

# Model 933A Portable Power Sentinel<sup>™</sup>

with

LEMORGJYLD

**Digital Signal Analysis** 



Built by Power Professionals, For Power Professionals

The Arbiter Systems<sup>®</sup>, Inc. Model 933A Portable Power Sentinel<sup>™</sup> is the most accurate and most affordable portable power quality meter in the industry. The proprietary EnergyDSA<sup>™</sup> Digital Signal Analysis algorithms allow the user to measure or record harmonics, flicker (per IEC 61000-4-15, P<sub>ST</sub> and Instantaneous), K-factor, and interruptions. The data logging capabilities allow the user to specify which data to log as well as when to log the data, continuously or when user specified thresholds are exceeded. The high accuracy, portability and data logging capabilities make the Portable Power Sentinel<sup>™</sup> the perfect field analyzer for the power quality engineer.

### Portability

Thanks to the high level of integration made possible with EnergyDSA<sup>™</sup>, the Model 933A Portable Power Sentinel<sup>™</sup> combines multiple capabilities into one compact, light weight instrument. Weighing less than 5.8 kg (12.8 lbs), the Portable Power Sentinel<sup>™</sup> is a power quality monitor, a data and event logger, a system monitor, and a revenue meter designed to accompany you wherever you go and operate continuously for a full eight-hour shift.

### Capabilities

Primarily designed for the power engineer, the Portable Power Sentinel<sup>™</sup> measures and records harmonics, flicker, K-factor, and interruptions. In addition to these measurements, the Portable Power Sentinel<sup>™</sup> has the ability to measure system time, phase, frequency, and phasors. When synchronized using the IRIG-B IEEE-1344 unmodulated input or the GPS input, the Model 933A is capable of accurate revenue metering and synchrophasor analysis per the IEEE-1344. Pre-fault data is buffered for a half second allowing for accurate fault recording and event driven data analysis. The host processor and the DSP each have 128 MB of memory which provides ample space for data storage.

### Features

The Model 933A Portable Power Sentinel<sup>™</sup> includes a 320 x 240 graphic LCD display with a CCFL backlight, a 30-key multifunction keypad, adjustable tilt-handle/bail assembly, RS-232 cable, safety ground cable, and power cord.

Communications are made via an RS-232 or USB 1.1 port that supports proprietary protocols.

Both the host and DSP processors have 128 MB of flash memory. The host processor memory stores all data types available including fault data (1/sec and 20/sec) and register data. The DSP memory is primarily for waveform storage with data for all channels continuously stored at approximately 170 samples per cycle, a fixed pre-fault window of 0.5 seconds, and a maximum of about 1000 seconds (17 minutes) of data storage.

The 933A is powered by either NiMH batteries (8 hours typical run time) or an external power supply (85 to 264 Vac or 110 to 370 Vdc).

### **Options and Accessories**

Available options include remote GPS receiver synchronization for 1  $\mu$ s timing accuracy allowing for increased revenue accuracy, optically isolated event inputs, flexible CT inputs, direct current inputs, and programmable KYZ output contacts. Available accessories include a USB cable and a wide selection of test leads.



# **Model 933A Specifications**

Input		Power Quali	ty
Configuration		Harmonics Me	asurement
3Ø	3-element, 2 <sup>1</sup> / <sub>2</sub> -element, 2-element, selectable	Standard	2 <sup>nd</sup> to 50 <sup>th</sup> (50 or 60 Hz) Per IEC 61000-4-7, 100 ms overlapping
1Ø	2-element, 1½-element, and 1-element, selectable	Measurements	data window THD, K-factor, sags, swells,
Voltage			and voltage, rms harmonic current
Range (3Ø/1Ø)	1 to 650 Vrms, selectable (phase-to- phase for 2 and 2½ element; phase-to-neutral for 1 and 3 element)		and voltage with K-factor compensation (each harmonic magnitude is multiplied by the
Overrange	1200 V peak, nominal		square of the harmonic number before summing), individual
Current			magnitude and phase
Model 933A-01	20 Amp direct input module	Logged Data	Selectable, may be regularly logged
Range (3Ø/1Ø) Low range Overrange	0.05 to 20 Arms, selectable, per element 1 mA to 1 A 40 A peak, nominal (maximum		or registered. Event-logged also available when user-specified limits are exceeded
	continuous input current: 20 Arms	Interruptions	
	per element)	Logged Data	Selectable, may be regularly logged
VA, W, VAR			or registered. Event-logged also
Range	Any voltage, current and number of elements within the specified limits		available when user-specified limits are exceeded
Compensation		Flicker	
CT and PT	Both magnitude and phase compensation, CT with 12 point	Standard	Per IEC 61000-4-15, P <sub>ST</sub> and Instantaneous
	nonlinear interpolation	Logged data	Selectable, may be regularly logged
Transformer Frequency	Both iron and copper loss		or registered. Event-logged also available when user-specified limits
Bange	45 to 65 Hz for specified accuracy		are exceeded
Harmonics	to 3 kHz	Limit Alarms	
Inputs		Functions	Upper or lower limits may be set on most measured functions.
Voltage	Safety banana plugs		Limits may also be set on maximum
Current	5-way binding posts (Model 933A-01)		imbalance (ratio of Zero and
Insulation	400 volts, nominal, to neutral/chassis,		Positive Sequence)
	surge voltage class III 600 volts, nominal, to neutral/chassis, surge voltage class II	Output	Via system interface and display



