HICKOK

POWER LINE PROBERS

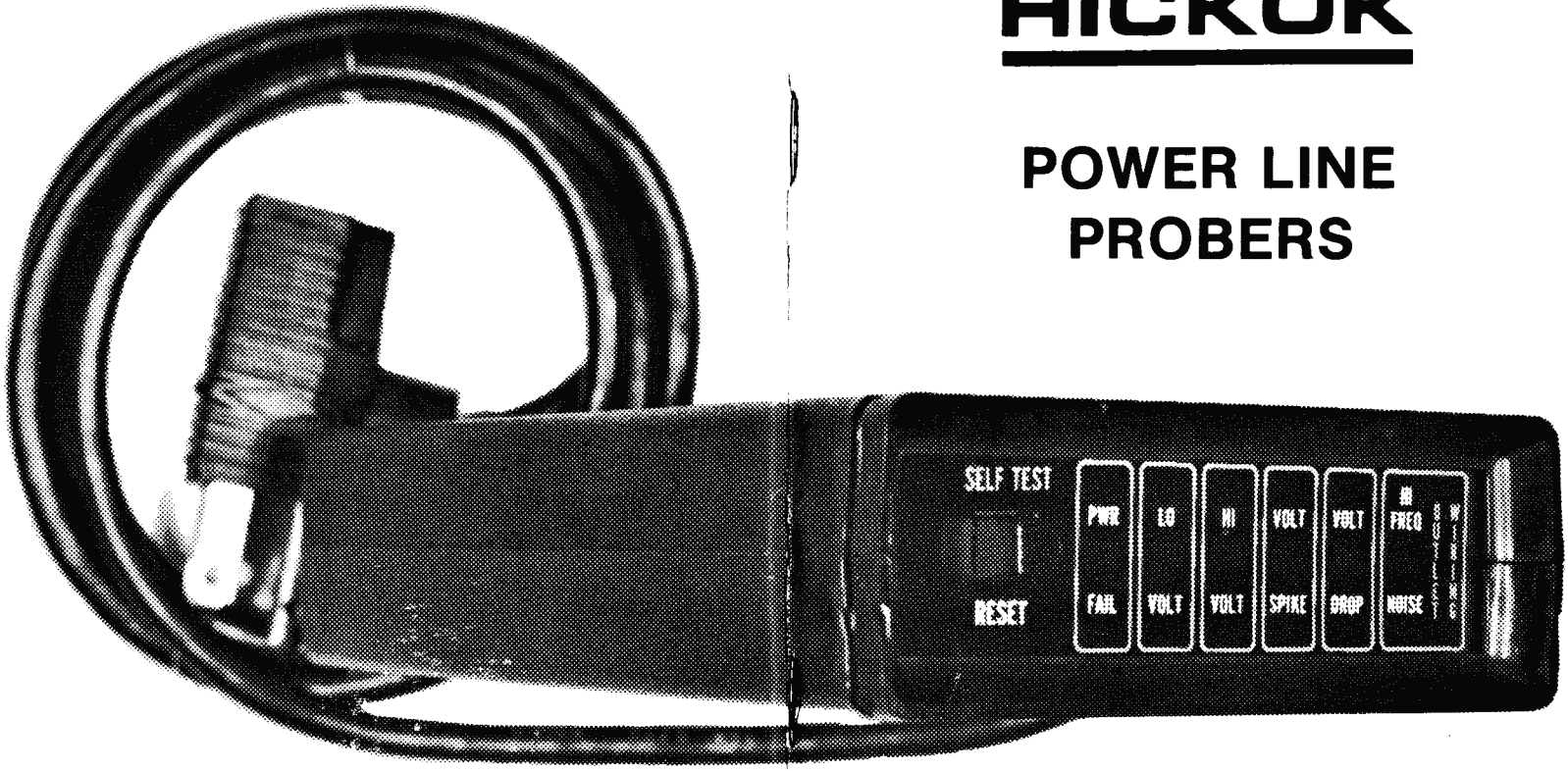

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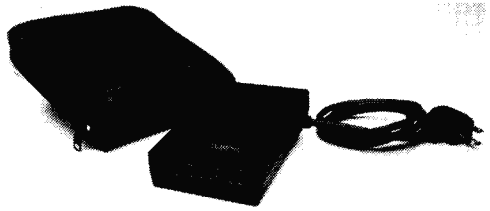
TABLE OF CONTENTS

SECTION I
GENERAL



Your POWER LINE PROBER is a sophisticated instrument designed to monitor power lines and to identify power line abnormalities which can affect the operation of electronic equipment. POWER LINE PROBERS monitor every significant power associated electrical condition which is known to affect the operation of electronic equipment.

The POWER LINE PROBERS have been designed to respond to abnormalities in the power lines in the same fashion in which operating electronic equipment responds. Some monitors are designed to measure the power lines to fixed voltage and time parameters. The fixed set point method does not necessarily catch all the abnormalities which can affect sensitive electronic equipment. The POWER LINE PROBERS do!

The POWER LINE PROBERS are a low cost method of monitoring the power line, and detecting the type of abnormalities which occur. By noting what kinds of abnormalities occur, the user can often determine the source of the problems. In the event the abnormalities cannot be prevented, the user can determine the most cost effective conditioning equipment to correct the problem. In addition, with the Data Output and other options available for the POWER LINE PROBERS, they can be used for continuous on-site monitoring. The user can automatically initiate action to protect equipment, or record the times at which abnormalities occur to name just a few uses.

POWER LINE PROBERS are small and lightweight yet extremely rugged for field portability. In addition, their high style case and convenient piggyback plug make them compatible with their surroundings in even the most sophisticated computer complex.

SECTION II
SPECIFICATIONS

MODELS 115 AND 116

NOMINAL LINE 120V RMS, 60Hz

TEST	FACTORY SETTINGS (RMS) VOLTAGE	FACTORY SETTINGS MINIMUM TIME	VOLTAGE THRESHOLD RANGE (RMS) (See Section VI)
PWR FAIL	80V ±3%	*	70 to 105V
HI VOLT	130V ±3%	*	125 to 140V
LO VOLT	108V ±3%	*	100 to 115V
VOLT DROP	95V ±3%	20msec ±10%	70 to 105V
VOLT SPIKE	200V peak ±10%	10μsec ±10%	Fixed
HI FREQ NOISE			
Hot Side to Ground	2V p-p at 100KHz	15msec ±10%	Fixed
Neutral to Ground	4V p-p at 100KHz	15msec ±10%	Fixed

Frequency response 10KHz to 5MHz

* Response time depends on original voltage and the voltage change. See ALARM RESPONSE graph, page 6.

OUTLET WIRING Tests for proper connections at outlet, responds to the following errors:

1. Neutral and hot lines reversed
2. Missing ground connection (15V RMS or greater to neutral)
3. Poor neutral connection (15V RMS or greater to ground)

SELF TEST Performs operational test of circuitry when unit is reset. All indicators on while button is depressed indicates proper operation.

RESET Clears all memories and alarms

Front Panel Indicators: Six individual indicators. Alarm condition activates appropriate light and latches into memory. Continuing or recurring condition causes indicator to blink except **PWR FAIL** and **VOLT DROP**.

