



YELLOW SPRINGS INSTRUMENT CO.

YELLOW SPRINGS, OHIO 45387

INSTRUCTIONS
FOR
YSI MODEL 80A SINGLE CHANNEL
AND
YSI MODEL 81A DUAL CHANNEL
LABORATORY RECORDERS

NOTICE

This manual contains complete operating instructions for both the YSI Model 80A Single Channel Laboratory Recorder and the YSI Model 81A Dual Channel Laboratory Recorder. The text is divided into three sections as follows:

Section I contains a general description, specifications, and operating procedures for the YSI Model 80A Recorder.

Section II contains a general description, specifications, and operating procedures for the YSI Model 81A Recorder.

Section III contains information that is common to both the YSI Models 80A and 81A Recorders.

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Section I

YSI MODEL 80A

SINGLE CHANNEL LABORATORY RECORDER

1. General Description

The YSI Model 80A is a versatile, general purpose D.C. voltage and current recorder. Its circuit consists of an input network, a solid-state chopper-stabilized amplifier, and a recorder. A voltage or current input to the instrument is first "conditioned" by the RANGE switch, the SPAN control, and the OFFSET control. The resulting voltage is then filtered to reduce any A.C. noise, and is amplified and applied to the recorder meter.

The recorder uses pressure-sensitive chart paper and a clamping bar which causes the meter stylus to strike the paper every two seconds. The result is a succession of marks which overlap to form a trace as the paper advances through the recorder.

2. Specifications

Accuracy: $\pm 2\%$ full scale on voltage ranges. $\pm 3\%$ full scale on current ranges.

Calibrated Ranges: Full scale voltages from 10 millivolts to 100 volts and full scale currents from 1 microampere to 10 milliamperes in decade steps.

Span Control Range: This control can increase any full scale voltage or current range by a factor of 10, except in 100V range.

Offset Control Range: This control allows the meter indication to be set at least ten times full scale in either direction from zero on any range.

Input: One megohm constant impedance on all voltage ranges. Ten millivolts drop across the input terminals for full scale on any calibrated current range.

Amplifier: A chopper-stabilized operational amplifier which operates at fixed gain provides 1 volt output for 10 millivolts input.

Readout: Meter — 1 milliamperes at 100 ohms, matched to the amplifier by the internal CAL control.

Chart Paper — pressure-sensitive, 2.31 inches wide (50 divisions), 750 inches (63 feet) long (4 divisions per inch).

Chart Speed — 1 inch per hour as supplied. 2, 3, 6, 10, 12, 15 and 20 inch per hour gear assemblies are available.

Marking Speed — once each two seconds.

Ambient Temperature Range: 0°C — 45°C (32°F — 113°F)

Stability: Better than $\pm 1\%$ per day with normal ($\pm 10\%$) line voltage variations and relatively constant ($\pm 5^{\circ}\text{C}$) ambient temperatures. Better than $\pm 3\%$ over the full ambient temperature range when no offset voltage is introduced with the OFFSET control. Derates to $\pm 10\%$ over the full ambient temperature range when the OFFSET control is at either extreme.

Line Voltage: Models for 117 volts A.C., 50-60 Hz, 10 watts (at 50 Hz, chart speeds are 5/6 those described) operate at 95-135 volts A.C.

Models for 230 volts A.C., 50 Hz, 10 watts operate 190-270 volts A.C.

Size: 11" x 6" x 5"

Weight: 9 pounds

Warning: The following voltages and current are absolute maximums which may be applied to the input terminals of the YSI Model 80A. If they are exceeded, the instrument will be damaged.

Maximum between HI terminal and ground:

± 500 volts with ranges of 100MV to 100V.

± 50 volts with range of 10MV.

Maximum between LO terminal and ground: ± 200 volts

Maximum current: ± 100 milliamperes

OPERATING PROCEDURES

This section contains general instructions for setting up and operating the instrument, including application information.

1. Grounding

The case of the YSI Model 80A should always be grounded. The three-wire line cord makes this a simple operation in most modern electrical systems.

Generally, the instrument will operate properly with grounded or floating inputs. However, we recommend that you ground one of the inputs when possible. In some systems you may find it necessary to shield the input leads in order to minimize pick-up noise and A.C. interference. A two-conductor shielded cable is most effective here. Use the conductors for the input leads and ground the shield to the recorder GND terminal.

