

## FACTS AND FIGURES ABOUT BATTERY PACKS AND RECHARGERS

This information was compiled to answer some of the most commonly asked questions about the rechargers and the rechargeable nickel-cadmium (ni-cad) battery packs used in Hewlett-Packard calculators. It supplements the Service and Maintenance section of your Owner's Handbook.

The first section discusses general characteristics applicable to all our calculators. Other sections describe details that apply to a specific product line: Classic (HP-35, 45, 55, 65, 67, 70, 80), Woodstock (HP-21, 22, 25, 25C, 27, 29C), Series E (HP-31E, 32E, 33E, 37E, 38E), Topcat (HP-91, 92, 97), and Sting (HP-10, 19C).

### GENERAL QUESTIONS

1. How long will my battery pack last?

Under normal conditions, a battery pack will last from 500 to 1000 charge/discharge cycles. A charge/discharge cycle is the charge-discharge-recharge sequence that your battery pack normally experiences as you use your calculator.

2. How can I get the maximum life out of my battery pack?

Fully charge the battery pack. Disconnect the calculator from the recharger and use the calculator on battery power alone until the low battery indicator turns on in the display. Then repeat this cycle.

Charging cycles other than this are common, especially leaving the calculator continually connected to the recharger, and will not harm the batteries. Another factor influencing battery life is temperature; extremes should be avoided.

3. What happens if I leave the calculator on after the low battery indicator turns on in the display?

Your display will start to behave erratically and give erroneous results. If the battery continues to be discharged, you may encounter cell reversal. The different cells in the battery pack discharge at a different rate until one of the cells actually reverses polarity with respect to the others. Cell reversal is frequently a permanent failure, in which case you will not be able to use or recharge your battery pack.

4. How should I store batteries?

Batteries should be stored at temperatures from  $-40^{\circ}\text{C}$  to  $55^{\circ}\text{C}$  ( $-40^{\circ}\text{F}$  to  $131^{\circ}\text{F}$ ) in a dry area free from corrosive liquids and gases. For long-term storage, it is advisable to remove the battery pack from the calculator to avoid possible damage by cell leakage.

5. How long a shelf life will a stored battery pack have?

Shelf life is dependent on many factors, including storage temperature, age (number of charge/discharge cycles), and operating history (type of charge/discharge cycles). Batteries can be stored indefinitely, charged or discharged. A fully charged battery pack will lose an estimated 1% of its charge per day, and within three months will be completely discharged. When left in this condition for a long period of time, one or more of the cells may experience cell reversal. For long periods of storage, it is wise to recharge a battery pack every two to three months.

6. How can I reduce this self-discharge?

Battery packs can be stored safely in a cold environment such as a refrigerator (preferable to a freezer). This will not halt the self-discharge, but will slow it down somewhat.

7. Why don't I get the full expected operating time from my battery pack?

The operating time from your battery can depend on several factors--ambient temperature, age (the number of charge/discharge cycles), type of operations being performed (e.g., programming vs. simple addition vs. printing), etc. Also, ni-cad batteries can develop a condition called "memory" that is a temporary loss of charging capacity. To illustrate, suppose your calculator is kept on the recharger continually, except for a 20 minute period each day when it is used on battery power. Over a long period of time (months), the batteries will begin to "remember" the capacity they are expected to deliver each day--20 minutes--and they will deliver no more than that amount. If you alternate using recharger and battery power for random periods, no harm is done. It is only the repeated discharge cycles that are all the same duration that produce the "memory". Full battery charging capability can

be restored to a good battery with several charge/discharge cycles in succession, as described in question #2.

8. My battery pack will not recharge or hold a charge. Should I replace it?

Before you replace your battery pack you should verify the source of the problem. It could be the battery pack, the recharger, or the calculator. Note that of these three, one, two, or all could be faulty. To determine the cause:

- a. Check that the recharger plugs are fully inserted, that the contacts on the battery pack are not dirty, and that the battery terminals in the calculator have not been flattened or broken (see your Owner's Handbook for details).
- b. Switch battery packs with someone who has a calculator in the same line as your own and a pack that is known to be good. If your pack behaves the same way in his calculator as it did in yours, the pack is defective or worn out and needs to be replaced. You could also check the battery voltage with a voltmeter (see the specific section for your calculator).
- c. Repeat the same procedure with your recharger to determine whether or not it is functioning properly. (If you have a Classic calculator, there are some specific conditions you will need to watch for. See Classic question #6.)
- d. If neither the pack nor the recharger are faulty, the charging circuitry in the calculator needs to be repaired by our Service Department. If this is the case, you can use a Reserve Power Pack to keep batteries charged for use until you have time to send the calculator in for repair.