DATA OUTPUT

Model 116 (typical)

Format	Serial, 600 baud, low true
Voltage Levels	±5V to ±12V (voltage and pullup user supplied)
Output Current Source/Sink	2mA max
Strobe Addressing	Requires 5V, 10mA, 15ms min. Strobe. Resets all alarms at completion of data output.
Voltage Isolation	500V (optically isolated)

Output Connector	Modular Jack (telephone line cord) Mating Connector (Saxton Products part no. 5142, typical) 1 each supplied with unit

OPTIONAL ALARMS

Audible Alarm — OPTION 01

Availability	All Models
Alarm	Approx 5 second beep at occurrence
Continuing Fault	Beeps alternately on and off during continuance of fault condition
Alarm Functions	All

Switch Closure — OPTION 02

Availability	Models without Data Output only
Alarm	Switch closure
Contact Rating	0.5A, 120V RMS max (resistive)
Alarm Functions	Power Failure and any combination of other alarm conditions. User specified, factory installed.

GENERAL SPECIFICATIONS

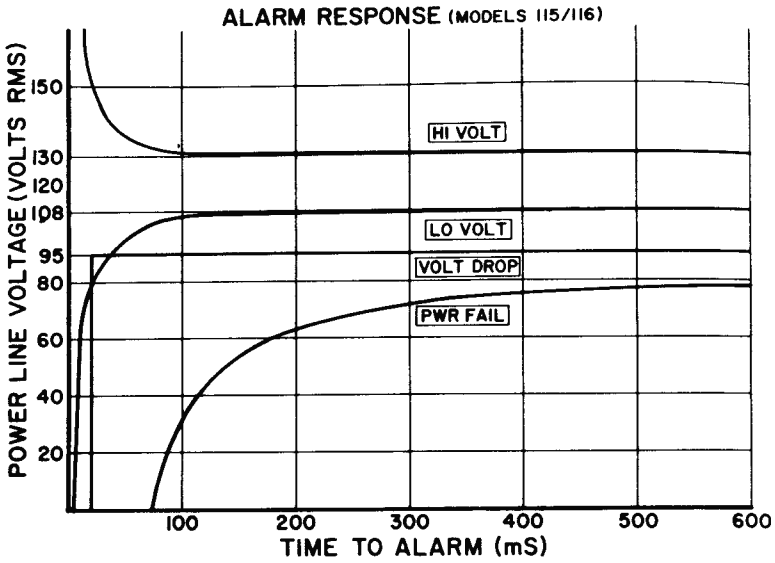
Power Requirement	2.5 watts max. Voltage/Frequency dependent upon model. See UNITS FOR VARIOUS VOLTAGES AND FREQUENCIES below.

Temperature	-20° to +50°C operating; -40° to +75°C storage
Shock & Vibration	Meets MIL-T-28800 specifications
Humidity	Up to 95% (noncondensing)
Dimensions	6 x 3.5 x 1.38 in. (15.2 x 8.9 x 3.3 cm)
Weight	1 lb (454 grams)
Case Material	High impact, fire retardant, ABS plastic
Plug	American Standard, 3 prong with parallel tap, 5 ft long cord
Accessories	Supplied with soft vinyl carrying case

UNITS FOR VARIOUS VOLTAGES AND FREQUENCIES

BASIC UNIT		WITH DATA OUTPUT	VOLTAGE/FREQUENCY
Model 115	or	116	120V/60Hz
Model 115A	or	116A	120V/50Hz
Model 115B	or	116B	120V/400Hz
Model 230C	or	231C	208V/60Hz
Model 230	or	231	240V/60Hz
Model 230A	or	231A	240V/50Hz
Model 230B	or	231B	240V/400Hz

Designation of voltage and frequency applicability is found on the rear panel of the unit. For units other than Models 115 and 116 an Addendum page is supplied with this manual.



SECTION III
OPERATING INSTRUCTIONS

Upon receiving your POWER LINE PROBER, remove the unit from its shipping carton and inspect it for visible damage. To test the POWER LINE PROBER for proper operation proceed as foilows:

1. Plug the unit into a three prong, grounded outlet. The **PWR FAIL** indicator will light if power is available at the outlet. All other indicators will be off.

2. Depress the **RESET/SELF-TEST** button. While the button is depressed, the POWER LINE PROBER will self-test its electronic circuitry for proper operation. While the button is depressed, all indicators should be lighted. If any indicator does not light, refer to CALIBRATION AND MAINTENANCE, Section IX.

3. Release the **RESET/SELF-TEST** button. At release all internal memory elements are reset. If no power line abnormalities are occurring, all indicators will be turned off. If any indicator is on, the POWER LINE PROBER has sensed a power line abnormality. If any indicators except **VOLT DROP** and **PWR FAIL** are flashing, the condition which caused the alarm is still occurring. The indicators for **VOLT DROP** and **PWR FAIL** turn on if an abnormality has been sensed. However, unlike the other indicators, they do not flash if the abnormality continues.

If the **HIGH FREQ NOISE/OUTLET WIRING** indicator is on and continues to flash after resetting the unit, it is very likely an outlet wiring problem is present. Refer to INTERPRETATION OF ALARMS, below, for further information.

If your POWER LINE PROBER has the AUDIBLE ALARM OPTION installed, it will beep for about 5 seconds when a power line abnormality is sensed. If the abnormality (except **VOLT DROP** and **PWR FAIL**) continues, the unit will intermittently beep at approximately two beeps per second.

SECTION IV
INTERPRETATION OF ALARMS

PWR FAIL

The **PWR FAIL** alarm senses for conditions in which the power line drops below a preset voltage (80V factory setting for the Model 115) for an extended period of time. The time that the line must remain below the set point varies with the amount the actual voltage is below the set point. Consult the graph on page 6, for the relationship between time and voltage. For most practical purposes the **PWR FAIL** senses for major interruptions of power. These interruptions are generally power source or intermittent connection related.

Since the POWER LINE PROBER also operates from the power line, if it senses a **PWR FAIL** condition, it cannot determine if any indications it may have of other power line abnormalities are correct. Therefore, to avoid possible misleading indications, **PWR FAIL** is an override condition which turns off all other alarms. In other words, if the POWER LINE PROBER senses a **PWR FAIL** condition it overrides all other indicators and only the **PWR FAIL** indicator will be illuminated.

Unlike the other alarms, except **VOLT DROP**, the **PWR FAIL** indicator does not blink if the power failure condition continues. If an extremely low line continues it can be generally detected because the **PWR FAIL** indicator will be more dimly lighted than normal. The **PWR FAIL** threshold can be field adjusted through the rear panel access door. See FIELD ADJUSTMENT OF ALARM THRESHOLDS, Section VI.

LO VOLT

The **LO VOLT** alarm senses for voltages below a preset threshold for a moderate time duration. The **LO VOLT** threshold is factory adjusted for 108V RMS in the Model 115. It can be field adjusted over a range of 100 to 115V via the access door located on the rear panel of the unit. See FIELD ADJUSTMENT OF ALARM THRESHOLDS, Section VI.

The time it takes the alarm to indicate a failure mode depends on the original voltage and the amount the voltage is below the alarm threshold. See ALARM RESPONSE graph, page 6, for the relationship between time and voltage.

When the POWER LINE PROBER detects a **LO VOLT** condition, the alarm is immediately latched into memory and the **LO VOLT** indicator is lighted. If the condition remains below the alarm threshold, the indicator will blink indicating that the condition persists. If the condition causing the alarm has stopped and the line is now above the threshold, the indicator will remain lighted continuously. This indicates that an alarm condition was sensed but the condition no longer continues.

