WARNING

Because of possible shock or fire hazards, connection of this instrument should be performed in compliance with the National Electric Code (ANSI C1) or any other requirements, or both, which may be applicable to the user. Installation, operation, and maintenance should only be performed by qualified personnel.

TM-111825

VOLUME 1-- OPERATOR'S MANUAL

SERIES 646
POWER LINE DISTURBANCE ANALYZER
MODELS 646-1 AND 646-3

April 15 1985
(Rev. A: Jan. 1, 1986)
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See opposite side relative to proprietary rights.

NOTE: Refer to Volume 2 of TM-111825 for Service and Maintenance instructions.

DRANETZ®

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SERIES 646
QUICK REFERENCE MENU LISTING

MENU LISTING	COMMENTS
MAIN MENU	PRIMARY MENU FOR OVERALL SYSTEM OPERATION
1 Program Summary	List programmed measurement limits
2 Standard Limits	Program the unit with default parameters
3 Data Summary	Print Data Summary, including worst-case
4 Clear Data	Erase all stored event data
5 Time	Display or set the time of day
6 Date	Display or set the date
7 Output	Select output device for event printout
8 Baud Rate	Select the RS-232C baud rate
9 Audio Alarm	Enable/disable the audible event alarm
A Self Test	Initiate internal self test
B New Unit ID	Specify a new Unit Identifier message
***PROGRAM TB2 PH-A (646-3 ONLY)**	PROGRAM LIMITS FOR "PHASE A" INPUT TO TERMINAL BLOCK 2
1 High Limit	Display or set the high limit
2 Low Limit	Display or set the low limit
3 Volt Sens	Display or set the voltage sensitivity
4 Imp Sens	Display or set the impulse threshold
5 Copy to B&C	Copy limits from Phase "A" to "B" & "C"
6 Freq Sens	Display or set the frequency sensitivity
***PROGRAM TB2 PH-B (646-3 ONLY)**	PROGRAM LIMITS FOR "PHASE B" INPUT TO TERMINAL BLOCK 2
(same as for TB2 PH-A, choices 1–4 only)	
***PROGRAM TB2 PH-C (646-3 ONLY)**	PROGRAM LIMITS FOR "PHASE C" INPUT TO TERMINAL BLOCK 2
(same as for TB2 PH-A, choices 1–4 only)	
PROGRAM TB1 AC	PROGRAM LIMITS FOR "AC" INPUT TO TERMINAL BLOCK 1
1 High Limit	Display or set the high limit
2 Low Limit	Display or set the low limit
3 Volt Sens	Display or set the voltage sensitivity
4 Imp Sens	Display or set the impulse threshold
5 Freq Sens	Display or set the frequency sensitivity
PROGRAM NEUT-GND	PROGRAM LIMITS FOR "NEUTRAL-TO-GROUND" INPUT TO TERMINAL BLOCK 1
1 High Limit	Display or set the high limit
2 Volt Sens	Display or set the voltage sensitivity
3 Imp Sens	Display or set the impulse threshold
PROGRAM DC CHAN	PROGRAM LIMITS FOR "DC" INPUT TO TERMINAL BLOCK 1
1 High Limit	Display or set the high limit
2 Low Limit	Display or set the low limit
3 Volt Sens	Display or set the voltage sensitivity
4 Imp Sens	Display or set the impulse threshold

*-These menus **ONLY** apply to the Model 646-3.

MENU LISTING		COMMENTS
PROGRAM TEMP	.....	PROGRAM LIMITS FOR TEMPERATURE PROBE
1	High Limit	Display or set the high limit
2	Low Limit	Display or set the low limit
3	Temp Sens	Display or set temperature sensitivity
4	Temp Scale	Choose Celsius or Fahrenheit scale

CAUTION

The following two menus list functions not normally required by the user. Read Manual TM-111825 carefully before attempting to change any parameters controlled by these menus.

MENU LISTING		COMMENTS
METER MENU	.....	METER/CALIBRATE MEASURED PARAMETERS[1]
1	Freq	Meter only, ac line frequency
2	Temp	Meter or calibrate temperature reading
3	**3 Int. DC	Meter or calibrate UPS battery reading
4	TB1 AC	Meter or calibrate TB1 ac level reading
5	TB1 Imp	Meter or calibrate TB1 ac impulse reading
6	Neutral	Meter or calibrate Neutral peak reading
7	Neut Imp	Meter or calibrate Neutral Impulse reading
8	DC Level	Meter or calibrate dc level reading
9	DC Imp	Meter or calibrate dc impulse reading
A	PH-A AC	Meter or calibrate TB2 Phase "A" level
B	PH-A Imp	Meter or calibrate TB2 Phase "A" impulse
C	PH-B AC	Meter or calibrate TB2 Phase "B" level
D	PH-B Imp	Meter or calibrate TB2 Phase "B" impulse
E	PH-C AC	Meter or calibrate TB2 Phase "C" level
F	PH-C Imp	Meter or calibrate TB2 Phase "C" impulse
CONFIGURATION	.....	INSTALL OPTIONAL FEATURES
1	3-Phase	Indicates "yes" if Model 646-3 is config.
2	Imp Dur	Indicates "yes" if Option 101 is installed
3	UPS	Indicates "yes" if Option 102 is installed
4	Temp Probe	Indicates "yes" if the temperature probe is in use

---

[1]-Before allowing the recalibration, the unit will ask "Are you sure?" and "Recalibrate?" before executing the recalibration.

**-A value in volts is shown only during calibration, otherwise, the unit will indicate "int. DC: OK."

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STATEMENT OF WARRANTY

All products of Dranetz Technologies, Inc. are warranted to the original purchaser against defective material and workmanship for a period of one year from the date of delivery. Dranetz will repair or replace, at its option, all defective equipment returned, freight prepaid, during the warranty period, without charge for repair, provided there is no evidence that the equipment has been mishandled or abused. This warranty shall not apply to any defects resulting from improper or inadequate maintenance, buyer-supplied hardware/software interfacing, unauthorized modification of misuse of the equipment, operation outside of the environmental specifications, or improper site preparation or maintenance.

The information in this manual has been reviewed and is believed to be entirely reliable. No responsibility, however, is assumed for any inaccuracies. The material in this manual is for information purposes only, and is subject to change without notice.

USER INFORMATION

WARNING

This equipment generates, uses, and can radiate radio frequency energy. If it is not installed and used in accordance with this instruction manual, this equipment may cause interference to radio communications. It has been tested and found to comply with the limits for a Class "A" computing device pursuant to subpart J of Part 15 of FCC rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference in which case the user, at his or her own expense, will be required to take whatever measures necessary to correct the interference.

NOTES:

FIGURE 1-1. SERIES 646 POWER LINE DISTURBANCE ANALYZER.

VOLUME 1
OPERATOR'S MANUAL

SERIES 646 POWER LINE DISTURBANCE ANALYZER
MODELS 646-1 AND 646-3

SECTION I
GENERAL INFORMATION

1.1 SCOPE

This manual consists of two volumes labeled Volume 1 (Operator's manual) and Volume 2 (Service manual). You are reading Volume 1 which is divided into three sections:

I. GENERAL INFORMATION
II. INSTALLATION AND OPERATION
III. OPERATIONAL TEST

Volume 2 contains the servicing instructions and consists of four sections. They are:

IV. THEORY OF OPERATION
V. MAINTENANCE AND CALIBRATION
VI. REPLACEABLE PARTS LIST
VII. SCHEMATIC DIAGRAM AND ASSEMBLY DRAWING

1.2 INTRODUCTION

This manual contains the operating instructions and specifications for the Series 646 Power Line Disturbance Analyzer. (See FIGURE 1-1 on the adjoining page for a photograph of the unit.) There are two models in this series: the Model 646-1 (single-phase), and the Model 646-3 (three-phase). The terms "646" and "Series 646" will be used when discussing features common to both models. A front panel photograph and a rear panel drawing of the Series 646 appear in FIGURES 1-2 and 1-3.

1.3 PURPOSE

The Models 646-1 and 646-3 are portable instruments designed to monitor the quality of ac power being supplied to sensitive electronic equipment. These units operate by continually measuring the voltages at their inputs, and then reporting any unusual occurrences (such as drop-outs and high voltages which sometimes occur during severe thunderstorms).

1.3.1 Disturbance Reporting

A disturbance is reported whenever the measured value falls outside "normal" (outside the programmable high or low limit).

For example: A Series 646 may be programmed to report whenever the line voltage falls below 105 V ac or rises above 125 V ac. Each time a disturbance is detected, a detailed printout describing the event is generated. This printout includes the time, date, amplitude, and duration of the disturbance.

1.4 APPLICATIONS

The Series 646 is a full-featured dedicated power line disturbance analyzer. Although its performance capabilities are not quite as powerful or expandable as the Dranetz Series 626 Universal Disturbance Analyzer, it incorporates some of the more popular features of the Series 626.

Programming the Series 646 parameters and data retrieval can be done locally from the unit's front panel or remotely using a Data Terminal or PC. (See Subsections 2.5 through 2.5.7 for information pertaining to remote operation.)

The following subsections illustrate some typical applications for the Series 646.

1.4.1 Pre-Installation Site Surveys

One important use of the Series 646 is to help determine the quality of ac power at a particular location BEFORE a computer (or other sensitive equipment) is installed there. One or more 646s may be set up to monitor the power at the proposed site over a period of several days or weeks. If any disturbances are detected, the source of each disturbance can then be determined.

Pre-Installation Site Survey Example: If the analyzer indicates that the monitored ac voltage dropped from 115 volts to 100 volts several times a day at regular intervals, it may be that machinery somewhere in the building is cycling ON and OFF. Moving to another circuit or adding some voltage regulation may solve this problem saving the plant manager the cost of purchasing expensive power conditioning equipment. In another situation, the analyzer may indicate that the commercial power is unreliable, and that power conditioning equipment such as a UPS should be installed to prevent expensive down-time (periods of system inoperation). In either case, a Series 646 can save time, money, and future problems by helping you make informed decisions.

1.4.2 Post-Installation Verification

After a computer (or other piece of equipment) has been installed, a Series 646 may be used to verify the quality of ac power at the installation site, including the performance of any power conditioning equipment. There are two reasons for such verification.

1) One reason is that some power conditioning systems may not provide a smooth waveform, or they may generate "glitches" (discontinuity of the waveform) when transferring from ac power to battery backup. A common test is to simulate disturbances by disconnecting the power from the input of the power conditioning system, using one or more 646 units to simultaneously monitor the power conditioning equipment's input and output.

2) Another situation is when different components of a computer system interact with each other, resulting in a malfunction.

Post-Installation Verification Example: A line printer or disk drive unit may generate enough "noise" (interference) on its own power line to cause a malfunction in a CPU plugged into an adjacent outlet.

1.4.3 Field Service and Troubleshooting

After the equipment has been installed and tested, ac power problems may still cause trouble. When malfunctions in electrical equipment occur, a Series 646 may be used to determine if poor power is causing the problem.

Series 646 Troubleshooting Example: A newly-installed air conditioning system or a relocated machine may have an affect on the ac power supplied to other equipment located within the same building. Previously installed power conditioning equipment may not be able to compensate for all of the power line faults. The Series 646 provides the field service technician with an easy-to-use portable instrument for quick determination of whether or not power line disturbances are the cause of the equipment malfunction.

1.4.4 Continuous Monitoring for Ongoing Maintenance

The Series 646 may be used as part of a permanent power maintenance program. By constantly monitoring key points within a power distribution system, a Series 646 can indicate deteriorating performance in expensive power conditioning equipment. In a serious and unexpected shutdown, data from a permanently installed 646 unit may quickly lead towards a preventive solution against future problems.

1.4.5 Other Applications

- A company owning several personal computers or word processors could benefit by owning one or more Series 646 units for monitoring power line disturbances that affect the performance of these computers.
- A Series 646 can be used to monitor ac power supplied to burn-in or life-test racks.
- Any manufacturer of electronic equipment can use the Series 646 as a laboratory recording instrument during tests to determine the affects of power line conditions on new and existing equipment.

1.5 EQUIPMENT CHARACTERISTICS

The following subsections describe the general appearance of the Series 646 and the characteristics specific to the Model 646-1 and to the Model 646-3.

1.5.1 Series 646 Physical Characteristics

The internal parts of the Series 646 are housed in a plastic enclosure with an integral bail handle. The approximate external dimensions of the unit with the handle in the carrying position are 7½ inches high by 12½ inches wide by 13½ inches deep (see TABLE 1-1 for the complete specifications).

1.5.1.1 Front Panel Characteristics

The Series 646 front panel is the same for both the Model 646-1 and the Model 646-3. Commands are entered at the keyboard. The liquid crystal display (LCD) provides prompt and status information. The printer provides a printed record of disturbance data and various summaries. See FIGURE 1-2 for a picture of the front panel.

1.5.1.2 Rear Panel Characteristics

The ON/OFF switch, fuse holder, 115/230-Volt ac voltage selector switch, ac power cord receptacle, and the barrier block connections for the input channels are all located on the Series 646 rear panel. There is one nine-terminal barrier block on the Model 646-1, labelled "TB1". There are two such barrier blocks included on the Model 646-3, labelled "TB1" and "TB2". TB1 is identical in both models and is used for the connection of single-phase ac, neutral-to-ground, and dc voltages. TB2 on the Model 646-3 is used for connection to a three-phase ac power line. The rear panel also provides access to the RS-232C communications port, temperature probe receptacle, and telephone jack for the optional modem. See FIGURE 1-3 for a drawing of the rear panel.

NOTE

The phone jack is present even if there is no modem in the unit. If a modem (Option 103) is installed, a decal under the phone jack states that the modem is registered with the FCC. The presence of a modem is also indicated when the unit is turned ON.

FIGURE 1-2. SERIES 646 FRONT PANEL.

TM-111825

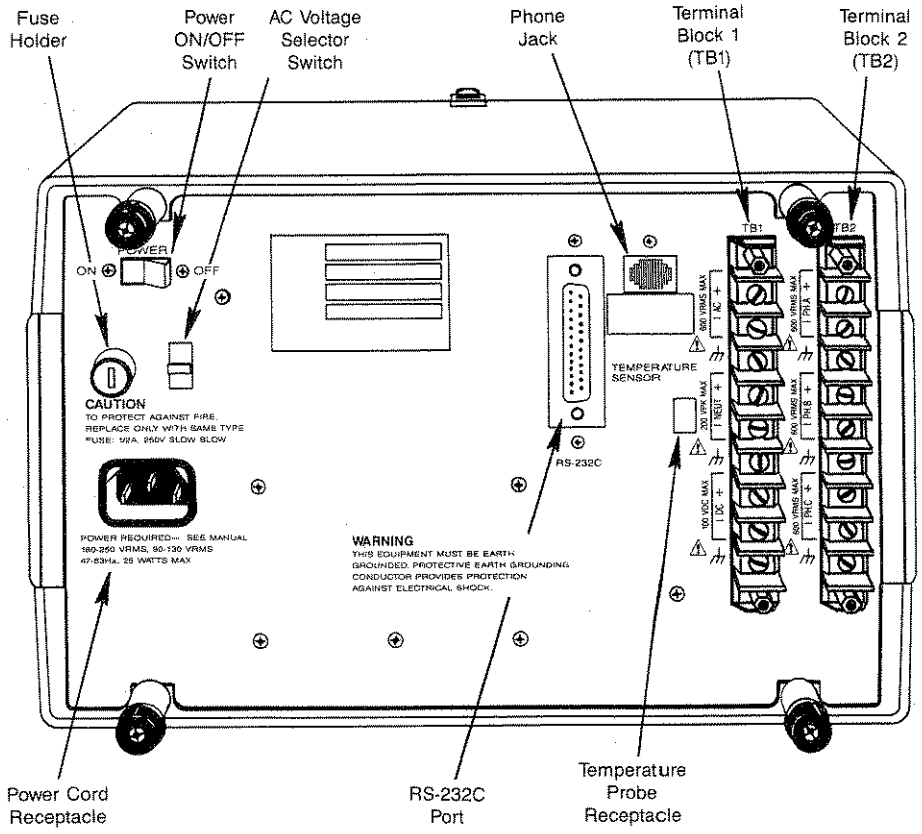

FIGURE 1-3. SERIES 646 REAR PANEL.

