APPENDIX A

DC
RECORDER MANUAL

Models 288, 291, 2146,
2194 & 300 Series

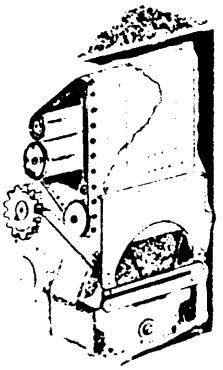
#16906
4th Edition, 3-72

gulton

Measurement & Control Systems Division
Gulton Industries Inc. Gulton Industrial Park
East Greenwich Rhode Island 02818
401 884 6800 TWX 710-387-1500

Summary

Description



The Rustrak DC* recorder prints through the impinging action of its stylus driven by the chopper bar against pressure-sensitive chart paper. Its presentation is a series of dots appearing as a continuous line.

Recording on the chord of the stylus arc by the edge of the chopper bar is possible with a stylus able to write along its length rather than its point. This results in chart paper printed with straight lines and rectilinear recordings.

Writing speed varies with motor speed. Chart speed and trace density depend on the ratio of the interchangeable gear box which couples the paper drive to the motor.

*DC Recorders are intended to record DC parameters such as voltage or current. The chart drive motor may operate from AC lines or be battery-operated without changing the DC designation.

Warranty

Rustrak warrants each instrument of its manufacture to be free from defects in material and workmanship under normal usage and service for a period of one year after its initial purchase from the factory or from any authorized Rustrak representative or distributor.

Our obligation under this warranty is limited to repairing or replacing any instrument or component which, upon examination by factory personnel, is found not to conform to the foregoing warranty, providing said instrument is returned to the factory, transportation prepaid. We shall not otherwise be liable for any damages, consequential or otherwise.

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

Rustrak reserves the right to discontinue any model at any time or change specifications and design without notice and without incurring any obligation.

This warranty does not apply to galvanometer stylus damage caused by improper chart installation, damages resulting from transportation, alteration, or misuse.

Rustrak recorders are warranted for one year against factory defects. Damage to the galvanometer stylus caused by improper chart loading is NOT a factory defect. To preclude damage to the stylus, follow chart loading instructions carefully. Safe chart paper in slowly, keeping it taut against the time drum which guides the paper and prevents snagging the stylus.

LABEL #A3354

CUSTOMER STOCK # [ ]

MODEL # [288] SERIAL # [N260948]

RECORDER RANGE [0-500 UA] EVENT [VDC]

MOTOR [2] RPM GEAR TRAIN# [1]

[110] VOLTS [60] CYCLES [ ] INV. [ ] UNR.

PAPER STYLE [WA] SPEED [1] IN/HR

MTG. HDW PANEL [X] PORTABLE [ ]

PANEL MTG/PORTABLE [ ] OPTIONS: TEAR OFF [ ]

