ACCESSORIES AND REPLACEMENTS

A-47L Energizer
May be used with the LAW-79KWH(T) on 120VAC Systems to add three additional ranges: 0-.75/1.5/3.0 Kilowatts.
Note: Based on a 15Amp continuous rating of A-47L, LAW-79KWH only.

Amptran® CT-50-1 and CT-50-2
Can be used to increase current input by 50 times, 5,000/3,000 Amps, respectively (Note: May add ±3% of reading to accuracy spec when PF is above 80% or ±4% when PF is below 80%.

Volt-O-Verter DC/AC
A1-2 and A1-3 invertors may be used to run the recorder from a 12VDC battery.

Instruction Book	P/N 961750
Voltage Leads (Set of 4)	DVL-1
Recorder Anti-Static Cleaning Kit	SCK-100
Power Line Cord	PC-4
Fuse .25Amps/250 Volts	5X20-235.250
Strip Chart Paper (LAW78KWH)	896W
Strip Chart Paper (LAW78KWH-T)	896W-6 OR 896W
Strip Chart Paper (LAW79KWH)	824W
Strip Chart Paper (LAW79KWH-T)	824W-6 OR 824W

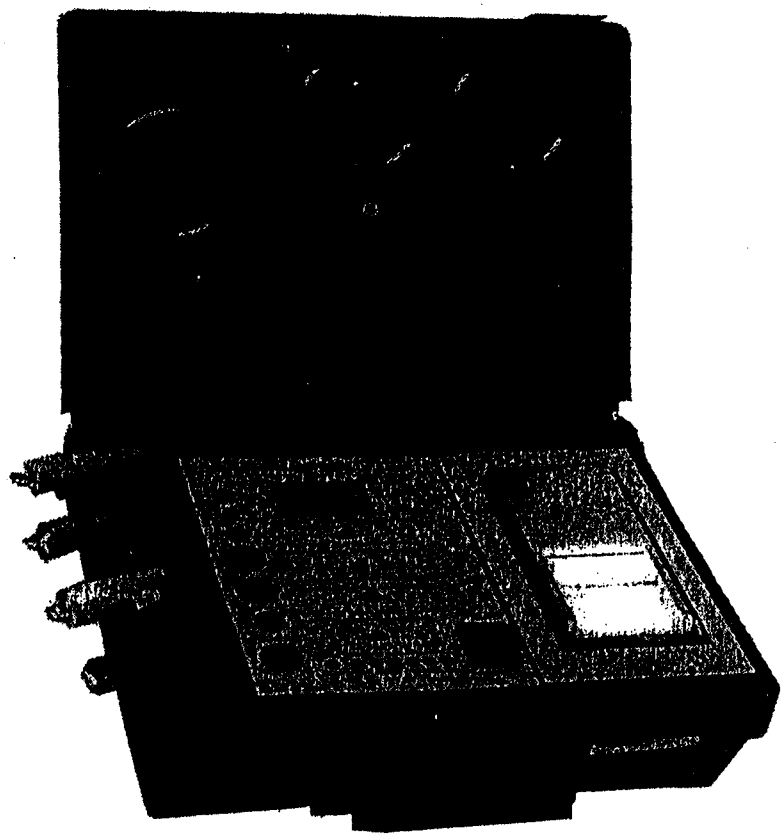
AMPROBE®

DIVISION OF CORE INDUSTRIES INC.
630 MERRICK ROAD, P.O. BOX 329
LYNBROOK, NY 11563
PHONE 516-593-5600 • FAX 516-593-5682

Part No. 961750
2/96

OPERATING INSTRUCTION MANUAL

AC KILOWATT-HOUR/KILOWATT/ KILOVAR TIME SHARING RECORDER



MODELS: LAW-78 KWH(T) AND LAW-79 KWH(T)

AMPROBE INSTRUMENT®
DIVISION OF CORE INDUSTRIES INC., LYNBROOK, NEW YORK 11563

PRECAUTIONS FOR PERSONAL AND INSTRUMENT SAFETY

1. Read these instructions thoroughly and follow them carefully.

2. In many instances you will be working with dangerous levels of voltage and/or current, therefore, it is important that you avoid direct contact with any uninsulated, current-carrying surfaces. Appropriate insulating gloves and clothing should be worn.

