

# 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

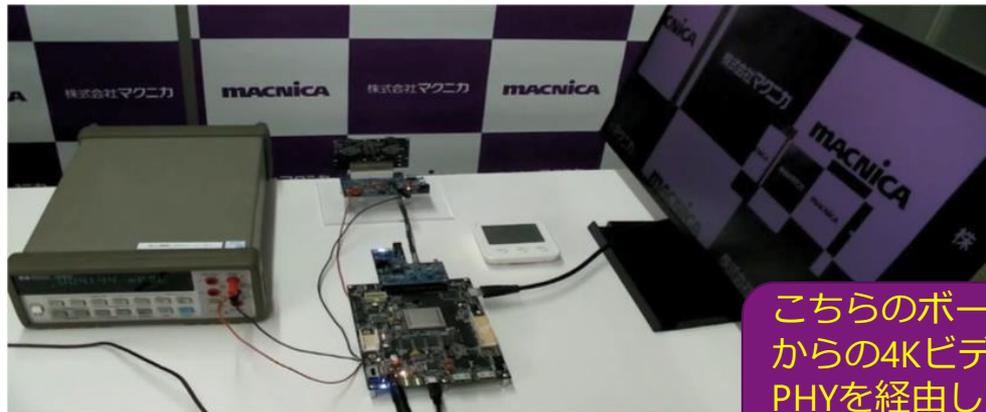
## 構成は

- 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' tool 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 details such as 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, and a table of design parameters.

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

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 cxp\_device\_top\_0/hsi\_0/\_XCVR/LANE0/RX\_CLK\_R with period 6.40ns
- Found inferred clock VIDEO\_KIT\_TOP/clk50m\_j with period 10.00ns. Please declare a user-defined clock on port clk50m\_j.
- Paths from clock (cxp\_device\_top\_0/hsi\_0/\_XCVR/LANE0/TX\_CLK\_R) to clock (cxp\_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\_0\_CLK\_PAUSE !!!) (false path) was not applied to the design because none of the paths specified by the constraint exist in the design.

Loc: Message

Find: [ ] Next Previous Find All Search in: [ ] Match case Match whole word

Fam: PolarFire Part: MPF100T-IFCSG325 VHDL

# 消費電力見積もり

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

The screenshot displays the SmartPower interface for a project named VIDEO\_KIT\_TOP+. The main window shows power consumption analysis results. A summary box at the top indicates a Total power consumption of 651.978 mW, composed of 102.945 mW Static and 548.032 mW Dynamic. Below this, a pie chart titled 'Power Usage' breaks down the total power into several categories: Net (129.974 mW), Core (194.945 mW), XCVR (134.792 mW), Other (6.57 mW), Other Static (6.45 mW), Core Static (62.728 mW), Memory (73.892 mW), and CSF (0.231 mW). The 'Operating Conditions' table lists various parameters such as Junction Temperature (25°C), Process, VDD, VDDAUX, VDDI18, VDDA, VDDA25, XCVR\_VDD\_CLK\_25, VDDI8, and VDD25. The Battery section shows a capacity of 1000.00 mAh and a life of 1.775 hours. The bottom panel displays a list of warnings, including 'No driver found for clock pin' for various components like IMX334 and TX CLK.

Power Consumption	Total	Static	Dynamic
	651.978 mW	102.945 mW	548.032 mW

Power Usage	Value
Net	129.974 mW
Core	194.945 mW
XCVR	134.792 mW
Other	6.57 mW
Other Static	6.45 mW
Core Static	62.728 mW
Memory	73.892 mW
CSF	0.231 mW

Operating Conditions	Value
1 Junction Temperature	25 C
2 Process	Typical
3 VDD	1 V
4 VDDAUX	2.5 V
5 VDDI18	1.8 V
6 VDDA	1 V
7 VDDA25	2.5 V
8 XCVR_VDD_CLK_25	2.5 V
9 VDDI8	1.8 V
10 VDD25	2.5 V

Battery	Value
Battery capacity	1000.00 mAhHrs
Battery Life	1.775 Hour(s)

