# AN150
# Using batteries in AEA Technology Equipment

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## Abstract:

AEA Technology's equipment operates from either wall power packs or 8 AA batteries. This paper discusses the use of batteries in AEA Technology equipment and how to squeeze the most from a set of batteries.

## General

### Battery types:

Since AEA Technology equipment uses 8 standard size AA batteries, there are multiple options available in the choice of batteries: Alkaline, NiMH, or NiCd. Sealed Lead Acid (SLA) or Starved Gel (SG) batteries with a 12-14 volt output are usable as an external power source. The only AEA Technology instrument that uses a Sealed Lead Acid battery is the VIA Echo MRI.

**Alkaline Batteries:**

A set of alkaline batteries will run longer than a NiCd types (on a single charge), but must be replaced after discharging. Alkaline batteries cost the most over the long run, but make a good stop gap solution when you are on the road and have forgotten to recharge your NiMH or NiCd set. Most convenience stores stock alkaline cells, plus newly purchased NiCd batteries may not have a full charge.

Using alkaline batteries in AEA equipment may result in a gradual display contrast shift caused by heat buildup in the unit. If alkaline cells are used on a consistent basis, try these solutions:

1. Set the "Battery Saver" time out to reduce power consumption when not in use.
2. Preset the contrast to a somewhat light setting, this will give a longer time before the display darkens to a re-adjustment level.
3. Reduce the backlight intensity to a lower level. The backlight's heat can be useful to operate in colder temperatures, but it can darken contrast at room temperature and warmer environments.
4. Use NiMH batteries instead. While NiMH batteries may have less capacity, they have a lower and very flat resistance (approx ½ Ohm), so the power loss in the batteries improves significantly. With NiMH batteries, the total power in the case is less than 4W for the entire battery life. NiMH batteries "hit the wall" rather suddenly compared with alkaline cells. The flatter resistance curve may even allow the 2000maHr NiMH batteries to outlast the 3500maHr alkaline batteries.

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**NiMH Batteries:**

NiMH batteries offer the most advantages compared to NiCd or Alkaline cells. When properly recharged, they last for over 500 charging cycles, thus the cost over the long haul is very inexpensive. Unlike NiCd cells, they do not lose capacity ("burn time") when recharged early, in fact they last longer when recharged prior to full discharge. Lastly, NiMH cells do not suffer from the infamous "memory" problem that so often reduces NiCd charge capacity.

One drawback of NiMH: you must use a recharger specifically designed for NiMH cells or the batteries will suffer damage long before reaching the 500 recharge cycles. Do not attempt to recharge NiMH unless their temperature lies between $10^{o}$ to $45^{o}$ C ($50^{o}$ to $112^{o}$ F).). Do not attempt to recharge batteries that show signs of outgassing (gunky residue near the anode or positive end or swelling).

The second NiMH battery drawback: They should not be fully discharged. When a NiMH cell fully discharges, cell voltage reversal occurs, and continued discharging eventually causes outgassing. Higher quality rechargers will revive these cells (that have not yet outgassed) by starting off with a low precharge current. Cheap rechargers may damage these cells. Batteries that show signs of outgassing should be replaced. Most battery authorities recommend replacing all the batteries as a set, many rechargers operate best when all the cells are at a similar stage in their recharging life cycle.

**NiCd Batteries:**

NiCd batteries are less popular now that NiMH batteries are available. NiCd cells are rechargeable in a NiMH charger, but not vice-versa. NiCd cell's lifetimes are shorter and they require a full discharge prior to recharging or a loss of capacity occurs (also known as acquiring a memory).). Do not over charge, overcharging NiCd cells results in outgassing. Allow NiCd cells to cool off prior to recharging.

**Sealed Lead Acid (SLA) or Starved Gel (SG):**

These types of batteries will not fit into the internal compartment of AEA Technology's hand-held instruments, so an external power cord will need to be purchased or custom made for your application. Only the VIA Echo MRI uses an SLA battery for its non-magnetic quality. SLA batteries (or car batteries) are advantageous when operating in a high magnetic field or when you are powering off of you automobile. You must use a SLA recharger for this battery. The required voltage for external batteries, SLA or SG type on AEA Technology units is 12 to 14 volts. See AEA Technology's web site under "Products" then "Accessories" for our DC Vehicle adapter.

