INSTRUCTION MANUAL
MODELS: DRT-100, DRT-200, DRT-1000

NOTE: These instructions apply only to instruments having model numbers listed above and with five digit serial numbers, with or without a model number prefix.

EXAMPLE: S/N 100-01234

or

Serial No. 01234

Manufactured by:

scientific, inc.
3170 Metro Parkway, Ft. Myers, FL 33916-7597
Phone: (941) 337-2116 Fax: (941) 332-7643

DRT TURBIDIMETER
INSTRUCTIONS

FOREWORD

The DRT Turbidimeters are direct reading Nephelometric Instruments which measure scattered light particles from particles in suspension or solution and direct light passing through a liquid. The ratioed optical signal which results is stabilized and amplified to energize a meter. The instruments use solid state electronic components. The devices resist thermal variation and are unaffected by normal line voltage fluctuations or lamp aging.

All models of the DRT Turbidimeter Instruments provide a linear readout of turbidity in Nephelometric Turbidity Units. Note that JTU (Jackson Turbidity Units), FTU (Formazin Turbidity Units) and NTU (Nephelometric Turbidity Units) are equivalent.

Turbidity is an expression of the optical properties that cause light to be scattered or absorbed through a liquid sample and is largely a function of the refractive index, the size and shape of the particles suspended or dissolved in the solution. As a result, turbidimeters do not produce an "absolute" measurement, but one that is "relative" to the optical nature of the solids in a solution. Formazin polymer is accepted as the turbidity reference standard because when carefully prepared, it is uniform in the number, size and shape of its particles.

The Models DRT-1000 and DRT-200 are equipped with a flow-thru unit as standard equipment. The flow-thru unit permits continuous monitoring of flowing liquids. The continuous monitor feature is designed in such a way that the instrument can be standardized to nephelometric values using a static reference standard without interrupting the continuous flow. The sealed flow-thru unit design combined with HF desiccant pillows prevent condensation from forming on the outside surfaces of the flow-thru vial under most humidity conditions.

Electrical installation including routing of the interconnecting cable, power connections, calibration and servicing should only be done by qualified electricians and in accordance with applicable codes and regulations.

The material contained in this manual will help the users to service the instruments in the majority of applications. However, in the event that unusual circumstances or problems not covered by this manual arise, please contact your local distributor or the manufacturer's plant.

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Our engineering staff is available to help you with your specific inquiries.

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DIAGRAMS

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ENGINEERING NOTE

Reference Standard Indexing
For all HF Turbidimeters except the Micro-T

The EPA recommends that cuvettes used for instrument calibration or sample measurement be indexed. For quick and repeatable indexing of the reference standard, an indexing ring and locator pin are included with this turbidimeter.

When shipped, the white locator pin is installed in the collar ring around the optical well of your turbidimeter. The indexing ring will be included in the accessory kit for your turbidimeter.

To index your reference standard, slowly rotate the reference standard, at least one complete revolution, while observing the reading, and locate the position of the lowest reading. Without moving the reference standard, install the indexing ring over the ridged cap of the reference standard such that the notch on the ring aligns with the locator pin.

When standardizing this instrument in the future, simply insert the reference standard and rotate it until the notch on the indexing ring faces the locator pin. Standardize as per the instruction manual for your instrument. Please note that this reference standard is only indexed to the turbidimeter for which it was aligned.

Please refer to the instruction manual supplied with your instrument for instructions on standardizing and reference standard care.

Revised 1/28/91

3170 METRO PARKWAY, FORT MYERS, FLORIDA 33916-7597 TELEPHONE (813) 337-2116 FAX # (813) 332-7643

I. THEORY OF OPERATION

The three Models of Turbidimeters covered by this Instruction Manual all have the same basic electronic circuitry.

The only variations occur in regard to the 4-20 mA output for recorder or control and the alarm circuit.

The DRT-1000 has the 4-20 mA circuitry with a load resistor to provide 0-10 MV at the recorder output jack. It also has the alarm circuit and a built in Sonalert alarm (see Alarm Circuit paragraph).

The DRT-200 has the 4-20 mA circuitry for direct 4-20 output to recorder or control (see Operating Instruction in Appendix for available output possibilities). The DRT-200 does not have the alarm circuit on the standard unit. Alarm facilities can be provided as an option (factory installed) for the DRT-200 in which case a relay is provided with contacts for customers remote alarm. These are rated 5 amps at 115 volts.

The Turbidimeter, which is a light sensing instrument, uses photo-resistive cells. These have high resistance when no light falls on them and the resistance decreases as the light intensity increases. In the DRT Series Turbidimeters the two side photocells are connected in parallel. They see very little light in a sample with low turbidity. The front photocell receives a high light intensity at low turbidity values. As the turbidity in a sample increases, the side photocells receive more light due to reflection from particles in suspension and the resistance decreases. The front photocell receives less light as turbidity and its resistance increases.

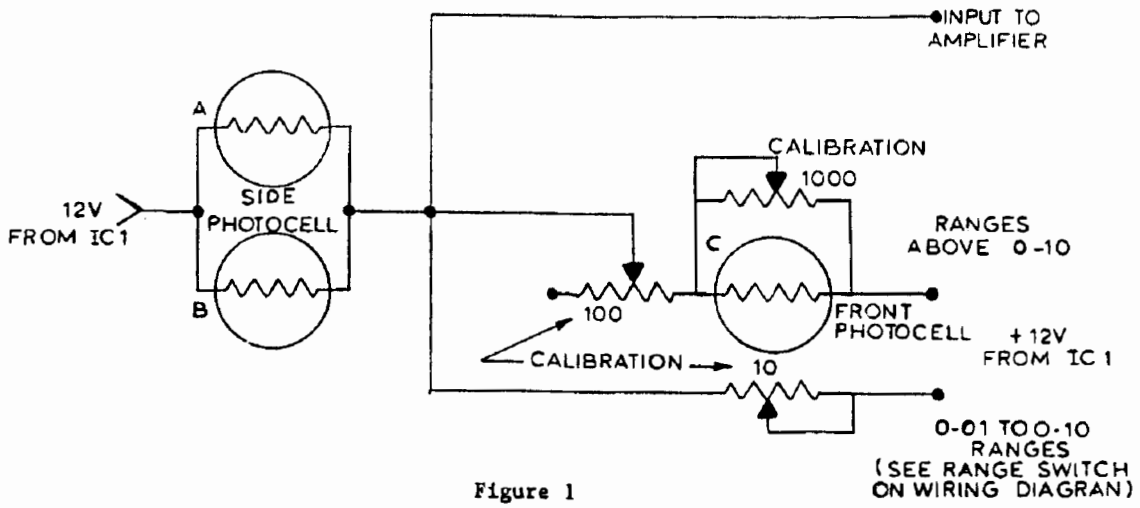


Figure 1

A. PHOTOCELLS

The voltage for the photocells is a stabilized D.C. voltage supplied by IC1. The side photocells (Figure 1, A & B) are supplied with a negative 12 volts from IC1. The front photocell (Figure 1, C) is supplied with + 12 volts by IC1. As the turbidity of the sample increases, more light is scattered to the side photocells and the output voltage of the amplifier, IC2-Pin 3, swings from + 12 volts to - 12 volts. The IC is a quad op-amp. Two of the amplifiers are used to amplify this signal from the photocells. The Range Switch governs the gain of the second amplifier of IC2 and the output can be read on a meter or recorder.

B. LAMP SUPPLY

The lamp supply is independent of all other circuitry. The lamp voltage is set at approximately 10 volts D.C. and is highly stabilized. The voltage will be at a value between 10.2-10.6 volts D.C. This exact value is not highly critical since the instrument will have been calibrated under these circumstances and, since it is stabilized, it is unaffected by line voltage fluctuations.

C. ALARM SYSTEM

The alarm system is a voltage comparator utilizing an amplifier built into IC2.

D. 4-20 MA OUTPUT CIRCUIT (DRT-200, DRT1000)

This circuit receives its signal for output to recorder or controller from the 4th amplifier of IC2.

The output can be varied from 0-1 mA to 10-50 mA by adjusting the 4-20 circuit "Zero" Trim Pot and "High" Trim Pot. By adding load resistors, the stability of adjustment for low mA outputs is increased.

E. POWER SUPPLY

This is a Rectifier Circuit which supplies +/- 23 volts and +/- 16 volts. All voltages measures with reference to TP11.

