EXTENDING VRLA SERVICE LIFE IN TELECOMMUNICATIONS REMOTE TERMINAL APPLICATIONS USING THE LEGACY J1C182BA POWER AND RINGING SYSTEM

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ABSTRACT

For two decades, charge control devices have been recommended for use with valve regulated lead acid (VRLA) batteries used in conjunction with the legacy constant current 3A or 3B Battery Charger. Using a charge control device acting as a shunt regulator is an effective method to extend VRLA battery life in 3A or 3B applications. Although some J1C182BA plants have been observed with high float voltages, the use of a charge control device with these plants has not generally been recommended nor required by VRLA battery manufacturers or by AT&T.

A study was commissioned by the AT&T Remote Terminal Power Committee (RTPC) in 2009 to determine the extent of overcharging issues associated with the J1C182BA. The study revealed a significant number of these legacy power systems overcharge the batteries. Charge control devices were installed to verify they could effectively control the J1C182BA float voltage. The existing GSB 100mA charge control device and a new 300mA charge control device were tested during the course of this study. The 300mA string charge control device proved technically and economically suitable for use with the J1C182BA as well as the 3A or 3B Battery Charger.

INTRODUCTION

The J1C182BA was designed for use with the same 48V 25Ah form factor battery as the legacy 3A/B Battery Charger. Beginning in 1992, VRLA batteries began replacing the KS-21906L4 “six pack” battery in both applications. The KS-21906L4 or equivalent product is no longer used in AT&T SE. The dominant 25Ah battery used in the AT&T SE region in the 3A/B or J1C182BA is the GSB PWL12V28.

The GSB String Charge-control Device (SCD) was custom developed for AT&T SE (formerly BellSouth) in 2002 and has been used with good success for nearly 9 years with the 3A/B Battery Charger. It has occasionally been used with the J1C182BA to mitigate overcharging in what was believed to be ‘bad actor’ systems. This study was designed to determine if charge control devices were necessary for the J1C182BA and if devices such as the GSB SCD-100 were effective in controlling float voltage in this application.

SITE AND J1C182BA SYSTEM STUDY

Selection of the Sample Group

The annual inventory of circuit packs at Remote Terminal (RT) sites in the 9 AT&T Southeastern states has been a requirement since 1994. It was thus possible to determine the total population of J1C182BA systems by selecting one unique circuit pack in the power shelf. The relevant population was established at 22,935 J1C182BA systems. This included customer premise, RT buildings and cabinet applications. One hundred (100) J1C182BA systems were selected for this study group and ultimately 107 systems were surveyed. These represented environmentally controlled and non-controlled applications (cabinets, customer premise, RT buildings, Controlled Environmental Vaults, Controlled Environmental Cabinets). Each location and system was visited to gather data: float voltage, number of strings, battery and ambient temperature, battery age, circuit pack equipage, and plant load. An average number of three (3) 48V strings are associated with each J1C182BA system.

Extent of the Overcharging Problem

The vast majority of J1C182BA systems had at least one string being overcharged (**Tables A, B, and C**). These data clearly indicate a significant number do in fact have float voltages above the acceptable limit. On average the strings associated with the affected systems were **1.6VDC** above the operating range for the battery when adjusted for temperature. Seventy-six (76) strings were **2.0VDC** to **5.4VDC** above the recommended operating range for the battery.

Table A. Float Voltage Standard

AT&T Network Standard, 25C	54.0VDC
BellSouth Network Standard, 25C	54.5VDC
GSB PWL Product Design, 25C	53.6-54.4VDC

Table B. Statistics Based on 54.5V at 25C

	#	Samples	Percentage
Pass	35	107	32.71%
Fail	72		67.29%

Table C. Statistics Based on 54.0 at 25C

	#	Samples	Percentage
Pass	16	107	14.95%
Fail	91		85.05%

Analysis to Identify Common Factors of Affected Systems

Once systems exhibiting the overcharging issue were clearly identified, we attempted to determine if there were certain factors common to affected systems. Several theories have been offered as to the reason some J1C182BA systems overcharge while other systems provide an acceptable float voltage across a wide range of temperatures. Lightly loaded systems, interaction between certain vintage circuit packs in the systems were among those ideas.

Circuit pack complement including 336(x) rectifier or 337(x) battery charger or J1C182BA shelf vintage, operating environment, temperature, battery age, mixture of battery ages, and system load were considered. Batteries were harvested from some affected systems and capacity measured to verify the condition of the batteries. Affected systems were documented where batteries were near 80% end of life as well as those with batteries in nearly new condition. There were no correlating factors.

