

B. B. Rekha, A. Kandaswamy and V. M. Mitha, "Embedded realization of a real time Heart Rate Variability logger for at-home sleep studies," *2015 IEEE Workshop on Computational Intelligence: Theories, Applications and Future Directions (WC1)*, Kanpur, 2015, pp. 1-6.  
doi: 10.1109/WC1.2015.7495532

Abstract: Sleep has no substitute and quality of sleep is a major concern for healthy living of human beings. Sleep breathing disorders are events characterized by pauses of breathing during sleep. Sleep breathing disorders like Obstructive Sleep Apnea (OSA) may result in cardiac disorders and fatalities. Though Polysomnography is considered as the gold standard for conducting sleep studies, current research directs that the trend of Heart Rate Variability (HRV) during sleep is indicative of sleep breathing disorder. Hence, reliable HRV recorders with ease of use may contribute to early screening of these disorders. This paper reports the prototype development of an embedded system for logging HRV during sleep for screening during sleep. The system is built with open source Arduino platform consisting of an ATMEGA328 microcontroller along with a provision for storage on a Secure-Digital card. 'R' peak detection is carried out using a combination of dynamic threshold and amplitude threshold. The logger is able to work on two modes: (1) plain, long duration logger and (2) HRV Logger. The estimated duration of logging is 72 hours with a +9 V battery supply. The system performance is compared with a commercially available Electrocardiogram (ECG) recorder system and a MATLAB based R peak detection system with real time recordings of 30 healthy adults. The system code is optimized to achieve a logging time of 6.25 milliseconds per sample and 0.98 seconds for each 'R' peak detection and storage. The proposed system was also tested with Sleep ECG samples from Physionet database and it achieved a maximum sensitivity of 97.7% and specificity of 95.56%. The maximum recorded percentage error of detection was 2%. The results indicate that the proposed system and software design can be developed as a compact, economical and portable device for early detection of sleep breathing disorders.

keywords: {Clocks;Electrocardiography;Heart rate variability;Real-time systems;Sleep apnea;Arduino platform;HRV Logger;Heart Rate Variability;Obstructive Sleep Apnea;Secure Digital card},

URL: <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=7495532&isnumber=7495493>

Prem Sunder R, Sundaravivelu K and Prabakaran P, "A novel approach to a Solar cell based battery charger for an automotive application," *2014 International Conference on Advances in Electrical Engineering (ICAEE)*, Vellore, 2014, pp. 1-3.  
doi: 10.1109/ICAEE.2014.6838540

Abstract: Many a times we would have faced the problem of a discharged battery when the vehicle is parked without use for a long duration. This is because of the battery getting drained by the sleep mode currents of the energy robbing devices that do not switch off even when the vehicle key is removed. In this paper an innovative design is proposed to utilize an alternative source of energy to maintain the State-of-Charge (SoC) of the vehicle battery healthy, through trickle charge mode, when the vehicle is not used for a long duration. Once the battery reaches its maximum SoC level through trickle charging, the additional power generated by the Solar panel is used to compensate the sleep mode currents of the various electronic controllers on the vehicle. This paper is intended to propose the alternative sources of energy to keep the vehicle battery healthy when the vehicle is in the idle state for a longer duration.

keywords: {automotive electronics;battery chargers;solar cells;alternative energy source;automotive;battery charger;electronic controllers;energy robbing devices;sleep mode currents;solar cell;solar panel;state-of-charge;Arrays;Batteries;Discharges (electric);Maximum power point trackers;Photovoltaic cells;System-on-chip;Vehicles;DC-DC Converter;Flexible Solar cell;MPPT;battery SoC;sleep mode current},

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C. C. G. Suj, S. Maragatharaj and R. Hemima, "Performance analysis of power gating designs in low power VLSI circuits," *2011 International Conference on Signal Processing, Communication, Computing and Networking Technologies*, Thuckafay, 2011, pp. 689-694.  
doi: 10.1109/ICSCCN.2011.6024639

Abstract: The growing market of mobile, battery powered electronic systems (e.g., cellular phones, personal digital assistants, etc.) demands the design of microelectronic circuits with low power dissipation. As density and complexity of the chips continue to increase, the difficulty in providing power dissipation might limit the functionality of the computing systems. Especially, at nanometer level the power dissipation consumes about 35% of the chip power. The purpose of this project is to analyse the performance of one of the most fruitful approaches to low power design called as "Power Gating". The focus is only on CMOS devices in nanometer scale, as this technology is being the most widely adopted in current VLSI systems. In this project, we compare the performance of various power gating designs using 65nm technology. In a power gating structure, a transistor with high threshold voltage (Vth) is placed in series with a low Vth device. The high Vth transistor is called as the Sleep Transistor. In the power gating structure, a circuit operates in two different modes. In the active mode, the sleep transistors are turned ON and can be treated as the functional redundant resistances. In the sleep mode, the sleep transistors are turned OFF to reduce the leakage power. When a sleep transistor is placed at VDD, it is called as the "Header switch" and while it is placed near the ground, it is called as "Footer switch". In this project, I have taken the footer switch exclusively for all my designs.