TM-111825

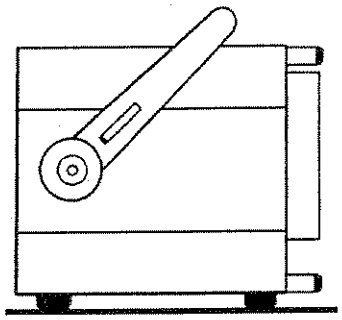

FIGURE 1-4A.
NORMAL OPERATING POSITION

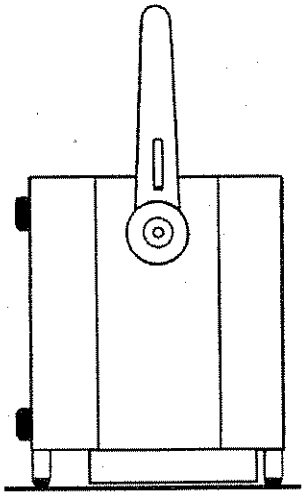

FIGURE 1-4B.
CARRYING POSITION

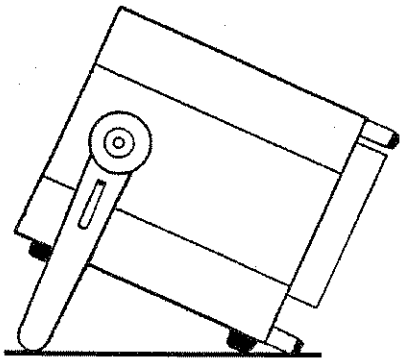

FIGURE 1-4C.
PROGRAMMING POSITION

NOTE

Pull Handle outward from both ends (at the pivot points) to change positions.

FIGURE 1-4. POSITIONING THE SERIES 646 BAIL HANDLE.

1.5.1.3 Physical Orientation

FIGURES 1-4A, 1-4B, and 1-4C illustrate the recommended positioning of the bail handle during normal usage. The normal recommended operation position of the unit is shown in FIGURE 1-4A. For carrying, the handle is positioned as shown in FIGURE 1-4B. For programming convenience, the unit is positioned as in Figure 1-4C. When not in use, you may rest the unit on its rear panel.

CAUTION

DO NOT operate the Series 646 unit while it is resting on its rear panel.

1.5.2 Model 646-1 General Characteristics

The Model 646-1 monitors single-phase ac power lines. Inputs are provided for three different voltages:

1) One channel for ac line-to-neutral voltage;
2) One channel for neutral-to-ground voltage;
3) One channel for dc voltage monitoring.

Connections are made to the screw-terminals on the barrier block (labelled "TB1") located on the rear panel.

TABLE 1-1 contains the technical specifications for Model 646-1.

1.5.3 Model 646-3 General Characteristics

The Model 646-3 monitors three-phase ac power lines. Inputs are provided for six different voltages:

1-4) Four channels for ac line-to-neutral voltage (thereby permitting the monitoring of three-phase power lines);
5) One channel for neutral-to-ground voltage;
6) One channel for dc voltage monitoring.

Connections are made to screw terminals on two barrier blocks (labelled "TB1" and "TB2") located on the rear panel.

TABLE 1-1 contains the technical specifications for Model 646-3.

TABLE 1-1. SERIES 646 SPECIFICATIONS* (PAGE 1 OF 6)

Absolute Maximum Ratings**

1) The ac voltage, referenced to safety ground, applied to input terminals marked "+" or "-" for measurement channels labelled "AC", "PH-A", "PH-B", or "PH-C" on the rear panel **MUST NOT** exceed 600 V rms.

2) The ac voltage, referenced to safety ground, applied to input terminals marked "+" or "-" for the channel labelled "NEUT" on the rear panel **MUST NOT** exceed 200 V pk (140 V rms).

3) The dc voltage, referenced to safety ground, applied to input terminals marked "+" or "-" for the channel labelled "DC" on the rear panel **MUST NOT** exceed 100 V dc.

Programmable Limits and Thresholds

Parameter	Minimum	Standard	Maximum
AC Voltage High Limit[1]	055 V ac	125 V ac	600 V ac
AC Voltage Low Limit[1]	050 V ac	105 V ac	595 V ac
AC Voltage Sensitivity[1,5]	002 V ac	003 V ac	999 V ac
AC Impulse Sensitivity[1]	0050 V pk	0100 V pk	2000 V pk
AC Frequency Sensitivity[2,5]	0.2 Hz	0.5 Hz	9.9
Neutral High Limit[3]	001 V pk	005 V pk	999 V pk
Neutral Voltage Sensitivity[3,5]	002 V pk	003 V pk	999 V pk
Neutral Impulse Sensitivity	0050 V pk	0050 V pk	2000 V pk
DC Voltage High Limit	002.0 V dc	005.2 V dc	100.0 V dc
DC Voltage Low Limit	001.0 V dc	004.8 V dc	099.0 V dc
DC Voltage Sensitivity[5]	000.2 V dc	000.2 V dc	100.0 V dc
DC Impulse Sensitivity	001 V pk	001 V pk	100 V pk
Temperature High Limit[4]	003°C	035°C	099°C
Temperature Low Limit	001°C	015°C	097°C
Temperature Sensitivity[5]	002°C	005°C	099°C

AC Voltage Inputs ("AC" on TB1; "PH-A", "PH-B", "PH-C" on TB2)

Range	50 to 600 V rms, 47 to 63 Hz
Resolution	1 V
Accuracy	±1% reading ±0.5% full scale
Input Impedance	10 Megohms, 56 pF, each terminal to ground
Common Mode Voltage	No Voltage greater than 600 V rms may be applied to either the "+" or "-" terminal at any time

* All specifications concerning impulse amplitudes and durations assume a half-sine wave shape.
** Damage to the equipment may result if the Absolute Maximum Ratings are exceeded.
1 All four ac measurement channels in the model 646-3 have independently programmable thresholds.
2 For the Model 646-3, frequency measurement is referenced to the Phase A input at TB2.
3 Although measured in peak volts, this value corresponds to steady-state voltage and does not include impulses.
4 The optional temperature probe accessory is required for temperature measurement. Temperature is measured in °C. If the Fahrenheit scale is selected, the unit converts all temperature measurements to Fahrenheit and allows programming of the high and low limits in °F. The temperature sensitivity, however, always remains in °C.
5 Use of sensitivity values less than the total computed accuracy tolerance at a given nominal input level is NOT recommended.

TABLE 1-1. SERIES 646 SPECIFICATIONS* (PAGE 2 OF 6)

AC Channel Impulse Response	
Range	50 to 2000 V pk, 1 to 1000 μSec
Resolution	1 V
Accuracy	±10% reading ±1% full scale for impulses with amplitudes >100 V pk and durations from 5 to 50 μSec; -50% @ 1 μSec & 1000 μSec Typically
AC Channel Impulse Duration Response (with Opt. 101 only)	
Range	1 to 1000 μSec
Resolution	1 μSec
Accuracy	±10% reading ±1% full scale for impulses with amplitudes >100 V pk and durations from 1 to 100 μSec
Neutral-To-Ground Input, AC Response ("NEUT" on TB1)	
Range	5 to 200 V pk (4 to 140 V rms), 47 to 63 Hz
Resolution	1 V
Accuracy	±1% reading ±0.5% full scale
Input Impedance	10 Megohms, 56 pF, each terminal to ground
Common Mode Voltage	No voltage greater than 140 V rms may be applied to either the "+" or "-" terminal at any time
Neutral-to-Ground Input, Impulse Response	
Range	50 to 2000 V pk, 1 to 1000 μSec
Resolution	1 V
Accuracy	±10% reading ±1% full scale for impulses with amplitudes >100 V pk and durations from 5 to 50 μSec; -50% @ 1 μSec & 1000 μSec Typically
Neutral-To-Ground Impulse Duration Response (With Opt. 101 only)	
Range	1 to 1000 μSec
Resolution	1 μSec
Accuracy	±10% reading ±1% full scale for impulses with amplitudes >100 V pk and durations from 1 to 100 μSec

*All specifications concerning impulse amplitudes and durations assume a half-sine wave shape.

TABLE 1-1. SERIES 646 SPECIFICATIONS* (PAGE 3 OF 6)

DC Voltage Input ("DC" on TB1)	
Range	1.0 to 100.0 V dc
Resolution	0.1 V
Accuracy	±3% reading ±0.5% full scale
Input Impedance	10 Megohms, 100 pF, each terminal to ground
Common Mode Voltage	No voltage greater than 100 V dc may be applied to either the "+" or "-" terminal at any time
DC Channel Impulse Response	
Range	5 to 100 V pk, 1 to 1000 μSec
Resolution	1 V
Accuracy	±10% reading ±1% full scale for impulses with amplitudes >10 V pk and durations from 5 to 50 μSec; -50% @ 1 μSec & 1000 μSec Typically
DC Channel Impulse Duration Response (with Opt. 101 only)	
Range	0 to 1000 μSec
Resolution	1 μSec
Accuracy	±10% reading ±1% full scale for impulses with amplitudes >10 V pk and durations from 1 to 100 μSec
Temperature Measurement (Requires Optional Probe Accessory)	
Range	3 to 99°C (37.4 to 210.2°F)
Resolution	1°C (1.8°F)
Accuracy	±3°C (±5.4°F)
AC Line Frequency Measurement (From Phase "A" for Model 646-3)	
Range	45.0 to 65.0 Hz
Resolution	0.1 Hz
Accuracy	±0.2 Hz

*All specifications concerning impulse amplitudes and durations assume a half-sine wave shape.

TABLE 1-1. SERIES 646 SPECIFICATIONS* (PAGE 4 OF 6)

RS-232C Communications Port	
Character Format	ASCII code, asynchronous, serial 8-bit word, 2 stop-bits, no parity
Data Rate	300, 1200, or 9600 baud
Pin-out Summary	Transmit Data (from 646): pin 3; Receive data (to 646): pin 2; CTS (always +12 V): pin 5; DSR (always +12 V): pin 6; DCD or RLSD (always +12 V): pin 8; DTR (must be +12 V): pin 20; Ground: pins 1 and 7
Printer	
Type	20 column with automatic paper take-up roll
Print Speed	Approximately 30 characters/second
Replacement Paper	Thermal paper roll, Dranetz P/N 102714
Time Clock	
Type	24-hour time, plus date
Accuracy	±2 seconds/day typically
Power Supply	
Voltage Range	90 to 130/180 to 250 V ac, switch selectable
Frequency Range	47 to 63 Hz
Power Consumption	25 Watts Maximum
Fuse Type	½A, 250 V, Slow Blow
Internal Batteries For Data Retention	
Battery Type	Nickel Cadmium, not user replaceable
Charge Time	2 days from complete discharge
Data Retention Time	Typically 1 month
Uninterruptible Power Supply (with Option 102 only)	
Battery Type	Nickel Cadmium, not user replaceable
Charge Time	24 hours from complete discharge
UPS Operation Time	Typically ½hour.

*All specifications concerning impulse amplitudes and durations assume a half-sine wave shape.

TABLE 1-1. SERIES 646 SPECIFICATIONS* (PAGE 5 OF 6)

Physical

Size (approx.)	Height:	7.5 inches (19 cm)
	Width:	12.5 inches (32 cm)
	Depth:	13.5 inches (34 cm)

Environmental

Temperature	Operating:	10 to 40°C	(50 to 104°F)
	Storage:	-20 to 55°C	(-4 to 131°F)
Humidity	10% to 90%, non-condensing		

Front Panel Key Function Summary**

Key	ASCII Equiv.	Function
OPERATE MODE	O	Enables disturbance analysis
PROGRAM MODE	P	Disables disturbance analysis
LOCK/UNLOCK	L	Enables security lock code
NEXT MENU	TAB	Selects next available menu
PRINT MENU	M	Lists choices for active menu
NEXT CHOICE	SPACE	Selects next available choice
PREVIOUS CHOICE	BACKSPACE	Selects previous choice or menu
CHOICE #	#	Selects choice from numbered list
NEW VALUE	=	Allows change of displayed value
ENTER	RETURN	Completes numerical entries
YES	Y	Allows action taken as prompted
NO	N	Prohibits action as prompted
HELP	H	Generates a short "help" message
PAUSE/RESUME	ESCAPE	Pause control during Data Summary
QUIT	(CONTROL-C)	Aborts printout in progress
PAPER FEED	LINE FEED	Generates three blank lines
SHIFT	(none)	Selects letters for ID message

*All specifications concerning impulse amplitudes and durations assume a half-sine wave shape.

**The ASCII equivalent characters may be used as commands to operate the Series 646 from an external terminal using either the RS-232C Serial Communications Port or the built-in modem (with option 103).

TABLE 1-1. SERIES 646 SPECIFICATIONS* (PAGE 6 OF 6)

Internal Auto-Answer Modem (Option 103):	
Modem Type	Bell 103, Auto-Answer
Telephone Connection	Direct-Connect
FCC Registration NO.	DRJ6YR-70737-DM-N
Ringer Equivalence	0.3B
Phone Jack (USOC)	RJ11
Data Format	Serial, Asynchronous
Data Rate	300 Baud
Operating Mode	Full Duplex
Transmit Level	-9 dBm Permissive
Transmit Mark Tone	2225 Hz
Transmit Space Tone	2025 Hz
Receive Mark Tone	1270 Hz
Receive Space Tone	1070 Hz

1.6 STANDARD FEATURES

Standard features of the Series 646 include a thermal printer for outputting disturbance data, a keyboard for making command entries, a 16-character alphanumeric display, and an RS-232C serial communication port for remote operation.

1.6.1 Series 646 Built-In Printer

The built-in thermal printer produces 20 characters per line at a rate of approximately 2 lines per second. While printing, new lines appear on the thermal paper from the feed near the bottom of the unit. A paper take-up mechanism retracts (pulls) the paper back into the unit form a slot near the top of the unit. All printouts should be read FROM THE TOP DOWN. The [PAPER FEED] key may be used to advance the paper for better viewing of the last line printed (this line is printed just above the paper feed slot). The message "*** PAPER LOW ***" is automatically printed whenever the thermal paper is running low.

* All specifications concerning impulse amplitudes and durations assume a half-sine wave shape.

1.6.1.1 The Paper Take-Up Feature

The paper take-up feature provides convenient storage of all data and other messages printed on an entire roll of paper. As printing occurs, paper is fed from a supply roll through the printhead to a take-up spool. Between the printhead and the take-up spool, the paper passes up along the unit's front panel, leaving the last 40 or so printed lines visible from the front of the unit. Paper that has been rolled onto the take-up spool may be read by gently pulling the paper out from the TOP of the unit until the desired portion of the tape is visible.

NOTE

To rewind the paper back into the unit, press the [PAPER FEED] key and the slack is taken up. NEVER PULL THE PAPER FROM THE BOTTOM OF THE PAPER FEED SLOT.

