



Power Management Products


ROHM Semiconductor

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Regulator Development Roadmap

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	2012	2014	2016	2018
Concept	<ul style="list-style-type: none"> ◆ Line up of General Purpose ◆ Suitable for ECU ◆ High Functionality 			
LDO	<ul style="list-style-type: none"> ▪ Ultra low Iq ▪ PIN-to-PIN compatible families ▪ up to 1A output current ▪ Low Iq with monitor function ▪ High temperature ▪ Higher voltages (48V) 			
Switching Regulator	<ul style="list-style-type: none"> ▪ SW controller (Boost/Buck and Boost) ▪ Low voltage drive (Built-in Nch/Pch FET) ▪ Low Iq ▪ Secondary ▪ Low noise ▪ Modularization ▪ High temperature ▪ Higher voltages (48V) 			
System Regulator	<ul style="list-style-type: none"> ▪ System for MCU ▪ ASSP suitable for ECU ⇒ 1 chip multi chip module ▪ High temperature ▪ High voltage 			
Transceiver	<ul style="list-style-type: none"> ▪ LIN Transceiver 	<ul style="list-style-type: none"> ▪ CAN Transceiver 	 Add in	

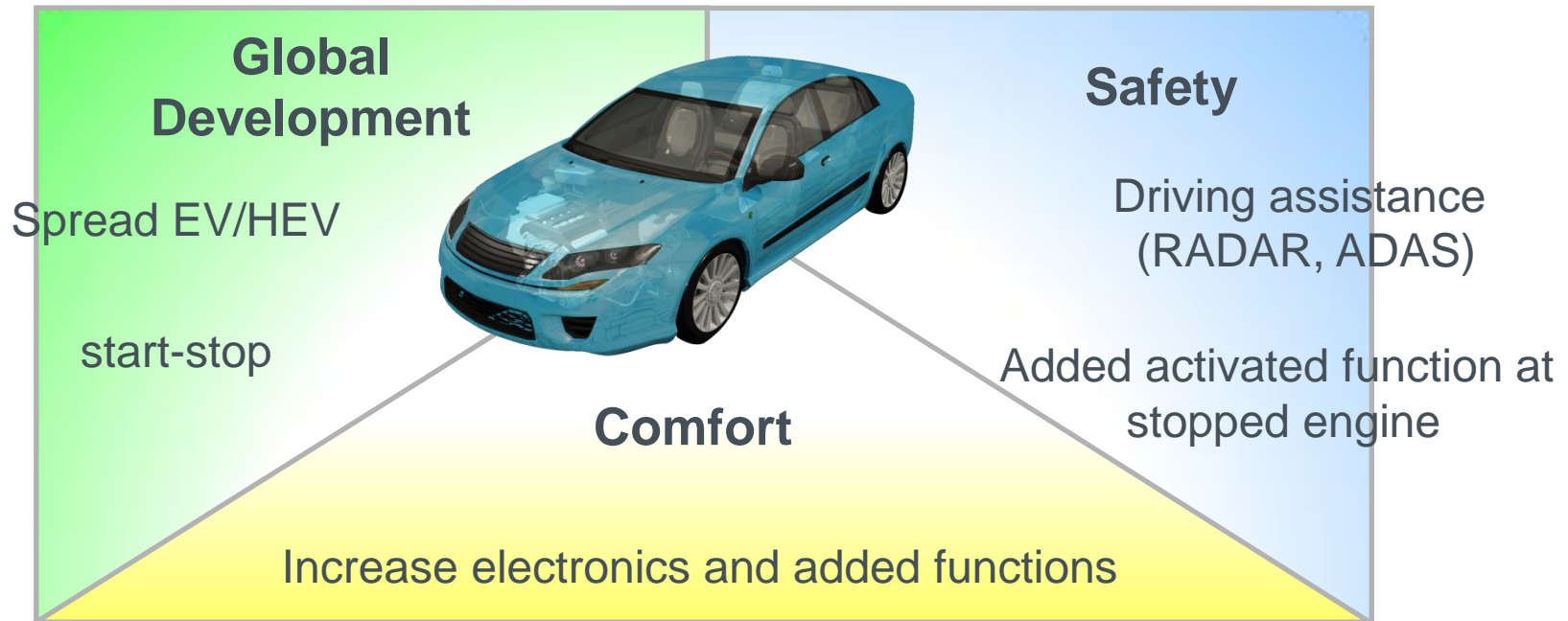
Automotive Market Trends

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	Body Control Module	Power Train	Safety Drive	Driver Information	
Market Trends					<p>increase power line</p> <p>increase current</p> <p>input voltage</p> <p>monitor and test</p> <p>miniaturize price</p>
			NCAP, JNCAP		
Power supply	LDO	PMIC	LDO, DC/DC, PMIC	LDO, DC/DC, PMIC	
Request for Power	<ul style="list-style-type: none"> • Increase SMPS • SBC 	<ul style="list-style-type: none"> • System Regulator Demand Increase • Self test and monitor 	<ul style="list-style-type: none"> • Miniaturize • PMIC 	<ul style="list-style-type: none"> • SMPS controller for Large Current + PMIC for core voltage 	<p>Increase power line and Complicate power design</p> <p>↓</p> <p>Solution propose using LDO, SMDS or PMIC.</p>



Technology for power supply



Required Technology for power supplies:

- Low quiescent current
- Various operating condition (e.g. cold-crank, load-dump)
- Higher Power density (large output currents and small PCB space)
- High efficiency
- Reduced conducted and radiated EMI

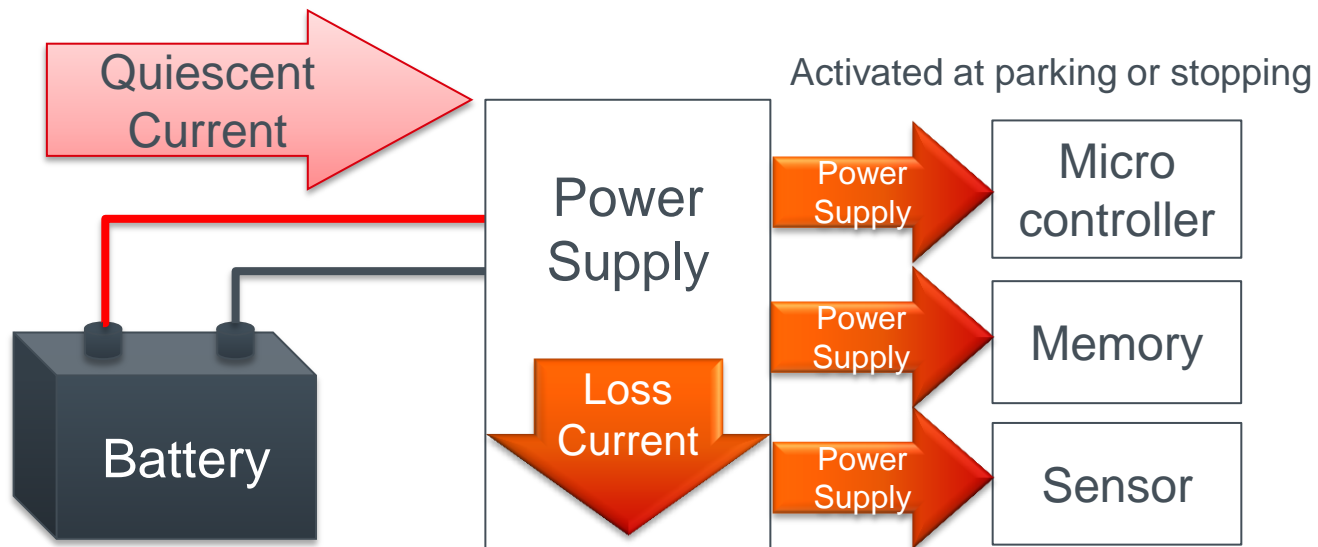
Low Current Consumption

Low quiescent current (Low IQ) regulators
– linear or switching

Low quiescent current requirement of power supply 7

Quiescent Current:

- The current which continues to be drawn from the battery when the application it powers is in standby or hibernation mode.

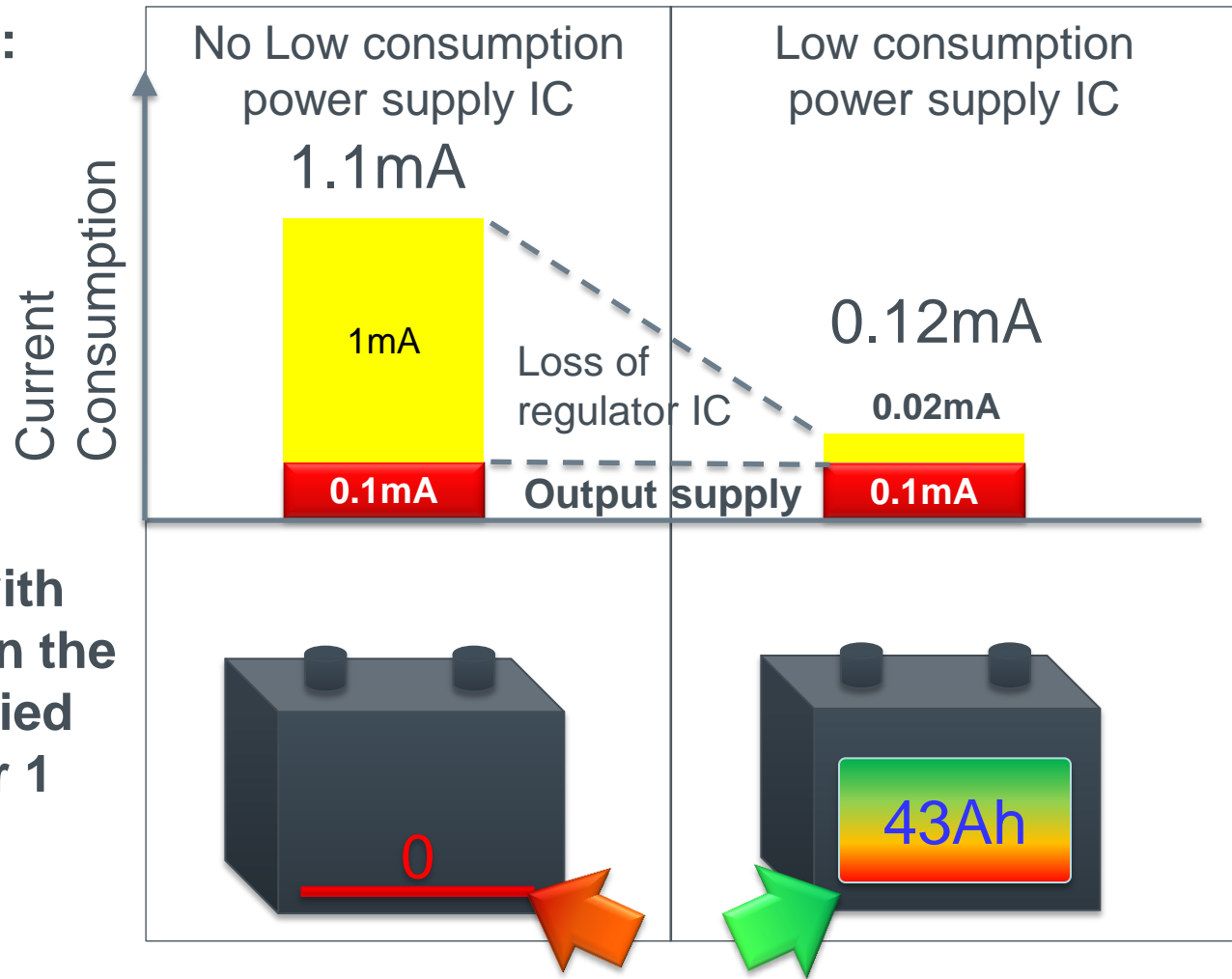


Reducing quiescent current saves fuel.

The effect of a low current consumption Regulator

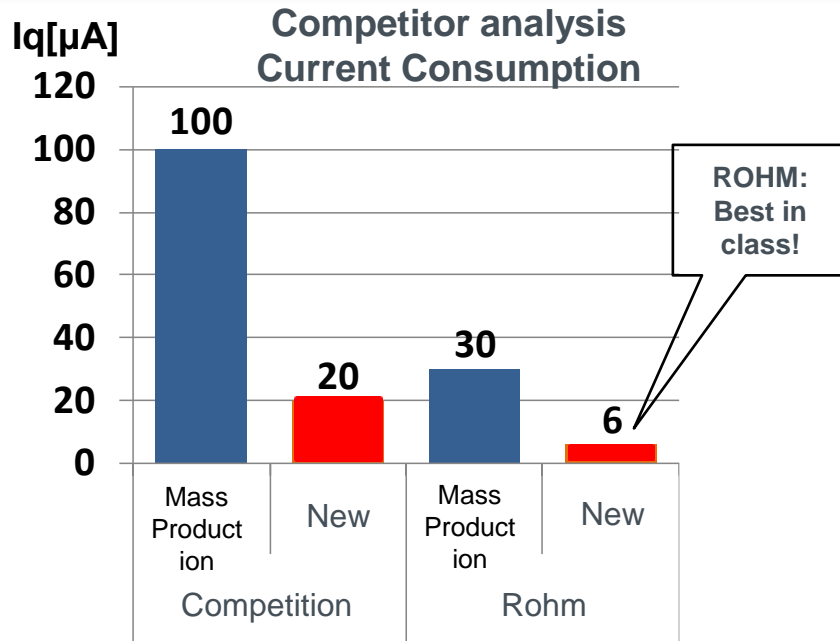
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For each ECU:



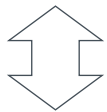
Low quiescent current (LDO)

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1. ROHM has developed an LDO with best in class quiescent current
2. Overshoot of output voltage for new ROHM products is more stable compared to competition

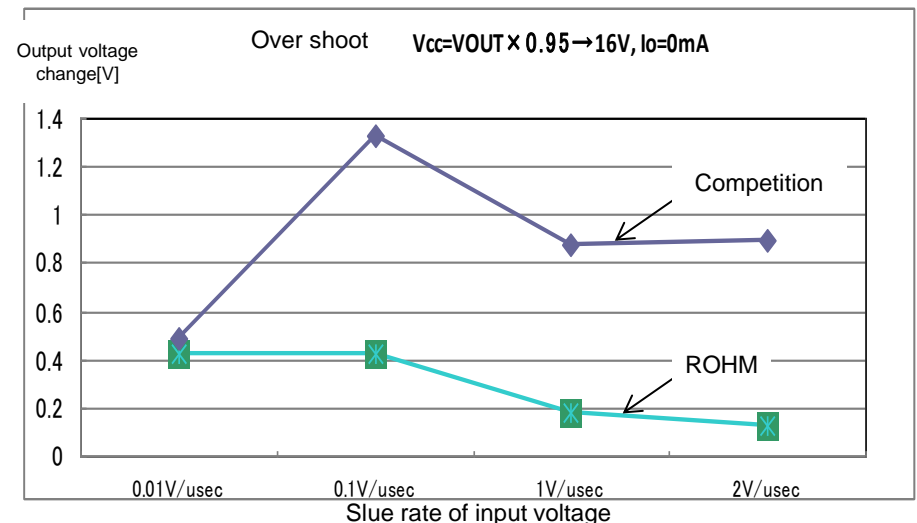
Low
quiescent
current



Trade OFF

Transient
Response

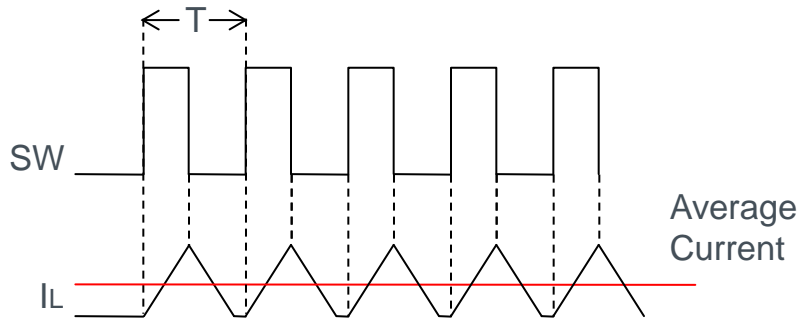
Output Voltage over shoot at Input Voltage transient



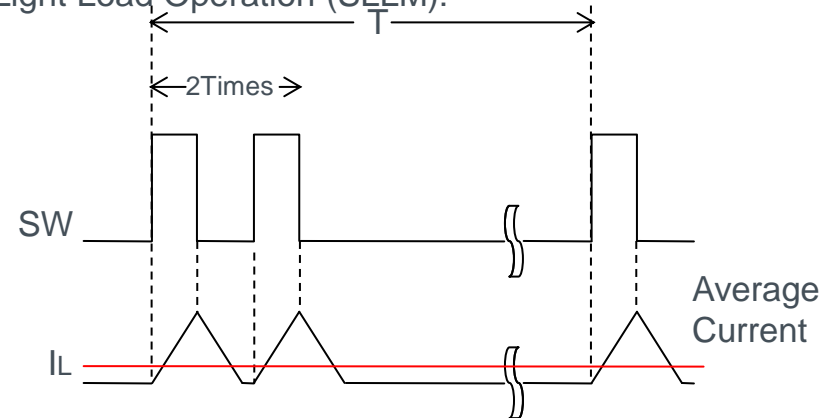
Low quiescent current (SWREG) High Efficiency

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Normal Operation:



Light Load Operation (SLLM):



The device enters a pulse skipping mode once average output current is falling below a certain limit.