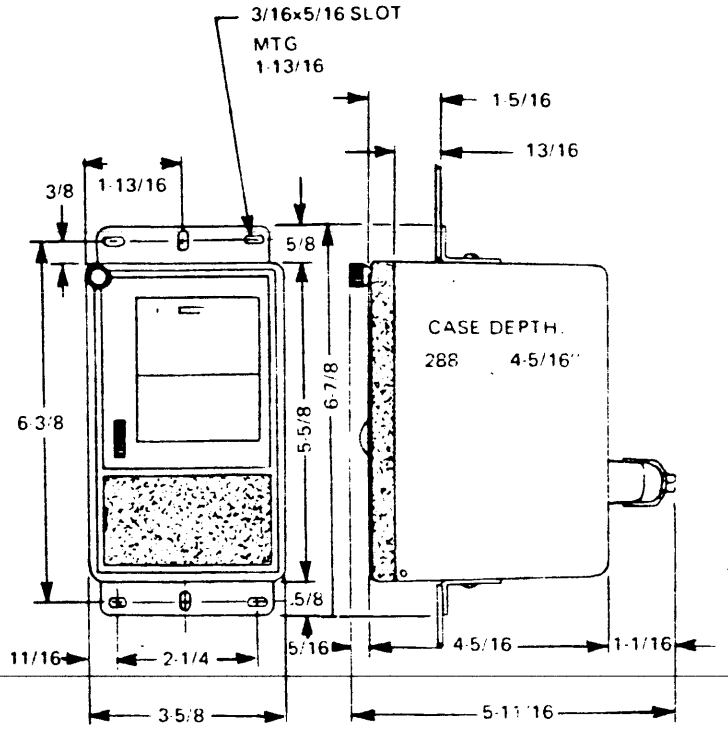
Installation

MODELS 288,

These recorders can be panel-mounted or used as table-top portable instruments. Hardware is furnished for both purposes.

Portable:

Install four (4) rubber feet in tapped holes at bottom of case using four (4) 4-40 x 1/4" screws provided. Snap white plastic cardholder into holes at top of case.

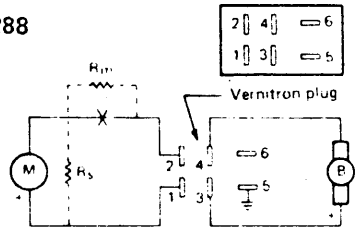


Wiring

Plug connections and terminals are identified on a label inside your recorder. Refer to this data for correct wiring.

SCHEMATICS

Model 288



Terminal Connections

PIN #	MODEL 288	MODEL 291	MODEL 2146
1	Galvo +	Galvo 1 +	Galvo +
2	Galvo −	Galvo 1 −	Galvo −
3	Motor (DC+)	Motor (DC+)	Motor (DC+)
4	Motor (1)	Motor (1)	Motor (1)
5	Ground (2) (3)	Galvo 2 +	Actuator
6	(2)	Galvo 2 −	Actuator

(1) DC Motors are polarized. Positive terminal is *always* pin 3

(2) Pins 5 & 6 are additional ranges in multi-range recorders

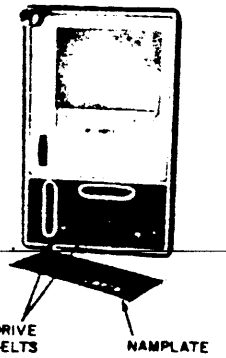
(3) If all pins are used, ground to chassis plug screw

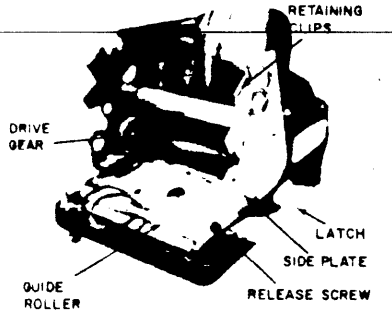
Loading Instructions

TEAR–OFF MODE

(USE PARTIAL OR FULL ROLLS OF CHART PAPER)

1. SNAP OUT NAMEPLATE USING SCREWDRIVER. REMOVE 2 BELTS. REPLACE NAMEPLATE.





2. OPEN RECORDER. UNLATCH RETAINING CLIPS. OPEN CHASSIS LATCH. REMOVE SUPPLY AND TAKE-UP ROLLERS. UNSCREW RELEASE SCREW 2 OR 3 TURNS. SPRING SIDE PLATE. REMOVE GUIDE ROLLER. SLIP ROLLER THROUGH 2 BELTS. RESEAT ROLLER TIGHTEN RELEASE SCREW.

CONVERSION INFORMATION

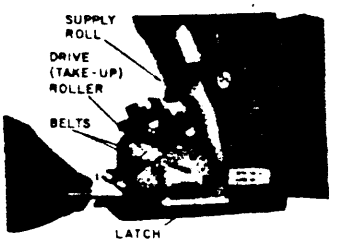
REROLL TO TEAR–OFF (uses drive belts)

Remove cardboard sleeve from take-up roller. Proceed with tear-off loading instructions.