1.6.1.2 Changing the Printer Paper

CAUTION

Use of thermal paper other than Dranetz P/N 102714 may damage the printer. Refer to Subsection 1.8 for ordering instructions.

When the unit prints the message "*** PAPER LOW ***", install a new roll of thermal paper immediately to avoid losing any disturbance data. To replace the paper, proceed as follows:

1) Press the [PAPER FEED] key three times to advance the paper several inches. Cut off the paper at the blank area just created.

2) Open the printer door by pulling the two knobs on the top of the door. Remove the take-up spool (forward spool) by gently bending the spring clips outward.

3) Remove the paper from the take-up spool by sliding the roll off the end of the spool. Set the paper aside for your records and replace the take-up spool.

4) Remove the supply roll (rear spool) by gently bending the spring clips outward. If there is still paper left, cut the paper so that the unused paper is left on the roll. Discard the roll and any unused paper.

5) Press [PAPER FEED] to eject any remaining paper.

6) Pull off one or two feet from a new roll of thermal paper and insert the end of the paper into the unit until it comes into contact with the internal rollers. Use the diagram on the printer door as a guide for proper orientation of the supply roll. Press [PAPER FEED] until the paper is firmly between the rollers, then mount the roll between the clips of the rear spool.

7) Press [PAPER FEED] to advance the paper approximately two feet. Insert the end of the paper into the slot on the take-up spool. Rotate the spool to wrap the paper several times around the spool while leaving several inches of slack.

8) Close the printer door.

NOTE

A decal on the printer door also provides instructions for loading the rolls of paper.

1.6.1.3 Removing a Portion of a Roll of Paper

To remove a portion of a roll of paper after a monitoring session, proceed as follows:

1) Press [PAPER FEED] to advance the paper several inches. Cut off the paper at the blank area just created.

2) Open the printer door by pulling the two knobs on the top of the door. Remove the take-up spool by gently bending the spring clips outward.

3) Remove the paper from the take-up spool by sliding the roll off the end of the spool. Set this paper aside for your records and replace the take-up spool.

4) Press [PAPER FEED] to advance the paper approximately two feet. Insert the end of the paper into the slot on the take-up spool. Rotate the spool to wrap the paper several times around the spool while leaving several inches of slack.

5) Close the printer door.

1.6.1.4 Cleaning the Printhead

During the course of normal printer operation, particles from the thermal paper accumulate on the printhead. After a period of time this accumulation can result in poor print quality. If printed characters appear too light to read or have dots missing, the printhead should be cleaned. This is easily done by removing the thermal paper and inserting a strip of bond paper (cut to approximately 11 inches long by 2¼ inches wide) into the printer and pressing the [PAPER FEED] key until the length of the paper passes through the printer. The bond paper is inserted in the same manner as a replacement paper roll. You should clean the printhead each time you replace the thermal paper roll. Precut cleaning paper may be ordered from Dranetz Technologies, Inc. (P/N 103418).

1.6.2 Alphanumeric display

The 16 character LCD (Liquid Crystal Display) provides prompting and visual feedback while entering commands. The display may be set to display the current time, present voltage measurement, or other parameters while the unit is in the Operate mode. The unit's handle may be positioned to prop up the front of the unit in order to make the LCD more visible (see FIGURE 1-4C). All messages seen on the display are also sent out through the serial port or modem (if in use).

1.6.3 Keyboard

All programmable functions of the Series 646 are controlled by the front panel keyboard. Instead of providing a separate key for each command, the Series 646 Keyboard is used along with its LCD to present command choices one at a time on the display. Once the desired function name appears on the display, other keys are used to actually perform the function. TABLE 1-1 includes a brief description of the functions of all front panel keys, and lists the ASCII equivalent characters used during remote operation from the serial port or optional modem. More detail concerning Series 646 programming is provided in the following subsections.

1.6.3.1 Audible Feedback

Each keystroke recognized by the unit is accompanied by an audible "click" sound to indicate that a key entry had been detected. This sound does not necessarily indicate that the proper command or key entry has been made; it only indicates that one of the keys has been pressed.

1.6.3.2 Disturbance Printout Delay

While the unit is in its monitoring state, disturbance printouts are normally displayed as fast at the Series 646 is able to produce them. Pressing any key, however, causes disturbance printouts to be delayed for ten seconds.

NOTE

The unit will not print event data while its ac power is lost. Any events will be stored in memory and printed once ac power returns.

1.6.3.3 Keyboard Security Lock

To discourage unauthorized personnel from tampering with the unit, the keyboard may be disabled by pressing the [LOCK/UNLOCK] key and entering the four-digit code.

NOTE

The code will not be echoed on the LCD or printer.

Once this is done, any attempt to use the keyboard will cause the unit to display the message "KEYBOARD LOCKED" on the LCD. The keyboard may be re-enabled by pressing [LOCK/UNLOCK] again, and then re-entering the same four-digit code.† Once a locked keyboard is re-enabled, the previous code is erased, therefore, every additional time that the keyboard is locked, a new code must be chosen.

1.7 STANDARD ACCESSORIES

Part Number	Quantity	Description
TM-111825, V. 1	1	Operators Manual for the Series 646.
102714-G2	3 rolls	Thermal paper for the Series 646 printer.
103418	1 strip	2½" x 11" strip of printer cleaning paper.
104943	1	Line cord to supply power to Series 646.
111024-G1	1	25-foot phone cord (only with Option 103).

†IMPORTANT--See page 1-21.

1.8 SERIES 646 OPTIONS

Option or Part Number	Description

PLEASE CONTACT THE DRANETZ ORDER ENTRY DEPARTMENT TO ORDER ANY OF THE LISTED OPTIONS: TEL: (201) 287-3680 or FAX: (201) 287-8627.

TM-111825 V. 2*	Maintenance manual for the Series 646.
Option 101	Impulse Duration. With Option 101, the Series 646 is capable of measuring the duration (in microseconds) of high-frequency transient voltages. Duration information is included in all impulse event printouts. This option must be installed at the factory.
Option 102	Uninterruptible Power Supply (UPS). Option 102 (the UPS) insures that the unit will be fully operational if a temporary loss of power occurs to its own power supply. Internal batteries provide power for up to 30 minutes, depending on the amount of printing which is required and the configuration of the unit. This option must be installed at the factory.
Option 103**	Internal Auto-Answer Modem. Option 103 is an internal, Bell 103 compatible, direct-connect modem, which allows remote operation of the Series 646 over public telephone lines. With this option, the unit answers a call and allows communication at 300 baud. This option must be installed at the factory.
111887-G1	Temperature probe accessory The probe consists of a temperature sensor mounted on the end of a ten-foot cable which plugs into a receptacle on the rear panel of the unit. This temperature probe allows the Series 646 to record any changes in temperature as disturbances.
111894-G1	646-R1 Rack Mount Adaptor Kit. (See Appendix B).
102714C	Thermal Paper for 646 printer. Available in quantities of 27 rolls per carton.
103100	Shipping Container for Series 646. Rugged, foam lined, briefcase style container for transporting Series 646 with additional room for its manual, line cord, and three rolls of thermal paper.
112931-G1	Single Channel Cable. Cable continas the lugs and clamps for connecting Series 646 input terminals to a single channel power source.

* See Subsection 1.9, item number 3 for information on obtaining volume 2, the Service and Maintenance manual for the Series 646.

** A 25 foot phone cord (P/N 111024-G1) is standard with the modem option.

1.9 FACTORY REPAIR

When factory repair is required, proceed as follows:

1. Contact Dranetz Service Corporation (formerly Dranetz Technologies, Inc., Customer Service Dept.) to obtain an authorization number for Factory repair.

Telephone No:	(201) 775-7081	Telex:	499-7808
TWX:	(710) 997-9553	Cable:	DRANETZ
FAX:	(201) 755-0292		

2. Fill out the REPAIR/SERVICE ORDER form enclosed in this manual. Ship it along with the malfunctioning equipment to Dranetz Service Corp.

3. In this manual you have been supplied a Control Form with a registration number on it. The purpose of this form is to allow you to obtain the Volume 2 Service/Maintenance manual for the Series 646 Power Line Disturbance Analyzer. Fill out and return this form if you want to obtain the Volume 2 manual. (If this form is missing, contact Dranetz Service Corp. and request a replacement.)

*** SPECIAL SECTION ON BYPASSING THE FOUR-DIGIT CODE ***

NOTE

This is a special section on how to bypass the four-digit code if it is forgotten or lost. This section and its page number are not referenced in the Table of Contents. If you desire to limit the number of persons who have access to this knowledge, remove this page completely from the manual and store it in a safe place.

How to ByPass the Four-Digit Code

Rather than pressing the [LOCK/UNLOCK] key, type out the letters to the word "UNLOCK".

NOTE

Typing a letter from the front panel keyboard requires two strokes: press the [SHIFT] key, and then press the key marked with the desired letter. The letters are located on the upper half of the keys.

NOTE

The letters to the word "UNLOCK" will NOT be echoed by the LCD or printer.

While bypassing the security code, the LCD continues to display the "KEYBOARD LOCKED" message until all of the letters of "UNLOCK" have been pressed.

NOTES

SECTION II
INSTALLATION AND OPERATION

2.1 GENERAL

This section contains the installation and operation procedures for the Models 646-1 and 646-3 of the Series 646 Power Line Disturbance Analyzer. Unless otherwise stated, these instructions apply to either model.

2.2 UNPACKING

Carefully open the upper end of the shipping container and remove its contents. **DO NOT** discard the shipping container and packaging materials until after inspecting the instrument for any shipping damage. Any damage caused by shipping and handling should be immediately reported to the carrier.

In the event that any physical damage exists, use the original packing case and materials to return the instrument to the Dranetz Service Corporation. Do this, however, ONLY after filing an insurance claim with your underwriter or carrier, or both. Also, before returning any equipment to the Dranetz Service Corporation, obtain a return authorization number (see the REPAIR/SERVICE ORDER form enclosed herein) by calling Dranetz Service Corporation.

2.3 INSTALLATION

The following Subsections contain information pertaining to the installation and configuration of the Series 646.

2.3.1 Installation Warnings

WARNING

Be sure that the Series 646 and all of the power connected to its input terminals are first turned off before proceeding with any installation.

2.3.2 Power Supply

WARNING

The ac outlet used as a source of power for the unit MUST be properly grounded. Connection to an improperly grounded outlet, or the use of an adapter which prevents proper grounding, may cause shock, fire hazard, or damage to the unit and any equipment connected to the unit.

The Series 646 requires ac power for both normal operation and charging its internal batteries. The unit operates from either of two voltage ranges: 90 to 130 V rms (115 V nominal) or 180 to 250 V rms (230 V nominal), with a line frequency of 47 to 63 Hz. An ac power cord, Dranetz P/N 104943, is provided as standard equipment for operation of the unit from 115 V nominal ac power sources. For 230 V nominal operation, ac power cord P/N 110726 must be used.

2.3.2.1 The AC Voltage Selector Switch

Before turning ON the unit for the first time, the ac voltage selector switch on the rear panel must be set for the proper ac operating voltage. Two switch positions allow the instrument to operate from either 115 V or 230 V nominal ac voltage. Before setting the switch, verify that the unit is switched OFF and that the ac power and all of the input voltages are disconnected. A screwdriver or other suitable tool may be used to move the switch to the desired position.

2.3.2.2 Replacement of the Fuse

If the instrument is switched ON with ac power applied and still fails to print the "Power-On" message, the fuse may have to be replaced.

CAUTION

Before replacing the fuse, make sure that the unit is switched OFF, and that the ac power and all of the input voltages are disconnected.

A screwdriver or other suitable tool may be used to remove the fuse holder from the Series 646 rear panel for access to the fuse. Replace the fuse ONLY with a ½A, 250 V, Slow Blow type fuse.

2.3.3 Connection of Monitored Inputs

WARNING

Because of possible shock or fire hazards, connection of this instrument should be performed in compliance with the National Electrical Code (ANSI C1) and/or any other requirements which are applicable to the user. Installation, operation, and maintenance should be performed ONLY by qualified personnel. Qualifications for performing such procedures should be self-determined.

CAUTION

To avoid damaging the unit, DO NOT apply voltages exceeding the Absolute Maximum Ratings (mentioned in TABLE *1-1) to any of the input terminals.*

Screw terminals are provided on the Series 646 rear panel for connection of all voltages to be monitored. Only those terminals marked "+" and "-" are measurement inputs. The earth ground terminals, marked "⏚" are internally connected to the chassis ground of the instrument. Unused input terminals should be connected to the nearest earth ground terminal to avoid unwanted pickup from adjacent channels; otherwise, these ground terminals are normally left unconnected.

2.3.4 General Voltage Connection Procedure

WARNING

Connection should ONLY be performed by qualified personnel. Conductors connecting to the measurement points should be approved for the specific use. When connected to branch circuits of 20 amperes or less, the minimum flexible cord size is No. 18 AWG (1 mm). For branch circuits with higher ampacity, refer to the National Electrical Code (ANSI C1-1975, Paragraphs 240-4 and 250-95). Special consideration of the ground may be required. Refer to article 250 of the above reference if in doubt. Outside the U.S.A. consult any applicable safety standards.

Make all voltage connections as follows:

1) Turn the Series 646 OFF;

2) Turn OFF all sources which are going to be monitored;

3) Make all of the connections to the Series 646 first, then be sure to replace the barrier block cover(s).

WARNING

DO NOT proceed until step (3) is completed!

4) Make the desired connections to the source(s) which are going to be monitored;

5) Turn ON the Series 646;

6) Turn ON the source(s) to be monitored.

2.3.4.1 Connections to the Model 646-1

CAUTION

The ac voltage applied to the AC terminals must not exceed 600 V rms. Peak voltage applied to the NEUT (neutral-to-ground) terminals must not exceed 200 V pk (140 V rms). The dc voltage applied to the DC terminals must not exceed 100.0 V dc.

FIGURE 2-1 illustrates the proper connections required for monitoring single-phase ac voltage, neutral-to-ground voltage, and dc voltage with the Model 646-1. Screw terminals for all of the inputs are provided on a barrier block, labelled "TB1", located on the unit's rear panel.

2.3.4.2 Connections to the Model 646-3

CAUTION

The ac voltage applied to the "AC", "PH. A", "PH. B", and "PH. C" terminals MUST NOT exceed 600 V rms. Peak voltage applied to the "NEUT" (neutral-to-ground) terminals MUST NOT exceed 200 V pk (140 V rms). The dc voltage applied to the "DC" terminals MUST NOT exceed 100.0 V dc.

The Model 646-3 provides two barrier blocks on its rear panel with screw terminals for all inputs. The terminal block labelled "TB1" is identical to that of the Model 646-1. It provides input channels for ac voltage, neutral-to-ground voltage, and dc voltage. The terminal block labelled "TB2" provides three more ac channels, identical in specifications to the AC input to TB1. Thus, four channels of ac voltage may be simultaneously monitored by the Model 646-3 provided that the line frequency is the same for all four channels.

Line frequency measurement is referenced to Phase A on TB2. FIGURE 2-2 illustrates connections for a 3-phase Delta system with no neutral conductor, and a separate single-phase source with neutral-to-ground monitoring. Figure 2-3 illustrates connections for a 3-phase Wye system with neutral, and a separate single phase source without neutral-to-ground monitoring. The Model 646-3 may also be used to monitor a single-phase system with complete Normal mode/Common mode measurements, as illustrated in FIGURE 2-4.

2.3.5 Installation Guidelines

Proper monitoring of ac and dc voltage disturbances requires careful attention to the method of connection between the Series 646 Power Line Disturbance Analyzer and the monitored circuits. To obtain the most accurate and useful data, the following helpful guidelines are suggested:

1) Twisted-pair wires should be used for each two-wire input channel.

