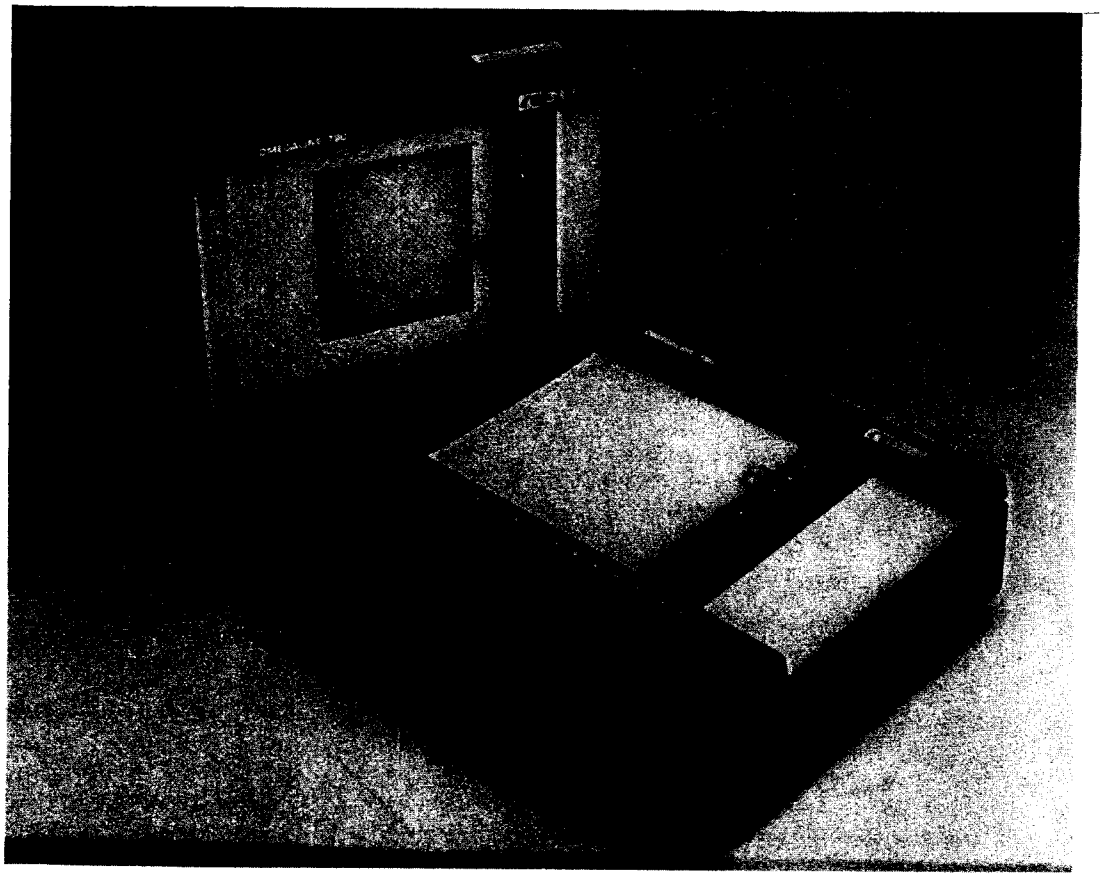
OMEGALINE® SERIES 790 RECORDER



Operator's Manual

OMEGA ENGINEERING, INC.
An OMEGA Technologies Company

WARRANTY

OMEGA warrants this unit to be free of defects in materials and workmanship and to give satisfactory service for a period of 13 months from date of purchase. OMEGA Warranty adds an additional one (1) month grace period to the normal one (1) year product warranty to cover handling and shipping time. This ensures that our customers receive maximum coverage on each product. If the unit should malfunction, it must be returned to the factory for evaluation. Our Customer Service Department will issue an Authorized Return (AR) number immediately upon phone or written request. Upon examination by OMEGA, if the unit is found to be defective it will be repaired or replaced at no charge. However, this WARRANTY is VOID if the unit shows evidence of having been tampered with or shows evidence of being damaged as a result of excessive current, heat, moisture, vibration, or misuse. Components which wear or which are damaged by misuse are not warranted. These include contact points, fuses, and triacs.

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OMEGA ENGINEERING, INC.
An OMEGA Technologies Company

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Direct all warranty and repair requests/inquiries to OMEGA Customer Service Department, telephone number (203) 359-1660. BEFORE RETURNING ANY INSTRUMENT, PLEASE CONTACT THE OMEGA CUSTOMER SERVICE DEPARTMENT TO OBTAIN AN AUTHORIZED RETURN (AR) NUMBER. The designated AR number should then be marked on the outside of the return package.

To avoid processing delays, also please be sure to include:

1. **Returnee's name, address, and phone number.**
2. **Model and Serial numbers.**
3. **Repair instructions.**

OMEGA's policy is to make running changes, not model changes, whenever an improvement is possible. That way our customers get the latest in technology and engineering.

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TABLE OF CONTENTS
OMEGALINE® 790 RECORDERS

SECTION 1 INTRODUCTION

1.1 GENERAL DESCRIPTION

The OMEGALINE® 790 is a portable potentiometric recorder which can measure the functional dependency of two voltage inputs (X-Y recordings), or measure a voltage input dependence on time (Y-t recordings). Also, the 790 may be used to record non-electrical quantities, if they may be converted into dc voltage through the use of suitable transducers or adaptors.

