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CAP-XX



## An Introduction to BriteFlash™

The high power LED flash solution for  
Camera Phones & Digital Still Cameras

March, 2009

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- Market-driven electronic components manufacturer
- World leader in thin, flat, small supercapacitors
- Our products deliver a number of benefits to enhance the performance of mobile multimedia devices
  - BriteFlash™ for a brighter flash & better photos
  - BriteSound™ for louder, clearer audio output
  - BritePower™ for secure power, pulse power & energy storage



- Everyone wants better photos
- But end-user buying behaviour actually works against achieving this:

<b>User Requirement</b>	<b>Effect on Camera</b>
“The more megapixels the better”	Smaller pixels
“I want more features, and I want it smaller”	Even smaller pixels
“I want an optical zoom lens”	Smaller aperture (higher f#)
“I like thinner devices”	More lens shading (larger CRA)

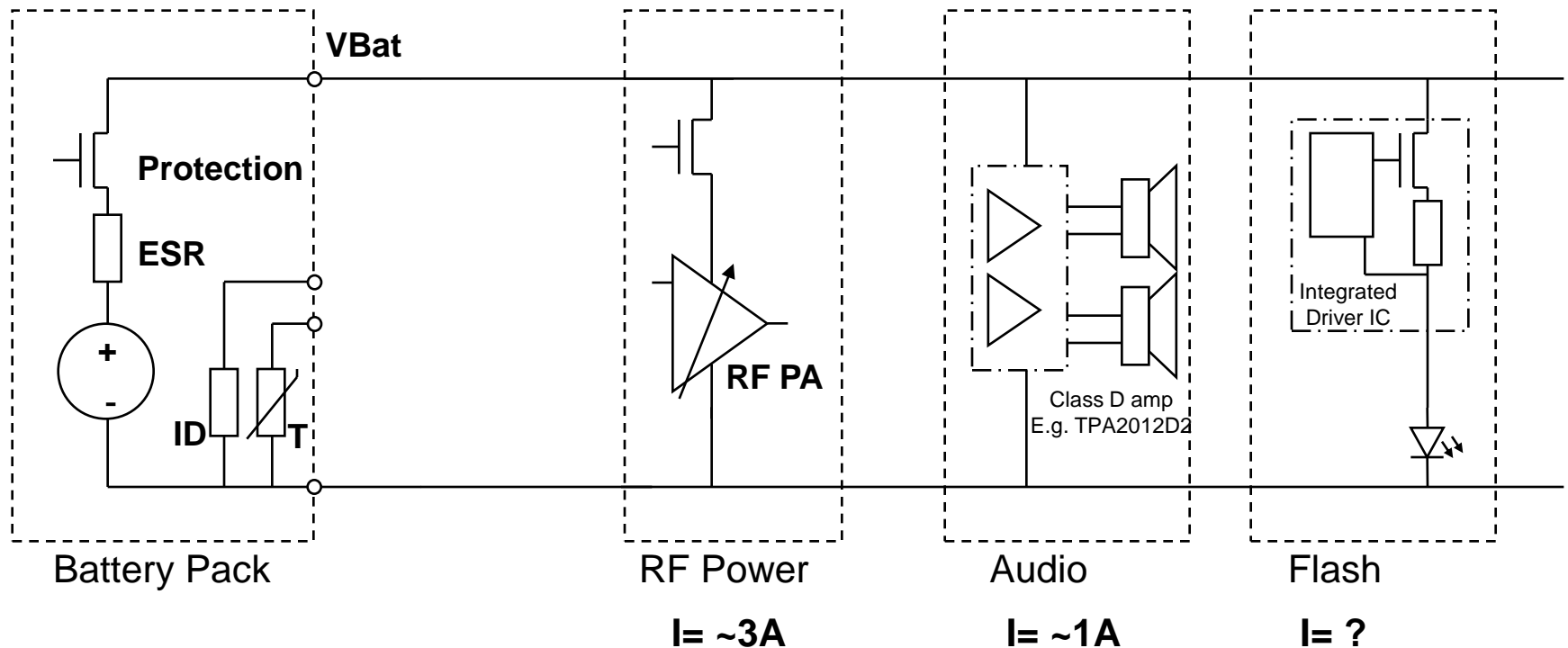
- Semiconductor processes get smaller every year, so what's the big problem with shrinking pixels?
- Semiconductor improvements *do* improve camera performance (eg, smaller feature sizes allow bigger fill factors, & copper wiring allows reduced pixel shading)

but...

