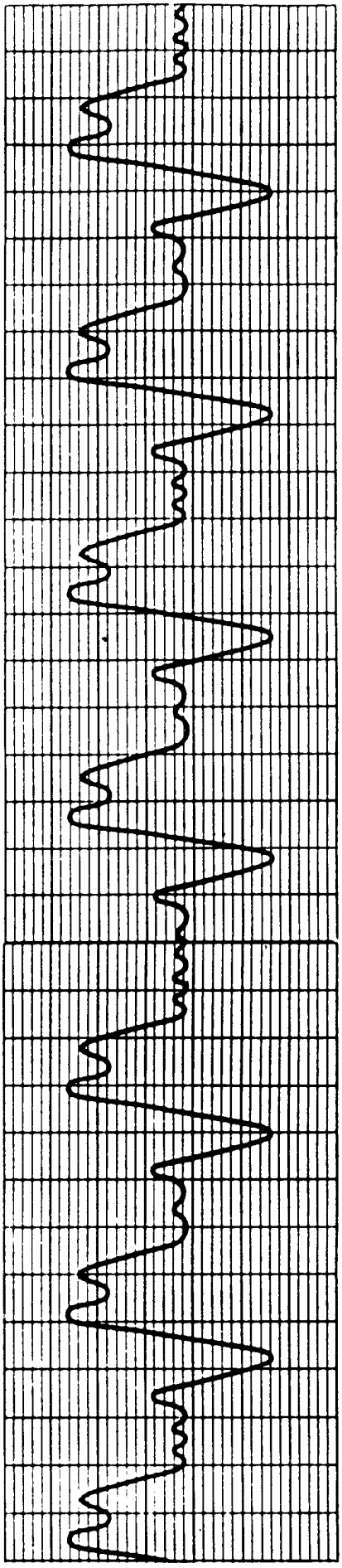

rustrak®

D.C. SIGNAL RECORDER INSTRUCTION MANUAL

This manual covers Models;
288, 2W288, 291, 2W291, 288E1,
2W288E1, Z171V, Z171

CONTENTS

IT IS SUGGESTED THAT THIS MANUAL BE READ IN ITS ENTIRETY BEFORE SETTING UP OR OPERATING YOUR RUSTRAK RECORDER

WARRANTY

The Partlow-West Company warrants Rustrak products described in this manual to be free of defects in material and workmanship under normal usage and service for a period of one year from the date of its initial purchase from the factory or an authorized Partlow-West Company distributor. The company's obligation under this warranty is limited to repairing or replacing an instrument or component which upon examination by factory personnel, is found not to conform to the foregoing warranty. The instrument must be returned to the factory, transportation prepaid. We shall not be liable for any damages, consequential or otherwise.

The foregoing warranty is exclusive and in lieu of all other warranties whether expressed or implied.

This warranty does not apply to galvanometer stylus damage or damages resulting from transportation alteration or misuse.

The Partlow-West Company reserves the right to discontinue any model or change specifications or design without notice and without incurring any obligation.

Caution - External Transformers, Shunts, Signal Conditioners And Senors.

Many Rustrak systems are not complete without the use of an external device. Failure to use the proper device can create an error or a **hazardous situation.** The part numbers of the approved devices are usually printed on the recorder scale.

RECEIVING

Each carton contains a recorder, one or more manuals to cover the models and features, and one roll of chart paper. In addition, Series 200 recorders are supplied with hardware kit A-6464. The kit contains hardware needed for bench or panel mounting. If items are missing, obtain them from your local distributor.

Shipping damage must be reported to your carrier immediately. Do not destroy packing material or containers, even if they appear undamaged, until your agent has examined them.

Under U.S. shipping regulations, damage must be claimed and collected by the consignee. Do not return merchandise damaged in shipping until your claim is examined and documented.

APPLICATIONS ASSISTANCE

Rustrak is prepared to offer almost any kind of help or suggestions you may need to get the most efficient use from our Rustrak recorder. Your local distributor can probably answer your questions; engineers at our East Greenwich, RI facility will also be pleased to assist you in any way.

GEAR TRAINS

Various ratio gear trains are available to alter any Rustrak recorder to run at chart speeds other than those originally chosen. High speed gear trains are available for 60 and 100 rpm motors.