Technologies used in ROHMs Low Iq DCDC

- Light Load Operation(SLLM)
- Optimized chip design for low current Consumption
- Automatically switching off internal modules if not needed
- SLLM Patent pending Technology

Low Input Voltage

Buck switching regulator - internal FET

Buck & Boost switching regulator - controller type

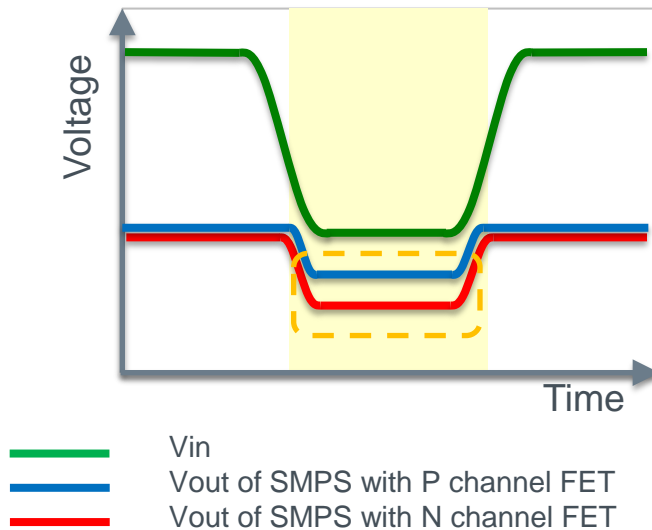
Request for low input voltage

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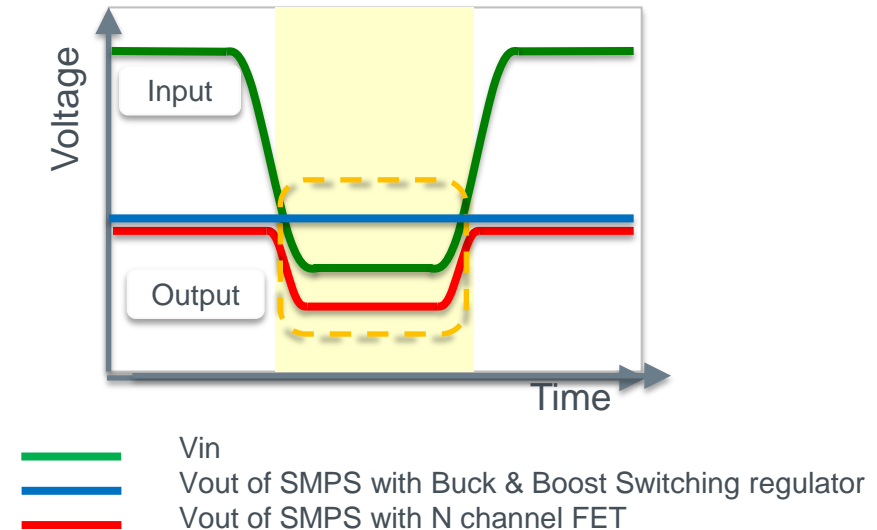
A micro controller reset can be caused by e.g. a low power supply.

- Cold-cranking pulse
- Start-stop function pulse

Solution 1: Reduce drop output voltage by 100% Duty control



Solution 2: Constant output voltage by Buck & boost control



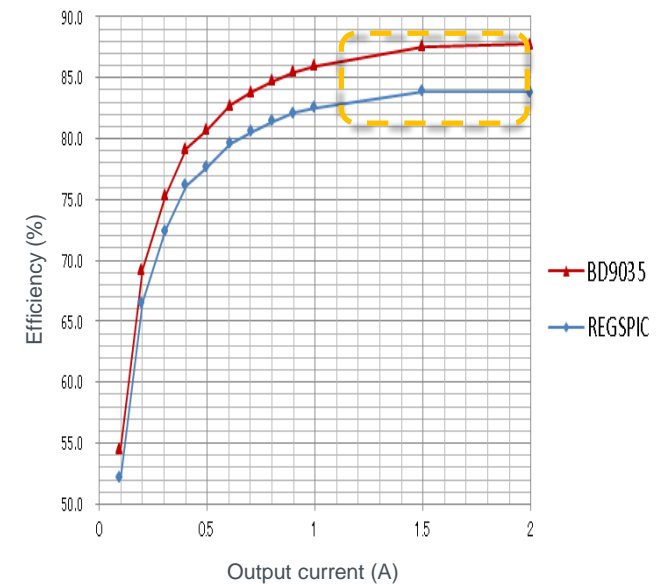
New Control Switching mode (REGSPIC)

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	Conventional Control mode	New Control mode
Simplified Circuit		
Control Mode	<p> A ON A OFF B ON B OFF </p> <p>Both switch A and switch B is active at all the time.</p>	<p> A ON A OFF B ON B OFF </p> <p>Buck Buck/Boost Boost</p> <p>Switch A and switch B is automatically controlled mode (ON/Switching/OFF) depend on relationship between input and output</p>

Efficiency

$V_{in}=12V$, $V_{out}=6V$, $f=350kHz$



5% efficiency improvement over a conventional type in buck mode.

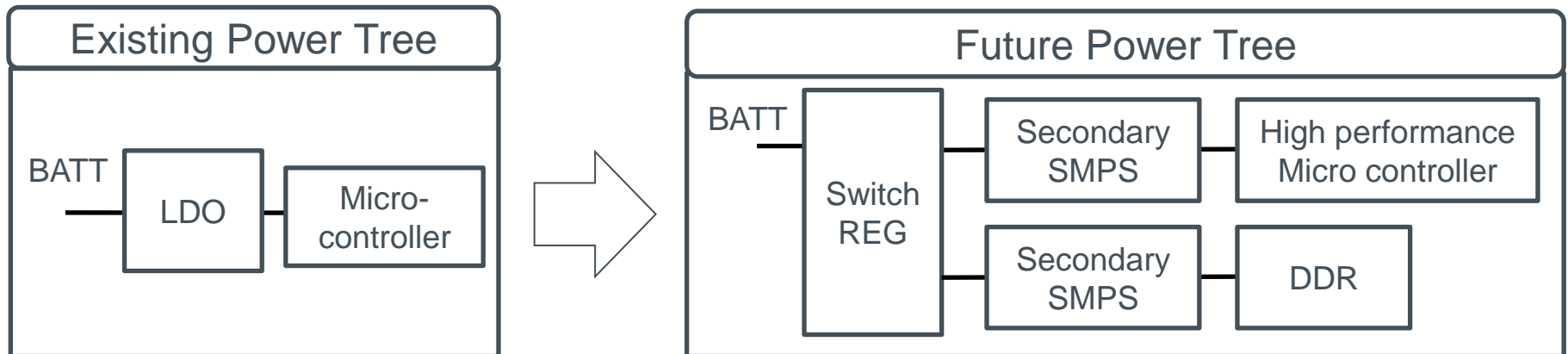
Higher Power Density

large output currents and small PCB space

Power tree for ECU trends

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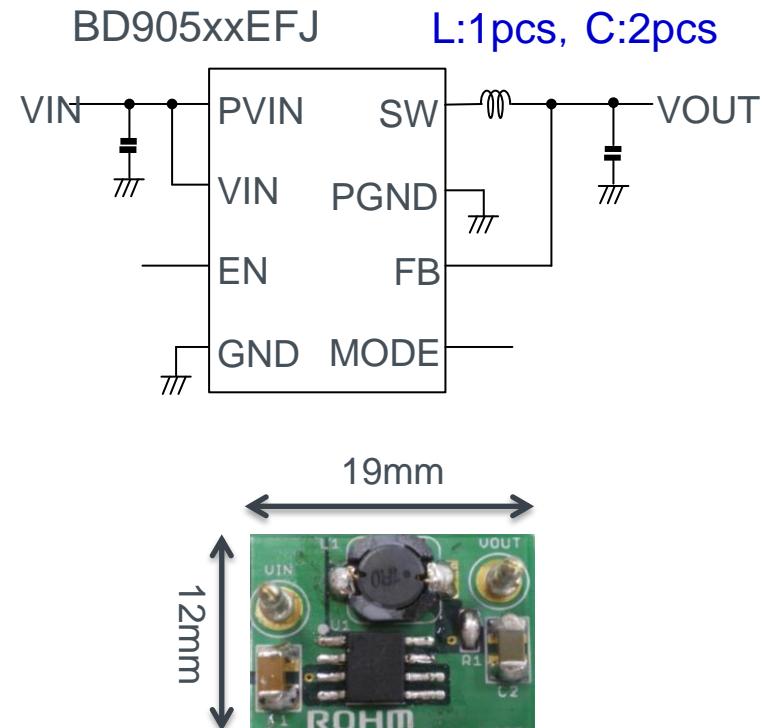
- Power supply for micro controller requires
 - high current,
 - low supply voltage
 - high frequency switching
- Smaller packages for power management ICs due to limited board space availability.



Required: Secondary SMPS with small package and large current

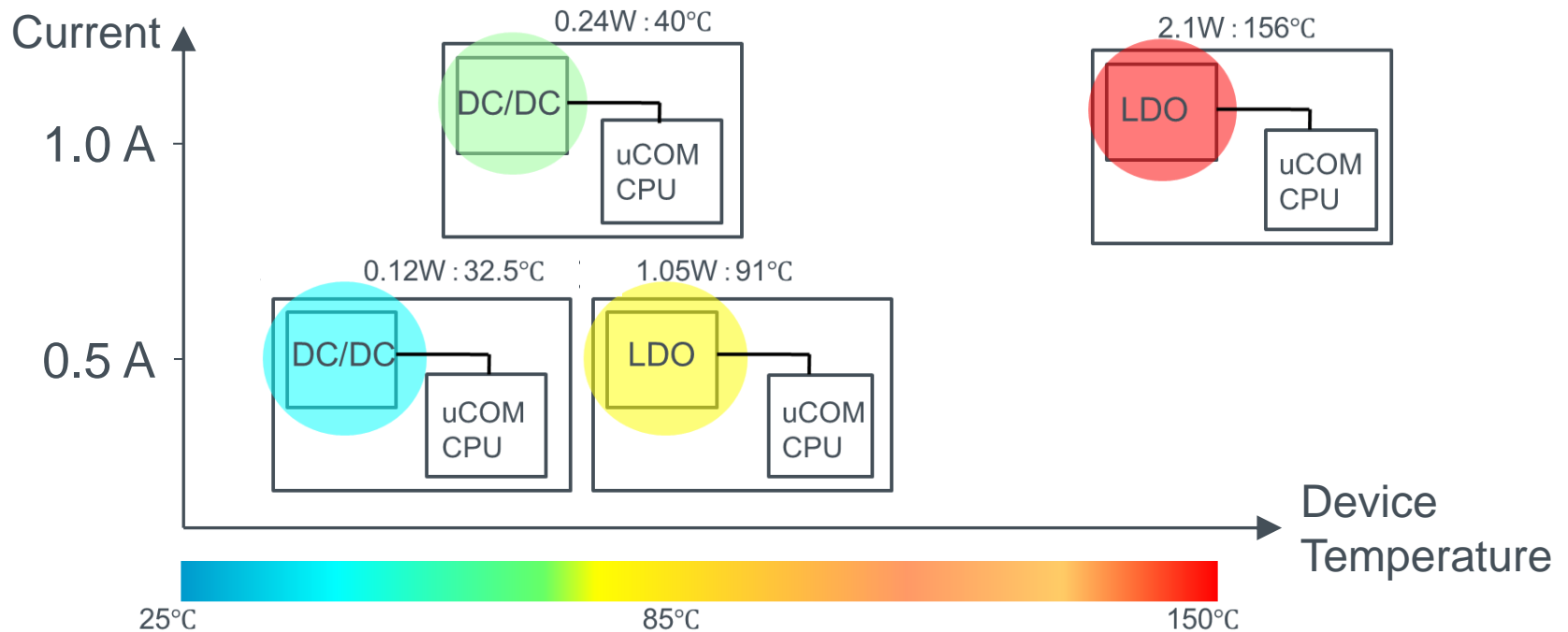
	General Purpose		New product
	LDO	Standard DCDC	BD905xx
External Parts number	2	15	3
Mounted areas	225mm ²	400mm ²	225mm ²
Design for power supply	Simple	Complicated	Simple
Efficiency	24%	Maximum over 90%	Maximum over 90%
Output current	1A	3A	3A

- Reduced external component count
- Small Package
- Large current capability



Power-loss Comparison secondary. DC/DC and LDO ¹⁸

Comparison heat loss at $V_{in}=3.3V, V_o=1.2V, P_d=2W$



Power Dissipation / Temperature	LDO	DCDC
1.0 A	2.1W → 156°C	0.24W → 40°C
0.5 A	1.05W → 91°C	0.12W → 32.5°C

LDO's

LDO Current Coverage

Output Current

1000mA

500mA

450mA

400mA

300mA

200mA

180mA

150mA

100mA

40mA

30mA

10mA

BD4xxM5 Series

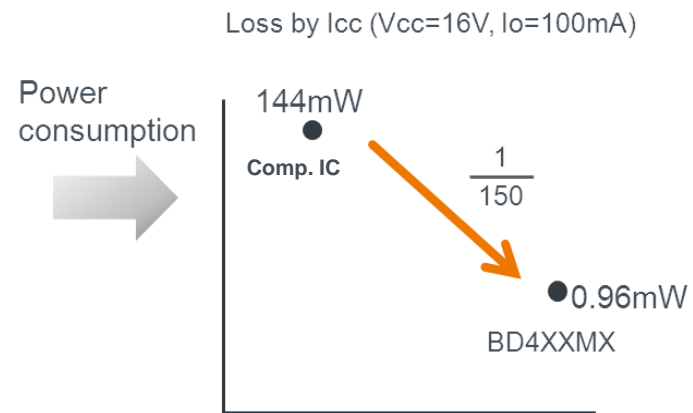
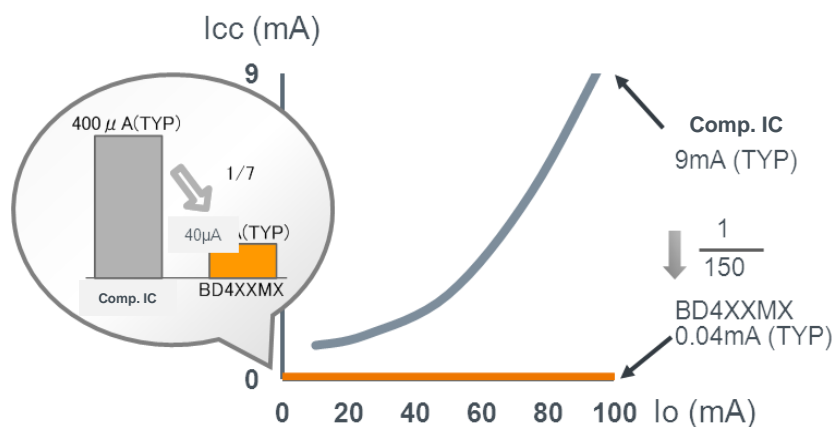
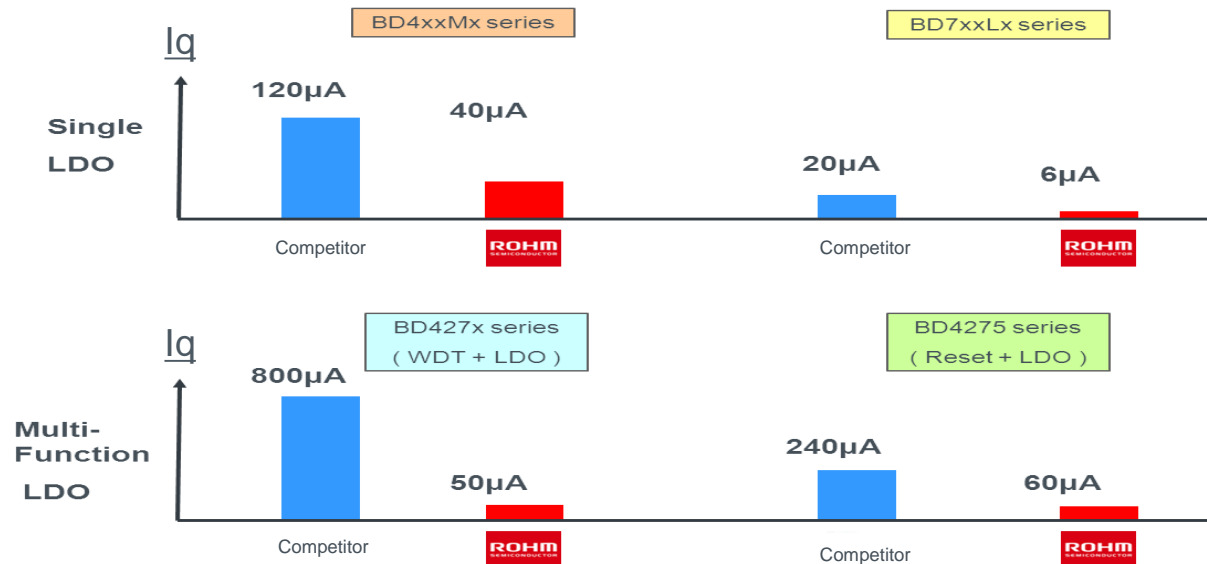
BD7xxL5 Series

BD4275 Series

BD4xxM2 Series

BD7xxL2 Series

ROHM's advantage over competition



Type	PKG	Specifications				Status (1)
		Io Max	Vo	Iq	INH	
BD433M2EFJ	HTSOP-J8	200mA	3.3V	40uA (Typ)	NO	MP
BD433M2FP3	SOT223-4					MP
BD450M2EFJ	HTSOP-J8		5.0V			MP
BD450M2FP3	SOT223-4					MP
BD433M2WEFJ	HTSOP-J8		3.3V		YES	MP
BD433M2WFP3	SOT223-4					MP
BD450M2WEFJ	HTSOP-J8		5.0V			MP
BD450M2WFP3	SOT223-4					MP
BD800M2EFJ	HTSOP-J8		ADJ		NO	D
BD800M2WEFJ	HTSOP-J8				YES	D

Type	PKG	Specifications				Status (1)
		Io Max	Vo	Iq	INH	
BD433M2EFJ	HTSOP-J8	200mA	3.3V	40uA (Typ)	NO	MP
BD433M2FP3	SOT223-4					MP
BD450M2EFJ	HTSOP-J8		5.0V			MP
BD450M2FP3	SOT223-4					MP
BD433M2WEFJ	HTSOP-J8		3.3V		YES	MP
BD433M2WFP3	SOT223-4					MP
BD450M2WEFJ	HTSOP-J8		5.0V			MP
BD450M2WFP3	SOT223-4					MP
BD800M2EFJ	HTSOP-J8		ADJ		NO	D
BD800M2WEFJ	HTSOP-J8				YES	D