EFFECTIVENESS OF THE STRING CHARGE-CONTROL DEVICE (SCD)

The 48V String Charge-control Device

When GSB was asked by AT&T SE (formerly BellSouth) to develop a charge control device for 3A/B applications, they selected Midtronics to custom manufacture the product. Midtronics is well known in the industry for their expertise in this field. The GSB SCD-100 is based on technology developed by Midtronics for their **12V** 100mA charge control device and used successfully for many years. However, the SCD-100 is a **48V string** charge control device and is deployed on the battery shelf rather than being attached to each 12V battery as part of the battery cable assembly. The product specifications for the SCD-100 are found in **Tables D** and **E (Page 3, 4)**.

Table D. Product Specifications GSB H06-0001-00, 48V 100mA String Charge-Control Device

Temperature Range:	-40°C to +65°C, 95% relative humidity, non-condensing
Battery Range:	4 x 12VDC mono-blocks (48VDC) nominally rated ≤60 Ampere Hours at the c/10 rate
Voltage Range:	0.0VDC to +65.00VDC
Voltage Accuracy:	+/- 20mVDC
Maximum Allowable Current:	7.5 Amps @ 60VDC @ 131°C
Shunt Current:	0.0 to 0.1 Amps. Charge current regulated from 0 to 100mA
Over Current Limit:	Limited to 100mA total current bypass
Temperature Compensation Range:	± 24mV per 1°C to a minimum of 52.80VDC
Nominal String Voltage Range:	53.52VDC to 54.48VDC @ 25°C (factory set to battery mfg. specific battery requirements)
Calibration:	Factory calibration only, single point off-set
Power Requirements:	Powered by charging system; no external or battery power required
Mounting:	Spring clip; attach to wall of battery shelf
Visual Operating Display:	Single LED illuminates when device is active; indicates current bypass (shunting current)
Housing Material:	Metal
Weight:	1.2 lbs.
Dimensions:	2.75"L x 1.385"W x 7.014"H

Table E. Product Specifications GSB H06-0001-00 R2, 48V 300mA String Charge-Control Device

Temperature Range:	-20°C to +65°C, 95% relative humidity, non-condensing
Battery Range:	4 x 12VDC mono-blocks (48VDC) nominally rated ≤60 Ampere Hours at the c/10 rate
Voltage Range:	0.0VDC to +65.00VDC
Voltage Accuracy:	+/- 20mVDC
Maximum Allowable Current: (Charge/Discharge)	7.5 Amps @ 60VDC @ 131°C
Shunt Current:	0.0 to 0.3 Amps. Charge current regulated from 0 to 300mA
Over Current Limit:	Limited to 300mA total current bypass.
Average Temperature Compensation Range:	± 86mV per 1°C to a minimum of 50.11VDC
Temperature Compensation/Range: (During Float the State)	The Current Bypass voltage threshold shall track the ideal calibration voltage curve within +/- 2% tolerance in the -20 to +65 degrees temperature range
Nominal String Voltage Range:	54.0VDC @ 25°C (Calibration Reference)
Calibration:	Factory calibration only, single point off-set
Power Requirements:	Powered by charging system; no external or battery power required
Mounting:	Spring clip; attach to wall of battery shelf
Visual Operating Display:	Single LED illuminates when device is active; indicates current bypass
Housing Material:	Metal
Weight:	1.2 lbs.
Dimensions:	2.75"L x 1.385"W x 7.014"H

Testing the SCD-100

Ten percent (10%) of the affected systems were selected for treatment. The standard 100mA version of the SCD-100 was installed at these sites. The sites were visited periodically to verify the effectiveness of the device in gaining control of the float voltage. The SCD-100 in many cases made a dramatic improvement in float voltage as shown in **Figures 1** and **2 (Page 5)**.