# 消費電力見積もり

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

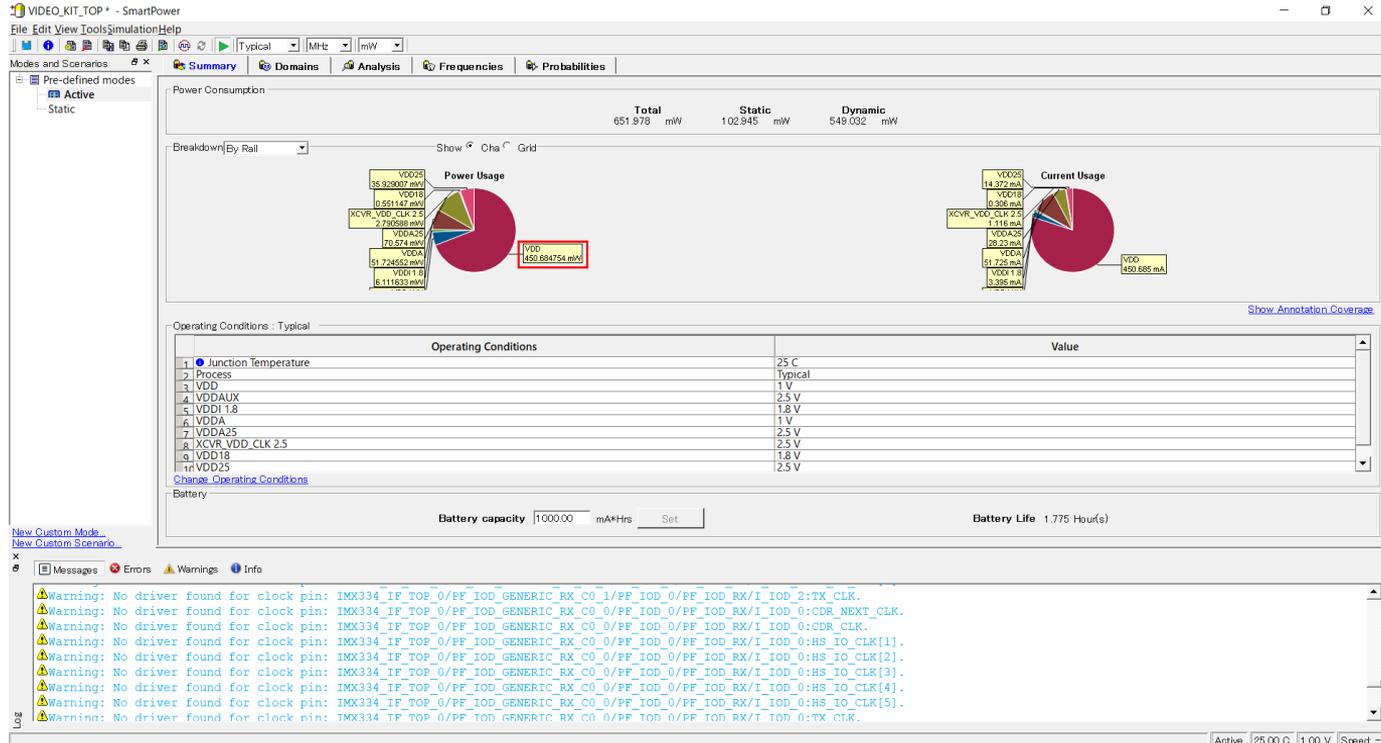
The screenshot displays the SmartPower software interface for a project named VIDEO\_KIT\_TOP+. The main window shows power consumption analysis results. At the top, the total power consumption is 651.878 mW, broken down into static power (102.945 mW) and dynamic power (548.032 mW). A pie chart titled 'Power Usage' shows the following components: Net (129.974 mW), Core (194.945 mW), Memory (73.892 mW), Core Static (62.728 mW), Other Ratio Static (9.45 mW), CSF (0.231 mW), XCVR (134.792 mW), I/O (9.577 mW), and VCC (0.231 mW). Below the pie chart is a table of operating conditions, including Junction Temperature (25°C), Process, VDD (1V), VDDAUX (2.5V), VDD118 (1.8V), VDDA (1V), VDDA25 (2.5V), XCVR\_VDD\_CLK\_25 (2.5V), VDD18 (1.8V), and VDD25 (2.5V). The battery capacity is set to 1000.00 mAh, resulting in a battery life of 1.775 hours. The bottom of the interface shows a log of warnings, including 'No driver found for clock pin' for various pins.