2) Cable length should be as short as possible, preferably less than 8 feet.

3) Connections to the monitored power line should be made as close as possible to the load.

4) The use of instrument-grade Potential Transformers for monitoring impulses on high-voltage power lines is NOT recommended. Most of these devices tend to distort the high-frequency waveforms associated with impulses and thus result in unreliable amplitude and duration data.

5) The ground terminals on the barrier blocks, and those of the RS-232C Serial Communications Port, are internally connected to the instrument's power supply safety ground. Be careful not to inadvertently contaminate a clean ground with a dirty ground. This can be avoided by not connecting the ground screw terminals to anything other than unused inputs on the Series 646 itself, and by making sure that any terminal connected to the Series 646 RS-232C port is powered from the same outlet as the Series 646 itself.

6) The Series 646 is designed to operate properly, even on disturbed power lines' therefore, the Series 646 power supply may be connected to the same power source that is being monitored.

NOTE

Be aware that extensive transient suppression incorporated within the Series 646 power supply may alter the transient characteristics of the ac power line to which the power supply is connected. Normally, this consideration only applies to completely unloaded power lines.

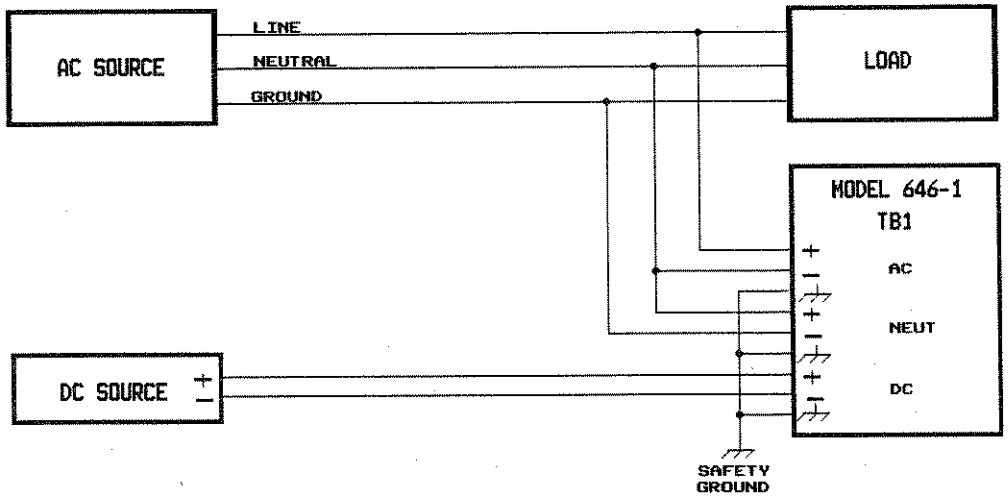

FIGURE 2-1. MODEL 646-1 SINGLE-PHASE INPUT CONNECTIONS

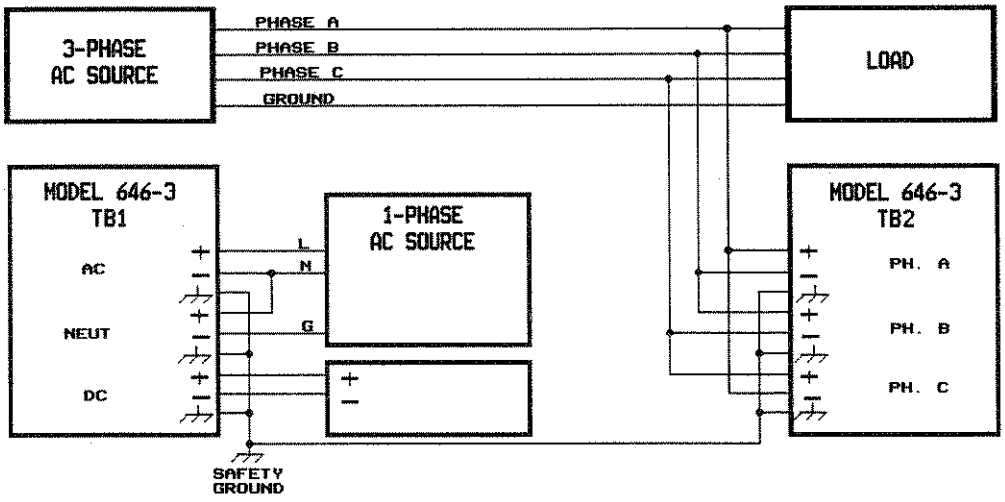

FIGURE 2-2. MODEL 646-3 INPUT CONNECTIONS: 3-PHASE "DELTA" SYSTEM.

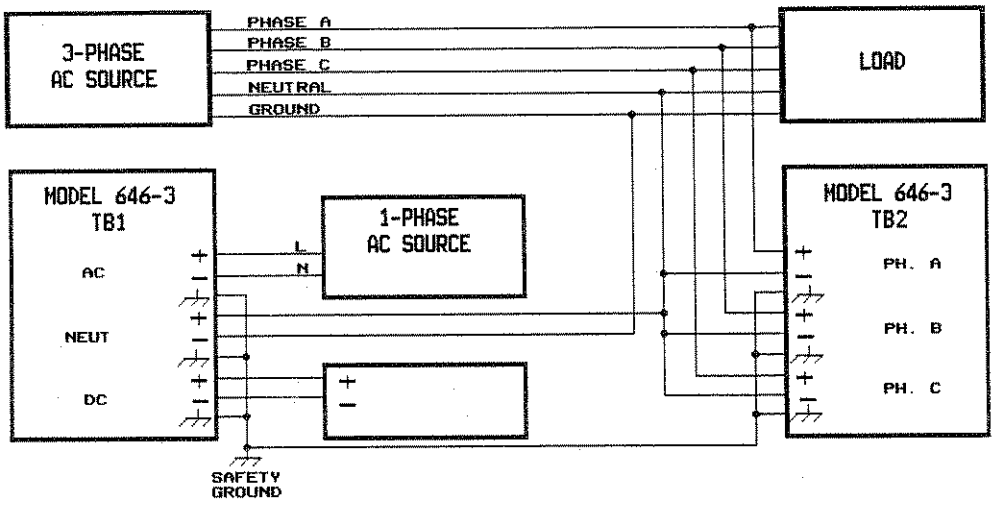

FIGURE 2-3. MODEL 646-3 INPUT CONNECTIONS: 3-PHASE "WYE" SYSTEM.

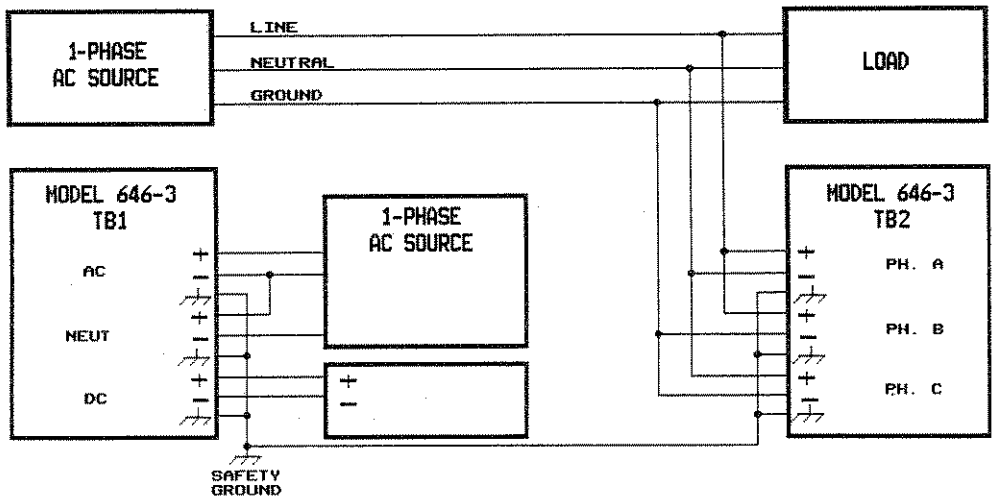

FIGURE 2-4. MODEL 646-3 INPUT CONNECTIONS: SINGLE-PHASE APPLICATIONS

2.4 OPERATING FEATURES

The section describes the Series 646's operating features, including information as to what functions are available and what buttons should be pressed to perform the functions.

CAUTION

DO NOT attempt actual power line voltage measurements without first reading the proper connection procedures and safety instructions.

2.4.1 Modes Of Operation

The series 646 has two basic modes of operation: "Operate" mode and "Program" mode.

2.4.1.1 Operate Mode

When turned ON, the unit is automatically in the Operate mode, ready to report disturbances. In this mode it will monitor its inputs and print disturbances as they occur. The Series 646 may execute several commands during this mode, including listing the programmed limit values, summarizing accumulated disturbance data, and displaying the present line voltage on its LCD. Any attempts to change the programming or to clear the data are ignored during this mode.

If the unit is in the Program mode, the Operate mode may be re-entered by pressing the [OPERATE MODE] key.

2.4.1.2 Program Mode

The Program mode is entered when the [PROGRAM MODE] key on the front panel of the unit is pressed. The program mode allows all of the programmable parameters to be changed.

NOTE

*No disturbances will be recorded while the unit is functioning in the Program mode. Also, it the unit is left alone for more than one minute, the LCD readout will alternately display "***PROGRAM MODE***" and "..press any key," as it awaits a response.*

Since all programmed settings are maintained by internal batteries while the unit is turned OFF, the Series 646 may be programmed at one location and then moved to another location for monitoring, without losing any of its setting values.

The unit leaves the Program mode and re-enters the Operate mode when the [OPERATE MODE] key is pressed.

2.4.2 Initial Power ON Procedure

Before turning ON the unit for the first time, verify that the ac voltage selector switch on the rear panel is properly set, and that the appropriate ac power cord is used to connect the unit to an available ac power source (refer to the instructions in Subsections 2.3.2 and 2.3.2.1). When this has been done, connect the unit's power cord to the ac power source and set the ON/OFF switch to ON. The Series 646 should print a "Power-ON" message identifying the type of unit and the options and accessories installed. The Series 646 then reports that it is in the Operate mode, prints the time and date according to its internal clock, and displays the message "MAIN MENU" on its LCD. The unit may then be programmed if the [PROGRAM MODE] key is pressed.

2.4.3 Introduction to the Series 646 Menus

Once the Series 646 is in the Program mode, nothing will happen until a key is pressed. Pressing the [HELP] key causes a message to be printed which lists the titles of the available menus and explains the use of the four basic keys needed to control the Series 646.

Each menu title represents a group of related function choices. Any desired function may be controlled by selecting a menu title, selecting one of the choices available under that menu, and instructing the Series 646 to act on that choice.

2.4.3.1 Selecting Menus -- the [NEXT MENU] Key

The [NEXT MENU] key allows the current menu to be changed. When the unit is first turned ON, the LCD displays the message "MAIN MENU". This means that the function choices listed under the Main Menu may now be executed. The Main Menu represents a group of functions affecting the overall operation of the unit: such as setting the time clock, erasing previously accumulated disturbance data, and setting the RS-232C baud rate.

NOTE

If the unit is a Model 646-1, the second menu reads "PROGRAM TB1 AC", indicating that there is a separate menu for programming limits which affect the ac voltage applied to the TB1 terminal block.

The [NEXT MENU] key may be used to find the names of all available menus. When the last menu is reached, pressing the [NEXT MENU] key restarts the cycle with the Main Menu choice. TABLE 2-1 provides a complete list of all available menus and their choices.

2.4.3.2 Listing the Menu Choices -- the [PRINT MENU] Key

The [PRINT MENU] key causes the unit to print a numbered list of choices for the current menu selected. This list appears on the unit's printer so that all choices for the particular menu may be seen at a glance. To obtain a complete list of all possible commands, alternately press the [NEXT MENU] and [PRINT MENU] keys.

TABLE 2-1. SERIES 646 COMMAND SUMMARY† (PAGE 1 OF 2)

Main Menu	Primary Menu For Overall System Operation
1 Program Summary	List programmed measurement limits
2 Standard Limits	Program the unit with default parameters
3 Data Summary	Print Data Summary, including worst-case
4 Clear Data	Erase all stored event data
5 Time	Display or set the time of day
6 Date	Display or set the date
7 Output:	Select output device for event printout
8 Baud Rate:	Select the RS-232C baud rate
9 Audio Alarm:	Enable/disable the audible event alarm
A Self Test	Initiate internal self test
B New Unit ID	Specify a new Unit Identifier message
*Program TB2 PH-A	Program Limits for "PH. A" input to TB2
1 High Limit	Display or set the high limit
2 Low Limit	Display or set the low limit
3 Volt Sens	Display or set the voltage sensitivity
4 Imp Sens	Display or set the impulse threshold
5 Copy to B&C	Copy limits from Phase "A" to "B" & " C"
6 Freq Sens	Display or set the frequency sensitivity
*Program TB2 PH-B	Program Limits for "PH. B" input to TB2
1 High Limit	Display or set the high limit
2 Low Limit	Display or set the low limit
3 Volt Sens	Display or set the voltage sensitivity
4 Imp Sens	Display or set the impulse threshold
*Program TB2 PH-C	Program Limits for "PH. C" input to TB2
1 High Limit	Display or set the high limit
2 Low Limit	Display or set the low limit
3 Volt Sens	Display or set the voltage sensitivity
4 Imp Sens	Display or set the impulse threshold
Program TB1 AC	Program Limits for "AC" input to TB1
1 High Limit	Display or set the high limit
2 Low Limit	Display or set the low limit
3 Volt Sens	Display or set the voltage sensitivity
4 Imp Sens	Display or set the impulse threshold
5 Freq Sens	Display or set the frequency sensitivity
Program Neut-Gnd	Program Limits for "Neut" input to TB1
1 High Limit	Display or set the high limit
2 Volt Sens	Display or set the voltage sensitivity
3 Imp Sens	Display or set the impulse threshold
Program DC Chan	Program Limits for "DC" input to TB1
1 High Limit	Display or set the high limit
2 Low Limit	Display or set the low limit
3 Volt Sens	Display or set the voltage sensitivity
4 Imp Sens	Display or set the impulse threshold
Program Temp	Program Limits for TEMPERATURE PROBE
1 High Limit	Display or set the high limit
2 Low Limit	Display or set the low limit
3 Temp Sens	Display or set temperature sensitivity
4 Temp Scale:	Choose Celsius or Fahrenheit scale

†The ASCII equivalent characters may be used as commands to operate the Series 646 from an external terminal, using the RS-232C Serial Comm. Port or the built-in modem (Option 103). (See Subsections 2.5 through 2.5.7).

* These menus ONLY apply to the Model 646-3.

CAUTION

The following two menus list functions not normally required by the user. Read this manual very carefully before attempting to change any parameters controlled by these menus.