# **Model 933A Specifications**

## Accuracy

Note: Accuracy specifications include all sources of uncertainty. Except as noted, specifications apply for the full operating range, including temperature (-10° to +50° C), line voltage, input range including specified overrange, power factor, input frequency, and drifts over a one-year calibration interval. Specifications assume synchronization to GPS and operation in 3-element mode or in a well-balanced system where imbalance does not degrade accuracy.

Watts, Wh	0.05% of reading, for voltage 7 to 650 Vrms and current 10 mA to 20 Arms and PF > 0.2
Vrms	0.05% of reading <sup>1</sup> or ±5 mV, whichever is greater
Low range	1% of reading
Arms	0.05% of reading <sup>1</sup> or ±0.1 mA, whichever is greater
Phase Angle, Ø	0.01°, phase-to-phase or voltage-to- current <sup>1</sup>
Underrange	$0.05^{\circ}$ (current 10 to 50 mArms)
VA, VAh	0.05% of reading <sup>1</sup> 0.1% (current 10 to 50 mArms)
VAR, VARh	Same as W, Wh except replace PF with $(1 - PF^2)^{0.5}$
Power Factor	0.0002 • sin (Ø) <sup>1</sup> 0.001 • sin (Ø) (current 10 to 50 mArms)
Harmonics	0.1% THD or 5% of reading, whichever is greater
Frequency	< 1 ppm (0.0001%) of reading, 50 or 60 Hz nominal, plus timebase error
System Phase	$0.03^{\circ}$ + [timebase error • $360^{\circ}$ • frequency] <sup>2</sup>
System Time	1 μs plus timebase error <sup>2</sup>
Event Inputs	±10 μs (typical)

### Flash Memory Data Storage

#### **Host Processor**

Capacity	128 MB. See Operation Manual for record length and capacity calculations
Data	All functions measured and totalized by Model 933A; each record is stored with a time tag
Storage Rate	Selectable Event data stored upon occurrence
Lifetime	100,000 storage cycles minimum
Data Retention	Indefinite; no power or battery is required to retain data
DSP Processo	r
Capacity	128 MB; about 1000 seconds or 17 min.
Data	Primary waveform
Storage Rate	10240 samples per second (approximately 170 samples per cycle) Fixed 0.5 seconds of pre-fault data. Event data stored to Host Processor flash memory upon occurrence. User has same triggers as the Host Processor flash and can select the max fault duration, post fault recording time, and retrigger on/off.
Lifetime	100,000 storage cycles minimum
Data Retention	Indefinite; no power or battery is required to retain data
System Con	trol and Monitoring
System Time, F	Phase and Frequency
System Time	Unlimited accumulation with $\pm 1 \ \mu s$ resolution

	resolution
Frequency	6 digits, xx.xxxx Hz
System Phase	0 to 360° with 0.01° resolution

# Phasors

Standard	Per IEEE Standard 1344 or PSCSV
Rate	20 Measurements/second

<sup>1</sup> For voltage 50 to 650 Vrms and current 50 mA to 20 Arms

<sup>2</sup> With GPS Option



# Interface

### Operator

Display	320 x 240 graphic LCD display with CCFL Backlight
Keyboard	30 keys: 5 soft function, 7 dedicated function, 5 cursor control, power on/off and 12 key numeric key pad

# Communications

Serial	RS-232, RJ-11 modular connector
USB	Version 1.1, B-Type receptacle

# Protocols

Proprietary PowerSentinel CSV933 (PSCSV933)

