

Introduction

The e-xpert series high precision battery monitors are widely known as the best available. The current industry standard e-xpert 501 model, was launched back in 2001 and can be found in many applications all over the world. Common applications where an e-xpert series battery monitor can be found are electric/hybrid vehicles, solar power systems and electrical marine systems. The recently launched e-xpert pro and e-xpert lite battery monitors will continue the e-xpert series' success by offering a number of improvements and many new features.

The purpose of this application note is to explain the importance of having a good battery monitor connected to your battery system as well as describing some battery monitor specific topics. Also explained are the differences between all e-xpert series battery monitors.

Why should I use an e-xpert series battery monitor?

Most people will understand the phrase :

“Operating your battery bank without good metering is like running your car without any gauges. Although possible to do, it's always better to know how much fuel is in the tank.”

Batteries are used in a wide variety of applications, mostly to store energy for later use. But how do you know how much energy is stored into your battery? No one can tell you that by just looking at it. Battery technology is often underestimated, but some basic battery knowledge and good monitoring is essential if you wish to squeeze the maximum life time out of your expensive batteries. The life time of batteries is dependent on many aspects. Battery life time reduces by under-charging, over-charging, too deeply discharging, too fast discharging and too high ambient temperature. By monitoring your battery with an advanced battery monitor like the e-xpert series, important feedback is given to the user so that measures can be taken when necessary. This way, by extending battery life time, an e-xpert series battery monitor will quickly pay for itself.

How does an e-xpert series battery monitor work?

The capacity of a battery is rated in Amphours (Ah). For example, a battery that can deliver a current of 5Amps for a period of 20hours is rated at 100Ah ($5 * 20 = 100$). An e-xpert battery monitor continuously measures the present current flow in or out of the battery so it can calculate the amount of energy removed from or added to the battery. But since battery age, discharge current and temperature all influence the battery's capacity, you cannot rely on an Amp-hours reading. When the same 100Ah battery is discharged completely in two hours, it will give you only 56Ah. As you can see the battery's capacity is almost halved. This phenomenon is called Peukert efficiency. When the temperature of the battery is low too, its capacity is decreased even more. This is why simple Amphour counters or Voltmeters are not able to give you an accurate state-of-charge indication.

An e-xpert series battery monitor can display both Amphours removed (not compensated) and actual state-of-charge (compensated by Peukert efficiency, charge efficiency and temperature). Reading state-of-charge is the best way to monitor your battery. This parameter is given in percent, where 100% represents a fully charged battery and 0.0% a completely flat battery. You can compare this with the earlier mentioned fuel-gauge in a car.

The e-xpert 501 and e-xpert pro are also able to estimate the time the battery can support the present load (time-to-go or time-left readout). This is actually the time left till the battery needs to be recharged again. Besides the main function of an e-xpert battery monitor, displaying the actual battery status, these products offer a lot of other features as well. The readout of actual battery voltage, current and temperature (with optional temperature sensor), the ability to store historic events like the total number of charge/discharge cycles, the PC computerlink and the internal potential free alarm relay are just a few features of the e-xpert series battery monitors.

In which way are battery voltage and current measured by the e-xpert battery monitor?

In order to accurately measure the charge status of your battery, all e-xpert battery monitors are equipped with state of the art measurement circuits to minimize all errors. The battery voltage can be easily measured by connecting the e-xpert's voltage sense wire to the positive terminal of your battery, as clearly explained in the installation guide supplied with all e-xpert battery monitors. Every e-xpert battery monitor has separate voltage sense wires to avoid any error caused by too high currents flowing through this wire.

The current flowing in- and out of the battery is measured by a shunt. In general, a shunt is just a big resistor which converts current into a small voltage suitable to be measured by the battery monitor. In order to measure this small voltage with the lowest possible error, special connection points called "Kelvin connections" are incorporated on the shunt. The two current measurement- or shunt inputs of the e-xpert battery monitor should always be connected to these Kelvin connection points only. Additionally, these two wires must be twisted together to avoid large current measurement errors due to noise pickup from the environment. It is important to closely follow the supplied installation guide when installing the battery monitor and especially when connecting the shunt. The installer must be absolutely sure that the shunt is located in the negative line and not the positive line. Installing the shunt in the positive line results in large measurement errors and might even damage the e-xpert battery monitor. Also important is that only one cable is present between the battery minus terminal and the "Battery side" of the shunt, while all DC consumer and charger minus cables are connected on the "load side" of the shunt.