LO VOLT is essentially sensing for conditions in which the power line is low but not technically in a power failure condition. So called brown outs are a typical example of this type of abnormal condition. These conditions are sometimes power company related but more often than not they indicate excessive power circuit loading or poor connections in the wiring between the power source and the outlet.

VOLT DROP

The **VOLT DROP** alarm senses for a short duration of line voltage drop below a preset threshold (factory threshold is set at 95V for the Model 115). The threshold can be field adjusted through the rear panel access door. See FIELD ADJUSTMENT OF ALARMS, Section VI.

The **VOLT DROP** alarm requires that the line voltage drop below the alarm threshold and remain below the threshold for one full cycle or more of the power line frequency. When this condition is detected, the alarm is immediately transferred to memory and the **VOLT DROP** indicator is lighted. Unlike the other indicators, except **PWR FAIL**, if the alarm condition persists, the **VOLT DROP** indicator does not blink.

Note that **VOLT DROP** and **LO VOLT** thresholds are normally at different settings. If the power line should drop below **VOLT DROP** threshold for an extended period but remain above **PWR FAIL**, both the **LO VOLT** and **VOLT DROP** indicators will be lighted. If this occurs, the user knows the line voltage was below 95V for an extended period (more than 50msec) but above 80V. Often this kind of information can be invaluable in determining the source of the problem.

When only the **VOLT DROP** alarm is lighted, the likely sources of the abnormality are large loads briefly applied to the power line or intermittent connections.

HI VOLT

The **HI VOLT** alarm senses for voltage above a preset threshold for a moderate time duration. The **HI VOLT** threshold is factory adjusted for 130V RMS in the Model 115. It can be field adjusted over a range of 125 to 140V via the access door located on the rear panel of the unit. See FIELD ADJUSTMENT OF ALARM THRESHOLDS, Section VI.

The time it takes the alarm to indicate a failure mode depends on the original voltage and the amount the abnormal voltage is above the alarm threshold. See ALARM RESPONSE graph, page 6, for the relationship between time and voltage.

When the POWER LINE PROBER detects a **HI VOLT** condition, the alarm is immediately latched into memory and the **HI VOLT** indicator is lighted. If the condition remains above the alarm threshold, the indicator will blink indicating that the condition persists. If the condition causing the alarm stopped and the line is now below the threshold, the indicator will remain lighted continuously. This indicates that an alarm condition was sensed but the condition no longer continues.

HI VOLT is essentially sensing for conditions in which the power line voltage is above safe limits for a moderate time period. Over voltage conditions can be extremely damaging to electronic equipment causing outright failure or at least substantially shortening the equipment life.

Conditions causing **HI VOLT** alarm are sometimes caused by power company malfunctions but more often are encountered due to too light a load on the power line within the facility. If there are in-house line regulators or stand by equipment, these should be checked as possible sources of the problem.

VOLT SPIKE

The **VOLT SPIKE** alarm senses for voltage spikes of greater than 200V peak and greater than 10μsec long on the power line. Spikes will be detected regardless of

their polarity or position on the power line waveform. If the POWER LINE PROBER senses a voltage spike it immediately transfers the alarm to memory and lights the **VOLT SPIKE** indicator. If voltage spikes continue to be sensed, each time a voltage spike is sensed the indicator will blink. If voltage spikes continue at a rate in excess of 2 per second, the indicator will blink at approximately a 2Hz continuous rate.

Voltage spikes are extremely serious power line abnormalities often causing equipment failure. Sources of voltage spikes are generally lightning striking the power lines or large inductive loads connecting or disconnecting from the power line such as motors, relays, and contactors etc.

HIGH FREQ NOISE

The **HIGH FREQ NOISE** alarm senses for the presence of voltages as low as 2V peak to peak with frequencies between 10KHz and 5MHz on the power line. For the alarm to be activated, 15msec of the high frequency noise must be present. The alarm senses for the presence of these signals between the hot line and ground and between the neutral wire and ground. If voltages in excess of 2V peak to peak at 100KHz are present between hot side and ground or 4V peak to peak at 100KHz are present between neutral and ground, the alarm will be immediately committed to memory and the **HIGH FREQ NOISE** indicator will be lighted. If the high frequency noise continues or reoccurs, the indicator will blink at approximately a 2Hz rate.

In addition to sensing for the presence of high frequency on the power line the **HIGH FREQ NOISE** indicator doubles as an outlet wiring test. Generally conditions causing a **HIGH FREQ NOISE** indication are different than those caused by outlet wiring. In most situations high frequency noise is an intermittent condition on the power line. If the indicator is turned on and continuously blinks, a test for proper outlet wiring should be performed before assuming that the condition is caused by high frequency noise. Once the outlet wiring is verified, continuing indication would be caused by high frequency noise.

High frequency noise on the line will not generally damage electronic equipment but it will often cause strange unexplained malfunctions. Sources of high frequency noise are generally other electronic equipment with improper EMI/RFI protection on the local power line.

OUTLET WIRING

The same indicator is used for **OUTLET WIRING** as for **HIGH FREQ NOISE**. The **OUTLET WIRING** alarm senses for improper or missing connections to the outlet the POWER LINE PROBER is plugged into. It will alarm under the following conditions:

1. Neutral and hot lines are reversed.

2. The ground connection is missing.

3. There is a poor connection between neutral and ground.

When these conditions exist, they are normally fixed conditions. The alarm will be immediately committed to memory and the condition will, of course, by its nature continue. The indicator will therefore blink continuously. If after plugging the POWER LINE PROBER into the outlet and resetting the unit, the **HIGH FREQ NOISE/OUTLET WIRING** indicator is lighted and immediately continues to blink, it is likely the POWER LINE PROBER has sensed an improper outlet wiring condition. If after reset, the indicator remains off and at some time later alarms, it is likely that the indication is the presence of high frequency noise on the line.

When using the POWER LINE PROBER to determine outlet wiring connections it is wise to unplug other pieces of equipment also connected to the same circuit as they may internally make the proper connections between neutral and ground. While they are plugged in, the proper connections exist; however, when they are unplugged, improper connections would be present.

SECTION V
ALARM RESPONSE TIME

The **PWR FAIL, LO VOLTS,** and **HI VOLTS** alarms are designed to respond with a variable delay to line voltage above or below their respective alarm thresholds. This variable delay closely simulates the response of the capacitive filtered DC power supplies in most electronic equipment.

Refer to ALARM RESPONSE graph, page 6. As you can see from the graph, the greater the deviation from nominal the high or low voltage condition is, the shorter the response time of the associated alarm. As an example, if the power line had been at a nominal 115V RMS and it drops to approximately 105V RMS, the **LO VOLT** alarm will take approximately 100msec to indicate this as a power line deficiency. On the other hand, if the line had been at its 115V RMS nominal and it drops to approximately 60V the **LO VOLT** alarm will detect this condition as a power line deficiency in only 15msec.

The length of time the sensors take to alarm also depends on the initial voltage of the power line. In the case of the **PWR FAIL** and **LO VOLT** alarms, the alarms will adapt by responding faster if the initial voltage is lower than 115V RMS and slower if the initial voltage is higher than 115V RMS. For the **HI VOLT** alarm, just the opposite is true. If the initial voltage is lower than 115V RMS, the alarm response is slower; if the initial voltage is higher than 115V RMS, the alarm responds more rapidly.

