

# Model 646 Power Line Disturbance Analyzer



**DRANETZ**  
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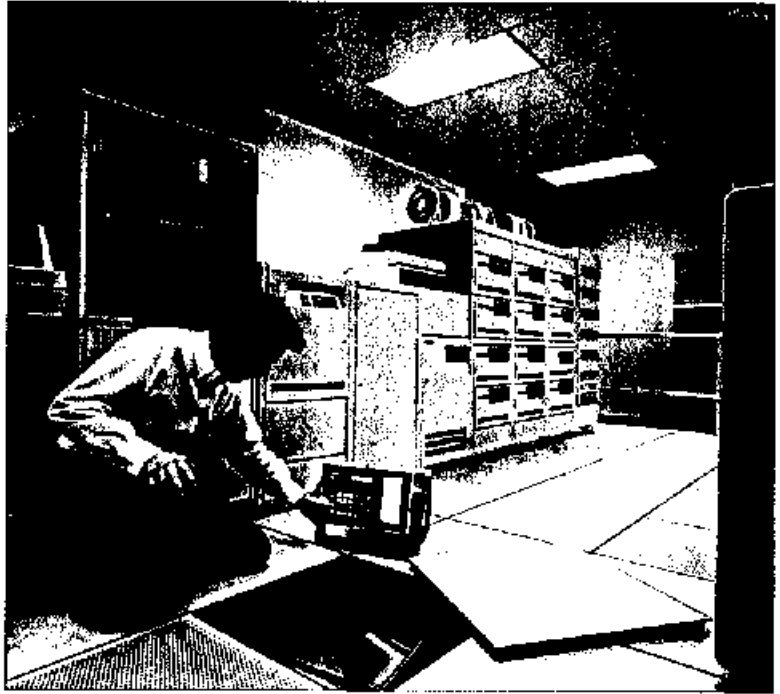
# Dranetz Series 646 Power Line Disturbance Analyzer . . . Easy to use, Dependable, and Affordable.

If you are responsible for pre-installation site surveys, the maintenance of computers and their peripherals, power surveys, or troubleshooting sensitive industrial or commercial equipment, the Dranetz Series 646 Power Line Disturbance Monitor was designed with you in mind.

Available in both single-phase and three-phase versions, the 646 can continuously monitor and record power line sags and swells, under and overvoltages, impulses, and frequency variations on both phase-to-neutral and neutral-to-ground. A separate DC channel is also provided for easy correlation of DC power supply disturbances with AC power line disturbances.

Standard features include user-friendly, menu-driven operating controls with alphanumeric display for prompting, environmentally protected membrane keypad, real time clock, nonvolatile data and setup memory, built-in thermal printer, and RS232C interface. A temperature probe is available as an accessory. Also available, three factory-installed options provide impulse duration measurements, an uninterruptible power supply, and an integral direct connect, auto-answer, Bell 103-compatible modem.

Separate **OPERATE** and **PROGRAM** modes, menu listing of all commands and programmable parameters, and two-key selection of the appropriate function through **NEXT MENU** and **NEXT CHOICE** keys makes operation easy . . . even for the infrequent user. The 646 is shipped with pre-programmed standard limits. If these limits are suitable for the application, it is only necessary to turn the power switch to the **ON** position to start basic monitoring operation. Results are clearly printed in exact order of occurrence, as a complete listing of all disturbances or in summary form, and fully annotated with numerical values, informative descriptors, and the exact time and date of occurrence for easy analysis.



## Optional Accessories

### Option 101 - Impulse Duration.

Adds high-frequency impulse duration measurement capability to within one microsecond.

Factory-installed option.

### 111887 - G1 Temperature Probe.

Allows the 646 to record changes in temperature as disturbances. The probe is a temperature sensor mounted on the end of a 10ft. cable that plugs into the 646 rear panel.

### Option 102 - Uninterruptible

Power Supply (UPS). Internal batteries provide power for up to 30 minutes of operation if AC power is lost. Factory-installed option.

### 111894-G1 - Rack Mount Adapter Kit.

Enables the 646 to be rack mounted.