9. What is the effect of temperature on the battery pack?

While ni-cad batteries do have a wide range of operating temperature, you should avoid extremes. Operating outside these limits may not cause permanent damage to the calculator, but you will probably get incorrect results and may damage the batteries. Low temperatures can shorten the operating time for the pack. High temperatures have a similar but less pronounced effect. More important is the accelerated deterioration of

the battery cell materials at high temperatures. This can result in decreasing battery life and possible leaks.

10. Which battery packs and rechargers can I use with my calculator?

The battery packs and the rechargers are completely interchangeable within each calculator line, but not between lines. There are two exceptions:

1) Topcat and Sting calculators use the same recharger. However, the older finned Topcat rechargers (model #82040A) will not work on Sting calculators. 2) The HP-29C requires battery pack model #82019B. This pack can be used with all other Woodstock calculators as well, as it has replaced the original model #82019A.

11. Can I use a recharger or battery pack not supplied by Hewlett-Packard in my calculator?

Rechargers or battery packs other than those supplied by Hewlett-Packard are not recommended, and may damage your calculator. Your warranty will not cover repair of a calculator damaged by the use of a non-HP accessory.

12. Do the rechargers supplied with the calculators comply with federal safety regulations?

Yes. The rechargers comply with OSHA regulations as stated in the Federal Register, Vol. 37 No. 202 dated October 18, 1972, as well as Underwriter's Laboratories certification.

13. Should my recharger feel warm?

Yes. It is perfectly normal for the recharger to feel warm but not hot.

14. Can I keep the recharger continually plugged into the wall?

Yes. You can leave your recharger plugged in continually. If the calculator is not also connected, be careful with the exposed plug, just as you would be with an extension cord.

15. Which end of the recharger should be plugged in first?

It makes no difference which end of the recharger is connected or disconnected first.

16. Should the calculator be turned off when the recharger is connected?

It is not necessary to turn the power off. There are two things you should be aware of. An interruption of power could occur that could clear or alter the contents of the stack, storage registers, or program memory. Also, there is a small possibility that power surges, stray transient voltages, or current fluctuations when the recharger is connected could damage the calculator or battery pack. This is more likely to occur outside the United States, where power supplies may not be as stable as those in the U.S.

17. Can I get a rebuilt recharger?

Rebuilt rechargers are only available for the Classic line. For details, contact our Service Department.

18. How can I recharge my calculator if I don't have an ac power source?

A recharger that will charge off a 10-16 volt dc power supply is available. This recharger comes standard with two power cords: one to fit a car cigarette lighter socket and the other with two leads that can be connected directly to the power source. Two versions are available for \$35 each: #82054A (Classic) and #82055A (Woodstock, except the HP-29C--see Woodstock question #7).

19. Can I get a replacement cord for my recharger?

Replacement cord kits are available only for the Classic line rechargers and Woodstock line 110/220 volt switchable rechargers. The parts center cannot accept credit cards or purchase orders. These kits are not available from the factory. Send your check or money order to:

Hewlett-Packard Company  
Mail Order Department  
P. O. Drawer #20  
Mountain View, CA 94043

Classic:	#82002-60901	\$3.00	Plus state and local taxes and \$1.50 handling charge per order.
Woodstock:	#82026-60901	\$2.00	

CLASSIC QUESTIONS (HP-35, 45, 55, 65, 67, 70, 80)

1. What are the voltages for my battery pack, low battery indicator and recharger?

Battery Voltages

Battery Pack: 3.30-4.50 volts

Individual Cell: 0.85-1.25 volts

Low Battery Indicator turns on: 3.45-3.55 volts

Before measuring battery voltage, fully charge the pack, remove it from the calculator, and let the batteries rest overnight. Battery voltages at or below the lower limits given are cause for battery pack replacement. Battery voltages above the upper limits are possible, especially when fully charged.

Recharger Voltages (unloaded)

There are three terminals on the plug at the end of the recharger cord. The terminals are marked +, -, and (unmarked).

