

Mastech Digital Multimeter

Test diodes and measure DC volts, AC volts, up to 10 amps AC or DC current, ohms and continuity with this 9-volt powered digital multimeter (battery included). This inexpensive troubleshooting tool is made in China. Dimensions are 2.75" x 5" x 1".

Description	Item code	Price
Digital multimeter	28.8031	\$19



AEE Solar Digital DC Volt & Amp Meters

Measure amps and volts in 12-, 24- or 48-volt systems with these high-quality, low-cost LCD digital meters. The surface mount, 3" x 2" x 1" plastic enclosure can be easily attached to wood or metal surfaces with two screws. Terminal strip on the back of the meter accepts 14 to 22 AWG wire.

Amp meters are available with a 100A/100mV shunt for measuring up to 100 amps with 0.1 amp resolution, a 500A/50mV shunt to measure up to 500 amps with 1 amp resolution or without a shunt for installations that already have a shunt. Current draw is only 20mA. Amp meter requires 4-conductor wire; volt meter requires 2-conductor wire. Use 22 gauge or larger for up to 50 feet. Use 18 AWG for up to 150 feet. 2-year warranty.



Description	Item code	Price
Digital volt meter 11 to 65 VDC	28.9228	\$42
Digital amp meter w/o shunt	28.9257	\$42
Digital amp meter w/ 100A shunt	28.9259	\$65
Digital amp meter w/ 500A shunt	28.9261	\$65

NEW! Atkinson PV and Wind Digital Monitor

This digital monitor and shunt combination can measure amps and amp-hours from two charging sources of up to 40 amps each on a 12-, 24- or 48-volt battery system. The monitor and shunt module are connected with a cat-5 network cable. The monitor stays in the battery voltage mode until the select button is pushed. The button can turn on the backlight, advance through display settings, reset amp-hours, lock the display in any mode or activate a scroll setting. Backlight comes on for 15 seconds every time the button is pushed and stays on in scroll mode.



Display module requires a shunt module to operate. Order both items. Cat-5 cable required to connect display to shunt.

Description	Item code	Price
Atkinson PVWDM digital monitor	28.2205	\$126
Atkinson PVWSM shunt module	28.2207	\$130
Cat-5 cable – 50'	30.4199	\$25
Cat-5 cable – 6'	30.4197	\$8

Hoyt Induction Amp Meters



These meters read DC amps from a wire that is placed in the slot frame on the rear of the meter case. No electrical connection is needed. The 30-amp meter will work with wires up to 8 gauge. The dual range meter has a 75-amp scale and a 600-amp scale. This amp meter will work with wire up to 20 gauge.

Description	Item code	Price
Hoyt 30A induction meter	28.8045	\$25
Hoyt 75A induction meter	28.8047	\$25
Dual Range 0-75 / 0-600 ADC	28.8049	\$25

Analog Amp Meters

These high quality amp meters mount in a 72mm square hole. The meter movement is very smooth and accurate. The shunt is built into the 30-amp meter so it can be in series with the load to be measured on the negative or positive wire. The 60-amp meter comes with a separate shunt. The mounting plate in the table below holds 1 meter and mounts in a 2-gang wiremold deep switch box.



Description	Item code	Price
Analog meter 0-30A DC	28.7332	\$12
Analog meter 0-60A DC	28.7362	\$18
Mounting plate for 2-gang wiremold box	28.9015	\$5

Kill-a-Watt AC Meter

This kilowatt-hour meter is easy to set up and use. It gives the user power usage information for individual appliances, displaying true power consumed (including power factor information), and keeps track of cumulative kilowatt-hours, cumulative time the meter has been plugged in, and amount of money the electricity consumed costs. A 15-amp circuit breaker protects against overloads. UL Listed.



Description	Item code	Price
Kill-A-watt portable kilowatt hour meter	28.2005	\$50

AC Kilowatt-Hour Meter

These EZ-Read cyclometer GE utility grade meters have been removed from service and reconditioned and certified. If you are selling power back to the utility grid, you can keep track of how much power your system is generating. Order one of the raintight meter bases to mount and connect wires to the meter. For use on 120 or 120/240 VAC systems. Maximum current 200 amps. GE Model I-70S, CEC approved. Please contact us for pricing on kilowatt-hour meters for higher power and for 3-phase systems.