2. Setup

a. Set the RANGE switch to the ZERO position and adjust the SPAN control to the CAL position. A detent on the SPAN control gives tactile and audible indications that the control is in CAL position.

b. Connect the recorder to an A.C. power source. If the source is not grounded (three-wire receptacle), connect to a proper ground through the GND terminal.

c. Set the function switch to the REC position. Allow the instrument to operate for a minute or two.

d. Adjust the OFFSET control to give a meter indication of zero.

e. Connect the input to the HI and LO terminals. The polarity of the connections will depend on the application. If input characteristics are not known, set zero in the center of the chart and try consecutively lower ranges until the stylus deflects. A deflection of one major division on the chart paper represents full-scale deflection on the next lower range. A positive voltage applied to the HI terminal will drive the meter indication up-scale.

f. Set the RANGE switch to the required full-scale range.

3. Offset and Span Controls for Scale Expansion

The OFFSET control allows the zero position to be set at any point

on the scale. For instance, if the OFFSET control is adjusted for a mid-scale meter indication with the RANGE switch in the ZERO position, the recorder will indicate mid-scale when the input is zero on any range at any SPAN setting.

The OFFSET control also makes it possible to move the zero position off the scale to the right or left for a scale expansion up to 10 to 1. This can be accomplished with a simple four-step approach:

1. Set the RANGE switch to the ZERO position and adjust the OFFSET control for a zero meter indication.
2. Connect the input and set the RANGE switch to a range at which meter indication is higher than 10% full-scale.
3. Readjust the OFFSET control for a zero meter indication.
4. Set the RANGE switch to the next most sensitive range and adjust the SPAN control for an on-scale indication.

The SPAN control provides continuous adjustment between ranges to establish a convenient correlation between input and the recorder. The OFFSET and SPAN controls, when used together, allow scale expansion up to 10 between ranges. For example: if a D.C. voltmeter indicates at all times in the upper half of its scale, the YSI Model 80A may be used to record the upper half-scale or full scale. This is accomplished by adjusting the RANGE, OFFSET and SPAN controls as described in the four steps above so the recorder reads zero when the voltmeter is at half-scale, and the recorder reads full-scale when the voltmeter is at full-scale.

4. Stylus Unclamping for Use as Voltmeter and Ammeter

The instrument can be used as an indicating voltmeter or ammeter for setup or measurements. During such operation the stylus must be free to deflect. To accomplish this, set the function switch to the AMP position when the clamping bar is just beginning to leave the stylus. The momentum of the drive motor will lift the clamping bar free of the stylus.

5. General Recording

The instrument can be connected directly across nearly any D.C.

voltage or current meter for voltage recording. The high input impedance of the recorder prevents any measurable effect on meter accuracy. Also, the SPAN and OFFSET controls allow precise calibration of the recorder to the meter.

For general D.C. voltage recording two points should be considered:

- circuit loading caused by the recorder's one megohm input impedance.
- maximum input voltage limit as noted in the Specifications.

The recorder input impedance will load the source by 1% when source impedance is 10K ohms — loading will increase as source impedance increases.

The maximum input voltage limit can be explained as follows: the potential between ground and the HI input must never exceed 500 volts on the 100MV to 100V ranges, and 50 volts on the 10MV range, and the potential between ground and the LO input must never exceed 200 volts. Therefore, the limit occurs when 200 volts is applied between ground and the LO input. In this case, the maximum allowable potential across the YSI Model 80A input terminals is 300 volts of the same polarity as is the 200 volts.

The instrument can be connected in series in a circuit to measure and record D.C. current up to 100 milliamperes. On calibrated ranges, the voltage drop across the input terminals will be 10 millivolts. The drop will increase to about 100 millivolts when the SPAN control is adjusted for maximum attenuation.

6. Temperature Recording with the YSI Tele-Thermometer

YSI Tele-Thermometers contain a Wheatstone bridge and indicating meter. When a YSI thermistor probe is connected to the bridge, the system will accurately measure temperature. The output of the Tele-Thermometer recorder jacks, which are connected across the indicating meter, can be applied to the recorder to form a temperature recording system. Use the following procedures to calibrate the recorder to the Tele-Thermometer.