### 103100 - Shipping Container.

Rugged, foam lined container for shipping or transporting the 646.

### Option 103 - Internal Auto-

Answer Modem. Adds a bell 103 compatible, direct connect modem that allows remote 646 operation over public telephone lines at 300 Baud.

Factory-installed option.

### 112931-G1 - Single Channel

Cable. Comes with lugs and clamps for connection to a single channel power source.

# Power Line Disturbances . . . An essential consideration for problem-free operation of electronic equipment

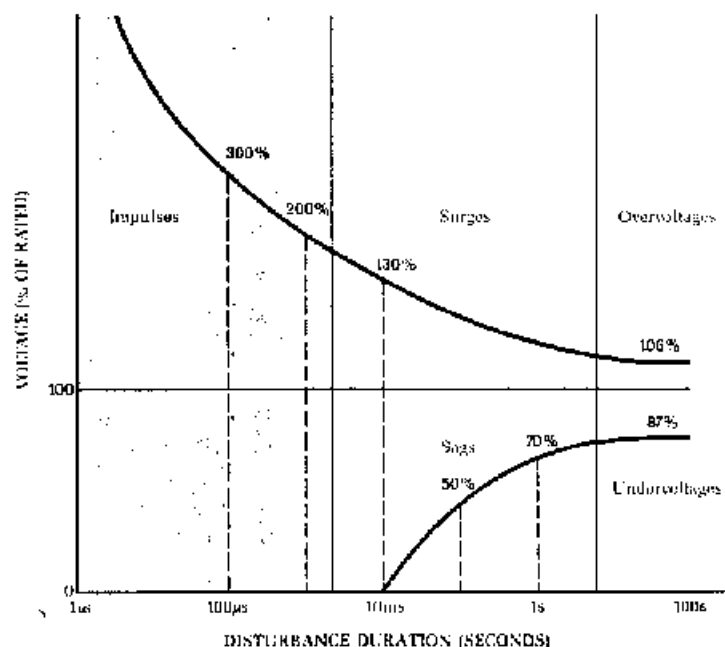
Detailed, accurate, and comprehensive analysis of AC power line disturbances is essential for pre-installation site surveys, correlating malfunctions of electronic equipment with power line disturbances, specifying corrective equipment, and monitoring the effectiveness of power line conditioning equipment. Only by assuring the overall quality of the AC power before sensitive equipment is installed, taking early corrective action if necessary, and continually monitoring to detect changes in the AC power distribution can operational problems due to power line disturbances be permanently avoided.

Although there are no firm industry standards to define acceptable AC power, various equipment manufacturers have developed internal guidelines for the design and reliable operation of computer and other microprocessor-based equipment. The plot shown below is a typical susceptibility profile for a particular piece of electronic equipment. Power line disturbances outside of the boundaries are unacceptable and can be expected to cause equipment malfunction, damage, or complete failure.

Any voltage fluctuation that exceeds allowable limits for more than 2.5 seconds is classified as an undervoltage or overvoltage condition. Undervoltage situations are normally caused by local line overloading or purposeful utility brownouts designed to extend system capability under high demand conditions. Both can be expected to cause erratic performance in sensitive equipment, or to produce excessive temperatures as motor loads draw more current. Overvoltage is usually caused by poor line regulation by the utility or lighter than expected loads. Both result in overstressed components, overheating, and incipient failures.

Sags and surges are short-term special cases of undervoltage and overvoltage conditions where the voltage fluctuation exceeds the allowable limit for greater than several milliseconds. Because sags and surges are transient conditions caused by momentary events, they usually exhibit larger voltage excursions than longer term undervoltages and overvoltages. Sags and surges are most commonly caused by connecting or disconnecting heavy inductive loads such as large motors, electric furnaces, air conditioning units, and the like. If they are of sufficient magnitude to cause resultant disturbances on internal DC power supplies, they can cause erratic performance.