3. Before connecting or disconnecting the meter to or from the circuit to be tested, turn off all power to the circuit.

4. Before applying test leads to circuit under test, make certain all switches are set to proper range and function.

5. Before using any electrical instrument or tester for actual testing, the unit should be checked on a known live line to make certain it is operating properly.

6. If the instrument should fail to indicate, do not touch the circuit until you have checked the see that all instrument switches are in proper position and the instrument has been checked on a known live line.

IMPORTANT: Failure to follow the instructions or to observe the above precautions may result in personal injury and/or damage to the instrument and/or accessories.

Table Of Contents

LIMITED WARRANTY

Congratulations! You are now the proud owner of an AMPROBE instrument. It has been crafted according to quality standards and contains quality components. This instrument has been inspected for proper operation of all of its functions. It has been tested by qualified factory technicians according to the long established standards of AMPROBE INSTRUMENT.

Your AMPROBE instrument has a limited warranty against defective materials and/or workmanship for two years from the date of purchase provided that, in the opinion of the factory, the instrument has not been tampered with or taken apart.

Should your instrument fail due to defective materials and/or workmanship during the two-year warranty period, return it along with a copy of your dated bill of sale which must identify your instrument by model number and serial number.

Above limited warranty covers repair and replacement of the instrument only and no other obligation is stated or implied. AMPROBE shall not be liable for any loss or damage arising out of the use or misuse of this product.

For your protection, please use this instrument as soon as possible. If unit is damaged or is ever in need of repair, please call AMPROBE at (516)593-5600 to obtain a Return of Materials Authorization (RMA) number. The unit should then be securely wrapped to prevent further damage in transit, insured and sent along with proof of date of purchase to:

Service Division
AMPROBE INSTRUMENT
630 Merrick Road (for U.P.S.)
P.O. BOX 329 (for P.P.)
Lynbrook, NY 11563-0329

Outside of the U.S.A., your AMPROBE representative will assist you.