keywords: {CMOS integrated circuits;VLSI;integrated circuit design;low-power electronics;CMOS devices;active mode;footer switch;functional redundant resistances;header switch;low power VLSI circuits;performance analysis;power gating designs;size 65 nm;sleep transistor;sleep transistors;threshold voltage;Adders;Clocks;Logic gates;MOS devices;Transistors;BCD Adder;Clock gated power gating;Sleep transistor Scheduling;Sleep transistors;distributed sleep transistor network (DSTN)},

URL: <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=6024639&isnumber=6024502>

G. L. Jones, P. G. Harrison, U. Harder and T. Field, "Fluid Queue Models of Battery Life," *2011 IEEE 19th Annual International Symposium on Modelling, Analysis, and Simulation of Computer and Telecommunication Systems*, Singapore, 2011, pp. 278-285.  
doi: 10.1109/MASCOTS.2011.61

Abstract: We investigate how a power-save mode affects the battery life of a device subject to stochastically determined charging and discharging periods. We use a multi-regime fluid queue, imposing a threshold at some value. When the power level falls below the threshold, (for example, 20% of charge remaining) a power-save mode is entered and the rate of discharge decreased. An expression for the Laplace transform of the battery life's probability density function is found and inverted numerically in particular instances. We show the life of battery can be significantly improved by the introduction of the power-saving threshold.

keywords: {Laplace transforms;probability;queueing theory;secondary cells;Laplace transform;battery life;fluid queue models;power-save mode affects;power-saving threshold;probability density function;rechargeable batteries;Batteries;Discharges;Equations;Laplace equations;Markov processes;Mathematical model;Reservoirs},

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W. Lepkowski, S. J. Wilk, S. Kim, B. Bakkaloglu and T. J. Thornton, "A capacitor-free LDO using a FD Si-MESFET pass transistor," *2009 52nd IEEE International Midwest Symposium on Circuits and Systems*, Cancun, 2009, pp. 953-956.  
doi: 10.1109/MWSCAS.2009.5235924

Abstract: The rapid growth in portable electronics has driven the market for ultra low dropout regulators (LDOs) that are more power efficient and lead to longer battery lifetime. Over the years various topologies based on P- or N-channel pass transistors have been introduced to meet these demands. For each of these implementations, the LDO has had a significant disadvantage whether it is stability issues and lower current drive associated with P-channel devices or the need for a charge pump to overcome the threshold voltage drop for enhancement mode N-channel devices. This paper presents a design methodology for an LDO that features a depletion-mode N-MESFET as the pass device that combines the advantages of both P and N devices allowing for ultra low dropout voltage and minimum layout area. The LDO also saves board space and simplifies design by achieving stability across all load and temperature conditions without the need of an output capacitor.

keywords: {CMOS integrated circuits;Schottky gate field effect transistors;integrated circuit layout;silicon-on-insulator;voltage regulators;LDO;depletion-mode N-MESFET;fully depleted SOS CMOS MESFET;layout area;pass transistor;stability;ultra low dropout regulators;Batteries;Charge pumps;Circuit topology;Consumer electronics;Design methodology;Drives;Low voltage;Regulators;Stability;Threshold voltage;MESFETs;fully-depleted;partially-depleted;silicon-on-insulator;silicon-on-sapphire},

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K. Sanghvi, P. K. Jain, A. Lele and D. Das, "Adaptive waiting time threshold estimation algorithm for power saving in sleep mode of IEEE 802.16e," *Communication Systems Software and Middleware and Workshops, 2008. COMSWARE 2008. 3rd International Conference on*, Bangalore, 2008, pp. 334-340.  
doi: 10.1109/COMSWA.2008.4554436

Abstract: Sleep mode is a key feature introduced in IEEE 802.16e standard, which ensures power-efficient operation of battery operated mobile devices. The 802.16e standard does not define when to take decision to trigger sleep mode. However to the best of our knowledge some published works define waiting time threshold as a time for which mobile subscriber station (MSS) waits before entering into sleep mode, which is constant. In this paper, we propose an algorithm which optimizes waiting time threshold according to traffic arrival pattern (downlink + uplink), which leads to significant reduction in energy consumption. We have compared the performance of our algorithm with constant waiting time threshold scheme through simulations for different DL to UL ratios. The results show that our algorithm reduces the power consumption significantly by 47% with little increase in average waiting delay by 11% at arrival rate 0.05 per MSS, which is well accepted within end to end delay for non-real time traffic. Furthermore, the simulation results of the proposed algorithm are within tolerable limit of theoretical analysis discussed in the paper.