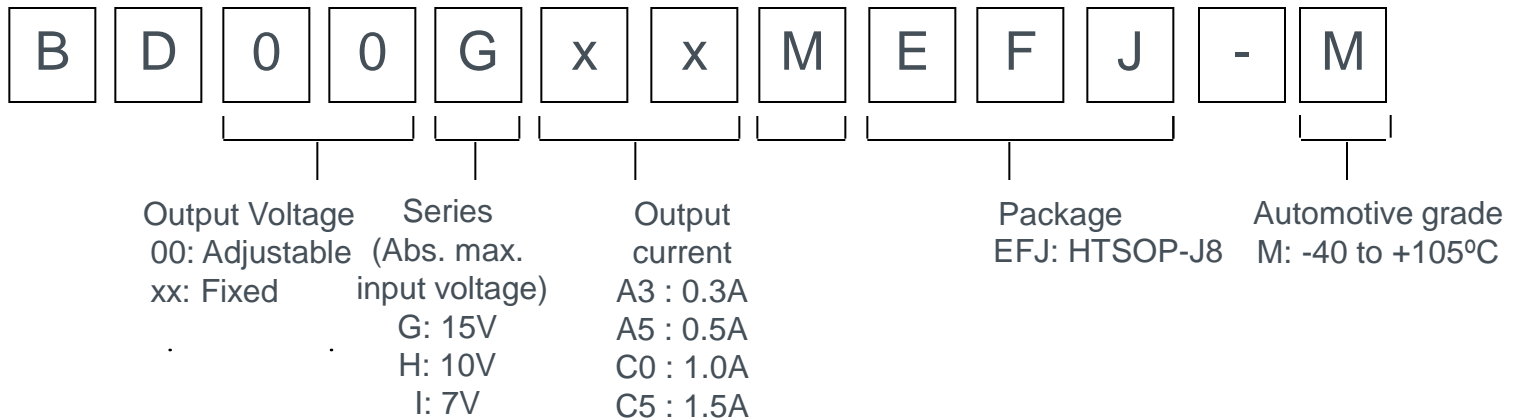
MP: Mass production, Q: In Qualification , D: In Development, P: In Planning

Type	PKG	Specifications				Status (1)
		I _o Max	V _o	I _q	INH	
BD733L2EFJ	HTSOPJ-8	200mA	3.3V	6uA (Typ)	NO	MP
BD733L2FP3	SOT223-4					MP
BD733L2FP	TO252-3 (DPAK)					MP
BD750L2EFJ	HTSOPJ-8		5.0V			MP
BD750L2FP3	SOT223-4					Q
BD750L2FP	TO252-3 (DPAK)					MP
BD733L5FP	TO252-3 (DPAK)	500mA	3.3V			MP
BD750L5FP	TO252-3 (DPAK)		5.0V			MP

Type	PKG	Specifications			Status (1)
		Io Max	Vo	Iq	
BD4269F	SOP-J8	150mA	5.0V	60uA	D
BD4299F	SOP-J8	250mA			D
BD4275FPJ	TO252-J5 (DPAK5)	500mA			Q
BD4275FP2	TO263-5 (D2PAK5)				MP
BD4271FP2	TO263-7 (D2PAK7)	650mA			D
BD4263F	SOP-J8	200mA			P
BD4263FS	SOP-20				P

MP: Mass production, Q: In Qualification , D: In Development, P: In Planning

BDxxG/H/Ixx-M Series:



Supply Voltage Current	15V (G)	10V (H)	7V (I)
0.3A (A3)	✓	✓	
0.5A (A5)	✓	✓	✓
1.0A (C0)	✓	✓	✓
1.5A (C5)		✓	

All pin-to-pin compatible

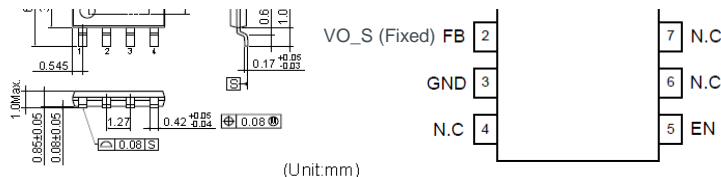
Automotive Secondary LDOs Line-up

Part Number	V _{IN}	V _{OUT}	I _{OUT}	Enable Pin	Circuit Current	Operating Temperature	Package	Status
BDxxGA3M-M	4.5-14V max. 15V	Fixed: 1.5-12V Adj.: 1.5 to 13V	300mA	Yes	0.6mA	-40 to 105°C	HTSOP-J8	MP
BDxxGA5M-M	4.5-14V max. 15V	Fixed: 1.5-12V Adj.: 1.5 to 13V	500mA	Yes	0.6mA	-40 to 105°C	HTSOP-J8	MP
BDxxGC0M-M	4.5-14V max. 15V	Fixed: 1.5-12V Adj.: 1.5 to 13V	1.0A	Yes	0.6mA	-40 to 105°C	HTSOP-J8	MP
BDxxHA3M-M	4.5-8V max. 10V	Fixed: 1.5-7.0V Adj.: 1.5-7.0V	300mA	Yes	0.6mA	-40 to 105°C	HTSOP-J8	MP
BDxxHA5M-M	4.5-8V max. 10V	Fixed: 1.5-7.0V Adj.: 1.5-7.0V	500mA	Yes	0.6mA	-40 to 105°C	HTSOP-J8	MP
BDxxHC0M-M	4.5-8V max. 10V	Fixed: 1.5-7.0V Adj.: 0.8 to 7V	1.0A	Yes	0.6mA	-40 to 105°C	HTSOP-J8	MP
BDxxHC5M-M	4.5-8V max. 10V	Fixed: 1.5-7.0V Adj.: 1.5-7.0V	1.5A	Yes	0.6mA	-40 to 105°C	HTSOP-J8	MP
BDxxIA5M-M	2.4-5.5V max. 7V	Fixed: 1.0-3.3V Adj.: 0.8-4.5V	500mA	Yes	0.3mA	-40 to 105°C	HTSOP-J8	MP
BDxxIC0M-M	2.4-5.5V max. 7V	Fixed: 1.0-3.3V Adj.: 0.8-4.5V	1.0A	Yes	0.3mA	-40 to 105°C	HTSOP-J8	MP
BUxxSD2M-M	1.7-6.0V max. 6.5V	Fixed: 1.0-3.4V ±2%	200mA	Yes	35µA	-40 to 105°C	SSOP5	CS: available
BUxxTD2ENVX	1.7-6.0V max. 6.5V	Fixed: 1.0-3.4V ±5%	200mA	Yes	35µA	-40 to 105°C	SSON004X1010	Under Planning
BD00JC0MNUV-M	3.0-5.5V	Adj.: 0.65-2.70V	1.0A	Yes Power Good	tbd	-40 to 105°C	VSON010V3030	Under Planning
BD00JA5MNUV-M	3.0-5.5V	Adj.: 0.65-2.70V	500mA	Yes Power Good	tbd	-40 to 105°C	VSON010V3030	Under Planning

Automotive Secondary LDO BDxxG/H/lxx-M Series

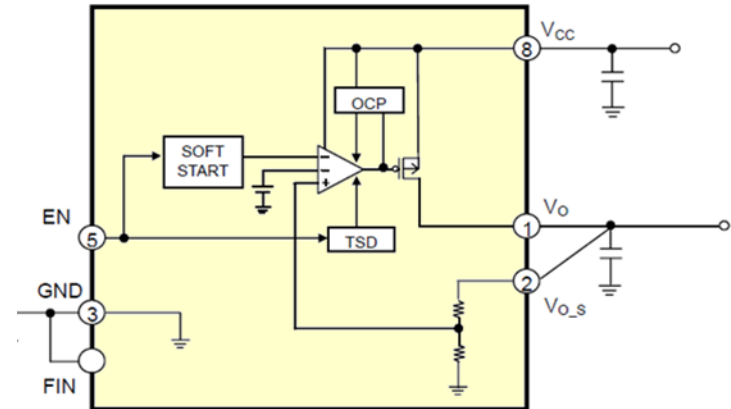
■ Features

- Input Voltage range: 4.5-14V / 4.5-8V / 2.4-5.5V
- Maximum Input Voltage: 15V / 10V / 7V
- Max. output current: 0.3/0.5/1.0/1.5A
- Output voltages:
 - Adjustable: 1.5-13V / 0.8-7V / 0.8-4.5V
 - Fixed: various between 1.0 and 12V
- High accuracy voltage output: $\pm 1\%$
- Drop-out voltage: typ. 0.6V / 0.6V / 0.4V
- Enable pin
- Supporting small ceramic capacitor down to 1 μ F
- Rich protections:
 - Soft start
 - Thermal shutdown
 - Over Current Protection
 - Pin-to-Pin short matrix protection
- Operational temperature range: -40 to 105°C

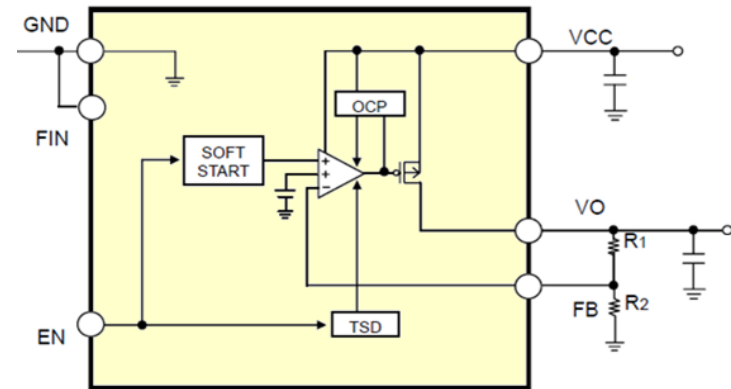


■ Application circuit

Fixed output voltage

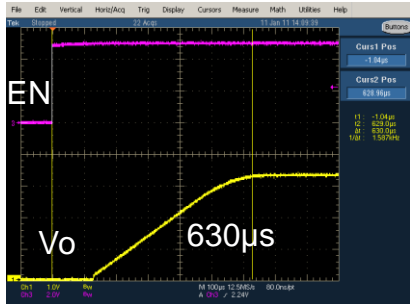


Variable output voltage



BDxxG/H/Ixx-M Series: Features

Soft-start



Soft-Start waveform (BD00GA5WEFJ)

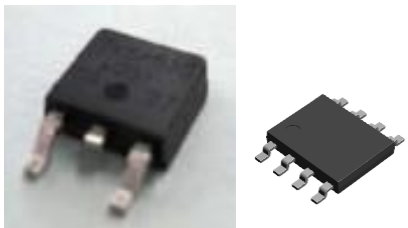
Over current protection

Ceramic capacitor min. 1µF



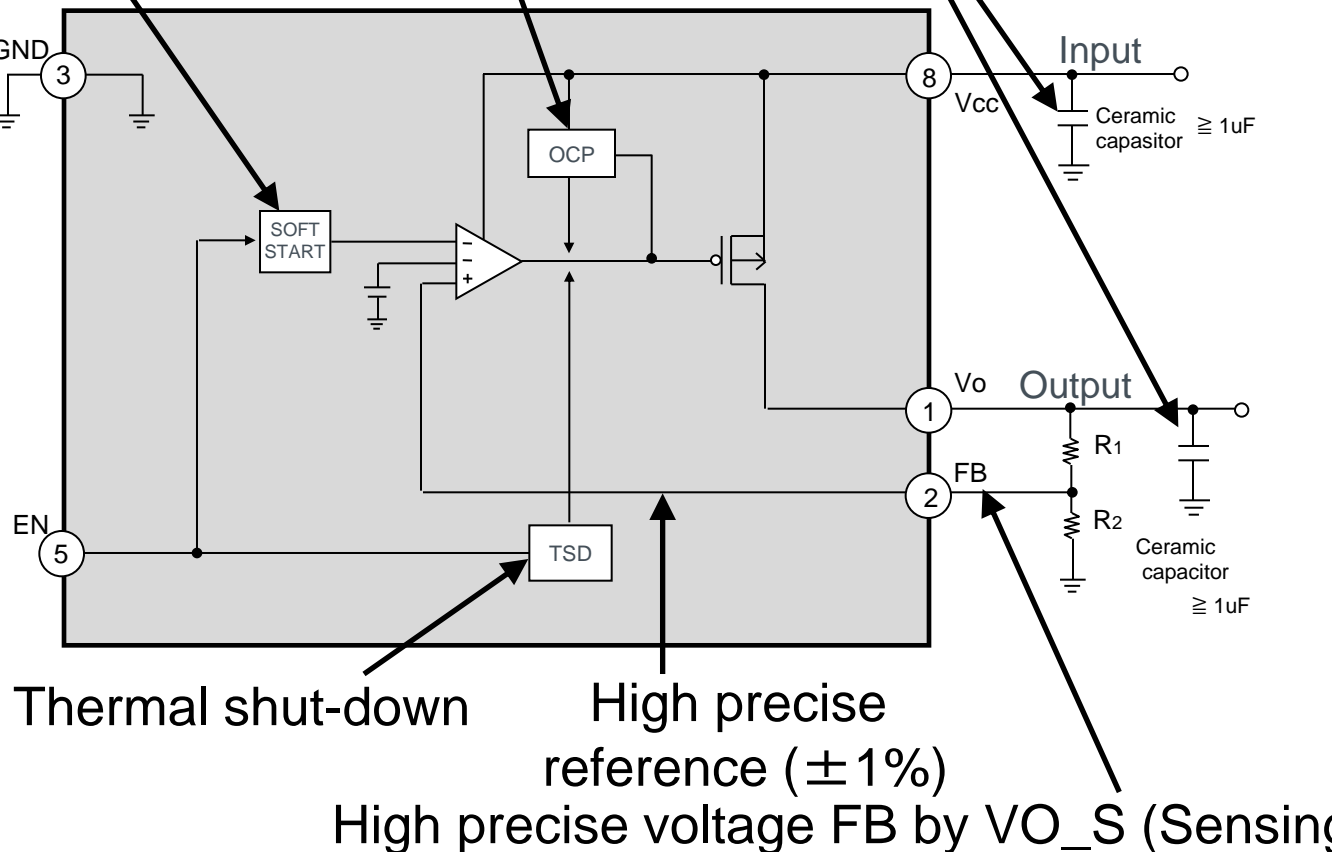
Low-ESR
Ceramic capacitor
supported

Small power package



61.8mm² → 29.4mm²

Δ: -52.4%





SMPS Products for Automotive

Switching Regulator Lineup

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Primary Boost/Isolated, Buck and Boost Switching Regulator Controller

Product Number	Control TYPE	Input Voltage	Output Voltage	Max. Freq.	Ext. Sync.	En.	Icc	Istby	Ext. TR	Control Mode	Package	Status
BD9032FV	Boost Isolated	3.5~35V	Adjustable (±1.5%)	600KHz (±10%)	—	○	2.1mA (Typ.)	0uA (Typ.)	Nch	Current Mode	SSOP B16	MP
BD9035EFV	Buck and Boost	3.8~40V	Adjustable (±1.5%)	600KHz (±7%)	○	○	6mA (Typ.)	0uA (Typ.)	Pch Nch	Voltage Mode	HTSSOP B24	MP

Primary Buck Switching Regulator with Built-in FET

Product Number	Output Current	Input Voltage	Output Voltage	Max. Freq.	Ext. Sync.	En.	Icc	Istby	PWR FET	Package	Status
BD90640EFJ BD90640HFP	4A	3.5~42V	Adjustable (±2%)	600KHz (±10%)	○	○	2.2mA (Typ.)	0uA (Typ.)	Pch	HTSOP8 HRP7	CS
BD90620EFJ	2A	3.5~42V	Adjustable (±2%)	600KHz (±10%)	○	○	2.2mA (Typ.)	0uA (Typ.)	Pch	HTSOP8	CS
BD90610EFJ	1A	3.5~42V	Adjustable (±2%)	600KHz (±10%)	○	○	2.2mA (Typ.)	0uA (Typ.)	Pch	HTSOP8	CS
BD90740NUX BD90740EFJ BD90740EFV	4A	3.5~42V	Adjustable (±2%)	2.3MHz	○	○	TBD	0uA (Typ.)	Nch	VSON10PX3030 HTSOP8 HTSSOPB24	Develop ment
BD90720NUX BD90720EFJ	2A	3.5~42V	Adjustable (±2%)	2.3MHz	○	○	TBD	0uA (Typ.)	Nch	VSON10PX3030 HTSOP8	Planning
BD90710NUX BD90710EFJ	1A	3.5~42V	Adjustable (±2%)	2.3MHz	○	○	TBD	0uA (Typ.)	Nch	VSON10PX3030 HTSOP8	Planning

Operating Temperature: 125°C Customer Samples: CS; Mass production MP

Switching Regulator Lineup - continued

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Low Quiescent Current Step Down Switching Regulator

Product Number	Output Current	Input Voltage	Output Voltage	Max. Freq.	Ext. Sync.	En.	Icc	Istby	TR	Light Load Mode	Package	Status
BD99011EFV/ BD99010EFV	2A	3.5~42V	5V / 3.3V	500KHz (±20%)	—	○	20uA (Typ.)	1uA (Typ.)	Pch Nch	○	HTSSOP B24	MP