For Technical Assistance call 1-800-477-8658

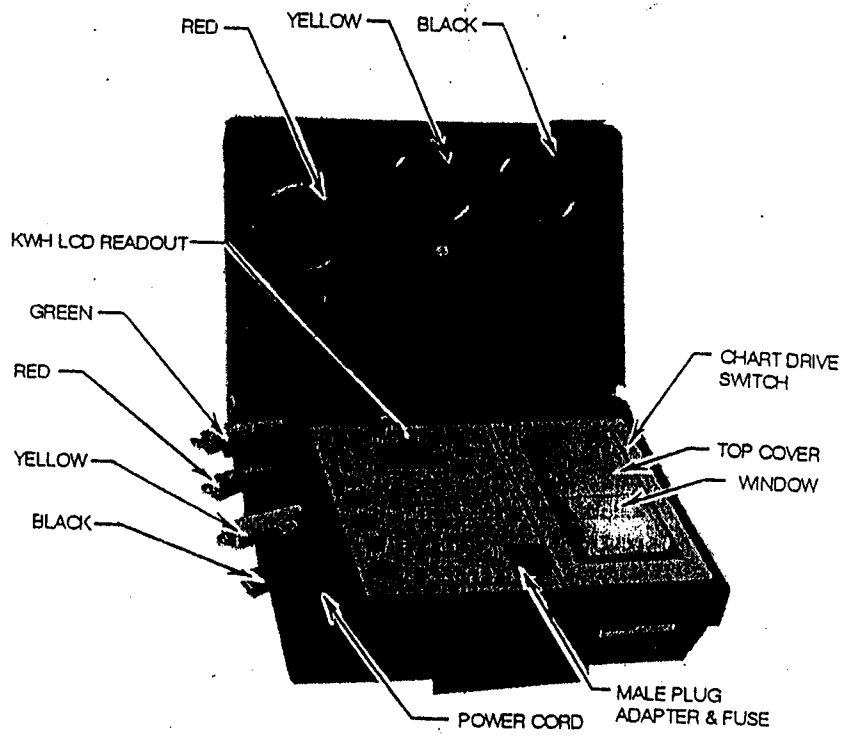


Fig. 1 LAW-79KWH

INTRODUCTION

The LAW-78/79 KWH recorder can be operated in three modes; Kilowatts/Kilowatt-Hour, Kilowatts/Kilovars Time Sharing, Kilovars only. In the Kilowatt/Kilowatt-Hour mode the Kilowatts will be recorded on the strip chart paper, and the total Kilowatt Hours will be indicated on the liquid crystal display. In Kilowatt/Kilovar Time Sharing mode both AC Kilowatts and Kilovars are sequentially recorded on the same chart. The two variables are recorded in the following sequence: eight dots for Kilowatts then two dots for Kilovars which results in two distinct patterns. One complete sequence of recording Kilowatts and Kilovars (8 dots then 2 dots) takes 50 seconds with a chart speed of 12 inches per hour; 10 minutes with a speed of one

inch per hour. When in the Kilovar mode the Kilovars will be recorded on the strip chart paper.

The LAW-78/79 KWH recorder is supplied with a line cord, four color-coded voltage test leads and three color-coded clamp-on current transducers (See Fig. 1). One roll of chart paper is supplied.

OPERATION

Zero Adjust:

1. Set chart drive switch to "OFF" position (See Fig. 2 and 3). Check zero setting of pointer before making any electrical connections to the instrument (See Fig. 4). If adjustment is necessary proceed as follows:

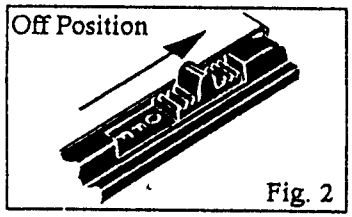


Fig. 2

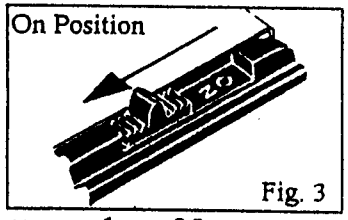


Fig. 3

a) Remove top cover by pulling bottom edge of frame toward you and lifting. The top cover will come loose, (See Fig. 5).

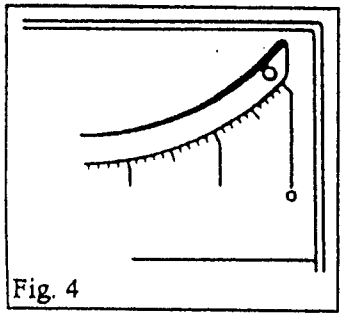


Fig. 4

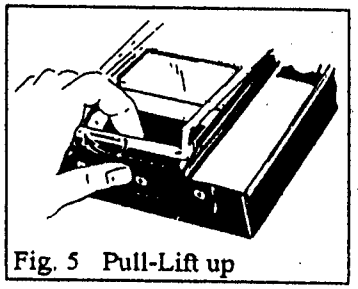


Fig. 5 Pull-Lift up

b) With strip chart roll removed from the chart well, the zero adjust star wheel is located at the bottom of the chart well (See Fig. 6).

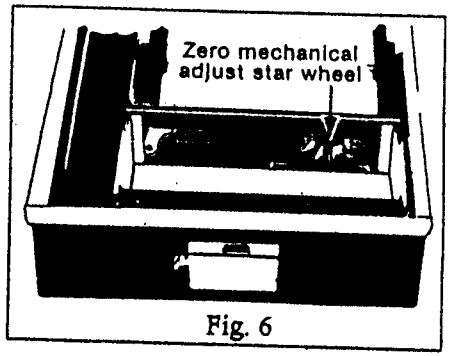


Fig. 6

c) Using your finger, turn star wheel until the pointer lines up with zero, at the extreme right side of the scale (See Fig. 4).

2. Connect the line cord to the proper line voltage.

Switch Positions for Recording or Indicating:

1. The chart drive switch is located to the right of the chart well.

2. In the downward position (exposing the word "ON"), the recording mechanism, is in operation feeding the strip chart and providing a permanent record of the variable being measured (See Fig. 3).

3. In the upward position (exposing the word "OFF"), the recording mechanism is uncoupled, stopping the chart feed and printing (See Fig. 2).

NOTE: Make sure chart drive switch is pushed all the way until a click is heard, when changing its position.

Except for the "ON/OFF" switch, all switches are located on the control panel on the front of the recorder.

Operating the Recorder:

1. After adjusting pointer to zero, as outlined above, with chart drive in "OFF" position , insert strip chart as follows:

   a) Place the chart in the well at the top of the recorder. Unroll approximately nine inches of chart, with the printed side up (See Fig. 7).

