ONE500 Battery Charger

Description of the ONE500 Integrated Battery Charger
Operation, Parameters and Protections

Ref: D-035568-ES-r00

Handbook

CONTENTS

1 INTRODUCTION

This document describes in detail the inner workings of the battery charger integrated into the ONE500 system. It aims to provide a complete technical reference of the charging algorithm, the phases that compose it, the parameters used by the firmware and the built-in protection mechanisms.

Unlike a user manual, this handbook is aimed at technical personnel, engineers and support teams who need to accurately understand the behavior of the charger in real operating conditions, as well as the criteria used by the system for battery management, detection of anomalous states and generation of errors.

Throughout the document, the complete charging cycle – Precharge, Bulk, Absorption and Flotation – is described, the default values for different types of battery are detailed and the protections implemented by the equipment are listed. This information allows the correct interpretation of the charger's operation, diagnoses incidents and verifies compliance with the operational requirements of the system.

2 DESCRIPTION OF THE CHARGING CYCLE

The ONE500 battery charger follows a multi-phase algorithm that optimizes the charging process according to the state of the battery.

Each phase has a specific purpose and the equipment moves from one phase to another automatically following a series of transition conditions.

- **PRECHARGE:** the precharge phase is designed to recover batteries that have been discharged below the safe level for normal charging. Apply a limited current to gradually raise the battery voltage before starting a full charge.
- **BULK:** is the fast charging stage where the maximum possible current is applied to charge the battery to approximately 80% of its capacity. This phase maximizes the charging speed while protecting the battery.
- **ABSORTION:** the absorption phase completes the battery charge by maintaining a constant voltage while the current gradually decreases. This phase ensures that the battery reaches its maximum capacity without overcharging it.
- **FLOAT:** while floating, the battery is kept fully charged by applying a very low maintenance current to compensate for self-discharge. This phase can continue indefinitely as long as AC power is available.

After the machine is turned on, the system remains in a state of rest (IDLE). To start the charging cycle, the system first checks that the following requirements are met:

1. The equipment has the battery charger license installed.
2. There is a battery connected.
3. The battery voltage is within a valid range.
4. The temperature of the equipment is safe for charging.

2.1 PRECHARGE

The pre-charge phase is only activated when the battery voltage is **below the Minimum Load Voltage** and above the Minimum tension for preload. If the battery voltage is equal to or higher than the normal charge threshold, the charging cycle starts directly in the fast or bulk charging phase, without going through pre-charging.

The goal of this phase is to safely recover deeply discharged batteries, progressively raising their voltage to a level where they can accept a normal load without risk, this avoids problems in cases where the system has been without electricity for several days.

During pre-charging, the charger applies a current whose maximum value is **Less than 800mA** or **half of the *Maximum Charging Current*.**

The pre-charge phase ends successfully when the battery voltage exceeds the normal charge threshold, allowing the system to automatically move to the next phase.

If the battery shows no signs of recovery, i.e. if the required voltage is not reached within the maximum time allowed, 15 minutes, it logs the error ***Battery Charge Error***.

Periodic tests are carried out every 10 minutes by default to verify the impedance of the battery. If the error exceeds the configured maximum value, the error is reported ***Battery Not Valid.***

In both cases, the charging process is stopped, indicating that the battery may be damaged or not valid for use.

2.2 BULK (Fast Load)

The fast charging phase starts when the battery voltage is **equal to or greater than the *Minimum Load Voltage***, either directly after initial verification or after successful completion of the preload phase.

In this phase, the charger applies the ***Maximum Charging Current*** almost constantly, with the aim of charging the battery as quickly as possible. Throughout the process, the system limits the maximum battery voltage to the value recommended by the manufacturer (5.5% higher than the ***Flotation tension***) to avoid overloading.

The phase ends when the following conditions are maintained for 30 consecutive seconds:

- The charging current drops 5% below the ***Maximum Charging Current***
- The battery voltage is as expected for a charged battery (95% of the ***Flotation tension***)

If the battery does not reach the expected levels after 24 hours, the computer shows the error ***Battery Charge Error***.

In this phase, in addition, periodic tests are carried out where it is verified that the impedance of the battery is within the established values. If the test fails, the error is reported ***Battery Not Valid.***

In both cases, the loading process stops.

2.3 ABSORTION (Slow Charging)

The absorption phase is responsible for completing the battery charge. During this phase, the charger maintains a **constant voltage equal to the absorption voltage**, while the current progressively decreases as the battery approaches its full charge. This behavior prevents overcharging and reduces stress on the battery.

The target voltage is automatically adjusted based on the temperature of the battery, applying thermal compensation to optimize the charging process according to environmental conditions. This compensation is carried out at a rate of **18 mV/°C**, as follows:

- For temperatures **above 20 °C**, the voltage is reduced.
- For temperatures **below 20 °C**, the voltage is increased.

