

System Design Consideration Using PMIC for Low-Power Wearable and IoT Applications

Emmanuel T. Nana

Technical Marketing Manager
Secure Interfaces & Power

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Agenda

- Power Management Requirements for RT600/500 Family
- Power Management IC (PMIC) Suitable for RT600/500 Family
- Introduction to PCA9420 PMIC
- Next Generation PMIC for i.MX 8M Mini & Nano

Power Management Requirements for RT600/500 Family



Power Management Requirements for i.MX RT600/500 Family

(1) Power Interface

- Always-on Supply
- VDDIO (1.8V or 3.3V)
- VDDCORE (0.7V – 1.1V)
- VDD1V8 (1.8V)

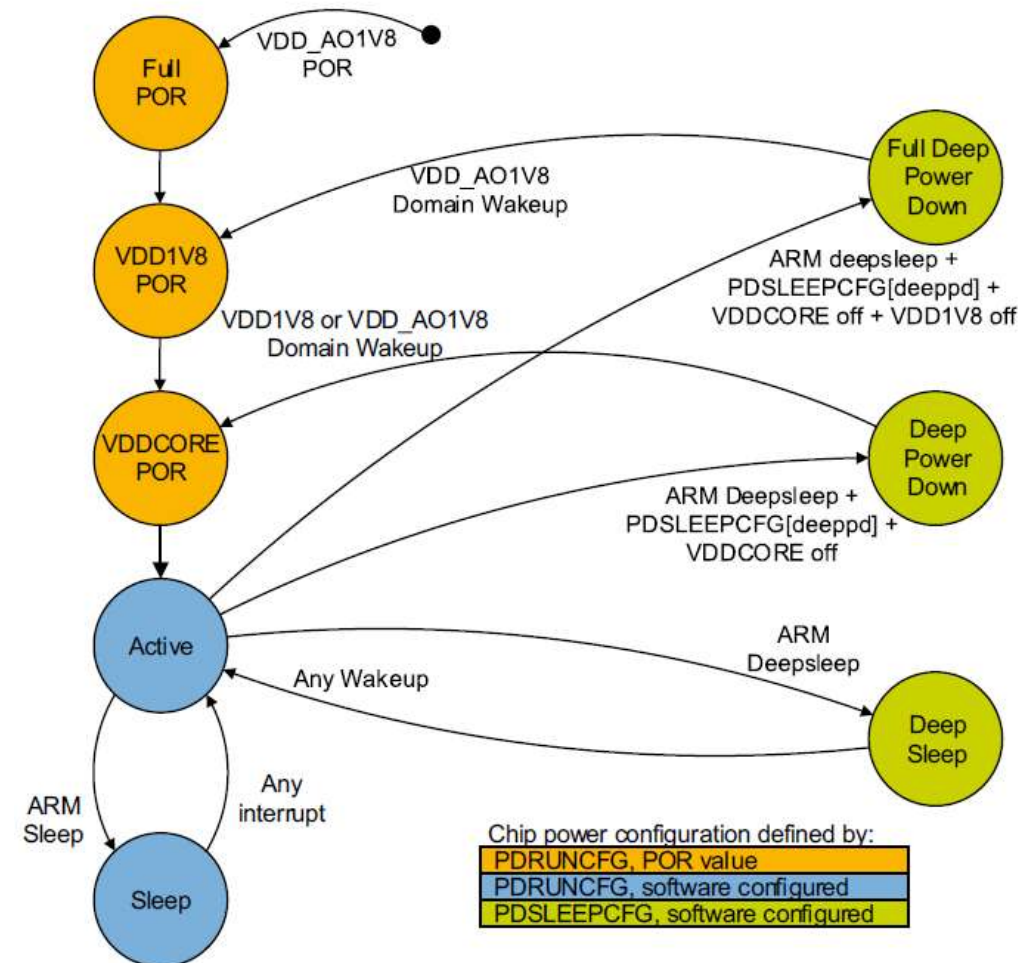
(2) PMIC Control

- LDO Enable
- PMIC_MODE0/PMIC_MODE1
- RESETN
- PMIC_IRQN
- PMIC_SCL/PMIC_SDA

Power Management Requirements for i.MX RT600/500 Family

(3) Power Mode Control

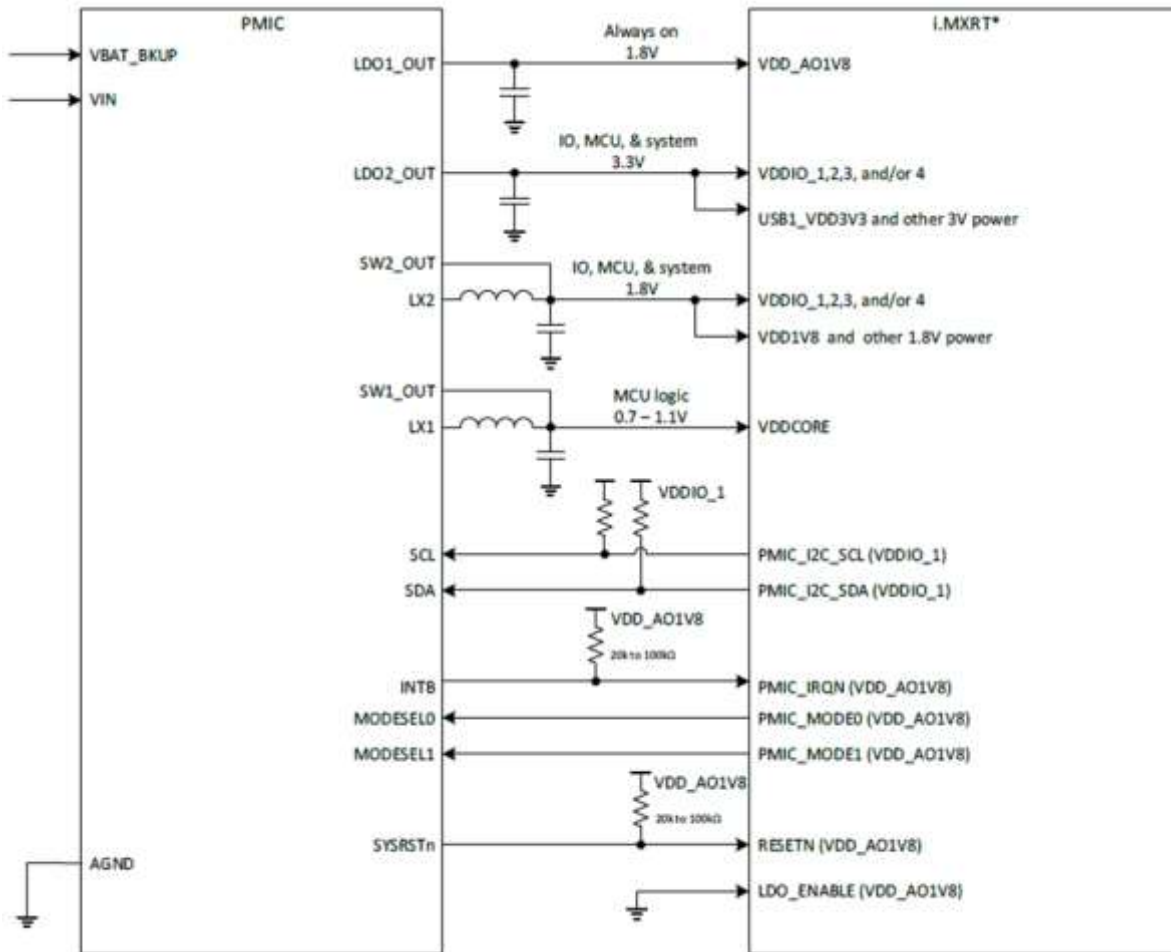
- Active Mode
- Sleep Mode
- Deep Sleep Mode
- Deep Power Down
- Full Power Down