MOTORS

A variety of motor speeds, voltages and frequencies are available. Please consult your distributor or the Rustrak sales department in East Greenwich, RI for galvanometer limitations.

INTRODUCTION

This manual describes standard Rustrak Series 200, 2W and optional features with which they may be equipped. All recorders described are for measuring DC voltage or current.

Information given for Series 200 single channel recorders is typical for Series 2W dual channel. Each channel's function can be determined by the recorders's model number suffix. Your recorder's model number is on serial plate along with primary power information. Use your model number suffix to determine which sections of this manual pertain to your instrument. Refer to other manuals for channels not contained in this booklet.

Example: Model 2W 288/2107
Refer To: 288 Section of this manual, 2107 Section of the AC Recorder manual

In some cases an intermediate amplifier is used in conjunction with transducer circuitry. Refer to the recorder's serial plate for the model number. Use the manual section determined by the model number suffix for operation.

RECORDER GENERAL DESCRIPTION

The Rustrak galvanometric recorder consists of several basic elements; galvanometer, spring loaded striker, backup bar (writing edge), chart drive motor and cam, and pressure sensitive paper.

A rotating cam lifts the striker away from the galvanometer pointer allowing free movement of the pointer. The cam allows the striker to fall against the pointer pressing it against the pressure sensitive paper. The force is absorbed by the backup bar located behind the paper. This action removes the white top coating on the paper and exposes the black base material at the point where the pointer and backup bar cross. Each strike makes one dot.

When chart speed, and cam RPM are chosen properly, the succession of dots has the appearance of a continuous line.

The motor which rotates the cam also provides the motion to move the chart paper through the recorder.

MODEL 288 RECORDER SPECIFICATIONS

Single channel analog chart recorder for measuring DC voltage and DC current. Use of different galvanometers and multipliers produces voltage sensitivity from 10 mV to 500 V and current sensitivity from 10 uA to 1 mA and higher using shunts.

Accuracy	± 2% (current recorder w/o shunt)
Response Time	1 second maximum
Usable Chart Width	2 5/16"
Chart Length	63 feet
Chart Speed	1/48"/hr to 120 /hr with std. motors and gear trains
Chart Motor Voltage	115 or 230 V, 50 or 60 Hz
	6, 12 24, 48 VDC unregulated or inverter motors
Striking Rate	1 per 12 sec. to 4 per sec.
Dimensions	3 5/8"W x 5 5/8"H x 4 5/16"D
Weight	3 3/4 pounds

MODEL 291 RECORDER SPECIFICATIONS

Two analog channels in a Model 288 case and chart drive configuration. Use of different galvanometers and multipliers gives voltage sensitivity from 57 mV to 500 V and current sensitivity from 10 uA to 1 mA and higher using shunts.

Usable Chart Width	Two one inch analog channels

Refer to Model 288 specifications at left for all other specifications

MODEL 288 EI (Formerly 2146) RECORDER SPECIFICATIONS

One analog channel and one event channel in a Model 288 case and chart drive configuration. Use of different galvanometers and multipliers gives voltage sensitivity from 57 mV to 500 V and current sensitivity from 10 uA to mA and higher using shunts.

Usable Analog Chart Width	2 inches
Event Channel	5/16 inch
Event Indication	1/16 inch rectangular trace with on-off signal
Event Response Time	10 Events per second
Event Voltage	6, 12, 24, 48 VDC and 6, 12, 24, 48, 115, 230 V 50/60 Hz +20 -15%
Event Power	2 Watts Nominal

SERIES 2W RECORDER SPECIFICATIONS

The Series 2W is a dual width recorder in which Models 288, 291, E1, four or eight events or other combinations are available.

Dimensions	6 5/8"W x 5 5/8"H x 8 1/4"D
Weight	6 pounds

AMPLIFIER SERIES Z17 SPECIFICATION

This DC signal recorder incorporates a chopper stabilized fixed gain amplifier to obtain higher sensitivities. Voltage sensitivities from .5mV to 150 mV with an input resistance of 100 M ohms (Z17V). Current ranges from 1 mA to 100 uA with an input resistance of 1K ohms (Z17I).