II. INSTALLATION

A. PACKING LIST OF CONTENTS

	Cat. No.	Model Numbers		
		DRT-100	DRT-200	DRT-1000
Instruction Manual	50000	1	1	1
Reference Standard 0.02 NTU	60002	1	1	1
Flow-Thru Unit with Delrin Head, Nylon Connectors, Elastomeric Seal & O-Ring, Screw In Vial & Flexible Tubing	50028	-	1	1
Clamp, Flow Restrictor	50004	-	1	1
Flow-Thru Vial (Screw In Type) (Spare)	50054	-	1	3
Cuvette 28mm x 91mm (Flat bottom)	50050	2	1	3
Lamp Source with Leads (Spare)	50006	1	1	1
Light Shield (Hood)	50009	1	1	1
Stand, Support	50012	1	-	1
Plug, Recorder	50011	-	-	1
Accessory Case	21116	1	1	1
Foam insert for accessory case	21115	1	1	1

B. SPECIFICATIONS

	DRT-100	DRT-200	DRT-1000
Ranges NTU (FTU, JTU)	6 Ranges 0-1000, 100, 10 1, .3, .1	9 Ranges 0-1000, 300, 100 30, 10, 3 1, .3 .1	9 Ranges 0-1000, 300, 100 30, 10, 3 1, .3, 1
Resolution & Linearity	±1% of full scale	±1% of fulll scale	±1% of full scale
Range Switch Congruence	±1% of full scale	±1% of full scale	±1% of full scale
Supply Voltage Nominal 115 or 230 Volts	85-130V, 185-270V 50/60 Hz	85-130V, 185-270V 50/60Hz	85-130V, 185-270V 50/60Hz
Power Consumption	45 Watts (Nominal) Fuse-0.5A (115V Fuse-0.25Z (230V)	45 Watts (Nominal) Fuse-0.5A (115V) Fuse-0.25A (230V)	45 Watts (Nominal) Fuse-0.5A (115V) Fuse-0.25A (230V)
Controls - Front Panel	Power ON-OFF Ref Adjust-10 Turn Range Switch, 6 Position	Reference Adjust Range Switch, 9 Position	Power ON-OFF Ref Adjust-10 Turn Alarm Setting Dial Range Switch, 9 Position
Controls - Rear Panel	None	N.A.	Alarm ON-OFF Recorder Jack Range Switch High-Normal
Reference Standard	0.02 NTU (Nominal)	0.02 NTU (Nominal)	0.02 NTU (Nominal)
Recorder Output	N.A.	4-20mA, Adjustable	0.10mV Adjustable
Dimensions	6 1/2" x 8 1/4" x 11"	Ind. Module 9" x 12" x 5 1/2" Sensor Module 4 1/2" x 6 3/4" x 10 1/2"	6 1/2" x 8 1/4" x 11"
Shipping Weight	18 Pounds	23 Pounds	18 Pounds

III. PRINCIPLE OF OPERATION AND DESCRIPTION

A. REFERENCE STANDARD

The Reference Standard supplied with this instrument is a pure liquid sealed in glass. It has a value of 0.02 NTU.

Extreme care should be taken to avoid surface scratches on the Reference Standard Cuvette. Scratches, together with dust or film cause analysis error. The Reference Standard optical surface should be wiped clean each time it is to be used and it is important to use a lint free wiper such as "Kimwipes".

If cleanliness of the Reference Standard Cuvette is in doubt, wash with detergent or HF scientific cuvette cleaner Catalog #70900, rinse several times and polish with "Kimwipes". Figure 2 shows the critical measuring area in all measuring containers.

The Reference Standard (Catalog No. 60002) should be replaced at least once per year.

The EPA recommends that cuvettes used for instrument calibration or sample measurement be indexed. For quick and repeatable indexing of the Reference Standard, an indexing ring and locator pin are included with this instrument.

When shipped, the white locator pin is installed in the collar ring around the optical well of your turbidimeter. The indexing ring is included in the accessory kit of this instrument.

To index your Reference Standard, slowly rotate the Reference Standard, at least one complete revolution, while observing the reading, and locate the position of the lowest reading. Without moving the Reference Standard, install the indexing ring over the ridged cap of the Reference Standard such that the notch on the ring aligns with the locator pin.

When indexing the Reference Standard in the future, simply insert the Reference Standard and rotate it until the notch on the indexing ring faces the locator pin. Please note that this Reference Standard is only indexed to the turbidimeter for which it was aligned.

Use the following procedure to standardize:

1. Place the Reference Standard in the Optical Well, indexed as described above.

2. Place the front panel Range Switch in the 0.3 NTU range.

3. Allow about 60 seconds for the photocells to settle.

4. Set the Reference Adjust knob, located on the front panel, such that the meter reads .02 NTU on the lower scale.

The instrument is now referenced to the factory Formazin calibration and unknown samples may be read directly in NTU. For best accuracy, the instrument should be standardized on a scheduled basis. The need to actually adjust standardization will vary depending upon the operational environment.

For accurate measurements in the low range rotate "grab sample" cuvettes in the well to obtain the minimum readings. Mark the cuvette and the instrument so that orientation of the cuvette will be identical each time it is placed in the instrument. Always use the light shield when measuring a grab sample.

NOTE: Always set the range switch to 1000 range before turning the instrument on and whenever the light shield or flow-thru unit is not in place over the well. After a new sample is in the well and the light shield is in place, turn the range switch counterclockwise to the range which provides best readability and sensitivity for the sample being measured.

C. PRE-INSTALLATION CHECKOUT

1. Extreme care should be taken when unpacking and handling the reference standard or sample cuvettes as surface scratches or finger smudges will cause analysis errors. Handle these items by the top only.

2. Check the mechanical meter zero when the instrument is positioned so that the face of the meter is in a vertical position and when there is no power on the instrument. Adjust to zero only if necessary by means of the black screw on the meter face.

D. INSTALLATION AND START-UP

1. The range switch located on the front of the instrument should be in the 1000 range position.

2. Connect the instrument line cord to a properly grounded pin receptacle and turn the instrument on by means of the front panel switch (DRT-100 and DRT-1000). The DRT-200 should be permanently wired through a breaker switch.

3. Allow fifteen (15) minutes warm-up and two (2) hours warm-up for maximum stability at the low ranges.

4. The DRT Turbidimeters should be left on. They are designed for continuous operation.

5. Do not leave the reference standard or filled cuvettes in the optical well for long periods.

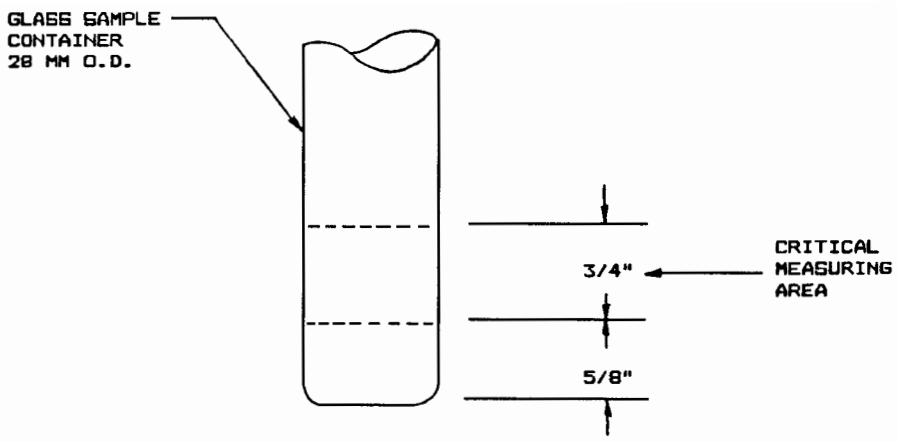
6. Leave the light shield in place on the instrument when it is not in use in order to protect the optical well for long periods.

7. The alarm switch located on the rear panel on the DRT-1000 should be in the OFF position, unless the alarm operation is required.

8. The normal-high switch located on the rear panel of the DRT-1000 should be in the normal position for nephelometer readings below 1000 NTU.

E. LAMP CIRCUIT

1. As covered under Theory of Operation, the lamp circuit is independent of the other circuits. The stability of the LM317 and associated circuits can be verified by connecting the turbidimeter through a "Variac" and varying the voltage between 90 and 130 volts. The lamp voltage should not vary more than +/- 0.05 volts. This same stability check can also be used on the +/- 12 volt supply.