Power Management IC (PMIC) Suitable for RT600/500 Family



Power Management IC (PMIC) Suitable for RT600/500 Family

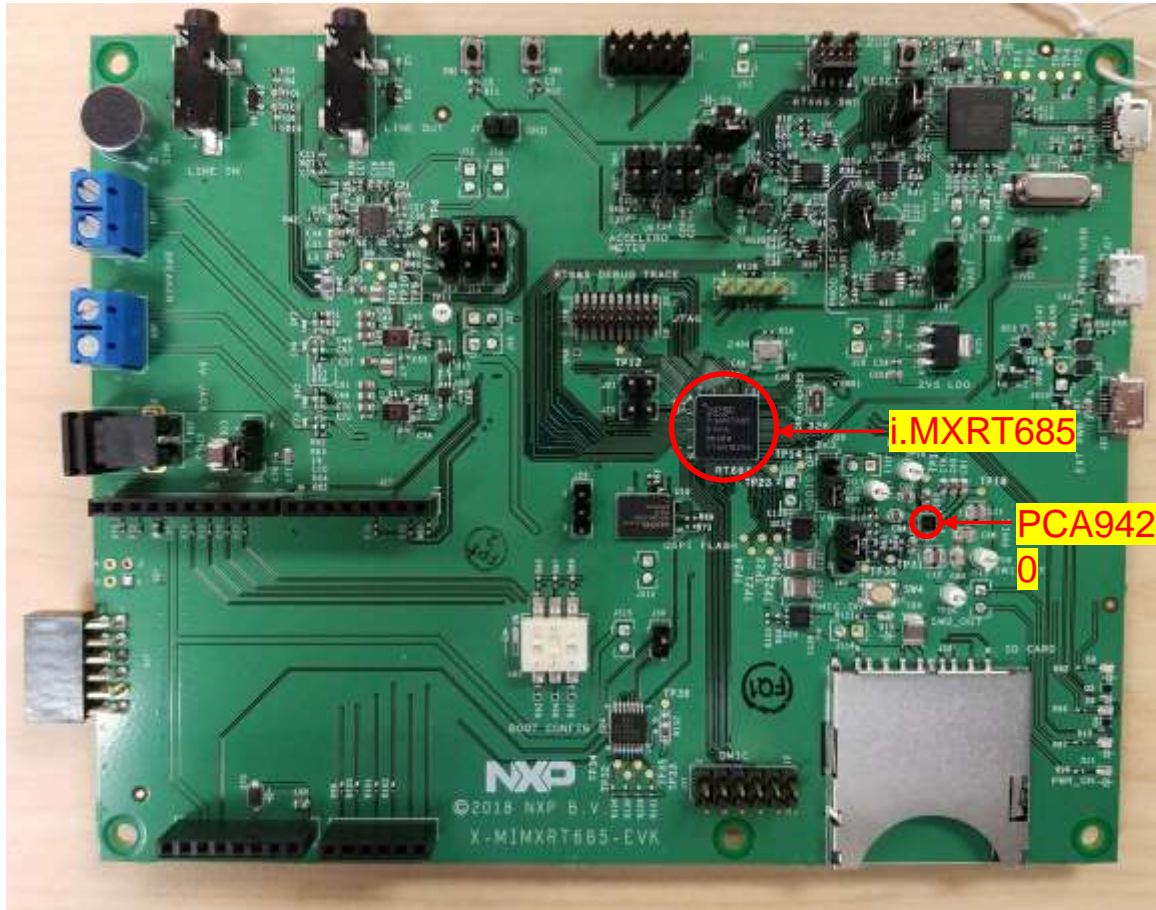


(1) Power-up Sequence

(2) Mode Setting

- Mode 0 – Run Mode
- Mode 1 – Deep Sleep
- Mode 2 – Deep Power Down
- Mode 3 – Full Deep Power Down