Accuracy	±1% of span
Max. short-term input	200% (1 minute)
Max. continuous input	150%
Response time	1 second max
Operating Temperature	-10 to 60°C, 14 to 140°F
Storage Temperature	-40 to 70°C, -40 to 158°F
Recording Width	2 5/16"
Dimensions	3 5/8" W X 5 5/8" H X 4 5/16" D
Weight	3.75 lbs
Input Connections	6 pin connector
Power cord	Fixed line cord
Primary Power	100-130V/50 Hz; 100-130V/60 Hz; 200-260V/50 Hz; 200-260V/60 Hz; 10-14 VDC (isolated)

EXTERNAL WIRING, SERIES 200

All recorders have a label inside showing all terminal and pin numbers regardless of whether or not they have been supplied pre-wired. The serial plate gives all voltage, frequency, model and serial information for the particular recorder.

The table below shows standard connection for Series 200 AC powered recorders.

Connector PIN #	Model 288	Model 291	Model 288E1
1	+ galvo	+ galvo LH	+ galvo
2	- galvo	- galvo LH	- galvo
3	high line	high line	high line
4	low line	low line	low line
5	case	+ galvo RH	event
6	NC	- galvo RH	event
lug	not used	case	case

When the above models are supplied with attached line cord, pins 3 and 4 are not used. (Includes CSA approved models). When the above models are supplied with DC motor, pin 3 is positive and pin 4 is negative. When a Z17 feature is installed, the recorder has attached line cord and the signal input is to the red (positive) and black (negative) binding posts.

EXTERNAL WIRING, SERIES 2W

These models are supplied with attached line cord as standard. All other inputs and outputs are via rear barrier strip or binding posts. The inside label identifies all connections.

INSTALLATION, SERIES 200, Z17

These recorders are furnished with A-6464 hardware kit for bench or panel mounting. Instructions are in the kit. A template for panel cutout dimensions is available.

INSTALLATION, SERIES 2W

These recorders are shipped with all hardware installed as a bench mount. A modification kit is available for panel mounting.

PRIMARY POWER

Rustrak recorders may be supplied AC or DC powered. Check your recorder's serial plate for the proper voltage and frequency. Your recorder is rated at +/- 10% primary voltage. Out of tolerance primary voltage may cause timing and measurement errors. Observe DC polarity before connecting your recorder. Reversed polarity could cause mechanical and/or electrical failure.

CALIBRATION PROCEDURE, SERIES 200,2W

All recorders without signal conditioners are calibrated by zeroing the galvanometer. The zero adjustment is located behind the front nameplate. Remove by inserting a small flat screwdriver into the left hand slot and prying.

Recorders are normally supplied as zero left, center, or right. Variations may place the zero some other place on or off scale.

ZERO ON SCALE

With signal disconnected, rotate the zero adjustment to give recording on the appropriate line of the paper. To check accuracy, apply a known voltage or current equivalent to full scale. The maximum error should be less than ± 2% of span. There is no adjustment for span.

ZERO OFF SCALE

Apply a known voltage or current equivalent to low end scale and adjust the mechanical zero adjustment to give recording on the most left hand line of the chart paper. Check full scale by applying a known full scale signal. The maximum error should be less than ±2% of full scale value.

CALIBRATION PROCEDURE, 217

Recorders equipped with DC amplifiers always have a 1 mA, zero left galvanometer.

1) With power disconnected (Series 200) or power switched off (Series 2W) zero the galvanometer according to the procedure above.

2) Connect a millivolt source to the input terminals observing polarity. Source resistance should be less than 100Ω. Switch the source to zero mV and adjust the amplifier ZERO for a reading corresponding to zero on the scale.

2A) If zero is not on scale adjust the mV source for signal equivalent to left hand scale and adjust the amplifier Zero for a reading on the most left hand line of the paper.

3) Apply a full scale signal and adjust the amplifier SPAN for a reading at full scale.

4) Repeat 2) and 3) as necessary.