Kilowatt-Hour Meter Sockets

We stock two types of kilowatt hour meter bases. The cast, low-cost round base has 1-1/2" threaded holes in the top and bottom. The Milbank brand sheet metal base is 8" W x 11.5" H (shown with meter mounted). Both are for single phase 2- or 3-wire 100-amp service and both come with sealing ring. Raintight, NEMA 3R for outdoor use.



Description	Item code	Price
GE kilowatt hour meter w/ EZ-Read cyclometer	28.3015	\$30
GE kilowatt hour meter w/ conventional dial	28.3018	\$32
Kilowatt hour meter socket 120/240VAC - round	28.3025	\$16
Kilowatt hour meter base 120/240VAC NEMA-3R	28.3031	\$48

Tech Tip: Amp-Hour Meters

With the use of an amp-hour meter, you can tell the condition of your batteries at a glance. An amp-hour meter is the best indicator of your system's condition. As you use power, the meter counts how many amp-hours are used. As the battery is charged, the meter goes backwards, toward zero. When the battery is full, the meter reads zero. This type of meter is a must for nickel-cadmium and nickel-iron batteries, where it is hard to tell state of charge from voltage, or specific gravity. The main destroyer of lead acid batteries is sulfation caused by undercharging. These sophisticated meters help you keep track of your batteries state of charge so you can keep them charged. Get maximum life out of your batteries and save money and system down time.

Note: Amp-hour meters lose accuracy if batteries are always run in a very discharged state.

Xantrex Link 10 Meters

Link 10 meters provide complete battery status information for a battery bank. Simple and easy-to-use digital display shows volts, amps, amp-hours consumed, and operating time remaining. It also has an easy-to-read multi-color LED bar graph. The Link 10 allows you to select automatic, sleep and scanning modes and automatically calculates and displays charging efficiency. By adding an optional prescaler, Link 10 can monitor battery banks up to



500 volts. The splash-proof panel allows for outdoor mounting and hands-free operation. It displays key historical battery information such as charge efficiency, deepest discharge, and average discharge and they are compatible with 12- and 24-volt DC systems. The shunt is included. Accessories include prescalers (0-100 or 0-500 volts) to extend voltage range covered by your meter. 1-year warranty.

Description	Item code	Price
Link-10 Standard – Meter w/ 500A/50mV shunt	28.1128	\$250
Pre-scaler 0-100V – Use w/ battery higher than 24V	28.1131	\$75
Pre-scaler 0-500V – For use w/ battery up to 500V	28.1134	\$80
Temperature sensor – Increases meter accuracy	28.1137	\$57
Mounting bracket	28.9014	\$7
Meter wire 8-conductor 18 AWG (price/ft)	50.1252	\$1

Xantrex Battery Monitor XBM

The Xantrex battery monitor uses sophisticated microprocessor technology to provide complete battery status information for your battery. A simple display shows volts, amps, amp-hours consumed, and operating time remaining. An optional communications kit is available that contains hardware and software to enable battery monitoring from a Windows-based laptop. The splash-proof panels allow for outdoor mounting and hands free operation. XBM is compatible with 12- and 24-volt DC systems and comes with a 500A/50mV shunt. Front panel measures 2.56" square and the back fits in a 2.05" hole. 1-year warranty.



Xantrex TM-500A

The TM-500A is similar to the Trimetric meter in a special package with fuse and fuse holder. An improved display shows volts, amps, amp-hours and percent without changing mode. Very easy to install and use. Installation is simplified with a special shunt that includes a phone-type jack. Install the shunt, plug the special six-conductor cable into the shunt and meter and all the connections are made! Meter shows days since fully charged, cumulative amp-hours, recharge indicator, low-voltage indicator, and full-charge indicator. Comes with a 50' six-conductor cable with jacks, fuse, and a special 500A/50mV shunt. Also is capable of turning DR, PS, and UX inverters on and off. 2550 amp-hour max battery size. Longer length cables are available for long runs. Use the 48-volt adapter for 48-volt systems.



Dimensions: 4.55" x 4.55" x 1.725". 2-year warranty.