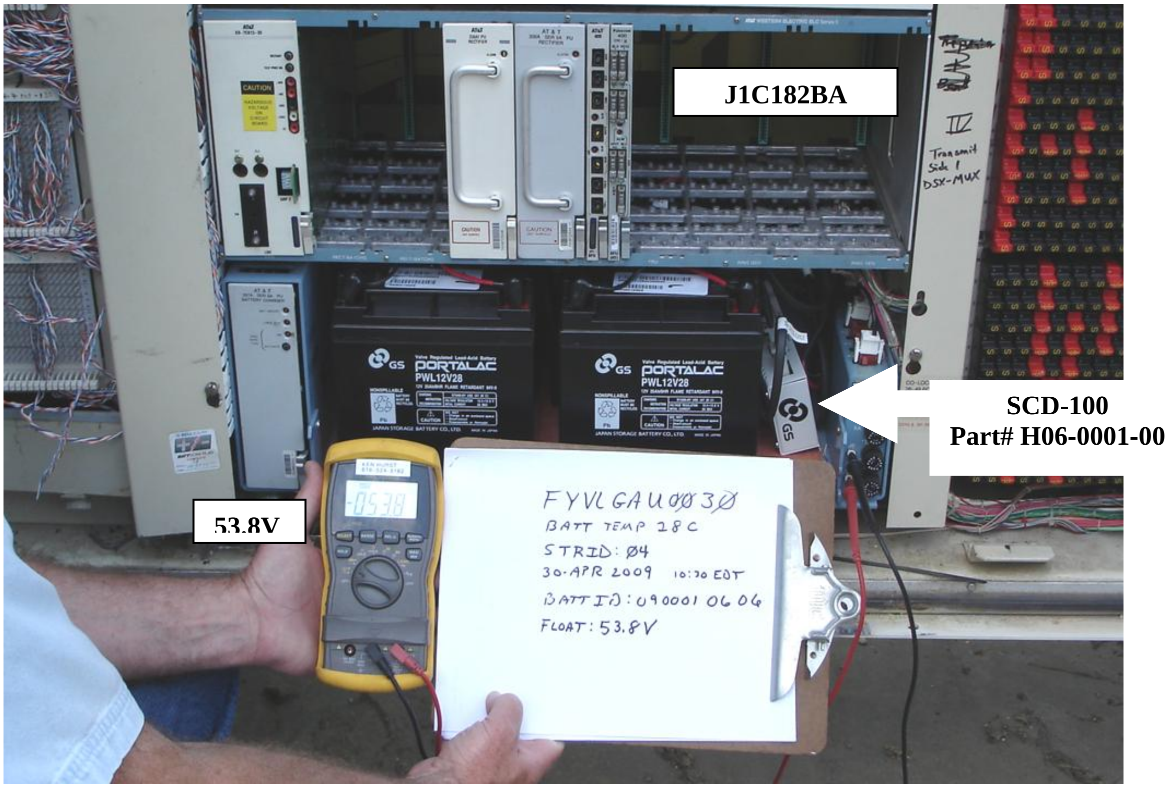

Figure 1. SCD-100 (100mA) Installed at FYVLGAU0030 – 53.8VDC @ 28C

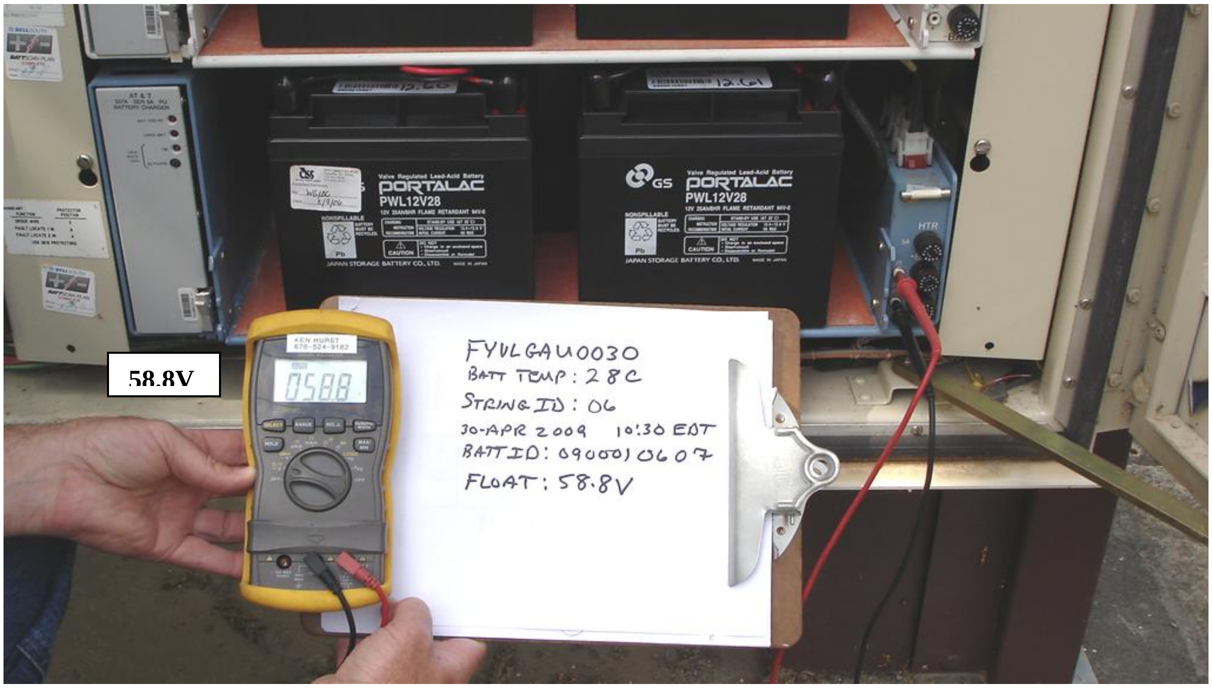

Figure 2. Without the SCD-100 Installed at FYVLGAU0030 – 58.8VDC @ 28C

AFFECTS OF OVERCHARGING ON BATTERY SERVICE LIFE

The GSB PWL Product Manual was used to develop a model to evaluate the affects of overcharging on service life (**Figure 3**). **Table F** is based upon data collected from the study sites and illustrates the significance of the problem. **Table G** (**Page 7**) is actual temperature data recorded jointly by AT&T SE (formerly BellSouth) and GSB at RT sites as part of a long term battery performance study.