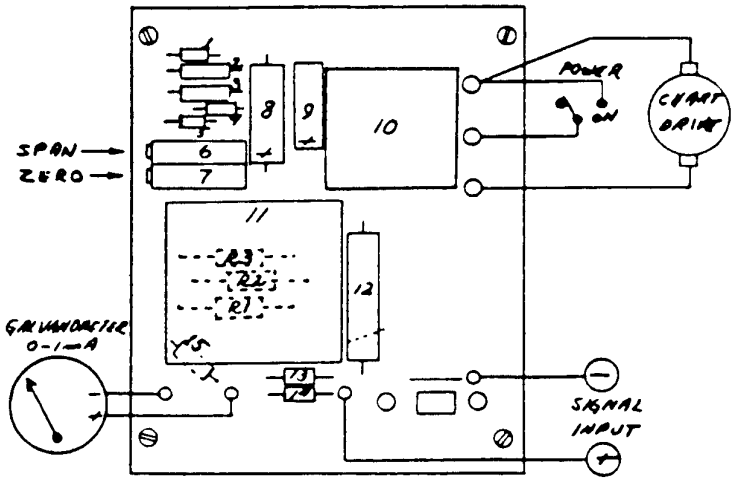

Figure 1 - Z17 Amplifier Assembly

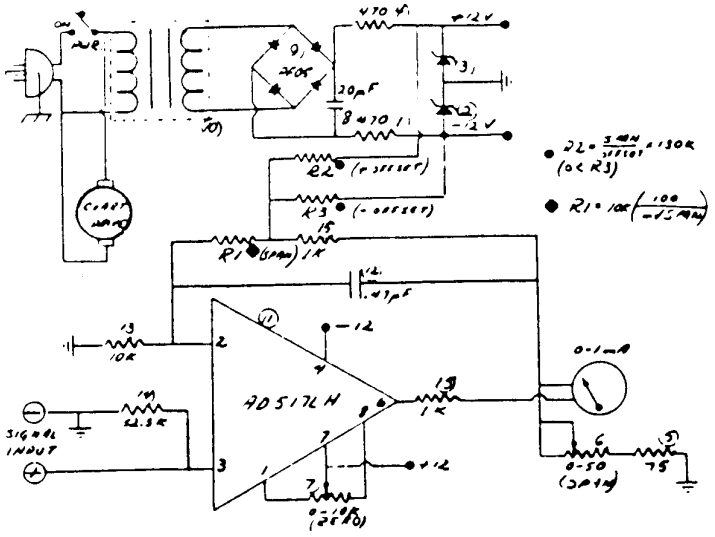

Figure 2 - Z17 Amplifier Assembly

CHART LOADING, RE-ROLL MODE

A warning to "RENEW CHART" appears on the last three feet of each roll of paper. Do not use partial rolls of paper in re-roll mode Refer to diagram at left.

1) Turn power off before loading chart paper.
2) Open recorder by loosening thumbscrew (1).
3) Unlatch paper retaining clips (2).
4) Open panel to chassis latch (3) RH side plate.
5) Remove supply (4) and take up roller (5). If paper is still attached to supply roller, carefully slide the paper from between the front panel and chart drive. Do not pull the paper backwards, through the recorder be cause of the danger of snagging the pointer.
6) Insert the supply roller into the new roll of chart paper. The perforated end of the paper is nearest to the roller shoulder.
7) Unroll about a foot of paper. Slide the paper between the panel and side plate, sprocket holes first. Keep paper taut and close to the drive drum to present snagging the pointer.
8) Engage the supply roller shaft in both seating notches (6) and check to be sure that the paper sprocket holes engage the time drum sprockets.
9) Slide cardboard sleeve all the way on the take up roller against the disc.
10) Butt paper against disc and tape the paper to the sleeve, printed side out. Wrap a few turns of the paper to be sure paper is started true.
11) Continue rolling paper and place roller shaft into notches. (Lower notch LH side).
12) Close clips (2), latch (3) and recorder front panel. Tighten thumbscrew (1).
13) Advance paper with the chart advance wheel (8), to assure that paper moves through the recorder. Set to time.