Xantrex model	Description	Item code	Price
TM-500A	Amp-hour meter w/shunt	28.1405	\$345
TM-500NS	Amp-hour meter w/o shunt	28.1403	\$295
TM48	48-volt adapter	28.1413	\$65
TC25	25-foot cable	28.1421	\$22
TC50	50-foot cable	28.1422	\$36

Description	Item code	Price
XBM meter w/ 500A/50mV shunt	28.1119	\$275
XBM communication kit with software for Windows	28.1120	\$150
XBM connection kit – 32 feet	28.1121	\$50
XBM connection kit – 50 feet	28.1122	\$62
XBM temperature sensor kit – 32 feet	28.1123	\$40
XBM temperature sensor kit – 64 feet	28.1124	\$60

Trimetric 2020

This amp-hour meter for 12- or 24-volt battery systems (and 48-volt with adapter) reads volts, amps and amp-hours on an LED display. Amp-hours can be displayed in actual amp-hour numbers or as “% full”. An LED lights when the battery is charging and flashes when the battery has been fully charged. Another LED flashes when batteries should be recharged, equalized, and during low battery voltage. It also records min and max voltage, days since batteries were last charged, days since equalized, and total lifetime amp-hours withdrawn from the batteries. The Trimetric can be located hundreds of feet away from batteries using inexpensive 4-conductor twisted-pair meter wire. For 48V systems or additional lightning protection on 12/24 V systems, use a 48V adapter with the meter. A shunt is required for operation. Use the 500-amp shunt if you have a 12V inverter larger than 800 watts or a 24V inverter larger than 1600 watts. Use a 1000-



amp 100mV shunt for systems with stacked SW inverters or where continuous current is over 300 amps. The 1000A/100mV shunt has the same resistance as the 500A/50mV shunt and may be used interchangeably. Order shunt separately. Allows for a maximum battery bank size of 2500 amp-hours. The positive lead to the Trimetric should be fused with a 1-amp fuse. Flush mount or use wiremold box to mount. Made in USA. Dimensions: 4.5" x 4.75". 2-year warranty.

Description	Item code	Price
Trimetric 2020 amp-hour meter	28.0020	\$175.00
48-volt adapter	28.0023	\$28.00
Surface mount box	28.0026	\$11.00
500A/50mV shunt	28.9253	\$35.00
100A/100mV shunt	28.9245	\$35.00
1000A/100mV shunt	28.9254	\$47.00
4-conductor 22 AWG wire	50.1243	\$0.30
4-conductor 18 AWG wire	50.1237	\$0.78

Pentametric Battery Monitor

The Pentametric monitor measures 1 or 2 battery systems with a common negative. With one battery system, battery current plus two charging sources/loads can be measured.



The new PentaMetric battery monitor system offers a lot more capability than the TriMetric monitor. The complete system consists of 3 parts: input unit (near batteries), display unit (shown here) and computer interface unit. It can monitor up to 3 shunts: For example; measure total solar input and wind input independently in addition to monitoring battery “state of charge”. You can access the data with display unit (shown above) with

LCD display and buttons up to 1000 feet from batteries. An optional computer interface with Windows software allows you to control and read out all data from the computer. It has a relay output to control a generator or external alarm and it has audible and visual alarms for high and low battery conditions. 2-year warranty.

Basic measurements include:

- 2 voltage channels: 8-100 volts. (For example you can monitor volts from two-battery systems).
- 3 amperage channels ±.01-200 amps (with 100A/100mV shunt). ± 0.1-1000 amps (with 500A/50mV or 1000A/10mV shunt). Each of these requires a separate shunt.
- Temperature -20 to +65 degrees C.

Secondary measurements

- Amp-hour (3 channels): to ±83,000 amp-hours
- Cumulative (negative) battery amp-hours (2 channels)
- Smoothed (time filtered) amps
- Volts (2 channels): 0-100 volts

- Watts (2 channels) ±.01- 20,000 watts
- Watt-hours (2 channels) ±21,000 kilowatt hours
- Battery % full (2 channels) 0-100%
- Days since batteries charged (2 channels) .01-250 days
- Days since batteries equalized (2 channels) .01-250 days

Data logging functions.

There are 3 types of data logging functions. With the computer interface all 3 types can be output to spreadsheet file.