# **Synchronization**

# **IRIG-B Unmodulated Input**

TTL-Level Shift per IEEE-1344 As output from an Arbiter Systems Model 1084B

# **Optional Remote GPS**

Tracking	GPS–L1 (1575.42 MHz); 12 channel (tracks up to 12 satellites)
Acquisition	2 minutes typical
Accuracy	UTC-USNO ±1 µs (only need 1 satellite with correct position)
Out-of-Lock Indication	Via system interface and status display; optional, via contact closure

## **Timebase Error**

GPS locked	Less than $\pm 1 \mu s$ , when locked to at least one satellite with correct position
Unlocked	10 ppm, typical, after being locked for 10 minutes minimum (< 1 second/day unlocked, typical)
IRIG-B	Less than ±1 µs + accuracy of IRIG-B source

# General

Physical	
Size	205 x 305 x 225 mm (8 x 12 x 8.75 in.) 483 x 483 x 305 mm (16 x 16 x 12 in.), shipping
Weight	5.8 kg (12.8 lbs), maximum 9.1 kg (20 lbs), shipping
Environment	
Temperature	Operating: -10° to +50° C Nonoperating: -40° to +75° C
Humidity	Noncondensing

# **Power Requirements**

#### **Internal Battery**

Туре	NiMH
Operation	8 hours typical
Charging	4 hours
Standby Use	5 VA typical

#### **External Power**

Range	85 to 264 Vac, 47 to 440 Hz or 110 to 370 Vdc, 25 VA typical charging battery, 5 VA typical stand-by use
Input	IEC-320 connector with fuse; surge withstand per ANSI C37-90.1 and IEC 801-4 standard



# **Model 933A Specifications**

# Options

Input Modules	
Description	<u>Order No.</u>
CT Input Module, 20 Amp Direct with 5-way Binding Posts	933Aopt01
CT Input Module with Banana Connectors. Uses standard shrouded banana jacks	933Aopt02
CT Input Module with Audio Connectors Requires use of CA0027100 or CA0027200, available separately	933Aopt03

### Accessories

#### Included

Description	<u>Order No.</u>
Operation Manual	PD0031100
Power Cord	P01R-P10R
CT Input Module, 20 Amp Direct with 5-way Binding Posts	AS0074100
Modular DB-9 to B.I-11 Adapter	01211
Preconfigured	AP0007700
RJ-11 Cable, Four-Pin Crossed	CA0023600
Available	
Description	Order No.
USB Data Cable	CA0026106
CT Input Module with 5-way Binding Post Connectors	AS0074100
CT Input Module with Banana Connectors.	AS0076500
CT Input Module with Audio Connectors Requires use of CA0027100 or	
CA0027200, available separately	AS0076700
CT Cable, Current Output	CA0027100
CT Cable, Voltage Output	CA0027200
Remote GPS Receiver with Mounting Bracket and 15 m (50 ft) cable	AS0077600
Remote GPS Receiver Extender Cable, 7.6 m (25 ft)	CA0029800
400 Amp 20:1 Precision CT, 0.1% Accuracy	09311A
400 Amp CT Bracket (each)	AS0036000

# Accessories (Continued)

1000:1 Clamp-On CT, 1000 A, Current Output	AP0001300
1000:5 Clamp-On CT, 1000 A, Current Output	AP0010200
100:1 Clamp-On CT, 600 A, Current Output	AP0010300
100:1 Clamp-On CT, 150 A, Voltage Output	AP0012300
1000:1 Clamp-On CT, 200 A, Current Output	AP0012800
Universal Test Plug, Current Shunt, Set of Three	AS0079030
3-Phase Safety Voltage Lead Set	813AT
3-Phase Spade-Lug Current Lead Set	816AT
3-Phase Univ. Test Plug Current Lead Set	811AT
1-Phase Clamp-On CT Test Lead	817AA
3-Phase Clamp-On CT Test Lead Set	817AT
3-Phase Satety C-Hook Current Lead Set	818AT
Programmable KYZ Contacts and Event Inputs	AS0077700

# **Cordset and Plug Styles**

The following are the available IEC-320 mating, right angle cordset plug style and specifications:

<u>Country</u>	Specification	Rating
Continental Europe	CEE 7/7	220V
Australia/NZ/PRC	AS 3112-1981	240V
U.K.	BS 1363	240V
India	BS 546	220V
Italy	CEI 23-16/VII 1971	220V
North America	NEMA 5-15P	
and ROC	CSA C22.2 #42	120V
	Country Continental Europe Australia/NZ/PRC U.K. India Italy North America and ROC	CountrySpecificationContinental EuropeCEE 7/7Australia/NZ/PRCAS 3112-1981U.K.BS 1363IndiaBS 546ItalyCEI 23-16/VII 1971North AmericaNEMA 5-15Pand ROCCSA C22.2 #42