keywords: {WiMax;mobile radio;telecommunication traffic;IEEE 802.16e;adaptive waiting time threshold estimation algorithm;battery operated mobile devices;mobile subscriber station;nonreal time traffic;power saving;traffic arrival pattern;trigger sleep mode;waiting time threshold;Batteries;Cities and towns;Delay effects;Downlink;Energy consumption;Energy management;Information technology;Internet;Traffic control;WiMAX;IEEE 802.16e;Power Saving;Sleep Mode;Waiting Time Threshold;WiMAX},

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G. Fischer, Sangmok Lee and M. Obara, "A programmable monolithic temperature logging device," *The 2002 45th Midwest Symposium on Circuits and Systems, 2002. MWSCAS-2002.*, 2002, pp. III-571-III-574 vol.3.  
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Abstract: This paper describes the design and the implementation of a miniature archival temperature monitoring device. The complete system consists of two components: a micro-chip and a small 3 V lithium battery with a charge of 30 mAh. Due to the nature of the application, the tag will spend most of its time in a sleeping mode. The MOS devices constituting the continuously operating oscillator are operated in weak inversion and thus dissipate not more than 1.5  $\mu$ W. The power consumed by the remainder of the chip's circuitry is minimized through effective power management. The temperature sampling events are controlled by an application specific protocol, which will be imported from a host PC prior to tag's deployment. The chip's memory consists of static RAM and can hold a maximum of 1,024 temperature readings.

keywords: {data loggers;monitoring;temperature sensors;1.5 muW;3 V;application specific protocol;archival temperature monitoring device;continuously operating oscillator;power management;programmable monolithic temperature logging device;sleeping mode;temperature sampling events;Batteries;Circuits;Energy management;Lithium;MOS devices;Oscillators;Sampling methods;Temperature control;Temperature measurement;Temperature sensors},

URL: <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=1187101&isnumber=26621>

W. Hamburg, "Hybrid battery system for a pocket computer," *Seventeenth Annual Battery Conference on Applications and Advances. Proceedings of Conference (Cat. No.02TH8576)*, Long Beach, CA, USA, 2002, pp. 227-  
doi: 10.1109/BCAA.2002.986402

Abstract: Summary form only given as follows. Hybrid battery systems that contain both primary and secondary cells may offer compelling advantages for our smallest and most personal electronic devices. While either commodity alkaline cells or a Li-ion pack are used in most such applications today, small air-breathing power sources, such as metal-air cells and fuel cells, promise much higher specific energy and correspondingly longer runtimes. Unfortunately, in scenarios demanding high peak power, the high impedance of most such cells requires using a capacitor or secondary cell for load leveling. We have explored this hybrid approach using our Itsy pocket computer. We started with the largest available commodity Zn-air button cells (#675/PR44) and the smallest available Li-ion and Li-polymer cells. After characterization, we selected a small Li-polymer cell and built two simple hybrid power systems. We evaluated runtime using three benchmarks: sleep-mode, idle-mode, and an MPEG multimedia player. The experiments showed this approach to be practical for systems of up to 50 mW average power, and that the hybrid offers approximately twice the energy of a Li-ion pack of comparable size. We found proper cell-holder design to be critical to realize this potential. With wider availability of large Zn-air cells, higher average power levels are possible, and for sufficiently large cells, the secondary cell could be entirely eliminated. Retaining the secondary cell, however, allows both hot swap battery changes and extending system runtime via opportunistic charging. It is unknown how well this more complex usage model can be understood and exploited by consumers.

keywords: {computer power supplies;lithium;notebook computers;primary cells;secondary cells;zinc;itsy pocket computer;Li;Li-ion cells;Li-polymer cells;MPEG multimedia player;Zn-air button cells;air-breathing power sources;cell-holder design;fuel cells;higher average power levels;hot swap battery changes;hybrid battery system;idle-mode;metal-air cells;opportunistic charging;personal electronic devices;primary cells;secondary cell;secondary cells;sleep-mode;Application software;Batteries;Capacitors;Fuel cells;Hybrid power systems;Impedance;Laboratories;Power system modeling;Runtime},

URL: <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=986402&isnumber=21256>

K. H. Schoenbach, J. S. Kenney and F. E. Peterkin, "Filamentary electrical breakdown in photoconductive GaAs-switches," *International Conference on Plasma Sciences (ICOPS)*, Vancouver, BC, Canada, 1993, pp. 193-  
doi: 10.1109/PLASMA.1993.593531

Abstract: Summary form only given. The temperature and electric field induced shift of the absorption edge in semiconductors has been used to study the temporal development of the electrical breakdown in a high-power photoconductive GaAs switch. The spatial distribution of the transmission of the probe laser light, with wavelength tuned to the band edge of GaAs, is recorded with a CCD (charge coupled device) camera.