The turbidimeter's optical system measures the liquid sample through this section of the reference standard, grab sample cuvette or flow-thru vial. It is therefore important that this 3/4" wide band of the glass container be kept clean and free of scratches or abrasion.

Figure 2

B. OPERATION OF CONTINUOUS MONITOR FLOW-THRU UNIT (DRT-1000 AND DRT-200)

The standard flow-thru unit supplied with the instrument is designed to operate at pressures up to a maximum of 60 p.s.i. and temperatures to a maximum of 120 degrees F fluid temperature. Flow rates through the unit can be adjusted from 0 to a maximum of 1 1/2 U.S.G.P.M. The speed of sensing turbidity changes will depend on the length of the take-off line and the flow rate, or velocity, through the take-off line. By keeping the lines small, approximately 3/16 inch I.D., and relatively short in length, the response time is kept short.

Depending on the type of fluid being monitored, a pressure drop through the line can cause gas or air in solution to come out of solution and interfere with the accuracy of the turbidity measurements. This can be prevented by creating a slight back pressure on the discharge side of the flow-thru unit using the flexible tube clamp. If the condition is severe, it may be necessary to run the incoming line through a stilling chamber to allow the air or gas to collect at the top of the chamber and be vented off. Increasing the size of the incoming line and/or reducing the flow rate will also help this condition.

Whenever a relatively cold liquid is being monitored under relatively high humidities, there is a tendency for condensation to form on the outside surfaces of the flow-thru vial. This will also interfere with accurate reading of turbidity. This condition can be corrected in most cases by placing desiccant, HF scientific part number 50018, in the bottom of the turbidimeter optical well before placing the flow-thru unit in position. The continuous flow-thru unit is sealed into the well by depressing the unit head so the O-ring seals the neck area of the well. In this way, the air inside the well is sealed in and the desiccant is allowed to dry the air to a very low dew point.

CAUTION

The desiccant does not have the capacity to remove condensate existing on the outside surface of the flow-thru vial before it is placed in the well.

To prevent this situation, fill the vial with a warm sample of the liquid after shutting off the flow. Then, after wiping the flow-thru vial clean, place it in the well and seal in place. Now the flow can be restarted and the cold fluid allowed to flow through the flow-thru unit. The desiccant has the capacity to maintain the air in the well at a low dew point under these conditions.

Always store the desiccant in an air tight container before use, otherwise, under damp conditions, they will lose their drying capacity.

C. LABORATORY GRAB SAMPLES

These cuvettes may be ordered in packages of 3 screw-top cuvettes with tops, catalog number 50051. Care must be taken when handling as surface scratches, dirt or finger smudges will cause analysis errors. It is recommended that they be carefully examined before a sample is drawn and wiped clean with a lint free wipe such as "Kimwipes: before placing in the optical well. Reference standard and cuvettes should be handled by the top portion only (see Figure 2). Cuvettes and Reference Standard should be indexed prior to use.

1. Set the range switch at 1000.

2. Connect instrument to a suitable power source and allow sufficient time for stabilization after turning it on.

3. Clean the reference standard with "Kimwipes" and place it in the sample well.

4. Place the "Light Shield" over the reference standard.

5. Set the front panel range switch to 0-1 range.

6. Set the front panel "Reference Adjust" until the pointer shows the same value as labeled on the reference standard. The instrument is now standardized on all ranges and ready for use.

7. Rotate range switch to 1000 range before removing reference standard from well.

8. Place cuvette containing grab sample into the well, place light shield in position over well and rotate range switch to the range which supplies best readability.

NOTE: If the liquid sample contains suspended solids (SS), the pointer will "hunt". This is due to large particles (SS) crossing the light path.

Readings should be taken without delay before turbid particles settle. However, be sure that all the gas bubbles have escaped.

IV. CALIBRATION PROCEDURES

A. STANDARD FORMAZIN SOLUTIONS

Calibration of this instrument is based on formazin, a material which can be made by synthesis and reproduced repeatedly. When properly mixed, it is uniform in the number, size and shape of its particles, thus making it an ideal turbidity standard. Calibration of this instrument is in Nephelometric Turbidity Units (NTU).

Calibration samples may be obtained by diluting formazin stock suspension using low turbidity water. Formazin stock suspension may be prepared by the user (reference A.W.W.A. "Standard Methods, 14th Edition) or it may be purchased in kit form (HF scientific Catalog Number 50040).

Each kit contains:

2-16oz. bottles formazin stock suspension, value 4000 NTU

1 gallon low turbidity water

7-28mm sample cuvettes with screw caps

Instructions for dilution

NOTE: When the prepared samples start to flocculate, they are unreliable and fresh ones must be made. This will occur more rapidly for the lower value diluted suspensions. The turbidity value of the water used for dilution will noticeably affect the accuracy of the 1 NTU formazin solution. If the turbidity value of the water is known, add it to the 1.0 NTU value, e.g., 0.1 NTU + 1.0 NTU = 1.1 NTU.

B. CUVETTE CLEANING

Cuvettes must be clean and free of rubs or scratches in the critical area (see Figure 2). Cleaning is accomplished by washing in a detergent solution then rinsing thoroughly 8-10 rinses in clean, preferably distilled water, to remove all streaks.

The cuvette should be replaced if scratches or rubs in the critical area affect readings.

Reusable cuvettes, (Catalog Number 50051, pkg. of 3) and the flow-thru vial (Catalog Number 50036, pkg. of 3) should be stored in a clean, dust-free environment.

C. ELECTRONIC CALIBRATION USING FRESHLY PREPARED FORMAZIN SOLUTION

DRT-100 and DRT-1000: Remove the case top by unscrewing the optical block collar and removing the collar and gasket. Then remove four (4) screws located two (2) on each side of the case near the bottom.

DRT-200: Open the indicator module door.

Calibration is accomplished by adjusting the trimming potentiometers using a small screwdriver. The calibration trimpots are identified as follows:

Range, 10, 100, 1000 (See Figure 3)

The DRT turbidimeters have been carefully calibrated by the factory. However, should the electronic P.C. board be replaced, or of very carefully prepared formazin suspensions indicate a need for recalibration, this may easily be accomplished at your facility.

To carry out a complete calibration the following formazin suspension values are required:

1000 NTU, 500 NTU, 100 NTU and 10 NTU

Fill, top and label separate cuvettes with a sample of each.

Always mix the contents of each cuvette by inverting several times before placing in the optical well for a reading. Keep the outside surface of cuvette clean.

1. **Set the front panel range switch in the 1000 range. The instrument should be on warm-up for a period of 1 hour.**

2. **Place the reference standard in the optical well (with light shield in place). Set the range switch at the 1 range. Adjust the reference adjust screw or knob to make the pointer read the "REFERENCE STANDARD" value.**

3. **Turn the range switch to the 100 range and remove the reference standard and replace it with the cuvette containing the 100 NTU suspension. Then with the light shield in place check the reading. Adjust the 100 trimpot marked as 100 on the printed circuit board to make the pointer read full scale value.**

4. **Turn the range switch to the 1000 range. Replace the 100 NTU suspension cuvette with the 1000 NTU suspension cuvette and, with the light shield in place, adjust the 1000 trimpot on the printed circuit board to make the pointer read full scale.**

5. Replace the 1000 NTU suspension cuvette with the 500 NTU suspension cuvette and then, with the light shield in place, adjust the "range" trimpot on the P.C. board to make the pointer read 500 (5 on scale). This is the mid-point of the scale.

6. Repeat the last three (3) steps until you can switch from 100 to 1000 with each of the three (3) standards, i.e., the 100, the 500 and the 1000, and each will read the correct values on the scale without further adjustment of the trimpots.

7. Place the 10 NTU suspension cuvette in the well and turn the range switch to the 10 range. With the light shield in place, adjust the trimpot marked 10 to cause the pointer to read the full scale value.

8. Finally, check each of the standards in each of the different ranges to be sure that the values are correct, including the reference standard value. Repeat steps 4, 5, 6, and 8 if necessary until each value reads accurately without adjustment.

When this procedure has been completed, the instrument is calibrated in all ranges.

If the instrument is being used in conjunction with EPA monitoring requirements, the instrument should be checked weekly for calibration at 40 NTU using a 40 NTU formazin standard which has been prepared in accordance with the procedure set out in Standard Methods, 14th Edition. In this case, the calibration consists of placing a cuvette containing the 40 NTU suspension into the instrument and, with the light shield in place and the range switch in the 100 range, check the reading. If it does not read 40 (4 on the scale), adjust the 100 trimpot on the P.C. board to bring the pointer on to the mark at 40% of scale.