- a. Connect a lead from the red jack on the thermometer to the LO

input terminal, connect another lead from the black jack to the HI input terminal, and connect the HI input terminal to the GND terminal on the recorder with a third lead. Turn the thermometer OFF.

b. Set the RANGE switch to ZERO and adjust the stylus to the extreme right hand mark on the chart paper. Turn the RANGE switch to 100 MV.

c. The red line position on the thermometer scale provides a convenient reference for adjusting the recorder span. Turn the thermometer ON and set to red line. With the SPAN control set the recorder stylus to the same percentage of full-scale deflection as the red line on the thermometer.

Calculate the deflection as follows:

a = number of degrees between left-hand end of scale and red line.

b = total number of degrees on the thermometer.

$\frac{a}{b} \times 100$ = percent of full-scale deflection of red line temperature.

Example: with a 0°C to 50°C range, the red line is at 5°C or 10% (1 major division) from the left edge of the chart. This percentage must be determined for each temperature range.

d. Insert the probe in the Tele-Thermometer. The thermometer-recorder combination is now ready to indicate and record temperature.

YSI thermistor probes do not show a linear response with temperature change. Therefore, no YSI Tele-Thermometer has a completely linear scale. When the output of a Tele-Thermometer is connected to the YSI Model 80A, the readout will not be precisely one-to-one. The error is not large and in most cases can be ignored. However, a variable resistor may be used to calibrate the recorder scale when greater accuracy is required. The resistor is inserted in place of the probe and adjusted for particular Tele-Thermometer readings. The recorder scale may be marked accordingly.

The resistor-substitution technique is helpful in setting the YSI Model 80A for expanded-scale use with the Tele-Thermometer. With this technique, any portion of the Tele-Thermometer scale can be

expanded by a factor of 10. That is, 10% of the Tele-Thermometer scale can be made to drive the YSI Model 80A meter stylus through full-scale deflection. For example, the YSI Model 43TA Tele-Thermometer has a range of 20° to 42°C . If in a particular application the total range of interest was 25° to 35°C , the recorder scale could be expanded to cover just this range as follows:

- a. Set the RANGE switch to the 10 MV position and adjust the OFFSET control so the recorder reads full-scale when the YSI Model 43TA Tele-Thermometer indicates 35°C .
- b. With the SPAN control adjust the recorder to read zero when the thermometer reads 25°C . These two operations must be repeated several times until both settings are correct.

7. Temperature Recording with YSI Thermilinear Components

YSI Thermilinear components and YSI Series 700 Probes are combinations of precision thermistors and resistors which feature linear resistance change with temperature change. When coupled with appropriate power supplies, such as YSI Thermivolt systems, they can be used with the YSI Model 80A for direct recording of temperature with resolution to 0.01°C .

8. Temperature Recording with Thermocouples

Since a thermocouple is a voltage generator whose output voltage is proportional to temperature, a complete temperature indicating and recording system can be obtained by using the YSI Model 80A recorder in conjunction with a thermocouple in the following manner:

- a. Adjust the recorder to the desired temperature range by setting the RANGE switch to 10 MV. Connect a voltage source corresponding to the temperature at the low end of the range to the HI and LO input terminals. (If the low temperature is the same as the reference junction temperature this is 0 volts).
- b. Set the OFFSET control to give a zero reading on the recorder. Apply voltage corresponding to the high temperature to the input terminals and adjust the SPAN control to give full-scale deflection of the recorder stylus.

- c. Repeat these two operations several times until both settings are correct. Now connect the thermocouple to the input terminals of the recorder with the plus lead going to the HI terminal, the minus lead going to the LO terminal and connect the LO terminal to GND. The instrument is ready for use.
- d. The above description applies to temperatures above the reference junction temperature. To measure temperatures below the reference temperature, reverse the thermocouple leads at the input terminals of the recorder.

Section II

YSI MODEL 81A

DUAL CHANNEL LABORATORY RECORDER

1. General Description

The YSI Model 81A is a versatile, general purpose D.C. voltage and current recorder capable of recording two independent variables simultaneously as a function of time. Its circuit consists of a pair of input networks, a switching circuit, a solid-state chopper-stabilized amplifier, and a recorder. A voltage or current input to the instrument is first "conditioned" by the RANGE switch, the SPAN control, and the OFFSET control. The resulting voltage is then filtered to reduce any A.C. noise, and is then amplified and applied to the recorder meter.

