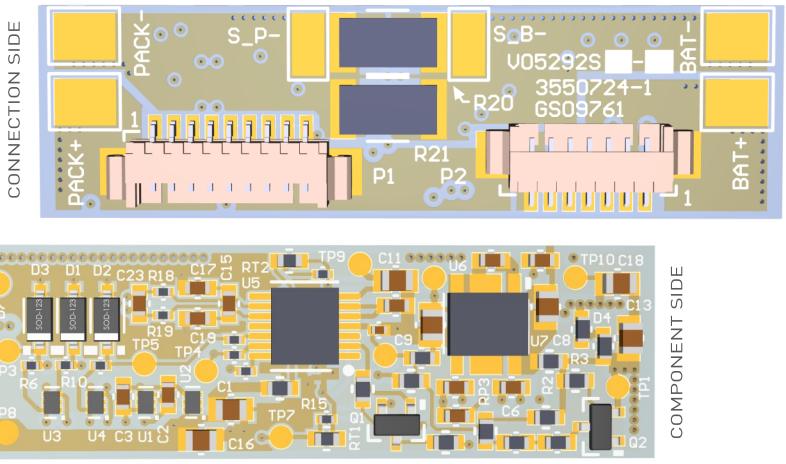
Battery Fuel Gauge
1 to 12 series cells, standalone fuel gauge

A universal State of Health and State of Charge fuel gauge

The Saft universal fuel gauge is specifically designed to provide optimum accuracy for reporting the available energy in Li-ion batteries consisting of series assemblies from 1 to 12 series cells with a maximum capacity of up to 29 Ah, including cells in parallel.



Benefits
- State of Charge and State of Health management for battery assemblies.
- Temperature compensation during charge and discharge measurement.
- No learning cycle required.
- Optimal performance from 0°C to +60°C.
- High reliability

Key features
- The fuel gauging algorithm is precisely based upon Saft's electrochemistry's ensuring the best possible accuracy.
- A five segment push button activated fuel gauge meter is available in green/red LED.[8]
- Supports Two-Wire I²C™ and HDQ Single-Wire Communication Interfaces with Host System
- NTC integrated in circuit
- EN 61000-4-2: +/-4KV in contact and +/-8KV in air.
- UL94-V0

Designed to meet all major quality, safety and environmental standards
- Quality: ISO 9001, and the Saft World Class program
- Environment: ISO 14001, RoHS

Typical applications
- Backup for industrial controls
- Medical apparatus
- Tracking devices
- Military applications
- Commercial instruments
- Industrial equipment

Maximum characteristics	
Maximum temperature range	-40°C to +110°C
Charger input voltage	60 V
Voltage communication	6.0V
Current (battery output or input)	12 A max
Capacity battery	29 Ah max
Operational characteristics	
Operating temperature range	-35°C to +85°C
Charger input voltage	2.2 V to 51.6 V
Voltage communication	3.3V or 5.0V
Current (battery output or input (charging)	10A max
Maximum circuit average consumption until +85°C	100 µA
Electrical characteristics[1]	
Voltage measurement (2.5V/cell to 4.3V/cell)	1s version = ± 0.2% 2s-6s version = ± 0.5% 7s-12s version = ± 1%
Current measurement	10 mA: ± 15% 100 mA : ± 3% 500 mA to 10A: ± 1%
Temperature measurement	± 2.0°C
Physical characteristics	
Dimension L x W x T (mm)	49 x 14 x 5.20
Weight	4.0 g

(1) Covering the temperature range of –40°C to +85°C

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Functions and operations

Measurement

The circuit measures current, voltage and temperature at 1 Hz during normal mode and 0.05 Hz during sleep mode, normal mode is enabled after reading a discharge current above 15 mA.

Fuel gauging technology

The implemented fuel gauging technology continuously analyses battery impedance, current and temperature, resulting in superior fuel gauging accuracy. In addition, the algorithm compensates for battery aging and self-discharge. Thus displaying the true state of charge, real battery capacity and state of health.