TABLE 2-1. SERIES 646 COMMAND SUMMARY (PAGE 2 OF 2)

Menu Listing		Comments
Meter Menu		Meter/Calibrate Measured Parameters*
1	Freq:	Meter only, ac line frequency
2	Temp:	Meter or calibrate temperature reading
3	**3 Int. DC:	Meter or calibrate UPS battery reading
4	TB1 AC:	Meter or calibrate TB1 ac level reading
5	TB1 Imp:	Meter or calibrate TB1 ac impulse reading
6	Neutral:	Meter or calibrate Neutral Peak reading
7	Neut Imp:	Meter or calibrate Neutral impulse reading
8	DC level:	Meter or calibrate dc level reading
9	DC Imp:	Meter or calibrate dc impulse reading
A	PH-A AC:	Meter or calibrate TB2 Phase A level
B	PH-A Imp:	Meter or calibrate TB2 Phase A impulse
C	PH-B AC:	Meter or calibrate TB2 Phase B level
D	PH-B Imp:	Meter or calibrate TB2 Phase B impulse
E	PH-C AC:	Meter or calibrate TB2 Phase C level
F	PH-C Imp:	Meter or calibrate TB2 Phase C impulse
Configuration		Install Optional Features
1	3 Phase:	Indicates "yes" if Model 646-3 is configured
2	Imp Dur:	Indicates "yes" if Option 101 is installed
3	UPS:	Indicates "yes" if Option 102 is installed
4	Temp Probe:	Indicates "yes" if the temperature probe is in use

Pressing [SHIFT]+[Q] causes the Series 646 to enter a special mode used by the Dranetz Test Department for some basic diagnostics. The Series 646 will display the message "646 Test Mode: Read Vol 2 Manual before proceeding. Shift-Q to quit." Pressing [SHIFT]+[Q] returns you to your previous step.

2.4.3.3 Choice Selection -- [NEXT CHOICE] and [CHOICE #] Keys

Pressing the [NEXT CHOICE] key cycles the unit through the choice of selections available under the current menu. Pressing the [CHOICE #] key allows the immediate selection of an already known menu choice.

*Before allowing recalibration, the unit will ask "Are you sure?" and "Recalibrate?" before execution.
**A value in volts is shown only during calibration, otherwise, the unit indicates "int. DC: OK."

For example: Suppose that the time clock needs to be reset for a different time zone. Because setting the time is one of the commands available under the Main Menu, the Main Menu should first be selected (refer to subsection 2.4.4). If the [PRINT MENU] key is pressed, the resulting list will illustrate that the fifth item is "Time". The user may repeatedly press [NEXT CHOICE] until the LCD displays the "Time" message. A faster way of reaching the "Time" command, however, is to simply press the [CHOICE #] key, followed by the [5] key. Either method will cause the LCD to display the current time, indicating that the unit is ready to accept a new time setting.

NOTE

Pressing [QUIT] or pressing [CHOICE #] and then [0] returns the LCD display to the menu title in use.

2.4.3.4 The [NEW VALUE] and [YES] Keys

The [NEW VALUE] and [YES] keys facilitate the selection of action functions (such as erasing all event data) and programmable parameters (such as a high voltage limit or the RS-232C baud rate). Which key to press next in order to actively perform a function depends on the type of choice desired. The display aids in the selection. If the choice is an action function, such as "Program Summary", the message "(use YES)" appears on the display every other second (see NOTE below). Pressing the [YES] key causes the action to be taken. If the choice is a programmable parameter, such as "Baud Rate:", the message "(use NEW VALUE)" appears on the display every other second (see NOTE below). Pressing [NEW VALUE] allows the new value to be entered.

For example: Under the Main Menu, the display may read "Audio Alarm: ON". To disable the alarm, press [NEW VALUE], and the display immediately switches to "Audio Alarm: OFF". To re-enable the alarm, press [NEW VALUE] again. Also under the Main Menu is a choice which displays the current time of day. To change the time of day, [NEW VALUE] is also used, but this time the display prompts for the expected time format of hours, minutes, and seconds. After the seconds have been keyed in, the display indicates that the unit is expecting the [ENTER] key to be pressed. If it is not pressed, the time is not changed.

NOTE

In general, the prompt messages "(use YES)" and "(use NEW VALUE)" appear ONLY while the Series 646 is in the Program mode. This is because the unit accepts new values and performs most functions ONLY while in the Program mode.

2.4.4 Main Menu

When the Series 646 is turned ON, the active (current) menu is the Main Menu. The Main Menu represents a group of commands affecting the overall operation of the unit. Pressing the [PRINT MENU] key while the Main Menu is active causes the Series 646 to print:

```
MAIN MENU
1   Program Summary
2   Standard Limits
3   Data Summary
4   Clear Data
5   Time 09:14:53*
6   Date 01/22/85*
7   Output: BOTH
9   Baud Rate: 9600
A   Self Test
B   New Unit ID
```

2.4.4.1 Program Summary

A Program Summary is a list of all programmable limits used by the Series 646 to decide when to report a disturbance. You should generate a Program Summary printout at the beginning of every monitoring session to verify that the limits which are programmed are as they should be. If a Program Summary printout is desired, select the "Program Summary" choice under the Main Menu and press [YES]; this may be done at any time. A Program Summary with the factory preset limits from a Model 646-3 appears in TABLE 2-2.

2.4.4.2 Standard Limits

To use the Series 646 as quickly as possible with meaningful results, each unit is shipped pre-programmed with factory preset standard limits. The standard limits represent typical values suggested for use when monitoring ac power lines with nominal voltages of 115 V rms. TABLE 1-1 (page 1 of 6) includes a list of the standard limits along with the minimum and maximum allowable programmable values.

The printout example in TABLE 2-2 illustrates the standard limits for the Model 646-3. If some or all of the programmable limits have been changed, the standard limits may be recalled by selecting the "Standard Limits" choice under the Main Menu, and pressing the [YES] key. As a safeguard, the Series 646 will reply "Are you sure?" (awaiting a [YES] response) before actually changing anything. This function is possible **ONLY** in the Program mode.

*The time and date will depend on the actual time and date that this menu is selected.

TABLE 2-2. PROGRAM SUMMARY PRINTOUT EXAMPLE (MODEL 646-3)

Printed Data		Description
PROGRAM TB2 PH-A		TB2 Phase A programmable limits
Hi Limit	125V	Highest acceptable level
Low Limit	105V	Lowest acceptable level
Volt Sens	003V	Smallest voltage change recorded
Imp Sens	0100V	Smallest impulse recorded
PROGRAM TB2 PH-B		TB2 Phase B programmable limits
Hi Limit	125V	Highest acceptable level
Low Limit	105V	Lowest acceptable level
Volt Sens	003V	Smallest voltage change recorded
Imp Sens	0100V	Smallest impulse recorded
PROGRAM TB2 PH-C		TB2 Phase C programmable limits
Hi Limit	125V	Highest acceptable level
Low Limit	105V	Lowest acceptable level
Volt Sens	003V	Smallest voltage change recorded
Imp Sens	0100V	Smallest impulse recorded
PROGRAM TB1 AC		TB1 ac programmable limits
Hi Limit	125V	Highest acceptable level
Low Limit	105V	Lowest acceptable level
Volt Sens	003V	Smallest voltage change recorded
Imp Sens	0100V	Smallest impulse recorded
Freq Sens	0.5Hz	Smallest frequency change recorded
PROGRAM NEUT-GND		Neutral-to-ground limits
Hi Limit	005V	Highest acceptable peak level
Volt Sens	003V	Smallest voltage change recorded
Imp Sens	0050V	Smallest impulse recorded
PROGRAM DC CHAN		The dc channel programmable limits
Hi Limit	005.2V	Highest acceptable level
Low Limit	004.8V	Lowest acceptable level
Volt Sens	000.2V	Smallest voltage change recorded
Imp Sens	001V	Smallest impulse recorded
PROGRAM TEMP		Temperature measurement limits
Hi Limit	035 C	Highest acceptable temperature
Low Limit	015 C	Lowest acceptable temperature
Temp Sens	005 C	Smallest temperature change recorded
Temp Scale: C		Scale in effect: °C or °F

2.4.4.3 Data Summary

During the course of a monitoring session, the Series 646 may report hundreds or even thousands of disturbances. As an aid to quickly locating the most critical information, the Series 646 maintains in its memory a detailed, pre-sorted summary of the most severe activity recorded during the entire session (which could span weeks or even months).* A printout of this information is available by selecting the "Data Summary" choice under the Main Menu and pressing the [YES] key. The resulting printout contains a great deal of information but in a concise form. (See Subsection 2.12.6 for an example of a Data Summary printout.)

Included in the printout is up to twenty-seven different categories (if using the maximum six input channels) comprised of up to ten recorded events (identified as "hits") each. The categories correspond to the different types of disturbances distinguished by the Series 646. There is one category for the ten most severe impulses detected on the AC input terminals, another category for ten most severe impulses detected on the NEUT inputs, a separate category for ten most severe undervoltage conditions on the dc channel, and so on, for a total of possibility of up to 270 detailed events (27 x 10).**

The Data Summary printout may be obtained while the unit is in either the Operate or Program mode. In the Operate mode, the summary information is always current. In the Program mode, all monitoring is disabled, so no new information is added to the summary. Generating the Data Summary printout does not erase any accumulated data, so this function may be used freely without loss of information. The accumulated data may **ONLY** be cleared with the "Clear Data" function.

2.4.4.4 Clear Data

Before each monitoring session you must clear the unit of any disturbance data from previous sessions. This may be done by selecting the "Clear Data" choice under the Main Menu, and pressing the [YES] key. As a safeguard, the unit displays on its LCD "Are you sure?" before erasing any data.

NOTE

The Series 646 will print the message "Data Cleared" along with the time and date when the data was erased.

2.4.4.5 Setting the Time

To set the Series 646's internal time clock, first select the "Time" choice under the Main Menu. If the unit is in the Operate mode, the LCD displays the current time (updated every second). If the Series 646 is now placed in the Program mode, the time is still updated, but the display prompts with the message "(use NEW VALUE)" on alternating seconds. Pressing the [NEW VALUE] key causes the display to read "HH MM SS" indicating that the unit is ready to accept a time entry in the format of hours, minutes, and seconds.

* A monitoring session lasts until either the "Clear Data" function is performed, or the battery runs down.
** See Appendix A for a complete description of the twenty-seven categories distinguished by the Series 646.

For example: To set the time to 2:30 pm, enter the six digits "143000" (24-hour format) with nothing in between. The cursor on the display echoes the entires by replacing "HH MM SS" with the newly entered digits. After the sixth digit has been selected, the display adds the message "enter," indicating that the Series 646 will wait until the [ENTER] is pressed before changing the time; this allows precise synchronization. The time must be specified in 24-hour format: where midnight is "00," noon is "12," and 2:00 pm is "14," etc. The Series 646 will not accept time entries for which the hour is greater than 23, or for which the minute or second is greater than 59. The [Quit] key returns you to the original time display without changing the previous setting.

2.4.4.6 Setting the Date

The date is set in the same fashion as the time. With the unit in the Program mode, select the "Date" choice under the Main Menu and press [NEW VALUE]. The prompt message "MM DD YY" appears on the display, indicating that the unit is ready to accept a date entry in the format of month, day, and year.

For example: To set the date to January 22, 1988, enter the six digits "012288," with nothing in between. The cursor on the display will echo the entries by replacing "MM DD YY" with the newly entered digits. After the sixth digit has been selected, the display adds the message "enter," indicating that the Series 646 will wait until the [ENTER] key is pressed before changing the date. The Series 646 accepts month numbers from 1 to 12 and day numbers from 1 to 31. The [QUIT] key returns you to the original date display without changing the setting.

2.4.4.7 Selecting the Output Mode

When the Series 646 detects a disturbance, it can perform one of four things, depending on the setting of its Output mode:

1) Send a message to its built-in printer, or

2) Send a message to its RS-232C Serial Communications Port, or

3) Send a message to both the printer and the RS-232C port, or

4) Send no message, but save the disturbance in its memory for printout at a later time and date.

To set the Series 646 to the desired Output mode, select the "Output:" choice under the Main Menu, and then press the [NEW VALUE] key until the appropriate indicator messages appear. The Output modes are defined as follows:

Output: PRINTER

The Series 646 sends disturbance report messages **ONLY** to its built-in printer. The unit, however, still responds to commands from its RS-232C port (if in use).

Output: RS-232C

The built-in printer is disabled as long as the RS-232C port is active. If the RS-232C port becomes inactive, the printer automatically is enabled, thus preventing the loss of disturbance data.

Output: BOTH

Disturbance report messages are sent to both the printer and the RS-232C port.

Output: SUM ONLY

In this mode, disturbance report messages are not output as the disturbances occur, but the Data Summary is always available on command, resulting in the "SUMmary ONLY" Output mode. This does not necessarily mean that any data is lost, because the Series 646 saves as many events as possible in its memory. If the Output mode is changed, all events stored are then printed. If all of the memory is filled, the message "STACK OVERFLOW" is printed.

A Model 646-1 can store up to 250 events in this manner; a Model 646-3 can store up to 500 events. This feature is useful when using the optional modem (Option 103).

NOTE

Since the Optional modem (Opt. 103) is internally connected to the unit's RS-232C port, all descriptions regarding the use of the RS-232C port apply to the modem as well.

2.4.4.8 Setting the Baud Rate

NOTE

The unit must be in the Program mode.

The baud rate of the unit's RS-232C Serial Communications Port is programmable from the Series 646 front panel to one of three values: 300, 1200, or 9600 baud. To change the baud rate, select the "Baud Rate:" choice under the Main Menu and then press the [NEW VALUE] key until the desired rate appears on the LCD.

2.4.4.9 Audible Alarm

The Series 646 is equipped with an audible alarm to signal the detection of disturbances. The alarm sounds on any out-of-limits condition, including impulses. To enable or disable the alarm, select the "Alarm:" choice under the Main Menu and press [NEW VALUE] so that the LCD indicates "Alarm: ON" or "Alarm: OFF", as desired (continual pressing of [NEW VALUE] toggles the readings).

2.4.4.10 Unit Self-Test

The Series 646 performs a self-diagnostic check every time the unit is turned on. This self-check verifies the unit's circuitry and memory. This self-test routine (discussed in Section III) can also be selected from the Main Menu.

2.4.4.11 Unit Identifier Message

Each Series 646 unit is uniquely identified by a programmable 16-character message which is printed when the unit is turned ON and before the Data Summary printout is displayed. To change the message, select the "New Unit ID" choice under the Main Menu and press [NEW VALUE]. The display is cleared and an entry of up to 16 characters in length is allowed.

Pressing [ENTER] accepts the entry. The Series 646 only accepts an entry of upper-case letters or numbers. Typing a letter from the front panel of the Series 646 keyboard requires two keystrokes: first press [SHIFT] and then press the key marked with the desired letter (A-Z).

2.5 REMOTE OPERATION

Up until this point, most descriptions of the operation of the Series 646 have assumed that commands are entered from the front panel keyboard, using the unit's LCD for prompting and feedback. Commands can also be entered from a PC or a Data Terminal. The PC or Data Terminal would have to be connected to the Series 646 either through the built-in RS-232C Serial Communications Port or the optional modem (Option 103).

NOTE

In order for the Series 646 to communicate with a PC, the PC must be equipped with appropriate software.

When communicating with a Data Terminal, the Series 646 interprets certain ASCII characters as equivalent to front panel keys and transmits messages exactly as they appear on its LCD and printer. In this way, the Series 646 uses the remote terminal to emulate the behavior of its own front panel. The Front Panel Key Function Summary in TABLE 1-1 (page 5 of 6) shows the ASCII equivalent and function of the front panel keys. For convenience, it is repeated on the following page in TABLE 2-3.

2.5.1 RS-232C Serial Communications Port Characteristics

The unit transmits and receives ASCII characters in serial form using an 8-bit word length, two stop-bits, and no parity. The baud rate may be set to values of 300, 1200, or 9600. To program the baud rate, select the "Baud Rate:" choice under the Main Menu and press [NEW VALUE] until the desired baud rate is indicated.

NOTE

The Series 646 activates the RS-232C port when it detects a +12 V level at pin 20 of the connector on the rear panel.

