

Microchip社 不揮発性FPGAの特徴

低消費電力編

～消費電力/温度測定してみた！～

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**Microchip Technology社のFPGAは
消費電力が低いって謳ってますが
本当でしょうか？**

温度と消費電力の実測

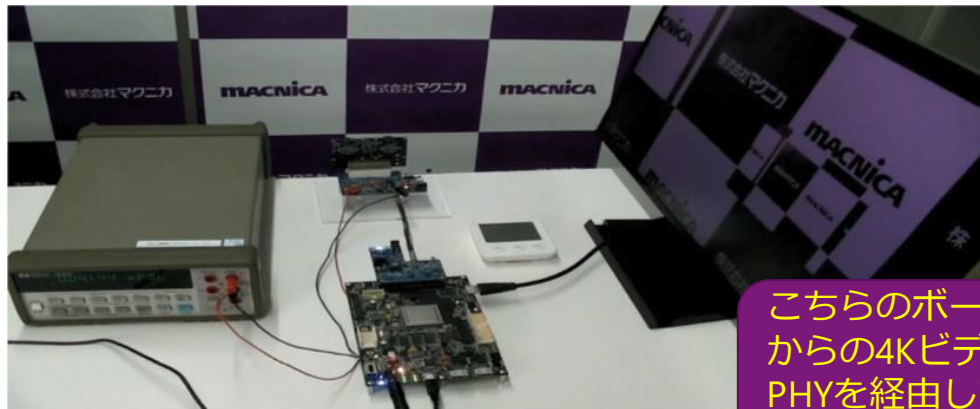
構成は

- カメラで映像を撮影
- 12.5GのCoaXpressで送出
- モニターにHDMIで出力

測定環境

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Video-KitとCoaXPress FMC Daughter Card



こちらのボードでは、デュアルカメラからの4KビデオデータをEqcologicのPHYを経由して12.5Gbpsでホスト側へ出力するデモを実施できます



Daughter CardにはPolarFire 100KLEのデバイスが搭載されています



なんと、このボードには
ヒートシンクやファンが付いていません
本当に大丈夫なんでしょうか？

Smart Power、MPE による消費電力の 算出

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消費電力見積もり

● Libero SoC開発ツール => SmartPower を起動

The screenshot displays the Libero SoC development tool interface. The main window shows the Design Flow on the left, with the 'Verify Power' step highlighted. A context menu is open over 'Verify Power', and the 'Open Interactively' option is selected. The central pane shows a list of reports, including 'Verify Timing' and 'Verify Power'. The right pane displays the 'Timing Report Max Delay Analysis' for the 'VIDEO_KIT_TOP' design. The report includes design parameters such as Family (PolarFire), Die (MPF100T), Package (FCSG325), and Temperature Range (-40 - 100 C). The bottom pane shows a list of messages, including warnings and errors related to clock annotations and timing constraints.

Libero - E:\sample\PFKCP_12GV12.4\cp_device\cp_device.prj

Project File Edit View Design Tools Help

Design Flow

Top Module(root) VIDEO_KIT_TOP

Active Synthesis Implementation: synthesis

Tool

- Simulate
- Constraints
 - Manage Constraints
- Implement Design
- Open Netlist Viewer
- Synthesize
 - Verify Post-Synthesized Design
 - Generate Simulation File
- Simulate
- Place and Route
 - Verify Post Layout Implementation
 - Generate Back Annotated Files
- Simulate
- Verify Timing
- Open SmartTime
- Verify Power (selected)
- Open SSN An
- Configure Hardware
 - Run
 - Clean and Run All
 - Open Interactively (highlighted)
 - Configure Program
 - Clean
- Programming Co
- Configure Program