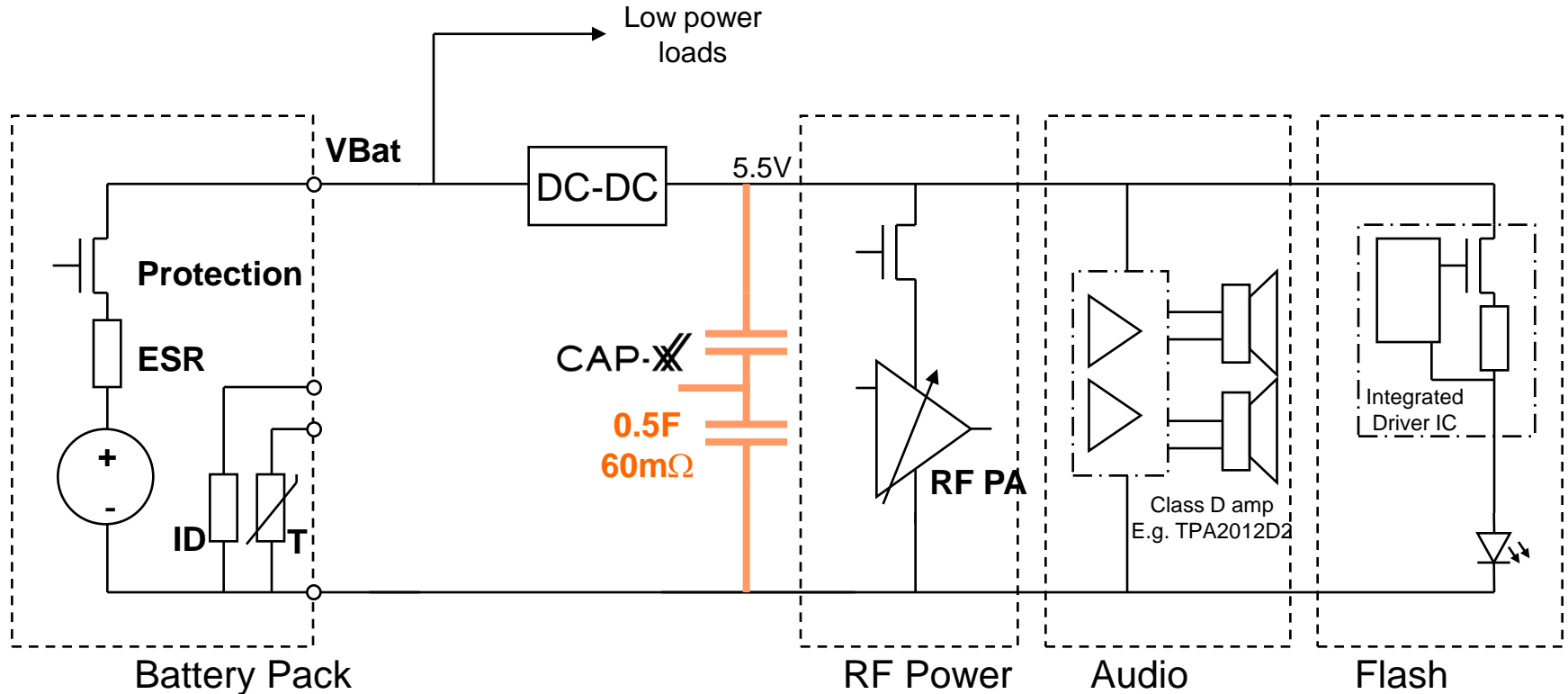
- The energy in light is comprised of a finite number of photons. If these are spread across more, smaller pixels, the signal in each gets smaller, but the noise remains constant
- The result is reduced camera sensitivity, due to a reduced signal:noise ratio, giving a poorer image

- How can I capture great images & still make phones & cameras that people want to buy?

Technique	Advantage	Disadvantage
Image stabilisation	<ul style="list-style-type: none"> <li>• Longer exposure time</li> </ul>	<ul style="list-style-type: none"> <li>• Motion blur</li> <li>• Difficult to implement well without gyro</li> </ul>
High ISO gain	<ul style="list-style-type: none"> <li>• Increased analogue domain gain</li> </ul>	<ul style="list-style-type: none"> <li>• Increased noise</li> <li>• Shot noise</li> </ul>
Software lens	<ul style="list-style-type: none"> <li>• Software de-blurring allows large aperture lens</li> </ul>	<ul style="list-style-type: none"> <li>• Limited performance</li> <li>• Requires extra processing in camera</li> </ul>
Conventional LED	<ul style="list-style-type: none"> <li>• Increased light</li> </ul>	<ul style="list-style-type: none"> <li>• Low performance</li> <li>• Bad reaction from subject</li> </ul>
Xenon strobe	<ul style="list-style-type: none"> <li>• Very bright</li> <li>• Short duration flash</li> </ul>	<ul style="list-style-type: none"> <li>• Large size</li> <li>• High voltage</li> <li>• Needs mechanical shutter for best performance</li> </ul>
High power pulsed LED	<ul style="list-style-type: none"> <li>• Bright flash</li> <li>• Controllable light energy</li> </ul>	<ul style="list-style-type: none"> <li>• Requires very high LED current</li> </ul>



- High current loads on the battery are completely asynchronous
- Several may require power at same time
- As battery discharges, current to constant power loads increases
- Battery pack ESR can be  $>100m\Omega$  with a current limit of  $\sim 3A$