V. SERVICING AND TEST POINTS

A. TEST POINTS

The Theory of Operation section should be understood before running the service tests as outlined below.

Refer to section 7, Wiring Diagram and Printed Circuit Board layout for location of the various test points.

The + and - 12 volt signals are derived from the + and - 16 volt supply using IC1 and its related circuits. If either the plus or minus 12 volts is missing, check the 16 volt supply first. If one or the other of the 16 volt supply is missing, check the power supply. The most common cause of either +/- 16 volts being missing is a defective zener diode, either D2 or D3. D3 is the positive supply and D2 is the negative.

Voltage test points (NOTE: All test point are reference to TP11)

+ 23 Volts D.C.	T.P. 1
- 23 Volts D.C.	T.P. 2
+ 16 Volts D.C.	T.P. 3
- 16 Volts D.C.	T.P. 4

To check the function of the photocells, you should measure the voltage at T.P. 7. The voltage there should swing from +12 volts D.C. TP - 12 volts D.C. with a large increase in turbidity.

Start with an empty optical well and T.P. 7 should read + 12 volts. By inserting a turbid sample, e.g. 1000 NTU, the voltage should swing to a negative voltage. If it does not swing negative, one of the three (3) photocells or associated circuitry is faulty.

If faulty photocells are indicated, we recommend replacing all three (3) photocells. This also calls for recalibration of the instrument.

B. ALARM CIRCUIT (DRT-100 STANDARD) (DRT-200 OPTIONAL)

The alarm circuit is used in order to provide an audible alarm for unattended on-stream monitoring. On the DRT-200, the alarm circuits should be connected to terminals 4, 5, and 6 (see Figure 3) as follows:

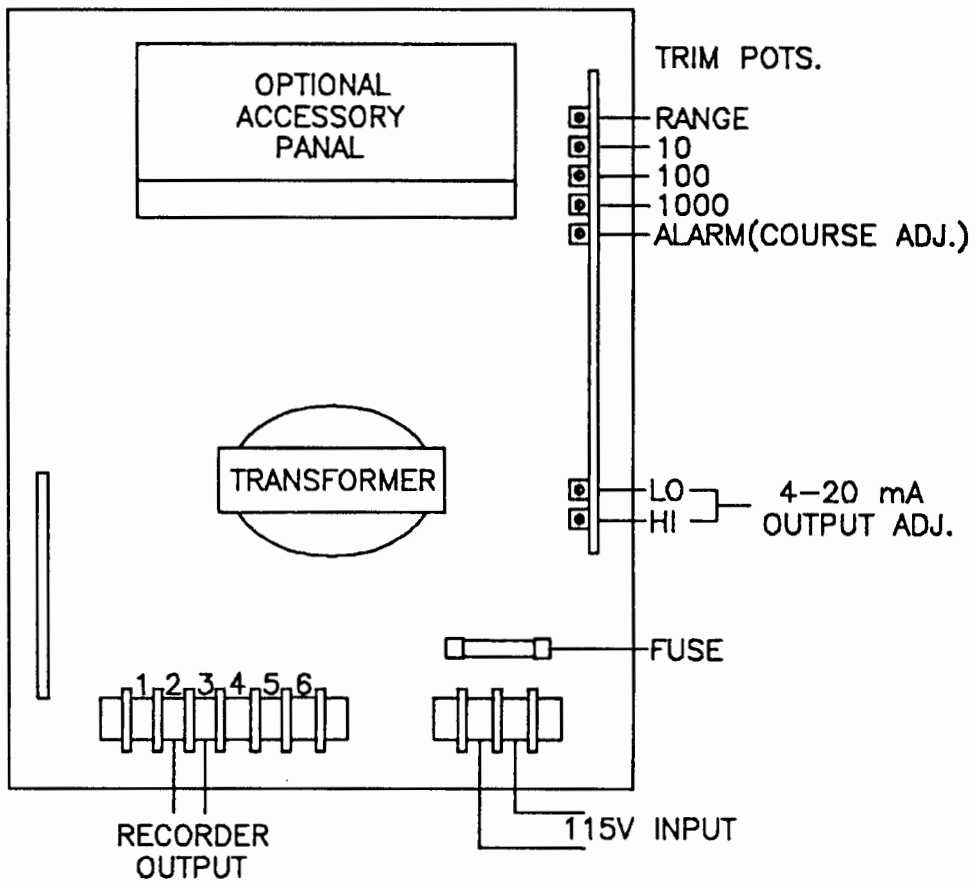

OPTIONAL
ACCESSORY
PANAL
TRIM POTS.
RANGE
10
100
1000
ALARM(COURSE ADJ.)
TRANSFORMER
LO
HI
4–20 mA
OUTPUT ADJ.
FUSE
1 2 3 4 5 6
RECORDER
OUTPUT
115V INPUT

Figure 3

For accurate setting of the alarm threshold, use the following procedure.

1. Turn front panel "Alarm Adjust" fully clockwise. (DRT-1000) (Located inside of the indicator module on the accessory panel on the DRT-200).

2. Insert reference standard and place light shield over reference standard.

3. Set front panel range switch to 1.0 range.

4. Turn front panel "Reference Adjust" to bring pointer to desired point on scale for alarm threshold. Due to factory calibrated range congruence, this scale point will remain the same in any range position.

5. Turn the rear panel alarm ON-OFF switch to "ON" (DRT-1000).

6. Slowly rotate the "Alarm Adjust" control counterclockwise until the alarm sounds. Stop at this point. The alarm is now set to operate at the desired scale value.

7. Turn the front panel "Reference Adjust" back to the correct reference value as stamped on the reference standard.

8. The front panel range selector may now be switched to the desired range of operation and the flow-thru unit reinstalled.

C. RECORDER CONNECTIONS

The DRT-100 is not equipped with a recorder output connection. The DRT-1000 is equipped with a 10 millivolt recorder output jack which is located on the back panel on the unit. A telephone type plug is supplied in the instrument accessories kit which is compatible with the jack.

The DRT-200 recorder connections are made at positions 2 and 3 of the six (6) position terminal strip as shown in Figure 3. The instrument has been factory calibrated to provide a 4-20 mA output at these recorder connections. The output from these two (2) connections can be adjusted to provide an output varying from 0-1 mA to 10-50 mA by adjusting the two (2) trimpots identified as LO and HI on the P.C. board at the right hand side of the enclosure. They are identified as 4-20 mA output adjustment. Outputs for millivolt recorders can also be obtained using a shunt resistor across terminals 2 and 3.

D. NORMAL-HIGH SWITCH (REAR PANEL) (DRT-1000 STANDARD)

1. NORMAL RANGE: This is the normal operating range for the instrument and no special instructions are required here except that this switch must be in the "Normal" position for routine operation as a nephelometer.

2. HIGH RANGE: By setting the "Normal-High" switch to high range, the instrument is suitable for measuring turbidity values in excess of 1000 Nephelometric Turbidity Units. The high range is used only for relative measurements of light transmission and does not include a standard reference value. A blank scale can be attached to the standard scale for marking in "PPM" to suit gravimetric analysis values. When reading in the high range, the signal is not linear with changes in PPM suspended particles over wide limits, but repeatability is accurate and linearity exists over relatively small changes in PPM. An accessory unit is available with facilities for greatly expanding the sensitivity of any particular portion of the scale. This feature is valuable in applications for monitoring and controlling higher turbidity values within relatively close limits.

3. LOW RANGE 0 TO 0.1: The lowest range on the instrument is 0-0.1 NTU full scale deflection. This is normally used only for exceptionally high clarity liquids such as alcohols and spirits. The facilities for measurement require high cleanliness in view of the extremely high sensitivity of the instrument in this particular range.

E. PROCESS CONTROL

A wide range of application literature is available for process control. In addition, many specialized modifications and accessories are available. Please contact the factory direct for this information. One of our application engineers will be most happy to assist you.

HF scientific, inc.
3170 Metro Parkway, Ft. Myers, FL 33916-7597
Phone: (941) 337-2116 Fax: (941) 332-7643

VI. MAINTENANCE

A. REMOVING INSTRUMENT CASE (DRT-100 & DRT-1000)

In order to remove the instrument case for maintenance or electronic calibration:

1. **Disconnect power source.**
2. **Remove the optical block collar and gasket (on top of the case) by unscrewing it from the optical block.**
3. **Remove four (4) screws. Two (2) on each side near bottom of case.**
4. **The case top can now be lifted off the lower half of the instrument case.**

B. REMOVING THE OPTICAL SYSTEM (DRT-200)

On the DRT-200, the optical system, including the lamp, may be removed from the sensor module by removing six (6) screws from the cover and removing the complete cover assembly. Be careful not to damage the gasket.

