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Power Management ICs

2011.7

FUJITSU SEMICONDUCTOR

shaping tomorrow with you

ECO is in our SEMICONDUCTORs

Digital Network built on personal computer and digital home appliances are growing rapidly in recent years. Multi-function electrical appliances are increasingly available making it more convenient for family and society.
On the other hand, increasing use of various types of electrical equipment will result in higher energy consumption. Global warming and environmental concern need to be addressed especially when usage is expected to spread widely.

Hence, integrating more features into the products while maintaining high energy efficiency and environmental friendliness have become more important for product development.

Fujitsu Semiconductor strives to contribute to green environment by developing power management ICs focusing on attributes like; high power efficiency for saving power, miniaturize packaging, reduce external components, and effective control technique for fast transient response and lower output voltage.

*Eco; An onomatopoeic word between Ecology and Economy.

Lineup from Application

Provided for different digital appliances from PC, cellular phones and communication networks to digital TV, digital cameras and DVC, power management ICs of Fujitsu Semiconductor combine state-of-the-art semiconductor design and production technology, system technology and application technology, and have risen to prominence as core technology of digital appliances.
Combining the above advanced technology, Fujitsu offers power management IC featuring high performance, advanced functions and user-friendliness.

Notebook computer power management IC

Application example

General-purpose DC/DC converter
- MB3800
- MB39A135
- MB39A136
- MB39A130A
- MB39A214
- MB39A202A

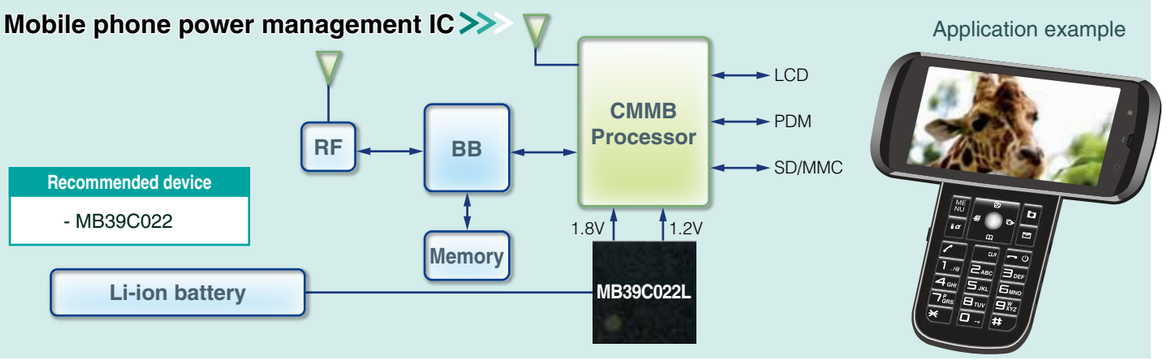
For charging control
- MB39A134
- MB39A132A

Monitoring of power supply voltage
- MB3771
- MB3773
- MB3793

Power management switch
- MB3841
- MB3842
- MB3845

Mobile phone power management IC

Application example

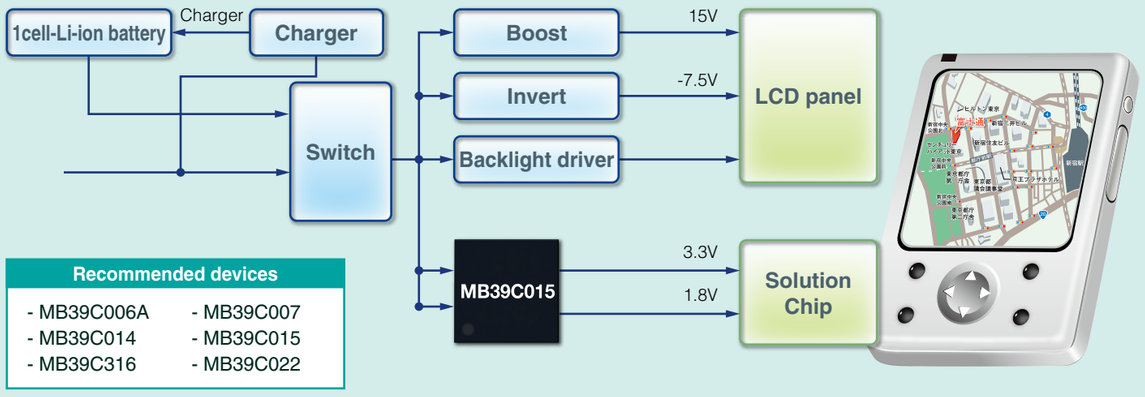


Recommended device
- MB39C022

PDM: Pulse Density Modulation

Portable device power management IC (GPS/PND/PMP)