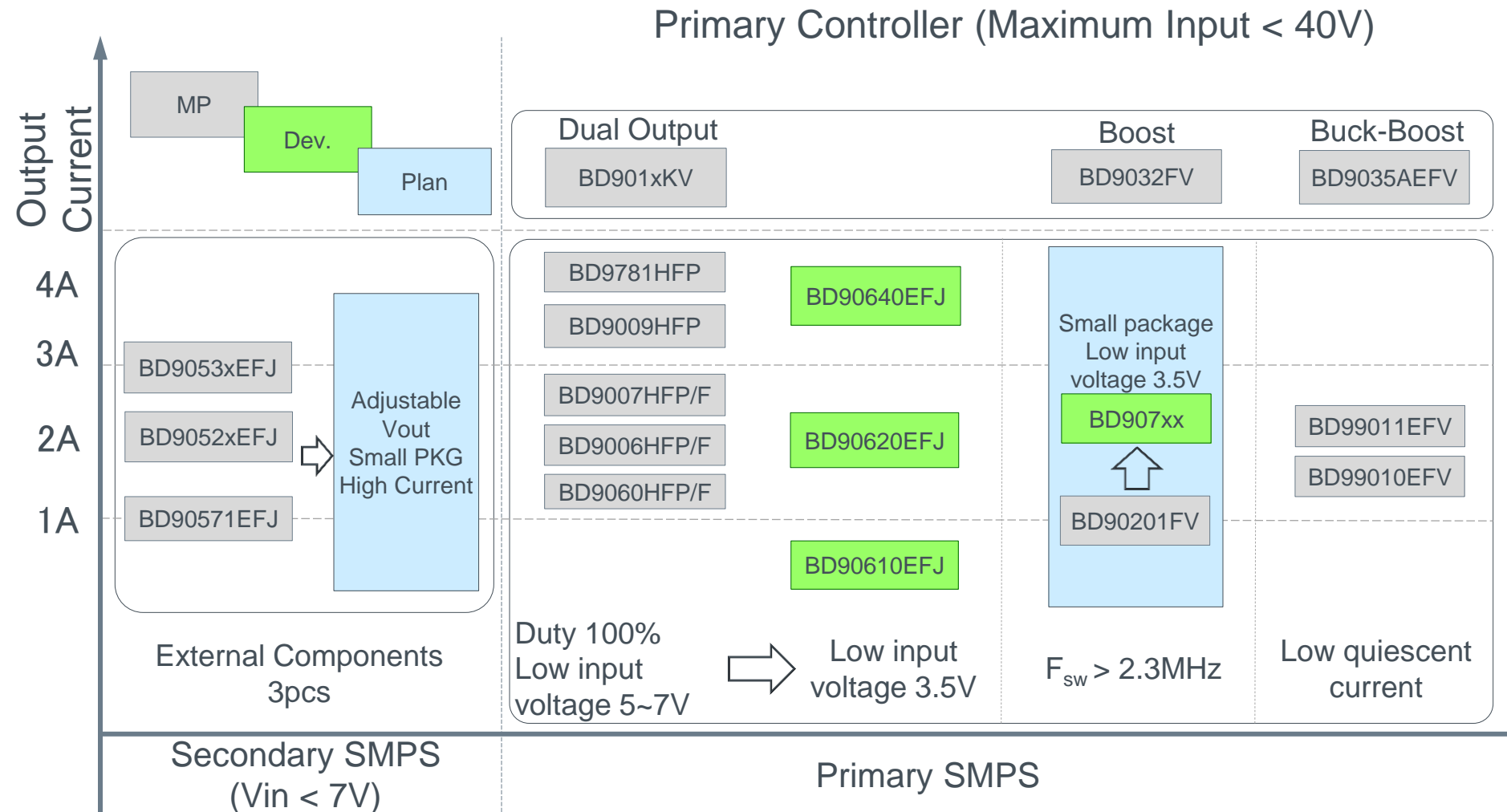
Secondary Switching Regulator

Product Number	Output Current	Input Voltage	Output Voltage	Max. Freq.	Ext. Sync.	En.	Icc	Istby	TR	Light Load Mode	Package	Status
BD90571EFJ	1A	2.7~6V	1.2V (±2%)	2.3MHz (±20%)	—	○	0.65mA (Typ.)	0uA (Typ.)	Pch Nch	○	HTSOP8	MP
BD9052XEFJ	2A	2.7~6V	1.2V / 1.5V / 1.8V(±2%)	2.3MHz (±20%)	—	○	0.65mA (Typ.)	0uA (Typ.)	Pch Nch	○	HTSOP8	MP
BD9053XEFJ	3A	2.7~6V	1.2V / 1.5V / 1.8V(±2%)	2.3MHz (±20%)	—	○	0.65mA (Typ.)	0uA (Typ.)	Pch Nch	○	HTSOP8	MP
BD90520EFV BD90520MUV	2A	2.7~6V	Adjustable	2.3MHz (±20%)	○	○	0.6mA (Typ.)	0uA (Typ.)	Pch Nch	○	HTSSOPB20 QFN20	Develop ment
BD90530EFV BD90530MUV	3A	2.7~6V	Adjustable	2.3MHz (±20%)	○	○	0.6mA (Typ.)	0uA (Typ.)	Pch Nch	○	HTSSOPB20 QFN20	Develop ment
BD90540EFV BD90540MUV	4A	2.7~6V	Adjustable	2.3MHz (±20%)	○	○	0.6mA (Typ.)	0uA (Typ.)	Pch Nch	○	HTSSOPB20 QFN20	Develop ment

Operating Temperature: 125°C Customer Samples: CS; Mass production MP

Switching Regulator Selection Diagram

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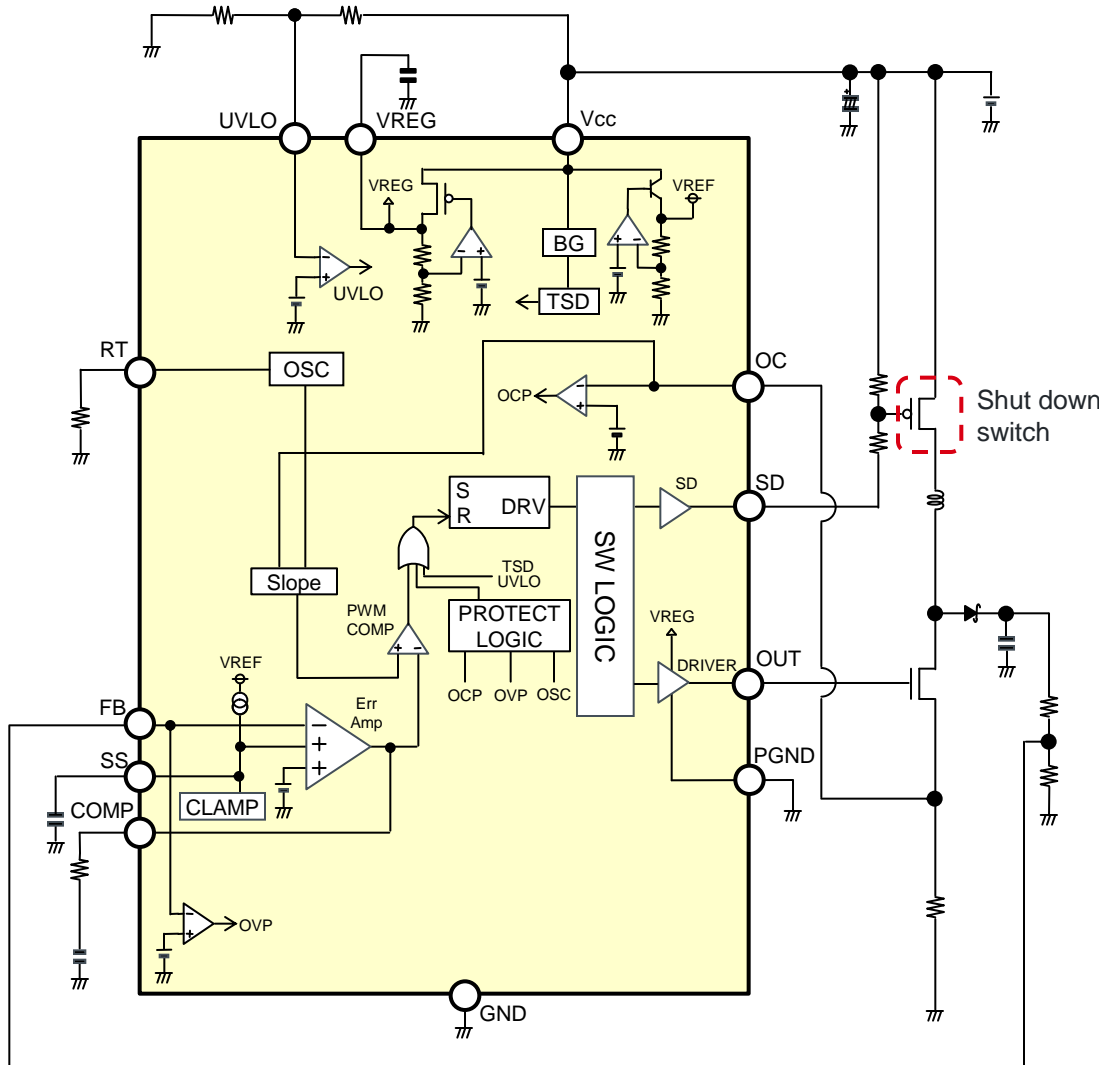


Isolated / Boost SMPS Controller

BD9031FV/BD9032FV

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Mass Production



Features

- Input Voltage Range: 3.5/4.5 ~ 35V
- Current mode control
- Adjustable output reference voltage: $0.8V \pm 1.5\%$
- Soft start adjustable
- Adjustable frequency: 100 ~ 600kHz
- Protections TSD / OCP / SCP
- Shut-down switch protects power path components
- Package: SSOP-B16



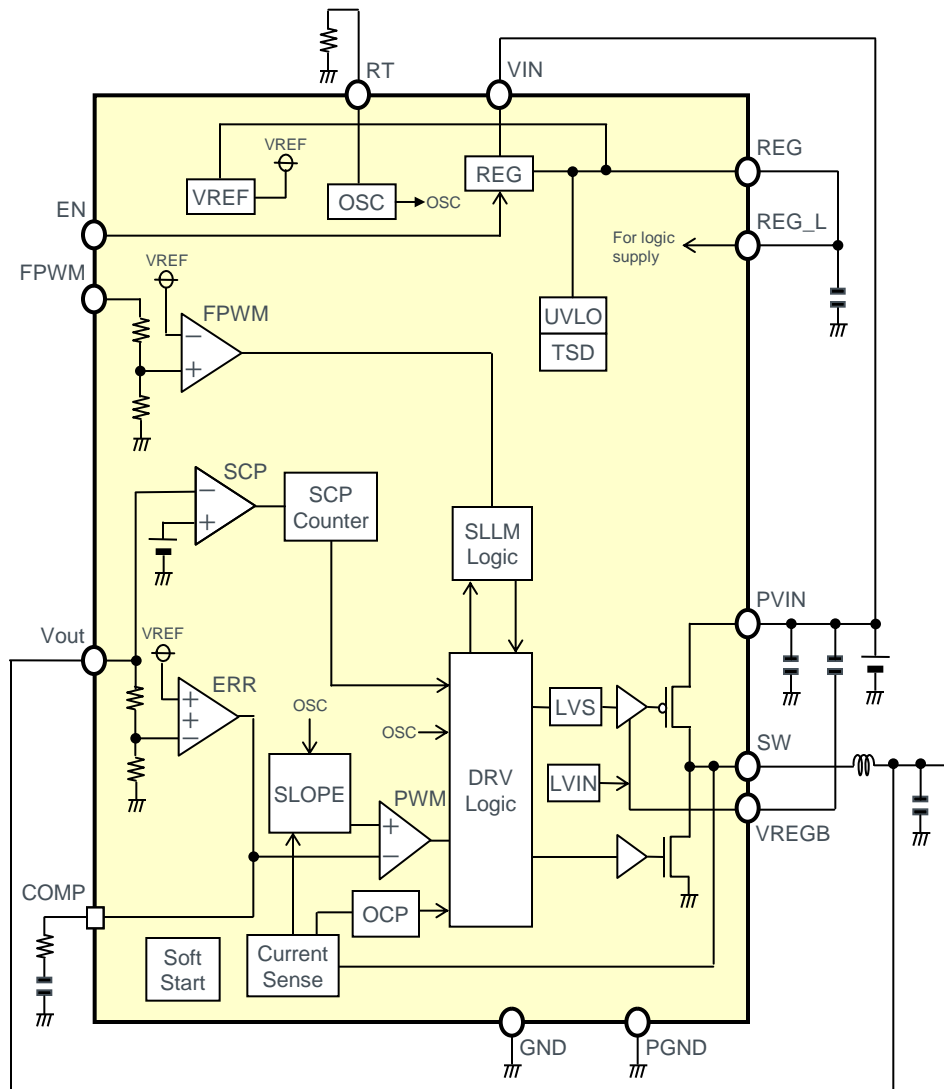
SSOP-B16

Low current consumption SMPS

BD99010EFV-M/BD99011EFV-M

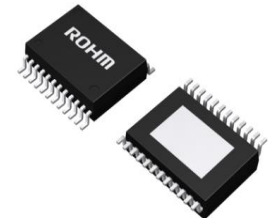
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Mass Production



Features

- Low quiescent current: **22μA**
- Synchronous Rectifier (No Schottky Diode)
- High Efficiency (selectable SLLM™ and PWM mode)
- Output Voltage Fixed
3.3V, 2A output (BD99010EFV)
5.0V, 2A output (BD99011EFV)
- Input Voltage Range: 3.6~35V
(Maximum Input Voltage: 42V)
- Adjustable f_{sw} 200 ~ 500kHz
- Protections TSD / OCP / SCP
- Current mode contrc



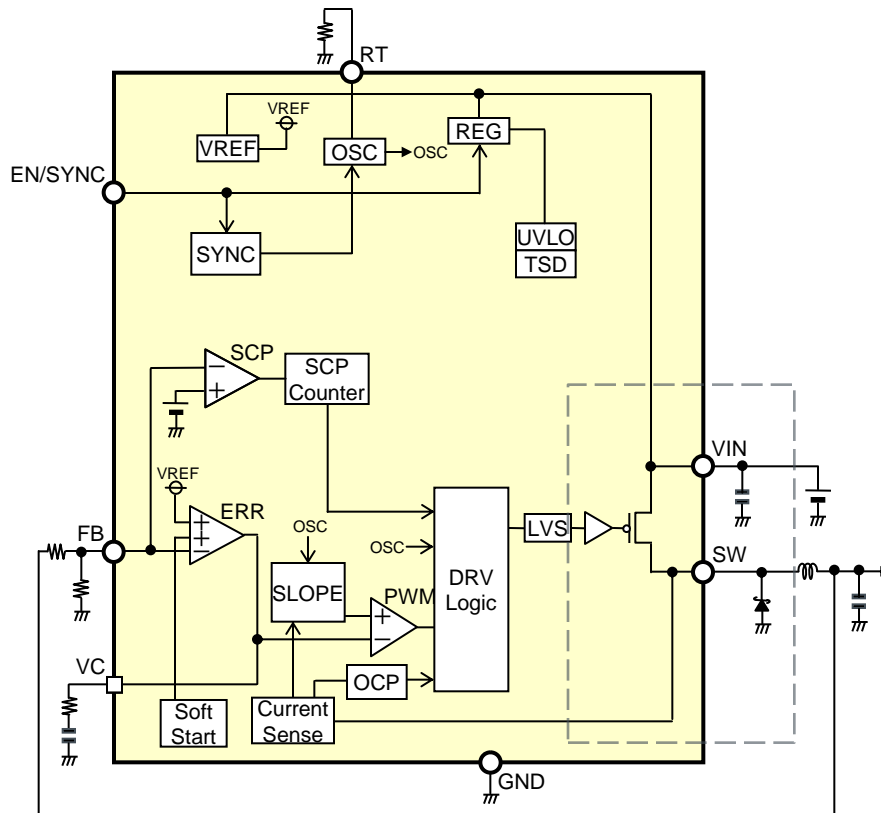
HTSSOP-B24

SMPS with P channel FET

BD90640/BD90620/BD90610EFJ

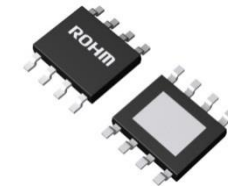
37

Customer Samples



Features

- Input Voltage Range: 3.5V~36V
(Maximum Input Voltage: 42V)
- Reduce drop voltage by 100% Duty control
- Output Current:
 - 1.25A: BD90610EFJ
 - 2.5A: BD90620EFJ
 - 4.0A: BD90640EFJ
- Adjustable switching frequency: 50~600kHz
- High precision reference voltage: $0.8V \pm 1.0\%$
- External synchronous frequency input
- Protections TSD / OCP / SCP
- Current mode control



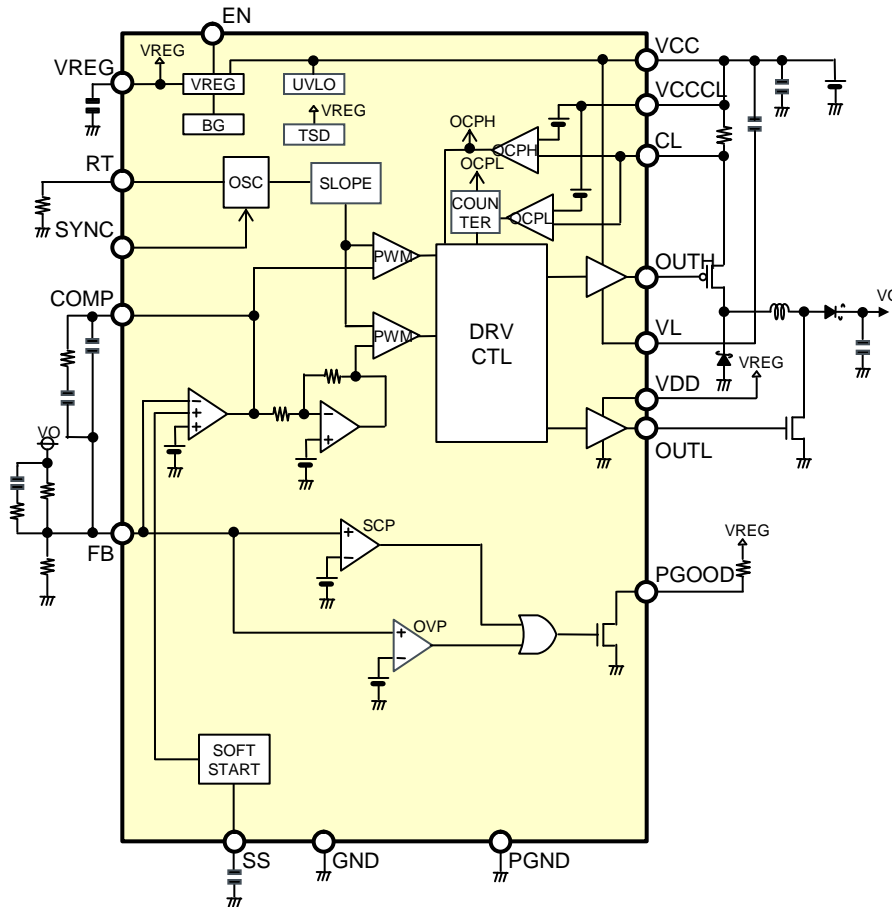
HTSOP-J8

Buck and Boost switching Regulator

BD9035AEFV

38

Mass Production



Features

- Input Voltage Range: 3.8V~30V (Maximum Input Voltage: 40V)
- High Efficiency by automatically control mode REGSPIC™ (Buck / Buck & Boost / Boost)
- High precision reference voltage: $\pm 1.5\%$
- Adjustable switching frequency: f_{sw} 200~600kHz / $\pm 1\%$
- External synchronous frequency input
- Protections TSD / OCP / SCP
- PGOOD output