Design Flow Design Hierarchy J Site View Report Files

Message

Messages Errors Warnings Manage suppressed messages

Message

- Option "-name" of set_clock_groups cannot be forward-annotated; there is no inclusion option in your place-and-route tool.
- Clock CORE/JTAGDEBUG_UJ_ITAG_266_0x_346_85_0_0(un1_DUT_TCK_inferred_clock) in set_clock_groups command cannot be found and will not be forward annotated
- Found clock cnp_device_top_0/hsi_0/_XCVR/LANE0/RX_CLK_R with period 6.40ns
- Found inferred clock VIDEO_KIT_TOP(clk50m) with period 10.00ns. Please declare a user-defined clock on port clk50m.
- Paths from clock (cnp_device_top_0/hsi_0/_XCVR/LANE0/TX_CLK_R) to clock (cnp_device_top_0/pil40m_0/pil40m_0/pil_inst_0/OUT0r) are overconstrained because the required time of 0.20 ns is too small.
- Timing constraint (to_get_pins { IMX334_IF_TOP_0/PF_JOD_GENERIC_RX_CO_0/PF_LANECTRL_0/LANECTRL*HS_IO_CLK_PAUSE }) (false path) was not applied to the design because none of the paths specified by the constraint exist in the design.
- Place and Route (VIDEO_KIT_TOP) Please refer to the log file for details about 14 Info(s)
- Generate Bitstream (VIDEO_KIT_TOP)

Loc Message

Find Next Previous Find All Search in Match case Match whole word

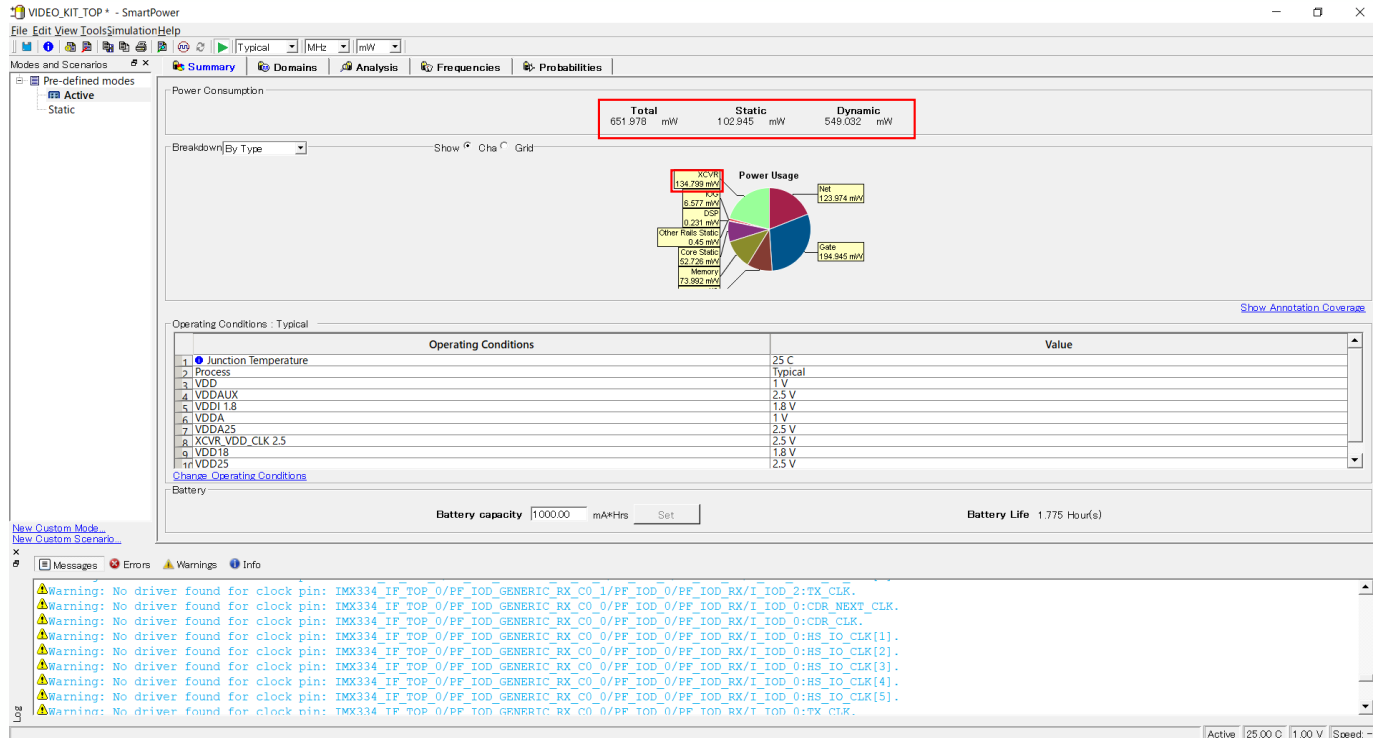
SmartTime Version 12.900.0.16
Microsemi Corporation - Microsemi Libero Software Release v12.4 (Version 12.900.0.16)
Date: Fri Jun 5 11:59:05 2020

