TI-30Xa Solar-like Raspberry Pi Laptop & Underclocking the Pi

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LimboMan
9 posts • Page **1** of **1**
Posts: 74
Joined: Sat Oct 31, 2020 7:12 pm

TI-30Xa Solar-like Raspberry Pi Laptop & Underclocking the Pi

Sat Dec 26, 2020 4:34 am

One of my creative interests is to have a solar powered Raspberry Pi Zero in a laptop built with modular components so that it can be built much like the ATX computer case standards. The key to this is to determine the specifications of the components that can produce a reliable level of solar generation, battery storage, and expected system power. The Zero is being chosen here because it is the simplest and least expensive of the Raspberry Pi's, although other Raspberry Pi's are encouraged as well. The Ti-30Xa Solar is memorable because it could be powered from a light bulb.

ATX case (mini-ITX, micro/mid/full)- chassis, houses motherboard, PSU, CPU, RAM, I/O/fans/heatsinks. A search on why laptops do not adopt ATX standards returned a great Quora result regarding space and connectors, however the Pi Zero does not require active cooling nor heavy power requirements:

"1) Standard Size. Discrete modules take more space due to connectors and having to leave space for the largest possible module - For example, if you have a graphics module which is half the size of standard, then there is going to be wasted space. If you want to invent something new which is too large to fit that space, then it will never sell. This means standards-based laptops are always going to be bigger than they need to be (just like desktop computer cases are big enough to accommodate worst case)

2) Connectors. Connectors take up space and limit performance. They add weight and cost. They also have reliability issues due to shock and vibration. Modularity means more connectors. These are not good things for laptops

3) Cooling. Laptop design is often limited by cooling solutions. Need for cooling is ever increasing. To deal with this, a future-proof laptop would have to have an advanced cooling design which is oversized to deal with the eventual higher loads. This is not just like adding another case fan. Sometimes new cooling

solutions and technology are the critical path to releasing a new device.

4) Power supply. Power requirements change from generation to generation, Having a battery and power system that can deal with future upgrades would be largely a waste of money.

5) Demand. Few people upgrade their upgradable desktop machines. They just buy a new one when it starts getting obsolete. The demand to do anything other than just put in a new storage device in a laptop is quite small. It would not justify compromising the system design in order to make a laptop capable of taking these sorts of updates."

Despite many of these great points, I am motivated to establish an ATX-like standard for not just laptops, but low-powered, solar-powered laptops. The reasoning is that it can be an open standard, and that can take a lot of the guess-work out of solar powered system builds/assembly, including battery management and plugs, of which there are many more types than an ATX power supply (DC, MC4, etc). While a solar panel with a 5V or 6V specification may work best for this project, a voltage regulator is needed since it cannot just be plugged into the Pi. Being able to purchase any of these components off-the shelf, either for repair & upgrade is what can make the project affordable.

While a system on a chip is its own standard- a proprietary design and dimension, there is still a *meta* standard that has attempted to fit within a chassis- that could be something like a portable Pelican case, which can fit a keyboard and a Pi + monitor, or something like a 3D printed Raspberry Pi case that can house a monitor and the Pi. Adding a solar panel to this is not trivial, but could involve a fold-out panel, or one that is permanently affixed to the back of the lid (opposite to the LCD screen).

From a recent solar panel purchase, a 21Watt panel with a 5V voltage regulator was able power my Raspberry Pi Zero in clear skies without a battery. A battery will be useful for storing excess charge, but being able to power on the Pi like a calculator, the TI-30Xa Solar shows how much performance can be self-sufficient. One important difference, however, is that the TI-30Xa could be powered by indoor lights, whereas larger solar panels needed to power a low-power System on a Chip like the Pi Zero require 80-150mA, which is only possible outside.

E-ink/Color for the solar laptop display has been a long interest of mine, since the power consumption would be much less than a transmissive TFT display.

On the topic of connectors, if all these components were assembled and designed, would it be possible to minimize shock and vibration? carrying a desktop around is obviously bad for the heatsink, PSU and the other loosest components of an ATX build, but a Pelican case has sufficient foam to keep most connectors in place. That said, it would be prudent to have designated spots in a case much like an ATX has 9+ chassis screws to keep in place.