The response of the alarms is analogous to the response of electronic power supplies. Due to the power stored in the filter capacitors of power supplies, how rapidly they reach operating limits depends both on the initial voltage and the value of the abnormal condition. If the initial voltage is higher than nominal, the power supply will have more energy stored in the filter capacitors. In the case of a drop in voltage, this extra energy will allow the supplies to operate longer before they reach the point of causing their associated circuitry to malfunction. If the initial voltage is low and drops below the proper line voltage specifications, the filter capacitors have less energy stored in them and can therefore supply their associated circuitry for a much shorter period of time before malfunction.

The converse is true for cases in which the line voltage suddenly goes above specified limits. If the initial voltage was low and increases above specification limits, the filter capacitors will take some time to charge before exceeding safe limits on their associated circuits. If the initial voltage was high and increases above specification limits, it will take only a short period of time to charge the capacitors above safe operating limits for their associated circuits. The POWER LINE PROBER is designed to respond in the same way at about the same speed as typical sophisticated electronic equipment.

SECTION VI
FIELD ADJUSTMENT OF THRESHOLD

The POWER LINE PROBER is designed to allow the user to easily and accurately adjust the alarm voltage thresholds of **HI VOLT, LO VOLT, PWR FAIL,** and **VOLT DROP** sensors. Only a standard voltmeter with an input impedance of 10MΩ or greater and sufficient accuracy is required to accurately readjust the threshold. The limits over which the threshold can be adjusted are contained in SPECIFICATIONS, Section II.

WARNING

In order to readjust the POWER LINE PROBER, it must be connected to a properly operating power line. The internal circuits including the test points to be monitored during readjustment are directly connected to the neutral side of the power line. Standard electrical safety practices should be observed as when working on any line operated equipment.

Before attempting adjustment, be certain that the outlet powering the unit is correctly wired and that the POWER LINE PROBER is correctly plugged into the outlet.

CAUTION

Be sure that tools and equipment used in making a threshold adjustment are properly insulated and that the person making the adjustment does not touch any exposed metal on tools, instruments, or the POWER LINE PROBER.

TO GAIN ACCESS TO ADJUSTMENTS

To gain access to the threshold adjustment controls, remove the screw locking the access door on the rear panel. Place two fingers on the access door and slide it toward the bottom of the unit. Once removed, the test points and adjustment

controls are plainly visible and each is labeled. The small square connector at the top left of the compartment is the test point block. The DC voltmeter will be connected between COM and the corresponding test point. The threshold setting for each of the four alarms corresponds directly to the DC voltage between COM and the test point.

The conversion factor is:

THRESHOLD VOLTAGE SETTING (VAC RMS) X 0.02 =
TEST POINT VOLTAGE (VDC)

For example:

100V RMS X 0.02 = 2.00V DC

In order to readjust the threshold for a 100V RMS threshold, the appropriate alarm adjustment must be adjusted to 2.00V DC.

ADJUSTMENT PROCEDURE

CAUTION

Dangerous voltage levels may be present at the test points in the event of an outlet wiring error. Be sure the outlet is wired properly before attempting to readjust the POWER LINE PROBER thresholds.

Tools Required

1. Small INSULATED screwdriver.
2. DC Voltmeter, 10MΩ input impedance, accuracy ±0.5% or better.

Procedure

1. Plug the POWER LINE PROBER into an appropriate outlet and verify proper outlet wiring.

2. Set the voltmeter to the 1V DC or 10V DC range as required.
3. Touch the negative (-) test probe to COM.
4. Touch the positive (+) test probe to the test point of the threshold to be adjusted.
5. Using the formula:

   THRESHOLD VOLTAGE SETTING (VAC RMS) X 0.02 =
   TEST POINT VOLTAGE (VDC)

   adjust the appropriate control as required to attain the DC volts determined using the formula above for the new threshold setting.
6. When the adjustments are complete, replace the access door and the locking screw.

SECTION VII
DATA OUTPUT (MODEL 116)

Model 116 and Model 231 POWER LINE PROBERS have data output capability. The status of the indicators can be inquired by applying the appropriate strobe pulse to the "Strobe Line." When a strobe pulse is applied, the "Output Line" will output in serial form the status of all indicators and at completion of the transmission will clear all alarms reenabling the POWER LINE PROBER to begin monitoring for additional power line disturbances.

The connection to the DATA OUTPUT is made through a standard modular type telephone jack located under the rear access door. A 7 foot modular type phone line cord terminated in spade lugs is supplied with the unit. This type of telephone line cord is commonly available at most telephone accessory outlets.

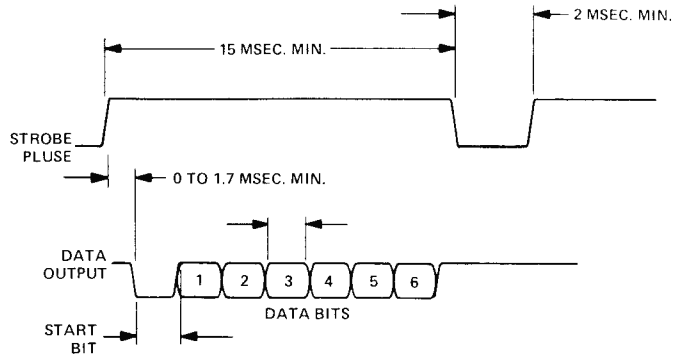
Figure 2 illustrates the pin connections to the output jack and details the specifics of the optical isolator devices internal to the POWER LINE PROBER. The figure also contains a typical interface circuit configuration which may be used with the DATA OUTPUT.

Specifications on the details of the data format and required signals are described below. The DATA OUTPUT is optically isolated from the remainder of the internal circuitry.

DATA OUTPUT FORMAT

600 baud asynchronous, serial, 6 data bits, 1 stop bit. The user must supply power and pullup resistors for the "Strobe" and "Output" lines. Requirements on the power and pullup limits are contained in SPECIFICATIONS, Section II. Below is a timing diagram of the output and strobe signals.

To enable transmitting of the POWER LINE PROBER alarm status, a 15msec strobe pulse is applied to the "Strobe Line." The alarm status will be output in serial form with a low level representing a valid alarm indication. At the completion of the output, all alarms will be automatically cleared. A minimum of 2msec should be allowed between strobes. Note that since the Strobe effectively clears the memory at completion of a data output cycle, the instrument will not catch abnormalities which might occur during "output."



DATA BIT	ALARM INDICATOR
1	Power Failure
2	Low Voltage
3	High Voltage
4	Voltage Spike
5	Voltage Drop
6	High Frequency Noise

Figure 1

During a power fail condition, if the line voltage drops below approximately 70V the data output may not respond to a strobe pulse since the unit power is obtained from the power line. When power is restored all memory except **PWR FAIL** is cleared. Any other power line disturbances detected prior to or during the power failure condition will not be indicated.

If the **SELF-TEST/RESET** button is depressed during a strobe pulse, all of the data bits will be valid except the **PWR FAIL** bit. The **PWR FAIL** bit will be invalid during a self-test only if a **PWR FAIL** condition exists simultaneously with the self-test.