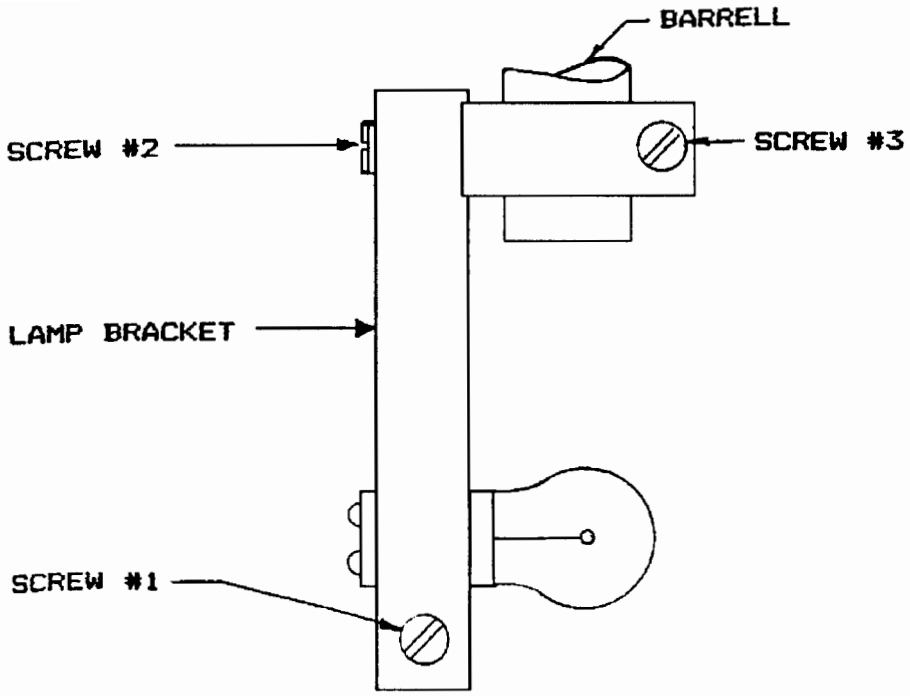
C. SPECIAL SERVICE NOTES

1. **If the P.C. board or the photocells are replaced in the field, recalibration will probably be necessary (see Section IV, Calibration Procedure).**
2. **Do not operate the instrument with photocells disconnected as this will cause damage to the operational amplifiers.**

D. SOURCE LAMP REPLACEMENT

The source lamp, catalog number 50006, will under normal circumstances, give exceptionally long life.

To replace the lamp, remove the instrument case (DRT-100, DRT-1000) or the optical system (DRT-200) in accordance with Section A or B above.



D. SOURCE LAMP REPLACEMENT (cont'd)

Referring to figure 4, the bulb may now be removed by loosening screw #1 and removing the electrical leads from the lamp bracket. Insert the new bulb and reconnect the electrical leads. Before tightening screw #1, be sure to position the filament so that it will be parallel to the axis of the optical well. The new bulb must now be focused. Insert the lamp alignment tool, HF scientific catalog number 70820, into the optical well. Loosen screw #3 and move the lamp bracket assembly in or out until a focused image of the filament is within the rectangular box on the lamp alignment tool. If necessary, the height of the filament image may be adjusted by loosening screw #2. Once the filament image has been aligned and focused within the rectangular box on the lamp adjustment tool, tighten screws #1, #2 and #3 snugly.* Replace instrument case or optical system and screws in proper locations.

* IMPORTANT - Do not tighten screw #1 to much as it may crush the base of the lamp.

VII. TROUBLE SHOOTING GUIDE

A. ELECTRONIC TROUBLE

SYMPTOM	PROBABLE CAUSE & CORRECTION
No pilot light or meter indication.	1. Check fuse or breaker & replace or reset if necessary. 2. Repetition of problem means probable short in transformer primary or secondary or power supply - regulator circuit.
Measurement below 100 is unobtainable with Reference Standard.	1. Photocells or Amplifier problem. Carry out Servicing Test Point Check. Also check for broken photocell connection.
No meter change when range switch rotated.	1. Check for faulty switch connections and replace if necessary.
NTU value on one scale does not verify on another scale within specified tolerances.	1. Check mechanical zero on meter. 2. May required instrument recalibration.
Pointer hunts when measuring with Reference Standard	1. Possibly due to air bubbles in Reference Standard. Standard should be stored in vertical position. Do not shake it. 2. Faulty standards should be replaced. 3. If hunting persists when measuring any sample, check circuit for faulty voltage, regulator or amplifier.
Value changes significantly when Reference Standard or Cuvette is rotated in the well.	1. Check for dirt or scratches on critical area of glass. Clean or replace as necessary.

B. FLOW THROUGH SENSOR TROUBLE

SYMPTOM	PROBABLE CAUSE & CORRECTION
When flow through the Sensor is started, air bubbles attach to the flexible tubing.	1. Increase flow velocity just enough to sweep off bubbles. Allow time to stabilize before taking measurement. The lower the range, the longer it takes to stabilize. In some cases two (2) hours or more.
Flowing turbidity is higher than static turbidity.	1. This occurs particularly in the lower ranges when small amounts of gas come out of solution due to a pressure drop in the lines. It can normally be corrected by creating a small back pressure on the outlet or downstream side of the flow through sensor. Use the adjustable tubing clamp for this purpose.
Large bubbles interfere with measurement.	1. These normally originate in the process line. If they cannot be eliminated at source or take-off point it may be necessary to install a stilling chamber in the take-off line to the Sensor Module. 2. If only occasional bubbles occur, the use of a signal damper accessory will prevent the peak from reaching the Recorder or Control.
Flow-Thru Unit plugs when used for turbidimeter measurements.	1. Insert a 1/16" mesh strainer between the flow-thru unit inlet and sampling point to retain occasional particles coarser than 1/16" diameter. NOTE: Use of a strainer is discretionary and in most cases is unnecessary.
Not sufficient travel on "Reference Adjust" knob to obtain "Reference Standard" value on meter.	1. Dirty Reference Standard. Clean with detergent and rinse thoroughly. Dry with "Kimwipes". 2. Check that Light Shield is correctly placed. 3. Bulb or lens (near bulb) dusty. Clean carefully in place.

B. FLOW THROUGH SENSOR TROUBLE

SYMPTOM	PROBABLE CAUSE & CORRECTION
Flow-Thru Vial or cuvette breaks while in the Optical Well	1. Turn instrument off and drain liquid out of well. Clean the insides of the well. Remove photocells and lenses. Clean and dry all parts & reassemble. Check calibration & recalibrate if necessary.
Condensate on Flow-Thru Vial interferes with accurate measurement.	1. Remove vial from optical well. Fill with warm sample of fluid. Reattach to flow-thru head and clean outside surfaces. Place new desiccant pillow in well after making sure the well is completely clean and dry. Re-install flow-thru unit and re-start flow of cold fluid. Be sure O-ring seal is in contact with inner wall of the well. 2. The desiccant pillow must be stored in an air tight container otherwise they will become saturated with water vapor & they will not properly dry the air in the well.
Repeated Reference Standard Measurements show different values.	1. This apparent instability is in many cases due to airborne particles or dirt on the glass surface of cuvette. Wiping with "Kimwipes" does not always remove them & can cause smears invisible to the eye. Wash Standard thoroughly in detergent, rinse completely and dry. Blow out dust from optical well and keep lenses clean.
Pilot Light on but no meter indication.	1. Check for broken wires at photocells. 2. Check if photocells are open circuits. 3. P.C. board faulty. Replace and calibrate DRT against formazin solutions.

HF SCIENTIFIC, INC.