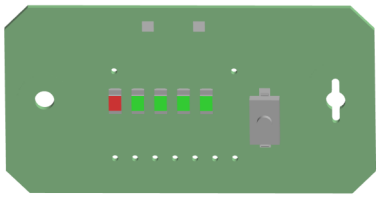
Communication

The circuit communicates from 3.0V to 5.5V with Two-Wire I²C™ protocol or HDQ Single-Wire (a protocol of Texas Instruments®). See the "Standard commands" table on the this page. For additional information on the communication possibilities review the Texas Instruments® document SLUA790.

The universal fuel gauge can also be read externally via Battery Management Studio (www.TI.com), on Microsoft® Windows® from the communication port. An EV2400 interface will be necessary.

Available types

GP 30968 (single cell version)
GP 30969 (two to six series cells)
GP 30974 (seven to twelve series cells)



(8) Standard LED fuel gauge indicator

SoC accuracy by Temperature and Discharge rate[4]								
Temperature [3] [2]	-35°C to -20°C		-20°C to 0°C		0°C to +60°C		+60°C to +85°C	
Discharge rate [1]	[2]		0.5	1.0	0.5	1.0	0.5	1.0
Single cell	[2]		± 10%	± 20%	± 6%	± 6%	± 6%	± 10%
Multi cell	[2]		± 10%	± 20%	± 6%	± 6%	± 6%	± 6%

(1) The decimal corresponds to the nominal capacity of the battery. A discharge rate of 0.5 for a battery of 3.0 Ah = 1.5A
(2) Note: For use of batteries below –20 ° C, please consult Saft
(3) Margin of error according to ambient operating temperature
(4) The accuracy level is based on a full discharge. If the usage profile is known, higher accuracy level is achievable.

The fuel gauge provides both the state of health and maximum capacity [4]

$$State\ Of\ Health = \frac{FCC}{DesignCapacity} \qquad State\ Of\ Charge = \frac{RemainingCapacity}{FCC}$$

(4) FCC register = FullChargeCapacity. Thus, the estimated maximum capacity by the system

Standard commands	Identifier	Command code	Unit
Control()	CNTL	0x00/0x01	N/A
StateOfCharge()	SOC	0x02	%
MaxError()	ME	0x03	%
RemainingCapacity()	RM	0x04/0x05	mAh
FullChargeCapacity()	FCC	0x06/0x07	mAh
Voltage()	VOLT	0x08/0x09	mV
AverageCurrent()	AI	0x0A/0x0B	mA
Temperature()	TEMP	0x0C/0x0D	0.1°K
Flags() [5]	FLAGS	0x0E/0x0F	N/A
Current()	I	0x10/0x11	mA

(5) Further details on Flags() registers is available upon request.

Battery capacity (Ah)[6]										
Cells in parallel #	1	2	3	4	5	6	7	8	9	10
MP 144350 xlr	2.6	5.2	7.8	10.4	13.0	15.6	18.2	20.8	23.4	26.0
MP 174565 xtd	4.0	8.0	12.0	16.0	20.0	24.0	28.0			
MP 174865 xlr	5.3	10.6	15.9	21.2	26.5					
VL 34570 xlr	5.4	10.8	16.2	21.6	27.0					
MP 176065 xtd	5.6	11.2	16.8	22.4	28.0					
MP 176065 xlr	6.8	13.6	20.4	27.2						

Battery voltage (V)[7]												
Cells in series #	1	2	3	4	5	6	7	8	9	10	11	12
GP 30968	4.2											
GP 30969		8.4	12.6	16.8	21.0	25.2						
GP 30974							29.4	33.6	37.8	42.0	46.2	50.4

(6) The above table (Battery Capacity) describes the maximum number of cells in parallel according to the cell type that can be monitored using the battery fuel gauge circuit.
(7) The table (Battery voltage) enumerates the number of cells in series available by battery fuel gauge type. For example, a 4s5p MP 176065 xtd battery would require a GP 30969 circuit. Where a 4s6p MP 174565 xtd battery would be outside the scope.

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