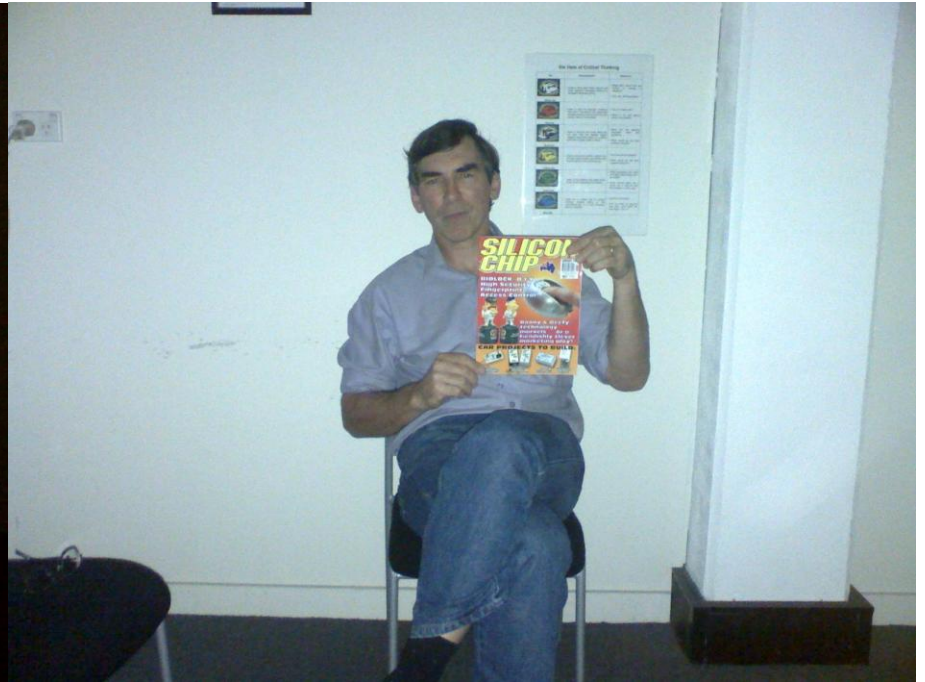
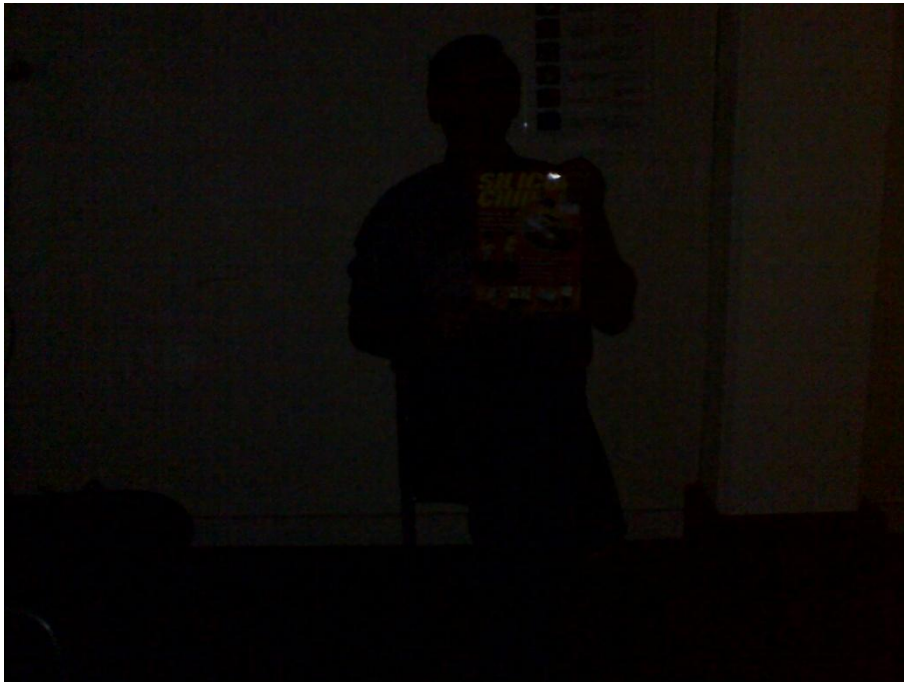


- High capacitance, low ESR supercap provides bulk energy storage to buffer a high power supply rail
- Battery & DC-DC supply average power, supercap supplies peaks



- Using a CAP-XX supercapacitor, it is possible to drive very high LED currents for an ultra-bright LED flash
  - For example: 2x Lumileds PWF4 LEDs, driven at 2.5A each, deliver more light than the SEMC K800i xenon strobe
- This BriteFlash™ solution can be <2mm thick
- The supercapacitor powering BriteFlash can also be used to enhance other features in the device
  - longer talk time & longer battery life
  - better audio
  - improved low temperature operation
- The following example images are taken with actual camera phones:

Which photo do you prefer?