Between the + and - terminals: 15-18 volts dc

Between the unmarked and - terminals: 5-6 volts dc

Recharger voltages outside the given ranges are cause for recharger replacement.

2. What is the recharge time of my battery pack?

14 hours (overnight), regardless of whether the calculator is on or off.

3. Can I use the recharger supplied with my calculator while I am outside the U.S.?

Yes. The recharger has a switch on the back that can be positioned at either 86-127 volts or 172-254 volts at a frequency of 48-66 Hertz, depending on the voltage requirements of the country you plan to visit. You will need to purchase a plug adapter with the proper plug prong configuration for that country.

If you prefer to purchase the entire recharger with the proper plug configuration, please contact the HP sales office in the appropriate country.

(A pamphlet listing the HP sales offices outside the United States is available from us upon request.)

Make sure the switch on the back of the recharger is set for the proper voltage, or you may damage the calculator.

4. How can battery life be extended during long calculations?

Key in only a decimal point. This display draws the least amount of power from the battery. When you want to continue calculating, you can, for example, just press [CLX] or [R+].

5. Will my calculator work off the recharger if the battery pack is not in place?

The battery pack does not need to be in place except with the HP-65 and HP-67. For either of these calculators, the card reader will not work and the calculator may be damaged unless the battery pack is in place.

6. How can I tell if my recharger is not functioning properly?

It can sometimes be difficult to determine if the recharger is actually at fault. There are two circuits in the recharger: a charging circuit for charging the battery, and an operating circuit for operating the calculator. Either one or both could be defective. If only the charging circuit is defective, the calculator will operate but the battery pack will not recharge. If only the operating circuit is defective, the battery pack will recharge but the calculator will not operate. If both are defective, nothing will work. Also, one or more broken wires in the cord will have the same effect. Be sure to check all possibilities while testing your recharger.

7. How does the card reader in the HP-65 or HP-67 affect recharging and battery use?

The card reader runs off the battery pack regardless of whether or not the recharger is connected. Extensive use of the card reader may, therefore, discharge the batteries even if the recharger is being used. Also, a fully discharged battery should be recharged for at least 5 minutes before trying to read a card.

WOODSTOCK QUESTIONS (HP-21, 22, 25, 25C, 27, 29C)

SERIES E QUESTIONS (HP-31E, 32E, 33E, 37E, 38E)

1. What are the voltages for my battery pack, low battery indicator, and recharger?

Battery Voltages

Battery Pack: 2.20-3.00 volts

Individual Cell: 0.85-1.25 volts

Woodstock Low Power Indicator turns on: 2.195-2.225 volts

Series E Low Power Indicator turns on: 2.165-2.225 volts

Before measuring battery voltage, fully charge the pack, remove it from the calculator, and let the batteries rest overnight. Battery voltages at or below the lower limits given are cause for battery pack replacement. Battery voltages above the upper limits are possible, especially when fully charged.

Recharger Voltages (unloaded)

There are two terminals on the plug at the end of the recharger cord.

Between the terminals: 8.9-10.5 volts ac

Recharger voltages outside the given ranges are cause for recharger replacement.

2. What is the recharge time of my battery pack?

With the calculator off, 6 hours; on, 17 hours.

3. Can I use the recharger supplied with my calculator while I am outside the U.S.?

Yes. Model #82026A has a switch on the back that can be positioned at either 86-127 volts or 172-254 volts at a frequency of 48-66 Hertz, depending on the voltage requirements of the country you plan to visit. Model #82041A does not have such a switch and will work only from 90-120 volts at a frequency of 50-60 Hertz. You will need to purchase a plug adapter with the proper plug configuration for that country. For a 110 volt non-switchable recharger, you may also need to purchase a 220 volt converter.



If you prefer to purchase the entire recharger with the proper plug configuration, please contact the HP sales office in the appropriate country. (A pamphlet listing the HP sales offices outside the United States is available from us upon request.)

Make sure the switch on the back of the recharger is set for the proper voltage, or you may damage the calculator.

4. How can battery life be extended during long calculations?

Key in the digit "1". This display draws the least amount of power from the battery. When you want to continue calculating, you can, for example, just press [CLx] or [R+].

5. Will my calculator work off the recharger if the battery pack is not in place?

No. A battery pack with no defective cells must be in place for the calculator to work properly.

