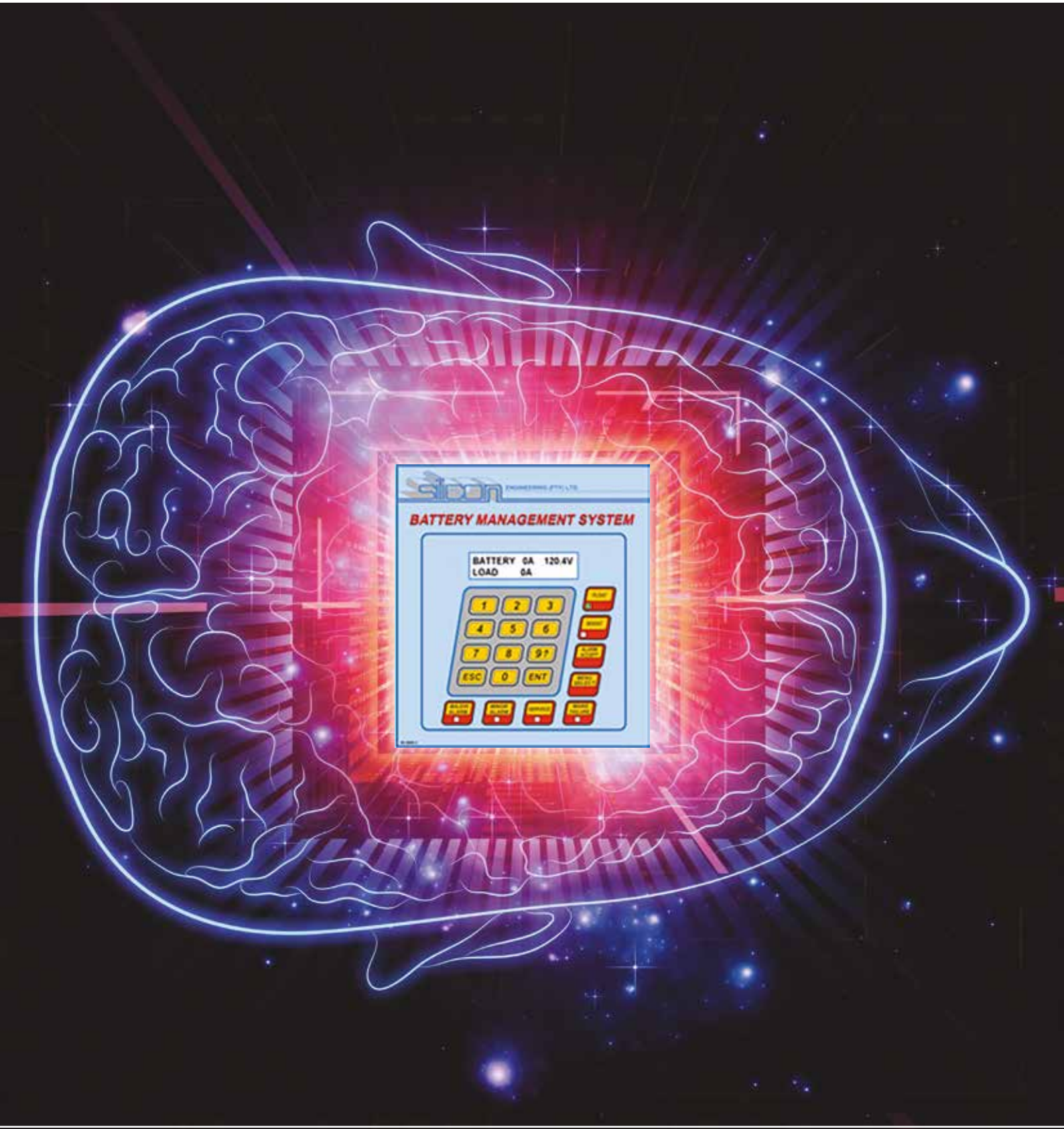
ENGINEERING (PTY) LTD

Battery Management System



Elite

Battery Management System

A Brief History of the Silicon BMS®

Silicon Engineering's first microprocessor controller, known as a SILICON BMS® (BATTERY MANAGEMENT SYSTEM), was commissioned in 1989. It has subsequently been installed above and below the earth's surface on Silicon Engineering Chargers.

Types of Batteries that can be Charged

Silicon Engineering developed the Silicon BMS® as a fully automatic charger control, DC system monitor and alarming system for mainly Silicon Engineering Chargers so as to ensure that the correct charge is applied to the many different types of un-resilient, battery technologies available today. The Silicon BMS® therefore, optimizes the correct charge supplied to the batteries as per the battery manufacturer's specifications. This assists the batteries in achieving their expected life span and lowering the cost of maintenance and increasing the reliability of the entire DC system.