The recorder utilizes pressure-sensitive chart paper and a clamping bar which causes the meter stylus to strike the paper once every second. When the instrument is recording two inputs, the inputs are switched each time the clamping bar activates. This creates two traces as the paper advances through the recorder. An identification circuit causes the instrument to switch to channel 1 for 1/16" out of every 1/2" of chart paper travel. The interrupted channel 2 trace can be readily identified.

2. Specifications

Accuracy: $\pm 2\%$ full scale on voltage ranges. $\pm 3\%$ full scale on current ranges.

Calibrated Ranges: Full scale voltages from 10 millivolts to 100 volts and full scale currents from 1 microampere to 10 milliamperes in decade steps.

Span Control Range: This control can increase any full scale voltage or current range by a factor of 10, except in 100V range.

Offset Control Range: This control allows the meter indication to be set at least ten times full scale in either direction from zero on any range.

Input: One megohm constant impedance on all voltage ranges. Ten millivolts drop across the input terminals for full scale on any calibrated current range.

Amplifier: A chopper-stabilized operational amplifier which operates at fixed gain provides 1 volt output for 10 millivolts input.

Readout: Meter — 1 milliampere at 100 ohms, matched to the amplifier by the internal CAL control.

Chart Paper — pressure-sensitive, 2.31 inches wide (50 divisions), 750 inches long. (4 divisions per inch).

Chart Speed — 2 inches per hour as supplied. 4, 6, 12, 20, 24, 30, and 60 inch per hour gear assemblies are available.

Marking Speed — once each second.

Channel Identification: A 1/16" break in the channel 2 trace in each 1/2" of chart paper travel.

Ambient Temperature Range: $0^{\circ}\text{C} - 45^{\circ}\text{C}$ ($32^{\circ}\text{F} - 113^{\circ}\text{F}$)

Stability: Better than $\pm 1\%$ per day with normal ($\pm 10\%$) line voltage variations and relatively constant ($\pm 5^{\circ}\text{C}$) ambient temperatures. Better than $\pm 3\%$ over the full ambient temperature range when no offset voltage is introduced with the OFFSET control. Derates to $\pm 10\%$ over the full ambient temperature range when the OFFSET control is at either extreme.

Line Voltage: Models for 117 volts A.C., 50-60 Hz, 10 watts (at 50 Hz, chart speeds are 5/6 those described) operate at 95-135 volts A.C. Models for 230 volts A.C., 50 Hz, 10 watts operate 190-270 volts A.C.

Size: 11" x 6" x 5"

Weight: 12 pounds

Warning: The following voltages and current are absolute maximums which may be applied to the input terminals of the YSI Model 81A. If they are exceeded, the instrument will be damaged.

Max. between HI terminal and ground:

± 500 volts with ranges of 100MV to 100V

± 50 volts w/range of 10MV

Max. between LO terminal and ground: ± 200 volts

Max. current: ± 100 milliamperes

OPERATING PROCEDURES

Operation of the YSI Model 81A is very similar to the YSI Model 80A, the primary difference being that the YSI Model 81A has two separate input channels. There is a three position selector switch for recording on channel 1 only, channel 2 only, or on both channels. Each channel is set up for operation exactly as described in the YSI Model 80A operating instructions.

After both channels have been set up when doing two channel recording, turn the selector switch to the "1 & 2" position and check that the two traces do not coincide. If they do, the operator may wish to adjust one of the traces up-scale or down-scale for easier identification. One of the OFFSET controls may be used. This adjustment will not disturb the sensitivity of either channel.

Refer to Sections I and III for all other instructions and operating procedures for the YSI Model 81A Dual Channel Recorder.

Section III

CHART DRIVE INSTRUCTIONS

1. Loading for Chart Re-roll Operation

To load the recorder so that the used chart paper is rewound on the take-up roll, observe the following diagram and instructions.

a. Open the front of the recorder by loosening the thumbscrew in the upper left corner, then remove both SUPPLY and TAKE-UP ROLLERS after releasing the RETAINING CLIPS. Lower the plastic CHASSIS LATCH.

b. Slide the roll of chart paper onto the SUPPLY ROLL, unroll about 12" of paper, and with a small piece of tape attach the end to the cardboard sleeve on the TAKE-UP ROLL. Roll several turns on the TAKE-UP ROLL with the white or graph side up.

