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Kneron KL720 Power Consumption

Document Name: **Kneron KL720 Power Consumption Measurement**

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Kneron Inc

Kneron Inc
Engineering Design Document

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0. Introduction

The purpose of this document is to provide power consumption measurement which is running with Kneron KL720 SDK1.0 code for the reference.

1. Terminology

96 board: A KL720 demo board with size 9x6

xxx_BAS: Base power of KL720 which include CM4 and some peripherals

0V9_NPU: 0.9v NPU and DSP power

VCC09V_OSC12M: 12MHz oscillator power

VCC18IO_RTC: 1.8V RTC power

2. Power consumption table of Chip

Note: Imax/Iavg is the measured result by meter on each power domain within specific period/operation.

96Board		1	2	3	4	5	6
Yolov5s TinyYolo V3 416 Yolo V3 416/608		RTC	scpu+ncpu on	Inference yolov5s_640	Inference tyv3_416	Inference yolo v3_416	Inference yolo v3_608
0V9_BAS	Imax	0 mA	395.192 mA	430.74 mA	430.694 mA	423.001 mA	426.408 mA
0V9_BAS	Iavg	0 mA	394.578 mA	428.897 mA	427.973 mA	418.465 mA	422.859 mA
0.9 V		0 mW	355.6728 mW	387.666 mW	387.6246 mW	380.7009 mW	383.7672 mW
0V9_NPU	Imax	0 mA	310.1 mA	1012.5 mA	942.9 mA	1151.7 mA	1106.7 mA
0V9_NPU	Iavg	0 mA	309.5 mA	1002.4 mA	936.4 mA	1122.5 mA	1081.9 mA
0.9 V		0 mW	279.09 mW	911.25 mW	848.61 mW	1036.53 mW	996.03 mW
1V2_BAS	Imax	0mA	49.166 mA	209.5 mA	236.3 mA	181.5 mA	180.8 mA
1V2_BAS	Iavg	0 mA	49.135 mA	206.3 mA	198.5 mA	157 mA	158.9 mA
1.2 V		0 mW	58.9992 mW	251.4 mW	283.56 mW	217.8 mW	216.96 mW
1V8_BAS	Imax	0 mA	61.69954 mA	68.60145 mA	69.29938 mA	67.21059 mA	67.77696 mA
1V8_BAS	Iavg	0 mA	61.68952 mA	68.30321 mA	68.66522 mA	66.39841 mA	66.82768 mA
1.8 V		0 mW	111.05917 mW	123.48261 mW	124.73888 mW	120.97906 mW	121.99853 mW
3V3_BAS	Imax	0 mA	1.09747 mA	1.03143 mA	1.09889 mA	1.09261 mA	1.102 mA
3V3_BAS	Iavg	0 mA	1.09638 mA	1.00075 mA	0.98241 mA	1.08982 mA	1.09633 mA
3.3 V		0 mW	3.621651 mW	3.403719 mW	3.626337 mW	3.605613 mW	3.6366 mW
VCC09V_OSC12M	Imax	0.0116mA	0.014 mA	0.01639 mA	0.01656 mA	0.01687 mA	0.01686 mA
VCC09V_OSC12M	Iavg	0.0116 mA	0.014 mA	0.01591 mA	0.01607 mA	0.01636 mA	0.01638 mA
0.9 V		0.01044 mW	0.0126 mW	0.014751 mW	0.014904 mW	0.015183 mW	0.015174 mW
VCC18IO_RTC	Imax	0.441 mA	0.6195 mA	0.6245 mA	0.6219 mA	0.6235 mA	0.6225 mA
VCC18IO_RTC	Iavg	0.44 mA	0.6194 mA	0.624 mA	0.6215 mA	0.623 mA	0.6217 mA
1.8 V		0.7938 mW	1.1151 mW	1.1241 mW	1.11942 mW	1.1223 mW	1.1205 mW
Summary		0.80424 mW	809.57052 mW	1678.3412 mW	1649.2941 mW	1760.7531 mW	1723.528 mW

In this table, NCPU(DSP) is down by disabling DSP PLL and asserting DSP reset. The power data of 0V9_NPU contains NPU power only.		Inference yolov5s 640	Inference yolo v3_608
0V9_BAS	Imax	405.786 mA	413.281 mA
	Iavg	399.077 mA	401.473 mA
0.9 V		365.2074 mW	371.9529 mW
0V9_NPU	Imax	865.3 mA	1026.4 mA
	Iavg	860.2 mA	986.9 mA
0.9 V		778.77 mW	923.76 mW
1V2_BAS	Imax	173.5 mA	177.3 mA
	Iavg	173 mA	158.8 mA
1.2 V		208.2 mW	212.76 mW
1V8_BAS	Imax	64.40072 mA	66.77406 mA
	Iavg	61.55325 mA	61.54387 mA
1.8 V		115.9213 mW	120.19331 mW
3V3_BAS	Imax	1.18971 mA	1.19417 mA
	Iavg	1.18767 mA	1.18978 mA
3.3 V		3.926043 mW	3.940761 mW
VCC09V_OSC12M	Imax	0.01315 mA	0.01347 mA
	Iavg	0.01312 mA	0.01331 mA
0.9 V		0.011835 mW	0.012123 mW
VCC18IO_RTC	Imax	0.6681 mA	0.6683 mA
	Iavg	0.668 mA	0.6682 mA
1.8 V		1.20258 mW	1.20294 mW
Summary		1473.2392 mW	1633.822 mW

3. Summary

All the measurement result includes only KL720 silicon power.

The system doing Tiny Yolo v3 416 inference with 125 frame rate per second consume total power around 1.650W. We can see the NPU and DSP power is 848mW which is the biggest consumer.

System running Yolo v3 416/608 consumes more power than Tiny Yolo v3 416. It's above 1.7W totally. NPU and DSP consume about 1W in this case.

A small table shows the power of NPU inference without DSP pre-processing and post-processing. Not only the DSP process is stopped by FW but the DSP PLL clock is also stopped and DSP reset is kept asserting. It helps customer analyze the pure NPU power consumption.

iAVG	RTC	scpu+ncpu on	Inference yolov5s	Inference Tiny yolo 416	Inference yolo v3_416	Inference yolo v3_608
Chip	0.80244 mW	808.41891 mW	1663.113072 mW	1594.108212 mW	1699.518168 mW	1670.004615 mW

iMAX	RTC	scpu+ncpu on	Inference yolov5s	Inference Tiny yolo 416	Inference yolo v3_416	Inference yolo v3_608
Chip	0.80424 mW	809.570523 mW	1678.34118 mW	1649.294145 mW	1760.753058 mW	1723.528002 mW