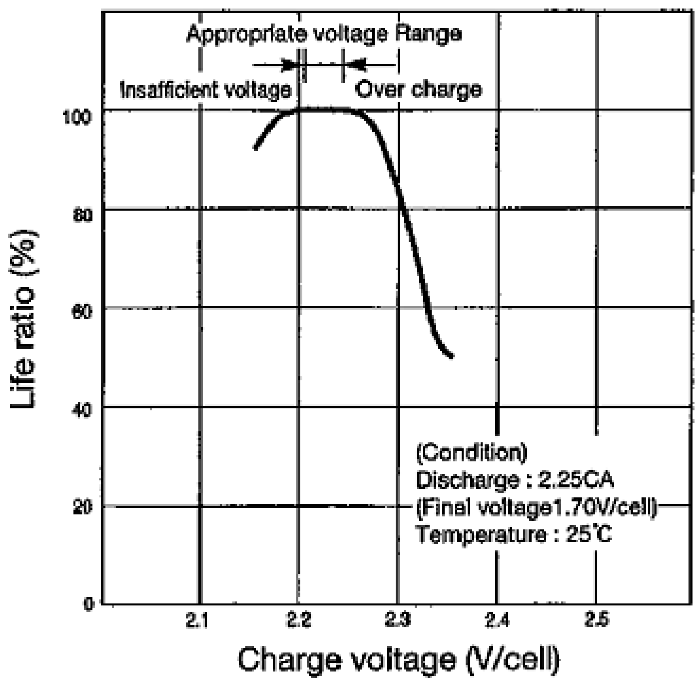

Figure 3. Charging Voltage and Service Life Ratio[1]

Table F. Average Overcharge Volts per String

Average Overcharge per Volts per String	1.669
Average Overcharge VpC	0.071
Recommended Float to achieve 100% of service life at 25C	2.250
Strings that are being overcharged - Average Float VpC	**2.321**

Table G. Actual Battery Temperatures in Georgia and Florida RT Sites

Average annual battery temperatures (Deg C) from 5 RT cabinets in Georgia and Florida for year 2002.	27.4 31.7 31.1 27.3 25.0
Average Deg C	**28.5**

A Life Ratio Calculation (**Table H**) was based upon the average float voltage of sites identified as overcharging and historical average battery temperature data in RT cabinets in Georgia and Florida (**Table G**). Conversely, **Table I** illustrates the expected service life of batteries **not** subjected to overcharging under the same thermal conditions. Improving float voltage control and adding temperature compensation could increase battery service life by an average of 3.59 years (**Table J**).

Table H. Life Ratio Calculation for Batteries Subjected to Overcharging

13	Design Life - Years
69%	Life Ratio - Temperature
60%	Life Ratio - Float Voltage
5.38	Expected Life - Years

Design Life Years * Life Ratio Temp% * Life Ratio Float%= Expected Life

Table I. Life Ratio Calculation for Batteries NOT Subjected to Overcharging

13	Design Life - Years
69%	Life Ratio - Temperature
100%	Life Ratio - Float Voltage
8.97	Expected Life - Years

Table J. Potential Improvement in Service Life with Proper Float and Temperature Compensation

8.97	Expected Life, Years - Temperature Penalty Applied
5.38	Expected Life, Years - Temperature and Overcharge Penalty Applied
3.59	Years - Theoretical Service Life Improvement that may be achieved by adding charge control and temperature compensation.

SUMMARY OF THE FINDINGS

In all cases the SCD-100 effectively lowered the float voltage to a more acceptable level. However, it was discovered that in some cases the charge control device could not shunt enough current to bring the float voltage to the desired level of 54.0 VDC at 25°C. This finding led to development of a 300mA version of the SCD-100. The new 300mA SCD-100 was field tested and proved effective at lowering the float voltage to the desired level. This increase in capability to shunt current should also allow for better performance of the temperature compensation feature built in to the device. Successful performance of the 300mA SCD-100 led to approval for use in AT&T.

- Based on the findings of this study, the J1C182BA plants are floating at a level which is too high in a majority of locations.
    - The result is reduced battery service life due to dry out or grid growth.
- Charge control devices do have a positive impact by lowering the float voltage to an acceptable level, which will result in longer battery life.
- The recommendation is to place a charge control device on each battery string associated with the J1C182BA power system in AT&T.

CREDITS

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REFERENCES

[1] GS Yuasa Portalac Technical Manual for PE/PX/PXL/PWL Series VRLA Batteries.