Standard Mot RAZR V6



Briteflash™ RAZR V6





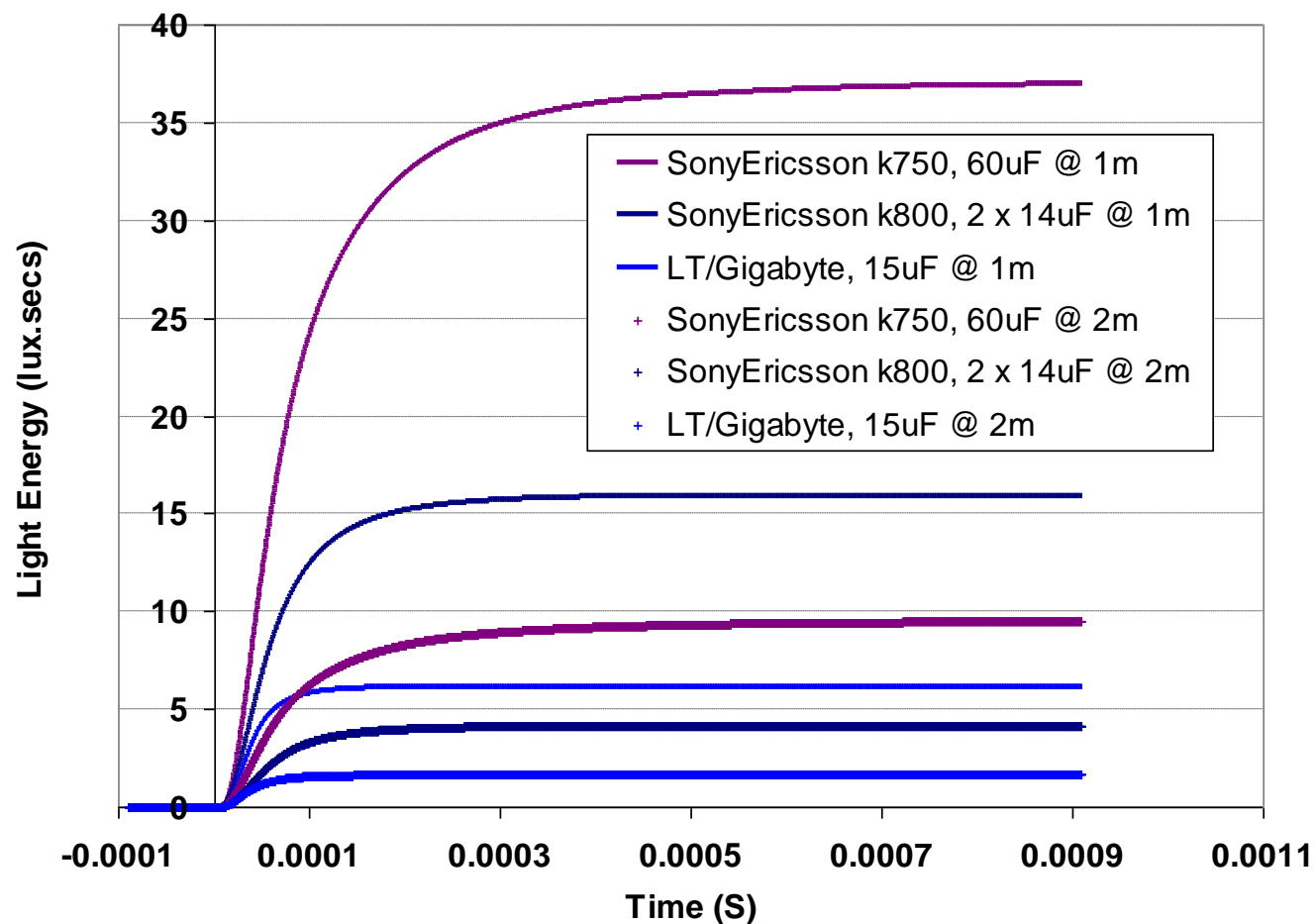
Standard Nokia N73

BriteFlash™ N73

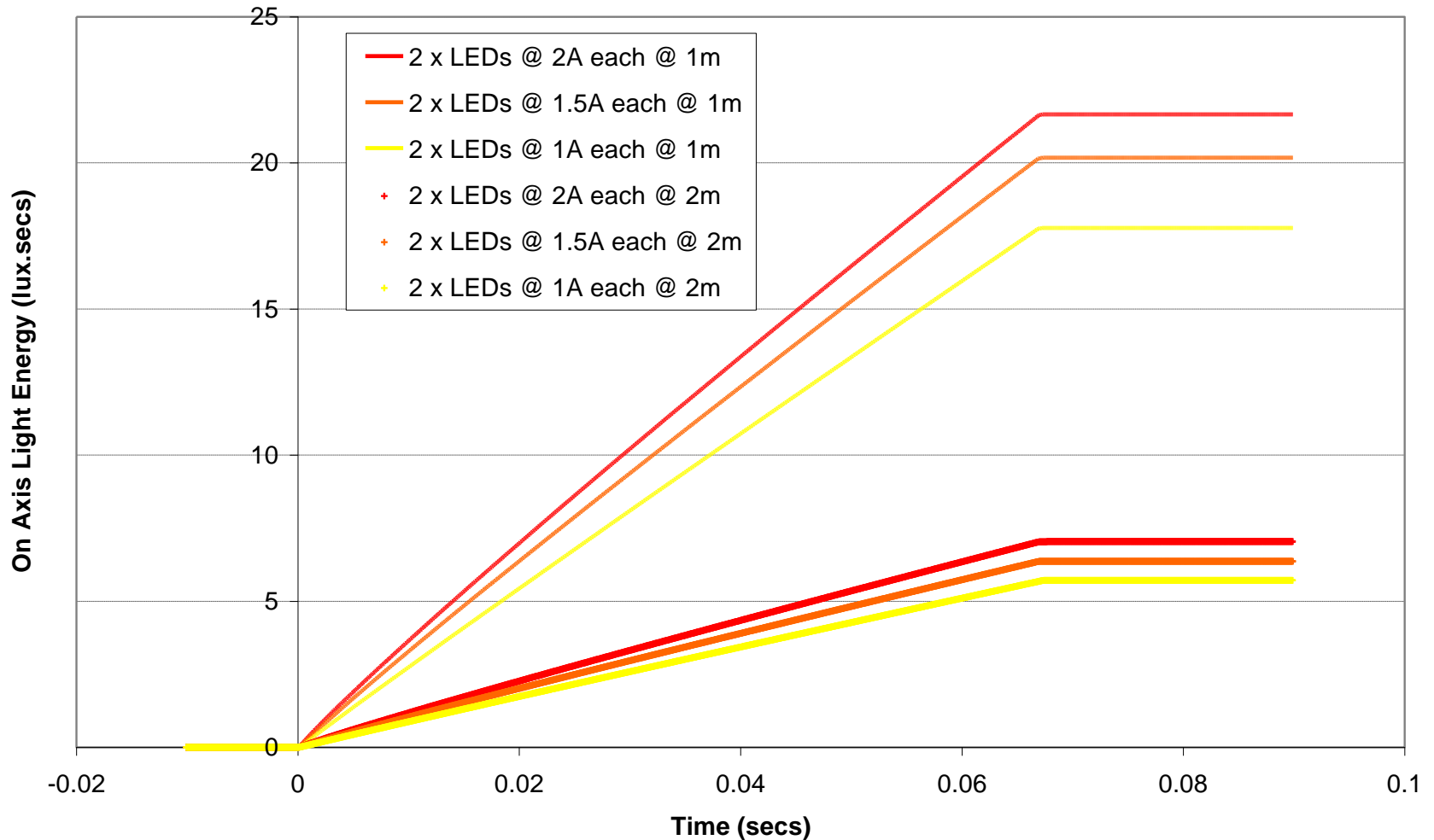
SonyEricsson K800i  
(xenon strobe)



