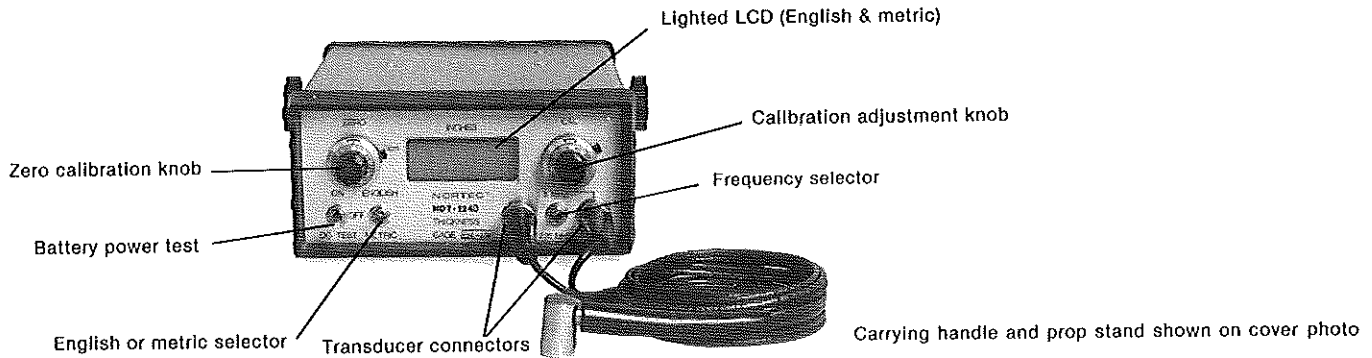


NDT-124D Specifications.



GENERAL DESCRIPTION:

The NDT-124D is a portable, handheld thickness gage designed primarily for accurate field measurements of materials where only one side is accessible. This instrument autoranges to 10 inches using a dual crystal pitch/catch technique. Its power will push through rough surfaces quickly and accurately getting test answers. And it's ideal for checking pipeline corrosion and wall thickness, as well as measuring other material thicknesses.

MEASUREMENT RANGE:

Autorange 0.050" to 10".

RESOLUTION:

0.001" for up to approximately 2" thickness, 0.010" for above 2".

LCD DISPLAY:

Fluorescent lighted Liquid Crystal Display, 4 digit, 1/2" high. Automatically lights upon return of thickness echo. Readable in bright sunlight and in complete darkness. Can be switch selected to read either English or metric units.

POWER:

AC/DC operation. 10 hour NICAD battery operation with automatic shutoff. 115VAC powered plug-in supply/charger (230VAC optional).

CALIBRATION:

Front panel zero and calibration adjustment knobs. Ten-turn duodials can be locked during use.

OPERATING TEMPERATURE:

-4°F to +130°F (-20°C to +55°C).

FREQUENCY:

Operation either at 2.25MHz for rough or cast materials, or 5MHz for general purpose thickness measurements.

WEIGHT:

2.5 pounds.

SIZE:

2 3/4" H x 5 3/4" W x 6 1/2" D.

APPLICATIONS:

Thickness gaging on metal, plastic, glass, and ceramics. Corrosion testing. Field, lab and production line measurements.

ACCESSORIES:

Dual element transducer (5MHz pitch/catch) Model E-Z-2x4-5 OR dual element transducer (2.25MHz pitch/catch) Model E-Z-2x4-2.25. Steel calibration step block Model 3098 (or metric Model 3231). Plug-in AC line supply/charger. Carrying strap. Snap-on front cover.

OPTIONS:

Easy grip dual transducer holder Model SPO 860. Replacement transducers: Model E-Z-2x4-5, Model E-Z-2x4-5-HT (high temperature available with or without handle).



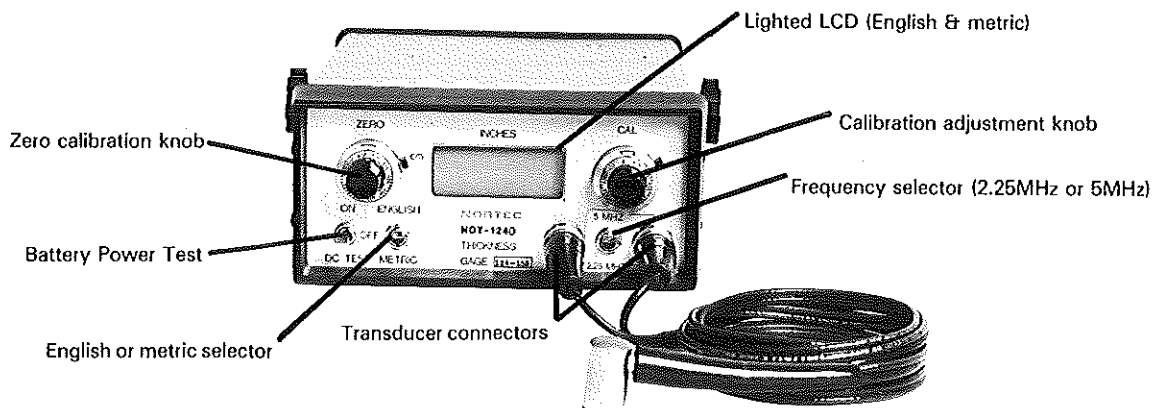
NORTEC CORPORATION
3001 George Washington Way
Richland, WA 99352
(509) 375-9141
TLX: 152-858

Eddy Current and Ultrasonic Instruments
Probes, Transducers, and Accessories

Specifications

NDT-124D Digital Ultrasonic Thickness Gage

MEASUREMENT RANGE:	Autorange 0.050" to 10"
RESOLUTION:	0.001" for up to 1.75" thickness 0.010" for above 1.75"
LCD DISPLAY:	Fluorescent lighted Liquid Crystal Display, 4 digit, ½" high. Automatically lights upon return of thickness echo. Readable in bright sunlight and complete darkness. Can be switch selected to read either English or metric units.
POWER:	AC/DC operation. 10 hour NICAD battery operation with automatic shutoff. 115VAC powered plug-in supply/charger (230VAC optional). Also available with SPO-1281, replaceable battery pack and internal charger.
CALIBRATION:	Front panel zero and calibration adjustment knobs. Ten turn duodials can be locked during use.
OPERATING TEMPERATURE:	0°F to +130°F (-18°C to +55°C)
FREQUENCY:	Operation either at 2.25MHz for rough or cast materials, or 5MHz for general purpose thickness measurements.
WEIGHT:	2.5 pounds.
SIZE:	2 ¾"H x 5 ¾" W x 6 ½" D.
INCLUDED ACCESSORIES:	Model E Transducer (5MHz). #3098 Steel Thickness Block. Carrying Strap. PS7110 115V Wall Plug-In Charger. Panel Cover. Carrying Strap Carrying Case. Operating Manual & Schematic.