The absorption phase ends when the charging current drops below the threshold defined for a fully charged battery, then moving on to the float phase.

In case the current does not decrease during the entire phase, the maximum waiting time will be exceeded, the equipment shows the error ***Battery Charge Error***.

As with fast charging, periodic tests are carried out to verify the impedance of the battery. If the error exceeds the configured maximum value, the error is reported ***Battery Not Valid.***

In both cases, the loading process stops. This behavior is common for very old batteries or with thermal problems due to prolonged saturation.

2.4 FLOAT

In the float phase, the battery is kept fully charged at a ***Flotation tension*** **Constant**, automatically adjusted for temperature, applying a minimum maintenance current intended only to compensate for natural self-discharge.

The battery can remain in this state as long as AC power is available and no abnormal conditions are detected.

The system automatically restarts a new full charge cycle when any of the following conditions are met:

- The battery remains **in the floating phase for 7 consecutive days**.
- Battery voltage drops by one **5% of the *Flotation tension*** during **30 consecutive seconds**.

The float phase has no more relevant events with the state of the battery, other than the natural discharge of the battery itself, which causes a restart of the charging cycle.

3 PARAMETERS AND DEFAULTS

The ONE500 equipment incorporates by default the configuration optimized for Lead-Acid batteries, responding to the values shown in the table for each parameter.

If necessary, these parameters can be modified individually or by applying the predefined profile for LiFePO4 batteries, which automatically adjusts all the internal values required for this type of battery.

Access to the charger's internal settings is restricted to ensure the security and integrity of the system. To make modifications, please request information from our technical support team via the support@lda-audioteh.com address.

Parameter	Description	Lead-acid battery	LiFePO4 Battery
Battery capacity	Nominal Battery Capacity in mAh	17000mAh (17Ah)	18000mAh (18Ah)
Nominal voltage	Nominal battery voltage	12000 mV (12 V)	12800 mV (12.8 V)
Flotation tension	Target stress during the flotation or maintenance phase	13650 mV (13.65 V)	13800 mV (13.8 V)
Maximum Charging Current	Maximum current during the fast-charging phase	2000mA (2A)	2000mA (2A)
Maximum battery voltage	Absolute permissible voltage limit (protection)	14.7V	15.0V
Minimum Load Voltage	Minimum voltage to start normal charging	9.5V	10.0V
Minimum tension for preload	Minimum voltage to start preload	8.0V	0.0V (disabled)
Undervoltage threshold	Minimum voltage before triggering alarm	10.5V	10.5V
Maximum temperature	Upper Permitted Temperature Limit	50°C	50°C
Minimum temperature	Lower permissible temperature limit	-5°C	0°C
Maximum Impedance	Allowable internal impedance limit	200mΩ	200mΩ
Testing period	Interval between battery tests	10 minutes	10 minutes

Table 1: Predefined values for Lead-Acid and LiFePO4 batteries

4 PROTECTIONS AND ERROR DETECTION

Code	Error	Description	Team response	Phase
041B	Battery Undervoltage	The battery voltage has dropped below the undervoltage threshold.	Error Sample	IDLE, BULK, FLOAT
041C	Battery Overtemperature	The battery temperature has exceeded the maximum temperature limit.	Stops charging, shows error	PRECHARGE, BULK, ABSORTION, FLOAT
043B	Battery Undertemperature	The battery temperature has dropped below the minimum temperature limit.	Stops charging, shows error	PRECHARGE, BULK, ABSORTION, FLOAT
040D	AC Power Error	The equipment has lost the main AC power and is running on battery.	Stops charging, shows error	ALL
0419	Battery Not Found	The system has not detected the presence of a battery, or the battery voltage drops below 2V during multiple charge cycles.	Stops charging, returns to IDLE	ALL
041A	Battery Not Valid	The impedance of the battery exceeds the maximum impedance limit.	Error Sample	PRECHARGE, BULK, ABSORTION
041D	Battery Charge Error	The maximum allowed time of the loading phase has been exceeded * PRECHARGE: 15 minutes * BULK: 24 hours * ABSORPTION: 24 hours	Stops charging, shows error	PRECHARGE, BULK, ABSORTION
0437	Battery Temp Sensor Failure	The voltage levels obtained by the temperature sensor are outside the valid ranges for the equipment.	Stops charging, shows error	ALL
0427	Batt CHG License Missing	The system has not detected the presence of the battery charger license.	Disable the charger	IDLE

Table 2: Understanding Battery Errors

NOTE: The errors displayed may appear during the IDLE, PRECHARGE, BULK, ABSORPTION, FLOAT phases.