Depending on the applied voltage, the temporal development of the switch current shows two distinctively different patterns. At low voltage the photocurrent scales linearly with the activating laser intensity (linear mode). Above a threshold voltage which is dependent on laser intensity, the photocurrent continues to flow as long as a voltage is applied even after the laser is turned off (lock-on mode). This "permanent photocurrent" is carried by one or more luminous filaments. The filamentary breakdown is preceded by the development of domain-like field structures in the anode region of the switch immediately after laser activation. The electric fields in the domains exceed values of 15 kV/cm. The current filament shortens these high field regions and heats the material along its path, causing irreparable changes in the switch material. keywords: {gallium arsenide;CCD camera;GaAs;absorption edge;activating laser intensity;anode region;applied voltage;band edge;charge coupled device;domain-like field structures;electric field induced shift;electrical breakdown;filamentary electrical breakdown;high field regions;high-power photoconductive GaAs switch;laser intensity;linear mode;lock-on mode;luminous filaments;permanent photocurrent;photoconductive GaAs switches;photocurrent;probe laser light;semiconductors;spatial distribution;switch current;switch material;temporal development;threshold voltage;transmission;Charge-coupled image sensors;Electric breakdown;Gallium arsenide;Laser mode locking;Laser tuning;Optical materials;Photoconductivity;Switches;Temperature;Threshold voltage}, URL: <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=593531&isnumber=12731>

T. Douseki, S. Shigematsu, Y. Tanabe, M. Harada, H. Inokawa and T. Tsuchiya, "A 0.5 V SIMOX-MTCMOS circuit with 200 ps logic gate," *1996 IEEE International Solid-State Circuits Conference. Digest of Technical Papers, ISSCC*, San Francisco, CA, USA, 1996, pp. 84-85. doi: 10.1109/ISSCC.1996.488524

Abstract: Multi-threshold CMOS (MTCMOS) circuit technology combining low-Vth CMOS logic gates and high-Vth MOSFETs is suitable for 1 V LSI's for battery-operated portable equipment. Improvements in MTCMOS device technology promise to lead to higher operating frequencies. However, higher frequencies will increase power consumption even if the supply voltage is 1 V. To reduce the power consumption, it is necessary to lower the supply voltage below 1 V, without sacrificing speed. A circuit consisting of depletion-mode MOSFETs operates with 200 mV supply. However, it cannot be applied to an LSI with more than 1 k gates because active-mode leakage current is too large. In addition, the circuit needs backgate bias, which is much larger than the supply voltage, to increase the threshold voltage and to reduce the leakage current in the sleep mode. To generate the large back-gate bias, multiple supply voltages or a boost circuit are required. The proposed low supply-voltage MTCMOS circuit with SIMOX technology uses enhancement-mode MOSFETs and contains no boost circuit. High-speed operation of this SIMOX-MTCMOS circuit at 0.5 V supply is obtained by use of low-Vth CMOS logic gates consisting of fully-depleted body-floating MOSFETs. keywords: {CMOS logic circuits;SIMOX;large scale integration;threshold logic;0.5 V;200 ps;LSI;SIMOX technology;SIMOX-MTCMOS circuit;Si;battery-operated portable equipment;enhancement-mode MOSFETs;fully-depleted body-floating MOSFETs;high-speed operation;low supply-voltage MTCMOS circuit;low threshold voltage;low-Vth CMOS logic gates;multi-threshold CMOS;power consumption reduction;CMOS logic circuits;CMOS technology;Energy consumption;Frequency;Leakage current;Logic circuits;Logic devices;Logic gates;MOSFETs;Voltage}, URL: <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=488524&isnumber=10440>

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Abstract: Plethora of miniaturized sensor nodes for biomedical sensors have been proposed in the last decade, however, their reliability on batteries and external wireless power transfer source still stands as the biggest challenge against their widespread adoption over existing traditional external biomedical instruments and tests. This paper discusses a novel technique of self-sustaining biomedical implants. The node scavenges energy from ambient stray television signals (470-590 MHz) and uses this harvested energy for its entire operation. The device employs highly optimized DC-DC boost (30mV-1.8V) converter charge pump circuit with a balanced tradeoff between switching frequency, output power and efficiency. The device consumes only 63μW in its normal mode and gives a efficiency of 72 %. keywords: {DC-DC power converters;biomedical equipment;body area networks;charge pump circuits;energy harvesting;prosthetic power supplies;radiofrequency power transmission;secondary cells;wireless sensor networks;DC-DC boost converter charge pump circuit;ambient stray television signals;biomedical applications;biomedical instruments;external wireless power transfer source;frequency 470 MHz to 590 MHz;miniaturized sensor nodes;output power;power 63 μW;self-sustaining WBAN implants;self-sustaining biomedical implants;voltage 30 mV to 1.8 V;1/f noise;Electrocardiography;Electromyography;Insulin;Switches;Temperature sensors;IR transceiver;biomedical implants;charge pump;microcontroller;self-start circuit;sub threshold ring oscillator;ultra-low power;voltage comparator}, URL: <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=7912050&isnumber=7911953>