TABLE 2-3. FRONT PANEL KEY FUNCTION SUMMARY

Key	ASCII Equiv.	Function
OPERATE MODE	O	Enables disturbance analysis
PROGRAM MODE	P	Disables disturbance analysis
LOCK/UNLOCK	L	Enables security lock code
NEXT MENU	TAB	Selects next available menu
PRINT MENU	M	Lists choices for active menu
NEXT CHOICE	SPACE	Selects next available choice
PREVIOUS CHOICE	BACKSPACE	Selects previous choice or menu
CHOICE #	#	Selects choice from numbered list
NEW VALUE	=	Allows change of displayed value
ENTER	RETURN	Completes numerical entries
YES	Y	Allows action taken as prompted
NO	N	Prohibits action as prompted
HELP	H	Generates a short "help" message
PAUSE/RESUME	ESCAPE	Pause control during Data Summary
QUIT	(CONTROL-C)	Aborts printout in progress
PAPER FEED	LINE FEED	Generates three blank lines
SHIFT	(none)	Selects letters for ID message

2.5.2 RS-232C Port Connections

Connection to the unit's RS-232C port is made by attaching the terminal's data cable to the 25-pin female "D" connector on the unit's rear panel. The "D" connector pin designations correspond to the EIA RS-232C standard for Data Communication Equipment (DCE). They are the same as those usually found on Data modems with RS-232 connections. A suitable data cable for use with most terminals would simply provide straight-through connections for pins 1,2,3,5,6,7,8 and 20. The Maximum recommended cable length is 50 feet. TABLE 2-4 illustrates the pin-outs for the Series 646 RS-232C Serial Communications Port.

TABLE 2-4. SERIES 646 RS-232C CONNECTOR PIN ASSIGNMENTS

25-Pin "D" Pin Number	Direction	Description
1,7	N/A	Ground
2	To 646	Serial data receive
3	From 646	Serial data transmit
5,6,8	From 646	CTS, DSR, DCD; always +12 V
20	To 646	DTR; must be +12 V to activate the port

2.5.3 Modem (Option 103)

As previously described, one of the options available for the Series 646 is Option 103, an internal modem. The modem is Bell 103 compatible and is registered with the Federal Communications Commission (FCC) for direct connection to public telephone lines. With the modem installed, the instrument will answer an incoming call and allow full-duplex (simultaneous transmit and receive) communication at 300 baud. Once communication has been established, operation is the same as if the RS-232C port were being used. A 25-foot telephone cord with modular plugs at both ends is provided. One end of the cord is plugged into the RJ11 jack on the Series 646 rear panel; the other end is connected to a telephone line. The telephone line must be wired to an RJ11 jack. Specifications for the modem are summarized in TABLE 1-1 (page 6 of 6).

NOTE

Before using the modem, please read the following information concerning FCC Rules and Regulations.

2.5.4 Compliance with FCC Rules and Regulations

The modem described in this manual has been approved by the FCC for direct connection to the Public Switched Telephone Network. To fully comply with FCC regulations, users must be aware of certain procedures and considerations regarding the actual installation and operation of registered terminal equipment. The following subsections (2.5.4.1 through 2.5.4.6) are paraphrased from a list of Federal Communication Commission Specifications, Part 68.

2.5.4.1 Notification of the Telephone Company

Before connecting to the telephone network, notify your telephone company of the line that you are using, the FCC Registration Number, the Ringer Equivalence of the modem, and the type of jack required for the connection. (This information appears on the label located on the rear panel of the 646 unit, but is also stated below for your convenience.) You must also notify your telephone company upon final disconnection of the equipment.

FCC Registration Number: DRJ6YR-70737-DM-N
Ringer Equivalence: 0.3B
Phone Jack (USOC): RJ-11

2.5.4.2 Connection to the Telephone Network

All direct connection to the telephone network must be made through standard plugs and jacks as described in Part 68, Subpart F, of the FCC Rules. You MAY NOT connect to party lines or public telephones.

After properly notifying the telephone company of your intended connection and installing the required jack, you may connect the modem by inserting the mating plug of the cable into the jack.

2.5.4.3 Responsibilities of the Telephone Company

The telephone company shall supply, upon request, the technical information required to permit compatibility with its facilities. To allow you the opportunity of maintaining uninterrupted service, the telephone company shall give you adequate notice of changes in its facilities and operations that may affect the use or performance of your equipment.

2.5.4.4 In Case of Trouble

If you experience operating trouble, disconnect the modem from the telephone line to determine if the equipment is malfunctioning. DO NOT use the modem until you solve the problem.

2.5.4.5 Incidence of Harm

If your modem causes harm to the telephone network, the telephone company shall, if feasible, notify you that service may be temporarily discontinued. If it becomes necessary to discontinue service immediately without prior notice, the telephone company shall promptly notify you and give you the opportunity to register a complaint to the Commission (FCC), pursuant to the procedures set forth in Part 68, Subpart E of the FCC Rules.

2.5.4.6 Modem Service

All service and repairs must be performed by Dranetz Technologies, Inc., or Dranetz Service Corporation. If unauthorized modification or repair is performed, both the FCC Registration and the manufacturer's warranty in effect will be null and void. If a malfunction is suspected, it is your responsibility to contact the Dranetz Service Corporation for further instructions.

2.5.5 Calling Sequence

The modem is "answer" only. To establish telephone communications with the Series 646, the user must originate a call using a terminal or computer equipped with a Bell 103 compatible modem. The following procedure describes how to originate a call using an acoustic coupler modem:

1) Connect the terminal or computer to the modem
2) Set the computer or terminal for 300 baud
3) Set the modem to the Originate mode
4) Dial the desired telephone number
5) Listen for the answer tone from the Series 646 modem
6) Mate the telephone handset with the modem
7) If no message appears within 20 seconds, hang up and try again

2.5.6 Selecting the Terminal

The Series 646 may be used with either a video display terminal or a printing terminal. When using a display terminal, the Series 646 duplicates the messages appearing on its LCD display, including the once-per-second updates mentioned previously. The Series 646 updates a line on the display by sending a "Carriage Return" character to move the cursor to the beginning of the same line. This requires that the terminal accept a "Carriage Return" character without generating an automatic line feed. Most video terminals can be set up to operate in this manner.

NOTE

If this were attempted using a terminal which prints on paper, it would either waste a lot of paper, or would cause the terminal to print over and over on the same line. Therefore, when using a printing terminal, type the letter "T" as soon as the Series 646 identifies itself. This will disable the once-per-second updates and avoid wasting paper.

2.5.7 The [HELP] Key

When using a remote terminal to communicate with the Series 646, each key on the unit's front panel is represented by an equivalent ASCII character as listed in TABLE 1-1 and repeated in TABLE 2-3. By Typing an "H" for "HELP", the usual help message is sent to the terminal along with a list of the equivalent characters.

2.6 PROGRAMMING THE SERIES 646

As the Series 646 takes its measurements, it compares the measured values against its programmed limits. From this comparison, the unit makes decisions as to whether or not there are conditions which should be reported. This section of the manual defines the various programmable limits available for each type of measurement. It also provides guidelines for setting limits for the unit to provide the most useful data for a given situation. The limits are listed in TABLE 1-1 (page 1 of 6).

2.6.1 Changing the Limits

The example Program Summary printout of TABLE 2-2 lists all of the programmable limits available for a Model 646-3 equipped with the temperature probe accessory. Seven groups of limits are illustrated in the example. There is one group for each measurement input: four channels of ac voltage, one neutral-to-ground channel, one dc voltage channel, and one temperature input. A separate program menu is available to program the limits for each input.

CAUTION

The equipment may damaged if the Absolute Maximum Ratings are exceeded. See TABLE *1-1 (page 1 of 6) for Absolute Maximum Ratings.*

To change any of the limits, perform the following:

1) Place the unit in the Program mode.

2) Select the program menu for the desired input (PROGRAM TB2 PH-A, PROGRAM TB2 PH-B, PROGRAM TB2 PH-C, PROGRAM TB1 AC, PROGRAM NEUT-GND, PROGRAM DC CHAN, or PROGRAM TEMP).

3) Select the appropriate choice (Hi Limit, Low Limit, Volt Sens, Imp Sens, Freq Sens, Temp Sens, or Temp Scale:) and then press [NEW VALUE].

4) Enter the new value and then press [ENTER].

For example: To change the setting for the smallest Impulse to be reported for the ac voltage channel of Terminal Block 1, select the "PROGRAM TB1 AC" Menu. Next select the "Imp Sens" choice by pressing [CHOICE #], selecting "4", and then pressing [NEW VALUE]. The LCD displays the message "????V", indicating that four digits are expected. If the desired value is 50 Volts, enter the four digits "0050". After the fourth digit has been entered, the message "enter" appears, indicating that the [ENTER] key must be pressed to complete the entry. All of the limits are programmed in this manner. The LCD always prompts for the exact format expected, that is, the number of question marks always equals the required number of digits.

2.6.2 High Limit

The High Limit (or "Hi Limit") for each channel represents the highest steady-state rms (root mean square) value considered to be normal for that input. When a measured value is found to be greater than its programmed High Limit, the message ">HI LIMIT" is printed and the alarm sounds (if enabled).

2.6.3 Low Limit

The Low Limit (or "Lo Limit") for each channel represents the lowest steady-state rms value considered to be normal for that input. When a measured value is found to be less than its associated Low Limit, the message "<LO LIMIT" is printed and the alarm sounds (if enabled). The neutral-to-ground channel is the **ONLY** input without a Low Limit, since the neutral-to-ground voltage is never too low (under ideal conditions it's zero).

2.6.4 Voltage Sensitivity

The Voltage Sensitivity (or "Volt Sens") is the smallest change in the steady-state rms voltage which causes a printout.

For example: The Series 646 may be programmed to print whenever the ac voltage applied to the AC input on TB1 changes by 5 volts or more. If the voltage for this channel was last reported at 115 volts, and then rises to 120 volts, the Series 646 prints "TB AC INCREASE" followed by "120 VAC." A decrease in voltage is reported in a similar manner. If this increase/decrease information is not desired, it may be suppressed by programming the Voltage Sensitivity to its highest possible value (see TABLE 1-1 for voltage sensitivity specifications).

2.6.5 Impulse Sensitivity

The Impulse Sensitivity (or "Imp Sens") represents the minimum amplitude for which transient Impulses are reported. The Series 646 prints whenever an Impulse is detected with an amplitude greater than or equal to the Impulse Sensitivity setting. It then ignores any Impulses with smaller amplitudes.

2.6.6 Frequency Sensitivity

The Frequency Sensitivity (or "Freq Sens") is the smallest change in the ac line frequency which causes a printout.

2.6.7 Temperature Measurement Limits

When the temperature probe accessory is used, the "PROGRAM TEMP" Menu allows programming of the High Limit, Low Limit, Temperature Sensitivity, and Temperature Scale. The High and Low limits, as well as the Temperature Sensitivity, may be programmed in either Celsius or Fahrenheit. If the Fahrenheit scale is selected, temperature readings are internally converted from Celsius to Fahrenheit at the time of printout using the conversion formula (°F) = (1.8 x °C) + 32.

2.6.8 Operator Error Messages

An error message appears on the LCD if an attempt is made to program a limit outside the allowable range of values. A warning message appears if an attempt is made to program a High Limit lower than the programmed Low Limit, or a Low Limit higher that the programmed High Limit.

2.6.9 Suggested Programming Guidelines

The best settings for any application are those allowing the Series 646 to reveal the critical behavior of the monitored inputs, without providing so much detail that it becomes cumbersome to find the most important disturbances. The amount of information most desirable varies with the application. In general, if disturbances are reported every few seconds or even every few minutes, the settings are probably too sensitive and should be adjusted.

When monitoring at an unfamiliar location, highly detailed data is necessary at first to obtain an adequate knowledge of the typical conditions at the particular site. Once the typical conditions are established, the limits should be made less sensitive so that only the unusual events are reported. In particular, the ac Voltage Sensitivities should not be set too low (too precise), otherwise the paper tape may fill up with insignificant increases and decreases in the voltage. As a safeguard, the Data Summary always retains the most severe events if the paper tape runs out.

2.6.10 Three-Phase Considerations (Model 646-3)

The Model 646-3 provides four ac voltage measurement channels with independently programmable limits. As long as the line frequency is the same for all of the ac inputs, the ac channels may be used to monitor:

a) Four separate sources, or

b) One single-phase source with both differential and common-mode analysis, or

c) One three-phase source.

If a three phase source is being monitored and identical limits are used for all of the phases, the Series 646 allows the limits programmed for Phase A to be copied to both Phase B and Phase C. This copying is performed while the unit is in the "PROGRAM TB2 PH-A" Menu (press [CHOICE #] and then [5]).

2.7 MEASUREMENT TECHNIQUES

Once the limits have been programmed and the Series 646 is placed in the Operate mode, the unit begins taking measurements for all of the inputs. To better understand the disturbance printouts, a brief discussion of the measurement circuits follows.

Each voltage input channel (three for the Model 646-1, and six for the Model 646-3) actually consists of two separate circuits. One circuit responds only to the lower frequencies and is used to measure the steady-state voltage levels without being affected by high-frequency transients. The other circuit responds only to the high-frequency transients. Thus, two voltage readings per channel are performed: one to measure the steady-state level and the other to detect transients or Impulses.

Measurements are performed once per ac cycle. At the end of each cycle, the Series 646 measures the peak voltages reached during the cycle from the steady-state circuits. It then converts the ac values to equivalent rms numbers. (The neut and dc values remain as peak values.) At the same time, the largest Impulse peak amplitude detected during the cycle is measured. If Option 101 is installed, the duration of the Impulse with the largest amplitude is recorded. Frequency measurement is made by averaging the period over eight cycles. The temperature from the temperature probe accessory is averaged over a period of eight ac cycles. Once all measurements have been taken, each reading is compared against both the programmed limits and the previous conditions to determine whether or not a disturbance or a change should be reported. Disturbances are classified according to five basic types or categories:

1) Sags
2) Surges
3) Undervoltages
4) Overvoltages
5) Impulses

2.7.1 Sag Detection

Sags are short-term conditions which apply **ONLY** to the ac voltage input channels. A sag occurs if the ac voltage level reaches a value lower than its programmed Low Limit, and returns to the normal range within 2.55 seconds. A complete sag disturbance record begins when an out-of-limits condition is detected and ends when the voltage returns to normal, resulting in at least two printouts:

1) The "<LO LIMIT" exceeded printout
2) The "SAG" printout when the voltage returns to within normal limits

Several increases or decreases may be reported while out-of-limits. Other reported information includes the channel, type of event, most extreme low voltage reached while out-of-limits, duration of the event in seconds, and the time and date the voltage returned to normal.

2.7.2 Surge Detection

Surges are short-term conditions which apply **ONLY** to the ac voltage input channels. A surge occurs if the ac voltage level reaches a value greater than the High Limit and returns to the normal range within 2.55 seconds. A complete surge disturbance record begins when an out-of-limits condition is detected and ends when the voltage returns to normal, resulting in at least two printouts:

1) The ">HI LIMIT" exceeded printout
2) The "SURGE" printout when the voltage returns to within normal limits

Several increases or decreases may be reported while out-of-limits. Other reported information includes the channel, type of event, most extreme high voltage reached while out-of-limits, duration of the event in seconds, and the time and date the voltage returned to normal.

2.7.3 Undervoltage Detection

Undervoltage disturbances are longer-term conditions (as opposed to sags) and apply to all measurement inputs*, including the temperature inputs.