TBS Electronics has a number of special connection kit accessories available, which contains the right twisted pair cable to professionally install the e-xpert battery monitor.

Why should I "synchronize" the e-xpert battery monitor with my battery?

In order to keep your battery monitor delivering accurate status information about your battery, it is important to regularly synchronize your battery monitor with your battery. Such a synchronisation step is also needed before you can actually use your battery monitor after installation. During operation, the e-xpert battery monitor automatically indicates when a synchronization step is required, by displaying the message SYNCHRONIZE. A synchronisation step means nothing more than performing a complete charge cycle on your battery.

Performing synchronisations regularly is also important to keep your battery healthy and to increase it's lifetime. You will notice that if you are often performing full charge cycles yourselves, the battery monitor will most likely not display the SYNCHRONIZE message, since the battery is already kept in good sync with the battery monitor.

What e-xpert model is the best choice for my application?

Currently, three e-xpert battery monitor models are available. All models are so-called ‘dashmount’ remote battery monitors, meaning that the readout unit should be mounted in your dashboard or instrument environment, while the shunt must be installed near your batteries. Typically the longest distance between the battery and the readout unit is 30 meters (100 feet) to avoid large readout errors.

e-xpert lite

The base model e-xpert lite lacks a number of features found in the e-xpert 501 and e-xpert pro models. The e-xpert lite is the perfect instrument for users who are mainly focused on accurate state of charge readout, very easy setup and quick readout parameter access. The basic set of features found in the e-xpert lite are more than sufficient to fit into small battery systems.

e-xpert 501

The e-xpert 501 adds a few extra features compared to the e-xpert lite unit. The most important ones are the “time-left” indication and the storage and recall of special history events. The e-xpert 501 also has communication capabilities and a temperature sensor input. Besides this, the e-xpert 501 is compatible with the optional 1:5 voltage prescaler which enables monitoring of battery systems up to 110VDC nominal.

e-xpert pro

On top of all features offered by the e-xpert lite and e-xpert 501 models, the e-xpert pro has a vast number of extra features. Having these extra features turns the e-xpert pro into a very flexible instrument that will fit almost any battery system. Extended history data storage, shunt type selection (voltage and current selectable), very extensive alarm relay programming parameters and additional battery properties entry are just a few features which makes the e-xpert pro the best instrument for any battery system. The e-xpert pro is also available as “hv” version which enables this model to directly monitor 36V, 42V and 48V battery systems. In the near future an optional 1:10 voltage prescaler will also be available which extends the the e-xpert pro input voltage range up to 350VDC.

Comparison table

	e-xpert lite	e-xpert 501	e-xpert pro	e-xpert pro-hv
Supported batteries	12V - 24V	12V - 24V	12V - 24V	36V - 48V
Number of batteries supported	2	1	2	2
Max. current range with incl. shunt	+/- 500A	+/- 500A	+/- 500A	+/- 500A
Frontpanel shape	Round	Square	Round	Round
Instrument panel mounting	Quick-nut	4 screws	Quick-nut	Quick-nut
State of charge bar	✓ (large)	✓	✓	✓
Potential free alarm relay	✓	✓	✓	✓
Time to go readout	✗	✓	✓	✓
Temperature sensor input	✗	✓	✓	✓
Data output	✗	✓	✓	✓
Historical data storage	✗	✓	✓ (extended)	✓ (extended)
Shunt type selection	✓	✗	✓	✓
Extensive alarm relay programming	✗	✗	✓	✓
Battery monitor status overview	✗	✗	✓	✓

Advanced battery properties entry	x	x	✓	✓
Reset menu	x	x	✓	✓
Extended operating temperature range	✓	x	✓	✓