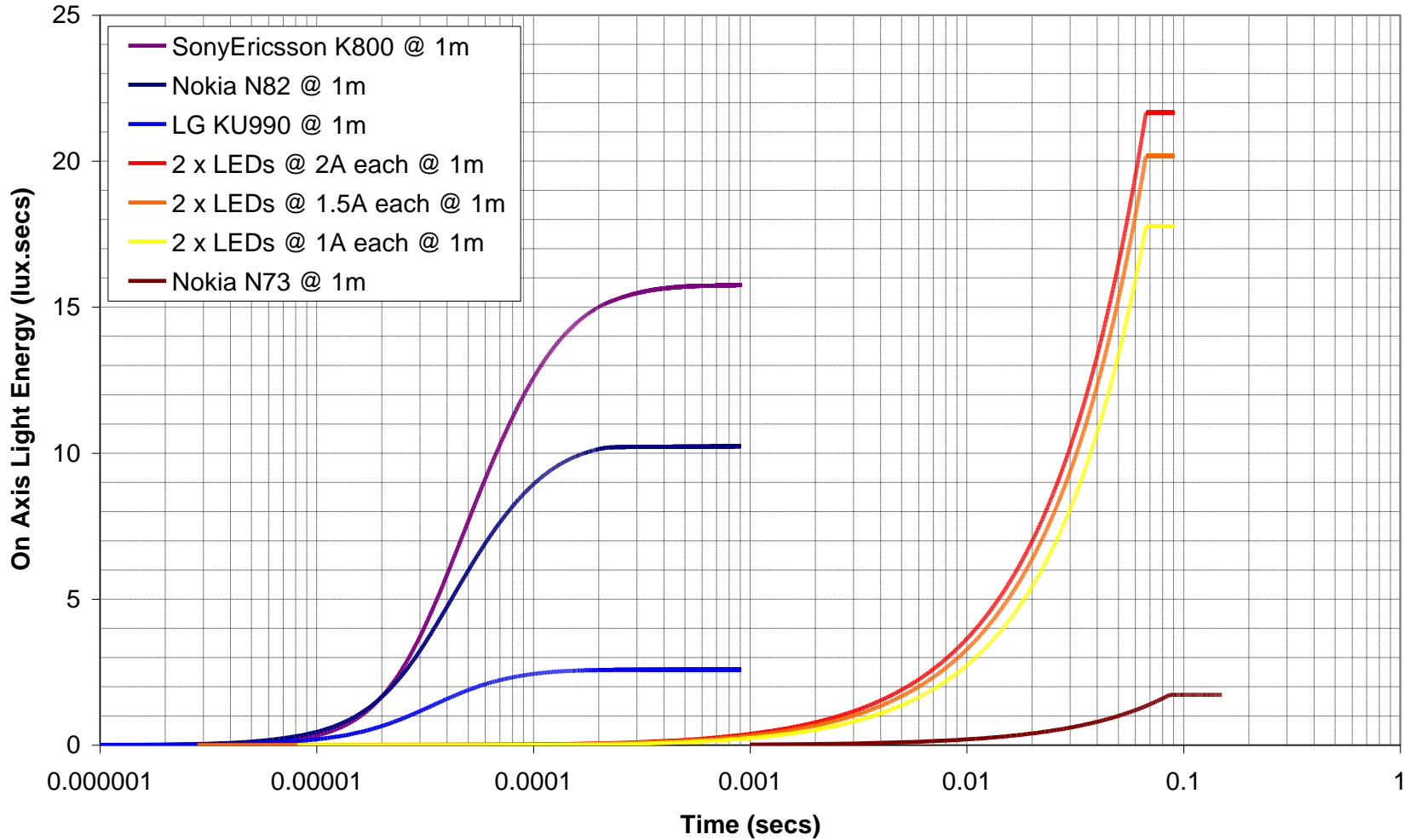
## Xenon phones, light energy



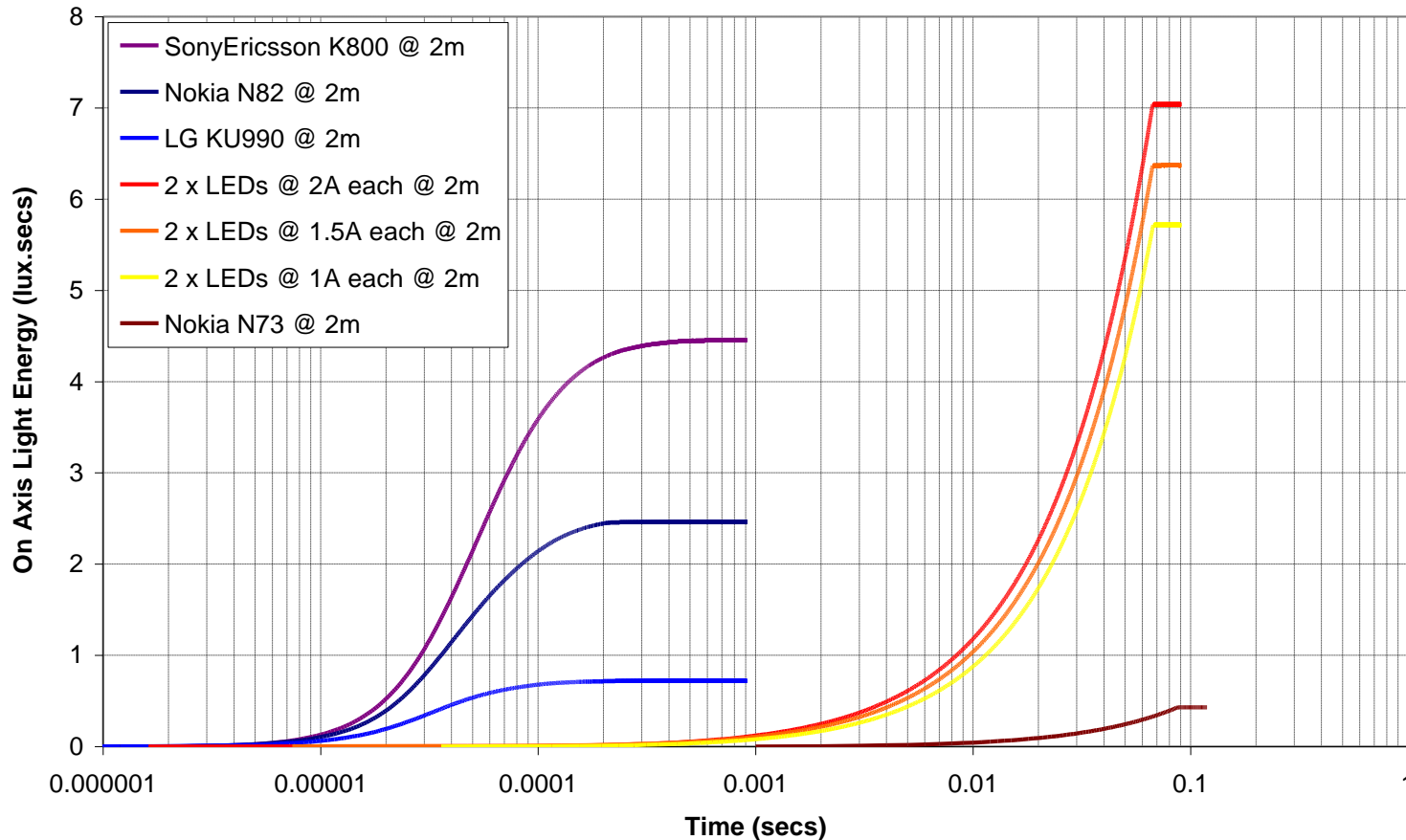
LED Flash Light Energy