The 790 can be used with either 110 or 220 Vac. Input ranges can be from 1 mV/cm up to 10 V/cm. Options include DIN input connections, a multifunction accessory for the Y-axis (including min/max relay contact, event marker, and 0-10 Vdc analog output).

The 790 recorder is manufactured using a modular technique, with one module for each channel, and for the time-base. The model 790 is an X-Y recorder; the 791 is an X-Y/Y-t recorder. Both units feature electrostatic paper hold and electric pen lift. The 791 also features sweep speeds from 0.1 to 20 s/cm and single or repeating sweep capability.

1.2 AVAILABLE OPTIONS

1.2.1 Multifunction Accessory for Y-axis-Option E-02

Max/Min relay contact: one relay contact can be positioned over the entire recording width. Accuracy is $<0.25\%$ FS; hysteresis is 0.5%; rated load: 42V @ 0.2 A; TTL and CMOS compatible; normally open contacts.

Event Marker: positive needle pulse with a duration of approximately 200 ms, and amplitude of 3 mm is superimposed to the measured value after being initiated by external TTL signal (open collector) or CMOS signal (15 V) or by switch.

Analog Output: 0 to 10 Vdc, potentially connected to the measuring circuit; max load 10 kohms. Accuracy: 0.5%; linearity: 0.25%.

Input Inversion: The polarity of the input signal is reversed when the invert contact is connected to the negative lead of the input terminals. The contacts of the multifunction accessory option are accessible through an 8-pin DIN connector (see paragraph 3.3.2).

1.2.2 DIN Input Connector-Option E-06

This option makes it possible to connect the input signal to the recorder via a standard 8-pin DIN connector, in addition to the standard banana plug sockets. The sockets of the DIN connector are connected to the banana plug sockets (see paragraph 3.3.1).

SECTION 2 INSTALLATION

2.1 UNPACKING

Remove the packing list and verify that all equipment has been received. If there are any questions about the shipment, please call OMEGA Customer Service Department at (203) 359-1660.

Upon receipt of shipment, inspect the container and equipment for any signs of damage. Take particular note of any evidence of rough handling in transit. Immediately report any damage to the shipping agent.

NOTE

The carrier will not honor any claims unless all shipping material is saved for their examination. After examining and removing contents, save packing material and carton in the event reshipment is necessary.

2.2 CONTENTS

Product Description	Quantity
Recorder unit	1 ea.
Ink pen, w/o writing tip	1 ea.
capillary writing tip set	1 ea.
felt writing tip set	1 ea.
recording ink, red	1 bottle
filling/cleaning syringe	1 ea.
cleaning needles set	1 ea.
110 Vac fuses	2 ea.
220 Vac fuses	2 ea.
disposable felt pen, red	1 ea.
chart paper	50 sheets
instruction manual	1 ea.

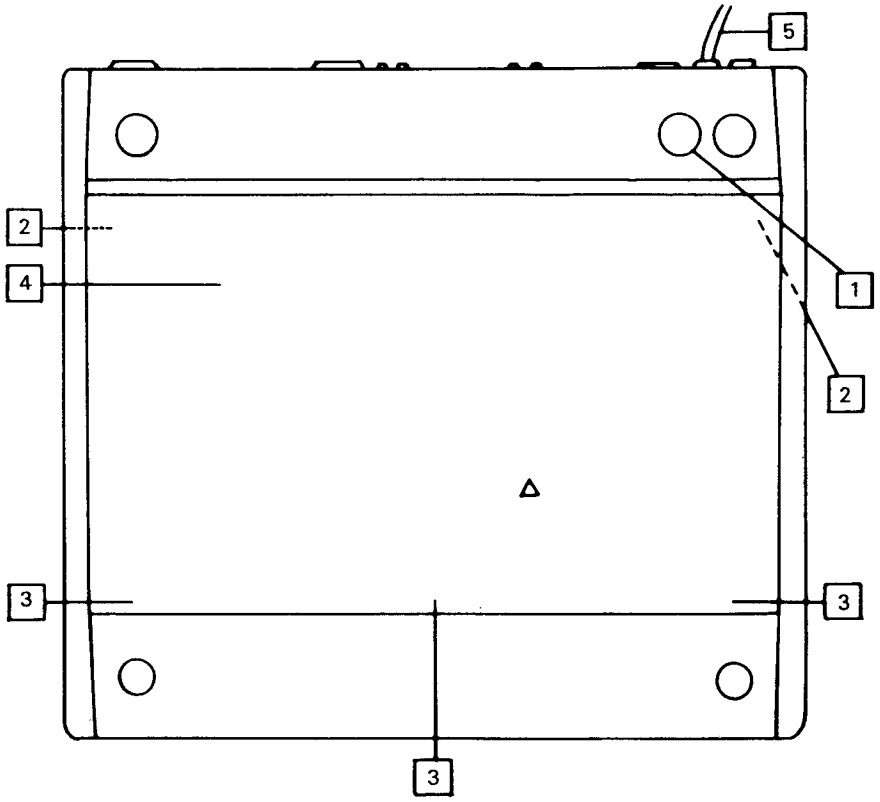
2.3 CHANGING POWER SUPPLY VOLTAGE AND FUSE

CAUTION

The instrument must be disconnected from the voltage supply when changing the setting of the supply voltage selector.

Check the power supply before operating the instrument, to make sure that the supply voltage selector (on bottom of unit, see Figure 2-1) has been set to the proper voltage. If the unit is to be operating at another voltage, change the supply voltage selector to the correct setting. To change the selector setting, either a screwdriver or coin may be used. Note that when changing the supply voltage, the fuse must also be replaced (110 and 220 Vac fuses are supplied with the unit).