i.MXRT685 Standard EV Kit



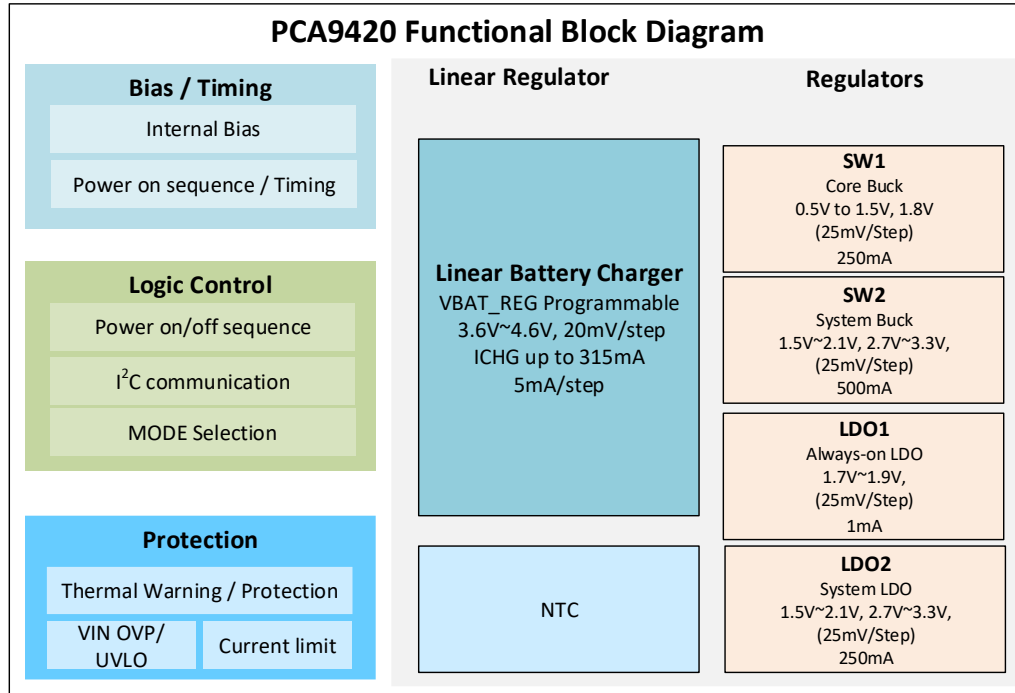
PCA9420 Feature List

- Suitable for Low-power processors in wearable & IoT applications
- 100nA (typ) Quiescent Current Consumption During Ship-Mode
- Flexible Mode Setting Capability (via GPIO or I2C) Accommodating Fast MCU Operation Mode Switch
- Integrated Single-cell Linear Li-ion Battery Charger (up to 315mA)
- 2x DC/DC, 2x LDO
- Programmable outputs in 25 mV steps
- Output can be enabled/disabled independently
- 20V DC Tolerance on Vin with programmable OVP
- I2C interface for communications
- Packages : QFN and WLCSP
- WLCSP 25-bump, 2.09mm x 2.09mm, 0.4mm pitch
- QFN 3mmx3mm, 24 pin

Introduction to PCA9420 PMIC



PCA9420 PMIC For Low Power Applications



- Ultra-compact Low-I_q PMIC for Low Power Applications
- Very low I_Q, high light load efficiency, longer system standby time
 - Very Low Quiescent Current in Ship mode (< 150nA)
- Highly integrated solution, flexible programmability, small solution size
 - 1x Linear Battery Charger (up to 315mA)
 - 2x Buck Regulators (500mA, 250mA)
 - 2x LDO (250mA, 1mA)
 - Built-in “Mode” Configuration to Accommodate Fast Mode Switch Supporting Different MCU Operation Modes
 - 20V DC Tolerance on Vin Pin with Programmable OVP
 - Fm+ 1MHz I²C Interface
 - Package:
 - WLCSP 25-bump, 2.09mm x 2.09mm, 0.4mm pitch
 - QFN 24-pin 3mm x 3mm