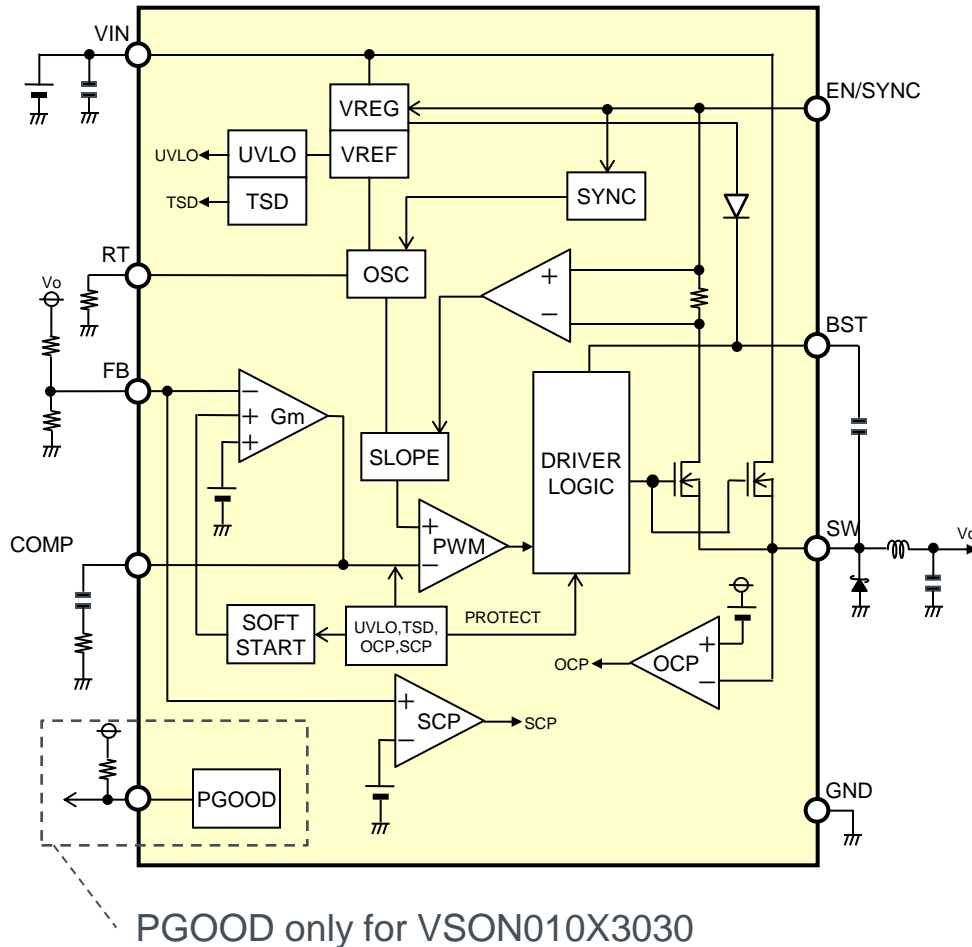
HTSSOP-B24

Primary SMPS with internal N-channel FET

BD907xxEFJ/NUX

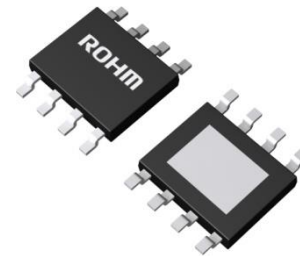
39

Development

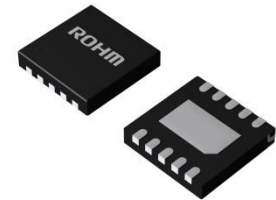


Features

- Input Voltage Range: 3.5V ~ 35V (Maximum Input Voltage: 42V)
- Adjustable output voltage (accuracy $0.8V \pm 2\%$)
- Output current:
 - 1A: BD90710EFJ/NUX
 - 2A: BD90720EFJ/NUX
 - 4A: BD90740EFJ/NUX
- Adjustable switching frequency: f_{sw} 100k ~ 2.4MHz
- Protections (TSD / OCP / SCP)
- Small size package:



HTSOP-J8
W(Typ.) x D(Typ.) x H(Max.)
4.90mm x 6.00mm x 1.00mm



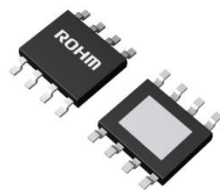
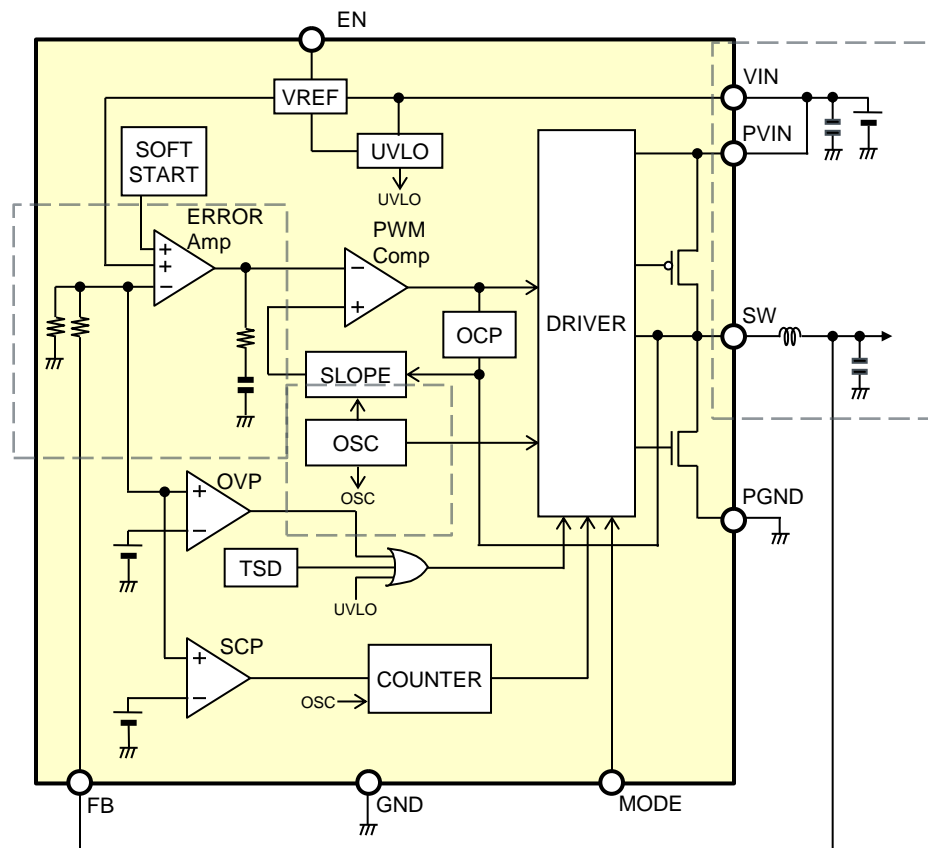
VSON010X3030
W(Typ.) x D(Typ.) x H(Max.)
3.00mm x 3.00mm x 0.60mm

Secondary SMPS

BD905xxEFJ

40

Mass Production



HTSOP-J8

Features

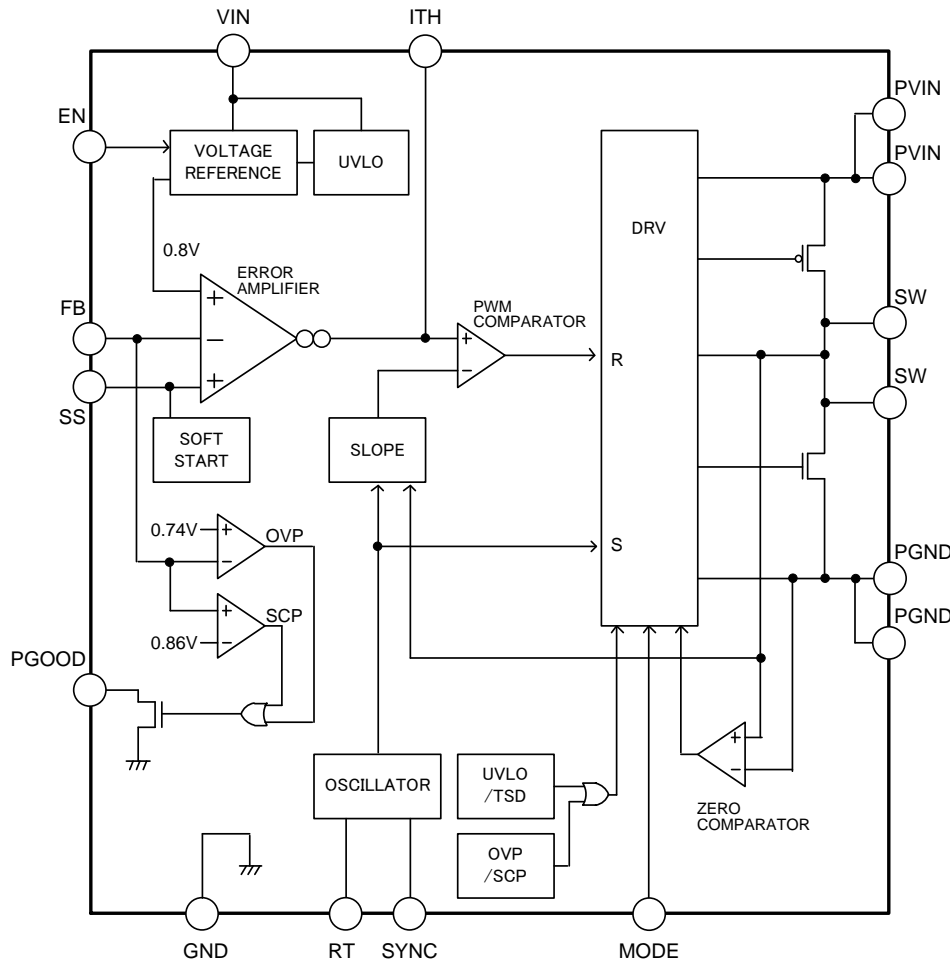
- Input Voltage Range: 2.7V~5.5V (Maximum Input Voltage: 7V)
- Very low external component count
3 components,
Included phase compensation (C,R)
- Fixed output voltage:
1.2V: BD905x2EFJ
1.5V: BD905x5EFJ
1.8V: BD905x8EFJ
- Output current:
1A: BD90571EFJ (1.2V only)
2A: BD9052xEFJ
3A: BD9053xEFJ
- Fixed switching frequency: 2.25MHz
- Current mode control
- Synchronous Rectifier (without FET)
- High Efficiency (selectable SLLM™ and PWM mode)
- Protections TSD / OCP / SCP

Secondary SMPS with Low Iq

BD905X0EFV/MUV

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Planning



Features

- Input Voltage Range: 2.65~5.5V (Maximum Input Voltage: 7V)
- Adjustable output voltage (accuracy $0.8V \pm 1.5\%$)
- Output Current:
 - 2A: BD90520EFV / MUV
 - 3A: BD90530EFV / MUV
 - 4A: BD90540EFV / MUV
- Low quiescent current: 60uA
- Switching Frequency: 300kHz~2.5MHz
- External synchronous frequency
- Current mode control
- Synchronous rectifier
- High Efficiency (selectable SLLM™ and PWM mode)
- Protections OCP / TSD / SCP



QFN20SV4040 HTSSOP-B20



ASSP Power Supply ICs for Automotive

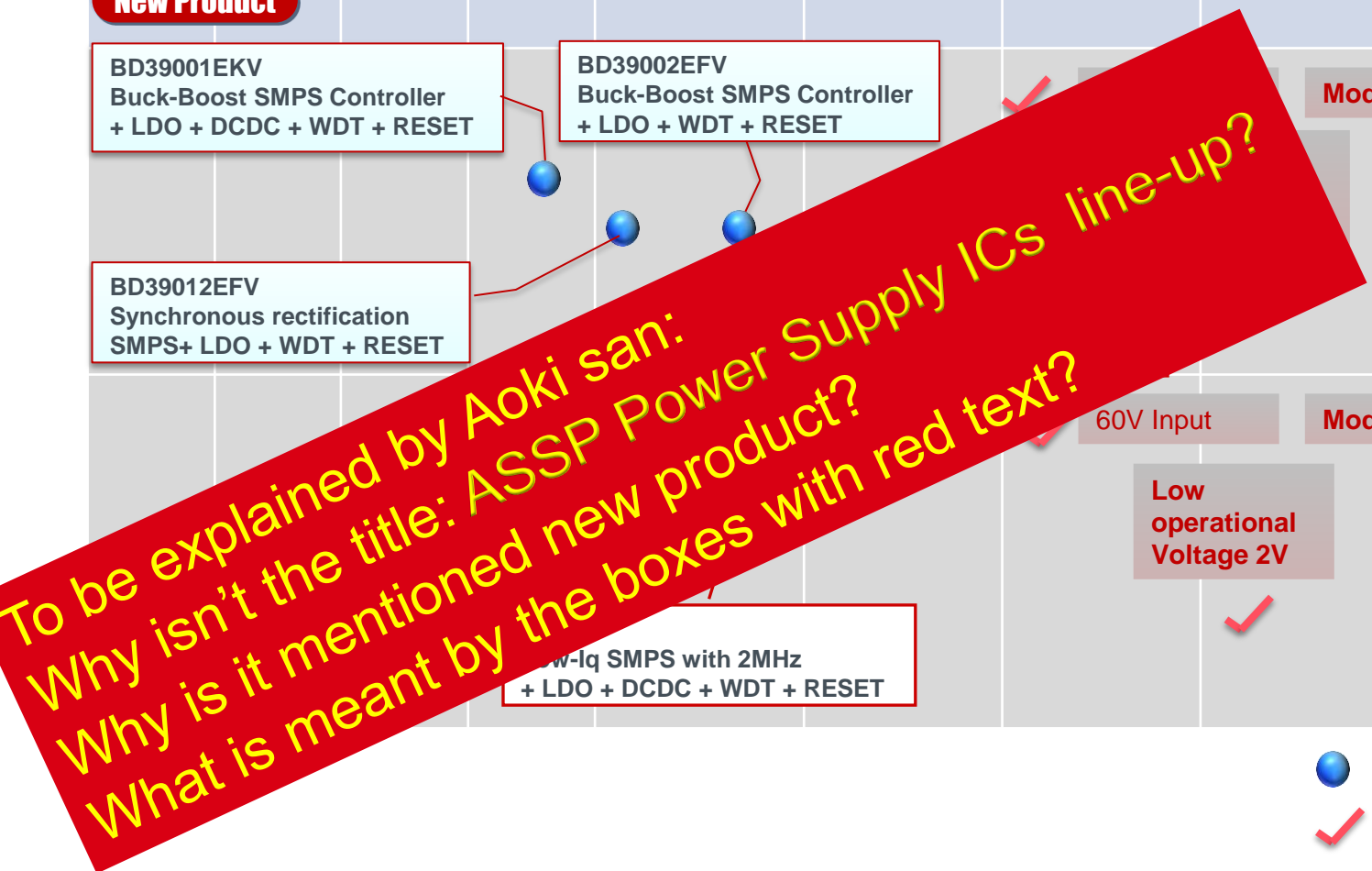
BD39001EFV

BD39002EKV

BD39012EKV

ASSP = application specific standard product

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System Regulator Lineup

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System Regulator for camera module

Part Number	Input Voltage	OUTPUT				SW Frequency	Sequence	Reset	Package	Status
		CH1	CH2	CH3	CH4					
BD8671KN	4.5 to 9.0V	Buck DC/DC 3.3V (150mA)	Boost DC/DC 12V (20mA)	Inv. Charge Pump -5V (5mA)	—	500kHz to 1.2MHz	—	—	VQFN28	MP
BD8676KN	4.5 to 9.0V	Buck DC/DC 3.3V (200mA)	Buck DC/DC 1.2V (120mA)	Boost DC/DC 15V (20mA)	Inv. Charge Pump -5V (5mA)	500kHz to 1.2MHz	○	2.7V	VQFN36	MP
BD8674KN	4.5 to 9.0V	Buck DC/DC 3.3V (250mA)	Buck-Boost DC/DC 5.0V (30mA)	—	—	500kHz to 1.2MHz	—	2.75V	VQFN28	MP
BD8678AMUV	4.5 to 9.0V	LDO 2.8V/50mA	Buck DC/DC 1.5V (150mA)	—	—	500kHz to 1.2MHz	○	2.4V	VQFN020V4040	MP
BD8682MUV-M	5.9 to 18V Absolute max. 40V	Buck DC/DC 3.3V (500mA) Adjustable output	LDO 2.8V or 3.3V (130mA)	LDO 1.8V (60mA)	Buck DC/DC 1.5V, 1.2V or 1.8V (250mA)	500kHz(CH1) 1MHz(CH4)	○	Vo2 × 0.86	VQFN32SV5050	MP

System Regulator for power train, HEV, EPS etc.