The fuse is located at the rear of the instrument. A screwdriver or coin is required to gain access to the fuse for replacement or checking.



1. Voltage Supply Selector
2. Screws to Fasten Side Walls
3. Screws to Fasten Bottom Plate
4. Bottom Plate
5. Power Cord

Figure 2-1. Voltage Selector Location

2.4 INPUT CONNECTIONS

The input signal is connected to the recorder through the input sockets at the rear of the unit. The input is floating and asymmetrical. The grounding socket at the back of the instrument is connected to the case ground.

Also, in units with the E-06 DIN input connector option, the input signal may be fed to the unit through an 8-pin DIN connector.

2.5 CHART PAPER INSTALLATION

The electrostatic paper hold and the pen lift must be switched off before the chart paper is inserted. The OFF-CHART-PEN switch should be set to the "OFF" position.

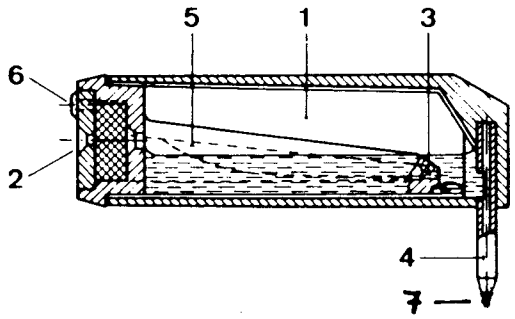
The chart sheet is pushed under the carriage, aligned and then electrostatically fixed when the paper hold is switched on. Switch the OFF-CHART-PEN switch to the "chart" position. Smooth down the sheet to remove any air bubbles. This prevents unwanted contact between the pen and the paper. The chart sheet must not exceed the DIN A4 format (11" x 7").

2.6 PEN INSTALLATION

In order to avoid damaging the writing tips, the writing carriage with the holder should be lifted when the writing device is pushed into or extracted from the holder. The omegaline 790 utilizes either a felt tip or capillary writing tip. Either may be used, simply by installing the pen into the writing tube.

2.6.1 Capillary Pen

The capillary pen is wear-resistant and insensitive to clogging. The amount of ink in the reservoir is visible, and the reservoir may be easily refilled with the filling syringe supplied with the recorder.



1 Ink reservoir
2 Self-sealing inlet
3 Pressure compensating channel
4 Writing tube
5 Capillary system
6 Air inlet
7 Felt or capillary writing tip

Figure 2-2. Capillary Pen Components

Refer to Figure 2-2. The capillary pen consists of an ink reservoir (1) with a self-sealing inlet (2), a pressure compensating channel (3) and the writing tube (4). The pressure compensating channel is connected to the reservoir by a capillary system consisting of parallel channels. If a temperature rise occurs, the increase of the volume of the air in the reservoir forces ink into the channel. If large variations of the temperature are likely to occur (on the order of 100 F), the pen should be filled to only ½ the capacity, in order to avoid ink leaking from the air inlet (6).

2.6.2 Filling the Capillary Pen

1. Draw approximately 1 mL of ink into the filling and cleaning syringe, with the cannula slipped on.
2. Pierce the elastic rubber seal of the pen with the cannula, and insert it approximately 5 mm deep.
3. Hold the syringe vertically with the pen slipped on and pointed upwards; using the syringe, suck some air out of the pen (in order to remove any remaining liquid from the pressure compensating channel). Next, squeeze the ink slowly into the ink reservoir, until the level of the liquid reaches the upper end of the pressure compensating channel.
4. With the pen in the normal use position, check whether any ink has advanced to the writing tip. If necessary, exert very light pressure on the piston of the syringe, keeping the air inlet (6) closed, at the same time, a small drop of ink is formed at the writing tip.
5. Withdraw the cannula from the pen. The pen is now ready for use.

2.6.3 Disposable Felt Pen

The 790 can also use disposable felt-tip pens. These convenient pens are easier to use than the refillable capillary pens, and no clogging can occur. They are especially useful in recording fluctuating values, since they leave a wide trace.

SECTION 3 OPERATION

3.1 SAFETY GROUNDING

For protection of the user, the recorder is provided with a protective grounding system. The power cord is fitted with a safety 3-prong plug. The case is electrically grounded through the cord. Also, the power circuit is insulated from the case, and tested with 1.5 kV against the case and measuring circuit(s). The input voltage signals are input to the recorder via special 4 mm safety sockets.

3.2 OPERATING CONTROLS (Refer to Figure 3-1)

3.2.1 Zero Adjustment

The zero point may be set to any value between -5 and +105%,by adjusting the zero control knob. To set the zero point, first set the CAL/VAR switch to the "CAL" position.

3.2.2 Range Selection

Select the input range using the range selector switch. Measurements in the 1 mV/cm through 0.1 V/cm do not use a voltage divider, and the recorder shows no definite reading when an open circuit condition exists. The 1 V/cm and 10 V/cm ranges, however, utilize a 100:1 voltage divider. The input amplifier is terminated at its input by the voltage divider. In the "0" position, the amplifier is separated from the input, and short circuited internally.

