



White Paper

Title: Built-In Battery Charging functions for Model 9004 and Model 9005

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9004-5 Battery Charging.docx

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These models of Bridge gas analyzers use a High technology NiMH battery for local power source. This requires us to have a 'smart' charger built into the unit - as this type of battery requires intelligent charging. This makes charging the battery a little more complex than people are used to - so it is worthwhile to know the following.

The battery charger is active when the unit has external power plugged in and the power switch on the unit is in the 'OFF' position. So - you can observe the action of the battery charge circuit by simply plugging external power into an 'OFF' unit. **All modes are indicated by a single LED - the lowest RED led in the battery power meter.**

The battery charging function sequences are described below:

1. Looking for a battery - if not found, then try to wake it up. If found, charge it in high current mode: The analyzer looks for a battery. It indicates this by a flashing the LED for ½ second once a second until it decides what to do next. (Usually once or twice)

If it does not see high enough voltage from the battery (set at 4.8 volts - which means that 4 of the 5 battery cells are active - very low charge state, but there) - it sends a small 'wake-up' charge to the battery once per second, and reverts to a 'one-second flash' mode, at a very low duty cycle. which looks to be about off - but if you look closely, you can see the LED flash very briefly once per second. It will do this forever, as long as it is powered - as this is the 'trickle charge' mode of the charger. Very discharged batteries can take up to 5 minutes of this trickle charge mode to reach the 4.8 Volt threshold, at which time the analyzer will auto-switch into high charge mode.

2. High current mode - but watching for overcharging: The analyzer (if it finds an awake battery) will charge it at high current - but it will keep track of it to see if the voltage has peaked or if the battery has gotten too warm. If either of these happens, it will stop high current charging and will go to trickle (top-off) charging. High current mode is indicted by the bottom Red LED staying full on. (In this mode, the unit draws about ½

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ampere from the external power supply – so this state can also be confirmed by measuring in the 12V input line.)

3. Trickle charge mode. Once the battery is fast charge, the analyzer will apply a 15 mA trickle charge to the battery, letting it cool down and topping it off. It indicates this mode (as previously stated) by 'flashing' the LED at a low duty cycle once per second - so dim you can hardly see it.

4. Timeout from high current mode: If the battery does not get to peak voltage or high temperature within 2 hours, the analyzer goes into trickle charge mode by itself. This timeout is a fail-safe mode, so that if there is a failure in the temperature or voltage sense circuit, the analyzer will not continue to dump current into the battery at the high current rate.

These cycles start all over again if you power cycle the analyzer with external power, or unplug and plug in external power with the switch OFF. Because the charger is 'smart' this really does not hurt anything. It automatically determines the state of charge of the battery and chooses the correct charge mode. However, because of this complexity - you can see how it can get a little confusing. This is because of the high-tech battery, though, not the analyzer. The NiMH batteries require quite a lot of protection to make sure that you do not get in trouble with them. Normally, you just plug the external power supply into the analyzer with the power switch OFF, after use and walk away. Even with a really dead battery, the analyzer will auto-switch into high current mode within 5 minutes or so - and then stay in this state for 90 minutes or more.

At the end of the charge cycle (overnight), the battery should have enough charge for 2 to 2 1/2 hours of operation. The battery charge indicator should be full on for 15 minutes or so after power on, and then gradually count down until it is fully off for the last 15 minutes or so of operation. There is no danger, by the way, in letting the battery fully discharge. The analyzer will operate right up to the last minute. The charge indicator is a prompt to let the user estimate when that will occur – not a strict indicator of time remaining.)

These batteries do not have to be discharged, by the way. You can run them for any time you wish - as they have no memory effect, and will pick up where they left off, or you can charge them back up. However, you can see that it takes almost as long to charge them as they last in the application - 90 minutes or so. However, the batteries have shown themselves to be very long-lived, so they will provide years of service.

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When you are not using the analyzer, though, it is best to keep it on the charger. There is no danger of overcharging the batteries, and this ensures you always have a complete battery charge.

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