Part Number	Input Voltage	OUTPUT				SW Frequency	Sequence	PGOOD	WUT	Package	Status
		CH1	CH2	CH3	CH4						
BD39002EV	4.5 to 30V (40V)	Buck and Boost SMPS controller	LDO 5V 300mA	Inverting Charge Pump -5V (5mA)	—	200 ~ 500KHz	○	○	○	HTSSOPB	Development
BD39003EKV	4.5 to 30V (40V)	Buck and Boost SMPS controller	LDO 5V 300mA	STEP UP DC/DC 15V (20mA)	Secondary SMPS : 600mA		○	○	○	HTQFP48	CS
BD39012EFV	4.5 to 30V (40V)	Synchronous Rectifier SMPS / 1A	LDO 5V 400mA	LDO2 1.8V (60mA)	—	200 ~ 500KHz	○	○	○		Development

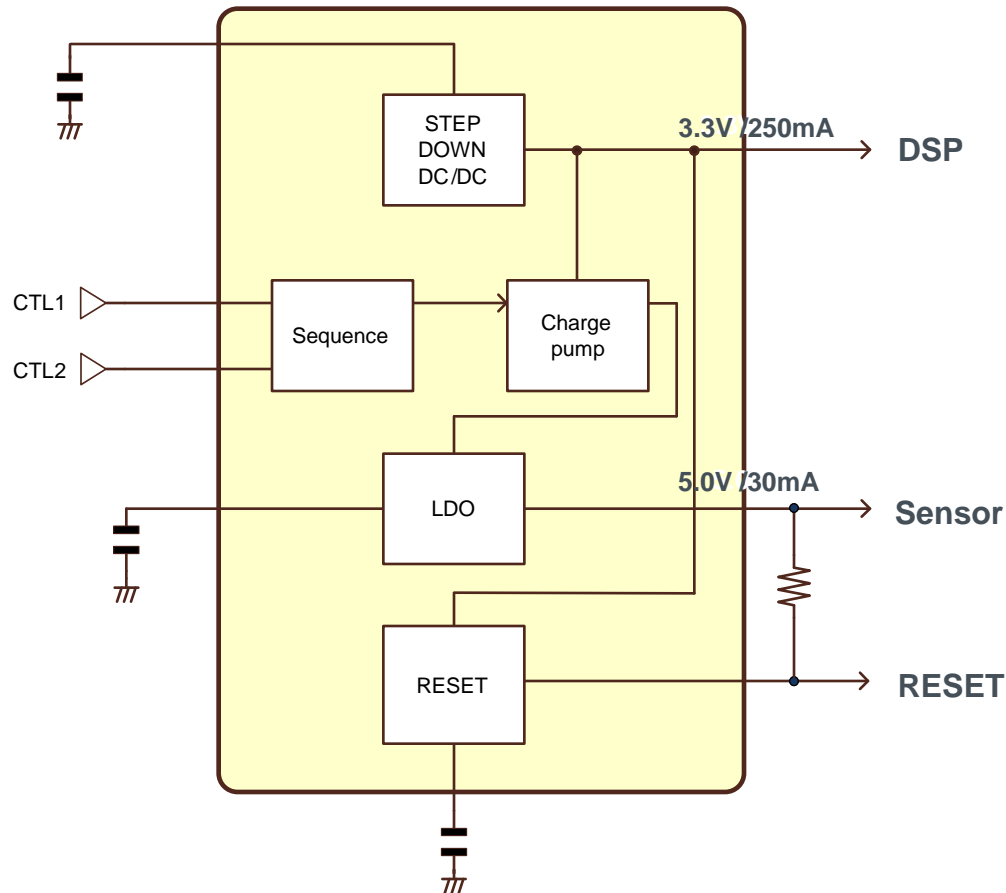
Operating Temperature: 125°C Customer Samples: CS; Mass production MP

PMIC for Camera Module (CMOS sensor)

BD8674KN

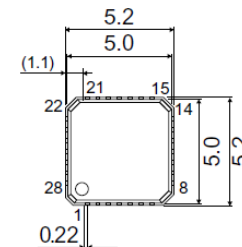
46

Mass Production



Features

- Input Voltage Range: 4.5V to 9.0V
- DCDC + LDO
 - Buck: 3.3V/250mA
 - LDO: 5.0V/30mA
- Negative charge pump: -5.5V / 5mA
- Reset output
- Startup sequence control circuit
- Small package: VQFN-28

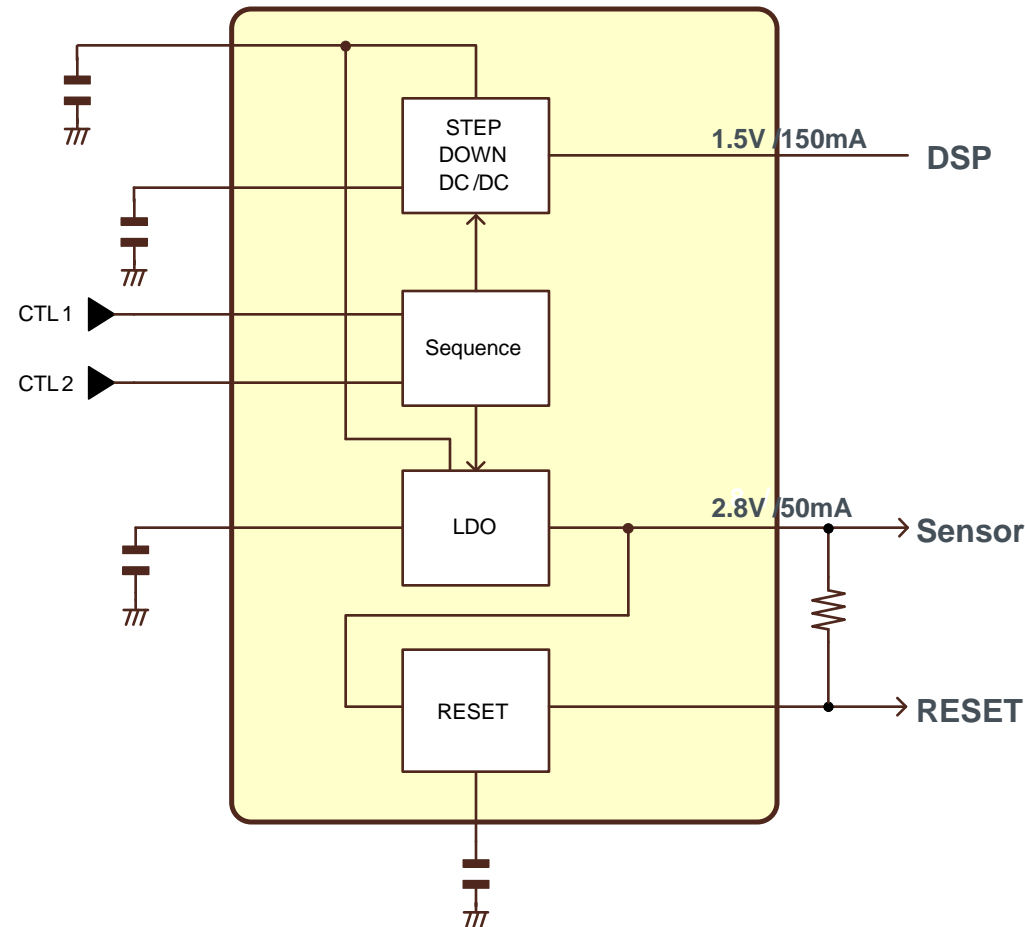


PMIC for Camera Module (CMOS sensor)

BD8678AMUV

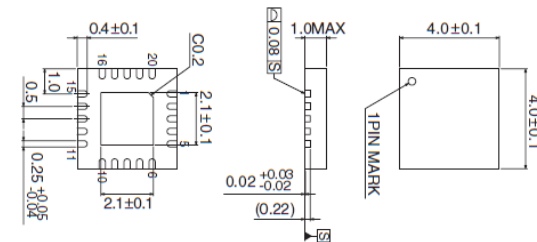
48

Mass Production



Features:

- Input Voltage Range: 4.5V to 9.0V
- Buck DC/DC converter: 1.5V / 150mA
- LDO: 2.8V/50mA
- Reset
- Startup sequence control circuit
- VQFN020V4040 Small package

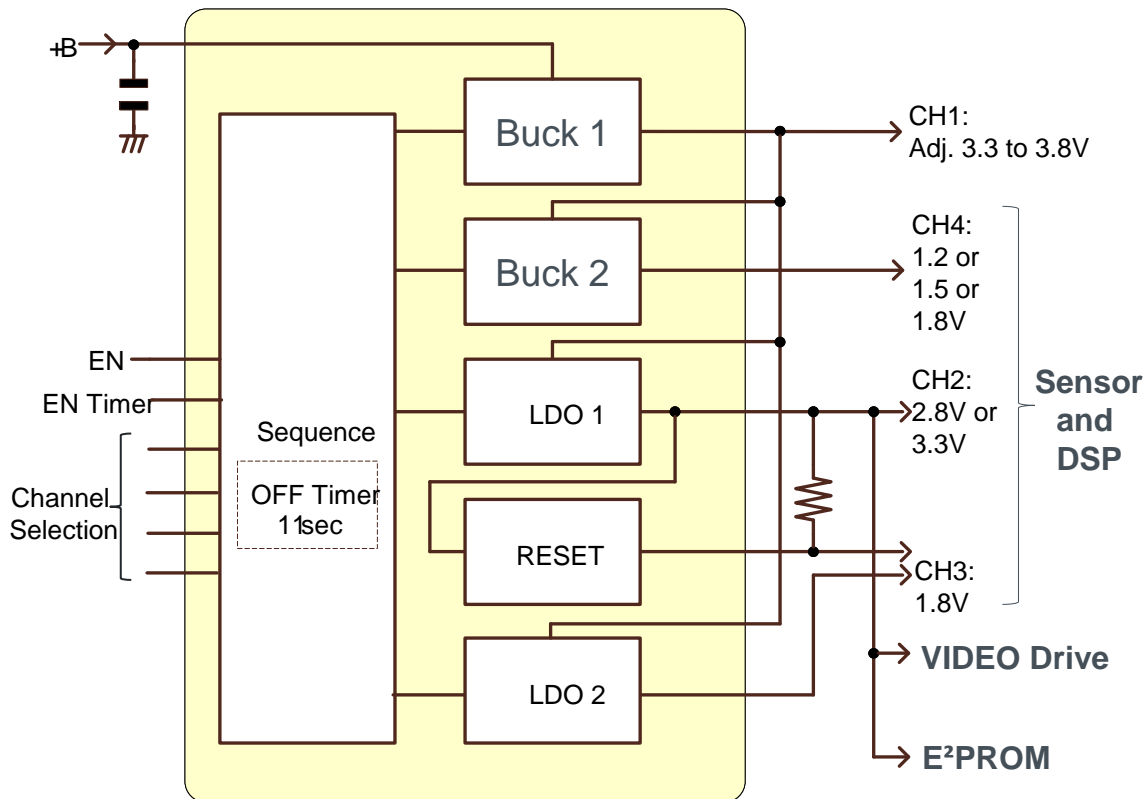


PMIC for Camera Module (CMOS sensor)

BD8682MUV-M

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Mass Production



Features

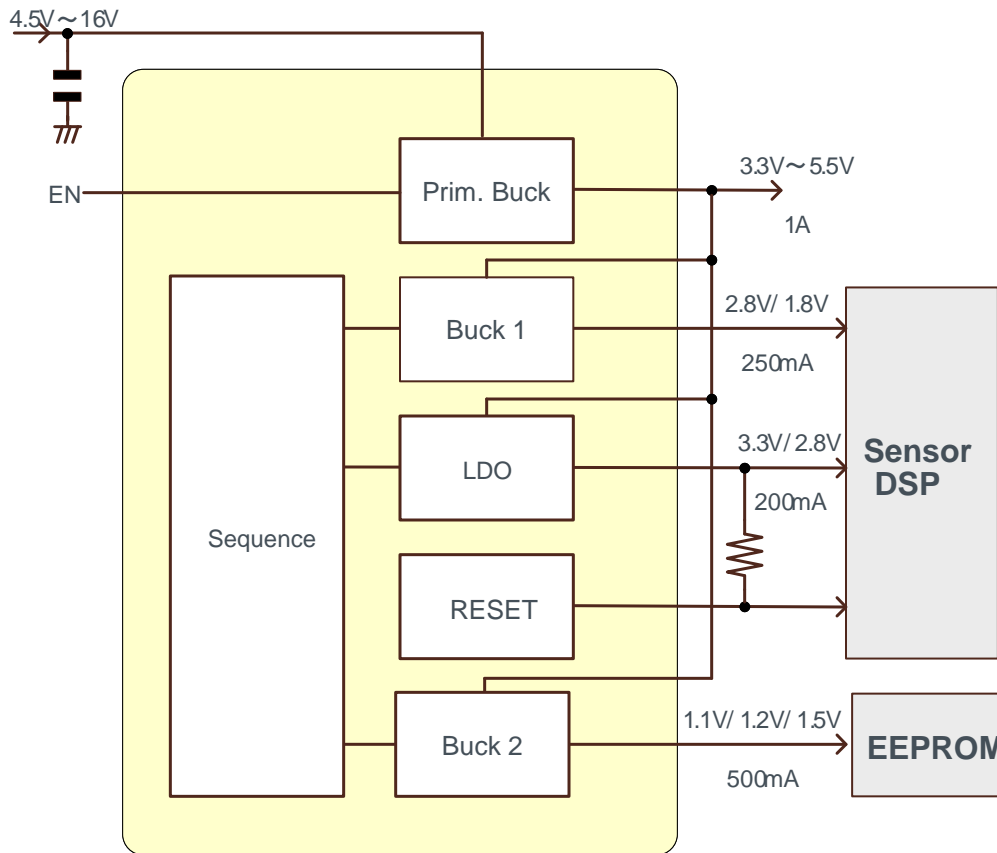
- Vin: 5.9V to 18V (Max: 40V)
- Dual Buck DC/DC converter
 - Buck 1: 3.3V / 500mA
 - Buck 2: 1.5V / 250mA
- Dual LDO
 - LDO 1: 2.8V / 130mA
 - LDO 2: 1.8V / 60mA
- Reset for 2.8V output
- Fixed startup sequence
- Selectable output
 - 2.8V LDO: 2.8V / 3.3V
 - 1.5V DC/DC: 1.8V / 1.5V / 1.2V
- 11s OFF timer
- Small package : VQFN32SV5050

PMIC for Camera Module (CMOS sensor)

BD868xMUV-M

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Planned



■ Features

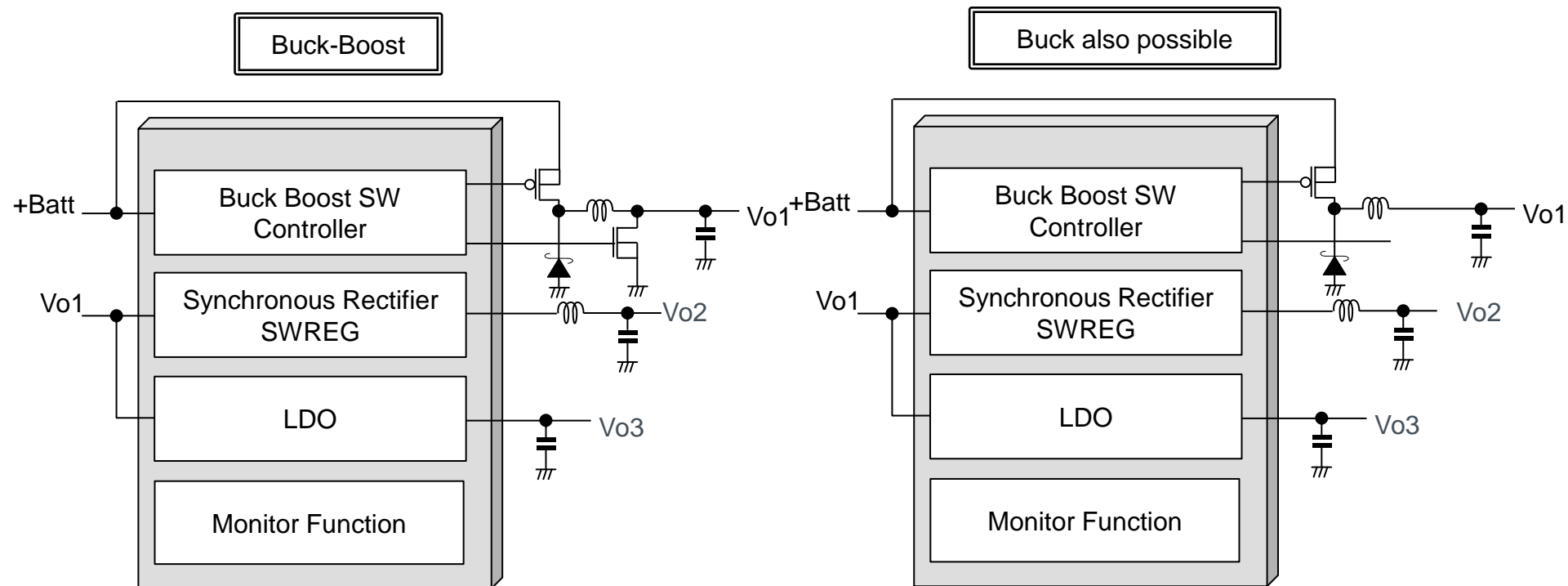
- Vin: 4.5V~16V (Max. Input:42V)
- Triple SMPS ($f_{sw} = 2.2\text{MHz}$ - fixed)
 - Primary Buck
Vout: Adjustable(3.3~5V)
Iout:1A
 - Secondary Buck 1
Vout: 1.8V or 2.8V
Iout: 250mA
 - Secondary Buck 2
Vout: 1.1V or 1.2V or 1.5V
Iout: 500mA
- Linear Regulator (LDO)
Vout: 3.3V or 2.8V
Iout: 200mA @ 3.3V
- Protections OCP/OVP/UVD/TSD
- Timer Latch with 10msec Delay
- Internal Sequence Control
- T_a : -40°C~+125°C
- Package: VQFN32SV5050 (5mm Square)

ASSP Power Supply for automotive

BD39001/BD39002

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- Power Supplies for automotive ECUs
- Improved efficiency by REGSPIC technology
=> Automatically topology between Buck Boost or Buck