3.2.3 Setting Intermediate Ranges

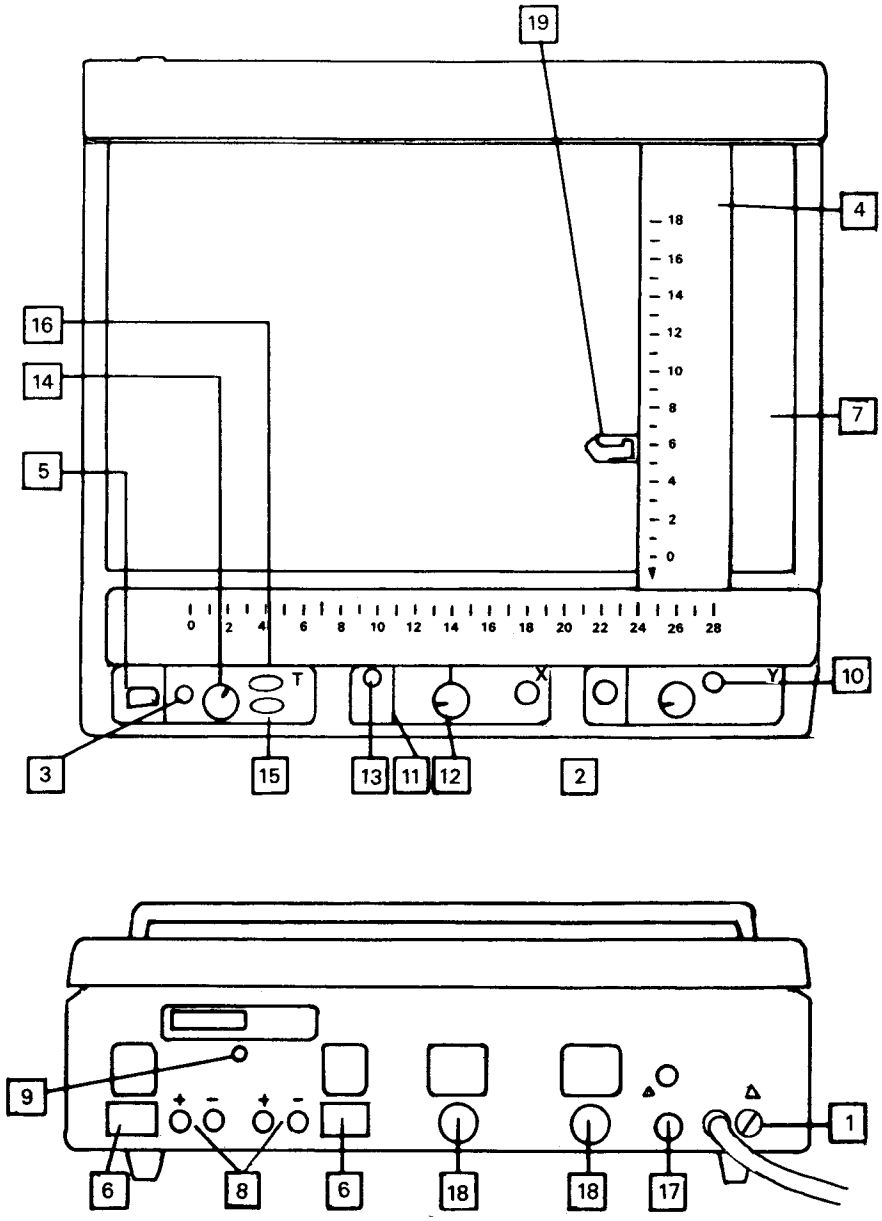
The input sensitivity can be increased up to 10x by the use of the sensitivity control, if the CAL/VAR switch is set to the "VAR" position. Therefore, is it possible to achieve full scale deflection for any intermediate input value from 10 to 100% of the selected measurement range. For example, if the input range is selected as 1 V/cm for the X-axis, by using the sensitivity control, the unit can be set for sensitivity anywhere between 0.1 and 1 V/cm (i.e. normally, an input of 28 V would give full scale deflection with 1 V/cm sensitivity; by using the sensitivity control, an input as low as 2.8 V can give full scale deflection of the X-axis).

The input accuracy in the intermediate ranges (expressed as % of scale) is increased in the same ratio of the amount by which the sensitivity was increased. The absolute accuracy expressed as a percentage of the selected calibrated input range is maintained.

3.2.4 Electric Pen Lift

The electric pen lift is a standard feature of the 790 recorder. It can be operated by using the OFF-CHART-PEN switch on the unit, or externally through a TTL or CMOS signal. In addition, if the 791 X-Y/Y-t recorder is used, the pen is automatically controlled if the pen was put down by the OFF-CHART-PEN switch before the time unit was started.

Either TTL (open collector) or CMOS (15 V signal) or contact closure is required for the external pen control. The control leads are brought to an 8-pin DIN socket at the back of the instrument.



1. Fuse
2. Measuring Unit
3. Time Unit
4. Writing Carriage
5. Power Switch
6. Cutout for Option E-06
7. Electrostatic Paper Hold Plate
8. Measuring Sockets
9. Grounding Sockets
10. Zero Adjust
11. CAL/VAR Switch
12. Measuring Range Selector
13. Sensitivity Controlling Resistor
14. Deflecting Speed Selector
15. Time Unit Function Switch
16. Off-Paper-Pen Switch
17. DIN Socket for External Control to Pen
18. Cutout for Option E-02
19. Pen

Figure 3-1. Operating Controls

3.3 TIME UNIT (MODEL 791 ONLY)

3.3.1 Single Sweep Operation

In order to deflect the carriage only once, a single time sweep, the time unit function switch (REP-1x-START) is put into the "1x" position. Putting this switch into the "start" position sets the pen onto the paper as if the OFF-CHART-PEN switch had been set into the "PEN" position. After a short pause, the pen carriage is deflected at the selected speed. The pen is then lifted from the paper when the carriage has been deflected completely over the chart paper, and the carriage is then returned to the starting position.