This disturbance differs from a sag in that the out-of-limits condition lasts longer than 2.55 seconds. Otherwise, an undervoltage disturbance is reported the same as a sag. The length of time spent out-of-limits is recorded for up to 999 seconds.

2.7.4 Overvoltage Detection

Overvoltage disturbances are longer-term conditions (as opposed to surges) and apply to al. measurement inputs, including the temperature inputs.

This disturbance differs from a surge in that the out-of-limits condition lasts longer than 2.55 seconds. Otherwise, an overvoltage disturbance is reported the same as a surge. The length of time spent out-of-limits is recorded for up to 999 seconds.

2.7.5 Impulse Detection

An Impulse is defined as a high-frequency transient superimposed on a steady-state signal.

For example When the Series 646 reports a 100 volt Impulse peak, for a brief time the voltage at the input was 100 volts away from an ideal sine wave. Impulses are measured for all of the voltage inputs. If more than one Impulse is detected during a cycle, e.g., an oscillatory transient, only the Impulse with the largest amplitude is recorded.

2.7.5.1 Impulse Duration

If Option 101 is installed, each Impulse printout includes duration information. Duration is reported in microseconds and is defined as an interval of time beginning when the Impulse amplitude exceeds approximately 25 V pk and ending when the amplitude falls below 10% of its highest peak value. If more than one Impulse is detected during a cycle, the duration of the Impulse with the largest amplitude is recorded.

2.7.6 Increases and Decreases

In addition to reporting out-of-limits conditions, the Series 646 also tracks changes in measured values based on the programmed Voltage, Frequency, and Temperature Sensitivities. This can be useful for obtaining detailed graphs of the behavior of monitored inputs.

*The neutral-to-ground channel is the ONLY exception because it doesn't have an undervoltage category.

2.7.7 Disturbance Printout Formats

All disturbance report messages follow a basic format. Each event is recorded in two or three lines on a printer. The first line always indicates the input channel and type of disturbance. The last line always indicates the date and time of the event. If there is a middle line, it contains the amplitude and duration information.

NOTE

The unit does not print event data while its ac power is lost. Any events are stored in memory and printed once the ac power returns.

2.8 THE METER MENU

The Meter Menu is provided so that any measurements (including ac voltage, ac line frequency, etc.) can be monitored by the LCD. Each of the measured parameters is represented by a choice under the Meter Menu. To monitor any parameter, select one of the measurements which can be monitored with the Meter Menu. The displayed information is updated every second. Impulse readings correspond to the last Impulse detected with an amplitude of 50 or more volts (5 volts for the dc channel). Impulse readings include duration information if Option 101 is installed.

CAUTION

DO NOT press [NEW VALUE] while the Meter Menu is active. Doing so changes the measurement calibration of the unit. Refer to Volume 2 (Service Manual, TM-111825) or contact Dranetz Service Corporation for further instructions if re-calibration is necessary or if you suspect that calibration has been accidently altered.

2.9 THE CONFIGURATION MENU

The Configuration Menu is used at the factory when installing some of the options available for the Series 646. This menu is required by the user **ONLY** if installing a temperature probe accessory not originally ordered with the Series 646.

CAUTION

You SHOULD NOT normally need to access this menu, since the configuration of the unit is listed on the printer each time the unit is turned ON.

2.10 INSTALLING THE TEMPERATURE PROBE ACCESSORY

If a temperature probe is ordered separately for a Series 646 which was previously purchased by the user, the temperature measurement circuitry inside the Series 646 must be enabled. To install the temperature probe, proceed as follows:

1) Place the Series 646 in the Program mode.

2) Select the Configuration Menu by pressing [NEXT MENU] until "Configuration Menu" is displayed on the LCD.

3) Select the "Temp Probe:" choice (choice "4"). If the LCD displays "Temp Probe: YES", skip step 4 and proceed instead to step 5.

4) Press [NEW VALUE] and the LCD will display "Temp Probe: YES".

5) Insert the connector end of the temperature probe cable into the receptacle labeled "TEMPERATURE SENSOR" on the rear panel of the unit (refer to the drawing of the rear panel: FIGURE 1-3). The Series 646 can now measure temperature.

2.11 DISABLING THE "↓" (DOWN ARROWS)

The Series 646 automatically prints one or more down arrows directly above a disturbance printout. The purpose of these "down" arrows is to indicate that the paper tape reading should be read from the TOP DOWN.*

To disable the down arrows from printing, simply press [SHIFT] and then the [A] key. The down arrows are then disabled for as long as the unit is left ON, or until the unit experiences a power loss. To re-enable the down arrows, press [SHIFT] and the [A] key again.

2.12 DISTURBANCE PRINTOUTS AND WAVEFORM EXAMPLES

The following subsections contain sample printouts of Series 646 disturbance detection. These examples assume the input is to Terminal Block 2 (TB2), Phase A channel (PH-A).

2.12.1 Sample Impulse Disturbance Printout

The printout below is taken from an actual impulse disturbance on TB2, PH-A. The reading indicates an impulse of 289 volts peak, 9 microseconds, occurred on April 10, 1988 at 11:35:42.

```
↓
TB2 PH-A IMPULSE
0289 V pk, 0009 uS
10-Apr-88  11:35:42
```

*This is done because the printouts from some older Dranetz equipment are read from the BOTTOM UP.

2.12.1.1 Impulse Waveform Disturbance

The waveform disturbance below is an example and is related to the previous printout. In this waveform there are 3 impulses. Because impulses 1 and 2 both occur within the same cycle, the larger of the two, impulse 2, is recorded by the Series 646. Impulse 3 occurs within the 3rd cycle and is therefore recorded.

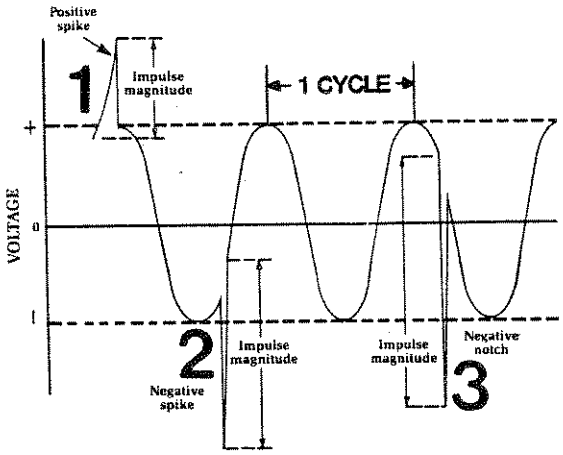

FIGURE 2-5. IMPULSE WAVEFORM DISTURBANCE

NOTE

Impulse magnitude is measured from the point it occurs on the waveform, NOT from the zero voltage reference point.

2.12.2 Sample Surge Disturbance Printout

The printout below is taken from an actual surge disturbance on TB2, PH-A. The top part of the printout indicates that the voltage upper limit (125 V ac) was exceeded on April 10, 1988 at 11:37:19. The voltage then increased to 132 volts ac (the highest reading detected over the voltage sensitivity of 3 V within the same cycle). When the voltage returned to normal, the disturbance is reported as a SURGE because the voltage exceeded the upper limit for 0.18 seconds. The maximum voltage reached, 132 volts, is also printed. The bottom part of the printout indicates that the voltage decreased to within normal limits: 122 volts ac.

NOTE

If the out-of-limits voltage lasted for more than 2.55 seconds, the disturbance would be classified as an overvoltage rather than a surge.

↓
TB2 PH-A >HI LIMIT
10-Apr-88 11:37:19

↓
TB2 PH-A INCREASE
132 VAC
10-Apr-88 11:37:19

↓
TB2 PH-A SURGE
132 Vmax, 0.18 Sec
10-Apr-88 11:37:19

↓
TB2 PH-A DECREASE
122 VAC
10-Apr-85 11:37:19

2.12.2.1 Surge Waveform Disturbance

The waveform disturbance shown below is an example and is not related to the surge printout above. It simply illustrates how a typical surge disturbance affects a voltage waveform.

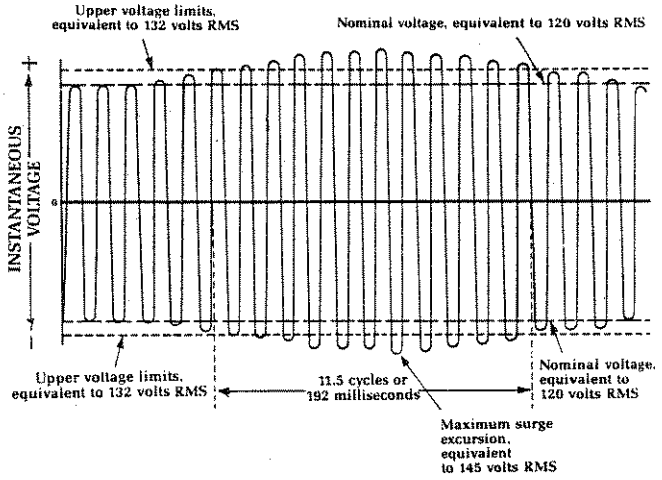

FIGURE 2-6. SURGE WAVEFORM DISTURBANCE

In the above waveform, the upper voltage limit of 132 volts is exceeded for 192 milliseconds before the voltage returns to the nominal voltage level of 120 volts. The maximum surge (highest rms voltage) reached in the example is 145 volts.

2.12.3 Sample Sag Disturbance Printout

The printout below is taken from an actual sag disturbance on TB2, PH-A. The top part of the printout indicates that the voltage lower limit (105 V ac) was crossed on April 10, 1988 at 11:40:24. The voltage then decreased to 104 volts ac (the lowest reading detected over the voltage sensitivity of 3 V within the same cycle). When the voltage returned to normal, the disturbance is reported as a SAG because the voltage is out-of-limits for 0.26 seconds. The minimum voltage reached, 104 volts, is also printed. The bottom part of the printout indicates that the voltage increased to within normal limits: 123 volts ac.

NOTE

If the out-of-limits voltage lasted for more than 2.55 seconds, the disturbance is classified as an undervoltage rather than a sag.

↓
TB2 PH-A <LO LIMIT
10-Apr-88 11:40:24

↓
TB2 PH-A DECREASE
104 VAC
10 Apr-88 11:40:24

↓
TB2 PH-A SAG
104 Vmin, 0.26 Sec
10-Apr-88 11:40:24

↓
TB2 PH-A INCREASE
123 VAC
10-Apr-88 11:40:24

2.12.3.1 Sag Waveform Disturbance

The waveform disturbance below is an example and is not related to the previous sag printout. It illustrates how a typical sag disturbance affects a voltage waveform.

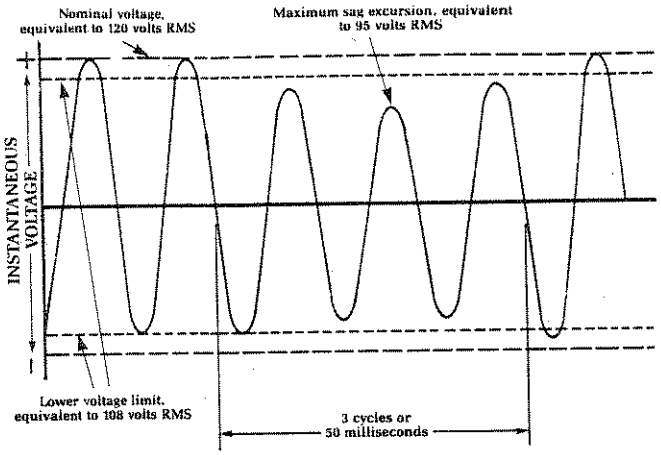

FIGURE 2-7. SAG WAVEFORM DISTURBANCE.

In this waveform, the voltage is less than the lower limit of 108 volts for 50 milliseconds before the voltage returns to the nominal voltage level of 120 volts. The maximum sag (lowest rms voltage) reached in the example is 95 volts.

2.12.4 Overvoltage Disturbance Printout

The following is a printout of an overvoltage disturbance on TB2, PH A.

↓
TB2 PH-A >HI LIMIT
10-Apr-88 11:43:01

↓
TB2 PH-A INCREASE
125 VAC
10 Apr-88 11:43:01

↓
TB2 PH-A INCREASE
129 VAC
10 Apr-88 11:43:01

↓
TB2 PH-A INCREASE
132 VAC
10 Apr-88 11:43:01

↓
TB2 PH-A INCREASE
135 VAC
10 Apr-88 11:43:01

↓
TB2 PH-A DECREASE
132 VAC
10 Apr-88 11:43:04

↓
TB2 PH-A DECREASE
129 VAC
10 Apr-88 11:43:04

↓
TB2 PH-A DECREASE
125 VAC
10 Apr-88 11:43:05

↓
TB2 PH-A HIGH
135 Vmax, 004 Sec
10 Apr-88 11:43:05

↓
TB2 PH-A DECREASE
122 VAC
10 Apr-88 11:43:05

The overvoltage printout indicates that the voltage upper limit (125 V ac) was exceeded on April 10, 1988 at 11:43:01. The unit then proceeded to print the voltage disturbances which were greater than the programmed voltage sensitivity of 3 volts*. When the change in voltage is an increase from the last reported voltage, the value is printed along with the word "INCREASE"; when it is a decrease, the value is printed along with the word "DECREASE".

When the voltage is once again within normal limits, the second to last reading indicates the highest voltage reached by printing the word "HIGH" and the value (135 volts), the duration that the voltage was out-of-limits (4 seconds), and the time when the voltage returned to normal (11:43:05). The last reading indicates that the voltage decreased to a level within normal limits: 122 volts ac.

* Increases and decreases are reported as often as once per cycle. For example, if the voltage sensitivity is set at 3 volts, the voltage increases out-of-limits to 12 volts within the same cycle, there will not be four printouts of 3 volt increases, rather, there will be one printout indicating the 12 volt increase.

2.12.5 Undervoltage Disturbance Printout

The following is a printout of an undervoltage disturbance on TB2, PH A.

↓
TB2 PH-A <LO LIMIT
10-Apr-88 11:41:00

↓
TB2 PH-A DECREASE
068 VAC
10 Apr-88 11:41:00

↓
TB2 PH-A DECREASE
024 VAC
10 Apr-88 11:41:00

↓
TB2 PH-A DECREASE
021 VAC
10 Apr-88 11:41:00

↓
TB2 PH-A DECREASE
017 VAC
10 Apr-88 11:41:00

↓
TB2 PH-A DECREASE
013 VAC
10 Apr-88 11:41:00

↓
TB2 PH-A DECREASE
000 VAC
10 Apr-88 11:41:00

↓
TB2 PH-A INCREASE
003 VAC
10 Apr-88 11:41:06

↓
TB2 PH-A LOW
000 Vmin, 006 Sec
10 Apr-88 11:41:06

↓
TB2 PH-A INCREASE
123 VAC
10 Apr-88 11:41:06

The undervoltage printout indicates that the voltage lower limit (105 V ac) was crossed on April 10, 1988 at 10:41:00. The unit proceeded to print the voltage changes which were greater than the programmed voltage sensitivity of 3 volts*. The increases and decreases are reported the same as with the overvoltage.

When the voltage is once again within normal limits, the second to last reading indicates the lowest voltage reached by printing the word "LOW" and the value (000 volts), the duration that the voltage was out-of-limits (6 seconds), and the time when the voltage returned to "normal" (11:46:06). The last reading indicates that the voltage increased to a level within normal limits: 123 volts ac.

2.12.5.1 Undervoltage Waveform Disturbance

The waveform disturbance shown below is an example and is not related to the under- and overvoltage printouts on the previous pages. It illustrates how a typical undervoltage disturbance affects a voltage waveform. In this waveform, the voltage was less than the lower voltage limit (108 V rms) for 20 seconds before the voltage returned to within normal limits (108 V rms to 132 V rms). Because the length of time spent out-of-limits was more than 2.55 seconds, the disturbance is classified as an undervoltage rather than a sag.