Underclocking the CPU to the minimum speed, or designing the CPU to run at Near-Threshold Voltage, is a CPU that Intel has prototyped in 2011 to run on solar power with their Pentium-based Claremont CPU, and is still a research concept applied as mentioned in their prototype IoT Edge Mote at the 2018 International Solid-State Circuits Conference.

NTV is not a critical need of a solar powered laptop, since the speed may be too slow compared to the useable performance like the Pi Zero.
However, this concept seems to be useful for potentially solar charging a laptop both indoors and outdoors. Determining an efficient way to idle a PC when it is not using much power, on a solar based laptop, as with e-ink, which uses no power on idle/static page.

A solar-powered -e-reader could potentially power the entire tablet- but some e-readers run at 400mhz, like the first generation Kindle. I am not sure if anyone is able to underclock the Pi Zero to 10mhz, but that is where NTV starts. My first Pentium was a 100mhz Packard Bell in 1996. I recall picking up a discarded 486DX2 running at 33 or 66mhz to test out- I remember testing if it was able to copy a CD-R on Windows 95 since CD burners at the store always said on their boxes that a 266 or 400mhz PC Pentium II was required. Sorry for that tangent, my point is I was able to copy the CD on 33mhz and similarly, I'd like to underclock an SoC to see if it can still run for 80% of things like-e-reading that are not considered productivity needs.

Link to my parts list: viewtopic.php?f=62&t=289595#p1753787 (https://www.raspberrypi.org/forums/viewtopic.php?f=62&t=289595#p1753787)

Last edited by LimboMan on Sat Dec 26, 2020 11:22 pm, edited 1 time in total.

scruss

Posts: 5565
Joined: Sat Jun 09, 2012 12:25 pm
Location: Toronto, ON

Re: TI-30Xa Solar-like Raspberry Pi Laptop & Underclocking the Pi

Sat Dec 26, 2020 10:51 am

It's very unlikely you can underclock the SoC at ~10% rated frequency. Also, solar calculators use tiny amorphous cells that produce very little power, and calculators stop their processor and displays as much as possible to conserve power. The Raspberry Pi isn't a fully static machine (unlike my RCA 1802 computer, which will happily run at 3 Hz) so that kind of power saving isn't going to be easy.

‘Remember the Golden Rule of Selling: “Do not resort to violence.”’ — McGlashan.
Pronouns: he/him

~~LimboMan~~

Posts: 74
Joined: Sat Oct 31, 2020 7:12 pm

Re: TI-30Xa Solar-like Raspberry Pi Laptop & Underclocking the Pi

Sat Dec 26, 2020 2:27 pm

> *scruss (./../memberlist.php?mode=viewprofile&u=20604) wrote: ↑ (./../viewtopic.php?p=1785972#p1785972)*
> *Sat Dec 26, 2020 10:51 am*
>
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Thanks, the RCA 1802 sounds like an awesome PC, I did not know it was sent to Jupiter, but I can tell it was brilliant. I have read of some other processors, like the ARM M0+, which have some of the lowest power usage.

I did find a underclocking thread on this forum: viewtopic.php?t=100990 (https://www.raspberrypi.org/forums/viewtopic.php?t=100990) It did find there was not much power saving, although this was not in the absolute. One commenter said, "Even if total energy is not saved, reducing power requirements may adapt the system to reliably work with power supplies and batteries that simply can't output the 12.5 watts peak power consumed when a Pi 3 at standard clock speeds is running full out."

That said, it would be interesting to underclock the RAM and I/O bus for lower system power, although there may be some other commercially available ARM SoC boards that use less.

Also, while I do like the concept of the TI-30Xa Solar, adapting it to a laptop with a Pi Zero may not be as easy using amorphous cells, thus using mono/polycrystalline would be a lot easier initially until the TDP could be optimized. I also suggested the Ti-30Xa Solar as an example since it is once of the few products, other than solar lights, that integrate solar panels for a function other than generating and storing power. But I do think amorphous silicon could be useful in cases if it was able to generate more current since some panels do not work at all unless they meet a threshold voltage.