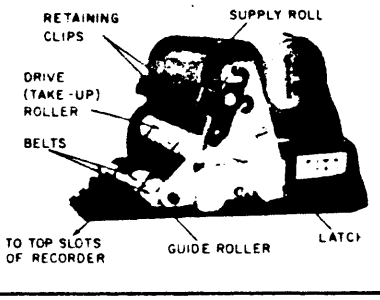
TEAR–OFF TO REROLL (Uses cardboard sleeve)

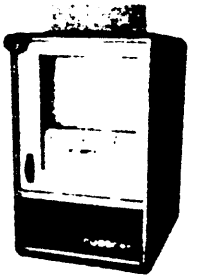
Store drive belts under front nameplate. Replace guide roller and finger tighten knurled release screw. Continue with reroll loading instructions.

3. PASS TAKE-UP ROLLER THROUGH BELTS. SEAT ROLLER TO ENGAGE DRIVE GEAR. PULL BELTS INTO CHAMFERED CENTER GROOVE OF GUIDE ROLLER AND ALIGN INTO V-SLOTS ON TAKE-UP ROLLER. INSERT SUPPLY ROLLER INTO SPOOL OF CHART PAPER (MAY BE PARTIAL ROLL) SO ROLLER SHOULDER IS NEAREST PERFORATIONS. UNROLL CHART PAPER AND SLIDE (BACK SIDE UP) BETWEEN SIDE PLATE AND LATCH. ENGAGE PAPER PERFORATIONS INTO DRUM SPROCKETS AND DROP ROLL INTO SEATING NOTCHES.



4. CLOSE RETAINING CLIPS. SNAP UP CHASSIS LATCH. PULL DRIVE BELTS INTO V SLOTS ON GUIDE ROLLER. CLOSE RECORDER.





5. ADVANCE PAPER AND SET TIME BY DEPRESSING AND TURNING CHART ADVANCE WHEEL. TEAR-OFF PAPER AS NEEDED.

Operating Instructions

MODELS 288,

1. Install recorder and wire as detailed on page 3.
2. Load chart paper as shown on pages 4 & 5.
3. Apply power to motor and zero trace if needed.
4. Feed in signal to be recorded.
5. Recorder can operate unattended until chart paper supply is depleted.

Calibration:

No calibration except for periodic adjustment of the mechanical zero is needed on Rustrak DC recorders.

Mechanical Zero:

If trace on chart paper is above or below zero with galvanometer terminals shorted and motor running, snap out front nameplate (using fine screwdriver in slot at left) and vary zero adjust screw.

The stylus also may be adjusted mechanically at any point upscale if the recorder is used over a narrow span of the calibrated scale. Calibrate against a standard meter across the galvo terminals and a source.

"Recorder Features"

TEAR-OFF or REROLL. Operating mode is quickly changed from one to the other in the field. Reroll generally used for long runs—tear-off feature allows sections of chart to be removed for immediate analysis and filing.

ACCESS WINDOW. Slides down for notes.

NAMEPLATE. Conceals mechanical meter zero adjustment and storage for tear-off feature drive belts. Snap out with fine screwdriver.

CHART ADVANCE FEATURE. Push in and roll down thumbwheel to advance chart for tear-off or to set time on chart.

QUICK REVIEW FEATURE. Recorded chart can be unrolled for analysis. Lift left retaining clip and set roll into closer notch. Unroll as needed. Rewind chart with thumbwheel then reseat roller into deeper notch. Lock retaining clip.

INTERCHANGEABLE GEAR TRAINS. Provide easy change of chart speed.

Cleaning Your Recorder

The coating used on Rustrak recorders is Nextel Brand Suede Coating by 3M. It was chosen because of its toughness and visual qualities.

It can be cleaned with a damp sponge. The usual household spray and liquid cleaners can be used on tough stains without damage to the coating.

