Electronics for the Future

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Rohm Power solution for Horizon SoC

23.Feb.2023

ROHM Co., Ltd
FAE2 Div. Analog power FAE Dept.
Automotive G

Dedicated power management solution

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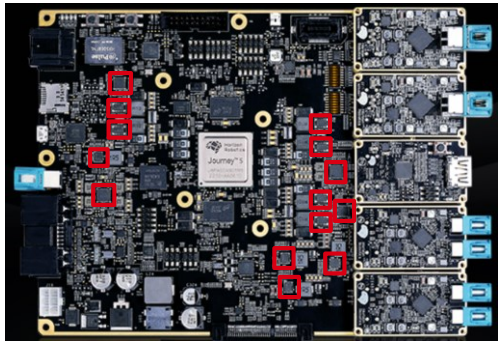
Collaborate with SoC vendor to develop dedicated PMIC

Collaborate with SoC vendor

ROHM offers flexible power supply ICs
For ADAS SoC Journey5

https://en.horizon.ai/

◆Ref EVK

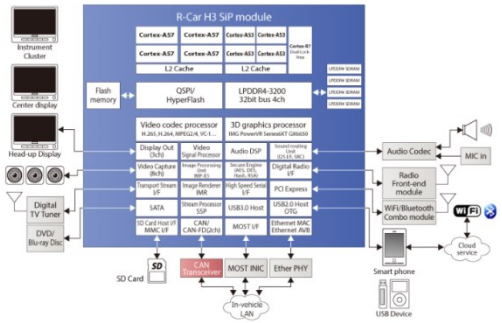


Rohm Power Device

RENESAS

ROHM offering optimized PMICs
for Renesas R-car H3, M3, V3 and E3 SoC series.

System Block Diagram
R-Car H3



Reference board of Renesas Gen.3 H3/M3 “Salvator–XS” and V3H “Condor” are using ROHM PMIC.

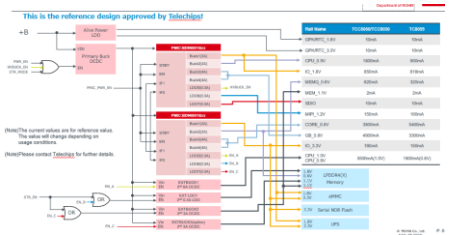
Telechips

ROHM offers flexible power supply ICs
for cockpit solution /SoC Dolphin series

◆Application

https://telechips.com/eng/main/main.php?intro=true

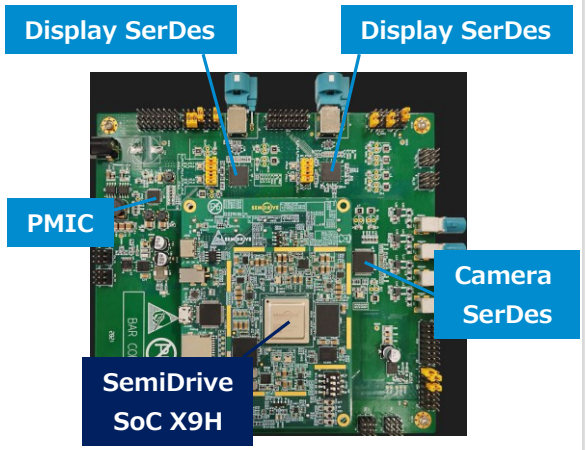
◆Ref Block



Feature:
- 2 PMIC Solution
- High efficiency
- Power ON/OFF sequence

芯驰 SemiDrive

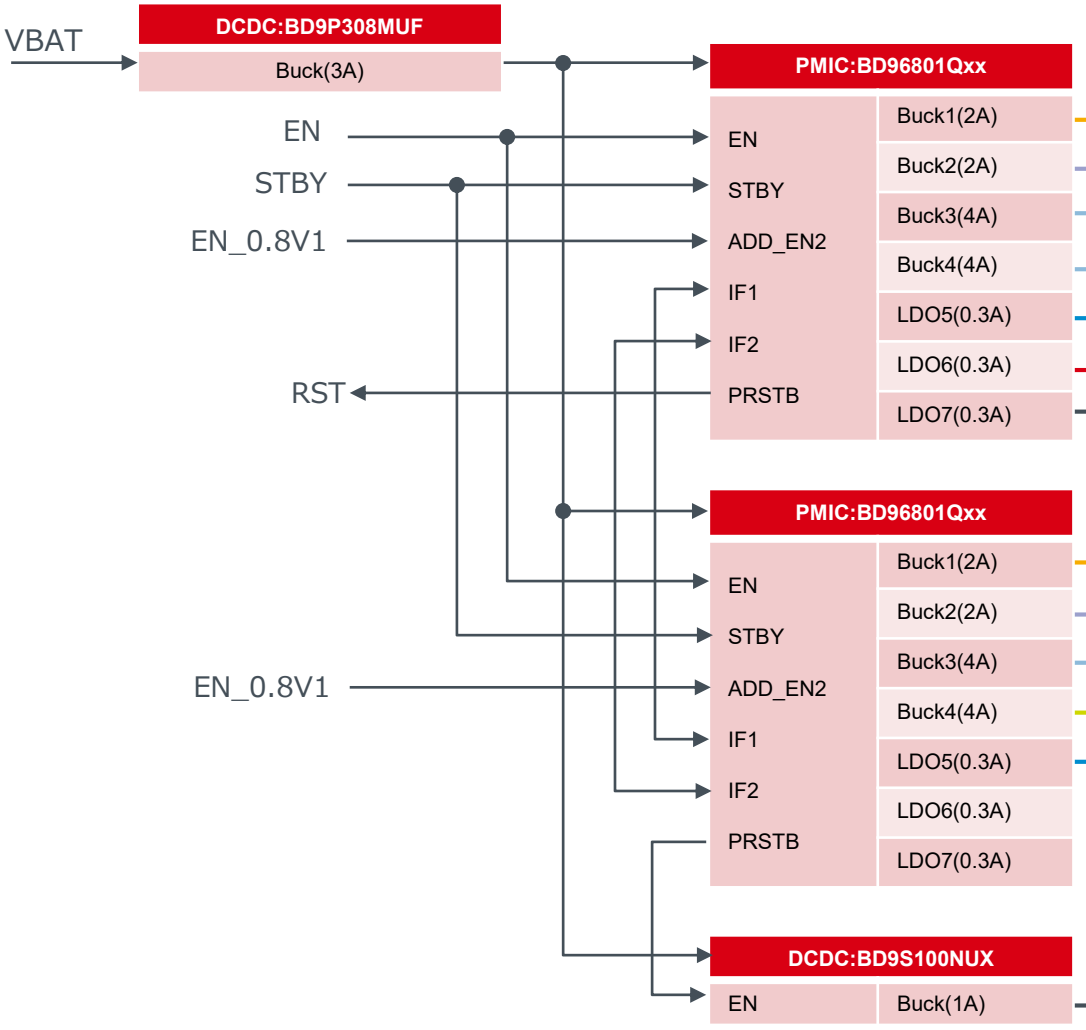
ROHM offers flexible power supply ICs
and SerDes for cockpit solution /SoC X9H