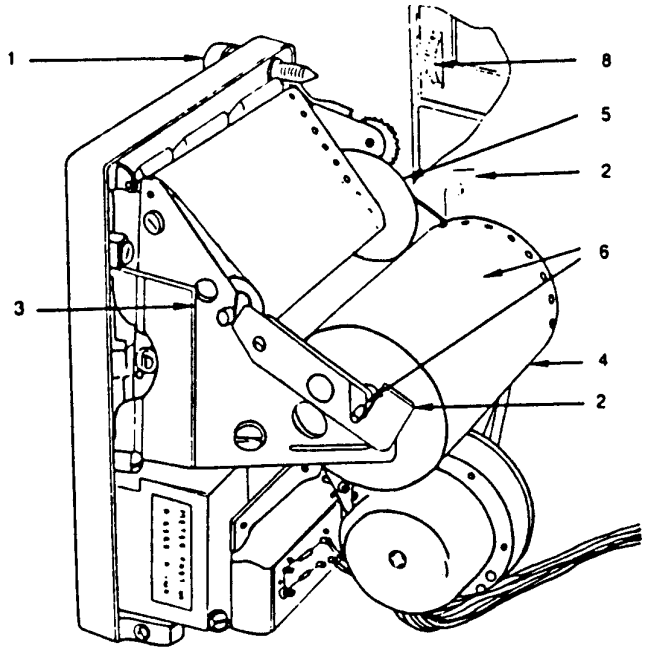

Figure 3 - Series 200 Reroll

CHART LOADING, TEAR-OFF MODE

A warning to "Renew Chart" appears on the last three feet of each roll of paper. Refer to the diagram below.

1) Turn power off before loading chart paper.
2) Open recorder by loosening thumbscrew (1).
3) Unlatch paper retaining clips (2).
4) Open panel to chassis latch (3) RH side plate.
5) Slide drive belts (9) from chamfered grooves to center of top roller to release pressure on paper.
6) Remove supply roll (4). If paper is still attached to supply roll, carefully slide the paper from between the front panel and chart drive. Do not pull the paper back wards through the recorder because of the danger of snagging the pointer.
7) Insert the supply roller into the new roll of chart paper. The perforated end of the paper is nearest to the roller shoulder.
8) Unroll about a foot of paper. Slide the paper between the panel and side plate, sprocket holes first. Keep paper taut and close to the drive drum to prevent snagging the pointer.
9) Engage the supply roller shaft in both seating notches (6) and check to be sure that the paper sprocket holes engage the time drum sprockets.
10) Pull drive belts (9) back into the grooves (10).
11) Close clips (2), latch (3), and recorder front panel. Tighten thumbscrew (1).
12) Advance paper with the chart advance wheel (8), to assure that paper drives through the recorder. Set to time.

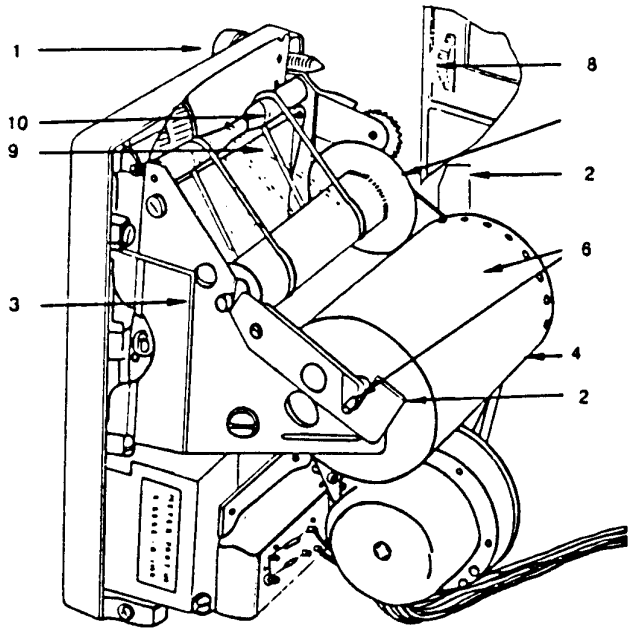

Figure 4 - Series Tear off

RECORDER STANDARD FEATURES, SERIES 200, 2W

REROLL OR TEAROFF chart drive mode may be quickly changed. Follow the instructions printed on the back of the nameplate.

NAMEPLATE provides access for mechanical galvanometer zero adjustment.

CHART ADVANCE Push in and roll down thumbwheel to advance chart paper for time setting.

QUICK REVIEW Chart may be unrolled for analysis. Lift left retaining clip and set roller shaft in top notch. Snap the clip back in place. Unroll the paper as needed. Rewind the chart with the gear. Return the shaft to the bottom position by unlocking and relocking the retaining clip.