Impulses, also known as transients, spikes, or noise, are the most troublesome and potentially damaging types of power line disturbances. Lasting from a fraction of a microsecond to a few milliseconds but with amplitudes of hundreds or even thousands of volts, they frequently result in annoying interference or damage. Impulse voltages may occur between phases or between phase and neutral. Such impulses are generally described as normal, differential, or transverse mode, are typically the result of connecting or disconnecting heavy loads or power factor compensating capacitors, and often exhibit decaying oscillatory characteristics at frequencies above 5 kHz. Impulse voltages, referenced to earth ground, which are common to all phase lines or common to phase and neutral lines, are known as common or series mode. They are usually the result of lightning strikes or utility breaker tripping and reclosure. Both types of impulses must be analyzed to provide a complete picture of power integrity.



AC POWER SUSCEPTIBILITY PROFILE

# Series 646 . . . Designed with you in mind

## Simple Keypad Descriptions

**OPERATE MODE** - Upon instrument turn-on or when depressed, unit monitors all inputs and prints out disturbances as they occur. Several commands may be executed while in OPERATE MODE, such as listing the values of programmed limits, summarizing accumulated disturbance data, and displaying the present line voltage and frequency on the LCD display. No change in programming or the clearing of data is possible in this mode.

**PROGRAM MODE** - When depressed, the monitoring operation is inhibited and new program limits can be entered and summary data cleared from memory. Although no disturbances will be printed while in the PROGRAM MODE, the voltage measurement circuits remain active and the unit can be used as a meter.

**LOCK/UNLOCK** - Locks the keyboard with a 4-digit code to prevent unauthorized access.

**SHIFT** - Allows use of alphanumeric unit identifiers.

**NEXT MENU** - Repeated pressing will list all available menus on the LCD display.

**NEXT CHOICE** - Repeated pressing will list in order all available choices for the current menu.

**PAUSE/RESUME** - Stops and restarts printer.

**QUIT** - Aborts a printout

**PRINT MENU** - When depressed, prints a list of available choices for current menu.

**PREVIOUS CHOICE** - Repeated pressing will step backwards through all available choices for the current menu.

**HELP** - Briefly describes the use of NEXT MENU, NEXT CHOICE, and NEW VALUE keys and lists all available menu titles on the printout.

### INSTRUCTIONS:

Use NEXT MENU to step thru Menus

Use PRINT MENU to list Menu Choices

Use NEXT CHOICE to step thru Choices

Use NEW VALUE to change status or limit on Display

Use YES to perform func. on Display

Available menus:

MAIN MENU  
PROGRAM TB2 PH A  
PROGRAM TB2 PH B  
PROGRAM TB2 PH C  
PROGRAM TB1 AC  
PROGRAM NEUT-GND  
PROGRAM DC CHAN  
METER MENU  
CONFIGURATION

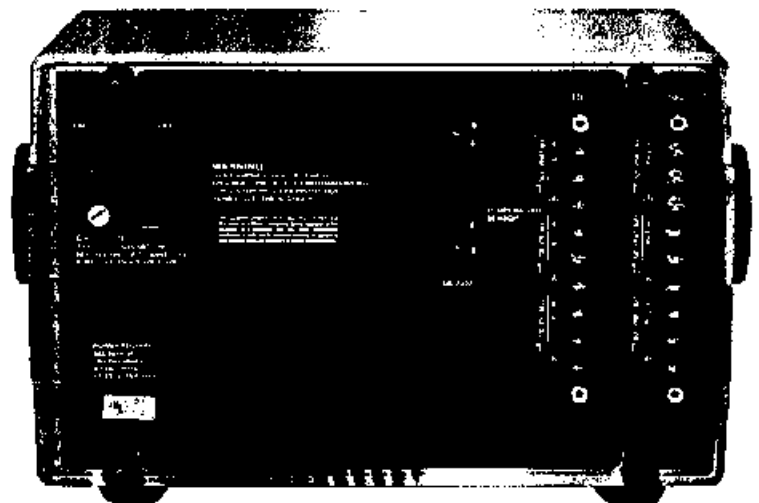
**PAPER FEED** - Advances printer tape.

**NEW VALUE** - Used to change programmable parameters. For example, under PROGRAM TB1 AC the display may read Imp Sens 0100V. To change the impulse sensitivity to 50 volts, press NEW VALUE followed by 0050 ENTER.