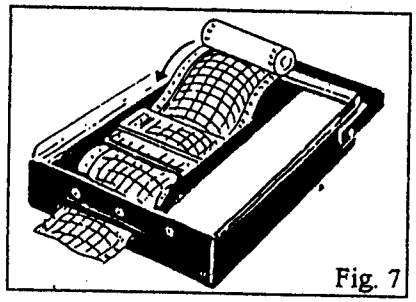


Fig. 7

   b) Slip leading edge of paper under glass. If leading edge is ragged, cut off a small piece at an angle. Feed over capstan wheels and through slot in bottom of recorder.

   c) Line up time arrow with any time line on left of strip chart (See Fig. 8) .This will synchronize the chart travel with the time lines on the chart.

   NOTE: Make sure the holes on both sides of the strip chart engage the sprockets of the capstan wheels.

   d) Replace metal top cover. Position the "U" shaped bend at the top of the cover over the small metal projections in the chart well. Press down on the front to snap into place. Make sure the strip chart is not binding with the cover in place.

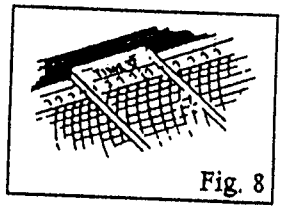


Fig. 8

   e) Write down the time started on the strip chart, through opening provided.

2. Set the mode switch "KW(KWH),KW/KVAR TIME SHARING,KVAR" to the proper setting.
   a) "KW(KWH)" mode records Kilowatts and counts total Kilowatt hours.
   b) "KW/KVAR TIME SHARING" mode records both Kilowatts and Kilovars.
   c) "KVAR" mode records only Kilovars.

1. If current in conductors is unknown, measure current using an AC clamp-on volt/ammeter, and set the "AMPS" switch to the proper range (i.e. 0-200, 0-400, 0-800 for the LAW-78KWH; 0-50, 0-100, 0-200 for the LAW-79KWH)

2. If circuit voltage is unknown, measure the voltage using an AC voltmeter, and set the "VOLTS" switch to the proper voltage and phase.

3. When monitoring Kilowatt-Hours the "Mode" switch must be in the KW(KW-HR) mode. Press the red reset push-button to zero Kilowatt-Hours on the LCD display prior to starting. The LCD display has an 8 digit display and is capable of counting a total of 99,999,999 Kilowatt hours.

NOTE: The LCD display does not shut off.

4. Set the "X¼, X½, X1" switch to the proper position, as indicated by table (see Table of Ranges on page 14). The red LED's on the control panel will indicate the KW/KVAR range that has been selected. Write this range on the chart paper.

5. Set "KVAR LAG/LEAD" switch to "KVAR LAG" position. Once recording is started, observe KVAR trace on strip chart. If it is below the "0" line, set "KVAR LAG/LEAD" to "KVAR LEAD" position.

6. Connect current transducers and voltage test leads as shown in the appropriate figures 9-12, on pages 12 & 13, that applies to the application.

CAUTION: Do not use current transducers on uninsulated conductors in circuits in which the line voltage is above 3000 volts AC.

Important General Notes:

1. When using the test lead with the green insulator, connect this to the Neutral before connecting the other leads.

2. Each color-coded current transducer must be connected to the same phase line that the corresponding color-coded voltage test lead is connected.

3. The current transducers must be clamped around the conductors so that the name "AMPROBE" faces towards the load (See Fig. 9-12).

Note: Any current transducer or voltage test lead that is not needed on a particular system should be stored in the recorder's case.