Design VIDEO_KIT_TOP
Family PolarFire
Die MPF100T
Package FCSG325
Temperature Range -40 - 100 C
Voltage Range 0.97 - 1.03 V
Speed Grade -1
Design State Post-Layout
Data source Production
Operating Conditions slow_lv_ht
Operating Conditions slow_lv_ht
Scenario for Timing Analysis timing_analysis

Fam: PolarFire Part: MPF100T-FCSG325 VHDL

消費電力見積もり

- SmartPower
- Toggle rate : 20%、Tj : 25°C



消費電力見積もり

- SmartPower
- Toggle rate : 20%、Tj : 25°C

The screenshot displays the SmartPower simulation tool interface for VIDEO_KIT_TOP+. The main window shows power consumption analysis results. The total power consumption is 651.878 mW, with static power at 102.945 mW and dynamic power at 548.032 mW. A pie chart titled 'Power Usage' breaks down the static power into components: Net (129.974 mW), Core (194.945 mW), Other (73.992 mW), Core Static (62.728 mW), Other Ratio Static (9.65 mW), and XCVR (0.231 mW). The dynamic power is also broken down into XCVR (134.792 mW), I/O (9.577 mW), and CSF (0.231 mW). The operating conditions table shows a junction temperature of 25°C and various supply voltages. The battery capacity is set to 1000.00 mAh, resulting in a battery life of 1.775 hours. The log window at the bottom shows multiple warnings about missing drivers for various clock pins.

Power Consumption

Total	Static	Dynamic
651.878 mW	102.945 mW	548.032 mW

Power Usage

Component	Value (mW)
Net	129.974
Core	194.945
Other	73.992
Core Static	62.728
Other Ratio Static	9.65
XCVR	0.231
XCVR	134.792
I/O	9.577

Operating Conditions: Typical

Operating Conditions	Value
1 Junction Temperature	25 C
2 Process	Typical
3 VDD	1 V
4 VDDAUX	2.5 V
5 VDD118	1.8 V
6 VDDA	1 V
7 VDDA25	2.5 V
8 XCVR_VDD_CLK_25	2.5 V
9 VDD18	1.8 V
10 VDD25	2.5 V

Battery

Battery capacity: 1000.00 mAhHrs Set

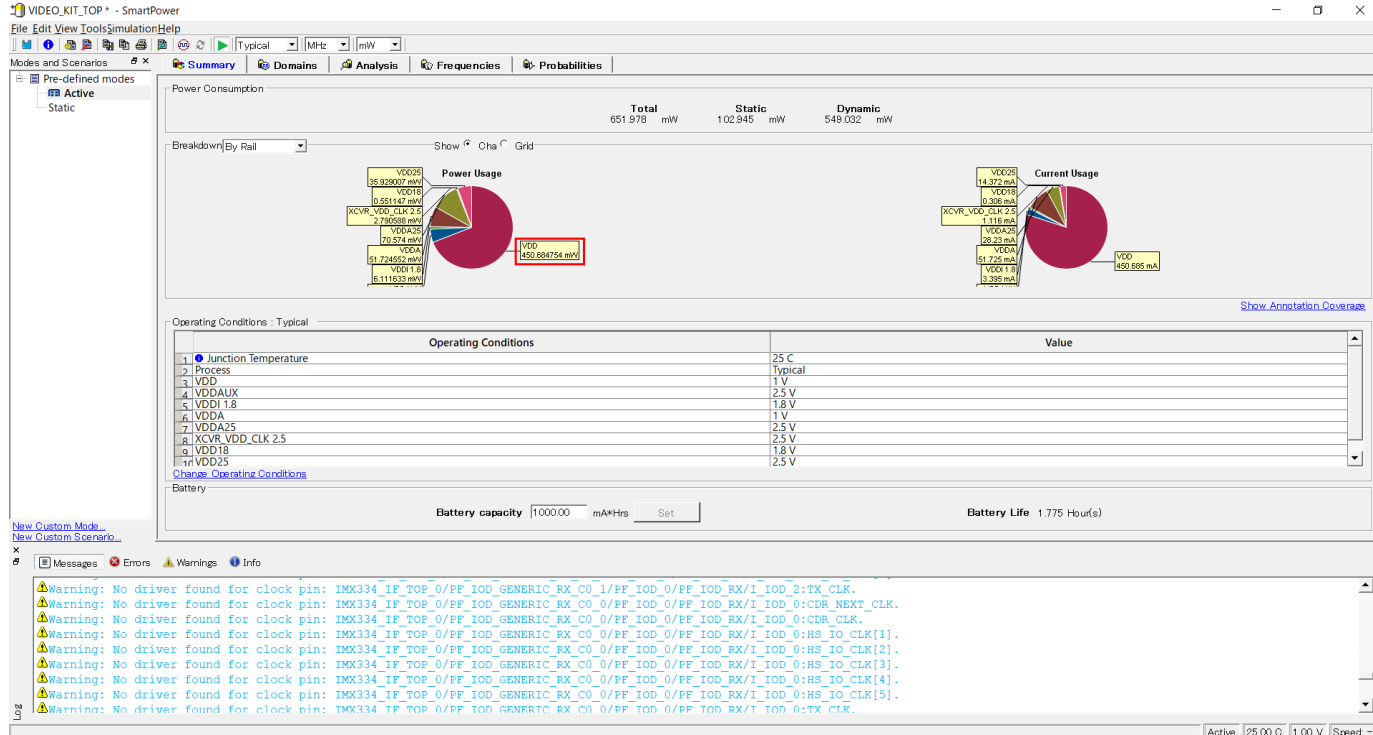
Battery Life: 1.775 Hour(s)