Carrying handle and prop stand shown on cover photo



NORTEC CORPORATION
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Telex 152-858

NORTEC

NORTEC

MODEL NDT-124D

ULTRASONIC DIGITAL THICKNESS GAGE

MOD. C, S/N _____

INSTRUCTION MANUAL

STATEMENT OF WARRANTY:

NORTEC instruments are warranted against defective materials and workmanship for one year. Batteries and probes (subject to wearout) are excluded from the warranty.

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REV. 4/13/83..22

NORTEC CORPORATION

421 N. Quay Kennewick, Washington 99336 (609) 735-7550 Telex 152-858

MODEL NDT-124D

ULTRASONIC DIGITAL THICKNESS GAGE

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A. <u>Internal Adjustments and Test Points</u>	10

I. GENERAL DESCRIPTION NDT-124D

The NDT-124D is a light weight, handheld portable, battery operated thickness gage. Its designed application is accurate thickness measurements under field conditions. Solid state circuitry and a liquid crystal display provide ruggedness and reliability.

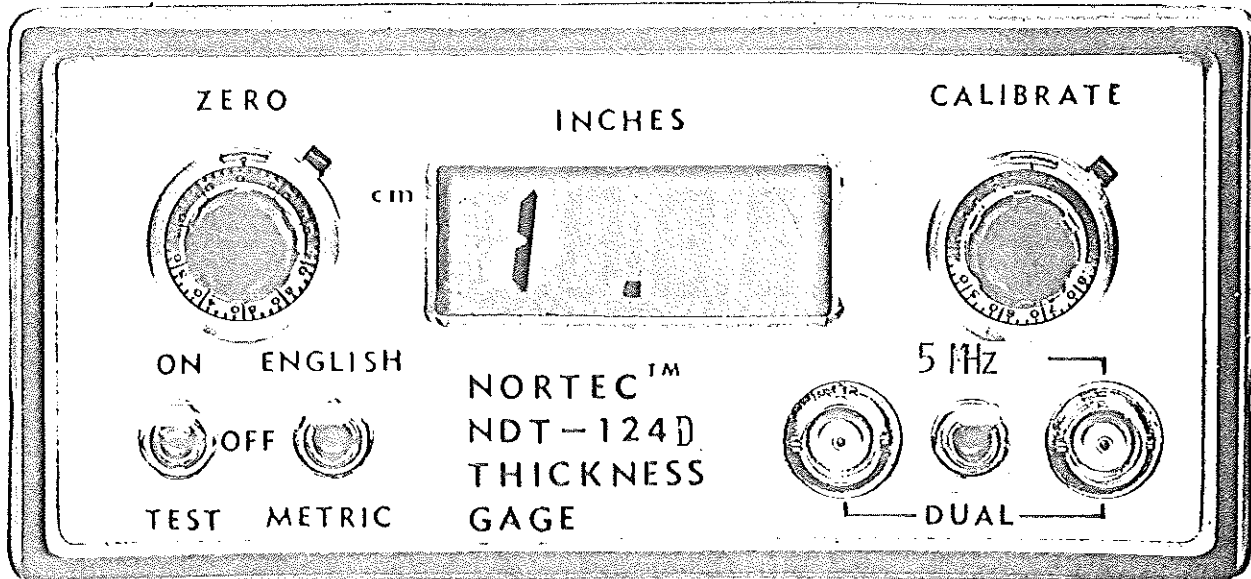
Operation is by dual crystal pitch/catch. The instrument is triggered by the first back echo, which increases its usefulness on rough or corroded surfaces. Selectable frequency 2.25 or 5 MHz allows better resolution or penetration depending on the application.

For ease of operation front panel controls have been limited to the essentials of Battery Test/Power, Metric/English, 2.25/5 MHz, Calibration and Zero controls. Resolution of 0.001 inch up to 1.75 inches provides excellent accuracy.

II. SPECIFICATIONS

Measurement Range	....	0.050" to 10" dual transducer (auto ranging).
Resolution	....	Up to 1.75" = 0.001" Over 1.75" = 0.010.
Operating Temperature	....	-4°F to + 130°F (-20°C to + 55°C).
LCD Readout	....	Liquid Crystal Display of 4 digits 0.5" high, readable from bright sunlight to complete darkness.
Fluorescent Lighted Display	....	Automatically lights on reception of echo from test piece.
NICAD Battery	....	Rechargeable cells operate for over ten hours. Slide out pack allows separate recharging if required.
Battery Charger	....	115 VAC line powered plug-in charger for overnight recharge. (220 VAC Available).
Size	....	2-3/4" H x 5-3/4" W x 6-1/2" D.
Weight	....	2.5 pounds.
Transducers	....	Model E, 5 MHz or 2.25 MHz.

III. CONTROLS



- 1) Zero - transducer zero. Adjusts low end of measured range.
- 2) Cal - high calibrate control. Adjusts high end of measured range (for material velocity changes).
- 3) Off/On/Test - turns instrument on in "On" position and reads battery voltage in "Test" position.
- 4) Metric/English - adjusts instrument to read in inches on "English" position and in centimeters on "Metric" position. The cm - arrow appears in "Metric" position to insure proper interpretation of readings.
- 5) 5 MHz/2.25 MHz - selects frequency to match transducer and application.

.IV. OPERATION

A. Preliminary

1. Select transducer (Model E 2.25 MHz or 5 MHz) and connect to BNC's on 124D front panel.
2. Set the frequency (5 MHz/2.25 MHz) switch to transducer used. The 5 MHz is used for most applications. The 2.25 MHz is used for rough or cast materials and plastic.
3. Set English/Metric switch to desired readout. English readout is in inches; metric is in centimeters.

(NOTE: The 124D will give direct conversion without recalibration from English to metric and from metric to English, using the Metric/English switch. However it is recommended that if the instrument is to be operated in the Metric mode, it be calibrated in Metric, and if it is to be used in the English mode it be calibrated in English to eliminate any cumulative error.)