The zero and full scale values for time base operation are permanently set, and may not be adjusted by the operator.

3.3.2 Repeating Sweep Operation

Repeated pen sweeps are achieved by switching the time-unit function switch to the "REP" position. The pen sweep process now starts without the "START" key having to be pressed. The pen is automatically set on the paper. The process continues as in the case of the single sweep, except that restarting takes place automatically, after the return of the pen to the zero position.

3.4 OPTIONS (Refer to Paragraph 1.2)

3.4.1 Option E-06 DIN Input Connector

The input signal is fed to the recorder through the 8-pin DIN socket. See Figure 3-2. The maximum permissible voltage between the input and ground is 250 V.

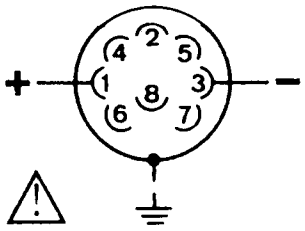


Figure 3-2. Option E-06; 8-Pin DIN Socket

3.4.2 Option E-02 Multifunction Option

The following functions are obtained through the 8-pin DIN socket at the back of the instrument. See Figure 3-3.

Min/Max contacts (MIN, MAX)
Event Marker (MARK)
Analog output (OUT)
Input Inversion (INVERT)

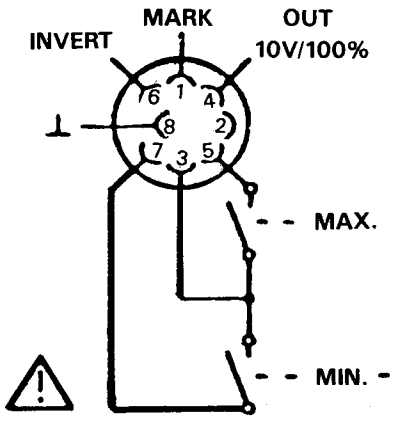


Figure 3-3. Option E-02; 8-Pin DIN Socket

3.5 MEASUREMENT CONSIDERATIONS

3.5.1 Grounding and Interference Voltages

If parasitic voltages are present in the measuring circuit, it is possible that indicating errors occur which may not be immediately recognizable as such. However, if the amplitude of the parasitic voltage is large, a rapid dropping of the deflection speed may be noticed, and there may be jerks in the pen movement. The maximum parasitic voltages at which the accuracy is not exceeded is shown in section 6, Specifications.

If for the above mentioned reasons, it becomes advisable to connect the positive input leg to the negative input terminal, because it is nearer to ground, then the zero of the recorder should be set to full scale, 100%. The full scale input will then be at 0%. Parasitic voltages may reach the input in many cases by unfavorable grounding of the measurement circuit.

The input of the 790 is floating, but the negative input terminal is nearer to ground, for constructional reasons. The minus terminal of the input should therefore be connected with that pole of the input voltage which is nearer to ground, and should be connected to ground if possible, either directly or via a condenser.

The following formula applies for the value of the interference rejection:

"A(dB)": A = 20 log(Vpp)/(V), where:

Vpp = interference voltage

V = voltage corresponding to 2x the accuracy class

Example: what is the maximum interference voltage at the input in the 1 mV/cm range (accuracy class of 0.5% in the y-axis), with the series mode rejection being 40 dB?

40 dB = 20 log[Vpp]/0.18 x 10^{-3}

So, the interference voltage [Vpp] = 0.18 x 10^{-3} x $10^{\frac{40}{20}}$ = 18 mV

3.5.2 Dynamic Response

When recording rapidly varying events, recording errors may occur as a result of the dynamic response. The magnitude of the respective error depends on the frequency, wave form and amplitude of the signal, as well as on the output impedance of the measuring circuit (the source impedance).

Bearing in mind that the slew speed of the recorder is nearly constant, the dynamic errors will decrease with decreasing amplitude. In borderline cases, one may obtain a more accurate record for the input signal by switching lower to a less sensitive (i.e. higher) range.

A typical curve of the amplitude A of the deflection, expressed as a percentage of the input vs. the frequency of the input is shown in Figure 3-4. The peak-to-peak value of the input is ⅔ (see solid line) and 1/10 (see dotted line) of the full scale value.