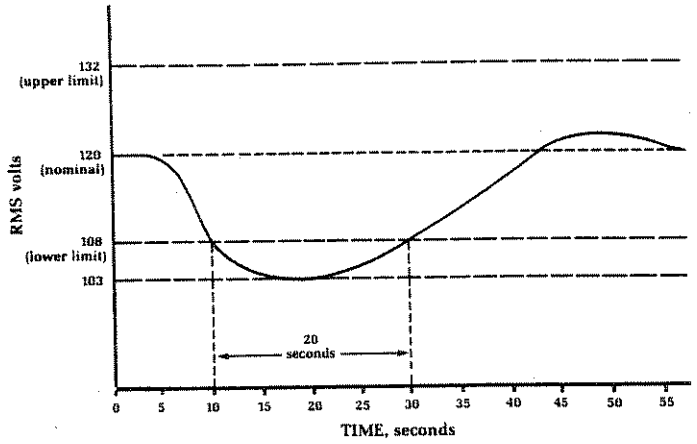

FIGURE 2-8. UNDERVOLTAGE WAVEFORM DISTURBANCE.

NOTE

An overvoltage waveform disturbance would appear the same as an undervoltage waveform disturbance, with the exception that the upper limit, NOT the lower limit, would be exceeded for more than 2.55 seconds.

* Increases and decreases are reported as often as once per cycle. For example, if the voltage sensitivity is set at 3 volts, the voltage increases out of limits to 12 volts within the same cycle, there will not be four printouts of 3 volt increases, rather, there will be one printout indicating the 12 volt increase.

2.12.6 Data Summary Printout

While in the Main Menu, if a Data Summary is requested, a Data Summary for all of the inputs and the temperature probe (if connected) is printed. A sample of a Data Summary for the TB2, PH-A input follows.

```
***DATA SUMMARY***
11:47:22  04/10/88

    Monitoring Period:
    04/01/88 -- 04/10/88

**** TB2 PH-A ****
146V MAX
000V MIN
**********
TB2 PH-A SAG
007 hits

075    Vmin,   0.03 Sec
10-Apr-88      11:22:52

074    Vmin,   0.06 Sec
10-Apr-88      11:22:52

075    Vmin,   0.09 Sec
10-Apr-88      11:22:52

099    Vmin,   0.15 Sec
10-Apr-88      11:24:57

000    Vmin,   2.23 Sec
10-Apr-88      11:26:15

104    Vmin,   0.09 Sec
10-Apr-88      11:39:24

104    Vmin,   0.26 Sec
10-Apr-88      11:40:24
**********

**********
TB2 PH-A SURGE
010 hits

125    Vmax,   0.22 Sec
10-Apr-88      11:22:52

125    Vmax,   0.03 Sec
10-Apr-88      11:22:52
```

Data Summary is indicated along with the time and date.

Length of the current monitoring period is given.

The monitored input (TB2, PH-A) is given, along with the minimum and maximum voltage achieved during the current monitoring period

Lists the number of sags recorded; lists the values, duration, time, and the date of up to the TEN most severe sags (only 7 were recorded here).

Lists the number of surges recorded; lists the values, duration, time, and date of up to the TEN most severe surges.

```
126    Vmax,  0.02 Sec
10-Apr-88     11:22:52

125    Vmax,  0.50 Sec
10-Apr-88     11:22:53

126    Vmax,  0.13 Sec
10-Apr-88     11:25:08

144    Vmax,  1.46 Sec
10-Apr-88     11:26:17

132    Vmax,  0.18 Sec
10-Apr-88     11:36:59

132    Vmax,  0.18 Sec
10-Apr-88     11:37:19

128    Vmax,  0.01 Sec
10-Apr-88     11:42:22

126    Vmax,  0.01 Sec
10-Apr-88     11:45:25
**********
**********
TB2 PH-A LOW
010 hits

000    Vmin,  098 Sec
10-Apr-85     11:22:43

073    Vmin,  009 Sec
10-Apr-85     11:22:52

073    Vmin,  020 Sec
10-Apr-85     11:23:13

000    Vmin,  009 Sec
10-Apr-85     11:26:07

000    Vmin,  006 Sec
10-Apr-85     11:41:06

000    Vmin,  002 Sec
10-Apr-85     11:41:46

000    Vmin,  004 Sec
10-Apr-85     11:42:22

000    Vmin,  002 Sec
10-Apr-85     11:45:25
```

Lists the number of undervoltages recorded; lists the values, duration, time, and date of up to the TEN most severe undervoltages.

```
000    Vmin,   004 Sec
10-Apr-85      11:46:10

000    Vmin,   005 Sec
10-Apr-85      11:46:37
**********
**********
TB2 PH-A HIGH
003 hits

144    Vmax,   021 Sec
10-Apr-85      11:25:58

146    Vmax,   006 Sec
10-Apr-85      11:26:13

138    Vmax,   004 Sec
10-Apr-85      11:43:05
**********
**********
TB2 PH-A IMPULSE
008 hits

0304   V pk,   0009 uS
10-Apr-85      11:22:13

0300   V pk,   0010 uS
10-Apr-85      11:22:13

0285   V pk,   0010 uS
10-Apr-85      11:24:06

0291   V pk,   0009 uS
10-Apr-85      11:24:53

0407   V pk,   0276 uS
10-Apr-85      11:32:38

0289   V pk,   0009 uS
10-Apr-85      11:35:42

0289   V pk,   0010 uS
10-Apr-85      11:36:06

0289   V pk,   0009 uS
10-Apr-85      11:36:09
**********
```

Lists the number of overvoltages recorded; lists the values, duration, time, and date of up to the TEN most severe overvoltages.

Lists the number of impulses recorded; lists the values, duration, time, and date of up to the TEN most severe impulses.

NOTES:

SECTION III
OPERATIONAL TEST

3.1 GENERAL

Section III of this manual provides information on an Operational Test to insure proper operation of the Series 646 unit. It also provides information regarding the calibration interval and battery pack replaement.

NOTE

The recommended calibration interval for this unit is once every 12 months.

3.2 MINIMUM PERFORMANCE CHECK

The following procedure is a preliminary performance check of the Series 646 unit. It should be noted that this check is **NOT** a calibration verification, but rather, a minimum performance operating check.

3.2.1 Self-Test Diagnostics Check

Whenever the unit is turned ON, a system Self-Test will automatically be performed which verifies the unit's circuitry and memory.

NOTE

If the unit is switched ON with ac power applied and fails to print the "Power-On" message, the fuse may have to be replaced. Refer to Subsection 2.3.2.2 for the fuse replacement information.

The Self-Test routine may also be accessed by user command; it is one of the choices which may be selected under the Main Menu. To select the Self-Test routine:

1) Select the Main Menu as described in subsection 2.6.3;
2) Press the [CHOICE #] key;
3) Press the [SHIFT] key;
4) Press the [A] key;
5) Press the [YES] key.

As the Self-Test is in progress, the Series 646 indicates any failures it discovers by printing one of the error messages listed in TABLE 3-1 (refer to TABLE 3-1 for the corrective action which should be taken). If no problems are discovered, the unit prints the message "Self-Test: OK".

TABLE 3-1. SERIES 646 SELF-TEST POSSIBLE ERROR MESSAGES	
ERROR MESSAGE	MEANING AND CORRECTIVE ACTION
EEPROM INVALID	The Series 646 uses an Electrically-Erasable Programmable Read-Only Memory (EEPROM) to store data which affects calibration. If this message appears, contact Dranetz Service Corporation for further instructions (see enclosed Repair/Service Order for the address and telephone number).
MEMORY INVALID	This usually indicates that the internal batteries are discharged, and that the programmable limits are invalid. The Series 646 automatically reprograms itself to use the standard factory set limits, and clears the disturbance data. If the Standard Limits are not desired, the unit must be reprogrammed. The Series 646 should then be left ON for at least 24 hours in order to recharge its batteries. (See Subsection 3.4 regarding battery pack replacement.)
TIME INVALID	This usually indicates that the batteries are discharged. The time and date should be reset. The Series 646 unit should then be left ON for at least 24 hours to recharge its batteries. (See Subsection 3.4 regarding battery pack replacement.)

3.3 CALIBRATION INTERVAL

The recommended calibration interval for the Series 646 is once every **12 MONTHS**.

We recommend that you return the unit to the factory for calibration. If you decide to do so, first contact Dranetz Service Corp. to obtain an authorization number.

Telephone Number:	(201) 755-7081
Telex Number:	499-7808
TWX Number:	(710) 997-9553
FAX Number:	(201) 755-0292
Cable:	DRANETZ

3.4 BATTERY PACK REPLACEMENT

The Series 646 contains an internal battery pack. For optimal use and reliability, we recommend that you have the battery pack replaced once every **2 YEARS**.

Replacement is performed at Dranetz Service Corp. by following the same procedure described above.

APPENDIX A
DISTURBANCE PRINTOUT CATEGORIES

A.1 GENERAL

The categories correspond to the different types of disturbances distinguished by the Series 646. Separate categories are maintained for each input terminal. The Series 646, Model 626-1, is capable of producing disturbance printouts in twelve categories. The Model 646-3 is capable of producing disturbance printouts in twenty-seven categories.

Within each category, up to the ten most severe disturbances, identified as "hits", are retained by the Series 646, therefore, up to 120 events (12 x 10) may be retained by the Model 646-1 and up to 270 events (27 x 10) may be retained by the Model 646-3.

A.2 CATEGORIES

TABLE A-1 on the following page lists all the disturbance categories for each measurement input. The first 12 categories apply to both Model 646-1 and Model 646-3. Categories 13 through 27 apply only to Model 646-3.

TABLE A-1. DISTURBANCE CATEGORIES FOR EACH MEASURED INPUT.

MEASURED INPUTS	CATEGORIES	
Terminal Block 1, "AC" Input		
Impulses	1	
Sags	2	
Surges	3	
Undervoltage Disturbances	4	
Overvoltage Disturbances	5	
Terminal Block 1, "NEUT" Input		
Impulses	6	
Overvoltage Disturbances	7	
Terminal Block 1, "DC" Input		
Impulses	8	
Undervoltage Disturbances	9	
Overvoltage Disturbances	10	
Temperature Probe Measurement		
Undervoltage Disturbances	11	
Overvoltage Disturbances	12	(Total of 12 for the 646-1)
Terminal Block 2, "PH-A" Input		
Impulses	13	
Sags	14	
Surges	15	
Undervoltage Disturbances	16	
Overvoltage Disturbances	17	
Terminal Block 2, "PH-B" Input		
Impulses	18	
Sags	19	
Surges	20	(Model 646-3 **ONLY**)
Undervoltage Disturbances	21	
Overvoltage Disturbances	22	
Terminal Block 2, "PH-C" Input		
Impulses	23	
Sags	24	
Surges	25	
Undervoltage Disturbances	26	
Overvoltage Disturbances	27	(Total of 27 for the 646-3)

APPENDIX B
RACK MOUNT ADAPTER

B.1 GENERAL

This appendix contains information pertaining to the assembly of the Rack Mount Adapter.

B.2 REQUIRED MATERIALS

The Rack Mount Adapter kit (P/N 111894-G1) consists of the following parts:

Quantity	Description	Part Number
1	Right-Hand Support Bracket	111376-G1
1	Left-Hand Support Bracket	111376-G2
1	Front Panel	111377
1	Unit Support	111378
6	Color Keyed Screws	104925-G1
4	#6-32 x ¼-inch long screws	

B.3 ASSEMBLY INSTRUCTIONS

NOTE

Refer to FIGURE *B-1 for the assembly locations as you follow the steps for putting together the rack-mount adapter.*

Below are the steps to follow for assembling the Rack Mount Adapter:

1) Lay the unit support (P/N 111378) on a flat surface with its edges pointing down and its rectangular slot facing forward.

2) Attach the front panel (P/N 111377) to the unit support with its painted side facing forward. Use two (2) of the color keyed screws to secure the front panel to the unit support.

3) As you are facing the rack-mount adapter, attach the right-hand side support bracket (P/N 111376-G1) to the back of the front panel using two (2) of the color keyed screws (the bent edge should be facing inward). Secure the side of the support bracket to the unit support using two (2) of the ¼-inch screws.

4) Attach the left-hand side support bracket (P/N 111376-G2) to the back of the front panel using two (2) of the color keyed screws (the bent edge should be facing inward). Secure the side of the support bracket to the unit support using two (2) of the ¼-inch screws. This completes rack-mount adapter assembly.

5) Lay your unit on its rear panel and remove its four (4) rubber feet from its bottom panel.

6) Place the rack-mount adapter over the unit so that the unit's front panel fits into the cut-out portion of the adapter's front panel.

7) Secure the unit to the adapter by reattaching the four (4) feet and their screws through the unit support's screw holes.

8) The rack-mount adapter containing your unit can now be attached to any 19-inch rack-mount by positioning the adapter into place and securing it to the front of the rack-mount through its four (4) slots (one in each corner).

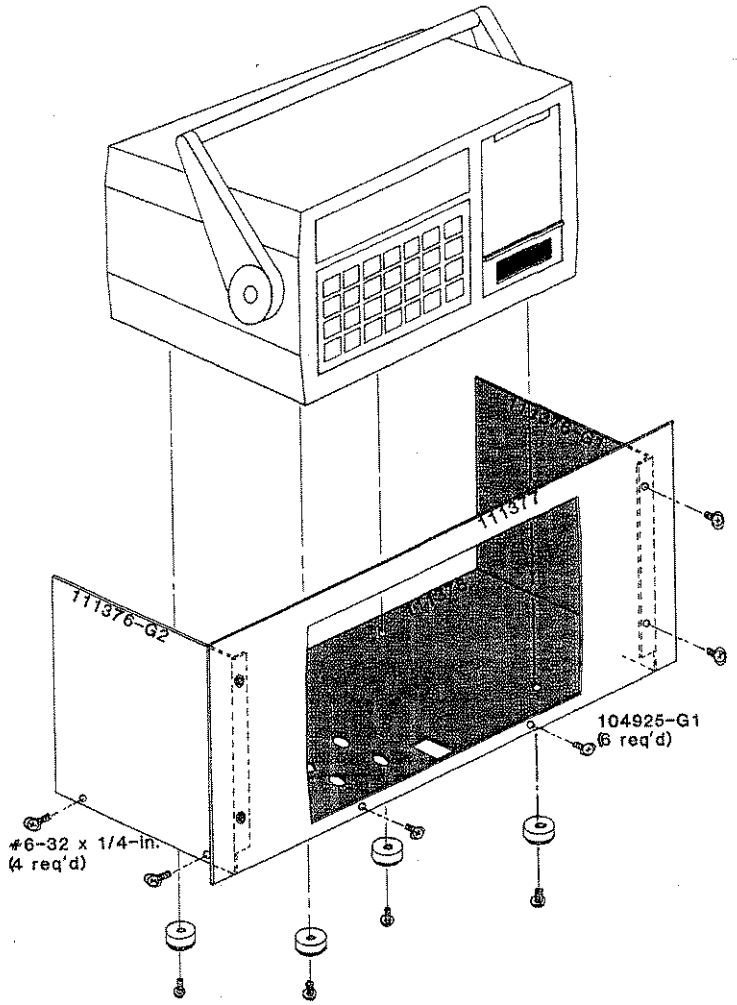

FIGURE B-1. RACK-MOUNT ASSEMBLY.