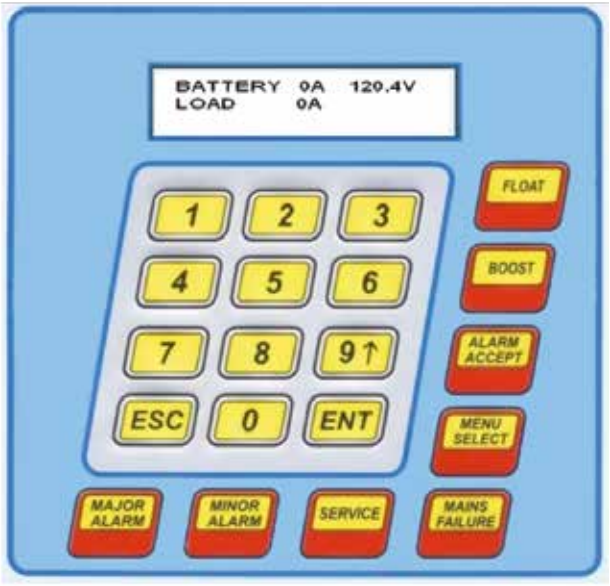
This is achieved by keeping the charging of the batteries at the best optimal rate at all times without excessive "boost charging" or over gassing. As the system returns to float charge mode as soon as is possible, there is no excessive electrical consumption for extended periods of time, therefore reducing the effect on our environment and reducing wastage.

The Third Generation of Silicon BMS®

The Third Generation of the Silicon BMS®, the Silicon BMS® Elite is a result of continuous improvements and upgrades of both the hardware and software over the years as well as improvement in technologies available.

The Silicon BMS® Elite is easily installed when upgrading from first and second generation Silicon BMS's®, as it is "hot swop-able" using the same mountings and cut-outs. It uses the same 'pin-for-pin' connection blocks. However when upgrading from the first generation unit (S90) to the third generation unit (Silicon BMS® Elite), two additional wires need to be installed between the upgraded power supply and the Silicon BMS® Elite.

The operation and interpretation of all generations of the Silicon BMS® has remained unchanged from the operator's perspective. However, with the correct passwords, much more information and settings are available than ever before. This makes the Silicon BMS® Elite ideal for situations where a skilled battery Technician is not available or for installations that are remote and/or difficult to maintain.



Silicon Engineering Micro-sense Communication System

In the un-likely event of the Silicon BMS® Elite's failure, the firing control card of the charger will automatically take over maintaining the correct float charge to the batteries. (i.e. default to float charger mode).

This is achieved by a feature, which is called ***Micro-Sense***. When the communication is healthy between the Silicon BMS® and the firing control card, a flashing red LED on the D200A charger card will flash once every second. Should this communication fail (red LED stops flashing), a Silicon Engineering Technician can be summoned to repair the fault without urgency, as the batteries will continue to be charged at float voltage until the communication is re-instated

SELF TEST AND PROTECTION

- The BMS Elite does a self-test on 'power-up.'
- Integrated "watch dog timer" to prevent system latch-up.
- Load Test circuit components are self-tested.
- Any self-test fault found is alarmed.
- Manual 'LED functioning' test to prove their operation.
- A **battery load test** is periodically, a**utomatically conducted** (default = every 8 hours), by switching off the charger and applying a 'dummy load' across the batteries for 10 seconds. If the site has high standing loads, the BMS Elite intelligently applies this extra load across the batteries. These results are then compared with the stored battery manufacturer's values and, dependent on the results, an alarm may be sent or the charger is returned to the charging mode.
- The BMS Elite turns the charger from boost charge back to float charge mode, in the shortest possible time – dependent on the battery requirements, extending the life of the battery and decreasing maintenance requirements.

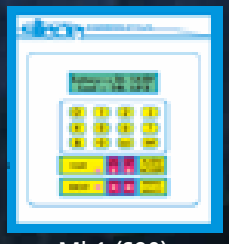
Battery Management System

SYSTEM FEATURES

- Built in (battery manufacturer approved) charger settings for all stationary battery technologies.
- The status of the entire system displayed on the back lit LCD. Both AC and DC voltages, DC currents, timers and alarms (back light turns off 10 minutes after the last key stroke).
- Re-configuring of the battery charger régime takes less than 60 seconds – and the Operator is assured that **all** the settings (including alarms) are correct.
- Charging protocols are easily set for each type of battery technology. (E.g. to auto boost – (or not), alarm values, timers etc.)
- All adjustments are password protected – no un-authorized changing of settings or tampering.
- Customer Set Password (3 Digits).
- An Event Recorder stores up to 2 000 events with a real time date/time stamp, on a FIFO basis.
- Up to 100 different event types can be logged.
- The results of past battery tests can be checked. (Built in history).
- The same BMS Elite is used for all Silicon chargers (5Amp to 1 000Amp, 24V DC to 220V DC systems).
- A single BMS Elite can control a battery bank as well as either a single or dual charger cards.
- BMS is equipped with a RS232 connection point to handle remote communication with system modules. (Ethernet, Cell phone or SCADA).
- Silicon's BMS Studio App. is available for use with the BMS Elite.
- Easy to read LCD in poorly illuminated areas (back lit).
- Older charger units are easily upgradeable from the old BMS or BMS+ to the new BMS Elite with minor alterations. (plug 'n play).
- Mature software (over 2 000 BMS's in service across Africa). Software is upgradeable.
- Separate charger/battery systems can be simply, easily, and reliably be paralleled.