Formulas

WRITING SPEED (strikes/sec.) = $\frac{\text{motor speed (rpm)}}{4}$

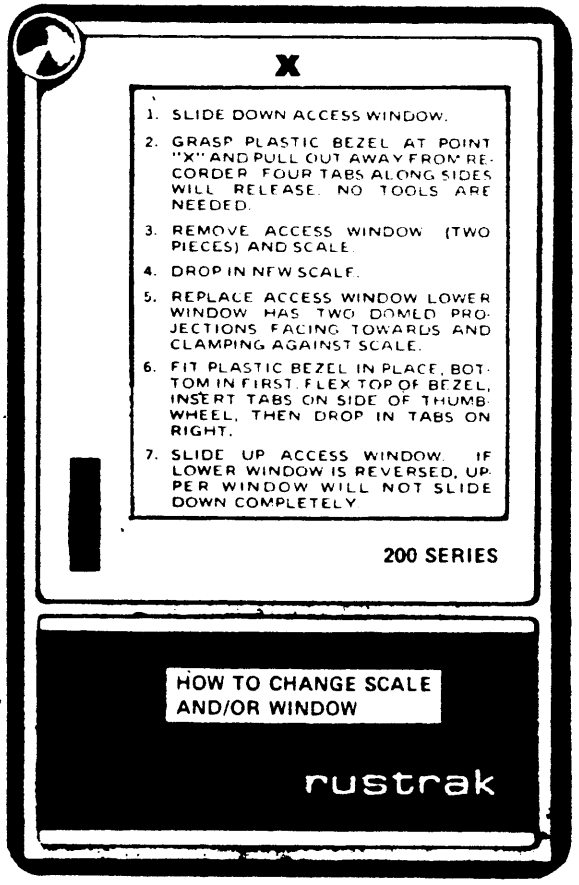
CHART SPEED (in./hr.) = $\frac{\text{motor speed (rpm)} \times \text{gear train assembly number}}{2}$