4. Switch On/Off/Test switch to Test position and note battery voltage. A full charge will be over 12.6 V. Low batteries will read 10.5 - 11 V. If no reading is obtained, battery voltage is below instrument cut-off voltage and batteries will have to be charged before use, or use online power. Charge time is approximately 14 hours.

B. Calibration (NOTE: All Procedures will be the same in Metric).

1. Turn instrument "On" using the On/Off/ Test switch.
2. Use the included steel thickness standard or accurate standards made from the material to be tested.
3. Place a small amount of ultrasonic couplant, mineral oil, or grease on the standard.
4. Push the transducer face into the couplant on the .200" step and firmly hold the transducer in this position.
5. If necessary, adjust the Zero control to read .200.
6. Remove the transducer from the .200 step and check the .500 step. If it reads .500, place transducer on the .300" and .400" steps and check them. If they read within .003", the instrument is calibrated and ready for use.

B. Calibration (Cont'd)

7. If the .500 step does not read correctly, adjust the Cal control to get .500. Then go back to the .200" step and readjust the Zero. Repeat this until both steps read correctly.
8. Then check the .300 and .400 steps and the unit is ready for use. If the instrument does not read .300" and .400" steps properly, check to see that a clockwise turn of Zero control produces an upward change in the thickness readings. If it does not, turn Zero control until it does produce a positive change in thickness readings. Then recalibrate between the .200" and .500" steps.
9. The accuracy of the readings is dependent upon the couplant thickness and smoothness of the part. A lighter couplant should be used on smooth surfaces for accuracy. On rough corroded surfaces, a thicker couplant is necessary.
10. There is no need to manually switch ranges on the NDT-124D; it is done automatically. Calibration should be performed on the range to be used, for best accuracy.
11. When the transducer is not in contact with the sample or the coupling is not adequate, it will read 1.
12. Accuracy of thickness readings is dependent upon the velocity of sound in the material. Density variations and other inhomogeneities may reduce the accuracy by affecting the velocity by as much as 2-5%.
13. For use in dark areas or at night, the NDT-124D has a fluorescent display which automatically lights on reception of the back echo from the test piece.

V. POWER SUPPLY

A. Batteries

The NDT-124D uses two cylindrical NiCad rechargeable batteries to power the instrument. These batteries will run the gage for over ten hours on a full charge.

B. Battery Cut-off

A circuit in the unit turns off the power when the voltage drops below a set level. This prevents malfunction of the instrument and deterioration of the batteries.

C. Recharging

A small plug-in charger is used to recharge the batteries or will operate the unit from the AC line. Overnight or 14-15 hours will completely charge the batteries. The instrument should be turned off when charging. The slide-in pack allows separate charging of a spare battery pack while the instrument is in use with a fresh (fully charged) pack. Remove four corner screws on rear panel slide out pack and unplug connecting cable. Then plug in fresh pack, replace screws, continue testing.

NOTE: NiCad battery will self-discharge when inactive. Battery manufacturer recommends complete recharge if inactive over 72 hours.

- D. Other 12-15 volt DC power sources can be used to run the NDT-124D, but the proper polarity must be observed or damage may result.

VI. TRANSDUCERS

The standard transducers for the NDT-124D are the Model E, 5 MHz or 2.25 MHz but other NORTEC dual transducers can be used. High temperature, various frequencies, smaller or contoured transducers are available as shown on pages 13 and 14.

VII. CIRCUIT OPERATION

The block diagram shows the function of the NDT-124D circuits.

The NDT-124D Digital Thickness Gage measures the ultrasonic pulse transit time through a known material and by proper calibration converts this to a thickness reading in inches on a digital display.

The circuit operates by a clock pulse triggering the pulser which energizes the transducer. The ultrasonic pulse coupled into the test sample reflects from the back surface to the transducer. The reflected signal activates the transducer which transforms the signals into electrical pulses. These pulses are amplified in the receiver section.

The clock also starts a ramp generator which increases linearly at a rate set by the internal calibrate control and the thickness range circuits. In addition the clock activates an inhibit gate that blocks the amplifier during the transmit pulse time. The clock, ramp and inhibit circuits are all contained in the NORTEC custom IC (integrated circuit).

The receive signal starts a trigger circuit which turns off the ramp. A peak voltage detector holds the maximum ramp voltage, thus converting the transit time to a voltage amplitude. This DC voltage is measured by the digital voltmeter and read out on the LCD display. The display is calibrated in inches or centimeters giving a direct readout of the material thickness.

The power supplies are: AC line with the charger or internal battery. The battery is a 12 volt nickel cadmium unit providing over 10 hours of continuous operation. Regulation at +7.2 volts for the general circuitry is provided by the IC regulator. A 150 volt inverter circuit for the pulser operates from the same battery. A cut off circuit in the power supply turns the unit off when the battery voltage reaches a set low value.

VIII. CIRCUIT DESCRIPTION

A. Power Supply

A 750 ma-hr nickel-cadmium battery supplies the power for the NDT-124D. A receptacle is provided to connect a charger or external battery. The nominal battery voltage is 12 volts.

Transistors Q-201 and Q-202 provide a low battery cut-off circuit to prevent deep discharge. When the switch is turned on, C-202 has no charge. Its charging current turns on Q-202 which turns on Q-201 through R-205. When Q-201 is on, current through D-201, a 9.5 volt zener diode keeps Q-202 on. If the battery drops below the set level, 10.5 volts, the zener diode stops conducting and allows Q-202 to turn off. This turns off Q-201 and power is removed from the instrument. The turn-off action is regenerative and will not turn on until C-202 is discharged. Normally R-101, R-102 and R-103 perform this task when the switch is turned off.

IC-201 contains a reference voltage source, differential amplifier, and a series pass transistor that supplies 7.2 volts to the NDT-124D. It will regulate for an input range of 11 to 15 volts.

B. Pulser

Q-204 forms a pulse amplifier from the instrument clock. The pulse amplitude is stepped up by a transformer and rectified. The no load voltage is approximately 100-110 V, loaded about 80-90 volts.

Q-205 is the pulser transistor. It operates in the avalanche mode. This transistor is selected for maximum avalanche voltage at the factory. The rapid rise time pulse output drives the transmit transducer.