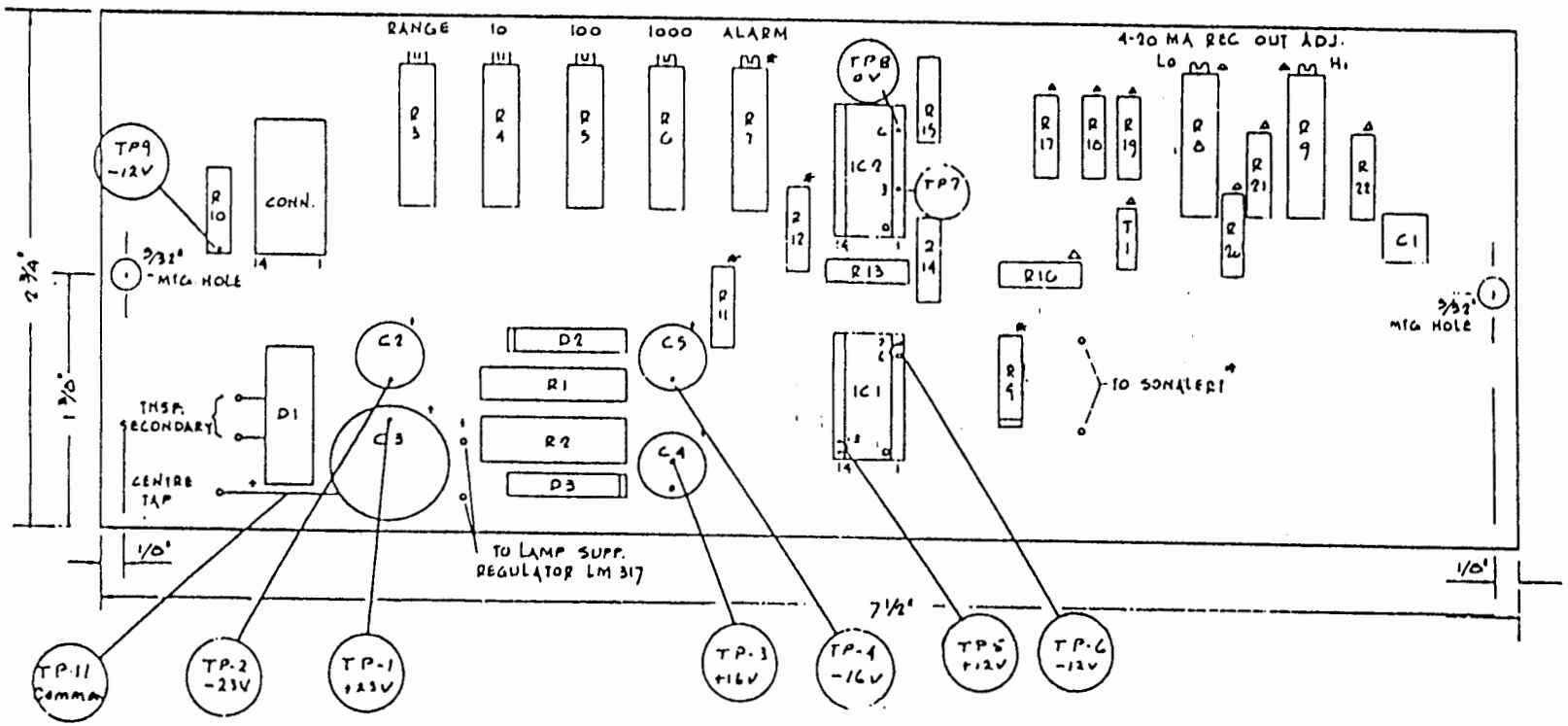
PARTS AND ACCESSORIES FOR DRT-100

CATALOG NO.	DESCRIPTION
50000	Instruction Manual
60002	Reference Standard 0.02 NTU
50096	Lamp Source with Leads 2/Pky
50016	Fuse 1/2 amp. for 115V operation
50017	Fuse 1/4 amp. for 230V operation
50040	Formazin Stock Solution Kit
50048	Cuvette 16mm 3/Pk
50051	Cuvette 28mm 3/Pk
50052	Cuvette 28mm 10/Pk
20108	Control Panel Mounting Kit
20784	Pilot Light
20755	Meter, Complete W/Scale
21032	Optical Block Collar Gasket
50023	Optical Block Complete W/Light Shield
50009	Light Shield
50055	Power Supply Board Unit (Old Models Only)
50056	Printed Circuit Board
50078	Range Switch Assembly, Complete (Old Model)
50107	Reference Adjust Potentiometer Assembly, Complete
50104	Reference Adjustment Knob
50105	Range Adjustment Knob
50110	Photocell (Set of 3)
21001	Lamp Bracket Assembly
51112	Range Switch Assembly (Late Model)

TERMS: 1% 10 Days, Net 30 Days
1 1/2% Per Month After 30 Days

F.O.B.:

HF scientific, inc.
3170 Metro Parkway, Ft. Myers, FL 33916-7597
Phone: (941) 337-2116 Fax: (941) 332-7643



R1	27Ω/1W
R2	75Ω 2W
R3	1K
R4	50K
R5	5K
R6	30K
R7	500K
R8	20K
R9	9K
R10	1.47K
R11	47.5K
R12	3.32 MΩ
R13	1.5K
R14	2.21K
R15	475Ω
R16	17.5K
R17	10Ω
R18	60Ω
R19	100K
R20	105K
R21	301K
R22	301K
D1	KBL02
D2	IN5353
D3	IN5353
D4	IN4005
T1	MJE700
C1	33μF
IC1	LM 326
IC2	LM 340
C2	100μF 35V
C3	1000μF 35V
C4	100 μF 35V
C5	100μF 35V
CONN	RIBBON CABLE CONN