## Xenon and LED Flash Light Energy @ 1m



Light Energy Comparison @ 2m



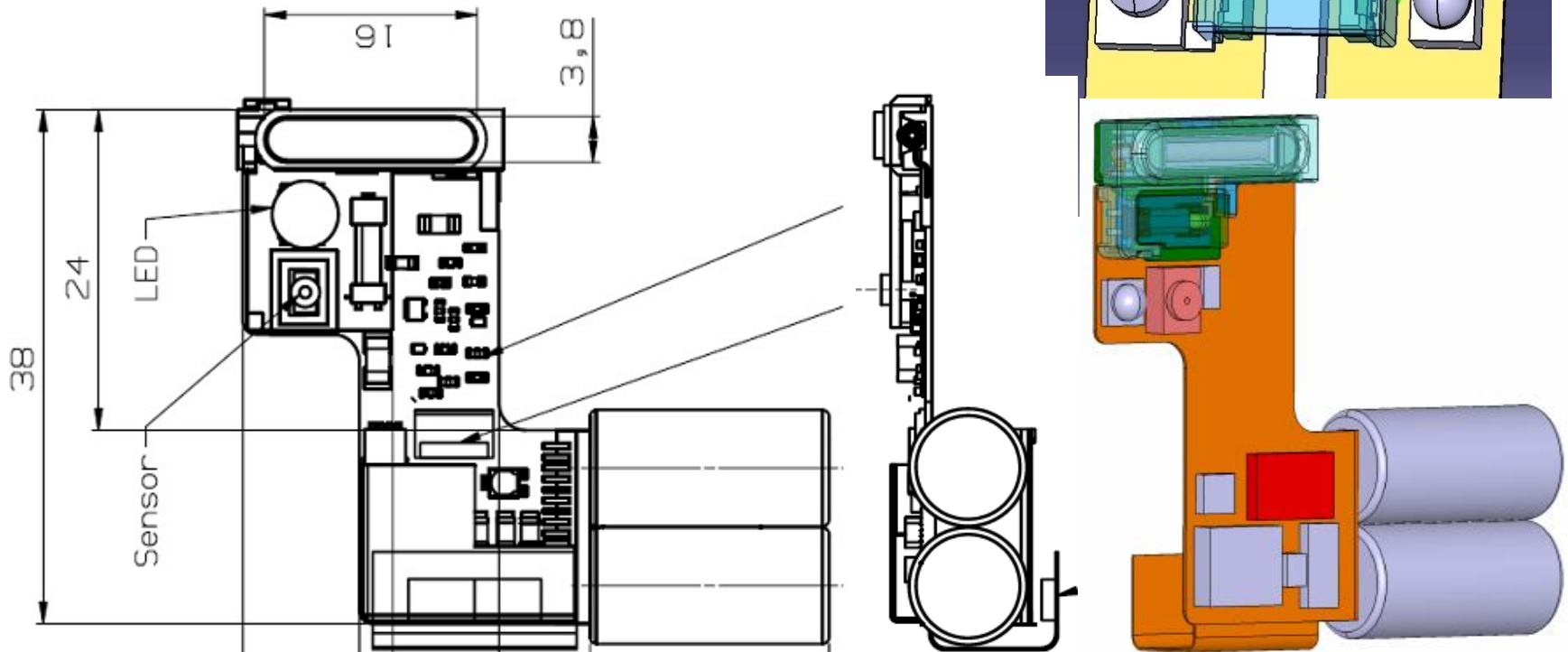
Conclusion: BriteFlash™ performs better than xenon