C. Receiver

The returning ultrasonic signal is amplified by IC-202. A tuning network on the input suppresses low frequency signals and peaks up the returning echo signals.

Q-203 is a current amp and Q-108 and Q-109 amplifies the signal further and rectifies it. The bias is adjusted for maximum signal level with minimum negative overshoot to obtain a video detected output at TP-6. (VIDEO)

VIII. CIRCUIT DESCRIPTION (Cont'd)

D. NORTEC Integrated Circuit, IC-203

This is a custom manufactured component that contains the logic necessary for a thickness gage. It contains a clock whose rate is controlled at 1200 pps by C-220 and R-221. Q-206 functions as a clock driver. A single-shot multivibrator and flip-flop delays the enabling gate to prevent the transmit and surface signals from toggling the thickness flip-flop. The delay period is adjusted by R-225, R-224 & C-219. Also, the IC contains a current source that is used in the time-to-voltage converter.

E. Time-to-Voltage Converter

Current from the NORTEC IC is gated by the time between the transmit pulse and the back surface reflection. This charges a range capacitor linearly and the resulting voltage is read by IC-207 and Q210 wired as a peak-detector.

The voltage on the peak detector is adjusted by the Cal and Zero controls.

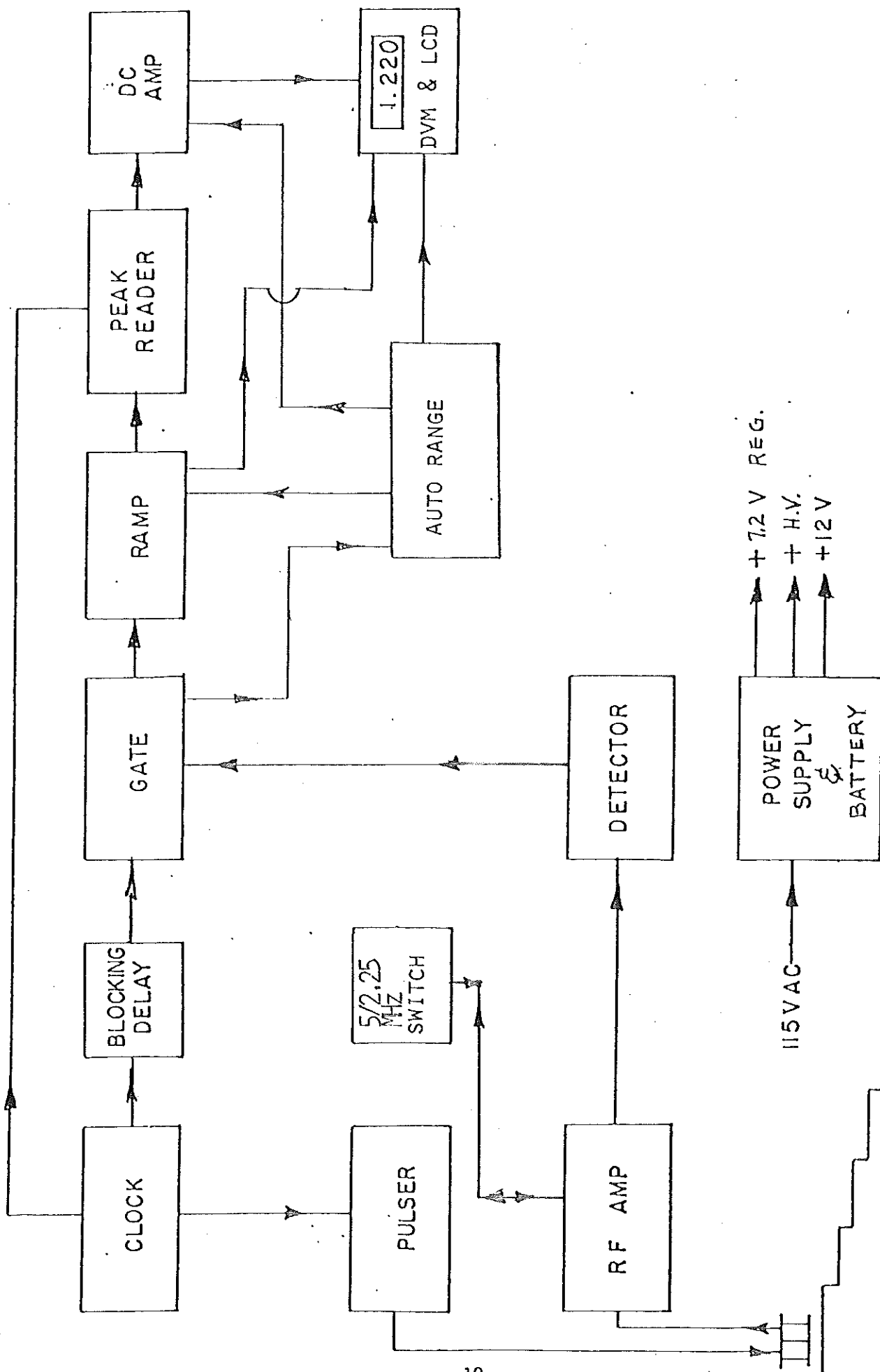
IC-208A reads ramp zero voltage. This voltage and the peak ramp voltage are read as thickness by the DVM.

F. Digital Voltmeter

IC-208B is a DC amp with a gain of 2.54 which is engaged in metric mode of operation.

A single chip differential input DVM IC-101 contains analog-digital converters, back plane oscillator, and a decoder driver for the LCD.