* ALARM CIRCUIT COMPONENTS, DRT-1000 ONLY

Δ RECORDER OUTPUT CIRCUIT COMPONENTS, DRT-1000 & DRT-200 ONLY

FIGURE A

HF INSTRUMENTS		DRT-1000	
19-2			
Nov 1977			
E.S.			
P.C. BOARD LAYOUT		90059	

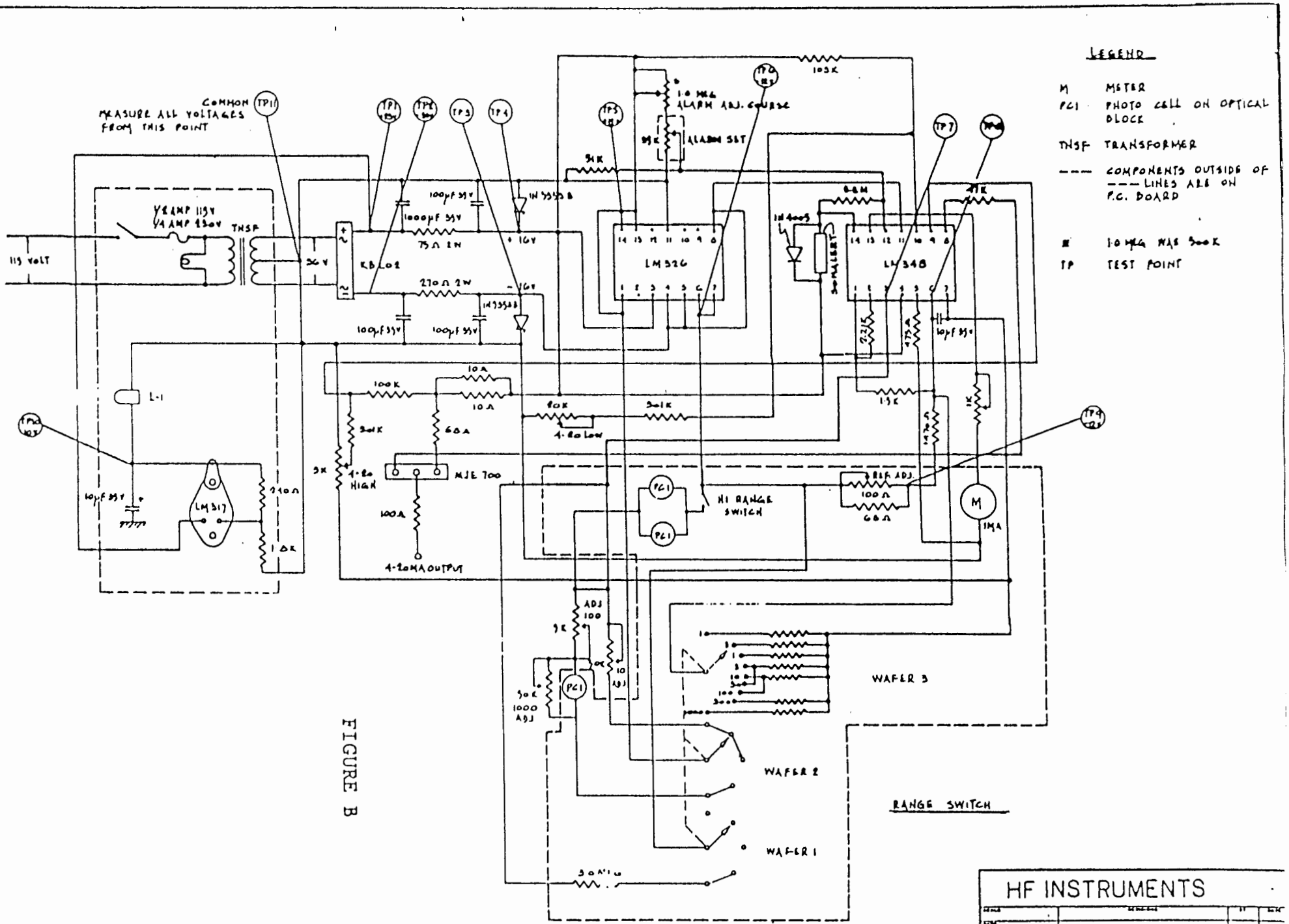


FIGURE B

HF INSTRUMENTS			
DRT-1000 WIRING INCL. SERVICE TEST POINTS			

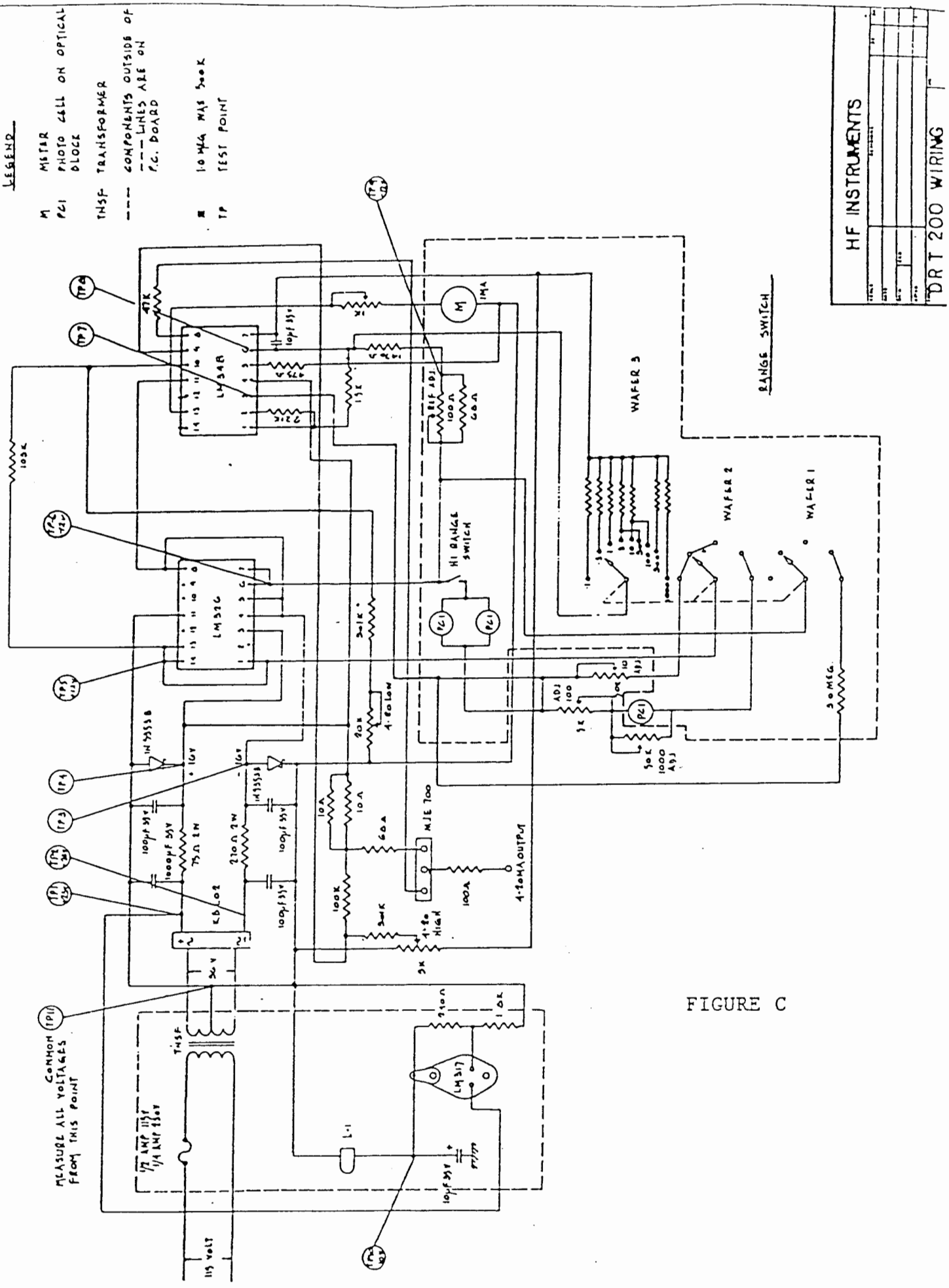

HF INSTRUMENTS
DRT 200 WIRING
LEGEND
M METER
PCI PHOTO CELL ON OPTICAL BLOCK
TNSF TRANSFORMER
---- COMPONENTS OUTSIDE OF ---LINES ARE ON P.C. BOARD
10 MEG MYLAR 200K
TP TEST POINT
RANGE SWITCH
WAFER 3
WAFER 2
WAFER 1
HI RANGE SWITCH
LM324
LM326
LM317
MJE 700
4-20MA OUTPUT
MEASURE ALL VOLTAGES FROM THIS POINT
COMMON
115 VOLT