Global semiconductor supplier ROHM, together with SemiDrive Technology, a leading automotive-grade chip vendor in China, have signed an advanced technology development partnership for the automotive field.

Rohm Power solution for J3 SoC

All power supplies are proposed in Rohm product!!



Jorney3

Voltage	Current	Rail Name
0.8V	4.5A	VDD_CORE_PD
0.8V	2A	VDD_CNN0
0.8V	2A	VDD_CNN1
0.8V	1.5A	VDD_CPU
0.8V	0.125A	VDD_CORE_AO
3.3V	0.01A	USB_VPH
1.8V	0.1A	SYS_PD
0.8V	0.28A	SYS_PD
0.8V	2A	VDD_DDR
1.8V	2A	SYS_IO
3.3V	0.625	SYS_IO
1.1V	1.45A	DDR

Peripheral

Voltage	Current	Rail Name
1.1V	1A	LPDDR4
1.8V	0.015A	
1.8V	0.05A	Flash
1.8V	0.2A	eMMC
3.3V	0.11A	

(Note)The current values are for reference value.
The value will change depending on usage conditions.

Rohm Power solution for J5 SoC

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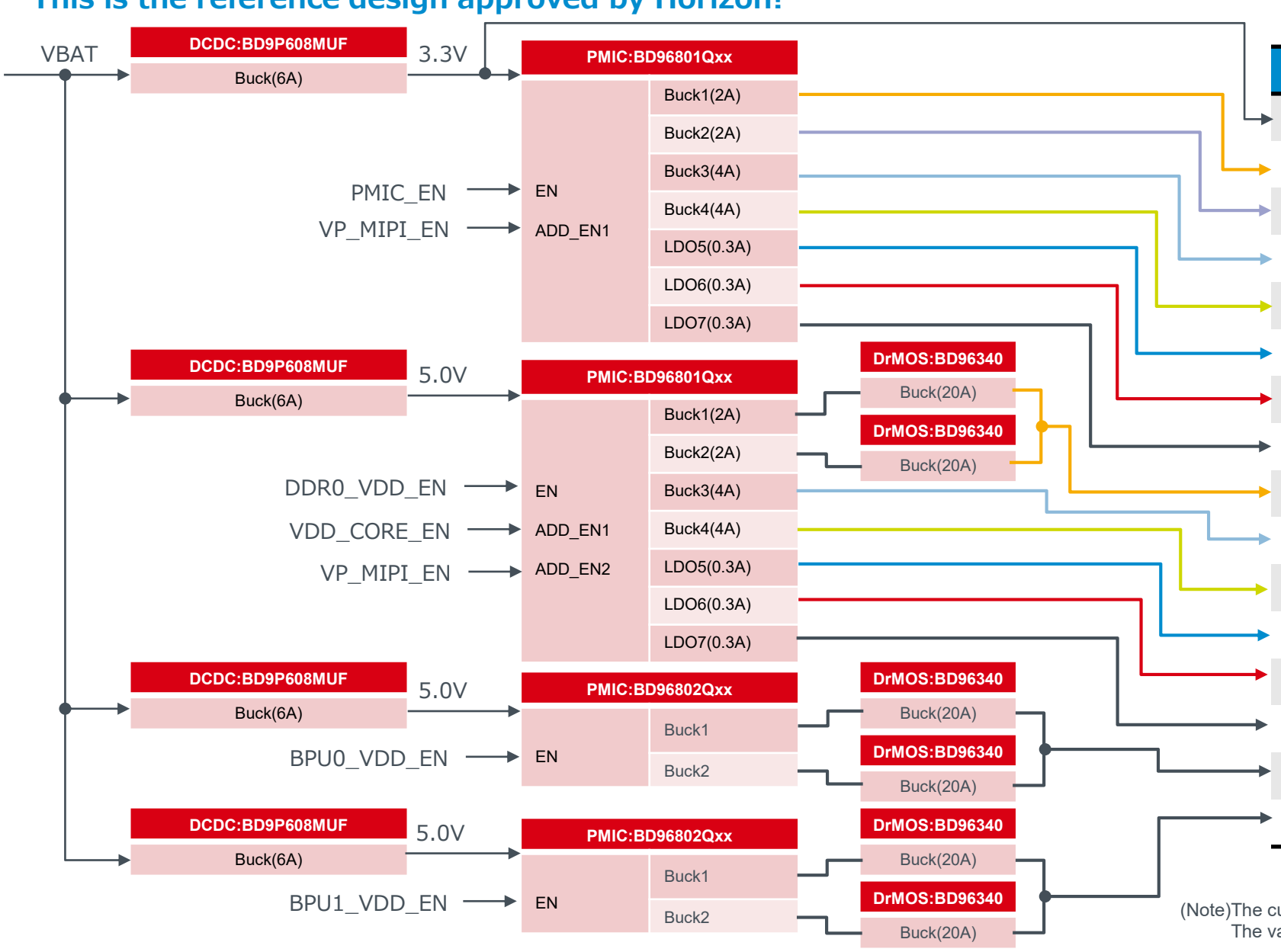
This is the reference design approved by Horizon!