Log

- Warning: No driver found for clock pin: IMX334_IF_TOP_0/PF_IOD_GENERIC_RX_CO_1/PF_IOD_0/PF_IOD_RX/I_OD_2:TX_CLK.
- Warning: No driver found for clock pin: IMX334_IF_TOP_0/PF_IOD_GENERIC_RX_CO_0/PF_IOD_0/PF_IOD_RX/I_OD_0:CDR_NEXT_CLK.
- Warning: No driver found for clock pin: IMX334_IF_TOP_0/PF_IOD_GENERIC_RX_CO_0/PF_IOD_0/PF_IOD_RX/I_OD_0:CDR_CLK.
- Warning: No driver found for clock pin: IMX334_IF_TOP_0/PF_IOD_GENERIC_RX_CO_0/PF_IOD_0/PF_IOD_RX/I_OD_0:HS_IO_CLK[1].
- Warning: No driver found for clock pin: IMX334_IF_TOP_0/PF_IOD_GENERIC_RX_CO_0/PF_IOD_0/PF_IOD_RX/I_OD_0:HS_IO_CLK[2].
- Warning: No driver found for clock pin: IMX334_IF_TOP_0/PF_IOD_GENERIC_RX_CO_0/PF_IOD_0/PF_IOD_RX/I_OD_0:HS_IO_CLK[3].
- Warning: No driver found for clock pin: IMX334_IF_TOP_0/PF_IOD_GENERIC_RX_CO_0/PF_IOD_0/PF_IOD_RX/I_OD_0:HS_IO_CLK[4].
- Warning: No driver found for clock pin: IMX334_IF_TOP_0/PF_IOD_GENERIC_RX_CO_0/PF_IOD_0/PF_IOD_RX/I_OD_0:HS_IO_CLK[5].
- Warning: No driver found for clock pin: IMX334_IF_TOP_0/PF_IOD_GENERIC_RX_CO_0/PF_IOD_0/PF_IOD_RX/T_OD_0:TX_CLK.

消費電力見積もり

- SmartPower
- Toggle rate : 20%、Tj : 25°C



消費電力見積もり

- SmartPower(Libero SoC)、Microsemi Power Estimator(MPE)
- Toggle rate : 20%、Tj : 25°C