- Xenon market cost ~US\$7 for a suitable strobe unit
- Xenon requires additional components in the handset
  - Mechanical shutter (US\$1)
  - White LED for Video lighting (US\$1.5)
- Total implementation cost for xenon is ~US\$9.5
  
- CAP-XX BriteFlash™ does not require a mechanical shutter or additional LEDs for video lighting
- Total implementation cost for BriteFlash™ is ~US\$6

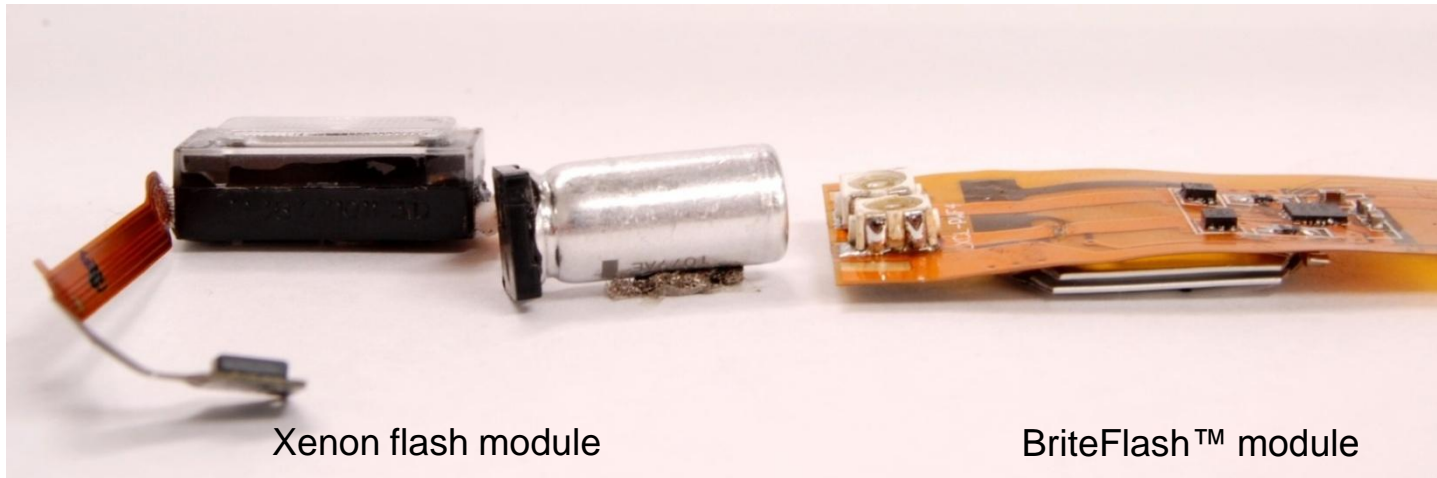
Conclusion: BriteFlash™ is cheaper than xenon



Xenon solutions require large, dielectric capacitors, a discharge tube & associated electronics. They occupy a lot of space



Supercaps are thin, flat & small, with ultra-high energy & power density



Xenon flash module

BriteFlash™ module

BriteFlash offers as much as a 50% volumetric saving over a xenon flash system



Conclusion: BriteFlash™ is smaller, lighter & more robust than xenon

	Xenon	Supercap
Light machine	Xe filled quartz tube • 15x5x3mm = 0.225cc	Si LED • 2x1.6x2x0.7mm = 0.00448cc
Energy Storage	Electrolytic cap 2x7Øx18mm = 1.766cc	Supercap 2x17x28.5x1mm = 0.96cc
FPC circuit	10x30x0.2mm = 0.06cc	10x30x0.2mm = 0.06cc
Control chip	4x4x1 = 0.016cc	4x4x1 = 0.016cc
Transformer	5x5x4mm = 0.1cc	n/a
Light sensor	3x3x1mm = 0.009cc	n/a
IGBT	1.5x1.5x0.8mm = 0.0018cc	n/a
Total	<b>~2.20cc</b>	<b>~1.04cc</b>

A	Burn	Burn the fully charged supercapacitor @ 4.5V with alcohol lamp. No ignition, no fire, no scattering of pieces and/or sparks over 70cm
B	Heat	Leave for 1hr @ 130°C at rated voltage = 4.5V, No smoke, no fire, no gas emission
C	Pierce	Prick the fully charged supercapacitor with a needle. No fire, no scattering of pieces and/or sparks over 70cm
D	Press	Press the fully charged supercapacitor 20 2/3 of its thickness with a 10mm diameter pole. No smoke, no fire, no gas emission

Conclusion: CAP-XX parts are very safe

- Certifications achieved
  - ISO 9001
  - Sony Green Partner
- Compliances established
  - RoHS & WEEE compliant
  - Lead-Free product
  - Sony Ericsson Design for Environment requirements
  - Motorola Restricted substance list
- Ongoing Approvals
  - Nokia Global Supplier requirements
  - Samsung Component Certification