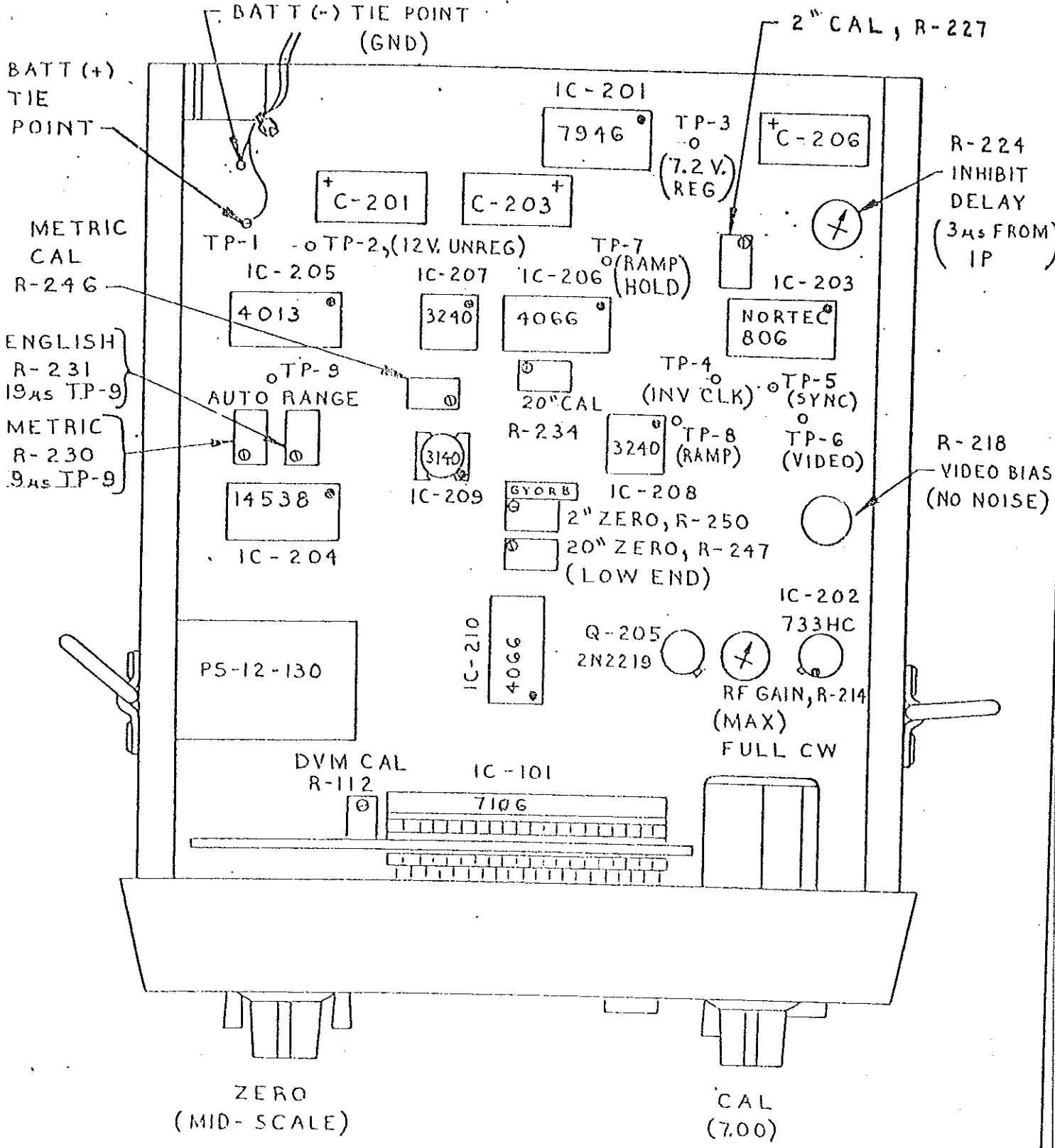
The Zero and Peak voltage difference is read by the DVM.



NDT - 124D BLOCK DIAGRAM

X. TROUBLESHOOTING

<u>SYMPTOM</u>	<u>PROBABLE CAUSE</u>	<u>REMEDY</u>
A. Display blank	1) Battery voltage too low	1) Recharge battery. Use with AC line charger
	2) DVM Defective	2) Repair DVM
B. Gage reads overrange (1.) regardless of thickness	1) No couplant under transducer	1) Use more couplant
	2) Defective transducer	2) Replace transducer
	3) Amplifier defective	3) Check amplifier signal at TP-RF Replace defective components
	4) +7.2 Volt regulator defective	4) Check IC-3+7.2V replace if needed
	5) No high voltage for pulser	5) Repair high voltage inverter circuit
	6) Pulser inoperative	6) Replace Q-6 2N2219 with NORTEC selected unit
C. Gage indicates much lower reading than actual thickness	1) Noisy or maladjusted amplifier	1) Check TP-RF; adjust gain or video bias or replace defective components, IC-2
	2) Defective or maladjusted inhibit gate	2) Check gate adjustment at TP-RF. If gate does not operate, replace NORTEC IC



APVD	DATE	DESCRIPTION	REV
		421 N QUAY NORTEC KENNEWICK, WA. 99536	
		INTERNAL ADJUSTMENTS AND TEST POINTS	
		DW 8-25-81 124D/129	DRAWING NO 124D-FC15A
		CLB 5-24-81	SCALE 1=1 SHEET 1 OF 1

Thickness Gaging Transducers

Contact Type—Dual Element

E Series

Pitch-catch transducers have wide application.

Model E series transducers are used primarily for thickness gaging applications, but can be used for flaw detection as well. They are dual crystal pitch-catch types, normally pro-

duced with PZT elements but with lead metaniobate offered on option.

These transducers are excellent when near-surface resolution is required or on rough or corroded materials. One crystal sends a high frequency beam into the test material, the other receives reflections.

All the units come with cables and BNC connectors except Model EMD which has microdot connectors on the transducer case. High temperature versions may be used to 850°F and above (intermittent operation).

Model E—Standard

Housing type—Standard cylinder

Dimensions— $\frac{1}{2}$ " d. x $\frac{3}{4}$ " ht.

Element—PZT standard. LM available.

Specify.

Element diameter—To fit housing provided.

Connector—BNC

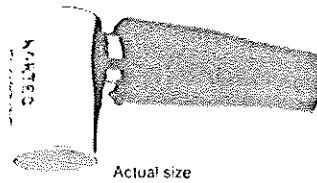
Connector location—At end of 6-foot cable attached to housing at side (standard) or top (specify).

Standard Frequencies, MHz—2.25, 3.5, 5

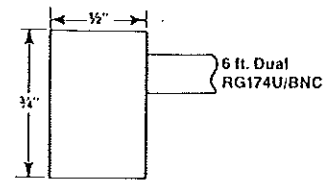
Option—Radius to fit concave or convex.

Specify on all E series.

Other—Sub-zero cable available.



Actual size



Model EMD—Microdot

Housing type—Standard cylinder

Dimensions— $\frac{5}{8}$ " d. x $1\frac{1}{8}$ " ht.

Element—PZT standard. LM available.