c. Keeping both rolls snug, with approximately 8" of free paper taut between them, take the white roll in your left hand, the black roll in your right... and with an angular push, slide the paper loop (perforated edge first) into the slot between the right side plate and the plastic CHASSIS LATCH. Work the black roll (right hand) into position first. Carefully engage the sprockets of the drive drum with the paper perforations, then pushing on the brake (which exerts a slight pressure on the supply paper, keeping it snugly rolled during operation) insert end pivots of the black roll into the top notches. Before continuing, and to save time later, double check to see that the paper perforations are properly engaged.

d. Work the white TAKE-UP ROLL into position. Once again with paper taut and evenly snug on roller, bring it over the DRIVE BELT ROLLER. End pivots of the white roll easily drop into their slots and the gear will engage. Note that there are TWO notches on the left side plate, the first of which does not engage the gear and is used for reviewing only. The furthest notch is for operation and will engage the gear. Lock the RETAINING CLIPS.

e. Close the recorder and tighten the knurled thumbscrew. Press in

and turn the thumb wheel to advance the paper to the desired starting point for recording.

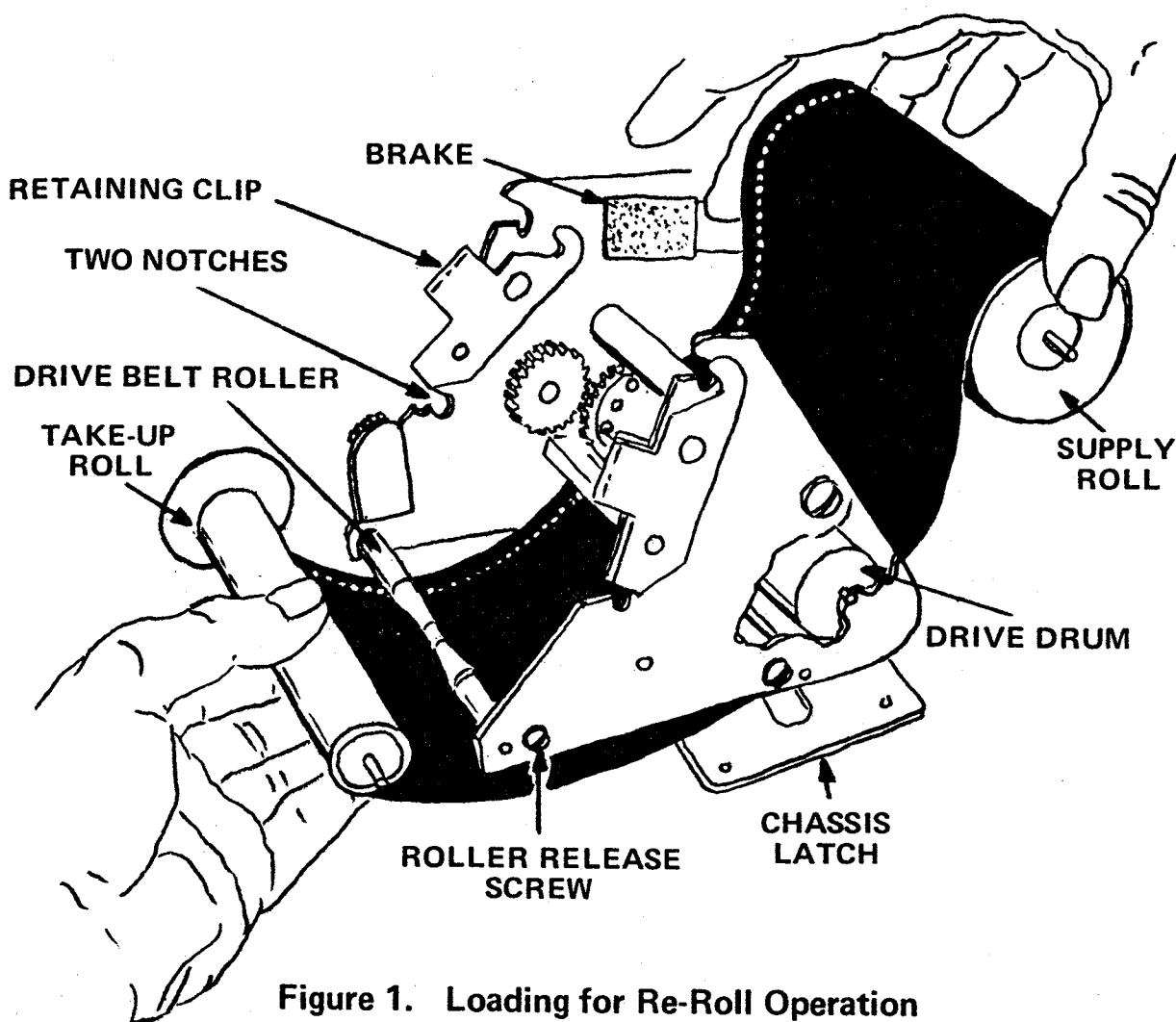


Figure 1. Loading for Re-Roll Operation

2. Reviewing Recorded Information

It is possible to review recorded data without disturbing the chart's time setting with the following procedures:

1. Turn the recorder OFF and open the recorder case.
2. Unlatch the left-hand RETAINING CLIP.