TYPICAL INTERFACE CIRCUIT FOR DATA OUTPUT

Under normal conditions the data output signals will have to be interfaced to be compatible with the input of the equipment which is monitoring the DATA OUTPUT. The DATA OUTPUT of the POWER LINE PROBER is the transistor of an optical isolator. The user must therefore supply both the power and the collector load for the transistor. Precautions should be observed to not exceed the 2mA source/sink specification of the transistor. A typical circuit is shown below where the emitter is connected to a minus supply voltage and the collector is connected through a resistor to a plus voltage. This configuration provides RS232 level compatibility. It is not recommended that the output when configured in this manner be transmitted over more than a 20 foot long wire without additional buffering.

The "Strobe Line" connects to the LED device of an optical isolator. To create the Strobe, a 10mA current must be applied between Pins 1 and 2 of the Jack with plus (+) applied to Pin 2. See figure 2 for details of the pin connections and typical circuits.

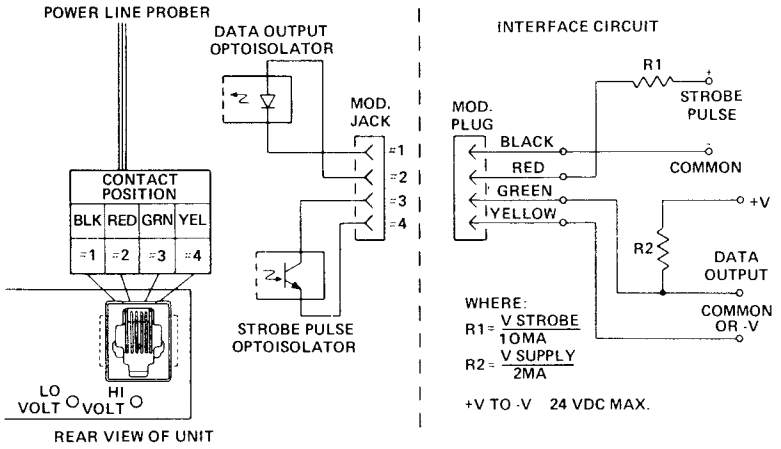


Figure 2

SECTION VIII
OPTIONAL ALARMS

SOUND ALERT ALARM (Option 01)

POWER LINE PROBERS equipped with the Sound Alert Alarm, in addition to lighting the appropriate indicator when a power line disturbance is detected, also emit a high pitched audible alarm. At the first detection of the disturbance, the instrument will emit about a 5 second high pitch sound. If the condition is not an on going or recurring condition, the alarm will silence itself after approximately 5 seconds and remain silent. If a condition other than **PWR FAIL** or **VOLT DROP** continues or recurs, the sound alert will beep intermittently at the same rate as the indicator blinks.

CONTACT CLOSURE ALARM (Option 02)

If your POWER LINE PROBER is equipped with the Option 02 Contact Closure Alarm, it has been fitted with detection circuitry and a relay which will provide an isolated hard contact closure in the event of specified alarm conditions. In the event of **PWR FAIL** the contact closure will always "make." In addition to contact closure with **PWR FAIL,** any combination of one or more of the other alarm sensors can be factory installed to cause contact closure. As an example, the Option 02 can be factory set to cause switch closure in the event of **PWR FAIL** or **VOLT DROP** or **LO VOLT** condition. Another example would be switch closure in the event of **PWR FAIL** or **HI VOLT**.

Once the switch has been closed due to an alarm condition, the switch will remain closed until the POWER LINE PROBER is reset using the front panel **SELF-TEST/RESET.** Connections to switch contacts are made through the modular type telephone line jack located under the rear panel access door. The contacts are located on Pins 1 and 2 of the modular jack. Switch contacts are completely isolated from all POWER LINE PROBER circuitry and are capable of making or breaking up to 0.5A at 120V RMS, resistive load. To control larger load power, the contact closure can be used in conjunction with external relays etc.

CAUTION

We recommend that contact closure NOT be connected directly to power line since dangerous voltages would exist on exposed pins of modular telephone plug should it become unplugged.

Below is a listing of the specific alarm functions which will activate the contact closure in your POWER LINE PROBER.

CONTACT CLOSURE TABLE UNIT SERIAL NO. _____

(used only if unit has Alarm Option installed)

- [x] PWR FAIL
- [ ] LO VOLT
- [ ] VOLT DROP
- [ ] HI VOLT
- [ ] VOLT SPIKE
- [ ] HIGH FREQ NOISE/ OUTLET WIRING

SECTION IX
CALIBRATION AND MAINTENANCE

Your POWER LINE PROBER has been designed using state of the art electronic technology and should provide long trouble free service. If difficulties are encountered, Hickok maintains complete service facilities to provide timely repair of our products. Refer to the warranty page at the rear of this manual for further details.

FIELD CALIBRATION

The POWER LINE PROBER is designed to maintain specified tolerances for 2 years without recalibration. If recalibration is desired proceed as follows:

Voltage Reference (V_{REF}) Check

Calibration check of V_{REF} can be accomplished through the rear panel access door. To gain access to the test points, remove the screw locking the access door on the rear panel. Place two fingers on the access door and slide it toward the bottom of the unit. Once removed, the test points and adjustment controls for thresholds are plainly visible and each is labeled. The small square connector at the top left of the compartment is the TEST POINT block. The DC voltmeter will be connected between COM and the corresponding test point.

CAUTION

Dangerous voltage levels may be present at the test points in the event of an outlet wiring error. Be sure the outlet is wired properly before attempting any measurements.

The Reference Voltage (V_{REF}) adjustment can be checked without further disassembly of the unit. Locate the Test Point connector under the rear access door.

Using a 10MΩ voltmeter with accuracy of at least ±0.1%, measure the voltage between test point (V_{REF}) and test point COM. The voltage should be 4.00 ±0.02V DC. If this voltage is not within specified limits, further disassembly of the unit will be necessary to readjust the reference.

Voltage Reference (V_{REF}) Recalibration

1. Disassemble the case by peeling off the four rubber feet on the bottom of the case and removing the four screws. The case halves will easily come apart.

> **WARNING**
>
> When power is applied to the unit, line voltage is present in portions of the circuit. It is suggested that only trained electronic technicians attempt to recalibrate the unit using all applicable electrical safety standard procedures. Under all conditions, remain insulated from the entire circuit to avoid possible dangerous electrical shock.

2. Using the voltmeter set to the 10V DC range, measure the voltage between test point COM and V_{REF}. Adjust the V_{REF} adjustment to obtain a reading of 4.00 ±0.02V DC V_{REF} to COM.

3. Disconnect the power and reassemble the case.

After completing the V_{REF} adjustment and reassembling the instrument, the alarm thresholds should be checked and readjusted if necessary. The threshold setting for each of the four alarms corresponds directly to the DC voltage between COM and the test point.

The conversion factor is:

THRESHOLD VOLTAGE SETTING (VAC RMS) X 0.02 =
TEST POINT VOLTAGE (VDC)

For example:

105V RMS X 0.02 = 2.10V DC

In order to readjust the threshold for a 105V RMS threshold, the appropriate alarm adjust must be adjusted to 2.10V DC.

Tools Required

1. Small INSULATED screwdriver.
2. DC Voltmeter, 10MΩ input impedance, accuracy ±0.1% or better.

Procedure

1. Plug the POWER LINE PROBER into an appropriate outlet and verify proper outlet wiring.
2. Set the voltmeter to the 1V DC or 10V DC range as required.
3. Touch the negative (-) test probe to COM.
4. Touch the positive (+) test probe to the test point of the threshold to be adjusted.
5. Using the formula:

   THRESHOLD VOLTAGE SETTING (VAC RMS) X 0.02 =
   TEST POINT VOLTAGE (VDC)

   adjust the appropriate control as required to attain the DC volts determined using the formula above for the threshold setting.