INTERCHANGEABLE GEAR TRAIN Gear trains affect chart speed. Fourteen different gears can provide up to 480/1 ratio of chart speeds. To change train, remove gear train spring. Move gear train in direction of arrow. Lift out from the top. Insert new gear bottom first and slide into place. Replace gear train spring. Test to be sure gear is engaged by noting zero clearance between top half round tab on side plate and gear train.

ACCESS WINDOW Slides down to provide access to chart for notes.

SCALE REPLACEMENT, SERIES 200, 2W

1) Lower access window then grasp plastic bezel at top center bending it to release both top tabs.

2) Lift out both windows noting their positions and lay to one side with the bezel.

3) Remove scale, Series 2W is held with tape.

4) Replace scale. Series 200 is self aligning. On 2W add double coated tape and line up the hash marks with the paper; press into place.

5) Replace the bottom window. Insert bottom two tabs of bezel.

6a) Series 200 replace top window then snap in left top tab then right.

6b) Series 2W replace bezel as in 6a) then replace top window by putting it one side then bending window so that it slides in on the other side.

7) Check access window to be sure of proper operation.

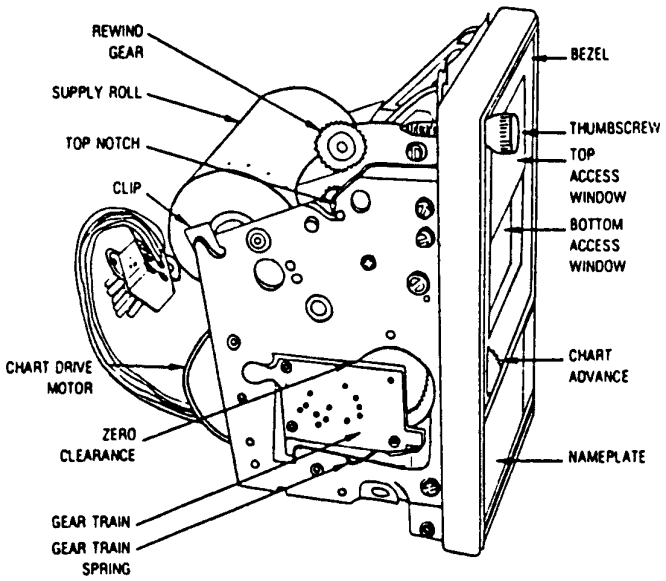

Figure 5 - Standard Model 288 With Case Removed

TWO POINT FEATURE OPERATION, (F137)

Series 200 and 2W may be equipped with 2 point feature in any or all channels. A SPDT microswitch is activated by a cam with half the number of lobes as the striker cam. The microswitch activates a 4 PDT relay which alternately connects the two channels to the galvanometer or if equipped with an amplifier feature to the amplifier input.

To Identify channel 2 another cam geared to the time drum disconnects channel 2 every 1/2 inch of paper travel. See sample trace.

The signal sequence for each revolution of the chart drive motor is 1,1,2, 1,2,1,2,1,2,1,2,1,2,1,2.

Some special DC powered recorders omit the 4PDT relay to conserve power. Both signals must have a common negative in this application.