3. Lift the left end of the TAKE-UP ROLL and place it in the outer notch. The TAKE-UP ROLLER gear should now engage the gear in front of it.
4. Re-latch the left-hand RETAINING CLIP. The TAKE-UP ROLL is now free and chart paper may be rolled off for review.
5. Hold slight tension on the paper and use the small gear to reroll the paper.
6. Unlatch the left-hand RETAINING CLIP, drop the TAKE-UP ROLL back into the lower notch, and re-latch the RETAINING CLIP.

3. Chart Paper Tear-Off Operation

The recorder may be converted for tearing off the used chart paper, rather than rewinding it, as follows:

- a. Pry off the cover on the lower front of the recorder with a screwdriver, remove the two drive belts stored behind the cover, and replace the cover.

- b. Open the front of the recorder, release the RETAINING CLIP, remove the TAKE-UP ROLL, loosen the ROLLER RELEASE SCREW, remove the DRIVE BELT ROLLER, slide the DRIVE BELTS on the DRIVE BELT ROLLER, reinsert the DRIVE BELT ROLLER, and tighten the ROLLER RELEASE SCREW.

- c. To load new roll of paper follow instructions for Chart Re-roll Operation.

- d. Remove the cardboard sleeve from the TAKE-UP ROLL (save for future use), slide the DRIVE BELTS to the center of the DRIVE BELT ROLLER, slip the TAKE-UP ROLL through the DRIVE BELTS, re-install the TAKE-UP ROLL in the side panels engaging the rear gear, fasten the RETAINING CLIPS. With your left hand tighten the chart paper to take up any slack, move the DRIVE BELTS to the grooves on the TAKE-UP and DRIVE BELT ROLLERS, and fasten the CHASSIS LATCH.

- e. Thread the paper through the tear-off slot at the top of the recorder, close the cover and set the time with the thumbwheel.