~~LimboMan~~

Posts: 74
Joined: Sat Oct 31, 2020 7:12 pm

Re: TI-30Xa Solar-like Raspberry Pi Laptop & Underclocking the Pi

Wed Dec 30, 2020 7:14 pm

Update2: Found a manufacturer of some of the lowest power SoCs: https://ambiq.com/apollo4-blue/ (https://ambiq.com/apollo4-blue/)

This article covers more background of modern lowest power CPUs: https://ece.engin.umich.edu/stories/mic ... t-computer (https://ece.engin.umich.edu/stories/michigan-micro-mote-m3-makes-history-as-the-worlds-smallest-computer)

"An Astonishing Lack of Power
A key breakthrough in the size/power matchup came with the Phoenix processor in 2008. The Phoenix processor is miniscule at 915 x 915µm2, and boasts ultra-low operating voltage and a unique standby mode that results in an average power consumption of only 500pW. (Consider that 1pW is the average power consumption of a single human cell.)

Blaauw explained why Phoenix’s extreme energy efficiency is so important: “As you shrink down in size, the percentage of the system tends to be dominated by the battery. It’s actually not hard to make chips small, but it is hard to make them low power. We could have very small chips, but we’d still end up with

really large batteries.”

With the M3, engineers at Michigan are the first to accomplish energy neutrality via indoor energy harvesting in a wireless system of its size. With a 1mm2 solar cell producing 20nW, the device can harvest enough energy under ambient light to run perpetually. The device’s standby power consumption is 2nA. That’s about a million times less power than the average mobile phone consumes while on standby, or the comparative difference between the thickness of a sheet of paper and the length of a football field."

https://blaauw.engin.umich.edu/wp-conte ... rement.pdf (https://blaauw.engin.umich.edu/wp-content/uploads/sites/342/2019/12/A-0.04mm3-16nW-Wireless-and-Batteryless-Sensor-System-with-Integrated-Cortex-M0-Processor-and-Optical-Communication-for-Cellular-Temperature-Measurement.pdf)

"World's smallest computer
On 21 June 2018, the "world's smallest computer"", or computer device was announced – based on the ARM Cortex-M0+ (and including RAM and wireless transmitters and receivers based on photovoltaics) – by University of Michigan researchers at the 2018 Symposia on VLSI Technology and Circuits with the paper "A 0.04mm3 16nW Wireless and Batteryless Sensor System with Integrated Cortex-M0+ Processor and Optical Communication for Cellular Temperature Measurement." The device is 1/10th the size of IBM's previously claimed world-record-sized computer from months back in March 2018, which is smaller than a grain of salt."

https://news.umich.edu/u-m-researchers- ... -computer/ (https://news.umich.edu/u-m-researchers-create-worlds-smallest-computer/)

"The reason for the curiosity is that IBM’s claim calls for a re-examination of what constitutes a computer. Previous systems, including the 2x2x4mm Michigan Micro Mote, retain their programming and data even when they are not externally powered.

Unplug a desktop computer, and its program and data are still there when it boots itself up once the power is back. These new microdevices, from IBM and now Michigan, lose all prior programming and data as soon as they lose power.

“We are not sure if they should be called computers or not. It’s more of a matter of opinion whether they have the minimum functionality required,” said David Blaauw, a professor of electrical and computer engineering, who led the development of the new system together with Dennis Sylvester, also a professor of ECE, and Jamie Phillips, an Arthur F. Thurnau Professor and professor of ECE.

In addition to the RAM and photovoltaics, the new computing devices have processors and wireless transmitters and receivers. Because they are too small to have conventional radio antennae, they receive and transmit data with visible light. A base station provides light for power and programming, and it receives the data."

It sounds a lot like the RCA 1802. It saves power, but unlike the 1802, not by turning off. It carries less baggage (less to boot. It appears similar to a Linux Live CD/USB, since the OS doesn't save anything. With ubiquitous networking options (low power Zigbee wifi, and external storage,) adapting the M0+ to a more general purpose SoC like the Raspberry pi doesn't appear to have much demand, since the power consumption on the Pi Zero is already relatively low.

The most critical applications of that smallest CPU would be medical, but a laptop could also use it.https://en.wikipedia.org/wiki/ARM_Cortex-M#Cortex-M0 (https://en.wikipedia.org/wiki/ARM_Cortex-M#Cortex-M0)+

It is 32-bit so I wonder if Raspup http://raspup.eezy.xyz/ (http://raspup.eezy.xyz/) could run on it since it would run relatively fast on a slower ARM. That or a Win95-era OS that also boots in RAM, but with less RAM requirements.
That said, if it loses all the data when it is powered off, if it can save data to a USB or microSD, does it really matter if it loses all the data? The USB and micro SD interface would probably use more power than the chip itself. Perhaps the wireless transmitters that use optical could be tethered to the microSD, or maybe there is an entirely different storage medium than can transfer data at a lower power than microSD. Having it solar powered, like the TI-30Xa, would essentially make it cordless (or cord-optional).