ALARM FEATURES

- Every alarm you could wish for is included as standard (up to 21 alarms).
- Keypad testing facility for alarm relays – (fast and safe).
- Local LED warning indication for non-skilled staff.
- Alarms are displayed locally on the LCD, by audio beeper and flashing red LED's.
- Alarms are available remotely via three zero potential relays. The intelligent BMS alarm system analysis determines whether to activate the Major (come now) or Minor (come soon) alarm. The alarms are digitally set for threshold alarm values and reset values. (e.g. Mains fail alarm set at 180VAC, alarm re-sets 198VAC). The third relay is for 'Mains fail' indication.
- BMS logic stops any battery load testing from taking place during mains failure or if the load test circuit fails. (e.g. MCB trips).
- Earth fault alarm indicates the polarity (positive or negative) and the value of the leakage impedance to earth of the entire DC system.
- Boost timer override & load test fail alarms are latched until manual reset.
- Alarm settings can be customer adjusted. (password accessible only).
- Alarm relay delay time can be adjusted via the keypad. (Default setting = 30 seconds).
- Ring back on Mains Fail Alarm (Optional) – allows for local maintenance without sending remote alarms, if specified.


Mk1 (S90)

Mk2 (BMS+)

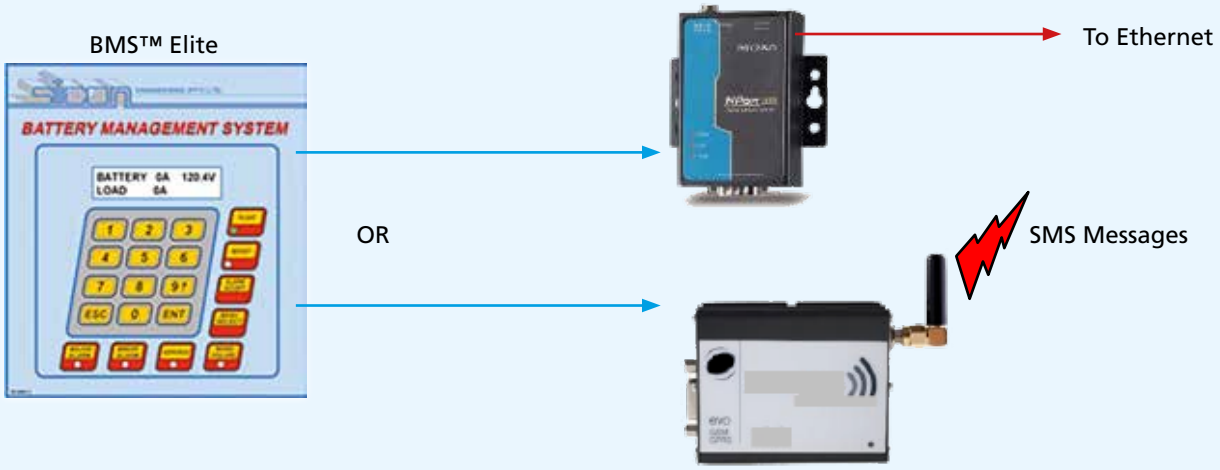
Mk3 (BMS Elite)

The Legend Continues ...

BMS Elite Software Alarm Logic

N°.	Alarm Description	Urgent Alarm	Non-Urgent Alarm	Reset
1	Main Fail		☑	Auto
2	Mains Fail & Battery Low	☑		Auto
3	Load High		☑	Auto
4	Load Low		☑	Auto
5	Load Low & Mains Fail	☑		Auto
6	Battery High	☑		Auto
7	Battery Low		☑	Auto
8	Battery Low & Charger Fail	☑		Auto
9	Battery End	☑		Auto
10	Charger Fail	☑		Auto
11	Bridge 1 & Bridge 2 Fail	☑		Auto
12	Bridge 1 or Bridge 2 Fail		☑	Auto
13	BMS out of Range		☑	Auto
14	Earth Fault (Pos. or Neg.)		☑	Auto
15	Boost Timer Override		☑	Manual
16	Load Test Fail	☑		Manual
17	Load Test Open Circuit		☑	Manual
18	Load Test Contactor Stuck	☑		Manual
19	Control Circuit Fail		☑	Auto

Optional Extra Silicon Engineering BMS Elite Nport® Modem/Ethernet Connection or GSM Module (SMS)



HEAD OFFICE (Gauteng)
Tel: +27 (0)11 474-3423
Fax: +27 (0)11 474-3407
P.O. Box 873, Florida Hills, 1716, Rep. of South Africa

KZN BRANCH
Tel: +27 (0)31 766-3368
Fax: +27 (0)86 270-7479
P.O. Box 690, Linkhills, 3652, Rep. of South Africa

Website: www.silicon-online.co.za