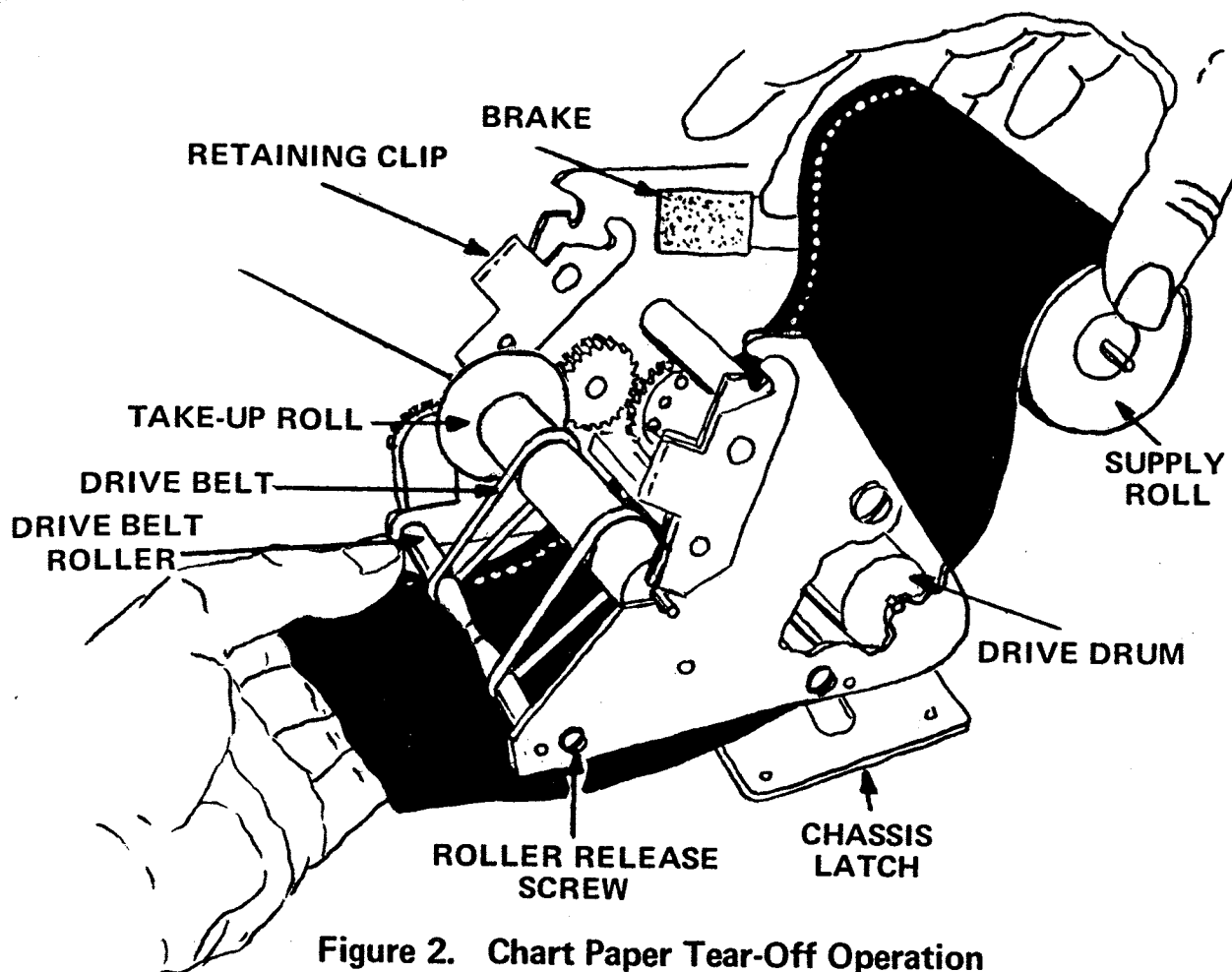


Figure 2. Chart Paper Tear-Off Operation

RECALIBRATION

Recalibration of YSI recorders is easily performed with either D.C. voltage or current standards. A simple circuit consisting of a flashlight battery and variable resistors with an output monitored by the standard (for example: a 1 milliamper or a 1 volt meter) can be used as an input. The recalibration accuracy will be a function of the accuracy of the standard. The following procedure is recommended:

1. Remove the two lower slotted screws on the back of the instrument to permit the inside of the electronic assembly to be exposed.

2. Perform the Setup procedures described earlier and adjust for zero-left operation. Switch the SPAN control to the CAL position.
3. In accordance with the standard being used, select the appropriate full-scale RANGE. (Example: for a 1 milliamper standard, select 1 milliamper).
4. Connect the standard input. Positive side to HI terminal, negative to LO, and connect GND and LO together.
5. Adjust the pot on the lower center of the circuit board for full-scale deflection. Only one range need be calibrated for the complete calibration of the instrument.
6. Disconnect the power source and reassemble the instrument.

ACCESSORIES AND SUPPLIES

The following items may be purchased from any YSI dealer.

#8040 Chart Paper, 2.31" wide (50 divisions) by 750" long (4 divisions per inch)

#4005 Connector Cable — for connecting YSI Tele-Thermometers to YSI Recorders.

Instruments are normally provided with gear assemblies to advance the chart paper 1" per hour in the YSI Model 80A, and 2" per hour in the YSI Model 81A. Additional gear assemblies are available for other chart speeds.

Gear Assembly	YSI Model 80A	YSI Model 81A
#8041	1"/hr	2"/hr
#8042	2"/hr	4"/hr
#8043	3"/hr	6"/hr
#8044	30"/hr	60"/hr
#8045	15"/hr	30"/hr
#8046	6"/hr	12"/hr
#8047	10"/hr	20"/hr
#8048	12"/hr	24"/hr

GUARANTEE

YSI recorders are unconditionally guaranteed for one year against defects in workmanship and components. Damage through accident, misuse, or tampering will be repaired at a nominal charge when the instrument is returned to the factory or to a YSI authorized dealer.

In communications regarding this instrument please mention model serial number.

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