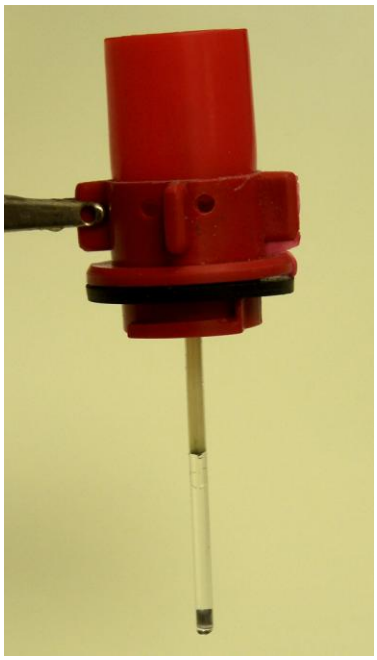
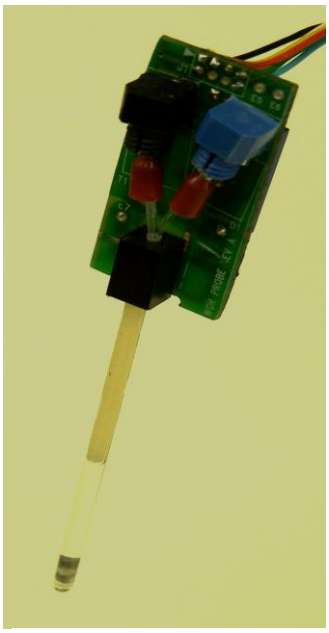
APPLICATION DATA: STATE of CHARGE SENSORS and LIQUID LEVEL SENSORS (07/12/2019)

STATE OF CHARGE SENSING

The JSA State-of-Charge Sensors (US patent 10,145,789) are special purpose refractometers designed for use in lead-acid open port batteries. This device is designed to accurately determine state-of-charge (SOC) levels of individual cells in terms of specific gravity. The sensor provides an analog DC output voltage approximately proportional to SOC and may be calibrated in any user convenient units including % charge or specific gravity. Cell temperature may also be sensed either by on on-board environmental sensor of an optional immersion temperature sensor for accurate in-cell measurements. Related applications for this sensor include fuel gauging for electric vehicles, feedback sensor for "smart" charging applications and load management for solar and wind back-up battery systems.



Battery Cap



OEM Configuration

The sensor active element must be fully immersed in the electrolyte for satisfactory operation. Configurations available include OEM for user packaging or a standard battery cap version as shown in the Figures above. An on-board environmental temperature sensor is standard equipment on all versions.

JSA Photonics LLC, 11701 Sky Valley Wy NE, Albuquerque, NM, 87111, 505-975-1534, sales@jsaphotonics.com, www.jsaphotonics.com

LIQUID LEVEL SENSING

A version of this technology is adaptable to liquid level sensing. The packaging is identical to the OEM and battery cap configurations. This version is designed to accurately determine electrolyte levels of individual cells. The sensor provides an analog DC output voltage approximately proportional to electrolyte liquid level. Cell temperature may also be sensed either by on on-board environmental sensor or an optional immersion temperature sensor for accurate in-cell temperature measurements.

OPTIONS

Several upgrade options are available for either Battery Cap or OEM sensor versions:

- The sensor requires 5 VDC regulated input however an on-board regulator is provided as standard equipment enabling the user to supply power from a battery or other unregulated 6-50 VDC source.
- An immersion temperature sensor option is available with RT curve type Z calibration factors.
- Custom probe lengths are available
- Complete PC based data acquisition systems
- Custom packaging in a user specified enclosure is available

SPECIFICATIONS*

Power source: 5 VDC regulated input or optional unregulated power input 6-35 VDC, Max current draw 35ma.

Output: Typically 1 - 4.0 VDC, minimum 2 volt swing with specific gravity ranging from 1.1 to 1.30. For level sensing output is 2.0 – 0.8 volts for full to empty.

Load Impedance, 100 kΩ minimum

Typical Temperature Limits: -10 to 40 °C. Correction may be required for large environmental temperature variations.