Jorney5

Voltage	Current	Rail Name
3.3V	1A	VDDIO_SD
1.8V	2A	VDD_IO_SD
0.8V	1A	VDD_AON
1.1V	1.7A	VDDQ_DDR0
1.1V	1.7A	VDDQ_DDR1
1.8V	0.2A	VPH_MIPI
1.8V	0.2A	VDDA_AON
1.8V	0.15mA	VDDA_PVT
0.8V	20A	VDD_CORE
0.8V	2.5A	VDD_DDR0
0.8V	2.5A	VDD_DDR1
0.8V	0.03A	VDDREF_PLL/VDDPOST_PLL
0.8V	0.15A	VP_MIPI
0.8V	0.3A	VP_PCIE
0.8V	24A	VDD_BPU0
0.8V	24A	VDD_BPU1

(Note)The current values are for reference value.
The value will change depending on usage conditions.

Product introduction

- SoC PMIC
- DCDC

Product introduction

◆SoC PMIC

◆DCDC

Concept of BD9680* Automotive Power Solution

Any SoC can be supported by combining the three ICs of Main PMIC, Sub PMIC, and Driver MOS.

Automotive PMIC for SoC

Main PMIC
BD96801

- DCDC×2ch 2A or Driver MOS(20A)
- DCDC×2ch 4A
- LDO×3ch 0.3A
- Secure Functional Safety as a system

Sub PMIC
BD96802

- DCDC×2ch 5A or Driver MOS(20A)
- Additional output, Safety architecture

Driver MOS
BD96340

- 10A～20Aoutput Temperature feedback Current feedback
- Large current for high power system