TRACE DENSITY (strikes/in.) = $\frac{1800}{\text{gear train assembly number}}$

DURATION OF ROLL (in hrs.) = $\frac{756}{\text{chart speed (in./hr.)}}$

Gear Train Ratios, Chart Speed, Writing Speed and Trace Density Table

DRIVE MOTOR (rpm)	WRITING SPEED	1/8 480 1	1/4 240 1	1/2 120 1	1 60 1	2 30 1	3 20 1	4 15 1	6 10 1	10 6 1	12 5 1	15 4 1	30 2 1	45 1.5 1	60 1 1	GEAR TRAIN NO GEAR TRAIN RATIO	
1/2	1 strike/ 8 seconds	1/32 inch 8 mm 144 weeks	1/16 inch 1.6 mm 72 weeks	1/8 inch 3.2 mm 9 months	1/4 inch 6.35 mm 18 weeks	1/2 inch 12.7 mm 9 weeks	3/4 inch 19 mm 6 weeks	1 inch 25.4 mm 1 month	1½ inches 38 mm 21 days	2½ inches 63.5 mm 302½ hrs	3 inches 76.2 mm 252 hrs	3 75 inches 95 3 mm 201 6 hrs	7½ inches 19 cm 100 8 hrs	11¼ inches 28 6 cm 67 2 hrs	15 inches 38 cm 50 4 hrs	English Units/Hour Metric Units/Hour Duration of Chart Paper Spool	Chart Speed
1	1 strike/ 4 seconds	1/16 inch 1 6 mm 72 weeks	1/8 inch 3 2 mm 9 months	1/4 inch 6 35 mm 18 weeks	1/2 inch 12 7 mm 9 weeks	1 inch 25 4 mm 1 month	1½ inches 38 mm 21 days	2 inches 50 8 mm 378 hrs	3 inches 76 2 mm 252 hrs	5 inches 12 7 cm 151 2 hrs	6 inches 15 2 cm 126 hrs	7½ inches 19 cm 100 8 hrs	15 inches 38 cm 50 4 hrs	22½ inches 57 2 cm 33 6 hrs	2½ feet 76 2 cm 25 2 hrs	English Units/Hour Metric Units/Hour Duration of Chart Paper Spool	Chart Speed
2	1 strike/ 2 seconds	1/8 inch 3 2 mm 9 months	1/4 inch 6 35 mm 18 weeks	1/2 inch 12 7 mm 9 weeks	1 inch 25 4 mm 1 month	2 inches 50 8 mm 378 hrs	3 inches 76 2 mm 252 hrs	4 inches 10 2 cm 189 hrs	6 inches 15 2 cm 126 hrs	10 inches 25 4 cm 75 6 hrs	1 foot 30 5 cm 63 hrs	15 inches 38 cm 50 4 hrs	2½ feet 76 2 cm 25 2 hrs	45 inches 1 14 mtrs 16 8 hrs	5 feet 1 52 mtrs 12 6 hrs	English Units/Hour Metric Units/Hour Duration of Chart Paper Spool	Chart Speed
4	1 strike/ second	1/4 inch 6 35 mm 18 weeks	1/2 inch 12 7 mm 9 weeks	1 inch 25 4 mm 1 month	2 inches 50 8 mm 378 hrs	4 inches 10 2 cm 189 hrs	6 inches 15 2 cm 126 hrs	8 inches 20 3 cm 94½ hrs	1 foot 30 5 cm 63 hrs	20 inches 50 8 cm 37 8 hrs	2 feet 61 cm 31½ hrs	2½ feet 76 2 cm 25 2 hrs	5 feet 1 52 mtrs 12 6 hrs	7½ feet 2 29 mtrs 8 4 hrs	10 feet 3 05 mtrs 6 3 hrs	English Units/Hour Metric Units/Hour Duration of Chart Paper Spool	Chart Speed