Specify.

Element diameter—To fit housing provided.

Connector—Microdot (requires dual BNC-to-microdot cable).

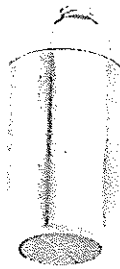
Connector location—Top of housing standard. Side mount optional. Specify.

Standard Frequencies, MHz—2.25, 3.5, 5

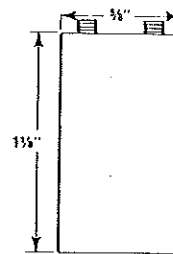
Option—Radius to fit concave or convex.

Specify on all E series.

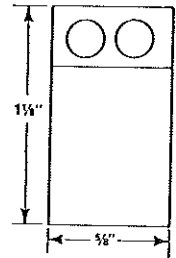
Other—Order dual cable separate—standard or sub-zero. Dual #3275 cable.



Actual size



Microdot connectors
Top, standard
Side, specify



Model EHT—High Temperature

This high-temperature E-Series transducer can be used at normal temperatures or intermittently at elevated temperatures up to 850°F.

Housing type—Standard cylinder

Dimensions— $\frac{1}{2}$ " d. x 1" ht.

Element—PZT standard. LM available.

Specify.

Element diameter—To fit housing provided.

Connector—BNC standard. Microdot available. Specify.

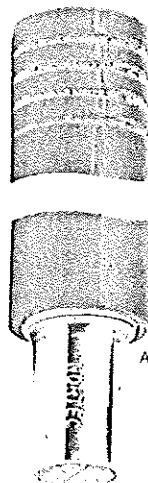
Connector location—At end of attached 6-foot cable.

Standard Frequencies, MHz—2.25, 3.5, 5

Option—Radius to fit concave or convex.

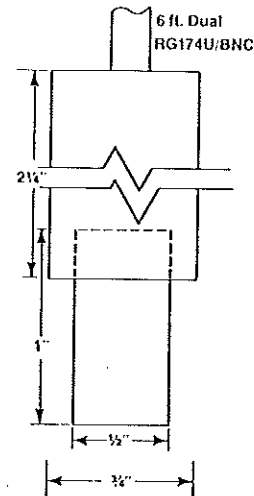
Specify on all E series.

Other—Handle optional.



Actual size

Shown with handle



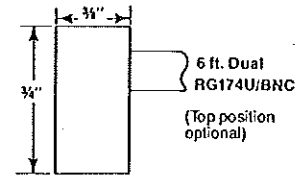
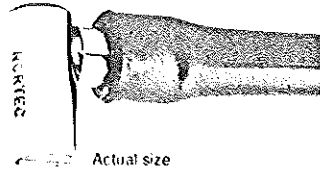
Thickness Gaging Transducers

Contact Type - Dual Element (cont'd)

E Series

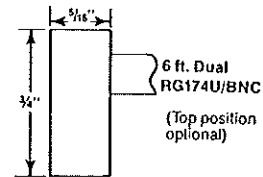
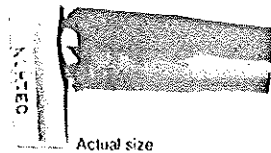
Model EM-Miniature

Housing type—Miniature
 Dimensions— $\frac{3}{8}$ " d. x $\frac{3}{4}$ " ht.
 Element—PZT standard. LM available.
 Specify.
 Element diameter—To fit housing.
 Connector—BNC
 Connector location—At end of 6-foot cable attached to housing at side (standard) or top (specify).
 Standard Frequencies, MHz—3.5, 5
 Option—Radius to fit concave or convex. Specify on all E series.



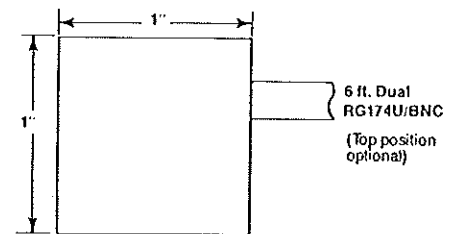
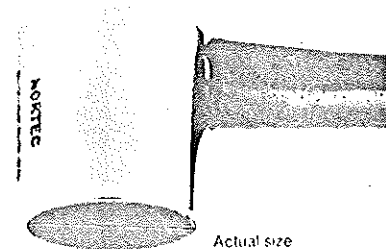
Model ESM-Subminiature

Housing type—Subminiature
 Dimensions— $\frac{5}{16}$ " d. x $\frac{3}{4}$ " ht.
 Element—PZT standard. LM available. Specify.
 Element diameter—To fit housing.
 Connector—BNC
 Connector location—At end of 6-foot cable attached to housing at side (standard) or top (specify).
 Standard Frequency, MHz—5
 Option—Radius to fit concave or convex. Specify on all E series.

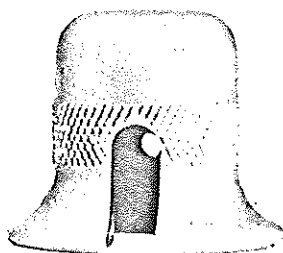


Model EHP

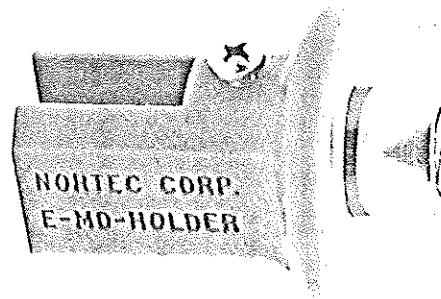
A lower frequency transducer for deep penetration.
 Housing type—Standard cylinder
 Dimensions—1" d. x 1" ht.
 Element—PZT standard. LM available. Specify.
 Element diameter—To fit housing.
 Connector—BNC
 Connector location—At end of side-attached 6-foot cable.
 Standard Frequencies, MHz—2.25, 3.5, 5
 Option—Radius to fit concave or convex. Specify on all E series.