**CHOICE #** - Bypasses NEXT CHOICE and PREVIOUS CHOICE keys and allows direct selection of a numbered menu choice.

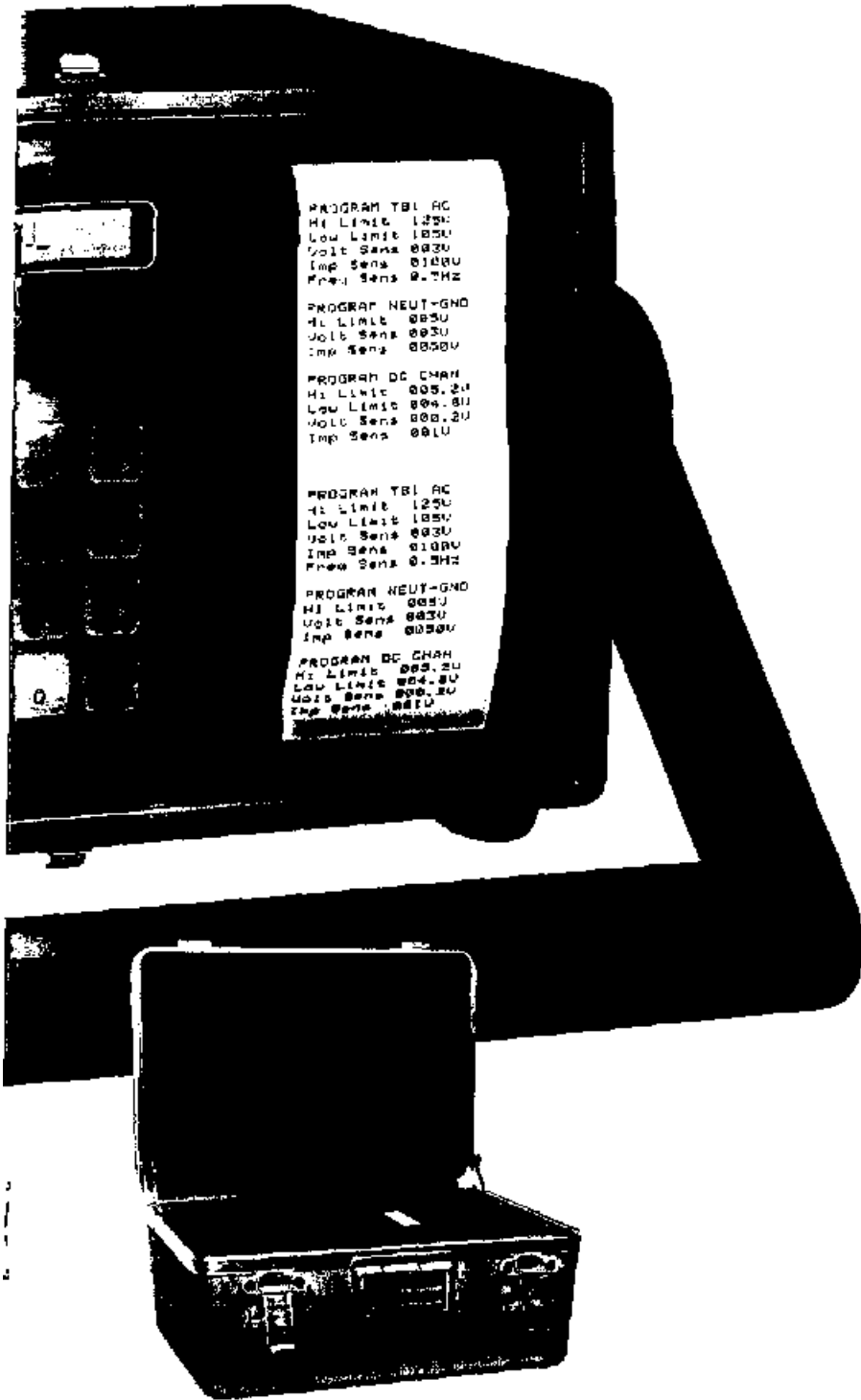
**YES and NO** - Allows response to prompted questions such as PROGRAM SUMMARY? in MAIN MENU.