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

Power Usage	Value
Net	129.974 mW
Core	194.945 mW
Memory	73.892 mW
Core Static	62.728 mW
Other Ratio Static	9.45 mW
CSF	0.231 mW
XCVR	134.792 mW
I/O	9.577 mW
VCC	0.231 mW

# 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

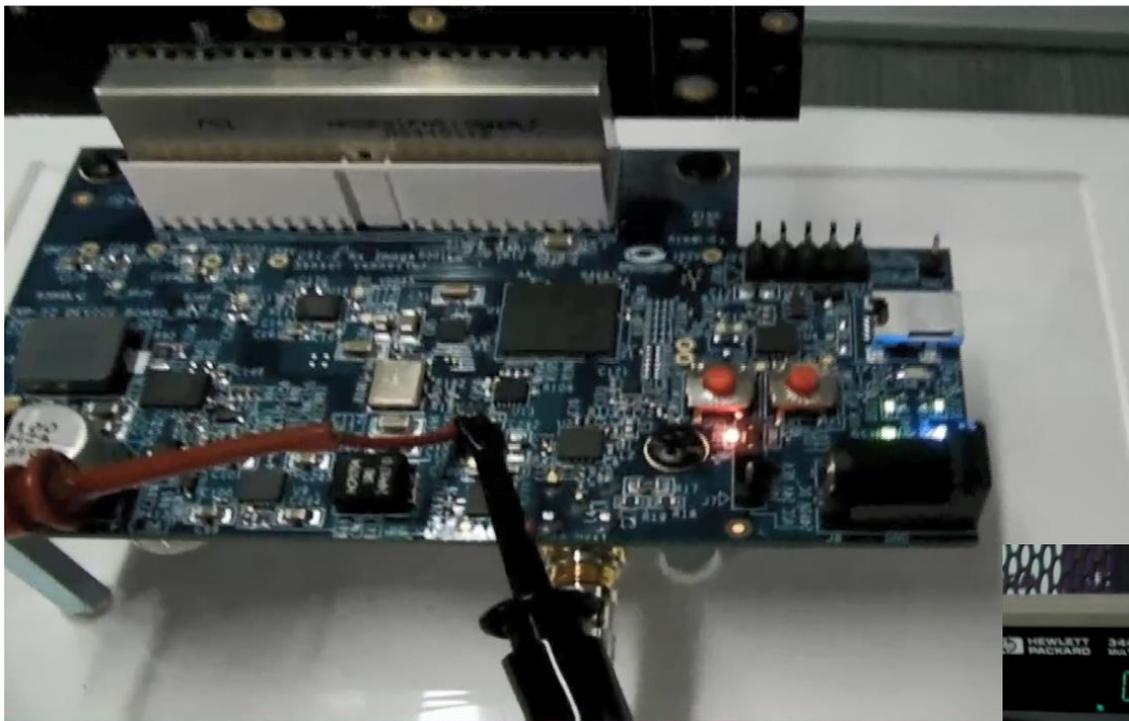
	mW
Total Power	544
Static	53
Dynamic	371
XCVR	120