J. G. Laven, R. Baburske, A. Philippou, H. Itani and M. Dainese, "RCDC-IGBT study for low-voltage applications," *2016 28th International Symposium on Power Semiconductor Devices and ICs (ISPSD)*, Prague, 2016, pp. 347-350. doi: 10.1109/ISPSD.2016.7520849

Abstract: The desaturation and charge recovery behavior for 1200-V RC-IGBTs with diode control is investigated. The low thickness of the drift-region of modern 1200-V IGBTs results in significantly reduced time constants of the diode-control feature. While a low desaturation time constant is well acceptable, the recovery time constant becomes critical when compared to typical locking time requirements of common gate driver units. The impact of different locking times on the overall performance is discussed and a novel device concept for RC-IGBTs is presented which overcomes this issue. The FWD-mode of the novel RC-IGBT is desaturated at a gate-emitter voltage of 0 V allowing for the first time a desaturation pulse pattern which may disregard the locking time requirements of the driving-unit. keywords: {insulated gate bipolar transistors;power bipolar transistors;power semiconductor diodes;FWD-mode;RCDC-IGBT;charge recovery behavior;common gate driver units;desaturation pulse pattern;desaturation time constant;diode control;driving-unit;free-wheeling diode;gate-emitter voltage;insulated gate bipolar transistors;low-voltage applications;recovery time constant;reverse conducting IGBT;voltage 1200 V;Anodes;Insulated gate bipolar transistors;Inverters;Logic gates;Switching loss;Threshold voltage;Transistors;Desaturation dynamics;Diode control;Neutral desaturation;Reverse conducting IGBT}, URL: <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=7520849&isnumber=7520753>

D. Lu, Y. Qian and Z. Hong, "4.3 An 87%-peak-efficiency DVS-capable single-inductor 4-output DC-DC buck converter with ripple-based adaptive off-time control," *2014 IEEE International Solid-State Circuits Conference Digest of Technical Papers (ISSCC)*, San Francisco, CA, 2014, pp. 82-83. doi: 10.1109/ISSCC.2014.6757347

Abstract: Improving battery longevity in portable devices usually requires the use of different voltage levels with a wide range of load capability for various functional blocks. Since a single-inductor-multiple-output (SIMO) converter can support multiple output voltages while using only one inductor, it is an excellent candidate to minimize the component count and thus the production cost. However, the cross-regulation and power consumption are two main issues of the previously reported SIMO converters [1-5]. Although pseudo-continuous conduction-mode (PCCM) control with a freewheel period [1] tries to augment power density and eliminate cross-regulation, associated power dissipation of freewheel switch exacerbates its overall efficiency. The charge-control technique with energy recovery presented [2] decouples the output channels between each switching cycle, at the expense of additional switching loss and slow response. The comparator-based controlled SIMO converters are investigated in [3, 4] and the cross-regulation in most channels is improved due to the fast response of the comparator. However, since the channel that is last connected to inductor is inevitably regulated by the accumulative error of all channels to balance the overall inductor current, every load transition at other outputs will introduce serious cross-regulation [3] and load-regulation problem [4] in the channel. In addition, cross-regulation and slow response also limit the application of dynamic voltage scaling (DVS) technique, which is widely used in single-output converters to improve the system power efficiency by providing variable voltage with fast reference tracking. keywords: {DC-DC power converters;adaptive control;inductors;power control;switching converters;DVS capable single inductor converter;DVS technique;PCCM control;accumulative error;associated power dissipation;battery longevity;charge control technique;comparator based controlled SIMO converters;cross regulation;dynamic voltage scaling;energy recovery;fast reference tracking;four output DC-DC buck converter;freewheel period;freewheel switch;inductor current;load capability;load regulation problem;portable devices;power consumption;power density;production cost;pseudocontinuous conduction mode;ripple based adaptive off time control;single inductor multiple output;single output converters;switching cycle;switching loss;system power efficiency;Inductors;Phase locked loops;Switches;Switching frequency;Voltage control;Voltage measurement}, URL: <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=6757347&isnumber=6757318>