Conclusion: CAP-XX parts are high quality

- Vibration

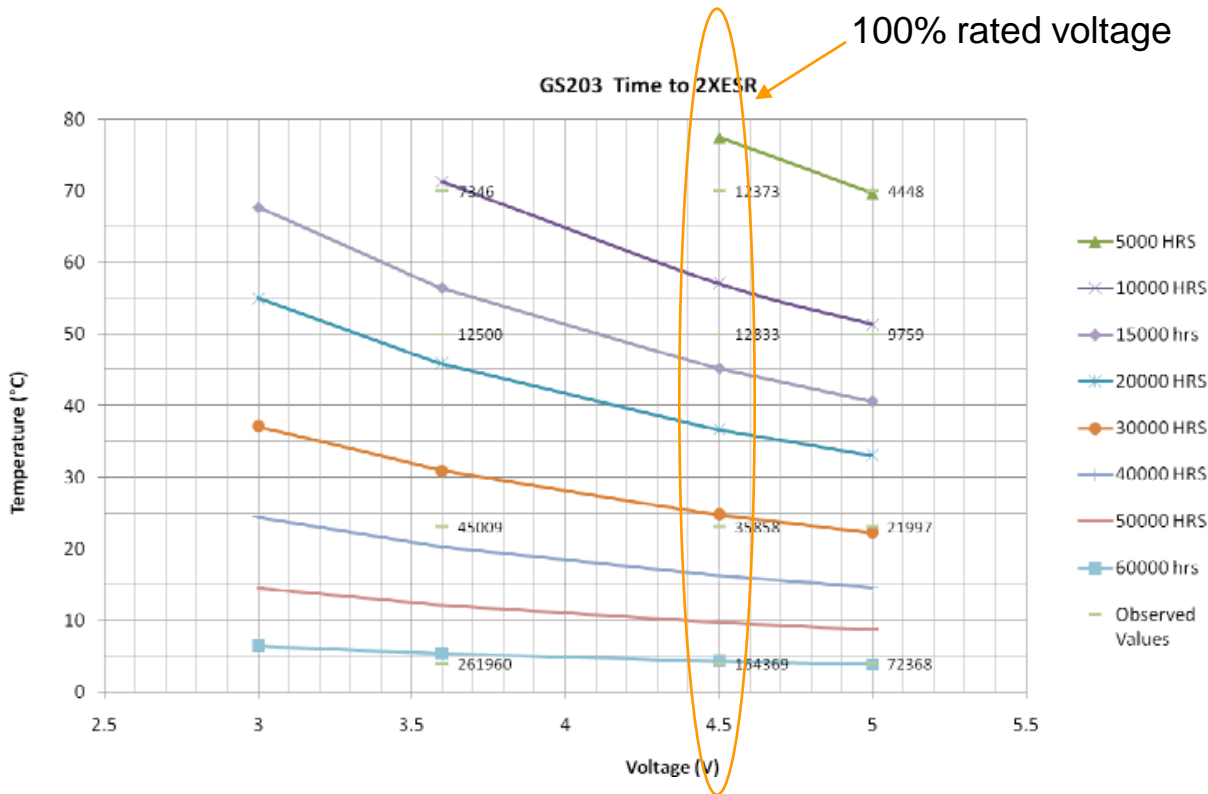
- Tested to IEC68-2-6
- Type Sinusoidal
- Frequency 55Hz-500Hz
- Amplitude 0.35mm 3dB (55Hz to 59.55Hz)
- 5g 3dB (59.55Hz to 500Hz)
- Sweep Rate 1 Oct/min
- No. of Cycles 10 (55Hz-500Hz-50Hz)
- No. of Axis 3 orthogonal

Conclusion: No electrical or mechanical degradation

- Shock

- Tested to IEC68-2-27
- Pulse Shape Half Sine
- Amplitude 30g 20%
- Duration 18ms 5%
- No. of Shocks 3 in each direction (18 in total)
- No. of Axis 3 orthogonal

Conclusion: No electrical or mechanical degradation



## Ageing

- At full rated voltage & 40C, it takes ~20,000h for ESR to double
- This equates to 2.3 years of constant flashing, or
- More than 1.2m photo sessions if the flash is turned on for 1 minute on each occasion
- For many applications, life could be far longer, depending on the operating conditions, initial C & initial ESR

Conclusion: CAP-XX parts are very reliable

- CAP-XX supercaps & BriteFlash power architecture are at the centre of a thriving LED flash ecosystem
- Major components are either being developed or optimised to utilise supercapacitors:
  - LED flash driver chips, Power Management ICs from eg, AnalogicTech, OnSemi & more
  - High current LEDs from eg, Lumileds, SeoulSemi & more
  - Camera modules/ISPs supporting pulsed LED flash from eg, Sony DIG, Omnivision & more
  - Flash modules built around the BriteFlash™ solution from eg, SeoulSemi, Stanley & more
- Conclusion: BriteFlash solutions are available now for simple integration into mobile phones & cameras



- CAP-XX BriteFlash™ delivers better performance than similar xenon strobe flash solutions
- CAP-XX BriteFlash™ is lower cost than xenon
- CAP-XX BriteFlash™ is smaller than xenon
- CAP-XX BriteFlash™ is safe & reliable
- CAP-XX BriteFlash™ is ready now

Conclusion: CAP-XX BriteFlash™ is the best flash technology for mobile phones & small digital cameras

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