Operating the Recorder as an Indicating Meter:

1. Connect line cord to proper voltage.

2. Move chart drive switch to "OFF" position, (See Fig 2).

3. Remove chart paper from instrument, exposing the scale plate and pointer.

4. Adjust pointer to zero, as indicated on page 7, and replace the cover.

5. Follow steps 2 through 8 of "OPERATING THE RECORDER" and connect as shown in Fig. 9-12.

6. Read value on appropriate range on scale plate.

CURRENT TRANSDUCER AND

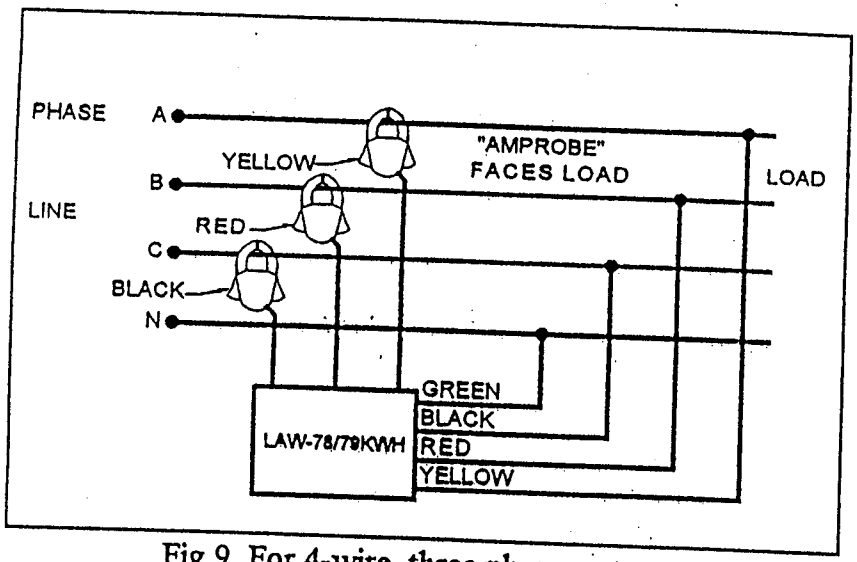


Fig 9. For 4-wire, three phase systems.

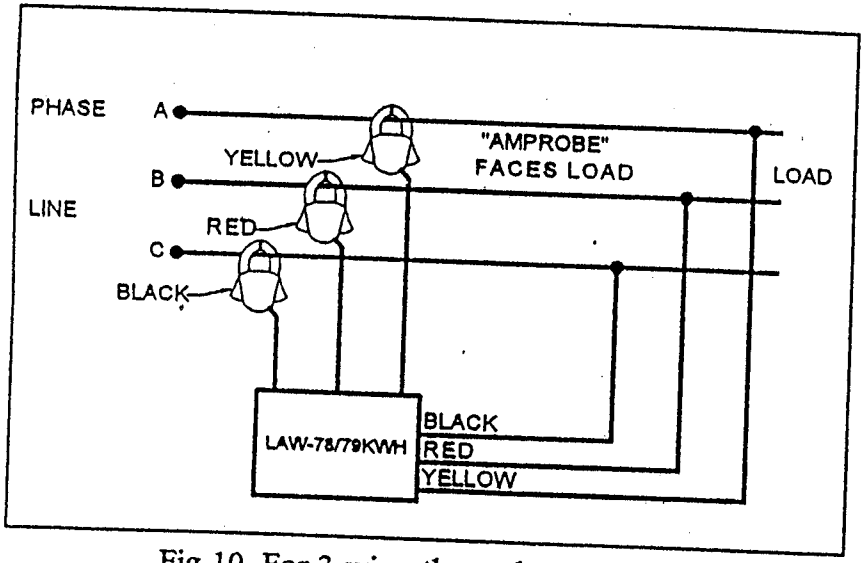


Fig 10. For 3-wire, three phase systems.