	mW
VDD	357

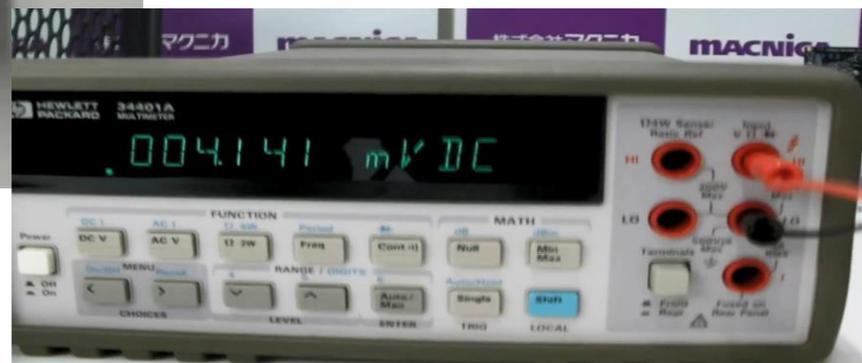
# 消費電力の実測

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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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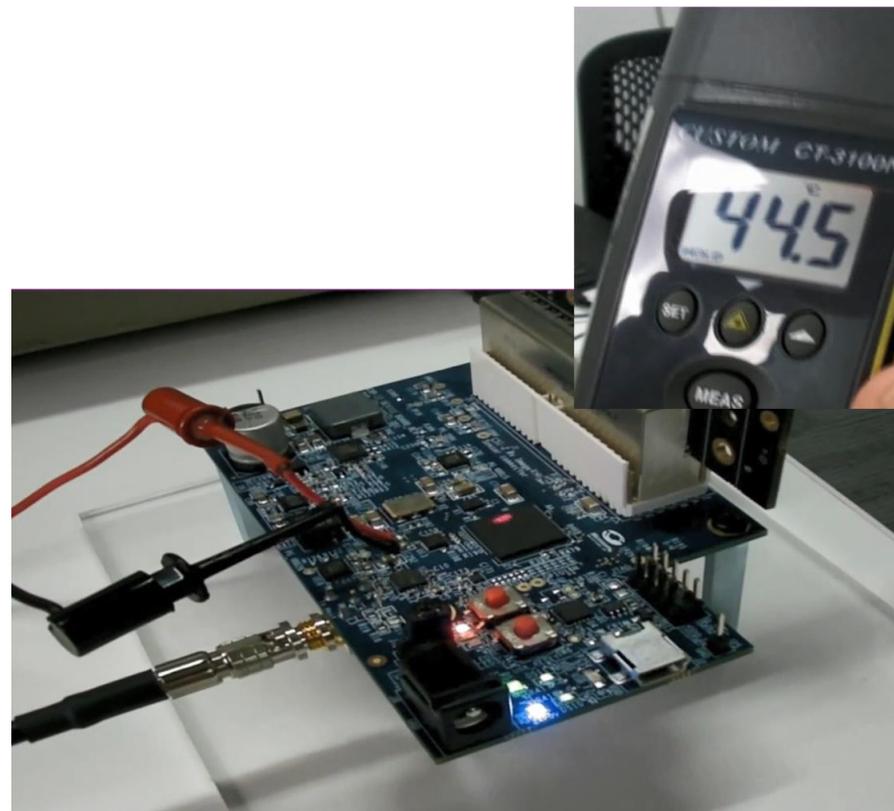
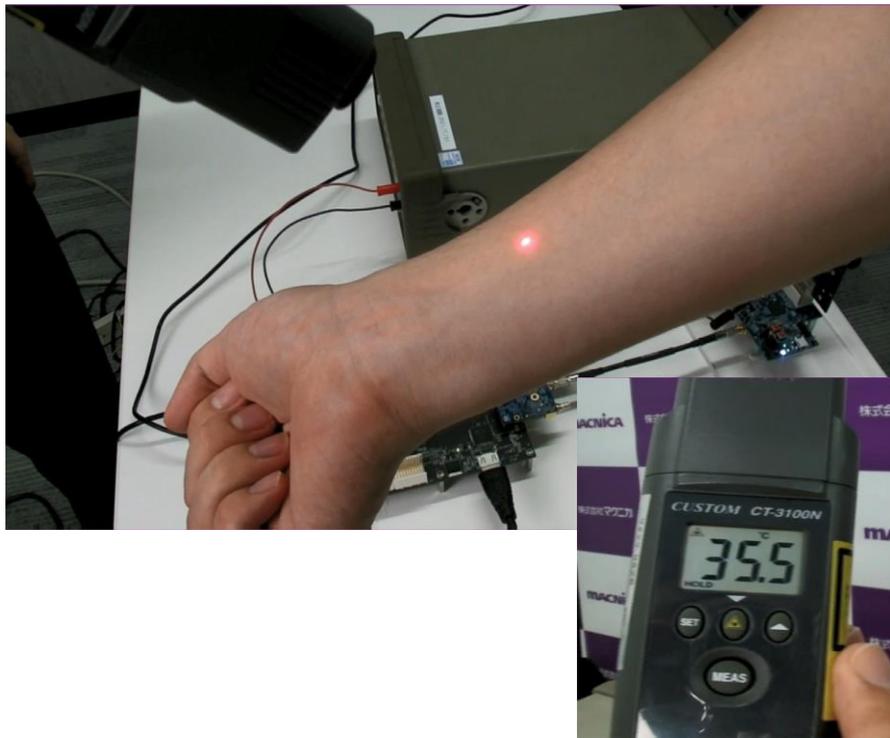
算出された消費電力だけでは  
デバイスの発熱量が  
ピンとこないと思われま

# 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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