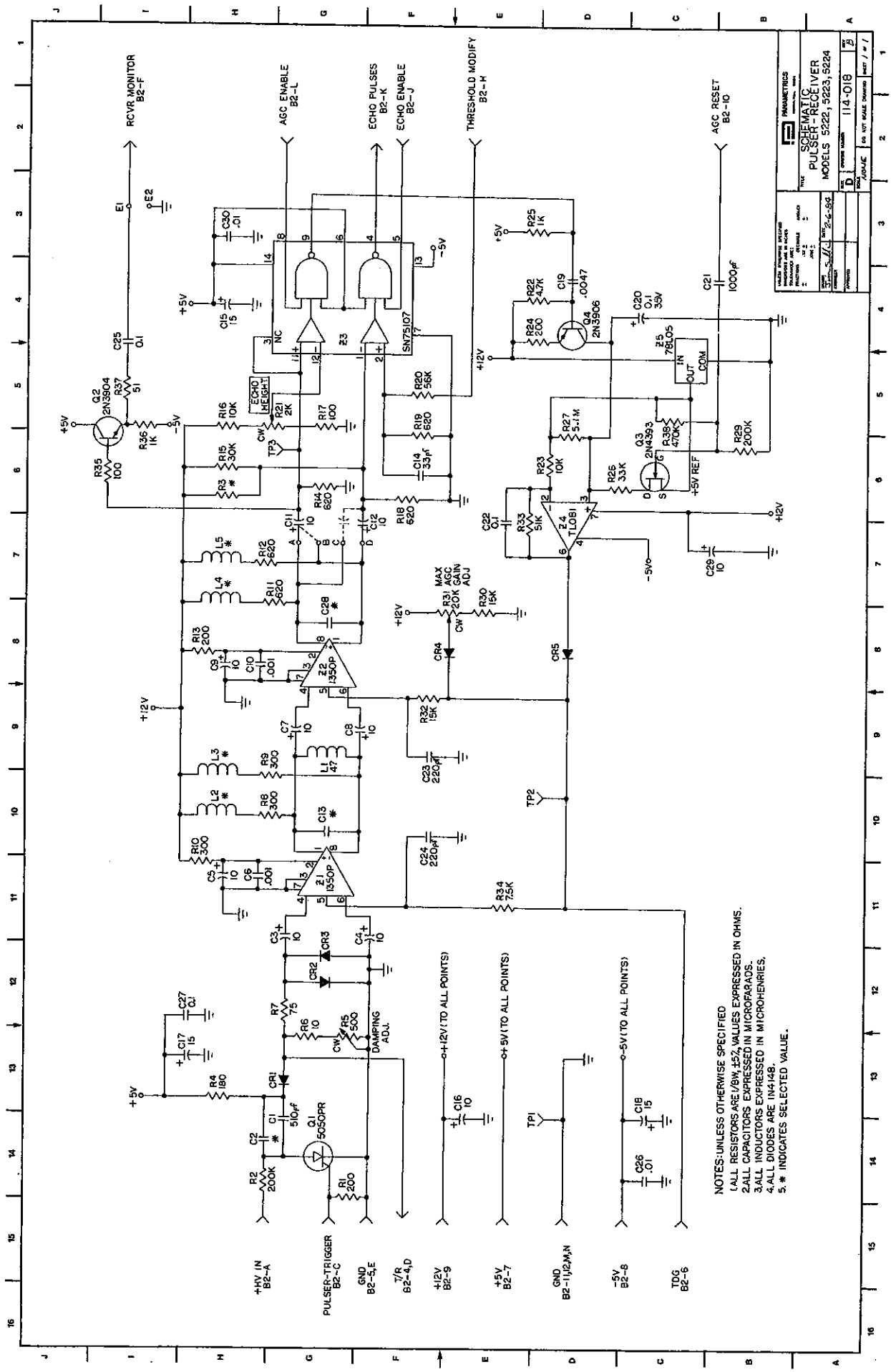
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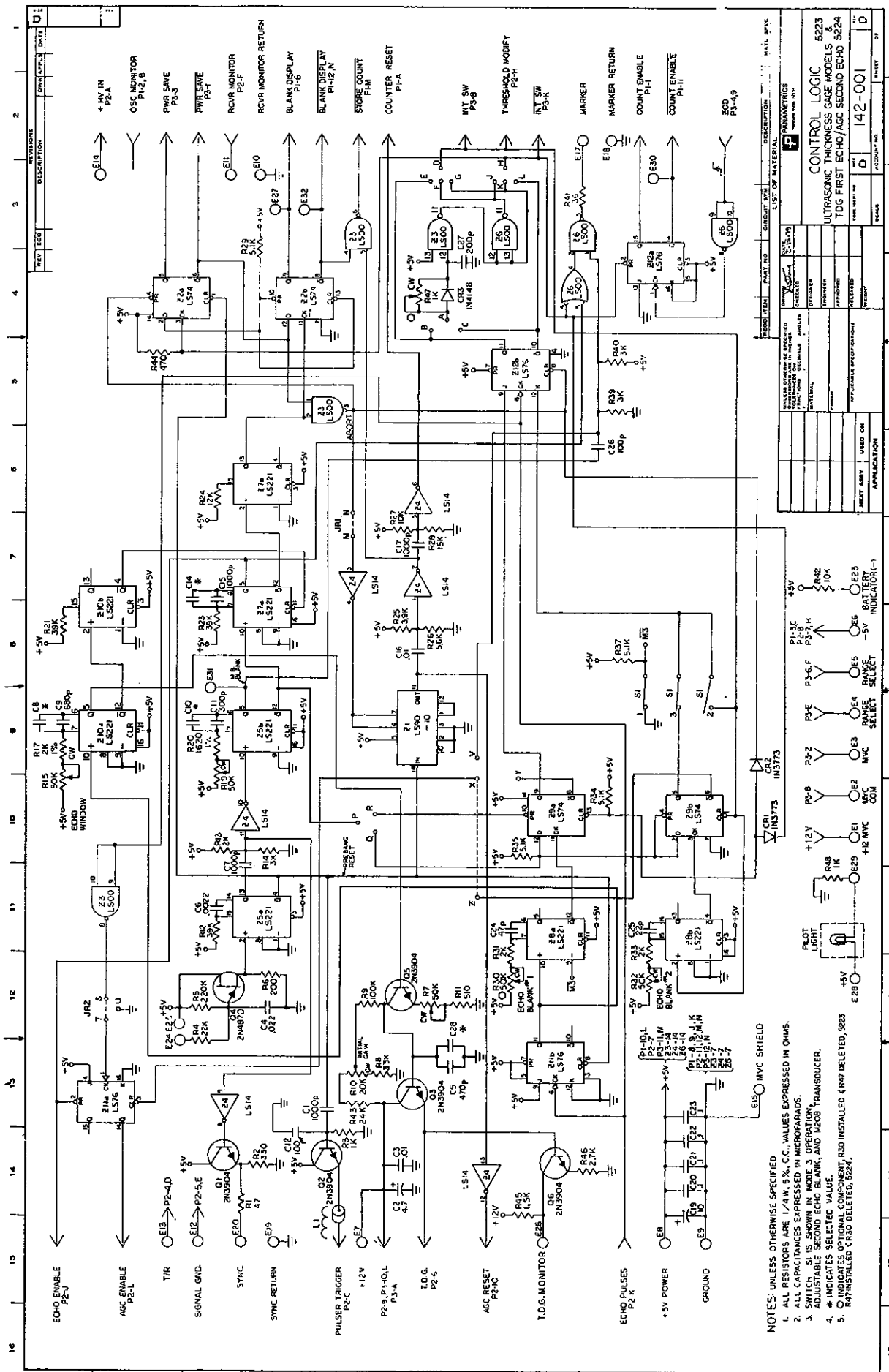
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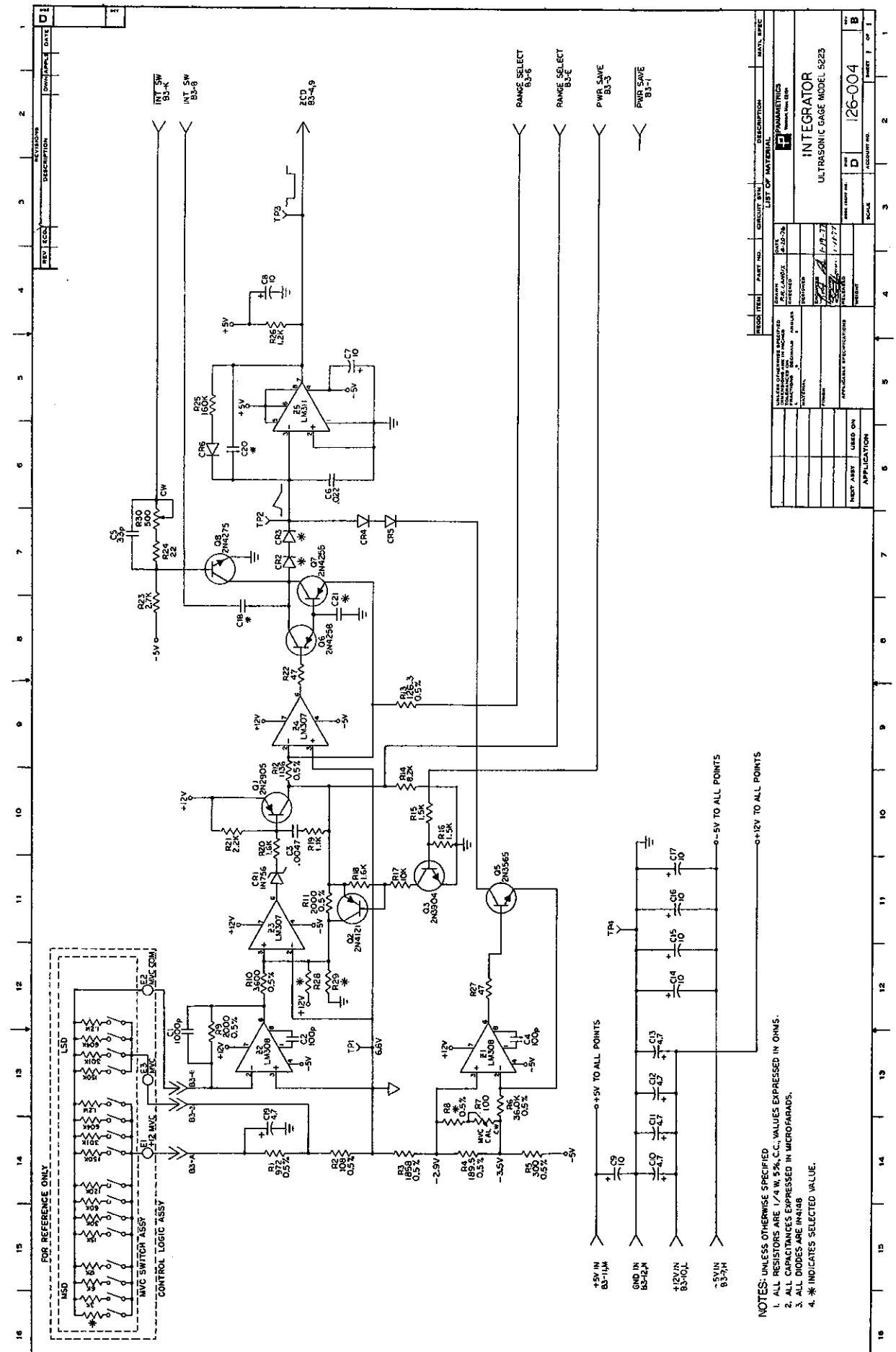
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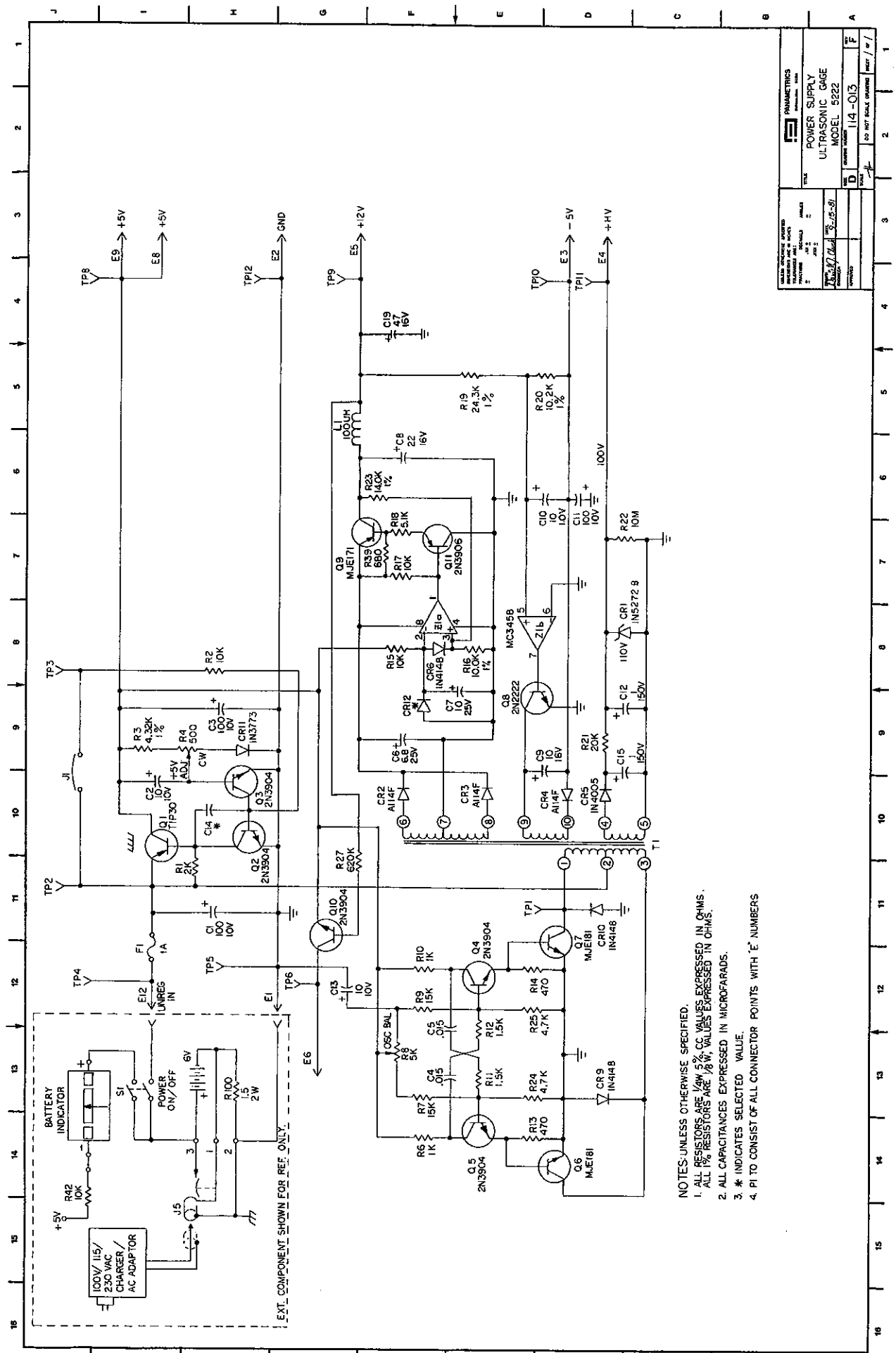
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APPENDIX III

TABLE 2 GUIDE FOR THE SELECTION OF DELAY OR IMMERSION TYPE TRANSDUCERS