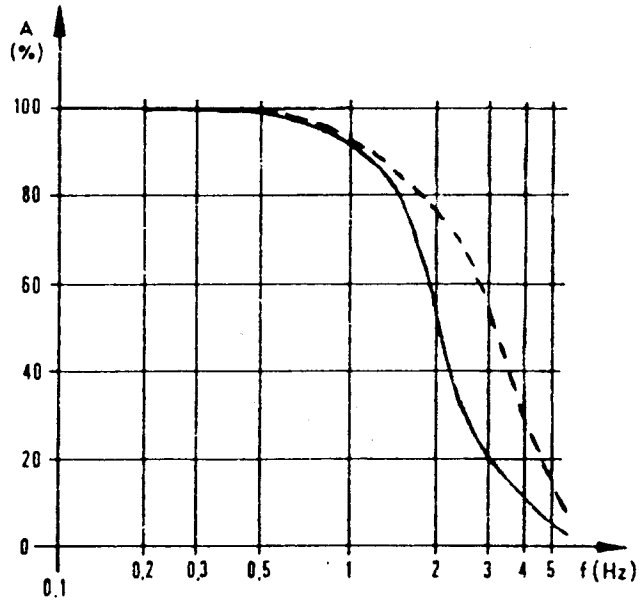


Figure 3-4. Typical Curve of the Amplitude, A, of the Deflection

3.6 PERFORMANCE CHECKS

3.6.1 Time Unit

In addition to the check of the operational modes "1x" and "REP" (refer to paragraphs 3.2.1 and 3.2.2), the slewing speed can also be checked. For this check, a stop watch or a watch with a second hand is required. Set the recorder to the 10 s/cm range, and start the recorder with the time-unit function switch. The measured trace should be selected as long as possible so that a high measuring accuracy is obtained. Assuming that the measured trace was selected to be 28 cm, the error of the time unit (in %) is calculated as follows:

[280s - measured time] / 280 * 100

3.6.2 Measuring Unit

With the input terminals shorted together, it should be possible to move the pen continuously across the total scale length by using the zero adjustment pot.

To check the dead band, set the input range selector to the 1 mV/cm range, and set the CAL/VAR switch to "CAL". Move the pen using the zero adjust knob to any one point on the scale. The amount of dead band (dead band = 2x the response sensitivity) can be determined by deflecting the pen carriage 2 to 3 mm by hand. After releasing the pen, it will stop at a certain position. If this procedure is repeated on the other side, then the difference of these two measurements indicates the amount of dead band. This shall not exceed 0.3% of the scale length.

3.6.3 Accuracy

The accuracy of the 790 can be checked at any value, by using a stable dc voltage source, and a high accuracy voltmeter.

3.6.4 Response Time

To check the response time, a step function corresponding to approximately 90% of the full scale input is applied to the unit. The response time can now be calculated on the basis of the recorded trace, and of the deviation in the time axis. If the response time is to be measured, the deflection in the Y-axis has to be made through the use of a ramp voltage.

The overshoot in both directions is shown (details A and B), in Figure 3-5.

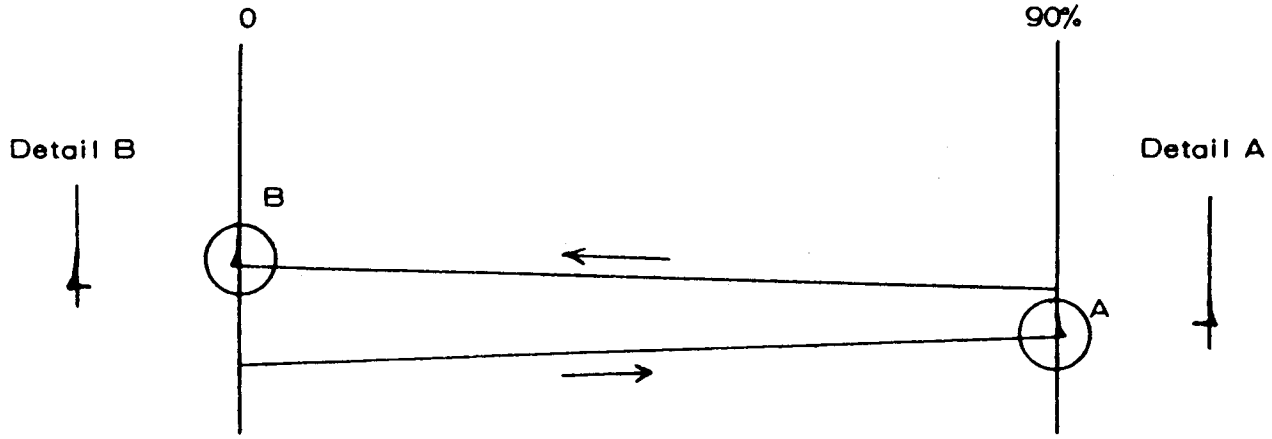


Figure 3-5. Overshoot

3.6.5 Limit Switch

The performance of the limit switch is checked by adjusting the zero value to zero, using the zero adjustment knob, and by then applying an input of approximately 200% of the full scale input (depending on the selected input range). The pen carriage should move 1 to 2 mm beyond the full scale mark. Reversing the polarity of the input signal allows the over-flow to be checked at the zero point, in the same way.

SECTION 4 THEORY OF OPERATION

4.1 GENERAL

Measurements with the 790 are performed using a compensation method. A dc motor moves the slider of a servo-potentiometer until the compensating voltage equals the input voltage which is amplified or attenuated, depending on the input range selected. This slider of the potentiometer is coupled to the recording pen.

The servo-potentiometer is connected to a high accuracy and stability reference voltage. The compensating voltage taken from the potentiometer is compared with the input voltage in a difference amplifier. The difference signal is amplified and puts the servomotor in motion. The motor comes to rest when the balancing process is completed. To obtain the required dynamic behavior of the recorder, the compensating voltage is connected by a differentiating amplifier. The differentiated voltage, which is proportional to the velocity of the writing arm, is used for the damping of the control circuit.

The end stage is equipped with an electronic circuit which acts as an end switch, by which overloading of the end stage and of the servomotor are prevented.

The chart paper is held to the unit electrostatically. In Y-t operation, the deflection of the pen is controlled through a quartz generator.