**ENTER** - When depressed, enters new programmed value into memory.



Simple, Safe and Fast Installation on Rear Panel

TYPICAL MENU PRINTOUT for Model 646-1 showing all programmed information. Entering any menu choice through NEXT MENU and NEXT CHOICE keys (or NEXT MENU and CHOICE # keys) allows any programmed value to be altered.



Rugged Shipping Container  
(P/N 103100) form-fitted foam  
with accessory compartment

Temperature Probe  
(P/N 111887-G1)



**PROGRAM TB1 AC:**

- 1 HI Limit 125V
- 2 Low Limit 105V
- 3 Volt Sens 003V
- 4 Imp Sens 0100V
- 5 Freq Sens 0.5Hz

**PROGRAM NEUT-GND:**

- 1 HI Limit 005V
- 2 Volt Sens 003V
- 3 Imp Sens 0050V

**PROGRAM DC CHAN:**

- 1 HI Limit 005.2V
- 2 Low Limit 004.8V
- 3 Volt Sens 100.0V
- 4 Imp Sens 001V

**PROGRAM TEMP:**

- 1 HI Limit 035 C
- 2 Low Limit 015 C
- 3 Temp Sens 005 C
- 4 Temp Scale: C

**CONFIGURATION:**

- 1 3-phase: No
- 2 Imp Dur: Yes
- 3 UPS: Yes
- 4 Temp Proba: Yes

Under MAIN MENU a data summary can be printed, output mode selected, and time, date, RS232C baud rate, and alarm condition changed.

**MAIN MENU:**

- 1 Program Summary
- 2 Standard Limits
- 3 Data Summary
- 4 Clear Data
- 5 Time 14:48:00
- 6 Date 08/22/94
- 7 Output: BOTH
- 8 Baud Rate: 9600
- 9 Audio Alarm: OFF
- A Self Test
- B New Unit ID

The METER MENU is used to select which parameter will be continuously displayed when in the OPERATE mode.

**METER MENU:**

- 1 Freq: 080.0
- 2 Temp: 020 C
- 3 UPS bat: 15.8
- 4 TB1 AC: 000
- 5 1 0000V, 0000uS
- 6 Neutral: 000
- 7 N 0000V, 0000uS
- 8 DC Level: 004.9
- 9 D 0000V, 0000uS
- A Ph-A AC: 119
- B A 0:45V, 0021uS
- C Ph-B AC: 121
- D B 0000V, 0000uS
- E Ph-C AC: 120
- F C 0000V, 0000uS

## Typical Portion of a Disturbance Printout

## Typical Portion of a Summary Printout

```

Dranetz Series 646
Model 646-1
Option 101
Option 102
Temperature Probe

TB AC < LO LIMIT
22-Aug-94 14:56:56
TB1 AC DECREASE
003 VAC
22-Aug-94 14:56:56
TB1 AC DECREASE
000 VAC
22-Aug-94 14:56:56
TB1 AC SAG
000 Vmin 0.66 Sec
22-Aug-94 14:56:57
TB1 AC > HI LIMIT
22-Aug-94 14:56:57
TB1 AC INCREASE
135 VAC
22-Aug-94 14:56:57
TB1 AC DECREASE
132 VAC
22-Aug-94 14:56:57
TB1 AC SURGE
135 Vmax 0.56 Sec
22-Aug-94 14:56:58
TB1 AC < LO LIMIT
22-Aug-94 14:56:58
TB1 AC DECREASE
014 VAC
22-Aug-94 14:56:58
TB1 AC DECREASE
000 VAC
22-Aug-94 14:56:58
NEUT-GND IMPULSE
0139 Vpk, 0019 uS
22-Aug-94 14:57:30
NEUT-GND IMPULSE
0178 Vpk, 0014 uS
22-Aug-94 14:57:34
NEUT-GND IMPULSE
0085 Vpk, 0025 uS
22-Aug-94 14:57:35
NEUT-GND IMPULSE
0106 Vpk, 0023 uS
22-Aug-94 14:57:49
DC CHAN IMPULSE
059 Vpk, 0031 uS
22-Aug-94 14:58:07
DC CHAN IMPULSE
091 Vpk, 0026 uS
22-Aug-94 14:58:09
DC CHAN IMPULSE
001 Vpk, 0026 uS
22-Aug-94 14:58:09
DC CHAN IMPULSE
001 Vpk, 0041 uS
22-Aug-94 14:58:30
TEMP INCREASE
030 degC
22-Aug-94 14:58:30
    
```

In less than 1 second, the AC channel falls to zero.