Attachments

Overview

	Apollo	Apollo2	Apollo4	Apollo2 Blue	Apollo3 Blue	Apollo3 Blue Plus
MCU Frequency	24 MHz	48 MHz	96 MHz 192 MHz TurboSPOT	48 MHz	48 MHz 96 MHz TurboSPOT	48 MHz 96 MHz TurboSPOT
MCU	32-bit Arm Cortex-M4F	32-bit Arm Cortex-M4F	32-bit Arm Cortex-M4F, DMA	32-bit Arm Cortex-M4F Dedicated BLE Core	32-bit Arm Cortex-M4F, DMA, Arm Cortex-M0 for BLE	32-bit Arm Cortex-M4F, DMA Arm Cortex-M0 for BLE
MCU Power Efficiency	34 µA/MHz	10 µA/MHz	3 µA/MHz	10 µA/MHz	6 µA/MHz	6 µA/MHz
NVM	512KB Flash	1MB Flash	2MB MRAM	1MB Flash	1MB Flash	2MB Flash
SRAM	64KB	256KB	1.8MB	256KB	384KB	768KB
Voltage	2.2-3.8 V	1.755-3.63 V	1.71-2.2 V	1.755-3.63 V	1.755-3.63 V	1.755-3.63 V

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scruss

Posts: 5565
Joined: Sat Jun 09, 2012 12:25 pm
Location: Toronto, ON

Re: TI-30Xa Solar-like Raspberry Pi Laptop & Underclocking the Pi

Wed Dec 30, 2020 10:39 pm

> *LimboMan (./../memberlist.php?mode=viewprofile&u=352743) wrote: ↑ (./../viewtopic.php?p=1788532#p1788532)*
> *Wed Dec 30, 2020 7:14 pm*
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There's a big difference between an ARM Cortex-M microcontroller and an ARM Cortex-A system-on-a-chip. Raspup can't run on a Cortex-M.

Cortex-M chips typically run at 48-200 MHz. They have a small amount of RAM (32-1024 KB) and built-in Flash storage (again, of the same order). They might have some extra I/O ports, but they're basically microcontrollers. They can't really run an OS as we would recognize it. Some of the really big ones (like the Cortex-M7 in the Teensy 4.1 (https://www.pjrc.com/store/teensy41.html) and the Colour Maximite 2 (https://micromite.org/product-category/maximites/)) have megabytes of RAM and storage, but don't exactly sip power. A 5-600 MHz core uses quite a bit of power.

Cortex-A SoCs are designed for applications on top of OSs. They can access lots of external RAM, and have useful peripherals for storage and networking. While they're energy efficient, it's not their primary application.

The smallest ARM system that I know of that's currently in production and can run Linux is the Allwinner F1C100s, as used in the Sipeed Lichee Nano (https://www.seeedstudio.com/Sipeed-Lichee-Nano-Linux-Development-Board-16M-Flash-WiFi-Version-p-2893.html). It's limited to 32 MB RAM, so it's going to be a *very* limited form of Linux.

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Pronouns: he/him

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Re: TI-30Xa Solar-like Raspberry Pi Laptop & Underclocking the Pi