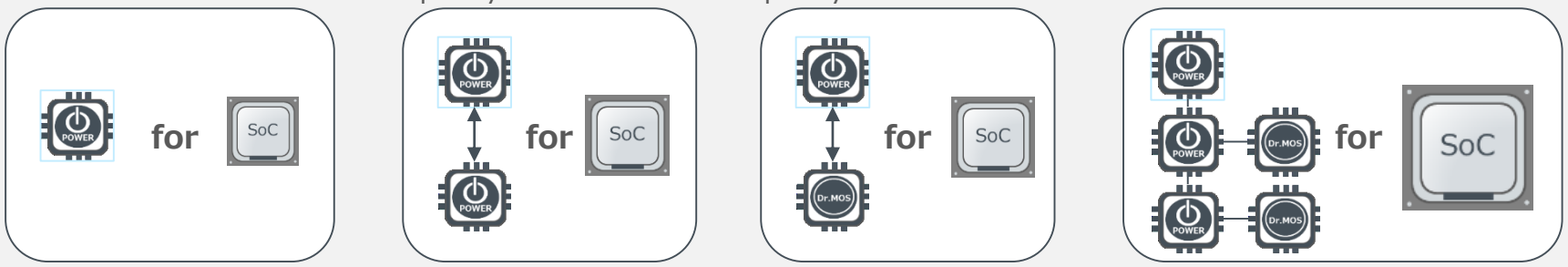
Application example

Reasonable ECU ：
Main PMIC, 1pc system

Mid power ECU ：
Main and Sub PMIC 2pcs system

High power ECU ：
Main PMIC and Driver MOS, 2pcs system

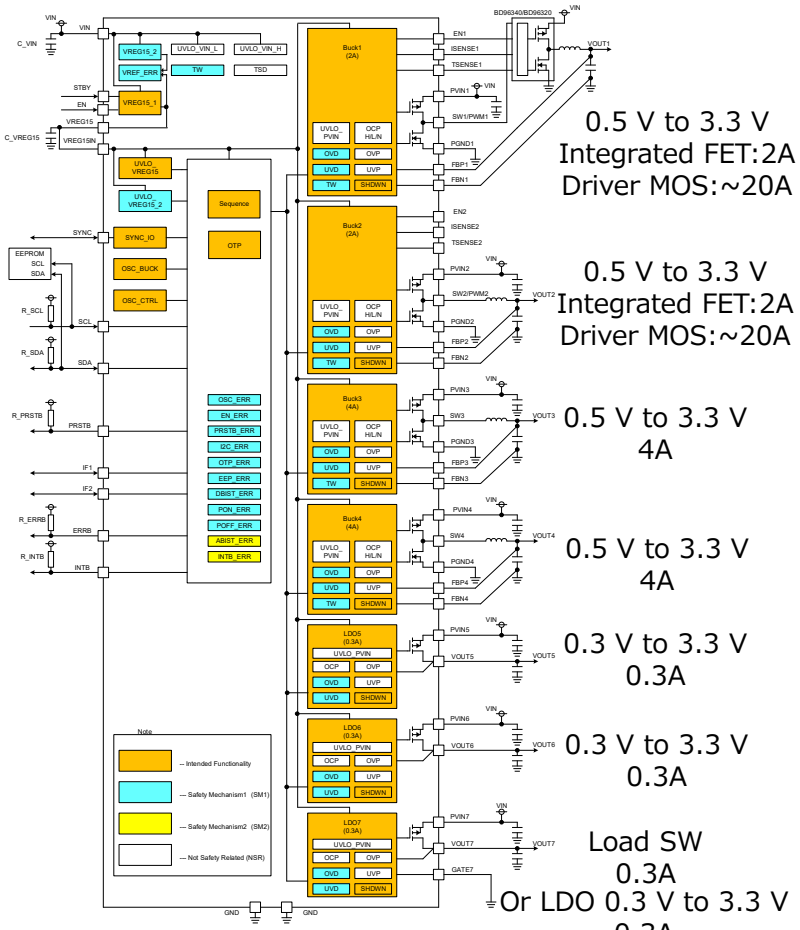
Complex and high power ECU ：
5～7pcs system



Main PMIC : BD96801QXX-C

BD96801 can be applied to various SoCs by using multi-phase and Driver MOS.
Furthermore, support a functional safety and the output voltage/sequence can be set by OTP.
Integrated Buck DCDC4ch(2A to 20A×2ch, 4A×2ch), LDO2ch, LoadSW1ch

Application Circuit



Features

- Built-in 2A MOSFETs or External Driver MOS selectable for Buck1 and Buck2.
- Built-in 4A MOSFETs for Buck3 and Buck4.
- Dual Phase Operation for Buck1&2 / Buck3&4.
- Multipurpose LDO for LDO5,6
- Load Switch or LDO selectable for LDO7 output.
- Programmable power sequencer by OTP/I2C/EEPROM
- Switching Frequency selectable (2.25/4MHz)
- Built-in protection (UVLO,OCP,OVP,UVP,TSD)
- Built-in detection (OVD,UVD, Thermal Warming)
- Built-in Q&A Watchdog, SYNC function (SYNC)
- Internal Spread Spectrum OSC
- ASIL-D support

Key specifications

- Input voltage range :2.7V ~ 5.5V
- Operating temperature range :-40ºC ~ 125ºC
- Output voltage DC accuracy :±1.2%

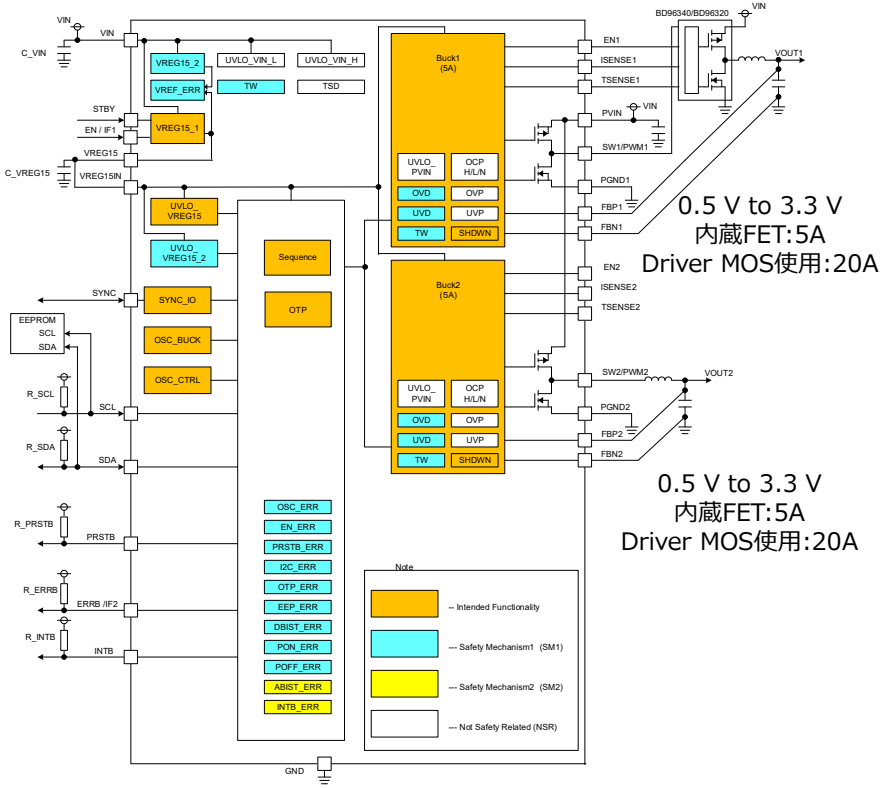
Package

UQFN48FV6060 6.0mm x 6.0mm x 1.0mm

Sub PMIC：BD96802QXX-C

BD96802 can be applied to supply core power of various SoCs by using multi-phase and Driver MOS. Furthermore, it can be used in combination with the Main PMIC BD96801.
Integrated Buck DCDC2ch(5A×2ch or 20A×2ch)