6. When the adjustments are complete, replace the access door and the locking screw.

PARTS REPLACEMENT

The only parts which can be easily user serviced are Field Replaceable Parts in the rear of this manual. To replace these parts, the case can be disassembled using the following procedure.

> **CAUTION**
>
> To avoid risk of dangerous electric shock, be certain the power cord is disconnected from any outlet before disassembling the case.

To disassemble the case, peel off the four rubber feet on the bottom and remove the four screws; the case halves will then come apart.

The Parts List and Schematics are provided to enable qualified personnel to review circuit operation of the POWER LINE PROBER. Servicing of the unit without proper isolation devices and test equipment can be dangerous and is not recommended.

FIELD REPLACEABLE PARTS LIST

ITEM	HICKOK PART NO.
Power Cord	3030-290
Case Top	3136-407
Case Bottom	3136-408
Front Panel	16025-710
Knob	11505-312
Access Door	4450-38

SECTION X
PARTS LIST

MODEL 115/116

When ordering parts be sure to give the reference designation, description, and the Hickok part number as listed in the following table. Parts listed are applicable to all models. Parts peculiar to a specific model are listed separately. Also include the model and serial number of the equipment. Minimum billing is $50.00. Orders for less than $50.00 will be accepted and shipped prepaid if accompanied by a check for the full amount plus $3.50 postage and handling.

REF. DESIG.	NOTES	DESCRIPTION	HICKOK PART NO.
C101		CAPACITOR, FIXED, ALUMINUM, . . . ELECTROLYTIC: .47 μf, 20%, 50 volts	3085-594
C102		Same as C101	
C103		CAPACITOR, FIXED, CERAMIC: . . . disc type, .001 μf	3111-522
C104		Same as C103	
C105		CAPACITOR, FIXED, CERAMIC: . . . monolythic type, .1 μf	3110-371
C106		CAPACITOR, FIXED, ALUMINUM, . . . ELECTROLYTIC: 1 μf, 20%, 50 volts	3085-577
C107		Same as C106	
C108		Same as C103	
C109		Same as C105	
C110		CAPACITOR, FIXED, ALUMINUM, . . . ELECTROLYTIC: 10 μf, 20%, 35 volts	3085-580
C111		Same as C106	
C112		Not used	
C113		Same as C110	
C114		CAPACITOR, FIXED, CERAMIC: . . . disc type, 100 pf	3111-516

REF. DESIG.	NOTES	DESCRIPTION	HICKOK PART NO.
C115		CAPACITOR, FIXED, CERAMIC: disc type, .01 μf, 25 volts	3110-332
C116		Same as C103	
C117		CAPACITOR, FIXED, POLYESTER FILM: .047 μf, 10%, 100 volts	3103-190
C118		Same as C103	
C119		Same as C114	
C120		Same as C114	
C121		Same as C115	
C122		Same as C105	
C123		Same as C106	
C124		Same as C105	
C125		Same as C105	
C126		Same as C114	
C127		Same as C115	
C128		Same as C105	
C129		CAPACITOR, FIXED, ALUMINUM: ELECTROLYTIC: 470 μf, 20%, 35 volts	3085-595
C130		Same as C105	
C131		Same as C115	
CR101		SEMICONDUCTOR DEVICE: zener diode 1N5735B	3870-369
CR102		SEMICONDUCTOR DEVICE: diode 1N4148 or 1N914	3870-289
CR103 thru CR108		Same as CR102	
CR109		SEMICONDUCTOR DEVICE: diode 1N4003	3870-329
CR110		Same as CR109	
CR111		Same as CR109	
DS101		LAMP: LED, rectangular MV57124	12270-146
DS102 thru DS106		Same as DS101	

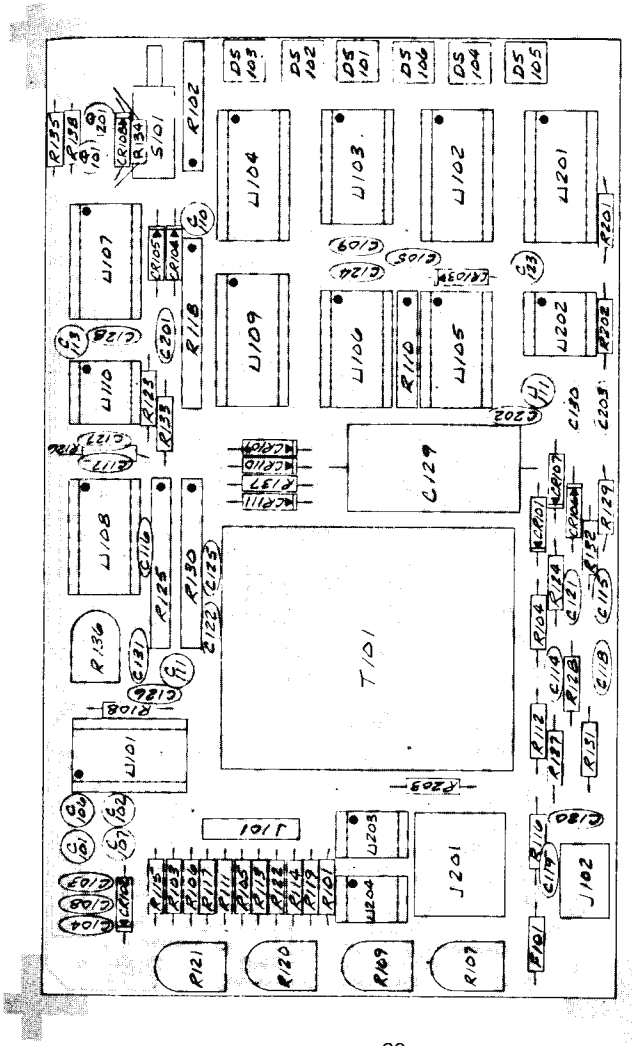
REF. DESIG.	NOTES	DESCRIPTION	HICKOK PART NO.
F101		FUSE: sub-miniature 3/4 amp, 125 volts	6900-114
Q101		TRANSISTOR: 2N3904	20861-141
R101		RESISTOR, FIXED, DEPOSITED CARBON: 16K ohms, 5%, 1/4 watt	18470-163
R102		RESISTOR, PRINTED CIRCUIT NETWORK: (7) 120 ohm resistors	16950-32
R103		RESISTOR, FIXED, METAL FILM: 1.33K ohms, 1%, 1/4 watt temp coeff	18581-133
R104		RESISTOR, FIXED, METAL FILM: 20.0K ohms, 1%, 1/4 watt temp coeff	18582-200
R105		RESISTOR, FIXED, DEPOSITED CARBON: 36K ohms, 5%, 1/4 watt	18470-363
R106		Same as R105	
R107		RESISTOR, VARIABLE: 100K ohms, horiz mtg	16925-820
R108		RESISTOR, FIXED, DEPOSITED CARBON: 15K ohms, 5%, 1/4 watt	18470-153
R109		Same as R107	
R110		RESISTOR, PRINTED CIRCUIT NETWORK: (4) 1 megohm resistors	16950-34
R111		RESISTOR, FIXED, METAL FILM: 511 ohms, 1%, 1/4 watt temp coeff	18580-511
R112		Same as R104	
R113		RESISTOR, FIXED, DEPOSITED CARBON: 56K ohms, 5%, 1/4 watt	18470-563
R114		RESISTOR, FIXED, DEPOSITED CARBON: 30K ohms, 5%, 1/4 watt	18470-303
R115		Same as R113	
R116		Same as R104	
R117		RESISTOR, FIXED, METAL FILM: 887 ohms, 1%, 1/4 watt temp coeff	18580-887
R118		RESISTOR, PRINTED CIRCUIT NETWORK: (5) 47K ohm resistors	16950-33
R119		RESISTOR, FIXED, DEPOSITED CARBON: 10K ohms, 5%, 1/4 watt	18470-103
R120		Same as R107	