VOLTAGE TEST LEAD CONNECTIONS

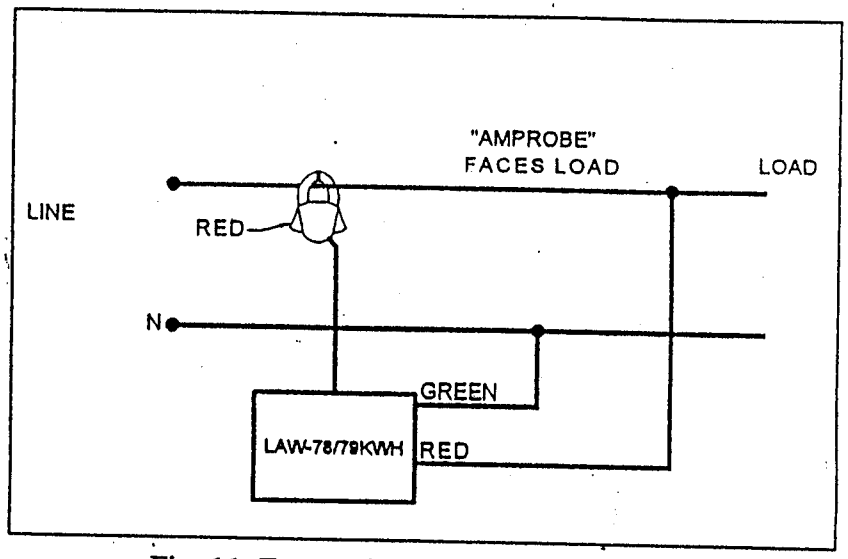


Fig. 11. For 2-wire, single phase systems.

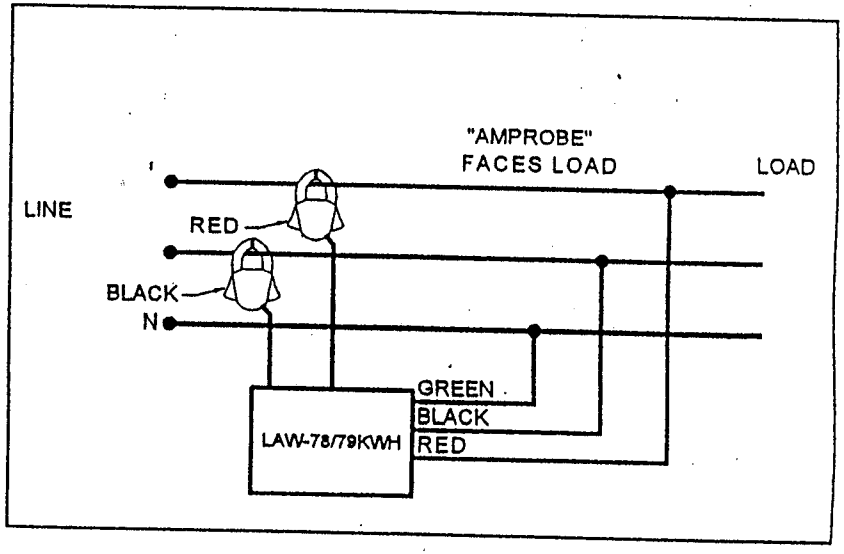


Fig 12. For 3-wire, single phase systems.

Table of Ranges								
			KW/KVAR RANGES					
	AMPERES		LAW78KWH(T)			LAW79KWH(T)		
VOLTS	LAW78(T)	LAW79KWH	x1/4	x1/2	x1	x1/4	x1/2	x1
120-1Ø	0-200	0-50	30	60	120	7.5	15	30
120-1Ø	0-400	0-100	60	120	240	15	30	60
120-1Ø	0-800	0-200	120	240	480	30	60	120
120/208-3Ø	0-200	0-50	30	60	120	7.5	15	30
120/208-3Ø	0-400	0-100	60	120	240	15	30	60
120/208-3Ø	0-800	0-200	120	240	480	30	60	120
240-1Ø (3-WIRE)	0-200	0-50	30	60	120	7.5	15	30
240-1Ø (3-WIRE)	0-400	0-100	60	120	240	15	30	60
240-1Ø (3-WIRE)	0-800	0-200	120	240	480	30	60	120
240-3Ø	0-200	0-50	30	60	120	7.5	15	30
240-3Ø	0-400	0-100	60	120	240	15	30	60
240-3Ø	0-800	0-200	120	240	480	30	60	120
208/277-1Ø	0-200	0-50	60	120	240	15	30	60
208/277-1Ø	0-400	0-100	120	240	480	30	60	120
208/277-1Ø	0-800	0-200	240	480	960	60	120	240
277/480-3Ø	0-200	0-50	60	120	240	15	30	60
277/480-3Ø	0-400	0-100	120	240	480	30	60	120
277/480-3Ø	0-800	0-200	240	480	960	60	120	240
240-1Ø (2 wire)	0-200	0-50	60	120	240	15	30	60
240-1Ø (2 wire)	0-400	0-100	120	240	480	30	60	120
240-1Ø (2 wire)	0-800	0-200	240	480	960	60	120	240
550-3Ø	0-200	0-50	60	120	240	15	30	60
550-3Ø	0-400	0-100	120	240	480	30	60	120
550-3Ø	0-800	0-200	240	480	960	60	120	240

NOTES:

1-The above nominal voltages may be exceeded by 10%.

