CEENBOT Modes with Attached Battery Charger

There are two modes in which the CEENBoT can be in with a charger attached: **ON with Power Mode** and **Charging Mode**.

ON with Power Mode (ONwPWR):
This mode allows the user to attach a charger to the CEENBoT while the CEENBoT is in its normal operating mode. To access this mode press and hold the PWR button while attaching the charger. The left LED will begin to blink green quickly signaling that it is now in the ON with Power Mode. Release the PWR button and the CEENBoT will start normally with the Attn. LED ON to signal that it is in this mode. If the battery voltage goes above 9.60V the over charge alarm **(OCA)** will be activated in which the system will be disabled and the left led will blink red while emitting a short tone. This alarm will continue until the user removes the charger.

Charging Mode:
This mode is used to charge the CEENBoT battery. The mode can be entered by simply attaching the charger to the CEENBoT. The charger can be attached with the CEENBoT ON or OFF. When the charger is removed the CEENBoT will always turn OFF regardless of the mode it was in when the charger was attached. The CEENBOT is equipped with a smart charger which runs a charging algorithm suitable for charging any NiMh or NiCd 7.2V battery pack from 1500mAh to 4500mAh. The charger current can range from 300mA to 1.5A with a charging voltage from 12Vdc to 14Vdc. When the charger is attached the CEENBoT first tests if the unloaded charger voltage is greater than 12.00V. If the charger is less than 12.00V the CEENBoT will emit 1 long beep with the Left LED red and shut off signaling a low charger voltage. If the charger passes this test then the CEENBoT will emit a long tone followed by two short tones signaling the charger has started. The four stages of the CEENBoT charging algorithm are explained below. When the charger is disconnected the CEENBoT will emit two short beeps then one long (opposite of prior) signaling the charger has been disconnected.
NOTE: The battery voltage must be at least 3.00V for the CEENBoT to recognize it. If the battery is this low plug it directly into the charger for 10min then connect it to the CEENBoT.

Stage 1:
For the first 30 second the battery will be connected to the charger 100%. The Left LED will blink green at 1Hz.

Stage 2:
 After 30 seconds the battery voltage will be tested with the charger connected. If the battery voltage is above 9.00V the program will jump to the trickle charge mode. Otherwise the current will be limited to 50% for 4 minutes. During this time the battery voltage will be monitored. Again, if the voltage reaches 9.00V during this time the program will jump to trickle mode. The Left LED will blink Red at 1Hz.

Stage 3:
After 4 min the current will be increased to 100% until the voltage goes above a max thread hold of 9.60V then drops back down. The Left LED will blink red 5.50Hz. The voltage is monitored and the max value is continuously stored then compared to the next value. Once the next value is less than the stored max. the program will jump to trickle charge mode. This is the ΔV characteristic or the "knee" in the charging plot. The Left LED will blink red at 17Hz.

Stage 4:
After this the charger will go into trickle mode where it will keep the battery topped off and supply enough current to power the control board circuits. The CEENBOT should take no more than 100mA quiescent after a charging cycle is complete. The current will be limited to 10% and will remain this way until the charger is removed or the battery voltage drops below 8.20V when the charging algorithm will start over. The Left LED will blink green at 6Hz.