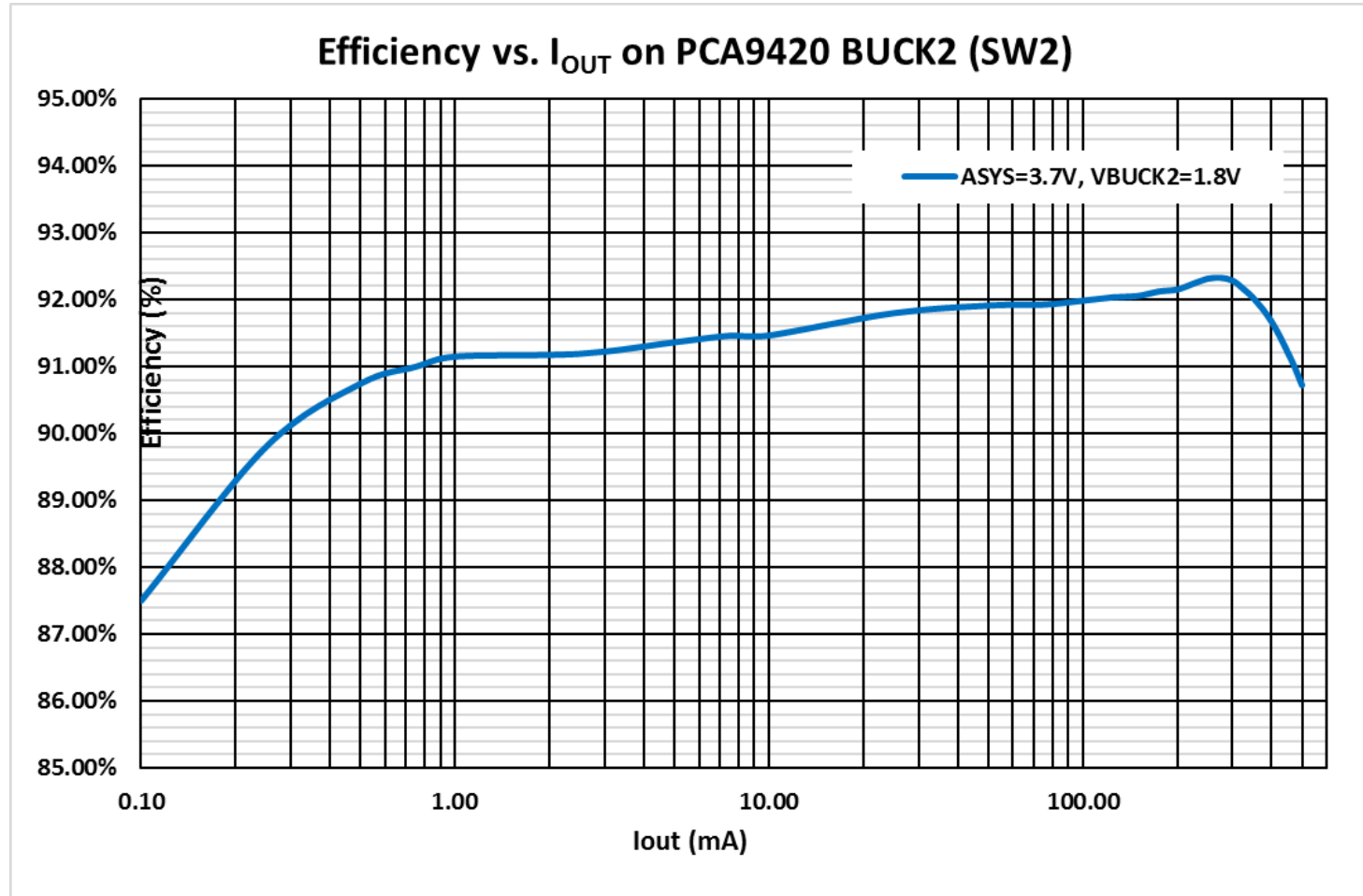
Target Applications

- Wearable devices – watch, band, fitness accessories, etc.
- Hearable device – earbud, headset, etc.
- Other low-power applications powered by li-ion battery

Buck1 (Core Buck) Efficiency vs. Load Current



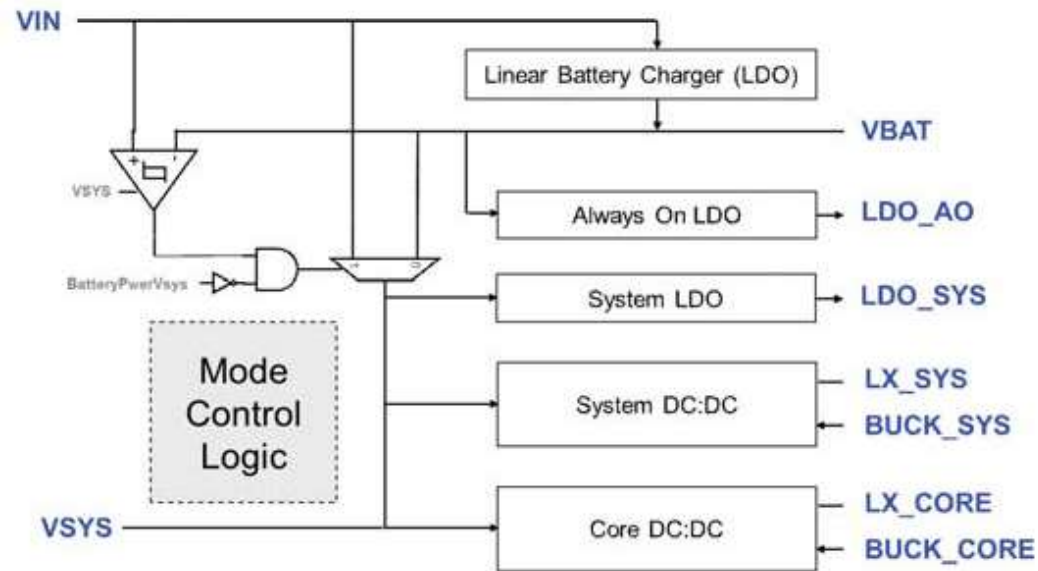
Buck2 (SYS Buck) Efficiency vs. Load Current



Test Condition: VASYS=3.7V, VBUCK2=1.8V, IBUCK2=0mA to 500mA

PCA9420 Functional Block Summary

	Linear Battery Charger	SW1	SW2	LDO1	LDO2
V_{OUT} Range	3.6V ~ 4.6V (CV regulation range) 0.5% Accuracy @ 25 °C	0.5V ~ 1.5V, and 1.8V	1.5V~2.1V 2.7V-3.3V	1.7V~1.9V	1.5V~2.1V 2.7V-3.3V
V_{OUT} Adjustable Resolution	20mV/step	25mV/step (DVFS)	25mV/step	25mV/step	25mV/step
Output Current Range	Up to 315mA	Up to 250mA	Up to 500mA	Up to 1mA	Up to 250mA
Input Voltage DC Rating	Up to 20V	Built-in	Built-in	Built-in	Built-in