4.2 BASIC CIRCUIT DIAGRAM DESCRIPTION (See Figure 4-1)

The input voltage is connected to the voltage divider, by which it is divided by the factor 10 in the 10 V/cm and 1 V/cm, while in the other ranges, the input voltage is led to the input amplifier via an active filter. An input voltage corresponding to the full scale value is amplified by the input amplifier to 10 V. The following stage is used to invert the signal. If the control input "Invert" coming from the optional 8-pin DIN connector is connected with the mass amplifier, the amplified input voltage is inverted. This inverter makes it possible to always connect the input signal to be measured in such a way that the pole which is nearer to the ground potential comes to the - terminal, and can even be grounded. The amplification can be increased up to the factor of 10 in the next stage, if the CAL/VAR switch is utilized. The amplifier adds the amplified input voltage and the voltage derived from the zeroing potentiometer, and the optional event marking pulse (if installed). Limiting of the end values also occurs at this point.

The end stage amplifier adds the voltage derived from the input and the compensating voltage from the differentiating amplifier. These two signals have opposite polarity. By altering the time constant of the differentiating member in the amplifier, the damping factor of the control circuit can be adjusted. The end stage drives the servomotor which is mechanically coupled to the servo-potentiometer.

A quartz controlled generator supplies a constant frequency of 32768 Hz, which is divided by a frequency divider to 1424.7 Hz. This frequency corresponds to a deflection of the writing carriage of 0.1 s/cm. A second divider effects a frequency division as required by the set time range. The pulse sequence is transformed into an analog signal by a counter and D/A converter, whose signal is fed into the X-axis stage. Control logic and "endcomp" control the sweep depending on the switch position of "REP" or "1x". Also, the pen is lifted at the return of travel.

The power supply is connected to the main transformer by a fuse, power switch, and through the voltage selector. The transformer supplies all rectifiers of the various section of the circuit.

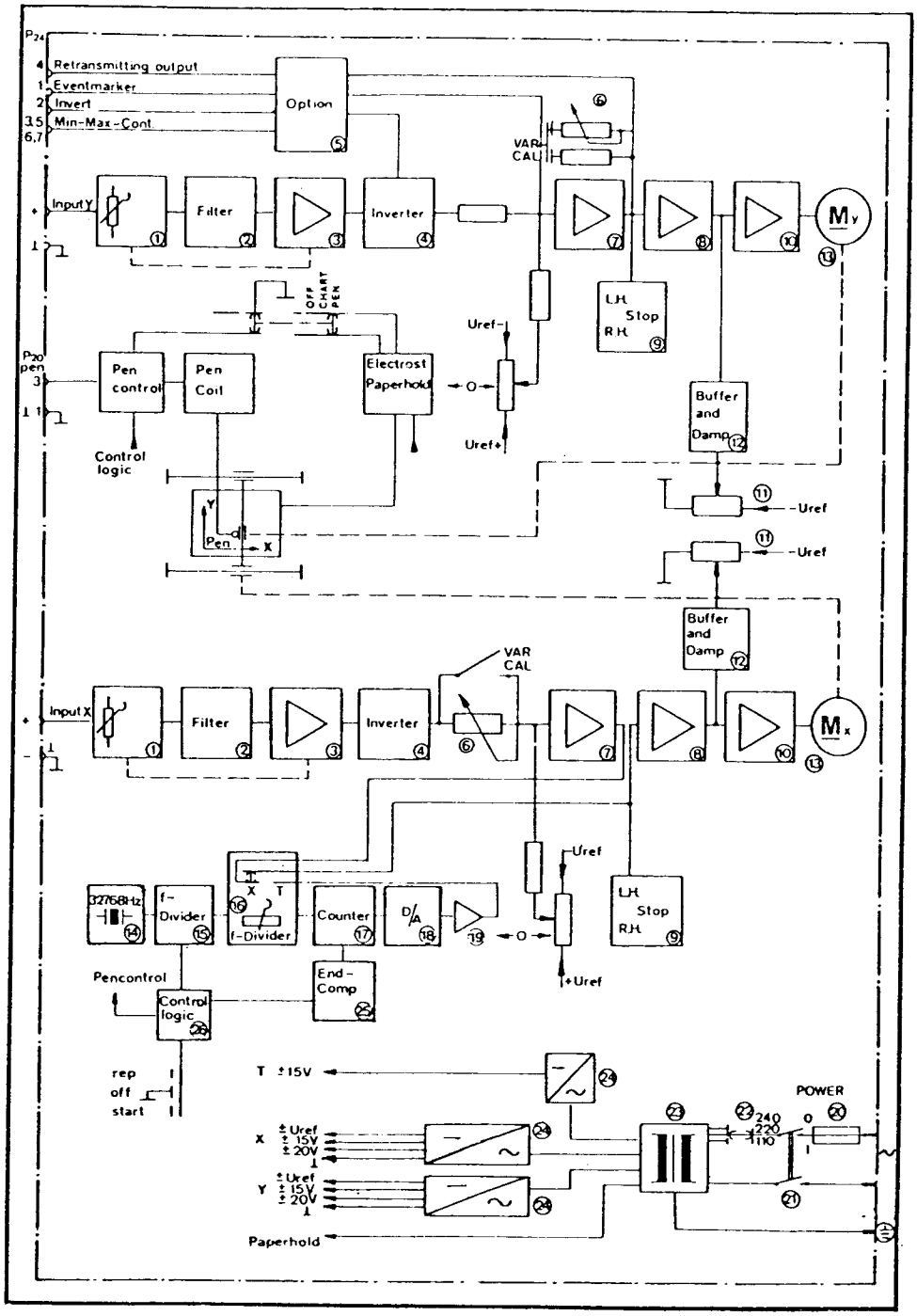


Figure 4-1. Block Diagram

SECTION 5 SERVICE INFORMATION

WARNING!