Man-Long Her, Pao-Hsun Wu, Wen-Zhi Huang, Yu-Lin Wang and Shih-Hao Kung, "Design and implementation of a wireless power transmission system with green energy concept," *CSQRWC 2012*, New Taipei City, 2012, pp. 64-67. doi: 10.1109/CSQRWC.2012.6294965

Abstract: With current trend of international environmental protection standard, the features and perspective of development in communication system is wireless power transmission and green energy. This paper provides a smart wireless charging device which can charge different types of hand-held devices and power down to sleep mode to save power when charging process is completed. keywords: {inductive power transmission;standards;communication system;green energy concept;handheld devices;international environmental protection standard;sleep mode;smart wireless charging device;wireless power transmission system design;Batteries;Coils;Green products;Power transmission;Radio transmitters;Receivers;Wireless communication;Green Energy;Wireless Charging Device;Wireless Power Transmission}, URL: <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=6294965&isnumber=6294951>

X. Ma, W. Shi, W. Ji and H. Xue, "The Overvoltage LSA Relaxation Mode Study in Photoconductive Semiconductor Switch," *2010 Symposium on Photonics and Optoelectronics*, Chengdu, 2010, pp. 1-4. doi: 10.1109/SOPO.2010.5504407

Abstract: The 11mm big gap semi-insulating(SI) GaAs photoconductive semiconductor switch (PCSS) is triggered by pulse laser, steady non-linear output waveforms are shown at 5kV~8kV bias voltage, the linear trend present when the bias voltage is higher than 9kV, the nonlinear Lock-on effect is gradually disappeared with the voltage increasing, eventually the pulse development into a complete linear waveform. Analysis that: the big gap SI-GaAs PCSS operate in higher than many times threshold voltage when switch satisfy  $2 \times 10^4 \text{ s} \cdot \text{cm}^{-3} \leq n_0 / \tau \leq 2 \times 10^5 \text{ s} \cdot \text{cm}^{-3}$  and  $n_0 \geq 10^{13} \text{ cm}^{-2}$  conditions, switch work in overvoltage LSA(Limit Space charge Accumulate) relaxation mode. keywords: {gallium arsenide;limited space charge accumulation;optical pulse generation;optical switches;photoconductivity;semiconductor switches;GaAs;big gap semi-insulating;limit space charge accumulate relaxation mode;nonlinear Lock-on effect;overvoltage LSA relaxation mode;photoconductive semiconductor switch;pulse laser;Optical materials;Optical pulses;Optical switches;Photoconducting devices;Photoconducting materials;Photoconductivity;Power semiconductor switches;Space charge;Threshold voltage;Voltage control}, URL: <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=5504407&isnumber=5503985>

Hassan Khaliq Qureshi, Sajjad Rizvi, Muhammad Saleem, Syed Ali Khayam, Muttukrishnan Rajarajan and Veselin Rakocovic, "An energy efficient Clique-based CDS discovery protocol for wireless sensor networks," *2010 44th Annual Conference on Information Sciences and Systems (CISS)*, Princeton, NJ, 2010, pp. 1-6. doi: 10.1109/CISS.2010.5464724

Abstract: Power- and location-unaware topology control protocols for wireless sensor networks (WSNs) generally conserve energy by forming node clusters using the connected dominating set (CDS) principle. CDS-based clustering allows nodes lying outside the CDS to enter the sleep mode thereby extending node and network lifetimes. In this paper, we introduce a simple, distributed and efficient graph-theoretic topology construction protocol that uses sensor cliques to discover a CDS in an energy efficient manner. Our simulation results show that the proposed protocol consistently outperforms existing solutions (Rule K, EECDS and A3) in terms of energy efficiency, message complexity and residual energy present in the CDS. keywords: {communication complexity;graph theory;routing protocols;telecommunication network topology;wireless sensor networks;CDS-based clustering;clique-based CDS discovery protocol;connected dominating set principle;graph-theoretic topology;location-unaware topology control protocols;message complexity;wireless sensor networks;Batteries;Charge coupled devices;Communication system control;Computer networks;Energy efficiency;Energy storage;Network topology;Power engineering and energy;Wireless application protocol;Wireless sensor networks}, URL: <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=5464724&isnumber=5464703>

Y. Sun, X. Wu and M. Zhao, "Single-inductor dual-output converter with dynamic power distribution," *2009 IEEE 8th International Conference on ASIC*, Changsha, Hunan, 2009, pp. 1097-1100. doi: 10.1109/ASICON.2009.5351385