Comparison

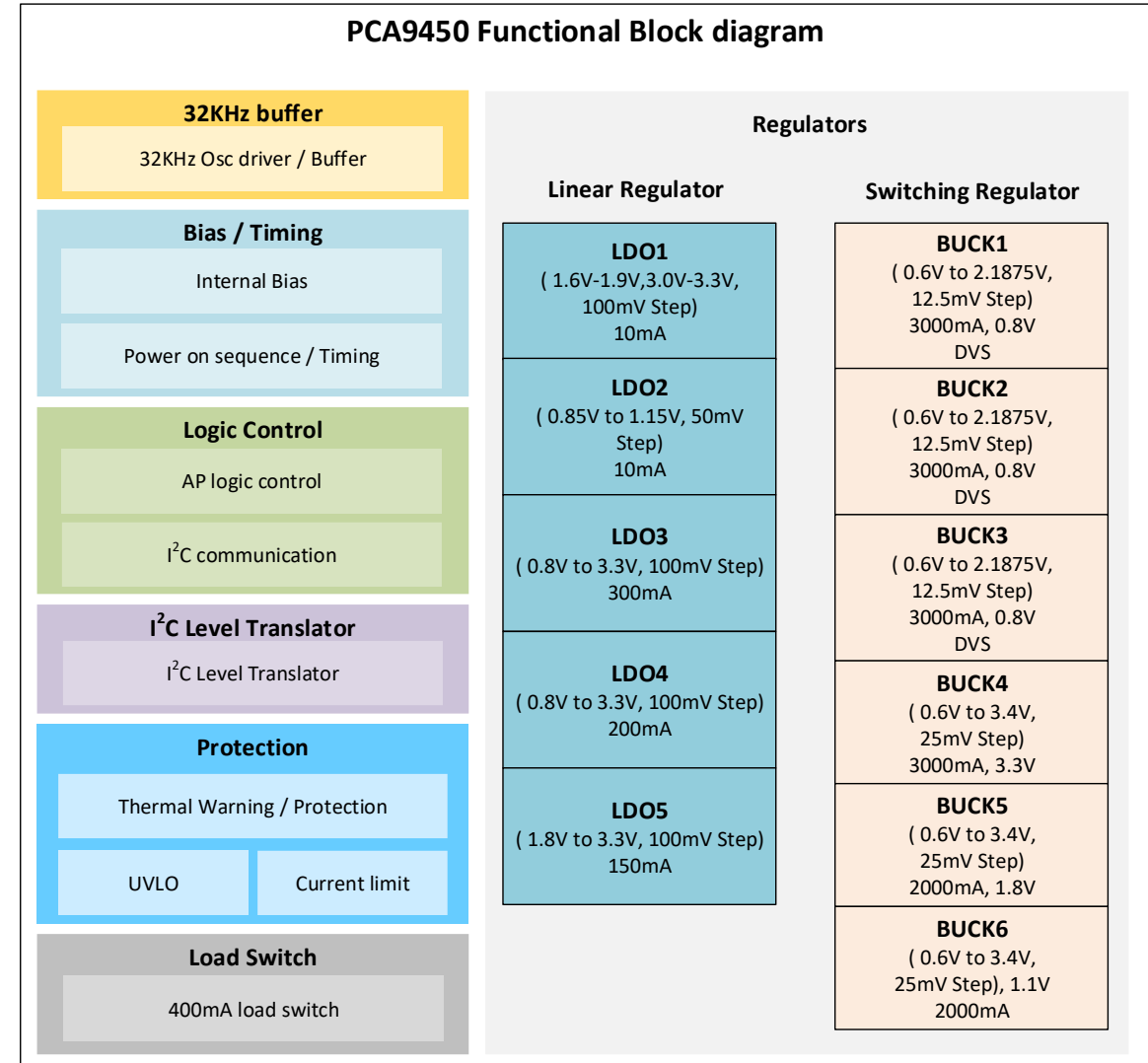
	PCA9420	Bx2512xA
Key Function Summary	1x Linear Battery Charger 2x DC/DC: 500mA/ 250mA 2x LDO: 250mA/ 1mA	1x Linear Battery Charger 1x DC/DC: 300mA 1x LDO(Load Switch): 100mA
Package	WLCSP (5x5 bump array): 2.09mm x 2.09mm = 4.37sqmm QFN (24-pin): 3mm x 3mm = 9sqmm	DSBGA 2.5mm x 2.5mm = 6.25sqmm 6 X 6 Bump Array
Battery Charger	Linear	Linear
Charger CC Current Range	5mA~315mA, 5mA/step (I2C programmable)	5mA~300mA (set by external resistor)
Charger CV Voltage Range	3.6V~4.6V, 20mV/step (I2C programmable)	3.6V~4.65V, 10mV/step (I2C programmable)
Number of Buck Converter	2	1
Buck Converter	Buck #1: 500mA output 1.5~2.1V/2.7~3.3V, 25mV/step Buck #2: 250mA output 0.5~1.5V/1.8V, 25mV/step	Buck#1: 300mA output 1.1~3.3V, 100mV/step
Number of LDO	2	1
LDO	LDO #1: 1mA output 1.7~1.9V, 25mV/step LDO #2: 250mA output 1.5~2.1V/2.7~3.3V, 25mV/step	LDO#1: 100mA output 0.8~3.3V, 100mV/step
NTC Sensing	Yes	Yes