6. Should my calculator feel warm while it is connected to the recharger?

Yes. It is perfectly normal for the calculator to feel warm but not hot.

7. Can I use the dc recharger with my HP-29C?

No. The dc recharger for the Woodstock line, #82055A, is not compatible with the HP-29C. This recharger was designed to meet the power requirements of the HP-21, 22, 25, 25C and 27 calculators before the HP-29C was added to the product line. The added programming and data storage capability of the HP-29C requires additional circuitry. This increases the power consumption of the calculator beyond the level that the recharger can supply from a typical 10-16 volt dc power source.

The Reserve Power Pack (which will operate from the dc recharger) could recharge a spare battery pack while the calculator is being used. When one battery pack becomes discharged, you can switch packs and the Continuous Memory of the calculator will retain your data and programs.

TOPCAT QUESTIONS (HP-91, 92, 97)

STING QUESTIONS (HP-10, 19C)

1. What are the voltages for my battery pack, low battery indicator and re-charger?

Topcat Battery Voltages

Battery Pack: 4.40-6.00 volts

Individual Cell: 0.85-1.25 volts

Low Battery Indicator turns on: 4.50-4.75 volts

Sting Battery Voltages

Battery Pack: 4.40-6.00 volts

Individual Cell: 1.10-1.45 volts

Low Battery Indicator turns on: 4.5 volts

Before measuring battery voltage, fully charge the pack, remove it from the calculator, and let the batteries rest overnight. Battery voltages at or below the lower limits given are cause for battery pack replacement. Battery voltages above the upper limits are possible, especially when fully charged.

Recharger Voltages (unloaded)

There are two terminals on the plug at the end of the recharger cord.

Between the terminals: 11.7-12.7 volts ac

2. What is the recharge time of my battery pack?

With the calculator off, 6 hours; on, 17 hours.

3. Can I use the recharger supplied with my calculator while I am outside the U.S.?

Yes. Model #82059A will work only from 90-120 volts at a frequency of 50-60 Hertz. You may need to purchase a 220 volt converter. Also, we have available a 220 volt recharger, model #82066A, for overseas use only (European plug). This recharger operates from 200-254 volts at a frequency of 50-60 Hertz. You will need to purchase a plug adapter with the proper plug prong configuration for the country you plan to visit. If you prefer to purchase the entire recharger with the proper plug con-

figuration, please contact the HP sales office in the appropriate country. (A pamphlet listing the HP sales offices outside the United States is available from us upon request.)

4. How can battery life be extended during long calculations?

For Topcat, key in only a decimal point; for Sting, key in only the digit "1". These displays draw the least amount of power from the battery. When you want to continue calculating, you can, for example, just press [CLX] or [R+].

5. Will my calculator work off the recharger if the battery pack is not in place?

No. A battery pack with no defective cells must be in place for the calculator to work properly.

6. Should my calculator feel warm while it is connected to the recharger?

Yes. It is perfectly normal for the calculator to feel warm but not hot.

7. Why does the low battery indicator flicker during printing operations?

The low battery indicator flickers on and off when using the calculator on battery power after a moderate amount of printing because of the high power consumption of the printer. While printing, this demand is enough to momentarily drop battery voltage below the low power level. The resulting intermittent indication is normal and will not be harmful nor cause erroneous results. When connected to the recharger, the printer still draws some power from the battery pack, again causing the flickering light. Because of this, even when using the recharger, the battery pack could become discharged during extensive or continuous printing operations, although this is not a common occurrence. A fully discharged battery pack should be recharged for at least 5 minutes before printing.

8. Why does the low battery indicator on my HP-10 stay on after attaching the recharger?

You must turn the calculator off and on again to reset the indicator.

This is probably the best solution, as there are no plans to produce a special dc recharger for the HP-29C.

8. Which battery pack and Reserve Power Pack should I use?

There are two battery packs currently in use for the Woodstock line. Model #82019A will work with all Woodstock calculators except the HP-29C. Model #82019B will work on all Woodstock calculators including the HP-29C. While both the "A" and "B" versions are in current use, the "A" version is no longer being produced; only the "B" version is available from Hewlett-Packard. Reserve Power Pack model #82028A has also been replaced by a "B" version, #82028B. This differs from the "A" version only in that it contains the "B" battery pack.