1. “Periodically logged data” can record any or all of the following at regular intervals: once per day to up to once per minute, amp-hours (3 channels), watt hours (2 channels), Temperature max/min (1 channel), volts (1 channel), amps (1 channel)
2. “Battery discharge voltage profile” data logs volts and amps every time charge level changes by 5% (or 10%) for 1 or 2 battery systems.
3. “Battery cycle efficiency data” documents system efficiency for up to 2 battery systems.

Description	Item code	Price
Pentametric display unit PM-100D	28.0011	\$199.00
Pentametric input unit PM-5000U	28.0013	\$220.00
Computer interface PM-100C	28.0015	\$100.00
Temperature Sensor TS-1	28.0018	\$29.00
500A/50mV shunt	28.9253	\$35.00
100A/100mV shunt	28.9245	\$35.00
8-conductor 22 AWG wire / per foot*	50.1255	\$0.20

8-conductor wire is ok for measuring one battery. One additional conductor will be required for two batteries.

Why Use Monitoring Tools?

Residential and commercial system owners and installers can now benefit from remote monitoring services for renewable energy systems. These services provide knowledge and control over energy system generation and demand and are remotely accessible via the internet. Monitoring systems typically consist of a local device that connects to the energy system, collects data, and communicates with the monitoring service provider's central data center. Using such a service, residential and commercial system owners can remotely monitor their solar electric installations and see the impact of changes in consumption as well as problems such as tree shading or equipment degradation over time. Installers can check system performance, diagnose problems, and take corrective actions quickly and cost-effectively – often without ever leaving their office. Over time your solar energy generation and demand fluctuates. Periodic meter readings provide only a summary view of energy consumption, while telling you little or nothing about PV generation or about short-term performance issues. Good monitoring and display tools can help reveal trends, transient issues, cost-saving opportunities and emerging issues. They feature real-time and historical system performance graphs and downloadable data. Additionally, they provide the independent third-party, revenue-grade monitoring and reporting required to collect performance-based financial incentives.

Fat Spaniel Technologies

Monitoring and Visualization Services

Finally, a monitoring product with residential and commercial system owners and installers in mind! Fat Spaniel Technologies' simple, powerful, and field proven monitoring and visualization services work with your residential or commercial solar electric or wind system to provide visually engaging, web-based displays. This remote monitoring solution allows you to manage and view your solar energy system or whole-building energy usage in a single view. You can view your system anytime, anywhere using a web browser or mobile phone. Residential and commercial installers can assure customers that their renewable energy system is operating properly. Fat Spaniel provides views for post-installation support, alerting you to failure issues and providing tools for remote troubleshooting. The Fat Spaniel service also generates the regular reports required for performance-based financial incentives available under programs such as California's CSI.

Residential Monitoring Service

Fat Spaniel's Residential Monitoring Service gives the residential system owner the monitoring and visualization tools to understand their solar energy system. The Residential Solution allows you to improve your net-metering results and reduce your electricity bill by managing your energy use.

The image at right is a typical Simple View showing real-time and historical data about energy generation, building energy usage, and environmental information. Energy information can be selected to show daily, weekly, monthly and yearly comparisons.

Fat Spaniel offers inverter-direct monitoring for most grid-tie inverters as well as revenue grade, inverter-independent monitoring that can be used for power purchase agreements, performance incentives and renewable energy credit trading.

Residential monitoring systems can be used for systems under 20 kW.

Inverter direct monitoring meets Calif. PUC < 10kW EPBB metering requirement, and is not designed to meet Calif. PUC PBI metering requirement. SMA and Fronius inverters require optional equipment from the inverter manufacturer. See information on the table on the next page. Xantrex inverters do not require extra equipment. Inverter direct monitoring comes with a simple web based view. Detail view and alerts are an extra cost option.

Inverter independent monitoring includes ANSI standard revenue grade meter with 2% accuracy and meets metering & reporting requirements of California EPBB & PBI programs and of all states requiring revenue-grade meters. These systems come with simple and detail web-based views, and alerts for inverter off condition and communications failures

Weather data and building load are options that can be added to the monitoring package. All packages include hardware, 5 years of hosted monitoring services and 5 years of warranty coverage. Broadband internet access is required for standard systems. Cellular and dialup modems are optional.