Next Generation PMIC for i.MX 8M Mini & Nano

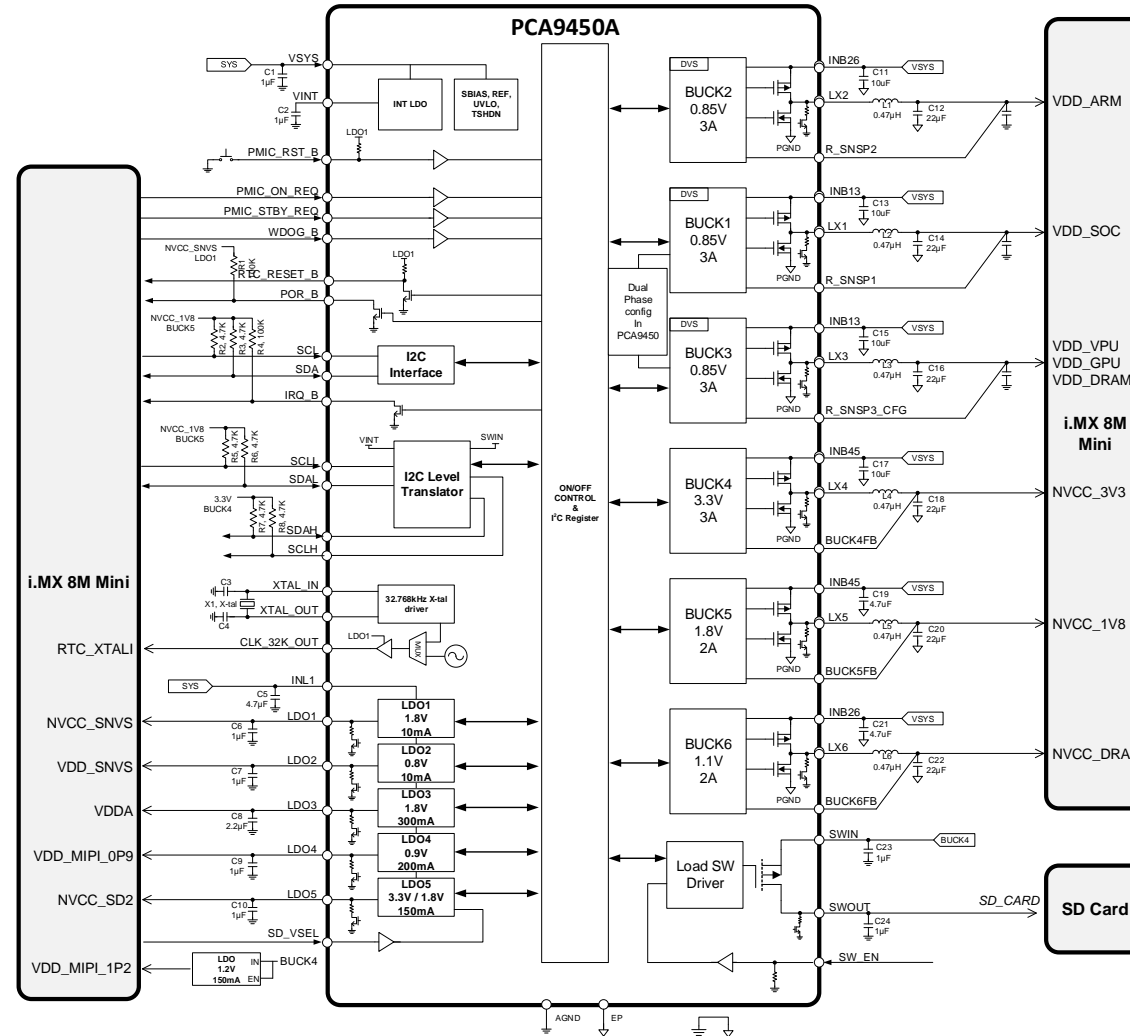


PCA9450 PMIC

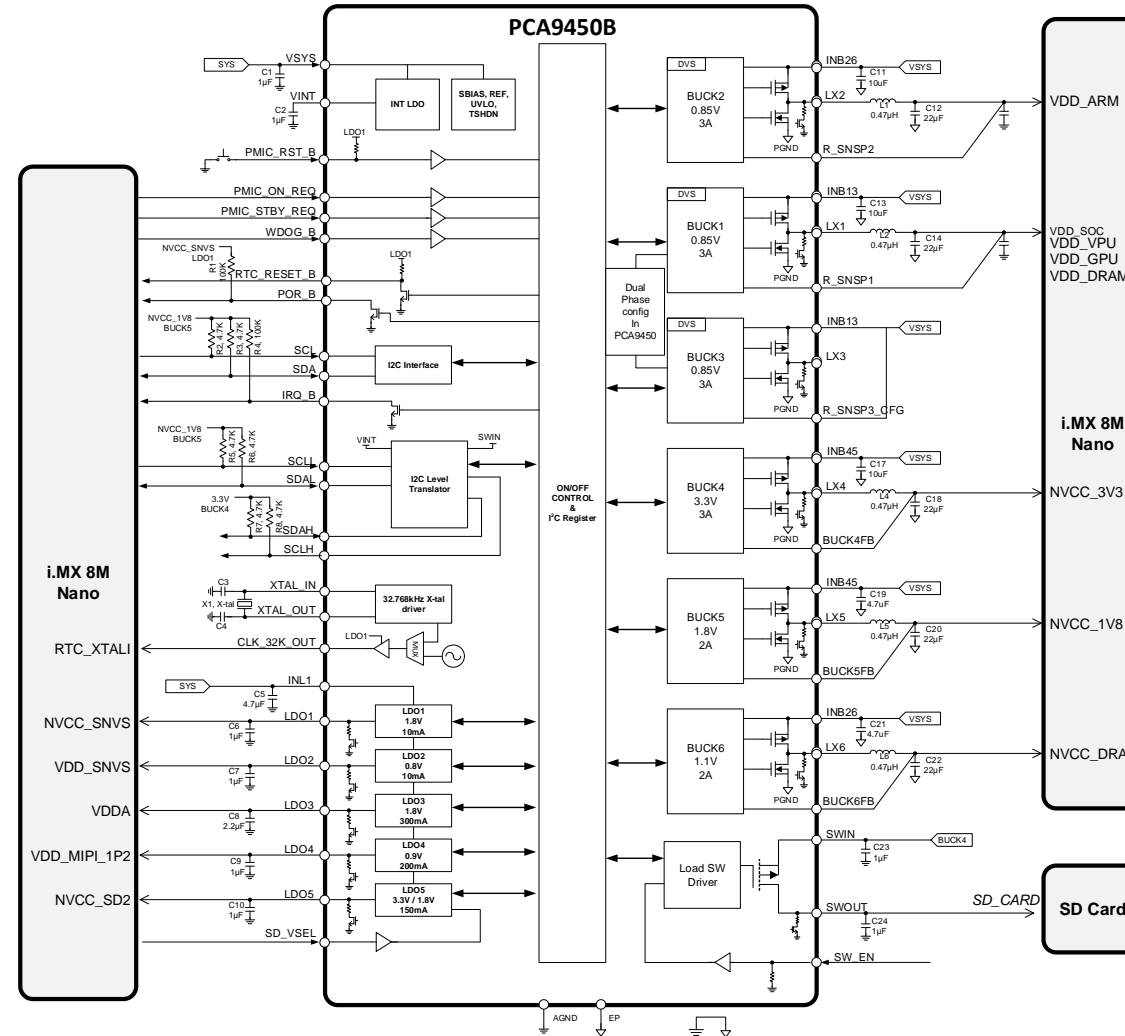
- **Optimized PMIC for i.MX 8M Mini/Nano/Plus**
 - PCA9450A for i.MX 8M Mini
 - PCA9450B for i.MX 8M Nano
 - All three options are pin-to-pin compatible
- **6x High-efficiency buck regulators**
 - Three 3A buck regulators with DVS and remote sense capability (Buck1/Buck3 can be configured as a dual-phase buck)
 - One 3A buck regulator
 - Two 2A buck regulators
- **5x LDOs**
 - Two 10mA LDO for SNVS power rails
 - One 150mA LDO with voltage select pin
 - One 300mA LDO, One 200mA LDO
- **1x 400mA Load Switch for SD Card**
- **32.768kHz Crystal oscillator buffer**
- **Integrated I²C level translator**
- **Power control I/O's**
 - Power On/Off Control
 - Standby/Run Mode Control
- **Fm+ 1MHz I²C Interface**
- **Offered in HVQFN Package 7mm x 7mm, 0.4mm, 56-pins**
- **MP in Q4-2019**



Configuration Example: i.MX 8M Mini + PCA9450A



Configuration Example: i.MX 8M Nano + PCA9450A



Key NXP Contacts

- **Product Marketing Director**
 - Haitao Hu
 - Office: +1 (408) 518-5610
 - Haitao.Hu@nxp.com
- **Technical Marketing Manager**
 - Emmanuel T. Nana
 - Office: 408-518-5306
 - Emmanuel.Nana@nxp.com
- **Regional Marketing Manager**
 - Ravi Shah
 - Office: 408-518-5309
 - Ravi.Shah@nxp.com



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