6	3 strikes/ 2 seconds	3/8 inch 9 53 mm 3 months	3/4 inch 19 mm 6 weeks	1½ inches 38 mm 21 days	3 inches 76 2 mm 252 hrs	6 inches 15 2 cm 126 hrs	9 inches 22 9 cm 84 hrs	1 foot 30 5 cm 63 hrs	18 inches 45 7 cm 42 hrs	2½ feet 76 2 cm 25 2 hrs	3 feet 91 4 cm 21 hrs	45 inches 1 14 mtrs 16 8 hrs	7½ feet 2 29 mtrs 8 4 hrs	135 inches 3 43 mtrs 5 6 hrs	15 feet 4 57 mtrs 4 2 hrs	English Units/Hour Metric Units/Hour Duration of Chart Paper Spool	Chart Speed
8	2 strikes/ second	1/2 inch 12 7 mm 9 weeks	1 inch 25 4 mm 1 month	2 inches 50 8 mm 378 hrs	4 inches 10 2 cm 189 hrs	8 inches 20 3 cm 94 5 hrs	1 foot 30 5 cm 63 hrs	16 inches 40 6 cm 47¼ hrs	2 feet 61 cm 31½ hrs	40 inches 1 02 mtrs 18 9 hrs	4 feet 1 22 mtrs 15 75 hrs	5 feet 1 52 mtrs 12 6 hrs	10 feet 3 05 mtrs 6 3 hrs	15 feet 4 57 mtrs 4 2 hrs	20 feet 6 1 mtrs 3 15 hrs	English Units/Hour Metric Units/Hour Duration of Chart Paper Spool	Chart Speed
10	5 strikes/ 2 seconds	5/8 inch 15 9 mm 50 days	1¼ inches 31 8 mm 604 hrs	2½ inches 63 5 mm 302 hrs	5 inches 12 7 cm 151 hrs	10 inches 25 4 cm 75½ hrs	15 inches 38 cm 50¼ hrs	20 inches 50 8 cm 38 hrs	2½ feet 76 2 cm 25 2 hrs	50 inches 1 27 mtrs 15 hrs	5 feet 1 52 mtrs 12 6 hrs	75 inches 1 91 mtrs 10 hrs	12 5 feet 3 8 mtrs 5 hrs	225 inches 5 72 mtrs 3 4 hrs	25 feet 7 62 mtrs 2 5 hrs	English Units/Hour Metric Units/Hour Duration of Chart Paper Spool	Chart Speed
12	3 strikes/ second	3/4 inch 19 mm 6 weeks	1½ inches 38 mm 21 days	3 inches 76 2 mm 252 hrs	6 inches 15 2 cm 126 hrs	1 foot 30 5 cm 63 hrs	1½ feet 45 7 cm 42 hrs	2 feet 61 cm 31½ hrs	3 feet 91 4 cm 21 hrs	5 feet 1 52 mtrs 12 6 hrs	6 feet 1 83 mtrs 11½ hrs	7½ feet 2 3 mtrs 8 4 hrs	15 feet 4 57 mtrs 4 2 hrs	22½ feet 6 86 mtrs 2 8 hrs	30 feet 9 14 mtrs 2 1 hrs	English Units/Hour Metric Units/Hour Duration of Chart Paper Spool	Chart Speed
16	4 strikes/ second	1 inch 25 4 mm 1 month	2 inches 50 8 mm 378 hrs	4 inches 10 2 cm 189 hrs	8 inches 20 3 cm 94½ hrs	16 inches 40 6 cm 47¼ hrs	2 feet 61 cm 31½ hrs	32 inches 81 3 cm 23 7 hrs	4 feet 1 22 mtrs 15 75 hrs	80 inches 2 mtrs 9 45 hrs	8 feet 2 44 mtrs 7 8 hrs	10 feet 3 05 mtrs 6 3 hrs	20 feet 6 1 mtrs 3 15 hrs	30 feet 9 14 mtrs 2 1 hrs	40 feet 12 2 mtrs 95 mins	English Units/Hour Metric Units/Hour Duration of Chart Paper Spool	Chart Speed
TRACE DENSITY		14400	7200	3600	1800	900	600	450	300	180	150	120	60	40	30	STRIKES PER INCH (DENSITY)	