Wed Dec 30, 2020 11:33 pm

> *scruss (./../memberlist.php?mode=viewprofile&u=20604) wrote: ↑ (./../viewtopic.php?p=1788626#p1788626)*
> *Wed Dec 30, 2020 10:39 pm*
>
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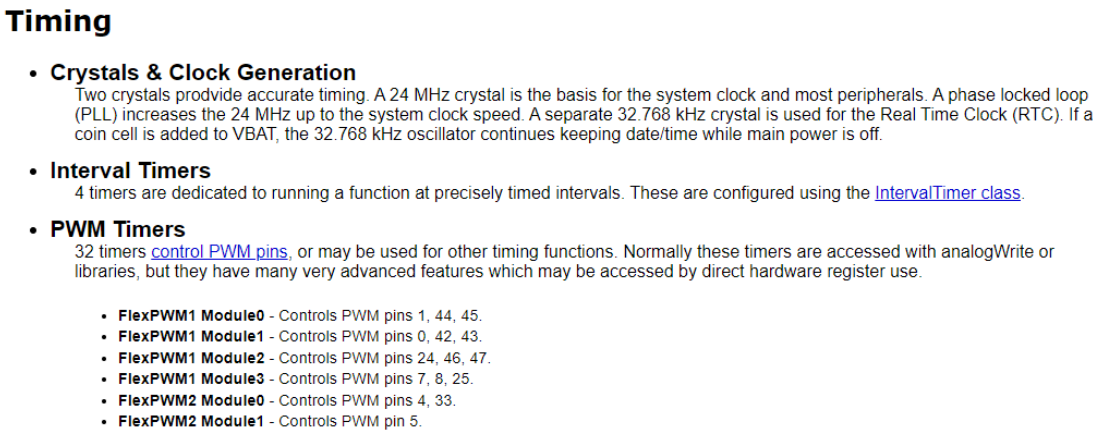
Thanks, I will look into these. http://arm.slitaz.org/rpi/ (http://arm.slitaz.org/rpi/) can run on 4-16MB of RAM, at least on x86. That port was only written for the first RPi. I've read of some others, like piCore, and DSL also use 16-48MB. Some SoCs have a lot of peripherals- though it may be possible to limit some of the peripheral power consumption as well.

Attachments



Teensy.PNG (60.76 KiB) Viewed 1457 times

~~LimboMan~~

Limbonian

Posts: 74
Joined: Sat Oct 31, 2020 7:12 pm

Re: TI-30Xa Solar-like Raspberry Pi Laptop & Underclocking the Pi

Thu Dec 31, 2020 1:07 am

> *scruss (./../memberlist.php?mode=viewprofile&u=20604) wrote: ↑ (./../viewtopic.php?p=1788626#p1788626)*
> *Wed Dec 30, 2020 10:39 pm*
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I've found why the Cortex-M chips can't run linux:

https://electronics.stackexchange.com/a/19243 (https://electronics.stackexchange.com/a/19243)
"Linux requires an MMU (Memory Management Unit). The ARM Cortex-M3 does not have one. It is impossible to run the mainline Linux kernel on the ARM Cortex-M3.

However, there is a variant of the Linux kernel for MMUless processors called uCLinux."

https://en.wikipedia.org/wiki/%CE%9CClinux (https://en.wikipedia.org/wiki/%CE%9CClinux)

Some more recent info: http://linuxgizmos.com/arm-announces-mb ... t-devices/ (http://linuxgizmos.com/arm-announces-mbed-os-for-iot-devices/)

https://www.freertos.org/ (https://www.freertos.org/)

As far as MO+, they are more power efficient than the Cortex-As, so it drives my curiosity that they can be powered by indoor light:
I recall the early Windows 3.1 and Windows 95 PCs having relatively graphic-rich OS's and ran on just a minimum of 1MB (3.1)-4MB (95) of RAM.

Update: it appears the Apollo 3 supports SPI and the 4 DSI : up to 640x480 resolution. My Packard Bell in '96 had 1MB of video RAM and it was a 640x480 CRT. I am curious if this is SoC is like Raspberry Pi's DSI with 4 lanes (even though only 2 are used). These appear to be made for things like smartwatches and smart home control panels, but they should have enough power to run a very lightweight desktop environment.
https://ambiq.com/wp-content/uploads/20 ... -Brief.pdf (https://ambiq.com/wp-content/uploads/2020/10/Apollo4-Blue-SoC-Product-Brief.pdf)

Update 2: 192mhz at peak speed, power (3uA/mhz) would be 576uA, or 0.576 millamps. By comparison, the Pi Zero W uses 700mA:
Zero HDMI off, LED off, USB WiFi 120 mA (0.7 W) https://www.pidramble.com/wiki/benchmar ... onsumption
(https://www.pidramble.com/wiki/benchmarks/power-consumption)

1000x less power.
While the mouse and keyboard could be run under blue tooth, it would possibly save more power to have it run the internet on the 2mbps connection:
https://maker.pro/raspberry-pi/tutorial ... -bluetooth (https://maker.pro/raspberry-pi/tutorial/connecting-raspberry-pi-3-wi-fi-via-bluetooth) it's unclear how many BT devices you can pair to a chip at a time, but it could cut out the power needed for a LAN+LED & Wifi.