REF. DESIG.	NOTES	DESCRIPTION	HICKOK PART NO.
R121		Same as R107	
R122		RESISTOR, FIXED, DEPOSITED CARBON: 6.8K ohms, 5%, 1/4 watt	18470-682
R123		RESISTOR, FIXED, METAL FILM: 383K ohms, 1%, 1/4 watt temp coeff	18583-383
R124		RESISTOR, FIXED, DEPOSITED CARBON: 47K ohms, 5%, 1/4 watt	18470-473
R125		Same as R118	
R126		RESISTOR, FIXED, DEPOSITED CARBON: 1.2K ohms, 5%, 1/4 watt	18470-122
R127		RESISTOR, FIXED, DEPOSITED CARBON: 620K ohms, 5%, 1/4 watt	18470-624
R128		Same as R127	
R129		Same as R124	
R130		Same as R118	
R131		Same as R108	
R132		RESISTOR, FIXED, DEPOSITED CARBON: 100K ohms, 5%, 1/4 watt	18470-104
R133		RESISTOR, FIXED, DEPOSITED CARBON: 11K ohms, 5%, 1/4 watt	18470-113
R134		Same as R132	
R135		RESISTOR, FIXED, DEPOSITED CARBON: 9.1K ohms, 5%, 1/4 watt	18470-912
R136		RESISTOR, VARIABLE: 5K ohms, horiz mtg	16925-846
R137		RESISTOR, FIXED, DEPOSITED CARBON: 51 ohms, 5%, 1/4 watt	18470-510
R138		RESISTOR, FIXED, DEPOSITED CARBON: 1K ohms, 5%, 1/4 watt	18470-102
S101		SWITCH: pushbutton, momentary 2p, 2t	19911-231
T101		TRANSFORMER: dual primary 50/60 Hz	20800-522
U101		INTEGRATED CIRCUIT: RCA 324G	9800-270
U102		INTEGRATED CIRCUIT: CMOS, quad nand r/s latch, MC14044BCP	9800-291

REF. DESIG.	NOTES	DESCRIPTION	HICKOK PART NO.
U103		INTEGRATED CIRCUIT: CMOS, quad nand, 4011	9800-131
U104		INTEGRATED CIRCUIT: CMOS, hex buffer, MC14050BCP	9800-292
U105		INTEGRATED CIRCUIT: quad 2-input NOR gate 4001	9800-96
U106		Same as U103	
U107		Same as U103	
U108		INTEGRATED CIRCUIT: quad comparator, LM339N	9800-290
U109		Same as U102	
U110		INTEGRATED CIRCUIT: low power timer, 1CM7555IPA	9800-254
U111		INTEGRATED CIRCUIT: positive voltage regulator, 8 volts, 5%, 100mA, MC78L08ACP	9800-289
		MISCELLANEOUS	
		CABLE ASSEMBLY	3030-290
		CASE	3145-773
		DOOR: battery	4450-38
		KNOB: black	11505-312
		PANEL: front	16025-710

MODEL 116

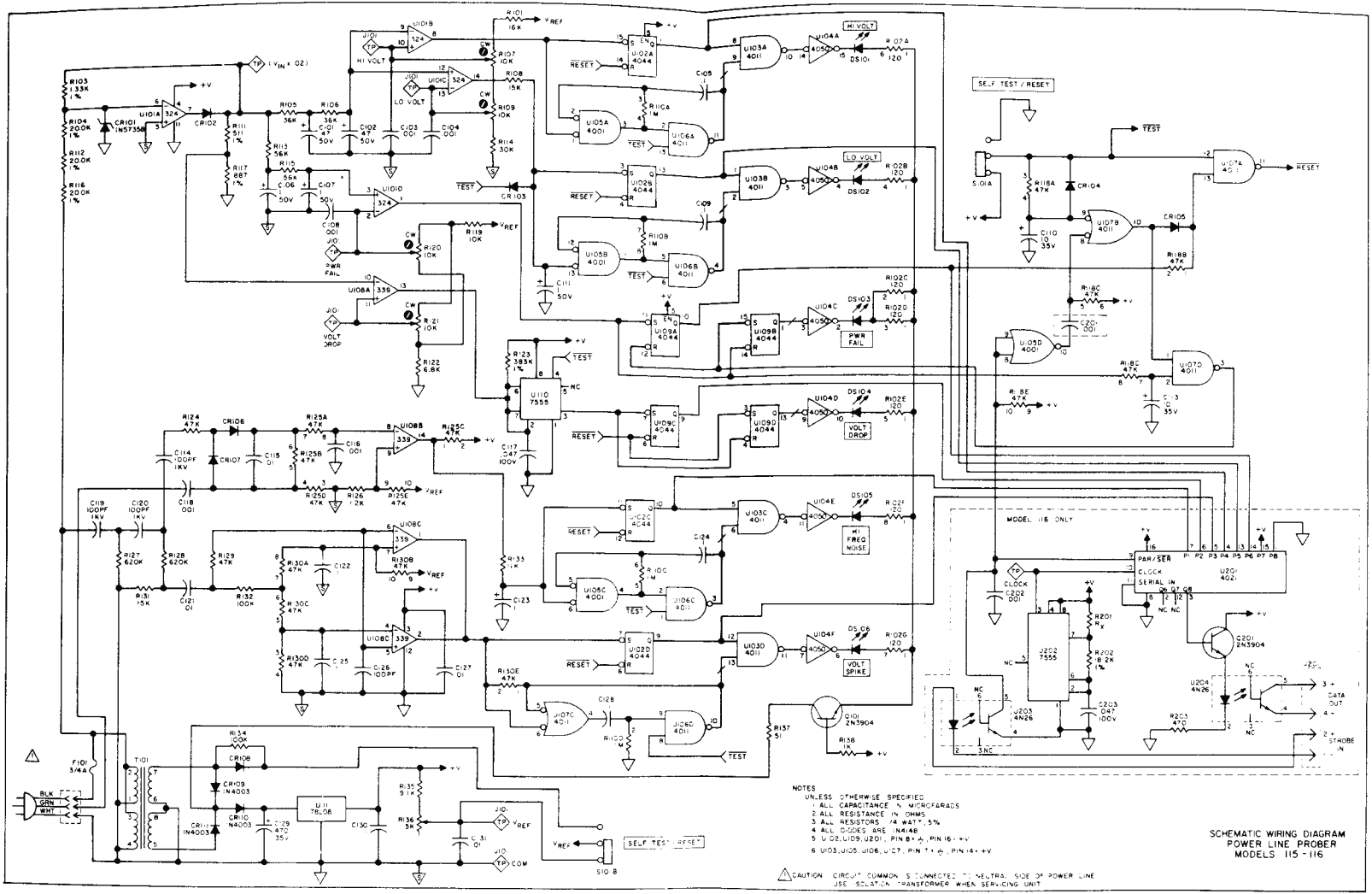
REF. DESIG.	NOTES	DESCRIPTION	HICKOK PART NO.
C201		Same as C103	
C202		Same as C103	
C203		Same as C117	
Q201		Same as Q101	
R201		RESISTOR, FIXED, DEPOSITED . . . CARBON: exact value determined in production	RX
R202		RESISTOR, FIXED, METAL FILM: . . 18.2K ohms, 1%, 1/4 watt temp coeff	18582-237
R203		RESISTOR, FIXED, DEPOSITED . . . CARBON: 470 ohms, 5%, 1/4 watt	18470-470
U201		INTEGRATED CIRCUIT: 8 bit static . . shift register, MC14021BCP	9800-294
U202		Same as U110	
U203		INTEGRATED CIRCUIT: opto . . . . isolator, 4N26	9800-293
U204		Same as U203	
		MISCELLANEOUS	
		CORD: modular type telephone line . . cord, 4 conductor	3675-73
		DOOR	4450-40