SOC Accuracy (calibration and configuration dependent) typically ± 5% or less with 5 point linear calibration. See typical response curve below.

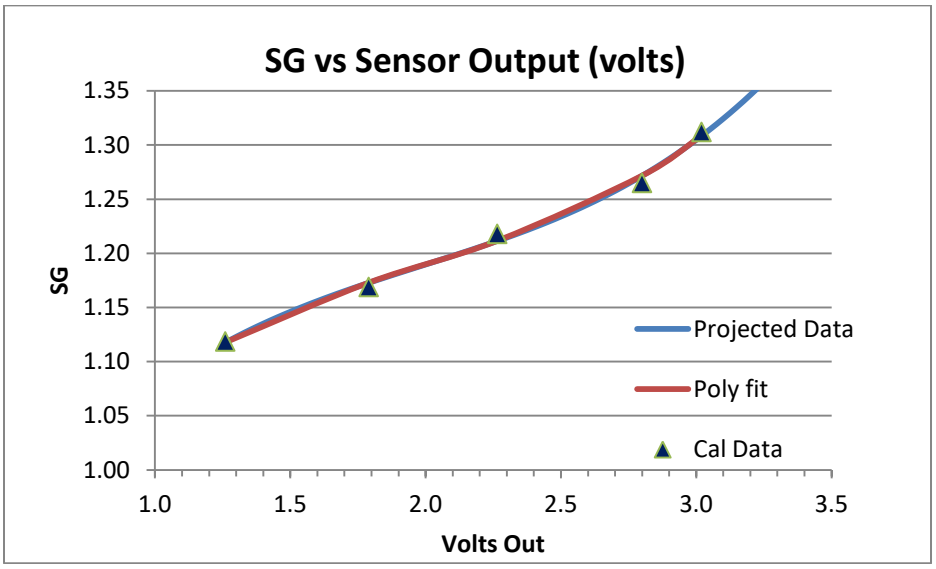
Temperature Sensor Accuracy ±5%

OEM Dimensions: 1.5" x .8" x .75". Standard probe length from bottom of board 2.25"

OEM Electrical Connector: 8 pin, 0.079" (2mm) dual row male header. Cabling is supplied with battery cap versions only.

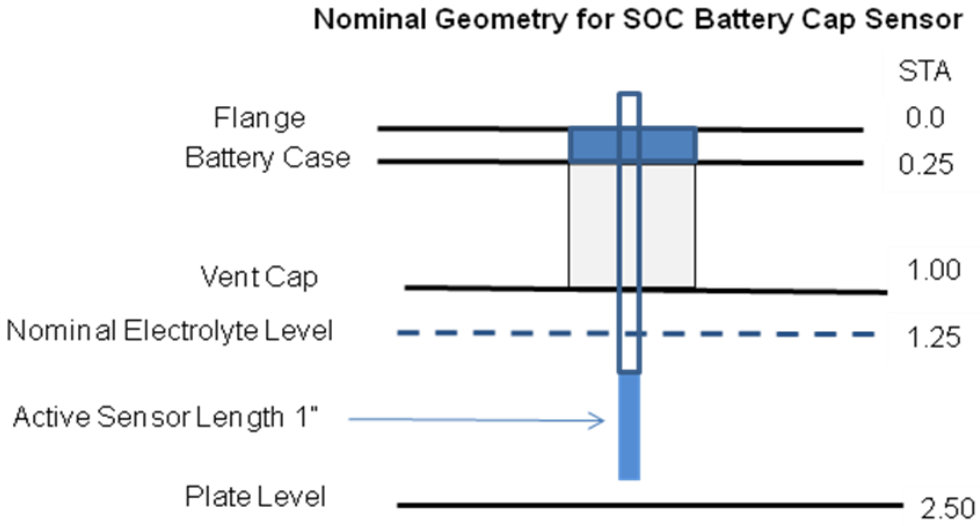
Units are factory calibrated and delivered with 5 point calibration data and supplied with Excel conversion software. Periodic calibration checks are recommended. The standard configuration is typically adequate for closed loop, smart charging and load management applications. Sensor-to-sensor response repeatability is not guaranteed at this time.