Application Circuit



0.5 V to 3.3 V
内蔵FET:5A
Driver MOS使用:20A

0.5 V to 3.3 V
内蔵FET:5A
Driver MOS使用:20A

Features

- Built-in 5A MOSFETs or External Driver MOS selectable for Buck1 and Buck2.
- Programmable power sequencer by OTP/I2C/EEPROM
- Switching Frequency selectable (2.25/4MHz)
- Built-in protection (UVLO,OCP,OVP,UVP,TSD)
- Built-in detection (OVD,UVD, Thermal Warming)
- Built-in SYNC function (SYNC)
- Internal Spread Spectrum OSC
- Sequence linkage with BD96801 is possible
- ASIL-D support

Key specifications

- Input voltage range :2.7V ~ 5.5V
- Operating temperature range :-40ºC ~ 125ºC
- Output voltage DC accuracy :±1.2%

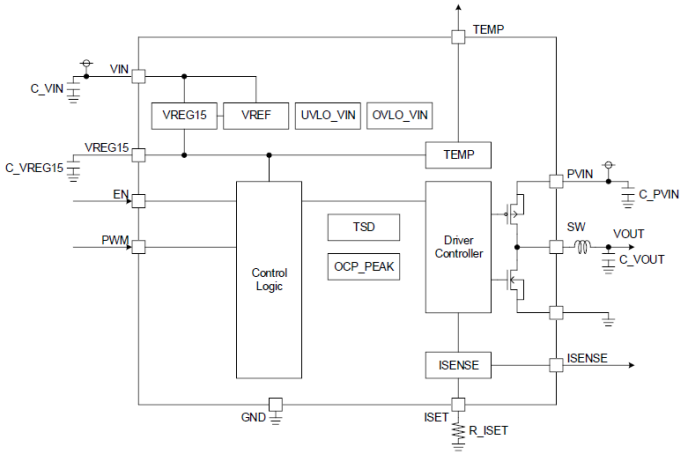
Package

UQFN40FV5050 5.0mm x 5.0mm 1.0mm

Driver MOS : BD96340MFF-C Driver + MOSFET

**BD96340 can be used in combination with BD96801 / BD96802, which is a 1-chip MOSFET and driver.
A flip chip PKG realizes low ON resistance and can supply a large current of 20A.**

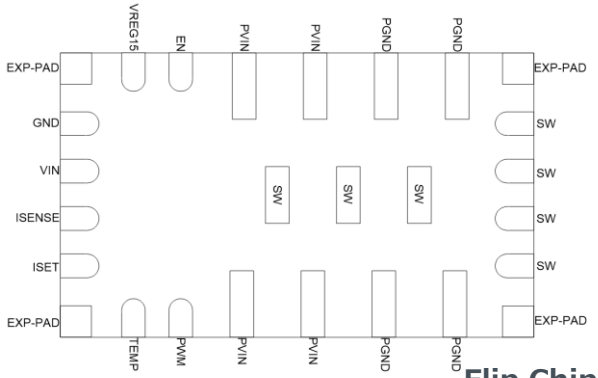
Application Circuit



Features

- AEC-Q100 Qualified
- Built-in MOSFETs of Max continuous current 20A, peak **30A** per channel.
- Built-in protection (UVLO,OVLO,OCP,TSD)
- Current Monitor Output(ISENSE)
- Die Temperature Monitor Output(TEMP)
- Automatic Phase Number Recognition Function

Package[Tentative]



(TOP View)

Flip Chip QFN
(23pin, 5.0mm x 3.0mm)

Key specifications

- Input voltage range :2.7V ~ 5.5V
- Operating temperature range :-40ºC ~ 125ºC
- Quiescent Current :0uA
- High Side FET On-Resistance :4mΩ(Tentative)
- Low Side FET On-Resistance :2.5mΩ(Tentative)

Product introduction

◆SoC PMIC

◆DCDC

Primary Switching Regulator N/N Line up

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Type		Buck						
Series		BD9Pxx5xxx-C		BD9P2x6xxx-C		BD9Pxx8xxx-C	BD9Pxx9xxx-C	BD9PAxxxxx-C
Built-in FET		Nch/Nch						
VIN		3.5V to 40V		3.5V to 40V			3.0V to 36V	3.0V to 36V
freq		2.2MHz		440kHz		2.2MHz	2.0MHz/400kHz	2.0MHz
Icc(typ)		10μA		10μA			5μA (T.B.D.)	50μA (T.B.D.)
*SSCG		✓						
Vout		0.8V to 8.5V	3.3V to 5V	0.8V to 8.5V	3.3V to 5V	0.8V to 8.5V	0.8V to 9.0V	0.8V to 9.0V
Nano Pulse Control™		✓						
Output Current	1A	BD9P105EFV-C BD9P105MUF-C	BD9P135EFV-C BD9P155EFV-C BD9P135MUF-C BD9P155MUF-C	–	–	BD9P108MUF-C	★ BD9P109NUF-C	–
	2A	BD9P205EFV-C BD9P205MUF-C	BD9P235EFV-C BD9P255EFV-C BD9P235MUF-C BD9P255MUF-C	★ BD9P206EFV-C	★ BD9P236EFV-C ★ BD9P256EFV-C	BD9P208MUF-C	★ BD9P209NUF-C	–
	3A / 3.5A	BD9P305EFV-C (2.2MHz/440kHz Selectable)	–	–	–	BD9P308MUF-C (2.2MHz/440kHz Selectable)	★ BD9P309NUF-C (3A) ※BD9P409MFF-C (3.5A)	–
	6A	–	–	–	–	BD9P608MFF-C (2.2MHz/440kHz Selectable)	★ BD9P609MFF-C	–
	10A	–	–	–	–	–	–	★ BD9PA00EFV-C ※ BD9PA01MFF-C