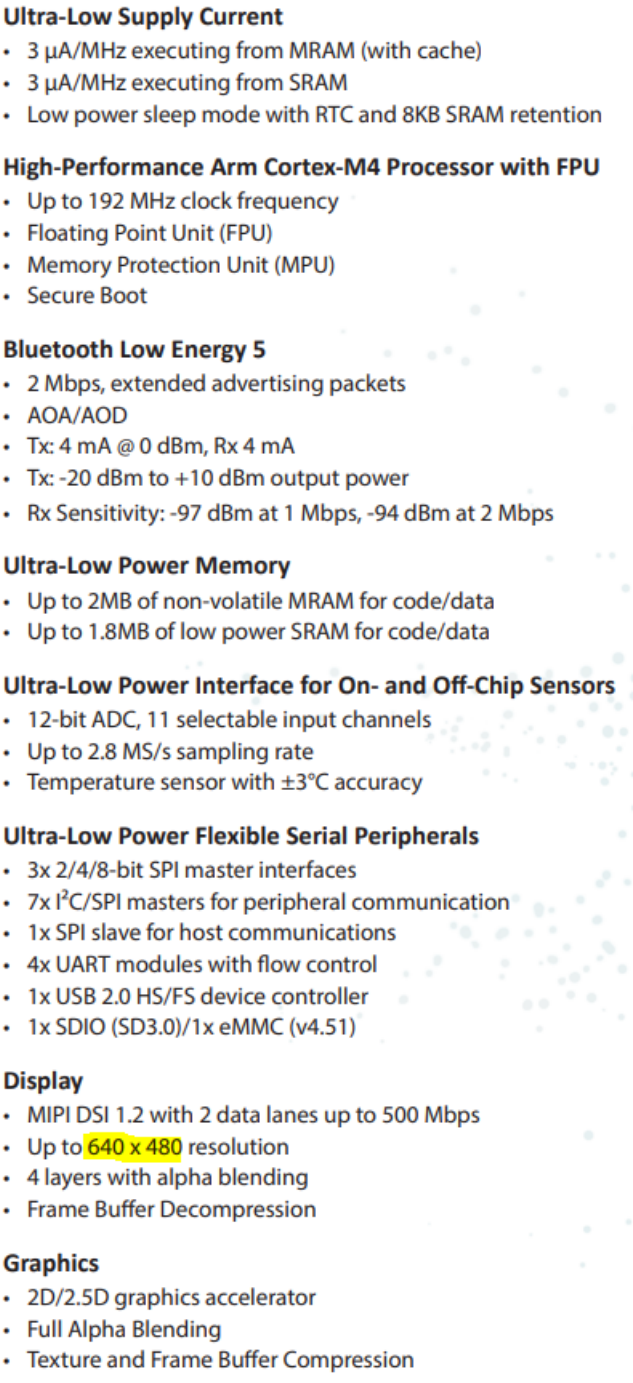
Add an e-ink screen with a max resolution of 640x480 via DSI, and you have a very capable laptop with potentially sub millwatt power consumption, although e-ink can use .4-1.1A per refresh on higher resolution (1872x1404) screens. It appears Rdot displays could lower it too, although I haven't seen used as pc monitors:

https://www.youtube.com/watch?v=HvSmbwIbFSA (https://www.youtube.com/watch?v=HvSmbwIbFSA)
https://rdotdisplays.com/articles/the-m ... nt-display (https://rdotdisplays.com/articles/the-most-energy-efficient-display)

"For E Ink and Rdot, energy is only required during switching and updating while no energy is consumed during idle state. Typically, the energy required for a full switch on an E Ink display is about 7 to 8mJ/cm2. The corresponding number for the Rdot display is about 1mJ/cm2 with the addition of 0,25mJ/cm2 every 15-60 minutes. LCD continuously consumes about 6µW/cm2." Update 3: Rdot resolution is not really high, more for signage digits than high pixel ppi count. Though even 400x300 might be useful as a GUI. I'd want at least 640x480 to do anything serious, lol.