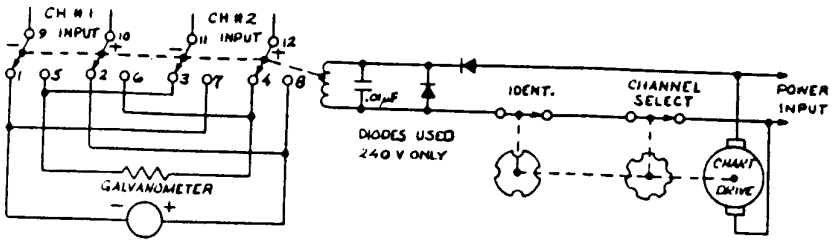

Figure 6 - F137 Schematic

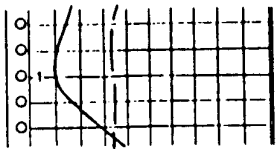

Figure 7 - F137 Identify

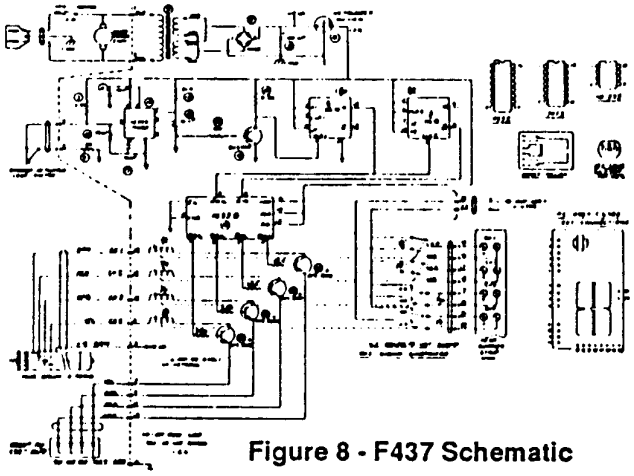

Figure 8 - F437 Schematic

TROUBLESHOOTING AND REPAIR (Mechanical)

Before returning an instrument to the factory or service center for repair, check the items mentioned in this section. Recorders returned to the factory for repair are subject to a minimum charge whether or not they are defective. All instruments returned to the factory are routinely recalibrated. If you know the problem or symptom be sure to include the information with the instrument. Be familiar with how the recorder operates. Refer to sections in this manual that pertain to the portion of the recorder that is malfunctioning.

If the recorder does not operate at all, check to see if instrument is properly connected to the correct power source as indicated on the serial plate. Be sure power switches, if any, are in the "on" position.

Following is a description of some common problems and possible solutions.

GALVANOMETER DOESN'T FOLLOW THE SIGNAL

With striker in its maximum open position the distance between the striker and paper should be 1/8". The pointer should be midway. If the pointer is not centered, the galvanometer could have a bent pointer, broken taut band, cracked jewel. Defects not so visible such as open or shorted coil or debris in the air gap will cause the problem.

CHART SPEED FAST OR SLOW

All AC powered recorders use synchronous motors to drive the chart so a properly functioning recorder will not have timing errors. Recorders with unregulated motors can be expected to gain or lose several hours a day in the worst case. Recorders with inverter motors will keep time to within seven minutes a day. If chart speed is fast, the brake spring may be too weak or the clutch too tight. This is sometimes indicated by tears through the lower side of the sprocket holes. If chart speed is slow, the brake spring may be too tight or the clutch too loose. Slow chart can also be caused by a very soft or spongy roll of chart paper sometimes indicated by tears through the top side of the sprocket holes. Other causes of slow chart speed are such things as gear train slipping out of engagement because of a weak gear train spring. An intermittent or low torque chart motor will cause slow speed.

TROUBLESHOOTING AND REPAIR (Electrical)

Instruments with amplifiers or other signal conditioning such as shunts or multipliers having functioning galvanometers may have developed one or more defective components. In general, if checkouts are made in the order outlined below the defective part will be located.

1) Measure main power on the PC board.
2) Measure AC voltage on all transformers secondaries.
3) Measure DC voltage across power supply capacitors.
4) Measure DC voltage across each zener and at the voltage pins of the operational amplifier.
5) Apply a signal and measure to see that it gets to the input pin of the operational amplifier.
6) All amplifier type signal conditioners have an output of 100 millivolts into a 100 load. Galvanometers are 1 milliamp, 100 Ω.
7) Visually inspect for broken connections, or defective components.
8) Recorders with multipliers or shunts can be checked by making a resistance reading. DC voltmeters will measure 1000 times the full scale voltage. (ie 100 VDC full scale resistance will be 1000,000) DC current meters will have a resistance of .1 ÷ full scale DC current (ie 10 mADC full scale will have a resistance of 10 Ω)

TROUBLESHOOTING AND REPAIR (General)

In the process of troubleshooting, resist the temptation to change the galvanometer zero adjust or any electrical adjustments unless you have facilities for complete calibration of the instrument. You may adjust the galvanometer zero but first note where it was, and after moving it return the zero (with no signal applied) to where it belongs. If the galvanometer has suppression (zero off scale) don't adjust unless you have facilities for calibration.

Bulletins are available that explain in detail some of the adjustments, repairs, and checkouts that can be made in the field.