2-Use 277/480-3Ø setting for 380V-3Ø.

READING CHART PAPER

Example:

1. Install chart paper in recorder. Select range to be used and mark this range on the chart paper.

2. Determine the number of divisions (lines) on the chart paper. The 824W (LAW-78KWH) and the 896W (LAW-79KWH) both have 30 divisions.

3 Determine the number of divisions (lines) on the chart paper. The 896W (LAW-78KWH) and the 824W (LAW-79KWH) both have 30 divisions.

4. Count the number of divisions to the place where a dot was made on the chart. Multiply the number of divisions counted by 4. THIS WILL GIVE YOU YOUR ACTUAL READING; 8 divisions times 4 KW = 32 KW thus 32KW is the value indicated on the chart, (fig 13).

Note: This procedure will work on any chart that is linear. The total number of divisions may change (30, 40, 50) but the procedure is the same.

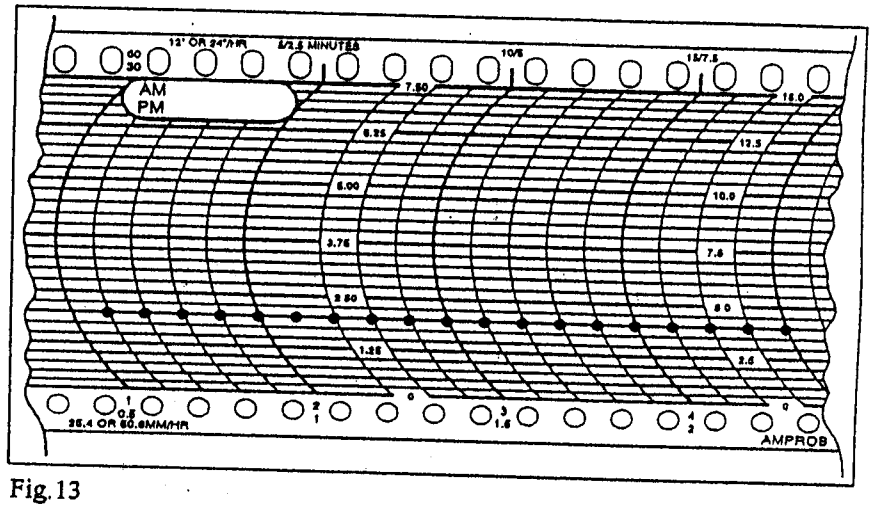


Fig.13

READING NOMOGRAPH TO DETERMINE POWER FACTOR

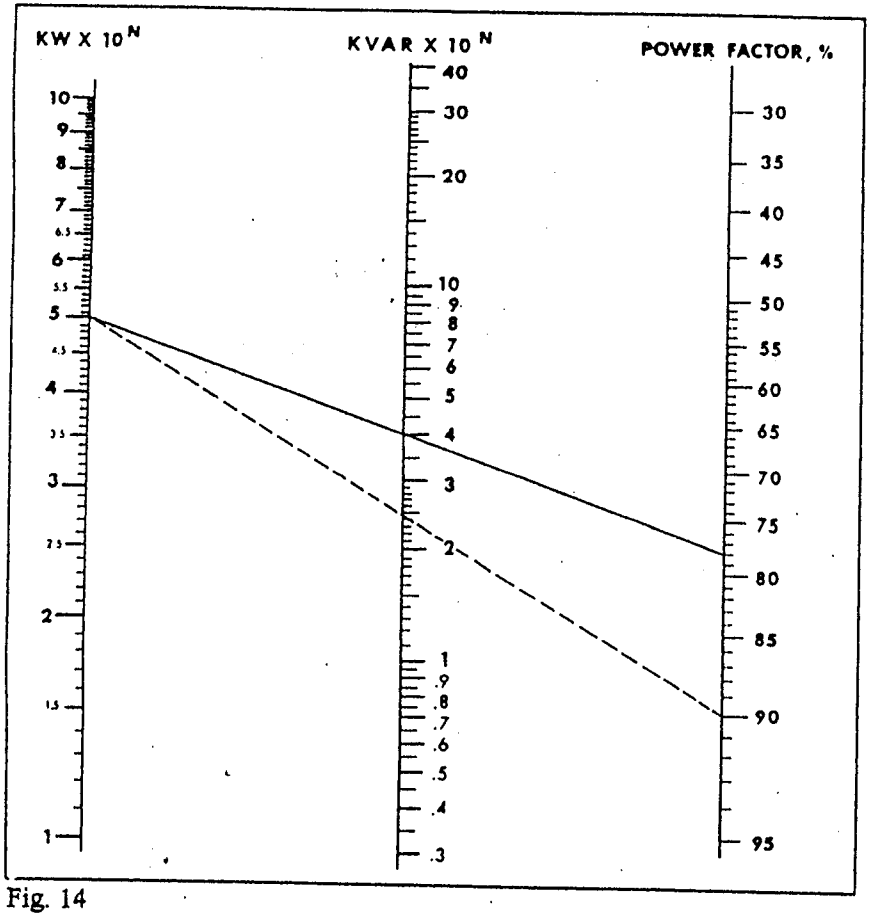


Fig. 14

Example:

Readings of 50KW and 40KVAR from the LAW-79KWH chart are plotted on the nomograph, Draw a line, through these points to the "Power Factor" scale and read the power factor - 78%. If power factor is to be improved to 90%, draw a line from 90% to 50KW. Read the KVAR where this line crosses the KVAR scale - 24.2 KVAR. Subtract this from the LAW-78/79KWH KVAR reading of 40; 40-24.2=15.8 KVAR of capacitance necessary to correct power factor to 90% (see fig. 14).

SPECIFICATIONS

Recording Ranges: LAW-79KWH 0-7.5/15/30/60/120/240 KW/KVAR*
LAW-78KWH 0-30/60/120/240/960 KW/KVAR*
*Leading or Lagging

Inputs:	**AC Amps**	**AC Volts**
LAW-79KWH(T)	0-50/100/200	120/208/220/240/277/480/550
LAW-78KWH(T)	0-200/400/800	120/208/220/240/277/480/550