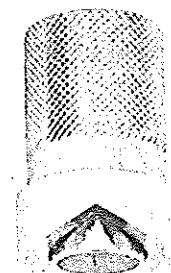
E Series Holders



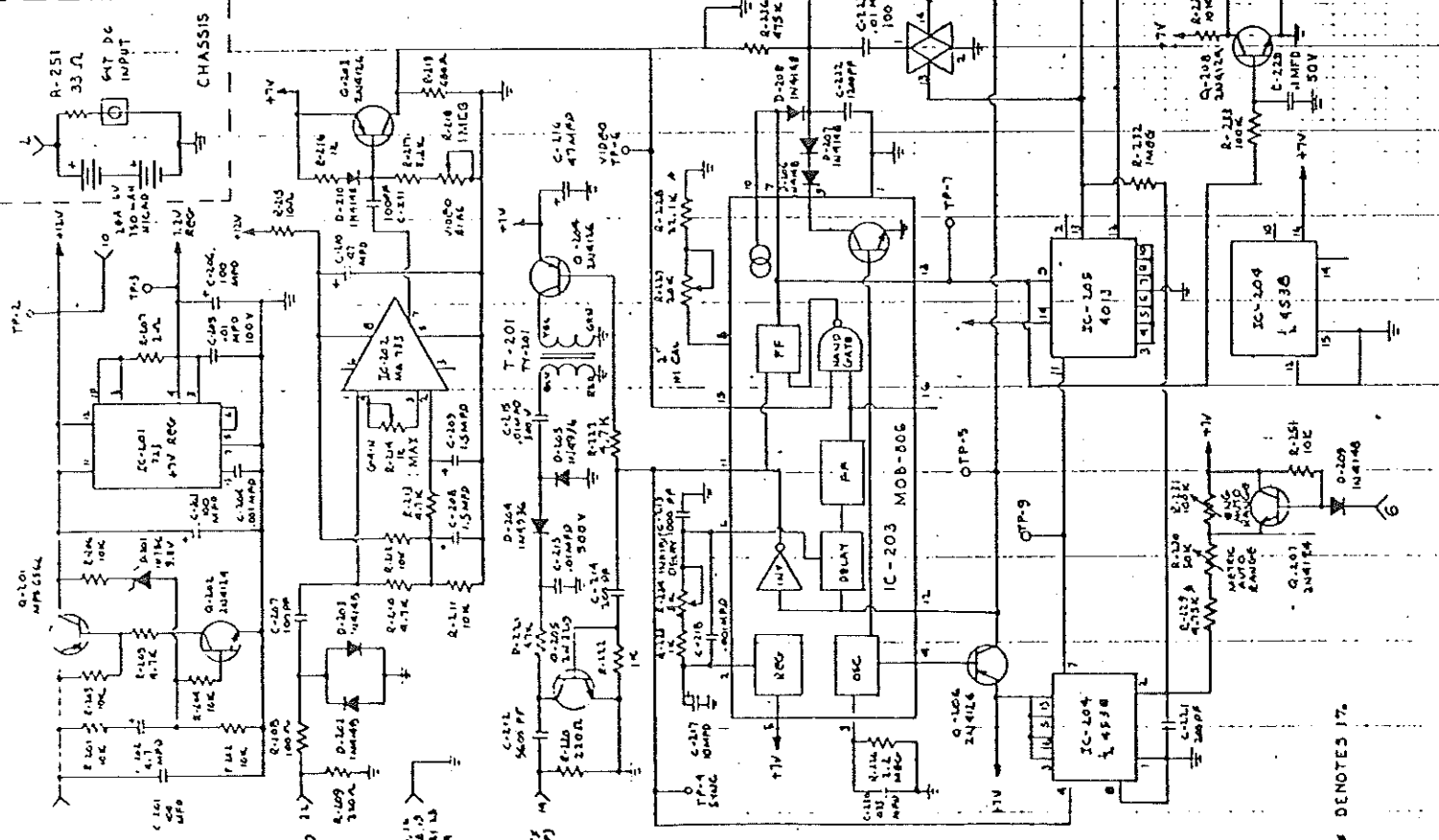
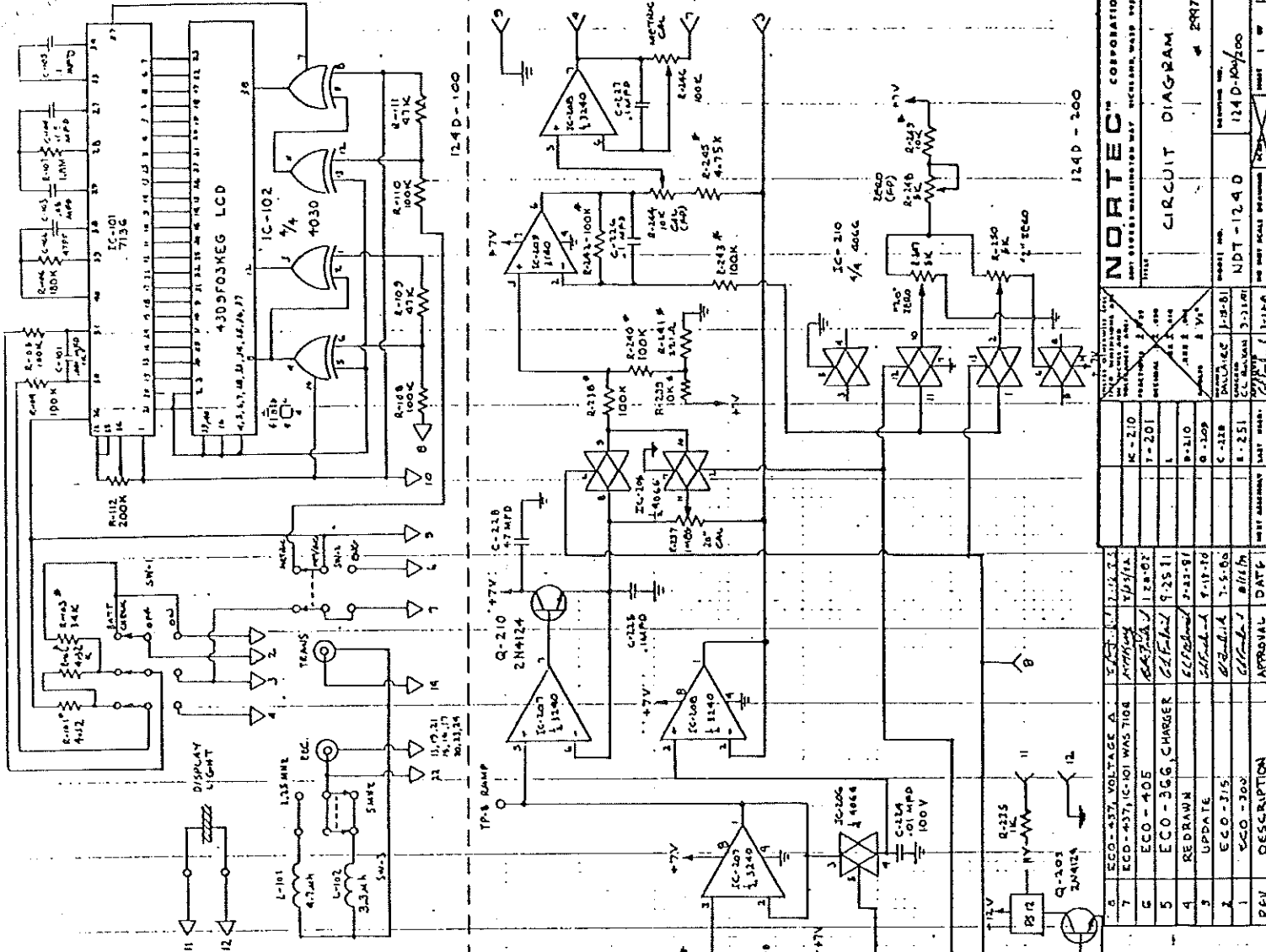
SPO 860