Abstract: A single-inductor dual-output switching converter was presented in this paper. This converter can be applied to solar-cell portable devices as battery power management system. Considering the limited power supplied by solar cells, two output channels, battery charging and power regulating, were designed for this converter. Controlled by it, the output electric energy could be dynamically distributed between two channels. The state-machine is used to decide the amount of energy delivered to each channel. The converter chip is designed in a 1.5 μm BCD (bipolar-CMOS-DMOS) technology. Simulation results showed that all main targets were well achieved. keywords: {BiCMOS integrated circuits;power converters;BCD technology;battery power management system;bipolar-CMOS-DMOS technology;dynamic power distribution;output electric energy;power regulating;single-inductor dual-output switching converter;size 1.5 μm;solar-cell portable devices;Carbon capture and storage;Circuit simulation;Current mode circuits;Equations;Feedback circuits;Joining processes;Power distribution;Radiofrequency interference;Resistors;Threshold voltage;SIDO;charger;fuel cell;solar cell}, URL: <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=5351385&isnumber=5351163>

Zhiyu Liu and V. Kursun, "Low energy MTCMOS with sleep transistor charge recycling," *2007 50th Midwest Symposium on Circuits and Systems*, Montreal, Que., 2007, pp. 891-894.

doi: 10.1109/MWSCAS.2007.4488714

Abstract: A new circuit technique is proposed in this paper to lower the energy overhead of mode transitions for effective energy reduction with the MTCMOS circuits. The charge stored at the virtual rails and the sleep signal lines are recycled during the active-to-sleep-to-active mode transitions with the proposed technique. Applying the charge recycling MTCMOS circuit technique to a 32-bit Brent-Kung adder reduces the energy overhead due to the mode transitions by up to 12.2% as compared to the conventional MTCMOS circuits. Furthermore, the standby mode power consumption is reduced by up to 92.8% as compared to a standard Brent-Kung adder in a 65 nm CMOS technology.

keywords: {CMOS logic circuits;adders;charge-coupled devices;energy consumption;low-power electronics;transistors;Brent-Kung adder;active-to-sleep-to-active mode transitions;energy overhead;energy reduction;multithreshold CMOS circuits;size 65 nm;sleep transistor charge recycling;standby mode power consumption;word length 32 bit;CMOS technology;Circuits;Energy consumption;Leakage current;Logic gates;Parasitic capacitance;Rails;Recycling;Sleep;Threshold voltage;Multi-threshold voltage CMOS;energy recycling;sleep switch;subthreshold leakage},  
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Abstract: A downside of using Multi-Threshold CMOS (MTCMOS) technique for leakage reduction is the energy consumption during transitions between sleep and active modes. Previously, a charge recycling (CR) MTCMOS architecture was proposed to reduce the large amount of energy consumption that occurs during the mode transitions in power-gated circuits. Considering the RC parasitics of the virtual ground and VDD lines, proper sizing and placement of charge-recycling transistors is key to achieving the maximum power saving. In this paper, we show that the sizing and placement problems of charge-recycling transistors in CR-MTCMOS can be formulated as a linear programming problem, and hence, can be efficiently solved using standard mathematical programming packages. The proposed sizing and placement techniques allow us to employ the CR-MTCMOS solution in large row-based standard cell layouts while achieving nearly the full potential of this power-gating architecture, i.e., we achieve 44% saving in switching energy due to the mode transition in CR-MTCMOS compared to standard MTCMOS.

keywords: {CMOS integrated circuits;MOSFET;integrated circuit layout;integrated circuit packaging;linear programming;recycling;MTCMOS circuits;charge recycling transistor;leakage reduction;linear programming problem;multithreshold;placement techniques;power-gating architecture;row-based standard cell layout;sizing techniques;standard mathematical programming package;CMOS logic circuits;CMOS technology;Chromium;Delay;Energy consumption;Linear programming;Logic devices;Mathematical programming;Recycling;Threshold voltage},  
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Abstract: A passive short-range remote triggered mode of operation for ultra-low power wireless sensor devices is proposed. When a triggering signal or coded sequence is detected, the node is enabled from sleep mode, which it is kept on standby in order to save energy. After a trigger command is received, the node turns on its power-consuming elements. The triggering schemes studied are based on passive circuits that allow ultra-low power operation in standby mode. The trigger detector is made up of two basic elements: a passive tuned filter and an active detector that converts the trigger signal to baseband. The active part of the circuit is a low power comparator that awakens the microcontroller unit of the node when it toggles its output. Two trigger schemes are presented: (a) a low frequency (LF-125 kHz) near field communications (NFC) link and (b) a RF frequency (868 MHz ISM band) link.