Features and Accessories

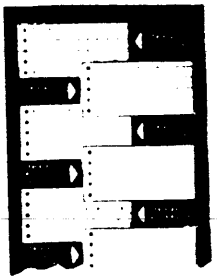


Chart Paper

Rustrak recorders use pressure sensitive chart paper in 63 foot rolls (one month's recording at 1 inch/hour)

MODELS 288

Usually Style A, 50 divisions, 2 9/16" wide, useable width, 2 5/16" (Also styles B, C, G, H, I, K and L)

WIRING; MODEL 288:

The second channel input is wired to pins 5 & 6 of the chassis plug. Other models use binding posts on the case rear. Check the label inside your recorder for correct wiring.

Troubleshooting and Repair

Your Rustrak recorder is engineered for long and dependable service. It needs no maintenance schedule or lubrication.

But as a precision instrument, it should be given the best of care.

Many problems during use are due to improper chart loading, incorrect wiring or mishandling.

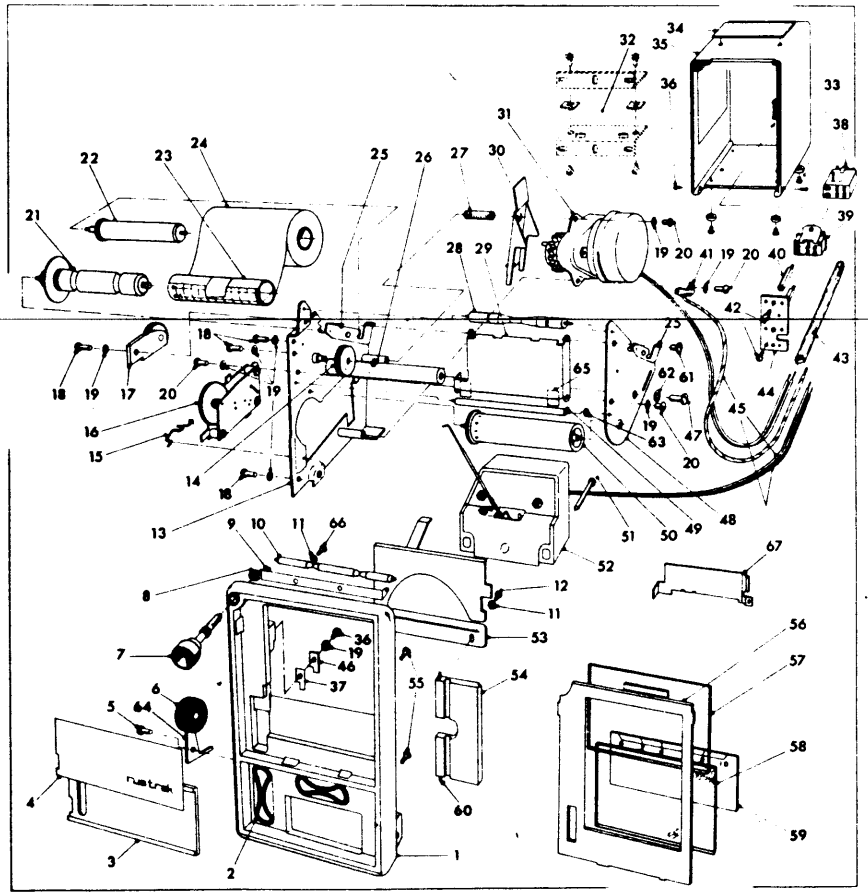
Typical problems are shown in the accompanying chart.

SYMPTOM	POSSIBLE CAUSE	SERVICE HINT
Meter records above or below zero with no signal applied.	Meter zero out of adjustment	Remove front nameplate. Adjust mechanical zero
Meter can't be zeroed	Stylus bent; cross arm bent	Return instrument to factory.
Meter reads zero with signal applied.	Meter open. Connections to meter open; multiplier resistor open.	Check meter (Do not use VOM) Check wiring to galvo. Check plug and terminal wiring Read out multiplier resistor with VOM.
Meter hangs above zero.	Dust in meter pivots.	Return recorder to factory.
Offset stylus visibly bent	Meter has been overloaded	Return recorder to factory.
Recorder has continuous trace	Stylus bent, rubs on chart paper.	Return to factory.
Meter reads consistently below zero.	Polarity to meter reversed	Check wiring to mating socket Check polarity of signal being recorded.
Reroll mode. Paper crinkles at view window	Take-up spool not seated to engage drive gear.	Unlatch retaining clip reseat take-up spool in further notch.
Reroll. Paper doesn't drive through recorder	Perforations not engaged in drive drum. Gear train doesn't engage drive drum	Reload following loading instructions. Bend tabs on gear train slightly for end play. Bend gear train spring for more tension
Tear-off. Paper doesn't drive through tear-off slot	Drive belts not seated on take-up roller. Also riding in large center groove of drive belt roller	Seat drive belts as shown in loading instructions.
Paper tears on drive drum	Roll of chart paper is spiraled	Reload taking care chart paper is perfectly aligned.
Chart advance thumbwheel is locked	Tab that disengages gear train is bent	Remove gear train and straighten tab

When testing, refer to Exploded View.