SmartPower

	mW
Total Power	651.978
Static	102.945
Dynamic	414.233
XCVR	134.799

	mW
Rail VDD	450.684

MPE

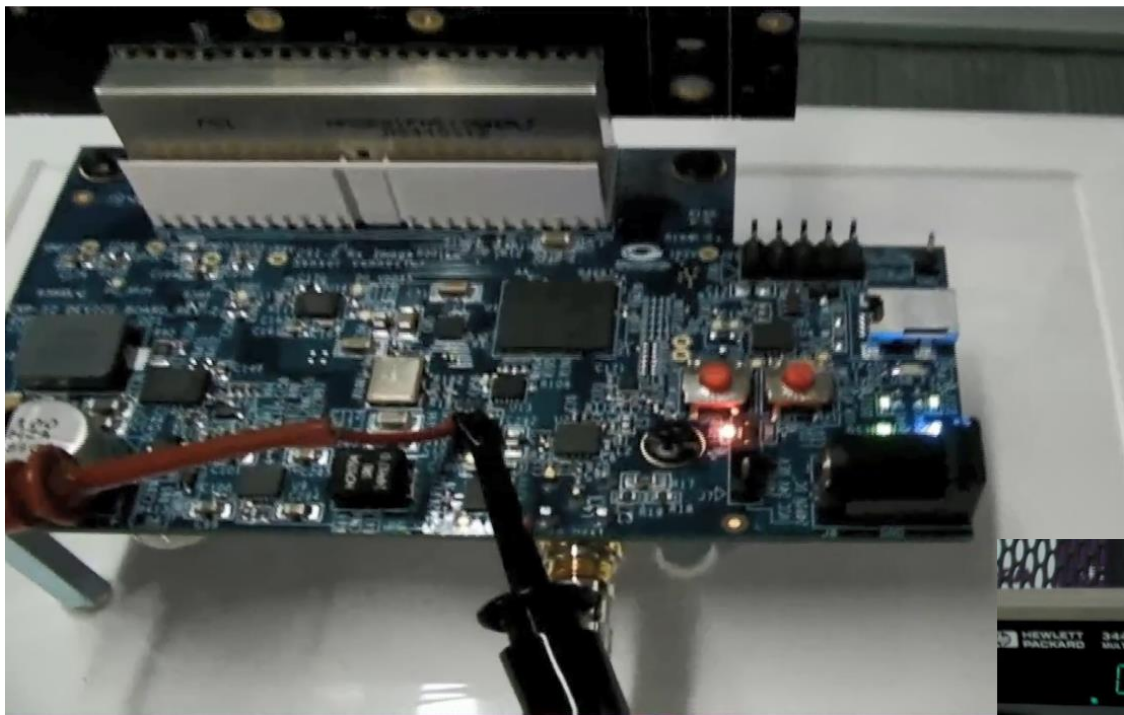
	mW
Total Power	544
Static	53
Dynamic	371
XCVR	120

	mW
VDD	357

消費電力の実測

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消費電力の実測



PF Core電源に直列に挿入されている
10mΩの抵抗の両端の電圧は、4.14 mV
を表示しています。
Core電圧は1Vですので、4.14mVを100
倍にすれば414mWになります。



消費電力比較(VDD)

- SmartPower(Libero SoC)、CXP Daughter Cardの実測値
- Toggle rate : 20%、Tj : 25°C

SmartPower

	mW
Total Power	651.978
Static	102.945
Dynamic	414.233
XCVR	134.799

	mW
Rail VDD	450.684

実測値

	mW
VDD	414.1

405.6156 mW (-10%) < 450.684 mW < 495.7524 mW (+10%)

消費電力比較(VDD)