Max. Conductor Diameter: LAW-79KWH(T) - 1" (2.5 cm)
LAW-78KWH(T) - 2" (5.1 cm)

Recorder Accuracy: All single-phase measurements (regardless of recorder sensitivity) or for 3-phase measurements with sensitivity =X1

Kilowatts ± 3% of full scale
Kilovars ±4% of full scale for sinusoidal waveforms

3-phase measurements with sensitivity = X½ or X¼:

Kilowatts ± 3% of full scale for power factor ≥ 50%
Kilovars ±4% of full scale for sinusoidal waveforms with power factors ≥ 87%

Dot Pattern: Watts 8 dots; Vars 2 dots

Kilowatt Hour Readout:	8-Digit LCD display, 1 Kilowatt Hour per count.
Kilowatt Hour Readout Accuracy:	Better than 2% of reading ±1 count, given the following conditions: 1. Sinusoidal waveforms with power factors ≥ 0.5 Ambient temperature =77°F (25°C) 2. Accuracy at temperature extremes: From 32°F (0°C) to 113°F(45°C), less than 2% deviation from 77°F(25°C) performance. Note: The 100A range (LAW79KWH only) and the 200A range (both models) meet ANSI standard C12.1 sections 5.1.8.3 through 5.1.8.8 and 5.1.8.11.
Chart Speed:	Depends on speed specified when ordering. See label between capstan wheels.
Lead Length:	All leads are 5 feet long. They may be extended to 100 feet by splicing in #18 AWG stranded copper wire. Polarity must be observed when splicing in extensions.
Operating Temp:	32°F to 113°F (0°C to 45°C)
Kilowatt-Hour Readout Battery Life:	5 Years
Power:	120V 60Hz, 8Watts

Fuse Rating:	.25 Amps/250 Volts
Weight:	7 Lb. (3.17 Kg)
Transducer Lead Length:	5ft.
Size:	Take up models 9" D x 10 3/4" W x 9" H (228.6mm D x 273mm W x 228.6mm H) Non Take-up models 13 1/2" D x 10" W x 5 1/2" H (349.9mm D x 254mm W x 139.7mm H)
Chart Paper Length:	60 ft. & 30 ft. for take up models 30 ft. for non take up models