Typical Sensor Response



Usage and Physical Configuration

Although the use of a sensor in each cell of a battery is recommended for critical applications, monitoring of single cell representative of each battery in the system or 1 sensor for every 3 cells is the minimum number of sensors recommended. The sensor is built into a standard vented bayonet type cap as shown above compatible with many open port batteries.



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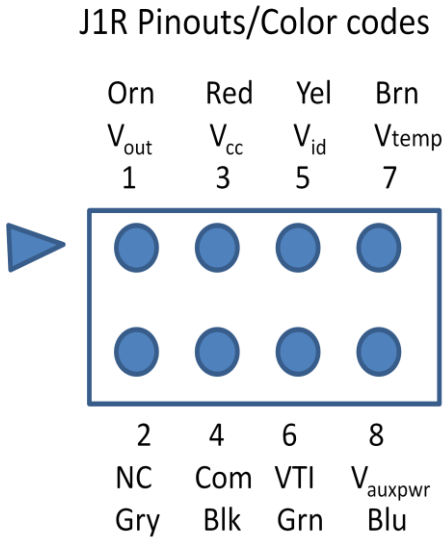
Note that the active sensor length of about 1" from the bottom of the probe must be totally immersed in the electrolyte for proper performance. The sensor has an additional feature of indicating a low SG reading when the electrolyte level is below minimum. The required physical dimensions to install this cap into a typical lead acid battery are shown in the figure above. Custom probe lengths or alternate packaging configurations are available.

Electrical Connections

The connections to the sensor are accessed via J1 in the OEM version or via the supplied cable in the battery cap enclosure version using the wire color codes shown below.



Electrical Connections		
Pin	**Symbol**	**Description**
1	Vout	Output 1-4 volts (typ)
2	NC	Common
3	Vcc	Fused +5VDC regulated input @35ma max
4	Common	Common
5	Vid	0-3.5 Vdc corresponding to 0-35ma LED diode current. Factory set using R4.
6	VTI	Immersion sensor RT curve Z. Nominal output at room temperature = 2.5 Vdc.
7	Vtemp	0-1 Vdc from on-board temperature sensor. ≈.75 Vdc at Room Temp
8	Vaux	DC input to on-board regulator for battery powered operation. 6-50 Vdc max.

PRECAUTIONS:

Do not use pin 8 if pin 3 is active and vice versa.

DO NOT APPLY UNFUSED BATTERY POWER, A 0.1 amp fuse is recommended.

Calibration

The sensor may be calibrated using the supplied Excel calibration table with a 5 data point requirement over the SG range of 1.10 to 1.35 or the user may supply a sufficient number of data points to yield desired accuracy over the desired SG range of operation. Typically, curve fitting with a 3rd polynominal yields sufficient accuracy for most purposes. The output voltage is initially set with R4 to 1.25 volts with using a calibration fluid of SG = 1.10 to assure sufficient dynamic range. For brief calibration check use a fluid with a SG midrange value of about 1.22 and add a small SG correction factor to the Excel table in the indicated block. A calibration fluid for this purpose is available.

On-board Temperature Sensor (TMP-36)

The on-board temperature sensor yields an output voltage on pin 7 of the J1R connector approximately proportional to temperature. The temperature in ºC can be determined from the following expression:

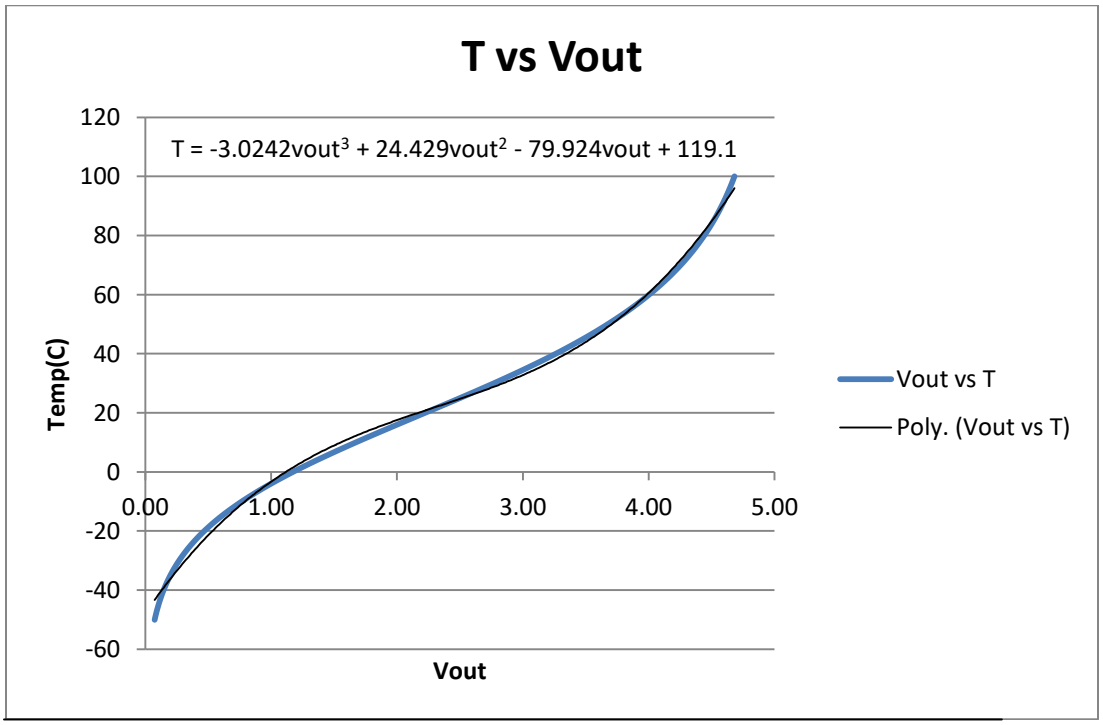
T(ºC) = 106*Vout - 54.5, ±2°C accuracy over temperature (typ), ±0.5°C linearity (typ)

The operating range of this sensor is −55°C to +150°C

At room temperature (25C) the output is approximately .75 Vdc. This temperature can be used as an input to the calibration sheet to correct for temperature effects.

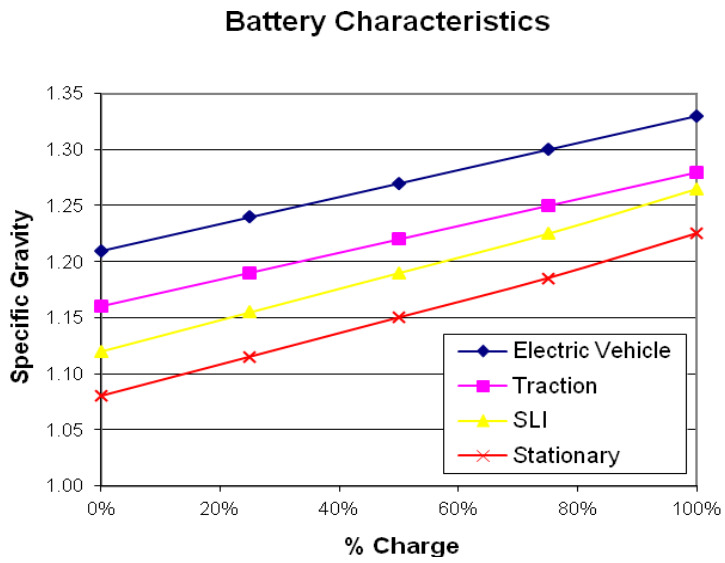
Immersion Temperature Sensor (if equipped)

The immersion temperature sensor is a micro thermistor inserted within the fiber bundle coupling to the active area of the sensor. The nominal characteristics of the output voltage vs temperature are shown in the chart below. Because the electrolyte acts as a heat sink, the self-heating effects of the thermocouple are negligible.



Battery Characteristics

The relationship of state of charge readings to battery capacity in terms of percentage depends on the battery type and characteristics. The chart below shows the approximate relationship of SG to battery capacity in percentage for various types of batteries. Note SLI means Starting, Lighting and Ignition.



* JSA reserves the right to alter specifications as necessary and without notice. Every attempt will be made to notify customers in advance of pending changes.