*SSCG: Spread Spectrum Clock Generator

No mark…Available in the market ★…In development ※…In Planning

2.2MHz Low Iq SMPS
BD9P108/208/308MUF-C

Available in the market

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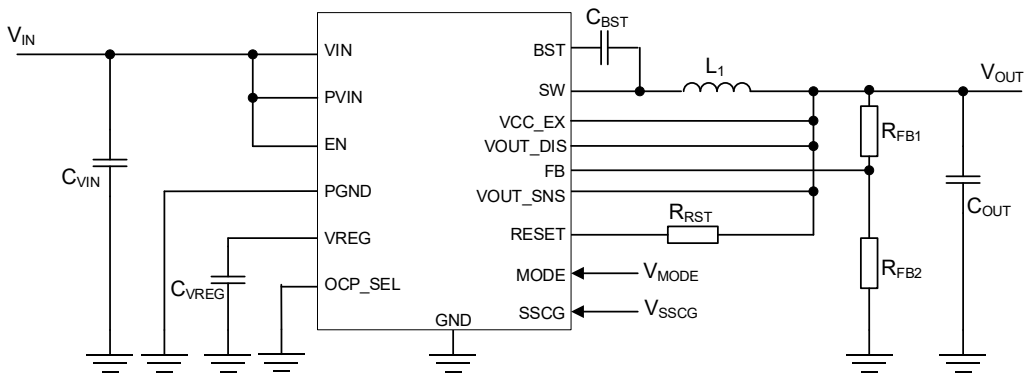
Features

- Nano Pulse Control™
- Integrated N-channel and N-channel power MOSFET
- Spread spectrum function
- Integrated RESET function
- External synchronization
- Built-in phase compensation
- Soft start function : 3.0ms (for 2.2MHz)
- Selectable light load mode (LLM) or Forced PWM mode
- Selectable output current (BD9P108MUF-C, BD9P208MUF-C)
- Selectable switching frequency (BD9P308MUF-C)
- OCP, SCP, TSD, OVP, UVLO
- AEC-Q100 qualified

Application Circuit

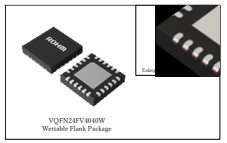
BD9Px08MUF-C



* The BD9P308MUF-C has the FREQ=SEL pin instead of the OCP_SEL pin

Key Specifications

- Input voltage range : 3.5V to 40V (Maximum rating : 42V)
  Start up is over 4.0V
- Output voltage : 0.8V to 8.5V
- Output current
  - BD9P108 : 1.0A (Max)/0.5A (Max)
  - BD9P208 : 2.0A (Max)/1.5A (Max)
  - BD9P308 : 3.0A (Max)
- Switching frequency
  - BD9P108/BD9P208 : 2.2MHz
  - BD9P308 : 2.2MHz/440kHz
- Reference accuracy : ±1.75% (-40°C to +125°C)
  : ±1.5% (-30°C to +105°C)
- Circuit current (No switching) : 15μA (Typ)
- Consumption current from VIN during operation
  : 20μA (Typ, VIN=12V, VOUT=5V, No load)
- Shut down current : 2.1μA (Typ)
- Operating temperature : -40°C to +125°C



VQFN24FV4040
4.0mm × 4.0mm × 1.0mm (Max)
Wettable Flank

Applications

- Cluster, meter panel, Car infotainment
- Automotive equipment
- Consumer power supply

2.2MHz Low Iq SMPS
BD9P608MFF-C

Available in the market

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Features

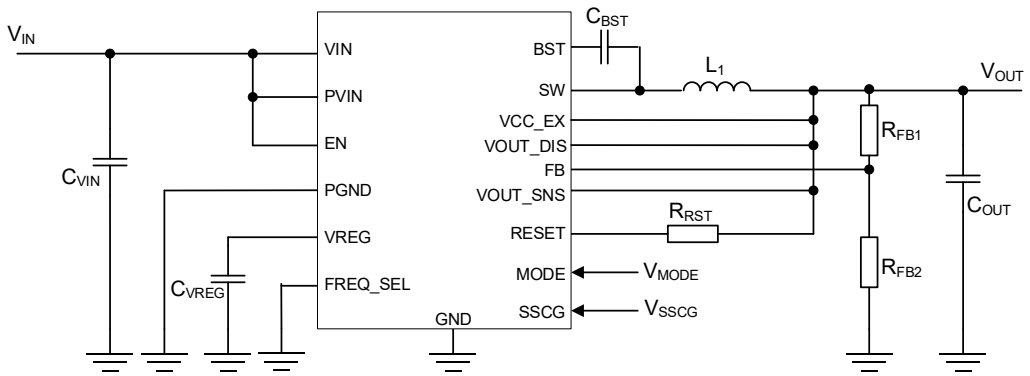
- Nano Pulse Control™
- Integrated N-channel and N-channel power MOSFET
- Spread spectrum function
- Integrated RESET function
- External synchronization
- Built-in phase compensation
- Soft start function : 3.0ms (f = 2.2MHz)
- Selectable light load mode (LLM) or Forced PWM mode
- Selectable switching frequency
- OCP, SCP, TSD, OVP, UVLO
- AEC-Q100 qualified

