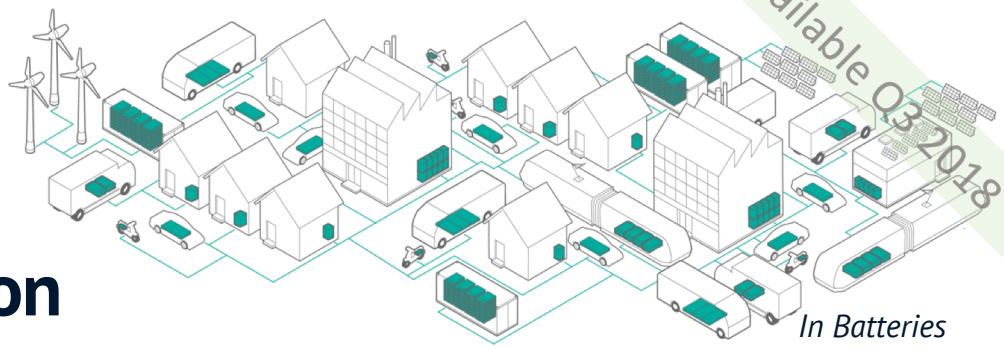
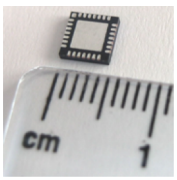


Available Q3 2018

Lithium-ion Battery Management Solution

In Batteries For Life

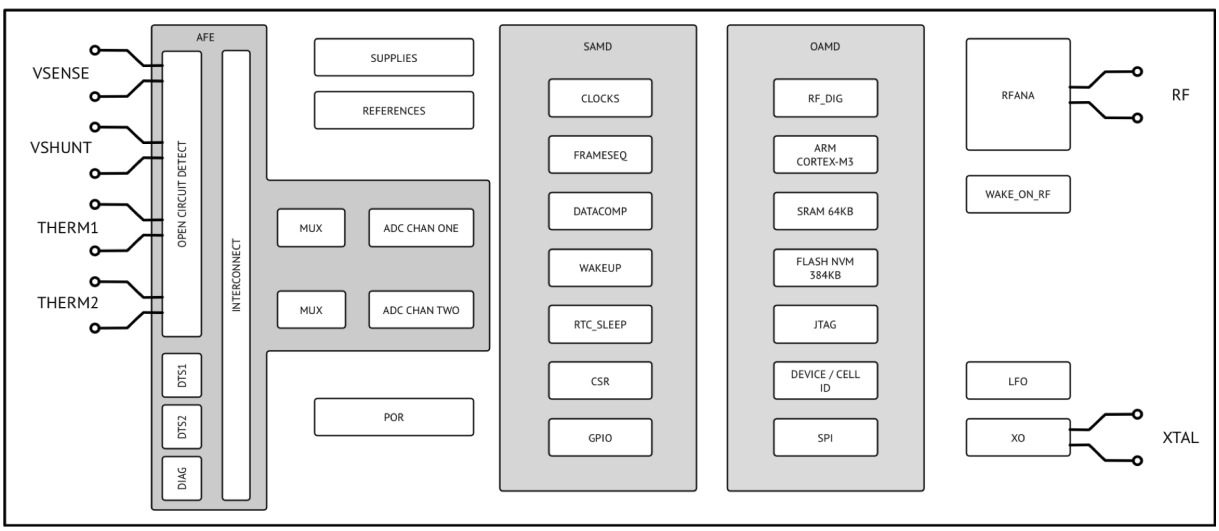


A revolutionary approach to lithium-ion battery pack design.

A per-cell embedded architecture. On cell monitoring and model processing with integrated wireless communications and topology aware balancing

- Endlessly scalable to any configuration, any capacity, any voltage of pack
- Patented secured RF technology eliminates 95% of cables and associated failures
- Novel cell modelling and diagnostics provide longer, more predictable battery life
- Data Analytics – secure & trusted disruptive insights across the whole cell life-cycle

ASIC Architecture



Cell Monitor - ASIC

- Suitable for all Li-ion chemistries, including LTO and Li-S
- Pouch, prismatic and cylindrical module formats
- Proprietary ASIC monitor with processor and communications
- Non-volatile memory
- Powered from cell, quiescent current lower than cell self-discharge
- Local cell model & processing
- Robust against comms. failure
- Per-cell current measurement

Pack or Module System

- Up to 175 cells per channel
- >10,000 cells per RF link bus
- Cell history stored at cell level, available at pack level
- Lightweight interface translates between NF comms and system bus (CAN, SPI, USB etc)
- System bus connects to Dukosi or Customers, Master or BCU
- Interface can perform data logging & basic contactor control
- Optional centralised current measurement.