Then shoots up, exceeding the programmed high limit, rising to 135 V and immediately falling back to 132 V.

In the next second, the AC voltage surges to 135 V, then drops through the programmed lower limit to 0 V.

A half a minute later, a series of four impulses appears on the neutral-to-ground channel. The first impulse reaches a peak value of 139 V with a duration of 19 microseconds.

Within seconds, a series of four impulses is detected on the DC channel.

Temperature increases by more than the programmed sensitivity to 30°C.

```

DATA SUMMARY
15:19:11 08/22/94
UNIT ID
DRANETZ 646-3
Monitoring Period
08/01/94 - 08/22/94
TB1 AC
138V MAX
000V MIN
    
```

Time and date.

Maximum and minimum excursions of AC channel.

```

.....
TB1 AC SAG
002 hits
000 Vmin, 0.66 Sec
22-Aug-94 15:03:25
000 Vmin, 0.90 Sec
22-Aug-94 15:03:27
.....
    
```

Two recorded surges with magnitudes, durations, and times of occurrence.

```

.....
TB1 AC SURGE
003 hits
134 Vmax, 0.86 Sec
22-Aug-94 15:03:25
136 Vmax, 0.98 Sec
22-Aug-94 15:03:28
137 Vmax, 1.64 Sec
22-Aug-94 15:03:29
.....
    
```

Three surges.

```

.....
TB1 AC LOW
003 hits
000 Vmin, 1.55 Sec
22-Aug-94 15:02:55
000 Vmin, 0.55 Sec
22-Aug-94 15:03:15
000 Vmin, 0.04 Sec
22-Aug-94 15:03:20
.....
    
```

Three AC voltage dropouts.

```

.....
TB1 AC HIGH
002 hits
138 Vmax, 0.05 Sec
22-Aug-94 15:03:10
138 Vmax, 0.05 Sec
22-Aug-94 15:03:20
.....
    
```

Two recorded events when AC voltage exceeded the upper limit.

# Specifications

<b>Available Models</b> 646-1	Monitor and record impulses, sags, surges, undervoltages, overvoltages and frequency variations on a single channel of AC voltage, neutral to ground voltage channel, and a single channel of DC voltage.
646-3	Monitor and record impulses, sags, surges, undervoltages, overvoltages and frequency variations on a single channel or 3 channels of AC voltage (total of 4 AC channels available), neutral to ground voltage channel, plus a single channel of DC voltage.
<b>AC Voltage Input Type</b>	2-wire differential
<b>Impedance</b>	10 M $\Omega$ with 56 pF, each terminal to ground
<b>Range</b>	50-600 VAC, 47-63 Hz
<b>Full Scale</b>	600 V
<b>Resolution</b>	1 V
<b>Accuracy</b>	$\pm 1\%$ rdg $\pm 0.5\%$ fs
<b>Selectable AC Thresholds</b>	
Upper Limit	55-600 V
Lower Limit	50-595 V
Sensitivity	2-600 V
<b>AC Impulse Voltage Range</b>	50-2000 V peak
Duration	1-1000 $\mu$ sec
Selectable Thresholds	50-2000 V
Resolution	1 V
Accuracy	$\pm 10\%$ rdg $\pm 1\%$ fs for half sinewave impulses 5-50 $\mu$ sec, typically -50% at 1 $\mu$ sec and 1000 $\mu$ sec.
<b>AC Neutral-to-Ground Voltage Impedance</b>	10 M $\Omega$ with 56 pF, each terminal to ground
Range	5-200 V peak, 47-63 Hz
Selectable Threshold	5-200V
Sensitivity	2-200 V
Resolution	1 V
Accuracy	$\pm 1\%$ rdg $\pm 0.5\%$ fs
<b>Neutral-to-Ground Impulse Range</b>	50-2000 V peak
Duration	1-1000 $\mu$ sec
Selectable Thresholds	50-2000 V
Resolution	1V
Accuracy	$\pm 10\%$ rdg $\pm 1\%$ fs for half sinewave impulses 5-50 $\mu$ sec, typically -50% at 1 $\mu$ sec and 1000 $\mu$ sec.
<b>DC Voltage Input Impedance</b>	10 M $\Omega$ with 100 pF, each terminal to ground
Range	1-100 VDC
Full Scale	100 VDC
Resolution	0.1 VDC
Accuracy	$\pm 3\%$ rdg $\pm 0.5\%$ fs
<b>Selectable DC Thresholds</b>	
Upper Limit	2.0 - 100.0 V
Lower Limit	1.0 - 99.0 V
Sensitivity	0.2-100 V