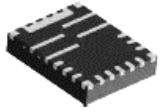
Key Specifications

- Input voltage range : 3.5V to 36V (Maximum rating : 42V)
  Start up is over 4.0V
- Output current : 6.0A (Max)
- Output voltage : 0.8V to 8.5V
- Switching frequency : 2.2MHz/440kHz
- Reference : ±1.75% (-40°C to +125°C)
  : ±1.5% (-30°C to +105°C)
- Circuit current (No switching) : 20μA (Typ)
- Consumption current from VIN during operation
  : 20μA (Typ, VIN=12V, VOUT=5V, No load)
- Shut down current : 2.1μA (Typ)
- Operating temperature : -40°C to +125°C

Application Circuit

BD9P608MFF-C





FLIP CHIP PKG
VFN20FV4535
4.5mm × 3.5mm × 1.0mm (Max)
Wettable Flank

Applications

- Cluster, meter panel, Car infotainment
- Automotive equipment
- Consumer power supply

Secondary Switching Regulator Line up

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Type		Buck (1ch)					
Series		BD9Sx0xNUX-C	BD9Sx1xNUX-C	BD9Sx0xMUF-C	BD9Sx4xMFF-CZ	BD9Sx4xNUX-C	BD9SA01Fxx-C
VIN		2.7V to 5.5V					
freq		2.2MHz					2.25MHz
Vout		0.8V to VIN	Fixed	0.8V to VIN × 0.8V 0.6V to VIN × 0.75V (303/402)	0.5V to VIN × 0.8V	0.5V to VIN × 0.8V	0.75V to 3.3V
Package		SON 2mm × 2mm	SON 2mm × 2mm	QFN 3mm × 3mm QFN 3.5mm x 3.5mm	VFN07FV2015A 2.0mm × 1.5mm	SON 2mm × 2mm	VFN18FV3530 3.5mm x 3.0mm
Output Current	0.6A	BD9S000NUX-C	BD9S012NUX-C (1.1V) BD9SD11NUX-C (1.15V)	-	-	-	-
	1A	BD9S100NUX-C BD9S109NUX-C	BD9S110NUX-C (1.2V) BD9S111NUX-C (1.8V)	-	-	※ BD9S14xNUX-C	-
	2A	BD9S201NUX-C BD9S209NUX-C BD9S231NUX-C	-	BD9S200MUF-C	※ BD9S24xMFF-CZ	※ BD9S24xNUX-C	-
	3A	-	-	BD9S300MUF-C ★ BD9S303MUF-C	※ BD9S34xMFF-CZ	※ BD9S34xNUX-C	-
	4A	-	-	BD9S400MUF-C BD9S402MUF-C	※ BD9S44xMFF-CZ	-	-
	6A	-	-	-	※ BD9S64xMFF-CZ	-	
	12A	-	-	-	-	-	★ BD9SA01Fxx-C

No mark…Available in the market ★…In development ※…In Planning

Secondary 2.2MHz SMPS
BD9S000/100/109NUX-C

Available in the market

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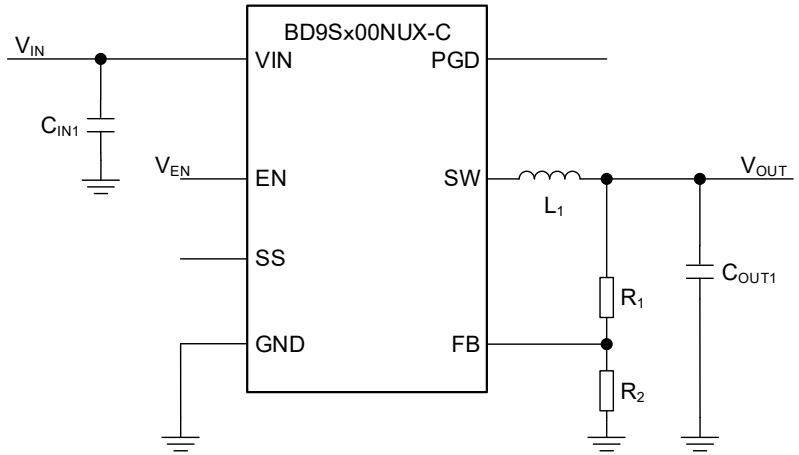
Features

- Integrated P-channel and N-channel power MOSFET
- Efficiency Optimized for 100mA to 300mA(over 80%)
- Forced PWM mode
- **Available in a Small VSON package (2mm x 2mm)**
- Space Saving
- Integrated Power Good function
- Built-in phase compensation
- Adjustable soft start function
- Output discharge function
  (the discharge resistances and pin configuration are different between BD9S100NUX-C and BD9S109NUX-C)
- OCP, SCP, TSD, OVP, UVLO
- AEC-Q100 qualified

Application Circuit



Key Specifications

- Input voltage range : 2.7V to 5.5V (Maximum rating : 7V)
- Output voltage range : 0.8V to VIN
- Reference voltage : 0.8V ±1.5%
- Output current
  - BD9S000NUX-C : 0.6A (Max)
  - BD9S100NUX-C : 1.0A (Max)
  - BD9S109NUX-C : 1.0A (Max)
- Switching frequency : 2.2MHz ±10%
- Pch FET ON resistance
  - BD9S000NUX-C : 270mΩ (Typ)
  - BD9S100NUX-C : 270mΩ (Typ)
  - BD9S109NUX-C : 150mΩ (Typ)
- Nch FET ON resistance
  - BD9S000NUX-C : 180mΩ (Typ)
  - BD9S100NUX-C : 180mΩ (Typ)
  - BD9S109NUX-C : 95mΩ (Typ)
- Operating temperature : -40°C to +125°C