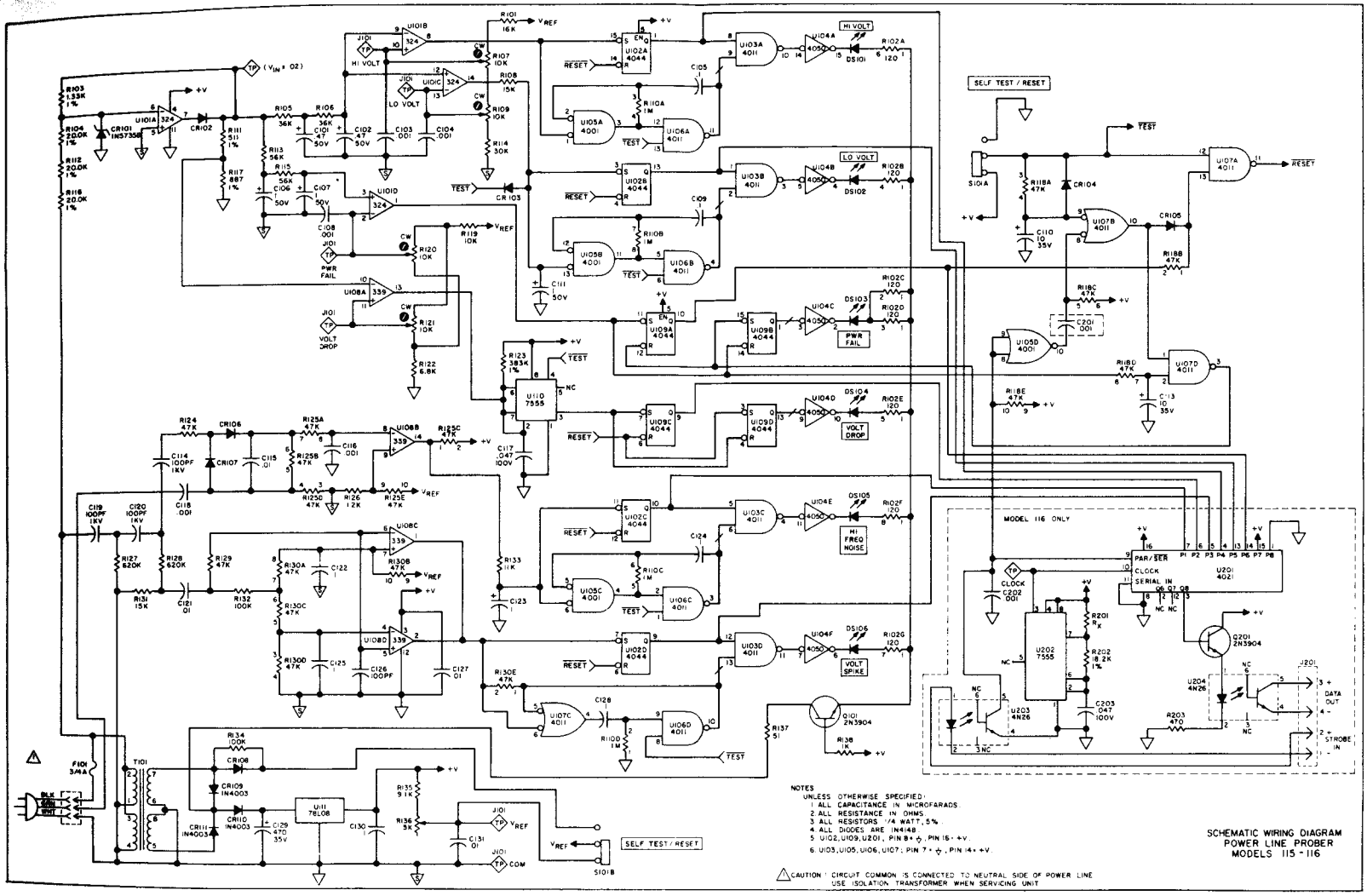


1. REFERENCE DESIGNATIONS:
   A. MODEL 115 : 100 SERIES.
   B. MODEL 116 : 200 SERIES.

NOTES:

BOARD ASSEMBLY - MAIN


SELF TEST / RESET
MODEL 116 ONLY
HI VOLT
LO VOLT
PWR FAIL
VOLT DROP
HI FREQ NOISE
VOLT SPIKE
TEST
RESET
+V
VREF
COM
BLK
GRN
WHT
DATA OUT
STROBE IN
NOTES
UNLESS OTHERWISE SPECIFIED
1. ALL CAPACITANCE IN MICROFARADS
2. ALL RESISTANCE IN OHMS
3. ALL RESISTORS 1/4 WATT, 5%
4. ALL DIODES ARE 1N4148
5. U102, U105, U201, PIN 8 = A, PIN 16 = +V
6. U103, U105, U106, U107, PIN 7 = A, PIN 14 = +V
CAUTION CIRCUIT COMMON IS CONNECTED TO NEUTRAL SIDE OF POWER LINE USE ISOLATION TRANSFORMER WHEN SERVICING UNIT
SCHEMATIC WIRING DIAGRAM
POWER LINE PROBER
MODELS 115 - 116


SELF TEST / RESET
MODEL 116 ONLY
HI VOLT
LO VOLT
PWR FAIL
VOLT DROP
HI FREQ NOISE
VOLT SPIKE
PAR/SER CLOCK
SERIAL IN
DATA OUT
STROBE IN
NOTES
UNLESS OTHERWISE SPECIFIED:
1 ALL CAPACITANCE IN MICROFARADS.
2 ALL RESISTANCE IN OHMS.
3 ALL RESISTORS 1/4 WATT, 5%.
4 ALL DIODES ARE IN4148.
5 U102, U109, U201, PIN 8 = ⏚, PIN 16 = +V.
6 U103, U105, U106, U107: PIN 7 = ⏚, PIN 14 = +V.
CAUTION: CIRCUIT COMMON IS CONNECTED TO NEUTRAL SIDE OF POWER LINE. USE ISOLATION TRANSFORMER WHEN SERVICING UNIT.
SCHEMATIC WIRING DIAGRAM
POWER LINE PROBER
MODELS 115 - 116