Exploded View of a Typical Model 288 Recorder

EXTRA COPIES OF EXPLODED VIEW ARE GRATIS FROM RUSTRAK BY SPECIFYING # 17102



ITEM	PART NO.	DESCRIPTION
1	C 4211 G1	Front Panel Ass'y
2	A 4553 P1	Base, Drive
3	B 4121 P1	Bezel, Lower
4	A 4228 P1	Nameplate
5	A 4218 P1	Screw, Special
6	A 3280	Thumbwheel, Chart Advance
7	A 4472 P1	Thumbscrew
8	A 4557 P1	Ring, Retaining
9	B 4119 P1	Bracket, Friction Roller
A 10	A 5366 P1	Friction Roller
11	LT 2	Lock Washer, Internal Tooth No. 2
12	2 56x1 8LG	Mach. Screw, Par HD SST
13	B 4554 G1	Left Hand Plate Ass'y
14	A 2232	Gear, Idle
15	A 2364	Spring, Gear Train
(1) 16	As Req'd	Gear Train Ass'y
17	A 4478 G1	Arm and Gear Ass'y
18	4 40x5 16LG	Mach. Screw, Par HD SST
19	LT 4	Lock Washer, Internal Tooth No. 4
20	4 40x1 4LG	Mach. Screw, Par HD, SST
21	B 4486 G1	Take-up Roller Ass'y
22	B 2216 P1	Roller, Supply
23	A 2254 P1	Sleeve, Cardboard
(2) 24	As Req'd	Paper, Strip Chart
25	A 5151 P1	Clip, Retaining
26	5100 18 C MF	Ring, Retaining
27	A 4189 P1	Spring, Brake
28	B 4220 P1	Roller
29	B 2474	Plate, Front Support
30	A 2313 P2	Brake
(3) 31	As Req'd	Motor Ass'y & Cam: 115V 60HZ 2RPM
32	B 4492 G1	Hardware Kit, Pane Mtg.
33	B 4549 G1	Rubber Feet, (4) With Screws
34	B 4313 P1	Cardholder
35	D 2244 2 G	Case, Basic
36	4 40x3 16LG	Mach. Screw, Fil HD SST
37	A 4257 P1	Ratchet, Chart Advance
38	A 4558 P1	Socket, Cable
39	A 4559 P1	Plug, Chassis
40	A 2229 P1	Spacer
41	A 4303 P1	Lug, Duel
42	6 32x1 4LG	Mach. Screw, Par HD SST
43	A 4546 P1	Tubing, No. 3 .234 I.D.
44	B 2456 P1	Board
45	A 4555	Wire
46	A 4251 P1	Stiffener, Ratchet
47	8 32x5 16LG	Mach. Screw, Par HD SST
48	C 4302 P1	Plate, Right Hand
49	A 2203	Roller, Center
50	B 4550 G1	Time Drum Ass'y
51	6 32x1 5 16LG	Mach. Screw, Par HD SST
(4) 52	As Req'd	Meter Ass'y (1 MA)
53	B 4497 G1	Striker and Arm Ass'y
54	C 4214 P2	Latch, Chassis
55	4 40x3 16LG	Mach. Screw, Par HD SST
56	B 4117 P1	Bezel, Front Pane.
57	B 4178 P1	Window, Access
58	B 4179 P1	Window, Bottom
(5) 59	As Req'd	Scale (Std.) Only
60	A 4551 P1	Pin, Latch
61	A 4562 P1	Machine Screw, Special
62	LT 8	Lock Washer, Internal Tooth No. 8
63	A 4157 P1	Washer, Nylon
64	A 4219 G1	Hinge Bracket Ass'y
65	A 4089	Spring, Leaf
66	2 56x3 16	Machine Screw, Par Head
67	A 4870 P1	Guard, Pointer

(1) SPECIFY GEAR TRAIN NO. REQUIRED. INTERCHANGEABLE GEAR TRAIN AFFECTS SPEED. SEE CATALOG.

(2) SPECIFY CHART PAPER STYLE.

(3) WHEN ORDERING, INCLUDE MOTOR SPEED, VOLTAGE AND FREQUENCY. SEE CATALOG.

(4) SPECIFY METER PART NO. WRITE FOR PRICES.

(5) SPECIFY SENSITIVITY RANGE, PARAMETER AND SPECIAL MARKINGS IF ANY.

(A) A 5366 P1 IS METAL ROLLER. FOR RUBBER ROLLER SPECIFY ASA 1335 G1.