A. Delay Type Transducers

THICKNESS APPLICATION	NORMAL THICKNESS RANGE	NORMAL THICKNESS ACCURACY	RECOMMENDED TRANSDUCER
Thin Sheet-Plate (metal,glass,ceramic)	0.1 - 6mm	0.003mm	A,B
Thin Wall Tube (metal, glass,ceramic)	0.2 - 6mm	0.006mm	A,B
Thin Wall Tube (small dia.)	0.2 - 3mm	0.006mm	B,C
Flat or Slightly curved thin metal, glass,ceramic with smooth surface (dry couple).	0.5 - 6mm	0.006mm	A,B,C with metal, with compliant layer on delay line
Thin plastic containers (dry or wet coupled)	0.3 - 2mm	0.03mm	A,B with compliant layer on delay line

THICKNESS APPLICATION	NORMAL THICKNESS RANGE	NORMAL THICKNESS ACCURACY	RECOMMENDED TRANSDUCER
Sheet (metal,glass, ceramic)	0.2 - 2mm	0.006mm	D
Sheet (metal,glass, ceramic)	.5 - 6mm	0.006mm	E
Tubing (metal,glass, ceramic) Min. dia. 50mm	2 - 6mm	0.01mm	E
Tubing (metal,glass, ceramic) Min. dia. 25mm	1 - 3mm	0.01mm	D
Tubing (metal,glass, ceramic)	0.5 - 1.5mm	0.01mm	F

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TRANSDUCER CODE	DESCRIPTION
A	10 MHz, 6mm dia. Delay Type
B	15 MHz, 6mm dia. Delay Type
C	20 MHz, 3mm dia. Delay Type
D	10 MHz, 6mm dia. Focussed at 50mm
E	5 MHz, 13mm dia. Focussed at 100mm
F	20 MHz, 3mm dia. Focussed at 25mm

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