VSON008X2020
2.0mm × 2.0mm × 0.6mm (Max)

Applications

- Cluster, meter panel, Car infotainment
- Automotive equipment
- Consumer power supply

Secondary 2.2MHz SMPS
BD9S201/209NUX-C

Available in the market

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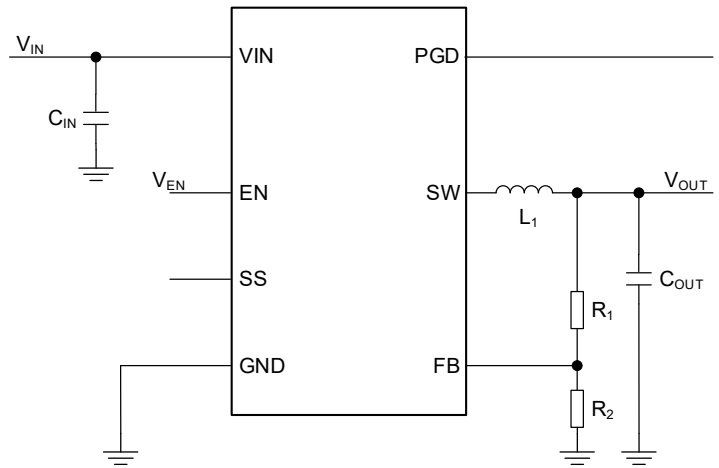
Features

- Integrated P-channel and N-channel power MOSFET
- Efficiency Optimized for 500mA to 1000mA (over 80%)
- Forced PWM mode
- **Available in a Small VSON package (2mm x 2mm)**
- Space Saving
- Integrated Power Good function
- Built-in phase compensation
- Adjustable soft start function
- Output discharge function
  (the discharge resistances and pin configuration are different between BD9S201NUX-C and BD9S209NUX-C)
- OCP, SCP, TSD, OVP, UVLO
- AEC-Q100 qualified

Application Circuit

BD9S201NUX-C



Key Specifications

- Input voltage range : 2.7V to 5.5V (Maximum rating : 7V)
- Output voltage range : 0.8V to VIN
- Reference voltage : 0.8V ±1.5%
- Output current : 2.0A (Max)
- Switching frequency : 2.2MHz ±10%
- Pch FET ON resistance : 150mΩ (Typ)
- Nch FET ON resistance : 95mΩ (Typ)
- Operating temperature : -40°C to +125°C

VSON008X2020
2.0mm × 2.0mm × 0.6mm (Max)

Applications

- Cluster, meter panel, Car infotainment
- Automotive equipment
- Consumer power supply

Secondary 2.2MHz SMPS
BD9S303MUF-C

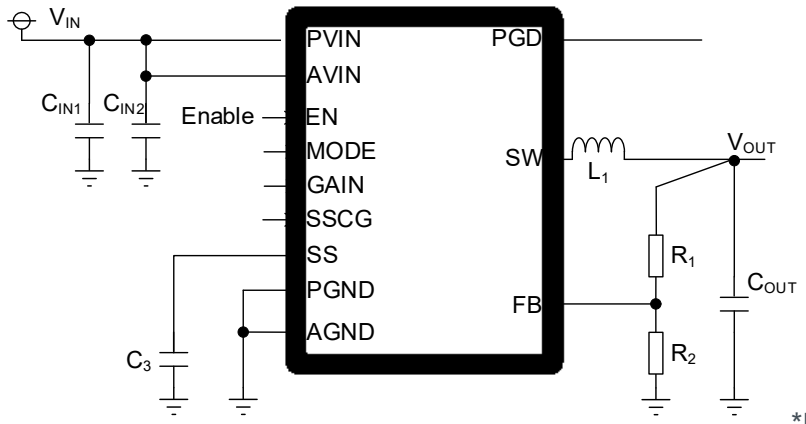
In Development | Confidential

【Only Accessible by BYD

Features

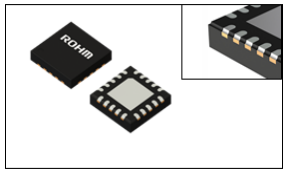
- Nano Pulse Control™
- QuiCur™
- Improvement for load transient response can achieve less COUT
- Quick load transient response can be achieved on the condition of GAIN=Hi
- Spread spectrum function
- Built-in phase compensation
- Selectable Light load mode(LLM) or Force PWM mode
- Integrated Power Good function
- Adjustable soft start function
- OCP, SCP, TSD, OVP, UVLO
- AEC-Q100 Planned to be supported

Application Circuit



Key Specifications

- Input voltage range : 2.7V to 5.5V (Maximum rating : 7V)
- Output voltage range : 0.6V to VIN x 0.75V
- Reference voltage : 0.6V ±1.5%
- Output current : 3.0A (Max)
- Switching frequency : 2.2MHz ±10%
- Circuit current (No switching) : 22μA (Typ)
- Consumption current from VIN during operation : 44μA (Typ, VIN=5V, VOUT=1.2V, No load)
- Pch FET ON resistance : 65mΩ (Typ)
  Nch FET ON resistance : 43mΩ (Typ)
- Operating temperature : -40°C to +125°C



VQFN20FV3535
3.5mm × 3.5mm × 1.0mm (Max)
Wettable Flank

Applications

- Cluster, meter panel, Car infotainment
- Automotive equipment
- Consumer power supply

*Designing/planning, spec, schedule etc. could change depending on the market trend.

Electronics for the Future

ROHM Co.,Ltd.