"With the increased performance capability Apollo4 is able to serve as both an application processor and coprocessor."
https://www.eenewseurope.com/news/ambiq ... pollo4-soc (https://www.eenewseurope.com/news/ambiq-cuts-power-half-apollo4-soc)

Attachments



Ultra-Low Supply Current
- 3 µA/MHz executing from MRAM (with cache)
- 3 µA/MHz executing from SRAM
- Low power sleep mode with RTC and 8KB SRAM retention

High-Performance Arm Cortex-M4 Processor with FPU
- Up to 192 MHz clock frequency
- Floating Point Unit (FPU)
- Memory Protection Unit (MPU)
- Secure Boot

Bluetooth Low Energy 5
- 2 Mbps, extended advertising packets
- AOA/AOD
- Tx: 4 mA @ 0 dBm, Rx 4 mA
- Tx: -20 dBm to +10 dBm output power
- Rx Sensitivity: -97 dBm at 1 Mbps, -94 dBm at 2 Mbps

Ultra-Low Power Memory
- Up to 2MB of non-volatile MRAM for code/data
- Up to 1.8MB of low power SRAM for code/data

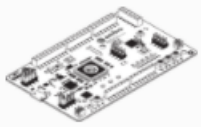
Ultra-Low Power Interface for On- and Off-Chip Sensors
- 12-bit ADC, 11 selectable input channels
- Up to 2.8 MS/s sampling rate
- Temperature sensor with ±3°C accuracy

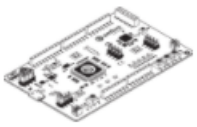
Ultra-Low Power Flexible Serial Peripherals
- 3x 2/4/8-bit SPI master interfaces
- 7x I²C/SPI masters for peripheral communication
- 1x SPI slave for host communications
- 4x UART modules with flow control
- 1x USB 2.0 HS/FS device controller
- 1x SDIO (SD3.0)/1x eMMC (v4.51)

Display
- MIPI DSI 1.2 with 2 data lanes up to 500 Mbps
- Up to 640 x 480 resolution
- 4 layers with alpha blending
- Frame Buffer Decompression

Graphics
- 2D/2.5D graphics accelerator
- Full Alpha Blending
- Texture and Frame Buffer Compression

apollo 4.PNG (135.67 KiB) Viewed 1424 times





Apollo4	Apollo2 Blue	Apollo3 Blue	Apollo3 Blue Plus	Apollo4 Blue
96 MHz 192 MHz TurboSPOT	48 MHz	48 MHz 96 MHz TurboSPOT	48 MHz 96 MHz TurboSPOT	96 MHz 192 MHz TurboSPOT
32-bit Arm Cortex-M4F, DMA	32-bit Arm Cortex-M4F Dedicated BLE Core	32-bit Arm Cortex-M4F, DMA, Arm Cortex-M0 for BLE	32-bit Arm Cortex-M4F, DMA Arm Cortex-M0 for BLE	32-bit Arm Cortex-M4F, DMA, Arm Cortex-M0 for BLE
3 µA/MHz	10 µA/MHz	6 µA/MHz	6 µA/MHz	3 µA/MHz
2MB MRAM	1MB Flash	1MB Flash	2MB Flash	2MB MRAM
1.8MB	256KB	384KB	768KB	1.8MB
1.71-2.2 V	1.755-3.63 V	1.755-3.63 V	1.755-3.63 V	1.71-2.2 V
12-bit, 11-channel, up to 2.8 MS/s Sampling Rate ADC	14-bit, 15-channel, up to 2.67 MS/s Sampling Rate ADC	14-bit, 15-channel, up to 2.67 MS/s Sampling Rate ADC	14-bit, 15-channel, up to 2.67 MS/s Sampling Rate ADC	12-bit, 11-channel, up to 2.8 MS/s Sampling Rate ADC
4	2	2	2	4
I²C/SPI master (8x) I²C/SPI slave USB FS/HS SDIO v3.0/1x eMMC	I²C/SPI master (4x) I²C/SPI slave	I²C/SPI master (6x) I²C/SPI slave	I²C/SPI master (6x) I²C/SPI slave	I²C/SPI master (7x) I²C/SPI slave USB FS/HS SDIO v3.0/1x eMMC
Dual/Quad/Octal-SPI Master (3x) 96 MHz SDR 48 MHz DDR	-	Dual/Quad/Octal-SPI Master 48 MHz SDR ISO7816 Master	Dual/Quad/Octal-SPI Master (3x) 48 MHz SDR ISO7816 Master	Dual/Quad/Octal-SPI Master (3x) 96 MHz SDR 48 MHz DDR
I²S master/slave (2x) full-duplex with ASRC	I²S slave for PDM Audio Pass-through	I²S slave for PDM Audio Pass-through	I²S slave for PDM Audio Pass-through	I²S master/slave (2x) full-duplex with ASRC
4x Stereo Digital Microphones 2x LP Analog Microphone with PGA	Dual Interface PDM for Mono and Stereo Audio Microphones	Dual Interface PDM for Mono and Stereo Audio Microphones	Dual Interface PDM for Mono and Stereo Audio Microphones	4x Stereo Digital Microphones 2x LP Analog Microphone with PGA
SPI 3-wire/4-wire Dual/QuadSPI MIPI DSI x2 4-layer Display Controller	-	SPI 3-wire/4-wire	SPI 3-wire/4-wire Dual/QuadSPI	SPI 3-wire/4-wire Dual/QuadSPI MIPI DSI x2 4-layer Display Controller
2D/2.5D GPU	-	-	-	2D/2.5D GPU
SecureSPOT 2.0	AES 128-bit Encryption	SecureSPOT	SecureSPOT	SecureSPOT 2.0
-	BLE 5	BLE 5	BLE 5	BLE 5