keywords: {comparators (circuits);wireless sensor networks;RF frequency link;active detector;frequency 125 kHz;frequency 868 MHz;low power comparator;near field communication link;passive tuned filter;trigger detector;ultra-low power wireless sensor devices;Battery charge measurement;Circuits;Detectors;Energy measurement;Frequency;Intelligent sensors;Microcontrollers;Protocols;Sensor phenomena and characterization;Wireless sensor networks},  
URL: <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=4394943&isnumber=4394880>

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Abstract: Based on the changing conditions of ground electric field during surveying the thunderstorm on the spot, the threshold of ground electric field which triggering the first lightning strike was determined, and a smart base station power supply against lightning which has the function of warning lightning was developed. The supply uses micro processor unit (MPU) as main control chips. On one hand it fulfills the function of warning lightning based on measuring the changing of ground electric field. On the other hand, it utilizes; current power supply mode of DC-DC using storage battery, carries out smart control through MPU, and realizes the physical isolation between power supply system of base station and outside. So it cuts off the paths that LEMP invades base station power supply and prevents it from being influenced by LEMP. The application experiment was done in strong thunder section in Qingyuan county of Guangdong province at the beginning of 2002. The experimental sample machines are installed in six wireless access base stations and one is located in mountain base station which altitude is six hundred and nine meters. The results of practical application show that this power supply runs stably and improves the ability to prevent lightning of base station.

keywords: {electric fields;electromagnetic pulse;lightning;lightning protection;microprocessor chips;radio access networks;telecommunication power supplies;thunderstorms;Guangdong province;Qingyuan county;current power supply mode;ground electric field;lightning prevention;lightning strike;micro processor unit;smart power supply;storage battery;thunderstorm;warning lightning;wireless access base station;Base stations;Battery charge measurement;Clouds;Control systems;Current supplies;Educational institutions;Electric variables measurement;Lightning;Power supplies;Semiconductor device measurement},  
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Abstract: The large magnitude of supply/ground bounces, which arise from power mode transitions in power gating structures, may cause spurious transitions in a circuit. This can result in wrong values being latched in the circuit registers. We propose a design methodology for limiting the maximum value of the supply/ground currents to a user-specified threshold level while minimizing the wake up (sleep to active mode transition) time. In addition to controlling the sudden discharge of the accumulated charge in the intermediate nodes of the circuit through the sleep transistors during the wake up transition, we can eliminate short circuit current and spurious switching activity during this time. This is in turn achieved by reducing the amount of charge that must be removed from the intermediate nodes of the circuit and by turning on different parts of the circuit in a way that causes a uniform distribution of current over the wake up time. Simulation results show that, compared to existing wakeup scheduling methods, the proposed techniques result in a one to two orders of magnitude improvement in the product of the maximum ground current and the wake up time.

keywords: {CMOS integrated circuits;circuit optimisation;circuit simulation;integrated circuit design;short-circuit currents;MTCMOS circuits;circuit registers;power gating structure;power mode transition;short circuit current;sleep transistors;spurious switching activity;user-specified threshold level;wake up transition;wakeup scheduling method;CMOS logic circuits;CMOS technology;Current supplies;Design methodology;Hardware;Logic devices;Permission;Registers;Short circuit currents;Switching circuits},  
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Abstract: Energy management is critical for emerging tiny wireless mobile devices such as sensors and PDAs, which are power limited by the capacity of their batteries. The energy cost of wireless transmission is high, being superlinear in the communication distance. Even an idle node that is turned on but otherwise not engaged in any activity may consume a significant amount of energy. Based on the observation that reduced communication distance between two communicating parties can significantly reduce the energy cost of the communication, we propose a motion prediction algorithm that exploits the movement history of a sender node to predict the likelihood that the node may move closer to the receiver by a given deadline. If the likelihood is high, then the transmission is postponed until the mobile node moves closer to the receiver at a future time. To reduce unproductive energy use by an idle node, we propose a sleep/wakeup algorithm that adoptively puts the node into sleep mode. However, while a mobile node is sleeping, it may miss critical opportunities for position update and motion prediction. The objective of this paper is then to realize an opportunistic scheduler that can balance the energy consumption by an idle system and the performance of motion prediction in saving energy for network transmission. The proposed system has been prototyped on an actual sensor network platform. Experimental results show that our opportunistic scheduler can achieve significant energy savings in terms of both network communication and keeping the system awake as necessary.

keywords: {energy conservation;mobile computing;power consumption;scheduling;telecommunication network management;wireless sensor networks;energy consumption;energy management;energy saving;motion prediction algorithm;opportunistic scheduler;sensor network platform;sleep-wakeup algorithm;wireless mobile device;wireless network;Battery charge measurement;Capacitive sensors;Costs;Energy consumption;Energy management;Energy measurement;Mobile communication;Personal digital assistants;Wireless networks;Wireless sensor networks},  
URL: <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=1509643&isnumber=32328>