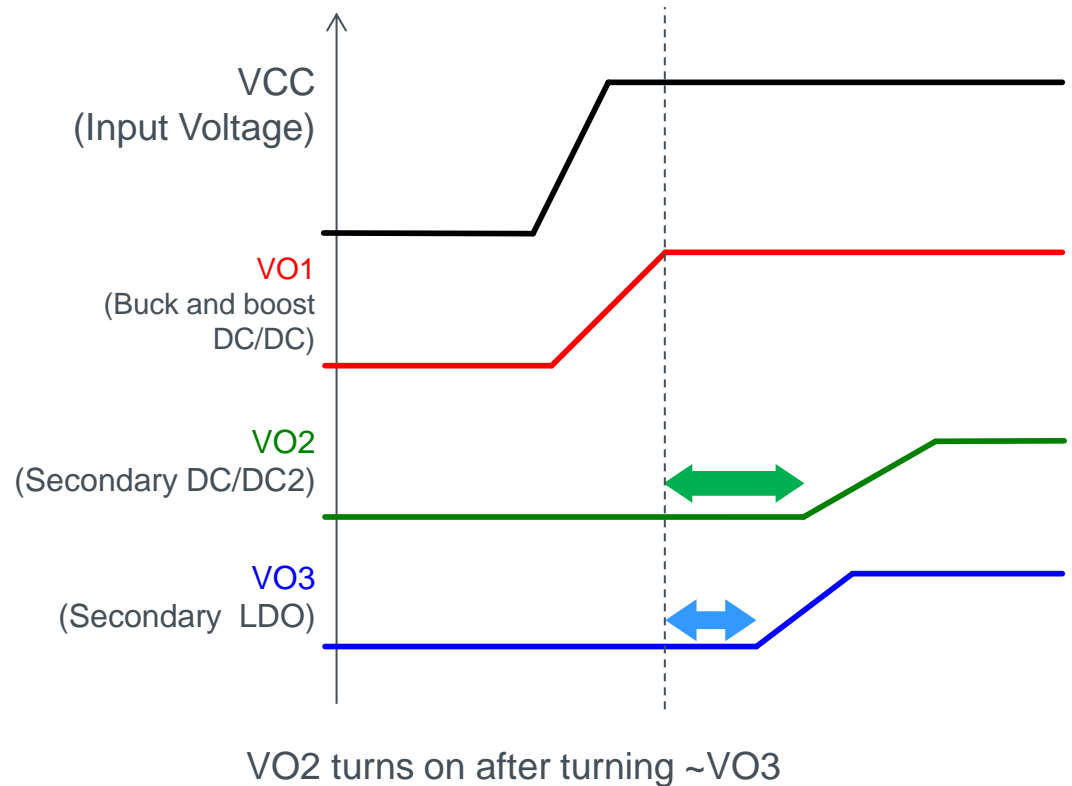
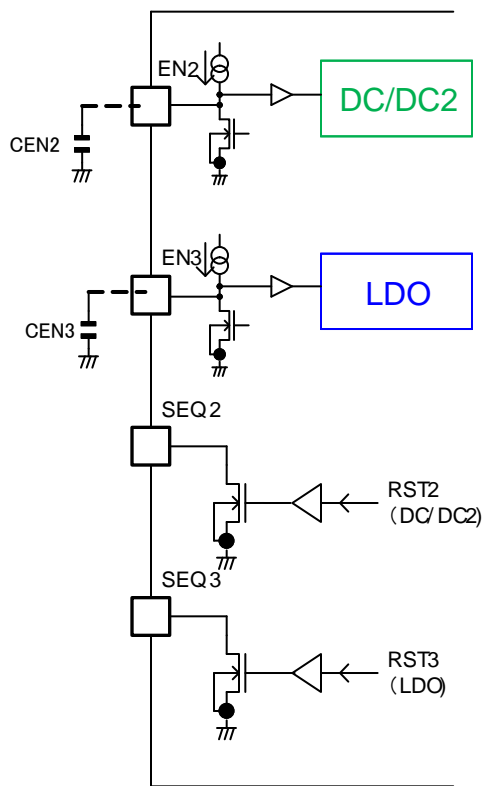
ASSP Power Supply for automotive BD39001/BD39002

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Feature: Start up sequence delay can be set by capacitors, EN2 and EN3.

Example for power-up sequence $VO1 \rightarrow VO3 \rightarrow VO2$

Setup by CEN2 > CEN3



ASSP Power Supply for automotive

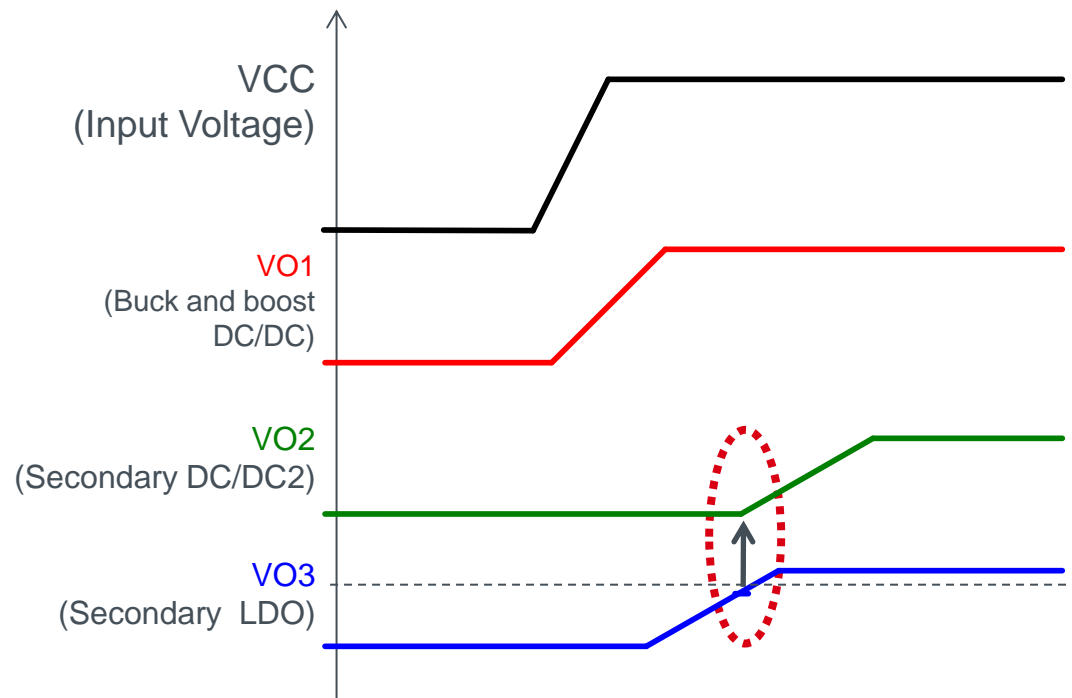
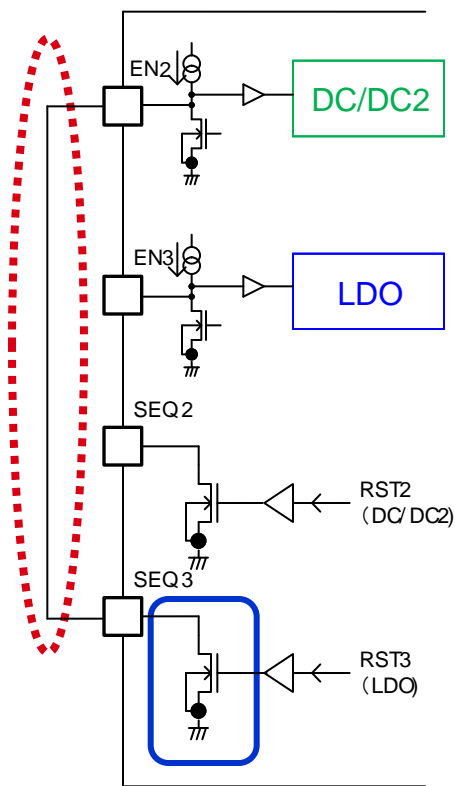
BD39001

53

Feature: Start up sequence can be set using EN2, EN3, SEQ2 and SEQ3 pins.

Example for power-up sequence VO1 → VO3 → VO2

Setup by connecting EN2 input to SEQ3 output.



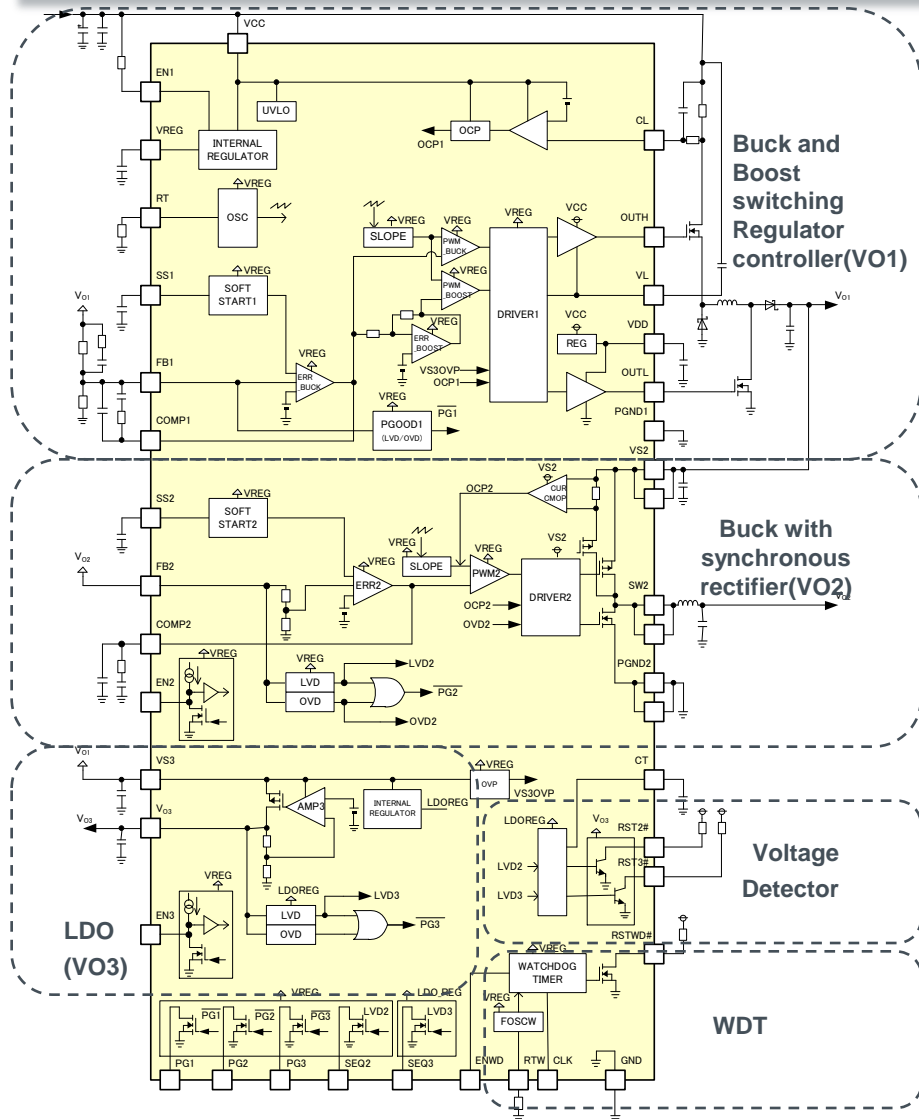
VO2 turns on after turning ~VO3

ASSP Power Supply for automotive

BD39001EKV-C

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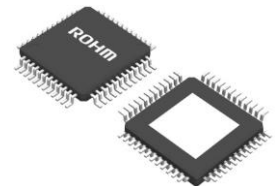
Development



Features

- Maximum Input Voltage :40V
- Input Voltage Range: 4V~30V
- Adjustable f_{sw} : 200~550kHz
- Primary Buck and Boost Switching Regulator controller
⇒ automatically control (REGSPIC)
- Sec. LDO: 5V / 300mA
- Sec. Buck: 3.3V / 600mA
- Integrated Monitor and Detection Functions
 - OVP/OVLO
 - Reset function
 - Window type watch dog timer
- Integrated sequence function
- Protections: OCP/TSD
- T_a : -40°C~+125°C
- Package: HTQFP48V

W (Typ) x D (Typ) x H (Max)
9.00 mm x 9.00 mm x 1.00 mm

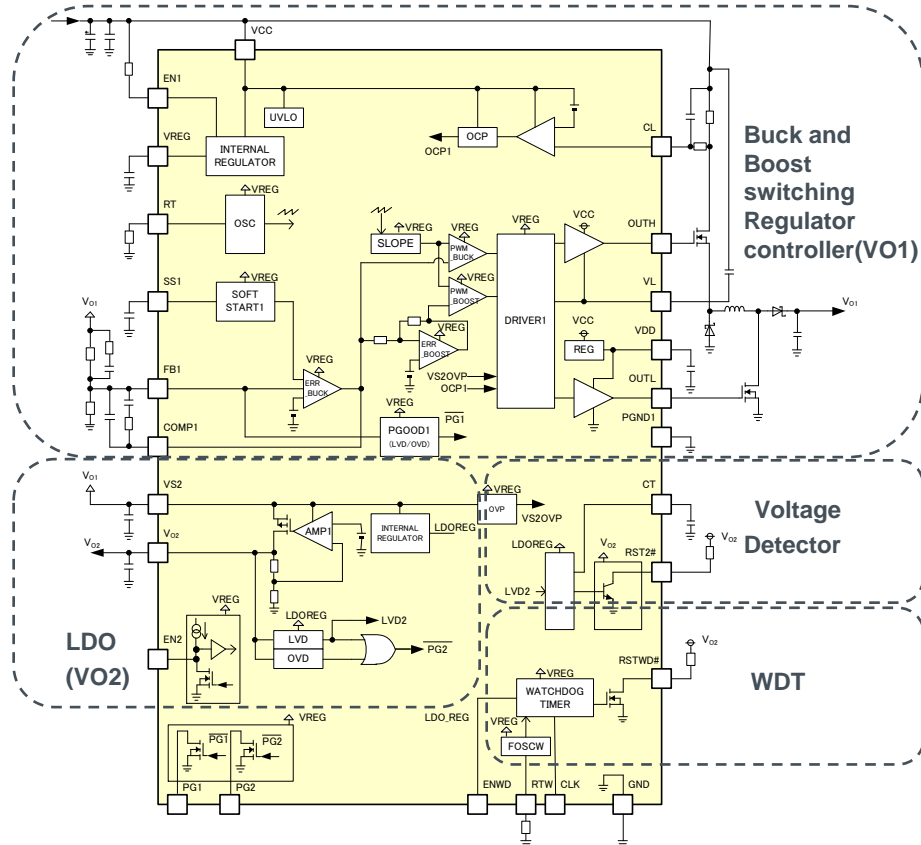


ASSP Power Supply for automotive

BD39002EFV

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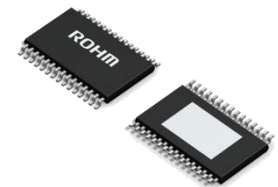
Development



Features

- Input Voltage Range: 4V~30V
- Maximum Input Voltage: 40V
- Adjustable f_{sw} : 200~550kHz
- Primary Buck and Boost Switching Regulator controller
⇒ automatically control (REGSPIC)
- Secondary LDO: 5V/300mA
- Monitor/Detection
 - OVP/OVLO
 - Reset function
 - Window type watchdog timer
- Sequence function by external capacitor
- Protection circuit(OCP/TSD)
- Package:HTSSOPB30

W (Typ) x D (Typ) x H (Max)
10.00 mm x 7.60 mm x 1.00 mm

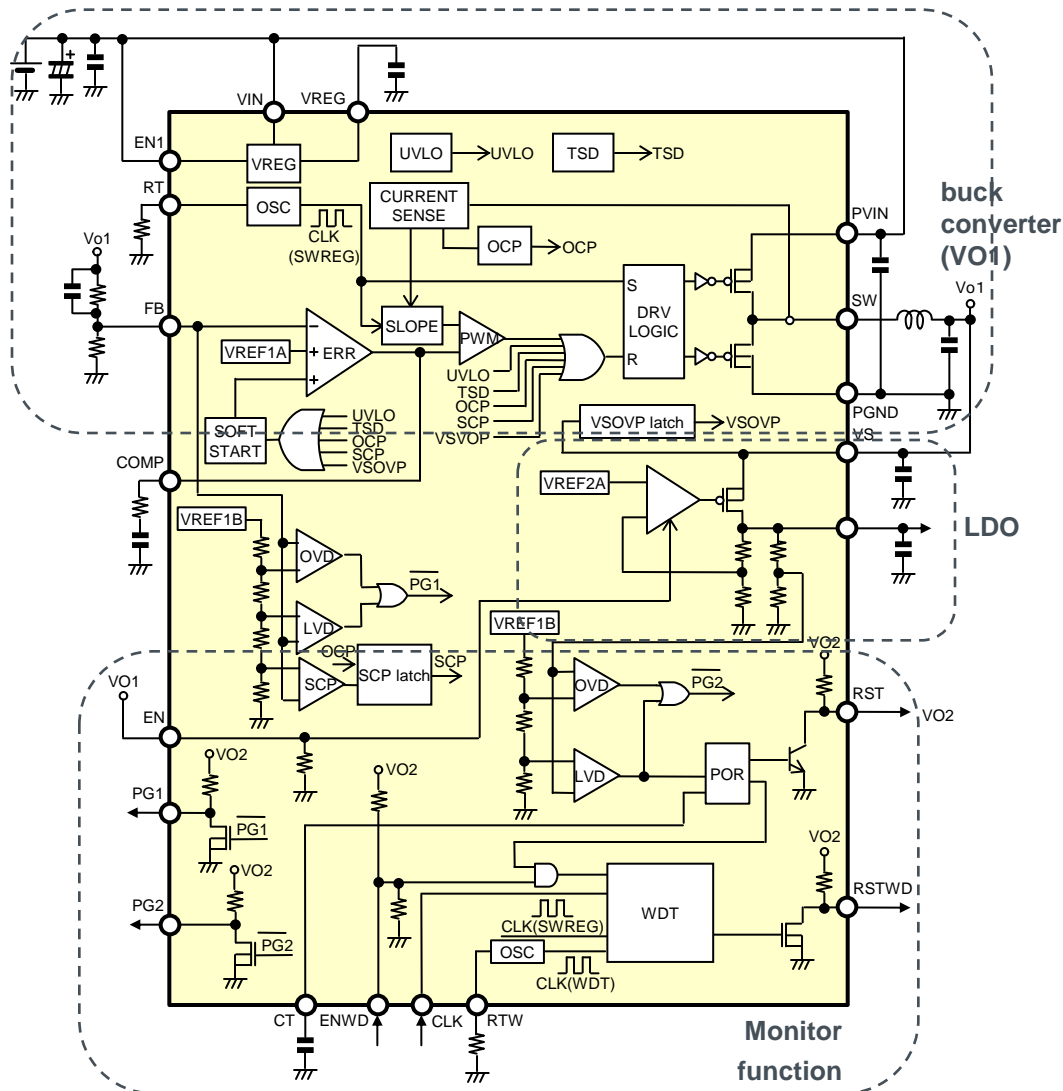


System power supply (Buck type)