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## Battery Operating Tips:

**Reduce backlight Intensity**. The brighter the backlight, the more power is consumed. Use the lowest intensity setting that works for the existing lighting conditions. The backlight may be helpful in maintaining the LCD's contrast in temperatures below 0° C (32° F) so it becomes difficult to reduce power at those temperatures.

**Use the Backlight timer.** Set the timer to 10 or 20 sweeps, the power consumption drops when the timer turns off the backlight. Pressing Enter (or any other key) activates the backlight for another interval.

**Turn the battery saver on**. The battery saver turns the unit off after approximately 5 minutes of inactivity. If you press any key prior to auto shutdown, the timer will reset.

NOTE: The battery saver's auto shut down saves all the instrument settings at the time of shut down. Powering back on takes about 5-15 seconds of recalibration (dependent on instrument type) and the instrument will return to the settings at the time of shut down.

**Use NiMH batteries for cold weather operations.** As temperatures drops below 0° C (32° F), continuing the LCD's operation will determine how long the instrument will be useable. NiMH batteries can delivery more power at lower temperatures than Alkaline batteries.

**Remove Batteries prior to long periods of inactivity.** This will prevent the mess and contact corrosion caused from leaking batteries. NOTE: the VIA Echo MRI's SLA battery is a factory install and removal only.

**Always use a recharger that matches the battery.** Do not attempt to recharge alkaline cells. The results can be as minor as cell leakage or major as instrument destruction.

**Typical Current Draw:**

| Model | Name | Function | Current (ma) | With Backlight | External Battery |
|---|---|---|---|---|---|
| 5013-5000 | VIA | Vector Z | 350 | N/A | |
| 5006-5001 | 140-525 | SWR | 300 | N/A | |
| 6010-5000 | Cellmate | SWR | 300 | 385 | |
| 6014-5xxx | Bravo | Network | 230 | 300 | Add 15 |
| 6015-5xxx | | Analyzer | | | ma |
| 6020-5xxx | 20/20 TDR | TDR | 180 | 315 | |
| 6025-5xxx | VIA Echo | VNA + | 488 | 520 | |

**Typical Operating Times by Battery Type:**

| Model | Name | Alkalines 3500 maHr | Alkalines With Backlight | NiMH 2000 maHr | NiMH With Backlight |
|---|---|---|---|---|---|
| 5013-5000 | VIA | 9 Hrs | N/A | 5 Hrs | N/A |
| 5006-5001 | 140-525 | 11 Hrs | N/A | 6 Hrs | N/A |
| 6010-5000 | Cellmate | 11 Hrs | 8 Hrs | 6 Hrs | 4.5 Hrs |

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| | | | | | |
|---|---|---|---|---|---|
| 6014-5xxx<br>6015-5xxx | Bravo | 14 Hrs | 10 Hrs | 8 Hrs | 6 Hrs |
| 6020-5xxx | 20/20 TDR | 16 Hrs | 10 Hrs | 10 Hrs | 6 Hrs |
| 6025-5xxx | VIA Echo | ~3 Hrs | ~3Hrs | ~3 Hrs | ~3Hrs |
| 6025-5350 | Echo MRI | N/A | N/A | SLA<br>~2Hrs | SLA<br>~2Hrs |

## Conclusion:

If your operating conditions require that your AEA Technology instrument be operated on battery power, AEA Technology recommends for best performance and economy using the battery types in the following order:

1. NiMH – Excellent power, ~ 8 Hrs use with backlight management, 500 recharges, and most economical.
2. NiCd – Good Power, ~ 8 Hrs use with backlight management, more temperature sensitive, & cell memory can shorten usage time.
3. Alkaline – Excellent power, ~12 Hrs use with backlight management, but only one life cycle per set so they are expensive compared to rechargeable types.

NOTE: The VIA Echo hand-held Network Analyzers draw much higher current. Expect about 3 Hrs typical with any AA cell used. The VIA Echo MRI uses only the factory installed SLA battery type. Additionally, operation within any strong magnetic field will significantly reduce the battery operating time.

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