- SmartPower(Libero SoC)、CXP Daughter Cardの実測値
- Toggle rate : 20%、Tj : 25°C

SmartPower

	mW
Total Power	651.978
Static	102.945
Dynamic	414.233
XCVR	134.799

	mW
Rail VDD	450.684

実測値

	mW
VDD	414.1

12.5Gbpsで動作させても、**低消費電力!!**

デバイス温度の実測

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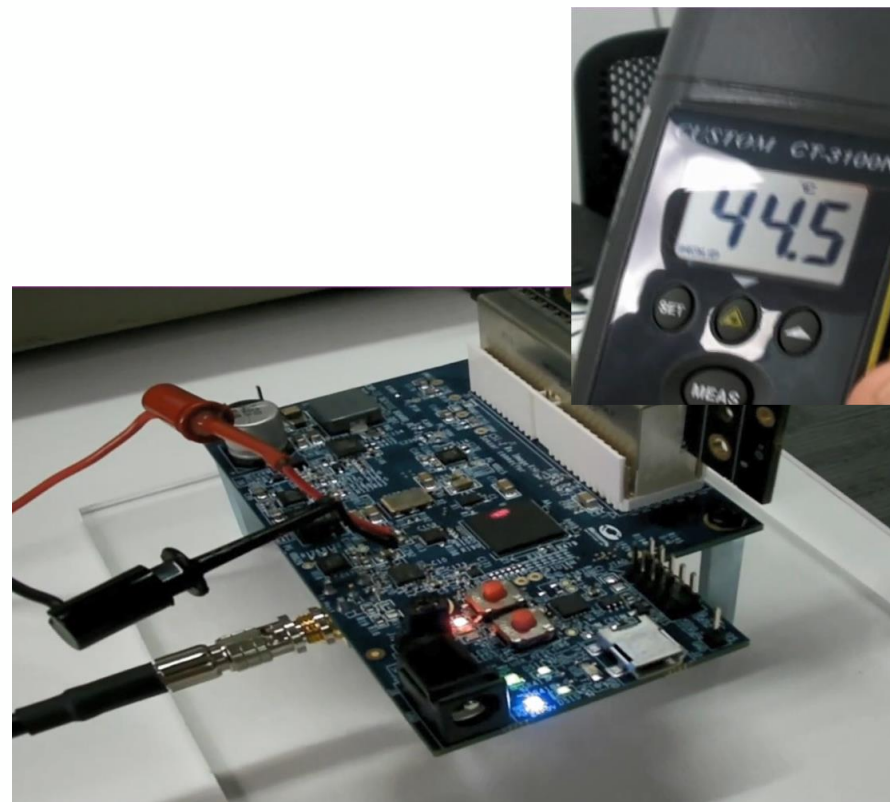
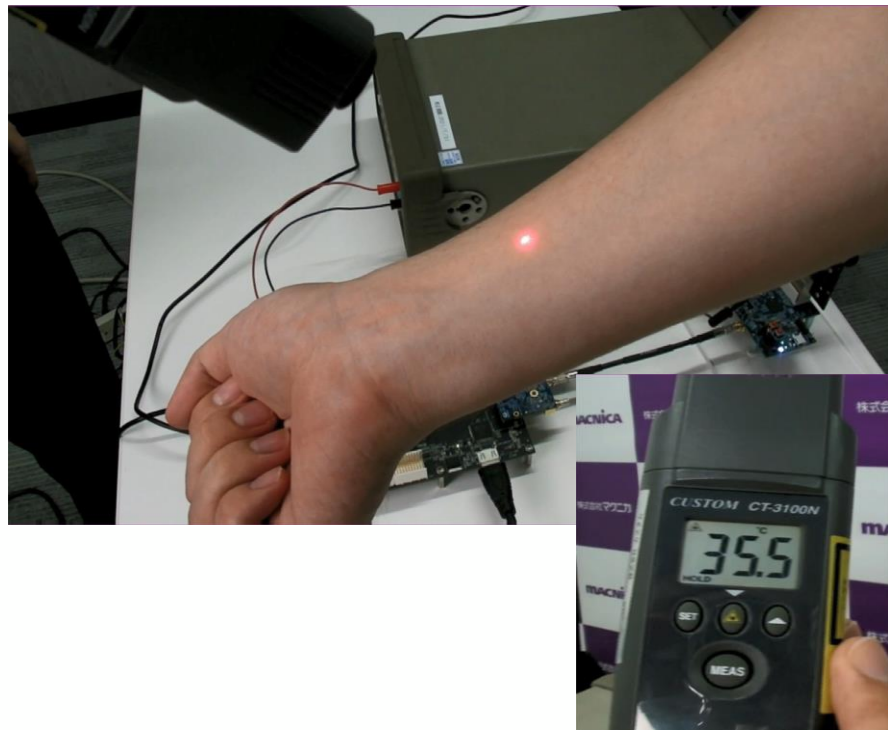
算出された消費電力だけでは
デバイスの発熱量が
ピンとこないと思われま

デバイス温度の実測

非接触型の温度計を使って

- 自分の体温を測定
- PolarFireのケース温度を測定

デバイス温度の実測



デバイス温度の実測

ご覧の通り、ケース温度はかなり低めです

これって凄いことだと思いませんか？

まとめ

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低消費電力FPGA『PolarFire』のまとめ

CoaXPress 12.5G で動作させても。。。

◆ FPGAのVDDの消費電力は、**414 mW**！

◆ FPGA全体の見積もりも 約652 mW程度！

◆ ヒートシンクや強制風冷無しでも ケース温度は **44.5 °C**！

◆ デバイス表面に触れても **熱くありません**！

低消費電力FPGA『PolarFire』のまとめ

低消費電力FPGAといえば

まさにPolarFire

小型カメラに搭載しても熱設計が容易です

是非、PolarFireをお試しく下さい！

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