FIGURE C

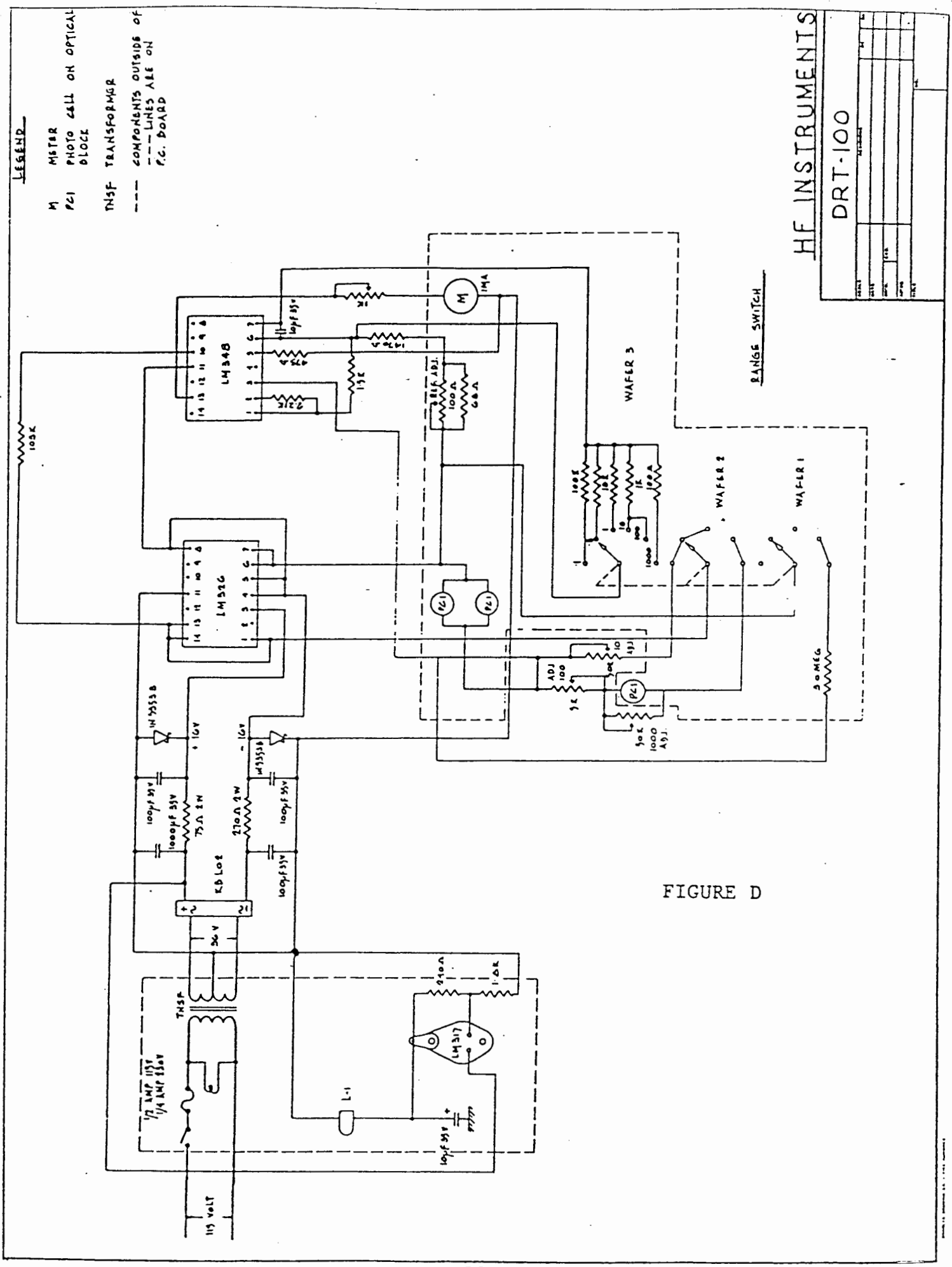
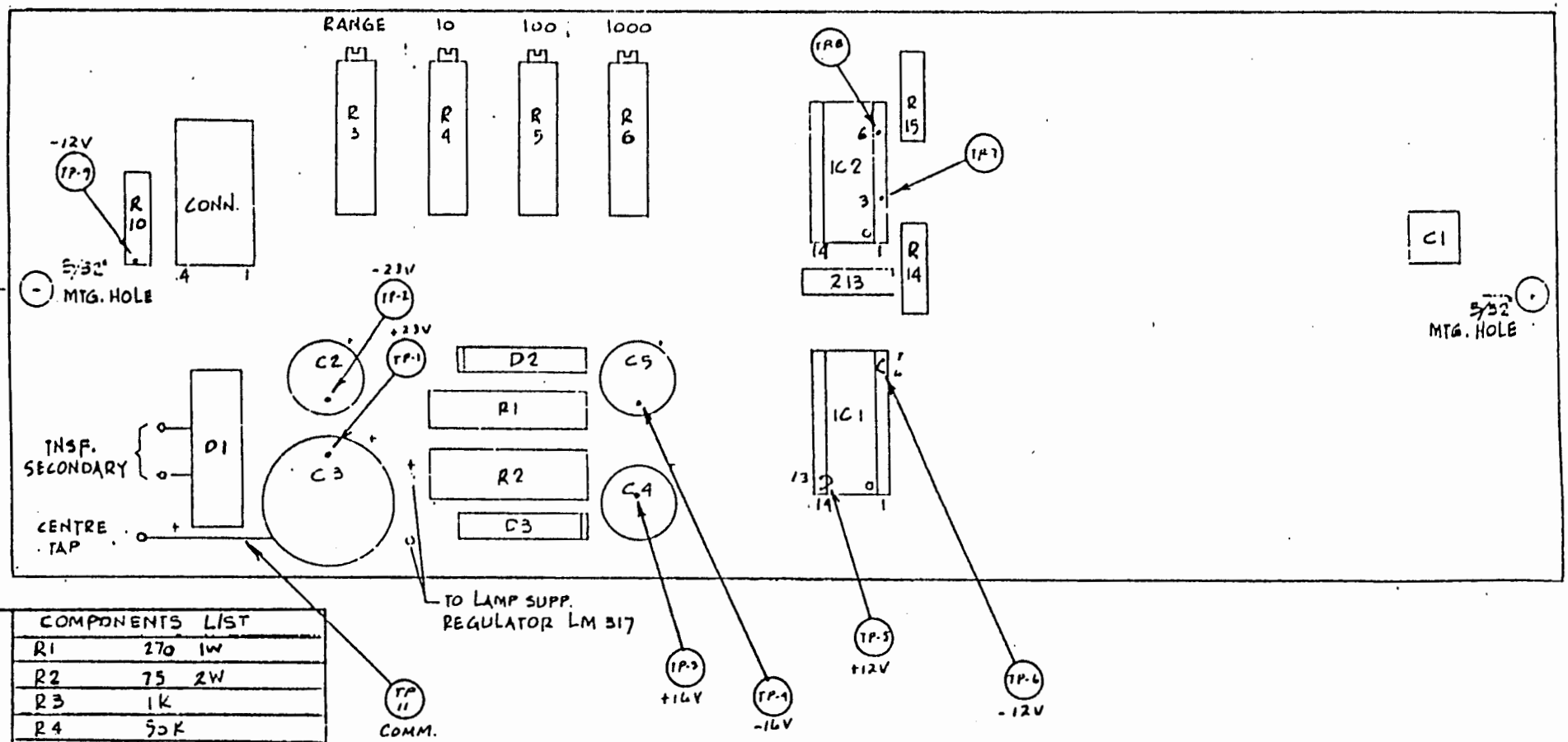

LEGEND
M1 METER
PC1 PHOTO CELL ON OPTICAL BLOCK
TNSF TRANSFORMER
--- COMPONENTS OUTSIDE OF ---LINES ARE ON P.C. BOARD
HF INSTRUMENTS
DRT-100
RANGE SWITCH
WAFER 3
WAFER 2
WAFER 1
LM348
LM326
LM317
1MA
105K
15K
100A
68A
1K
10
100
1000
5K
50K 1000 ADJ.
3 MEG
ADJ 100
10 ADJ
+16V
-16V
100pf 35V
1000pf 35V
750Ω 2W
270Ω 2W
K.D Lo4
24 V
TNSF
1/2 AMP 115V
1/4 AMP 230V
115 VOLT
L-1
910Ω
1.0K
10pf 35V

FIGURE D



COMPONENTS LIST	
R1	270 1W
R2	75 2W
R3	1K
R4	50K
R5	5K
R6	50K
R10	1.47K
R13	1.5K
R14	2.21K
R15	475Ω
D1	KBL02
D2	IN5353
D3	IN5353
C1	10µF
IC1	LM326
IC2	LM348
C2	100µF 35V
C3	1000µF 35V
C4	100µF 35V
C5	100µF 35V
CONN.	RIBBON CABLE CONN

FIGURE E

NO.	REVISIONS	DATE	BY	APPROVED

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES AND TOLERANCES ARE: FRACTIONS ± 1/64, DECIMALS .XX ± .01, .XXX ± .005, ANGLES ± 1°, MATERIAL: —, FINISH: —

HERE ASSEMBLY NO.

APPROVALS	DATE
DRAWN BY: D.A.D.	1/31/91
CHECKED:	

DO NOT SCALE DRAWING

SHABAN MANUFACTURING COMPANY
FORT MYERS, FLORIDA

P.C. BOARD ASS'Y.

MODEL NO. DAT-100 | DRAWING NO. SA-1206-D

SCALE: — | PART NO. 30036 | SHEET 1 OF 1

WARRANTY

HF scientific, inc., as vendor, warrants to the original purchaser of the instruments to be free of defects in material and workmanship, in normal use and service, for a period of one year from date of delivery to the original purchaser. HF scientific, inc.'s, obligation under this warranty is limited to replacing, at its factory, the instrument or any part thereof. Parts which by their nature are normally required to be replaced periodically, consistent with normal maintenance, specifically lamps, and fuses are excluded. Also excluded are accessories and supply type items.

Original purchaser is responsible for return of the instruments, or parts thereof, to HF scientific, inc.'s factory. This includes all freight charges incurred in shipping to and from HF scientific, inc.'s factory.

HF scientific, inc. is not responsible for damage to the instrument, or parts thereof, resulting from misuse, negligence or accident, or defects resulting from repairs, alterations or installation made by any person or company not authorized by HF scientific, inc.

HF scientific, inc. assumes no liability for consequential damage of any kind, and the original purchaser, by placement of any order for the instrument, or parts thereof, shall be deemed liable for any and all damages incurred by the use or misuse of the instruments, or parts thereof, by the purchaser, its employees, or others, following receipt thereof.

Carefully inspect this product for shipping damage, if damaged immediately notify the shipping company and arrange an on-site inspection. HF scientific, inc. cannot be responsible for damage in shipment and cannot assist with claims without an on-site inspection of the damage.

This warranty is given expressly and in lieu of all other warranties, expressed or implied. Purchaser agrees that there is no warranty on merchantability and that there are no other warranties, expressed or implied. No agent is authorized to assume for HF scientific, inc. any liability except as above set forth.

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