BD39012EFV

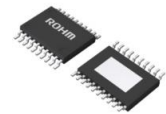
56

Development



Features

- Maximum Input Voltage: 40V
- Low voltage operation: $V_{in} > 4V$
- Adjustable f_{sw} : 200~550kHz
- Primary Buck (Adjustable V_{out} / 1A)
- Secondary LDO (V_{out} 5V / 300mA)
- Built-in monitoring function
 - PGOOD function for LDO
 - Reset function
 - Window type watch dog timer
- Protection circuit: (OCP/TSD)
- Package: HTSSOPB24



HTSSOP-B24

ASSP Power Supply for automotive

BD39001/BD39002

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Error Detection:

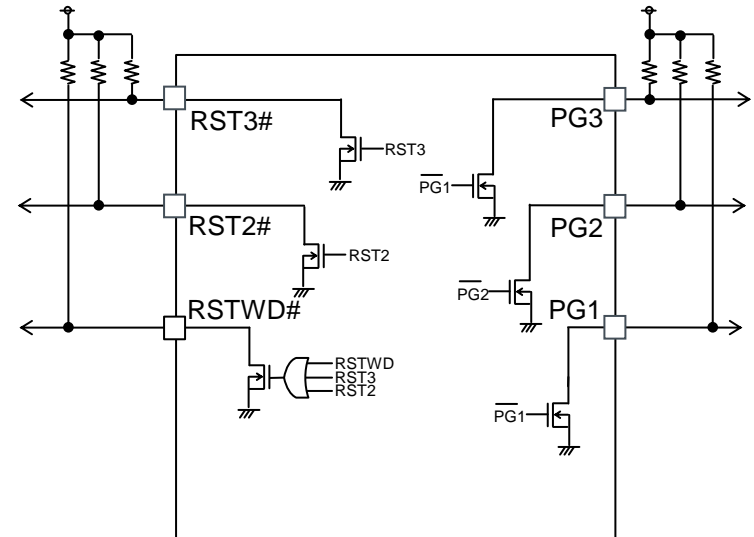
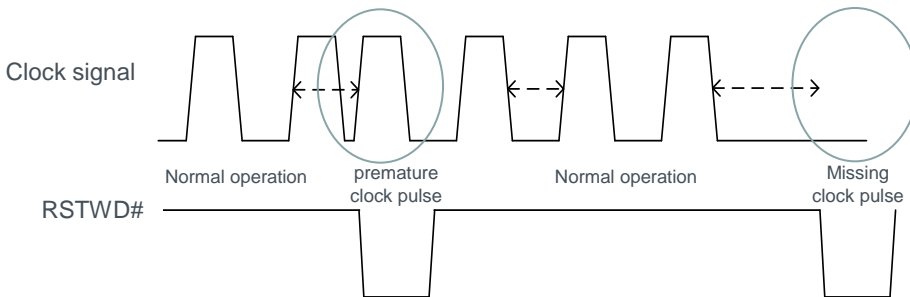
PGOOD:

When each output voltage (VO1, VO2, VO3) is detected to over voltage threshold and under voltage threshold, PGOOD is output LOW level

All outputs are control independently
(Open drain outputs)

Window type watch dog timer:

Both slow error (long) and fast (short) error can be detected



Reset for VO2 and VO3

- Both VO2 output and VO3 output are monitored
- Capacitor at CT terminal can be set power on reset time.

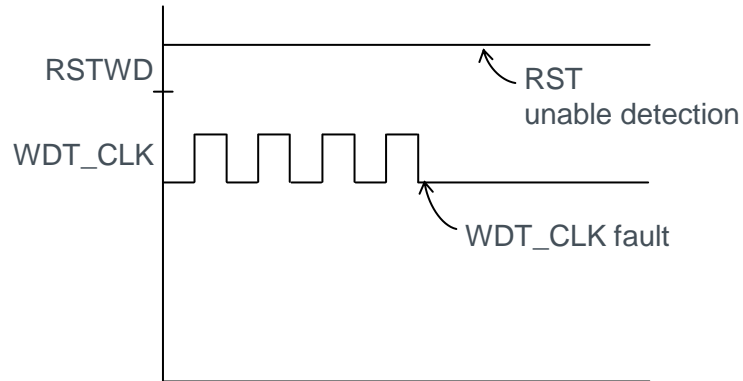
ASSP Power Supply for automotive

BD39001/BD39002

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Monitoring internal WDT clock:

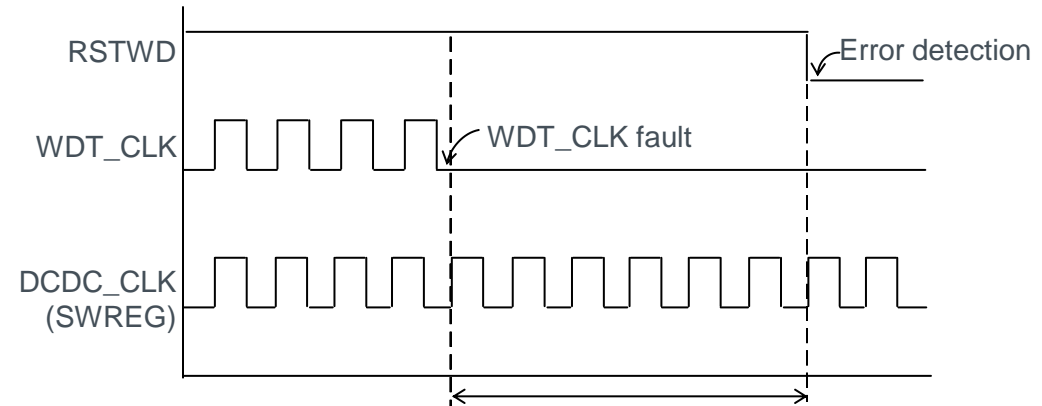
Standard Type



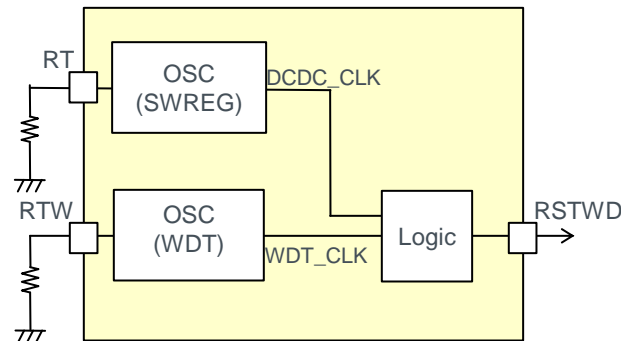
Reset can't detect error WDT_CLK,
→ RESET is always off



BD39001EKV



After WDT_CLK stop. DC/DC clock counter starts up
and after a certain time RSTWDT becomes low.

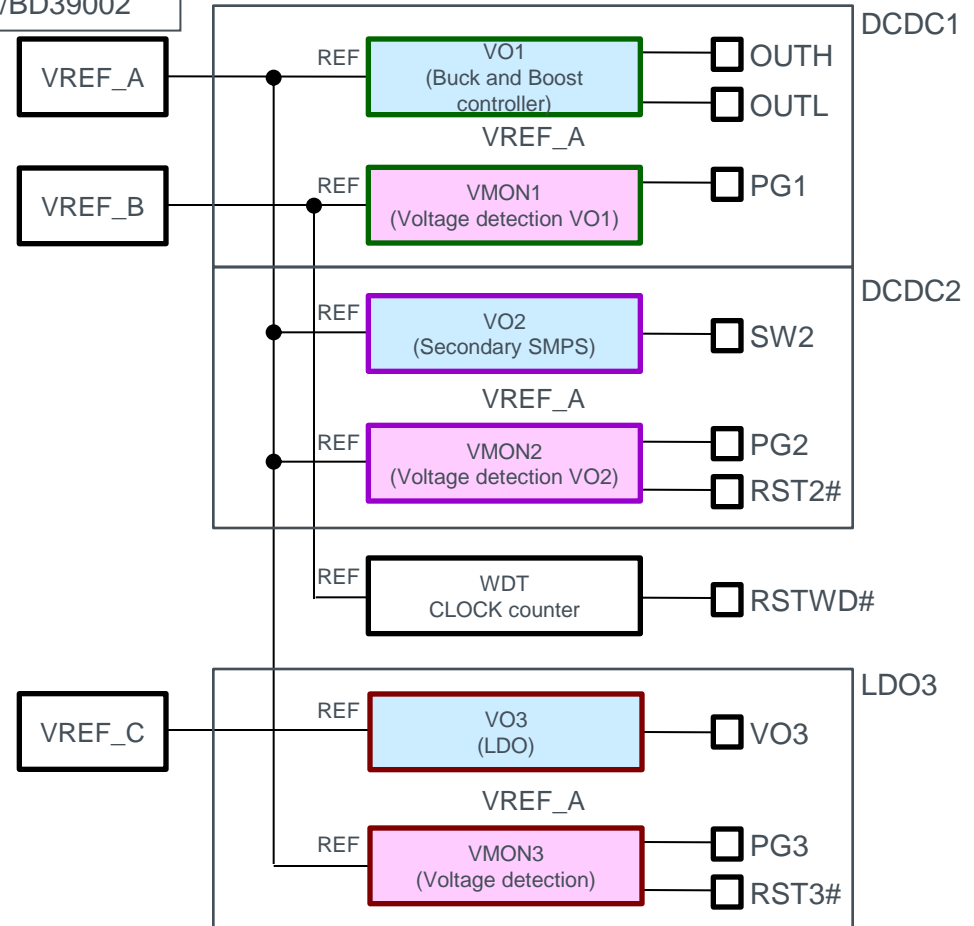


DC/DC_CLK:
clock for switching regulator
WDT_CLK:
clock for watch dog timer

Reference voltage composition

Block	Reference voltage	Voltage detection
DCDC1	VREF_A	VREF_B
DCDC2	VREF_A	VREF_A
LDO3	VREF_C	VREF_A

BD39001/BD39002



If VREF_A fails, fault is detected by VREF_B

If VREF_C fails, fault is detected by VREF_A

Voltage Detectors

- Automotive Voltage Detector
- Standard Voltage Detector
 - 5pin type
 - 3pin type

Voltage Detectors – Line up

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Detection Voltage [V]	Standard				With Adjustable Delay Time				With Fixed Delay Time								Bipolar
	Open Drain		CMOS		Open Drain		CMOS		Open Drain				CMOS				Open Collector
									Delay time (ms)								
									50	100	200	400		50	100	200	
6.0	BD48xxG BD48xxFVE BD48KxxG BD48LxxG	BD48ExxG-M	BD49xxG BD49xxFVE BD49KxxG BD49LxxG	BD49ExxG-M	BD52xxG BD52xxFVE	BD52ExxG-M	BD53xxG BD53xxFVE	BD53ExxG-M	BD45xx5G	BD45xx1G	BD45xx2G ☆BU45Kxx2G ☆BU45Lxx2G	☆BU45Kxx4G ☆BU45Lxx4G ☆BD45ExxG-M	BD46xx5G	BD46xx1G	BD46xx2G ☆BU46Kxx2G ☆BU46Lxx2G	☆BU46Kxx4G ☆BU46Lxx4G ☆BD45ExxG-M	BD47xxG
5.9																	
5.8																	
4.9																	
4.8	BD48xxG BD48xxFVE BD48KxxG BD48LxxG	BD48ExxG-M	BD49xxG BD49xxFVE BD49KxxG BD49LxxG	BD49ExxG-M	BD52xxG BD52xxFVE	BD52ExxG-M	BD53xxG BD53xxFVE	BD53ExxG-M	BD45xx5G	BD45xx1G	BD45xx2G ☆BU45Kxx2G ☆BU45Lxx2G	☆BU45Kxx4G ☆BU45Lxx4G ☆BD45ExxG-M	BD46xx5G	BD46xx1G	BD46xx2G ☆BU46Kxx2G ☆BU46Lxx2G	☆BU46Kxx4G ☆BU46Lxx4G ☆BD45ExxG-M	BD47xxG
4.7																	
4.6																	
2.5																	
2.4	BU48xxG BU48xxFVE BU48xxF	BU48ExxG-M	BU49xxG BU49xxFVE BU49xxF	BU49ExxG-M	BU42xxG BU42xxFVE BU42xxF	BU42ExxG-M	BU43xxG BU43xxFVE BU43xxF	BU43ExxG-M	BD45xx5G	BD45xx1G	BD45xx2G ☆BU45Kxx2G ☆BU45Lxx2G	☆BU45Kxx4G ☆BU45Lxx4G ☆BD45ExxG-M	BD46xx5G	BD46xx1G	BD46xx2G ☆BU46Kxx2G ☆BU46Lxx2G	☆BU46Kxx4G ☆BU46Lxx4G ☆BD45ExxG-M	BD47xxG
2.3																	
2.2																	
2.1																	
2.0	BU48xxG BU48xxFVE BU48xxF	BU48ExxG-M	BU49xxG BU49xxFVE BU49xxF	BU49ExxG-M	BU42xxG BU42xxFVE BU42xxF	BU42ExxG-M	BU43xxG BU43xxFVE BU43xxF	BU43ExxG-M	BD45xx5G	BD45xx1G	BD45xx2G ☆BU45Kxx2G ☆BU45Lxx2G	☆BU45Kxx4G ☆BU45Lxx4G ☆BD45ExxG-M	BD46xx5G	BD46xx1G	BD46xx2G ☆BU46Kxx2G ☆BU46Lxx2G	☆BU46Kxx4G ☆BU46Lxx4G ☆BD45ExxG-M	BD47xxG
1.9																	
1.0																	
0.9																	

Package Lineups

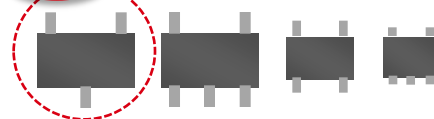
G : SSOP5(SOT23-5)

SSOP3(SOT23-3)

FVE : VSO5

F : SOP4(SC82)

NEW



☆ : Under Development



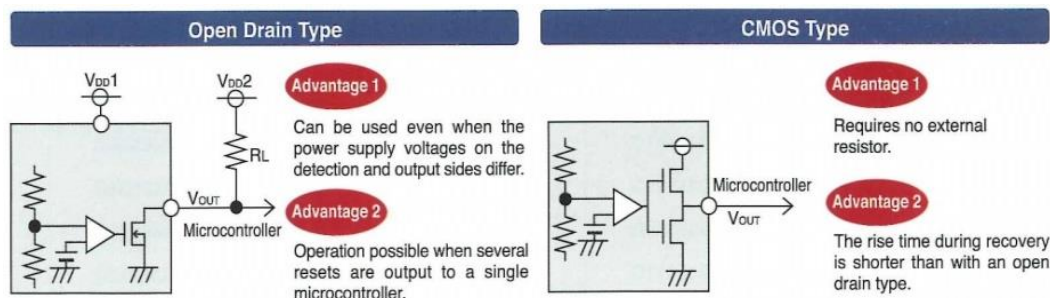
-M : High reliability grade (105°C)

▪ AEC-Q100 qualified

Automotive Voltage Detector (w/o and with WDT)

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Part Number	Detection Voltage	Delay Time	Detection Accuracy	Output Type	Circuit Current	Operating Temperature	WDT	Package	Status
BD45ExxG-M	2.3 to 4.8V	typ. 50, 100 or 200ms	$\pm 1.0\%$	Open Drain	0.85 μ A	-40 to 105°C	-	SSOP5	In development
BD46ExxG-M	2.3 to 4.8V	typ. 50, 100 or 200ms	$\pm 1.0\%$	CMOS	0.85 μ A	-40 to 105°C	-	SSOP5	In development
BD48ExxG-M	2.3 to 6.0V	max. 100 μ s	$\pm 1.0\%$	Open Drain	0.90 μ A	-40 to 105°C	-	SSOP5	MP
BD49ExxG-M	2.3 to 6.0V	max. 100 μ s	$\pm 1.0\%$	CMOS	0.90 μ A	-40 to 105°C	-	SSOP5	MP
BD52ExxG-M	2.3 to 6.0V	adjustable by ext. C	$\pm 1.0\%$	Open Drain	0.95 μ A	-40 to 105°C	-	SSOP5	MP
BD53ExxG-M	2.3 to 6.0V	adjustable by ext. C	$\pm 1.0\%$	CMOS	0.95 μ A	-40 to 105°C	-	SSOP5	MP
BD37AxxFVM	1.9V / 4.1V	typ. 6.9ms	$\pm 1.5\%$	Open Drain	5 μ A	-40 to 105°C	Yes	MSOP8	MP
BD87AxxFVM	2.8V / 2.9V / 3.4V / 4.1V	typ. 6.9ms	$\pm 1.5\%$	Open Drain	5 μ A	-40 to 105°C	Yes	MSOP8	MP



What was updated? Outstanding ToDos?	Date	Who did it?
Revision History added last slide, added page numbering on all slides, some formatting	26.09.2014	CL
System Regulator Product Roadmap – slide 23 needs update		
Download Datasheets for mentioned devices 1. prepare a complete list 2. download latest datasheets		
Automotive Market Trends – slide 4 needs update		
Insert Voltage detectors	13.10.2014	CL
Have a look for Voltage tracker?		
What about IPS? Do we have slides available?		
Checking status for Automotive Voltage Detector		