Model	Description of products	Item code	Price
Residential inverter-direct monitoring products			
2151	Basic inverter-direct PV monitoring for one SMA SB-series inverter. Simple View only. Includes enclosure-requires SMA RS485 com card	29.1121	\$999
2151-W	SMA SB monitor above w/ weather and environmental monitoring; includes irradiance, module temperature and ambient temperature.	29.1124	\$2,999
3151	Basic inverter-direct PV monitoring for a single Xantrex GT-series inverter. Simple View only. Includes enclosure.	29.1131	\$999
3151-W	Xantrex monitor above w/weather and environmental monitoring; includes irradiance, module temperature and ambient temperature	29.1134	\$2,999
4551	Basic inverter-direct PV monitoring for a single Fronius IG-series inverter. Simple View. Includes enclosure. (requires Fronius ComCard, Datalogger and Interface Box. Fronius IG inverter with S/N higher than 1715 may use EZ Card instead of Datalogger and Interface Box.)	29.1135	\$999
4551-W	Fronius monitor above w/weather and environmental monitoring; includes irradiance, module temperature and ambient temperature	29.1137	\$2,999
7700	Detail View option offers historical information and alerts to systems above	29.1143	\$332
7800	Add monitoring to an additional inverter (except Xantrex, which requires an additional 3151 gateway for each inverter)	29.1142	\$332
Residential inverter-independent monitoring products – meets metering & reporting requirements of California EPBB & PBI programs			
1272-15-240	Revenue-grade inverter-independent PV monitoring: 15A/240V, 2-wire single phase inverters with simple and detail web views	29.1137	\$2,599
1272-60-240	Revenue-grade inverter-independent PV monitoring: 60A/240V, 2-wire single phase inverters with simple and detail web views	29.1138	\$2,599
1272-AA-VVV	Revenue-grade inverter-independent PV monitoring: for other than 15A or 60A/240V, specify amps and volts in the model # to the left	29.1139	\$2,599
8205	Basic Weather station with temperature and sunlight monitoring for 1272 above	29.1190	\$1,999
8295	Full Weather Station with temperature, sunlight and wind monitoring for 1272 above	29.1191	\$3,299
1235	Revenue-grade inverter-independent PV monitoring for 2-wire single-phase inverters w/ 3-wire bldg demand w/detail web views	29.1154	\$2,999
1235-W	Premium pkg w/ bldg demand (same as above w/ addition of a complete weather station for temperature, sunlight and wind monitoring)	29.1155	\$6,199
Off-grid monitoring products			
4701-12	TriStar Off Grid WebView – connects to Morningstar TriStar Charge control on 12 volt system – no enclosure	29.1105	\$998
4701-24	TriStar Off Grid WebView – connects to Morningstar TriStar Charge control on 24 volt system – no enclosure	29.1106	\$998
4701-48	TriStar Off Grid WebView – connects to Morningstar TriStar Charge control on 48 volt system – no enclosure	29.1108	\$998
Options			
9041	Cellular modem add-on – requires purchase of cellular service from a communications service provider	29.1145	\$998
7750	Add 5 more years of monitoring service	29.1181	\$499
7752	Add 5 more years of monitoring service on a TriStar off grid system	29.1182	\$298
7760	Add 5 additional years of Fat Spaniel Gateway warranty (parts only)	29.1183	\$100
1760	System Installer Portal – web-based aggregated view of data from all of an installer's end-user systems with access to views for each individual installed system, system status info and to data downloads	29.1299	\$7,500

Commercial Monitoring Service

With Fat Spaniel Technologies Commercial Monitoring Service, you get an accurate and real-time view of your savings and production, whenever and wherever you need it. It allows you to view your whole-building energy picture by monitoring one or many building systems in a single view.

The image at right is a typical commercial simple view showing real-time and historical data. Custom commercial views are available to view selected aspects of your whole-building energy picture. Monitor one or many building systems in a single view. Call for more information.

Features:

- View one or many building systems, from a single inverter to multi-inverter installations
- Reduce your energy bill through tighter management of energy production and usage.
- Improve net-metering results by maximizing export and load-shifting
- View real-time and historical energy production and usage
- Access your system information anytime, anywhere
- Show off the environmental benefits of your installation
- Automated alerts reduce service calls
- CEC approved as an eligible system performance meter