Before carrying out any maintenance work, the instrument must be disconnected from the power socket!

To guarantee trouble-free operation of the 790, general maintenance is required at regular intervals. It includes visual inspection, and, if necessary, cleaning and lubrication of mechanically stressed parts. Use in a low dust or dust-free location, prolong the intervals. Noticeable accumulations of dust and dirt should be removed with soap and a lint-free cloth.

NOTE

Let the instrument dry before re-use.

5.1 CLEANING THE RECORDING FACE

Any soiling of the recording face diminishes the retaining force of the electrostatic paper hold. It is advisable to clean the surface immediately after it is soiled. Clean the face with a mild soap and soft cloth. Afterwards, wipe the face with a damp cloth, and rub until the surface is completely dry. Strong solvents or silicon based drying agents must not be used. Any mechanical cleaning, such as brushing or scraping will damage the unit.

5.2 CLEANING CAPILLARY PEN

Each time the pen is to be refilled, or has been stored for a long period of time, it should be cleaned. For cleaning, the pen is set up on the filling and cleaning syringe under lukewarm water. The remaining water is then sucked out of the pen. Wipe the outside of the pen dry before refilling.

If ink has dried up at the writing apertured, or if the aperture has become clogged by paper particles (the recording trace is interrupted) the cleaning needle (capillary cleaner) should be used. The cleaning needle (capillary cleaner)is set on the writing tip, and carefully pressed down several times to clear the blockage.

5.3 CLEANING THE GUIDE RAILS

The guide rails of the pen carriage arm (X-axis) and the guide rail of the pen carriage (Y-axis) should be cleaned periodically (approximately every 18 months) with a clean, dry cloth.

The guide rail of the X-axis is accessible when the "electrostatic paper hold" is removed. To remove the electrostatic paper hold, remove the bottom cover (three screws), then pull away the two electrical connections. Then, remove the paper hold (four screws) assembly. To re-install the paper hold, reverse the disassembly instructions.

The guide rail of the Y-axis is accessible when the scale plate is removed (four screws). The cover must first be removed (three screws on each side; loosen only).

5.4 LUBRICATION

All cord rollers, gears and cords should be lubricated every 18 months.

SECTION 6 SPECIFICATIONS

DESIGN: flatbed
RECORDING AREA: 11'' x 7'' (280 x 180 mm)
DEADBAND: 0.3%, max.
SCALE: 0-28, X-axis; 0-18, Y-axis
RESPONSE TIME: 0.6 s, X-axis; 0.4 s, Y-axis
SLEW SPEED: 0.6 m/s, X-axis; 0.8 m/s, Y-axis
LIMITING FREQUENCY: 1 Hz
DAMPING: based on DIN 43782
OPERATING TEMPERATURE RANGE: 32° to 122°F
TEMPERATURE COEFFICIENT: 0.02%/°C
PAPER FORMAT: single sheet, 11.7'' x 8.2'', per DIN A4
PEN LIFT: electromagnetic, external control from TTL, CMOS or switch
OPERATING POSITION: Horizontal up to 85 degree angle
RECORDING MODE: ink, with capillary writing tip, or felt-tip pen
POWER: 110/220/240 Vac ±10%, switch selectable, 50/60 Hz
POWER CONSUMPTION: 20 VA
LIMIT SWITCH: effective between 1 and 2 mm beyond full scale or below zero point
DIMENSIONS: 5.2'' H x 15.2'' W x 14.2'' D
WEIGHT: 14.3 lb
SENSITIVITY: 1/10/100 mV/cm, 1/10 V/cm, switch selectable
ACCURACY: ±0.5%
LINEARITY: 0.3%
VARIABLE SENSITIVITY: increases sensitivity up to 10x per range, max. (i.e. using 1 mV/cm range, max. sensitivity is 0.1 mV/cm)
ZERO ADJUST: continuous, between -5 to +105%
INPUT TYPE: Floating, asymmetrical, 4 mm safety sockets, or DIN 8-pin connector (optional)
POTENTIAL BETWEEN INPUT AND GROUND: 250 V max.
OVERLOAD: 250 V max.
INPUT CURRENT: 10 nA max.
INPUT RESISTANCE: 1000 Mohm, up to 0.1 V/cm range; 1Mohm over 1 V/cm range
SOURCE RESISTANCE: 1 kohm; 10 kohm max.
COMMON MODE REJECTION: greater than or equal to 80 dB, ac; 90 dB, dc
CHART SPEEDS (MODEL 791 ONLY): 0.1, 0.2, 0.5, 1, 2, 5, 10, 20s/cm, switch selectable
CHART DRIVE ACCURACY: ±0.5%
DRIVE TEMPCO: 0.1% per 10°C

6.1 OPTIONS AND ACCESSORIES

Part No.	Description
E-00	19'' Rack Mount Assembly
E-02	Multifunction Accessory for Y-axis
E-06-X	DIN Input Connector for X-axis
E-06-Y	DIN Input Connector for Y-axis
SL-622	50 Sheet Chart Paper
SL-301	Disposable Red Pens, 3 ea.