SERIES 200, 2W, REPLACEMENT PARTS

A-4553-P1	Tearoff Drive Belt (2 Reqd.)
A-3280-P1	Chart Advance thumbwheel
A-4218-P1	Thumbwheel Screw
A-4219-G1	Thumbwheel Hinge Bracket
A-4422-P1	Thumbscrew (Panel)
A-8204-P1	Thumbscrew Retaining Ring
Specify pt. no.	Gear Train
A-2354-P1	Gear Train Spring
A-4478-G1	Chart Review Arm & Gear
A-5151-P1	Retaining Clip For Supply Roll
A-4185-P2	Brake Spring
A2313-P2	Brake
Note 1	Galvanometer
C-4214-P2	Chassis Latch
A-4551-P1	Pin For Chassis Latch (2 Reqd.)
A-4252-P1	Chart Advance Ratchet
A-4251-P1	Chart Advance Ratchet Stiffener
Note 1	Chart Drive Motor & Cam
L-473-5	Parts Price List
L-479	Exploded View Model 288

SERIES 200 REPLACEMENT PARTS

B-4488-G1	Take Up Roller
B-2316-P1	Supply Roller
B-4550-G1	Time Drum
A-2254-P1	Cardboard Spool, Striker & Arm
B-4117-P1	Top Front Panel Bezel
B-4131-P1	Bottom Front Panel Bezel (Nameplate)
B-4178-P1	Top Window
B-4179-P1	Bottom Window
A-4558-P1	6 Pin Female Cable Connector
L-479	Exploded View Model 288
L-473-5	Parts Price List
Note 1	Chart Drive Motor and Cam

Note 1: When ordering replacement galvanometers specify the part number of the part. When ordering chart drive motors specify voltage, frequency, R.P. M. and complete recorder model number.

SERIES 2W REPLACEMENT PARTS

B-4953-G1	Take Up Roller
B-4768-P1	Supply Roller
B-4766-G1	Time Drum
A-2254-P7	Cardboard Spool
B-5166-G1	Striker & Arm
C-6956	Top Front Panel Bezel
A-4228-P9	Bottom Front Panel Bezel (Nameplate)
B-4776-P1	Top Window

B-4777-P1	Bottom Window
MSS-22	Power Slide Switch
Note 1	Chart Drive Motor & Cam.
L-473-5	Parts Price List

CHART PAPER

Standard Chart Paper, 200 Series (Single Width)

Minor Divisions	Major Divisions	Style/PT
20	4	G
30	6	I
40	8	H
50	10	A
60	12	K
65	13	C
75	15	B
80	16	L
15	3(2 Channel)	F
20	10(2 Channel)	D

Chart Paper for Specific Models, 200 Series

Description	Model Used On	Style/PT
50 Div + 1 Event	288E1	N
4 or 8 Events	292-4 or 8	EE
25,100,300 Amps AC	231	A
150,300,600 Volts	231	A

Standard Chart Paper, 2W Series (Double Width)

Left Channel	Right Channel	Style/PT
G	G	WGG
I	I	WII
A	A	WAA
N	N	WNN
D	D	WDD
D	EE	WDEE
A	EE	WAEE
EE	EE	W16E
A	P	C-6804
A	D	WAD
A	I	WAI

SERVICE AND REPAIR

If the instrument should require repair which you are unable to perform, return it to your local distributor or to the manufacturer.

If the instrument is in warranty, follow the instructions on Page 1 of this manual. Warranty repair must be performed at the factory unless special arrangements have been made.

IT IS SUGGESTED THAT GENUINE RUSTRAK PAPER AND REPLACEMENT PARTS BE USED IN THIS RECORDER.

RE-SHIPPING THE EQUIPMENT

The equipment should be reshipped in the original packing if still intact. Do not pack the instrument in dirty materials such as popcorn, shredded newspaper or foam unless the recorder is sealed in a plastic bag. The company cannot be responsible for damage which is the result of poor packing.

Never ship a recorder with chart paper installed.

Always be sure that the striker is in the open position to allow free movement of the galvanometer pointer. If this is not observed, the galvanometer will be damaged.

Observing these simple procedures will prevent unnecessary delays and expense to you.

Ship to: Partlow-West Company
Two Campion Road
New Hartford, NY 13413
Tel: (315) 797-2222
Fax: (315) 797-0403