E-MD Top Holder



3136 Transducer E-Standard Alignment Shoe



REV	DESCRIPTION	APPROVAL	DATE
1	ECO-215	OFF	11/16
2	ECO-215	OFF	11/16
3	UPDATE	OFF	11/16
4	REDRAWN	OFF	11/16
5	ECO-366 CHARGER	OFF	12/81
6	ECO-405	OFF	12/81
7	ECO-337, IC-101 WMS TUB	OFF	12/81
8	ECO-337 VOLTAGE A	OFF	12/81

REV	DESCRIPTION	APPROVAL	DATE
1	ECO-300	OFF	11/16
2	ECO-315	OFF	11/16
3	UPDATE	OFF	11/16
4	REDRAWN	OFF	11/16
5	ECO-366 CHARGER	OFF	12/81
6	ECO-405	OFF	12/81
7	ECO-337, IC-101 WMS TUB	OFF	12/81
8	ECO-337 VOLTAGE A	OFF	12/81

8 DENOTES 17.

124D-100

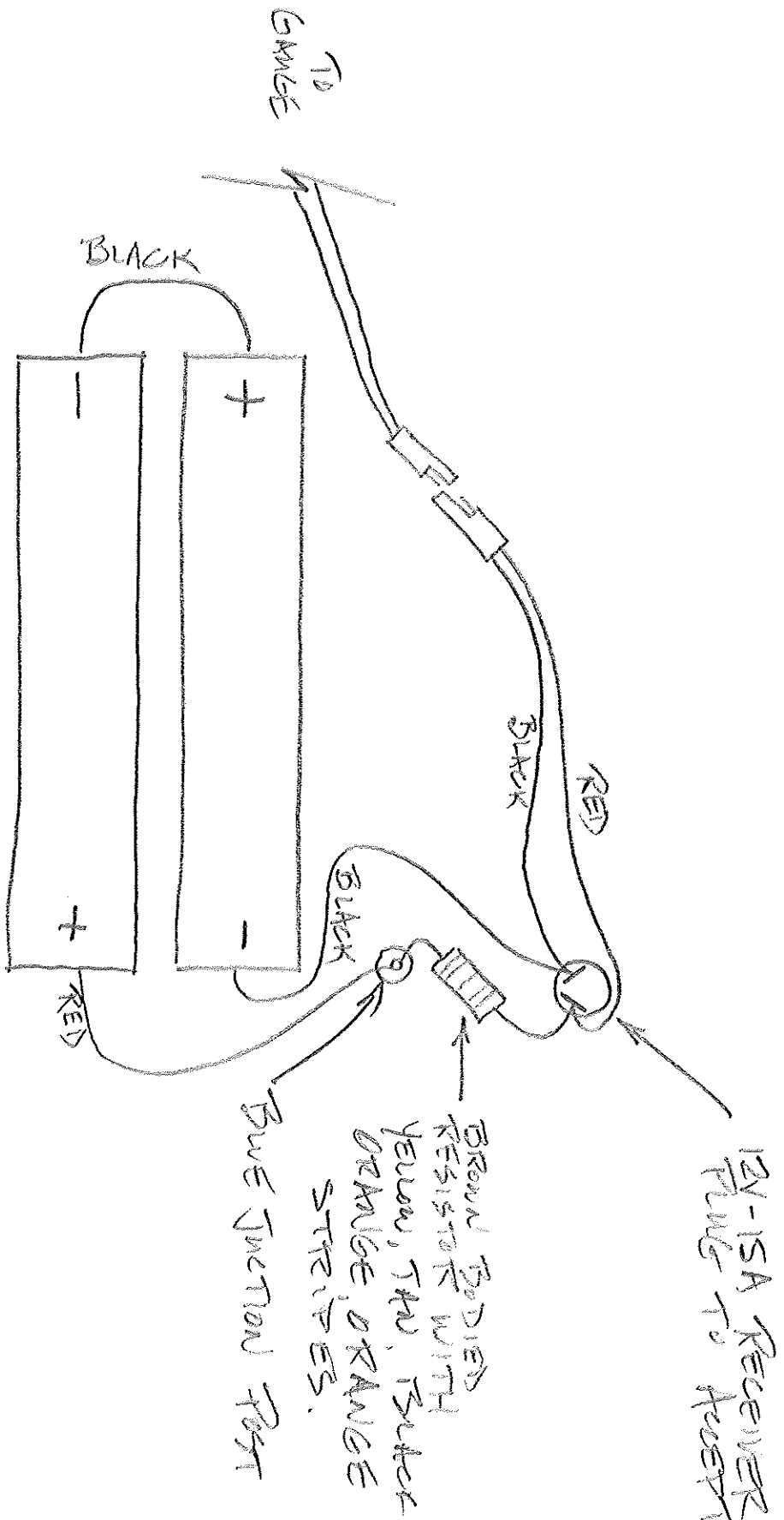
124D-200

CIRCUIT DIAGRAM

NORTEC CORPORATION

NDT-1240

174D-100/500



WIRING DIAGRAM FOR BATTERY REPLACEMENT ON GUNGE-1