Eco System & Software

- Embedded software provided
- Cradle to grave provenance and history
- Highest data granularity and availability
- Maximises residual value on reuse
- Facilitates recycling
- Improved manufacturing processes – 'intelligent' cells reduce logistics costs
- Advanced diagnostics and prognostics from cell to fleet

Built for use in IS026262 compliant systems, qualified to AEC-Q100

Maximum Ratings

Maximum Supply Voltage	5.5V
Storage Temperature	-40°C to 125°C
ESD (all pins)	2kV AEC-Q100 HBM
Peak Temperature (max reflow)	260ºC

Supply Characteristics

Supply Voltage (typ. from cell)	1.5 to 5.0V
Operating Temperature (full perf.)	-20°C to 60°C
Operating Temperature (red. perf.)	-40ºC to 125 ºC
Active Mode Current, with comms (100 cell system)	Typ. 15mA, peak 50mA
Active Mode current, no comms	Typ. 10mA
Sleep Mode Current (inc. operational functional safety)	Typ. 20µA

Current Channel

Sampling Rate (active mode)	Max. 100Hz
Sampling Rate (Fast/EIS mode)	Max. 5kHz
Sampling Rate (sleep mode)	Max. 10Hz
Current shunt range	±25mV, ±100mV
Current shunt resolution	3µV
Current shunt TME	±41µV

RF Communications

- Band 868MHz and 915MHz
- Modulation / rate 2FSK 500kb/s, OOK 100kb/s
- Protocol TDMA with fixed time slot
- TDMA frame rate ⩾1Hz
- Tx/Rx port optimised for near field coupling to antenna
- Wakeup on radio Typ. 0.1s Max. 1s
- Patented near field coupled communications
- Galvanic isolation guaranteed by creepage and clearance distances, typically >10kV
- Number of channels dependant on regulatory environment
- High EMC immunity, low emissions
- Single microstrip or flat pair linking all cells.
- No cell connector required.
- Communication authenticated and encrypted

Other Communications

- SPI Master/Slave port
- UART
- JTAG
- 8xGPIO
- Passive balancing control

Voltage Channel

Sampling Rate (active mode)	Max. 100Hz
Sampling Rate (Fast/EIS mode)	Max. 5kHz
Sampling Rate (sleep mode)	Max. 1Hz
Voltage range	1.5V to 4.5V
Voltage resolution	100µV
Voltage noise (active)	$25\mu V_{rms}$
Voltage offset error (active)	$\pm 200\mu V_{rms}$
Voltage gain error (active)	±0.04%
Voltage Total Measurement Error (active)	Max. ±2mV
Voltage TME (sleep)	Max. ±25mV

Temperature Channel

On chip temperature sensor (all mode)

Operational	-40°C to 125°C
Resolution	0.1°C
Accuracy	±2°C

External Thermistor (two independent channels, 10K NTC, System Active mode only)

Resolution	0.1°C
Accuracy	±0.5°C

Sample rate (all channels) 1Hz

Cell Modelling and API

- Model runs on each cell
- Processing scales with pack configuration
- Estimates of SOC, SOH, P_{avail} etc at >1Hz
- Advanced coulomb counting
- Kalman Adaptive Modelling
- Customer can integrate own model via API
- Histogram and other usage profile logging
- Event logging (over-voltage etc)

Firmware – Embedded Software Provided

- ARM Cortex M3 processor
- 64kB SRAM / 384kB Flash (program and data logging)
- Robust RTOS application, built from MISRA C 2012
- Firmware upgradeable over-the-air
- Cell usage profile logging
- Wake from sleep on over/under voltage, current, temperature, timer, GPIO and RF
- Unique read-only ID, all data and program secured

ISO26262 Functional Safety

- CMS ASIL B decomposed from ASIL C battery pack.
- ASIL D achievable with additional pack level protection
- All sensor pathways are subject to BIST
- Redundant references and ADCs
- Functional Safety case for both Active and Sleep modes

Applications

Automotive	Stationary Energy Storage	Industrial
BEV	Domestic storage for PV	Industrial micro-grid, UPS
HEV	Micro-grid	Materials handling
PHEV	Distribution network storage	ROV's / Robotics

For more information, contact
Dukosi Ltd, Unit 4, Bush House Cottages, Edinburgh
EH26 0BA, UK. +44 (0)131 445 7772
info@dukosi.com