DSI M4.PNG (116.55 KiB) Viewed 1425 times

LimboMan

Posts: 74
Joined: Sat Oct 31, 2020 7:12 pm

Re: TI-30Xa Solar-like Raspberry Pi Laptop & Underclocking the Pi

Sat Jan 02, 2021 3:09 am

I've found an e-ink display forum as a great resource, so I've cross linked these threads:
https://forum.ei2030.org/t/e-ink-low-po ... ame-lid/82 (https://forum.ei2030.org/t/e-ink-low-power-cpu-solar-power-3-sides-of-the-same-lid/82)

I've moved some of my research to the Tensilica LX6-based ESP32 boards such as the Firebeetle and the Inkplate on Crowdsupply. Currently researching FabGL as the GUI:
https://hackaday.com/2019/07/08/esp32-g ... i-library/ (https://hackaday.com/2019/07/08/esp32-gets-advance-windowed-apps-using-this-vga-gui-library/)

~~LimboMan~~

Posts: 74
Joined: Sat Oct 31, 2020 7:12 pm

Re: TI-30Xa Solar-like Raspberry Pi Laptop & Underclocking the Pi

Mon Jan 04, 2021 12:34 am

> *scruss (./../memberlist.php?mode=viewprofile&u=20604) wrote: ↑ (./../viewtopic.php?p=1788626#p1788626)*
> *Wed Dec 30, 2020 10:39 pm*
>
> The smallest ARM system that I know of that's currently in production and can run Linux is the Allwinner F1C100s, as used in the Sipeed Lichee Nano (https://www.seeedstudio.com/Sipeed-Lichee-Nano-Linux-Development-Board-16M-Flash-WiFi-Version-p-2893.html). It's limited to 32 MB RAM, so it's going to be a *very* limited form of Linux.

I may be interested in trying out the Lichee Nano: I've found a transflective display on Aliexpress that supports FPC, but i will need to confirm it works:
https://www.aliexpress.com/item/4000419622239.html (https://www.aliexpress.com/item/4000419622239.html)

https://www.electronics-lab.com/licheep ... arm9-core/ (https://www.electronics-lab.com/licheepi-nano-high-performance-sd-card-sized-linux-board-based-on-an-arm9-core/)
" F1C100 supports Full HD video playback, including H.264, H.263, MPEG1 / 2/4 decoders. The integrated audio codec and I2S / PCM interface enable the user for an excellent audio experience. The TV-IN and TV-OUT interfaces allow the use of video devices such as the camera and the TV.

Display I/F – 40-pin RGB LCD FPC connector supporting 272×480, 480×800, 1024×600 and other resolutions resistive and capacitive displays
Video Decoding – H.264 / MPEG up to 720p
I/Os via 2.54mm pitch through holes and 1.27mmm pitch castellated holes
SDIO for WiFi module
2x SPI, 3x TWI (I2C),3x UART
1x TV out, 2x TV in"

https://www.digikey.com/en/products/det ... 03/5300387 (https://www.digikey.com/en/products/detail/sharp-microelectronics/LS013B7DH03/5300387) are these plug and play ready for loading linux? (assuming the resolution is larger)

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