<b>DC Impulse Voltage Range</b>	5-100 V peak
Duration	1-1000 $\mu$ sec
Selectable Thresholds	1-100 V
Resolution	1 V
Accuracy	$\pm 10\%$ rdg $\pm 1\%$ fs for half sinewave impulses 5-50 $\mu$ sec, typically -50% at 1 $\mu$ sec and 1000 $\mu$ sec.
<b>Line Frequency Range</b>	45.0 - 65.0 Hz
Resolution	0.1 Hz
Selectable Thresholds	0.2 - 9.9 Hz
Accuracy	$\pm 0.2$ Hz
<b>Remote Operation RS-232C Port</b>	300, 1200 or 9600 baud
<b>Internal Memory (Printer Buffer)</b>	
Model 646-1	Last 250 Events
Model 646-3	Last 500 Events
<b>Power Supply Voltage Range</b>	90-130/180-250 VAC, switch selectable
Frequency Range	47-63 Hz
Consumption	25 W, maximum
<b>Internal Battery (Standard)</b>	
Purpose	Maintains clock, threshold settings, and data memories when AC power is lost or instrument is turned off.
Type	Rechargeable NiCd
Charge Time	2 days (from complete discharge) to full charge. Constant trickle charge with unit on.
Data Retention	1 month, typical, with full charge
<b>Physical Dimensions</b>	7.5" x 12.5" x 13.5 (19 cm x 32 x 34)
Weight	11 lbs. (5.0 kg) approximate
<b>Environmental Temperature</b>	10 to 40°C, operating -20 to 55°C, storage
Humidity	10% to 90%, non-condensing
<b>Factory Installed Options</b>	
Option 101	AC/DC impulse duration measurements
Range	0-1000 $\mu$ sec
Resolution	1 $\mu$ sec
Accuracy	$\pm 10\%$ rdg $\pm 1\%$ fs for half sinewave impulses 1-100 $\mu$ sec and > 100 VAC, peak and > 20 VDC, peak
Option 102	Uninterruptible power supply
Purpose	Maintains complete operation of the instrument, including printer, when AC power is lost.
Type	Rechargeable NiCd
Charge Time	1 day, complete discharge to full charge. Constant trickle charge with unit on.
UPS Operation	1/2 hour, typically, depending on options, amount of printing, and state of charge.
Option 103*	Built-in, direct-connect, auto-answer modem (Bell 103 compatible).
<b>Temperature Probe Accessory</b>	
Part Number	P/N 111887-G1
Range	3-99°C, 38-218°F (selectable)
Resolution	1°C
Accuracy	$\pm 3^\circ$ C

\*When used over dial-up or leased telephone lines, most commercial telephone modems, including the Dranetz supplied internal modems, require a data communications grade line for reliable data transmission. This telephone line should also be protected from environmentally induced transients, such as lightning, in accordance with the AT&T Technical Bulletin PUB43801, "Lightning And 60 HZ Disturbances at the Bell System Network-Terminal Interface."

Specifications subject to change without notice.