Application example

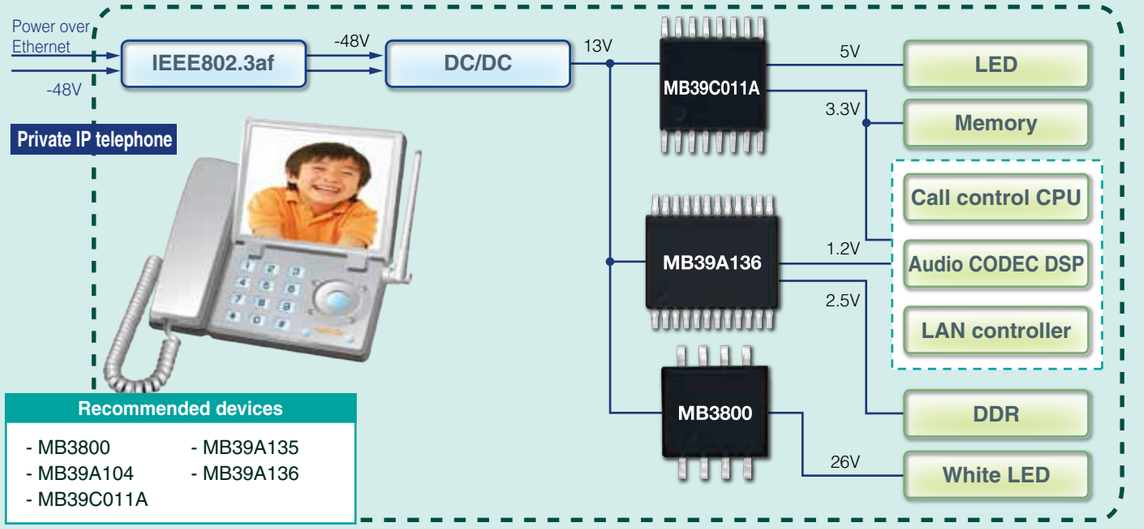


Recommended devices
- MB39C006A
- MB39C007
- MB39C014
- MB39C015
- MB39C316
- MB39C022

PND: Personal Navigation Device, PMP: Portable Media Player

IP telephone power management IC

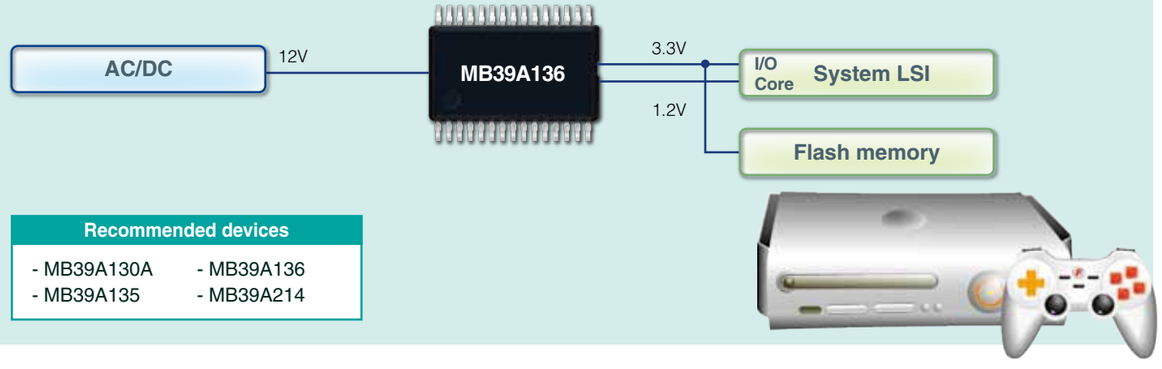
Application example



Recommended devices
- MB3800
- MB39A104
- MB39C011A
- MB39A135
- MB39A136

Game machines power management IC

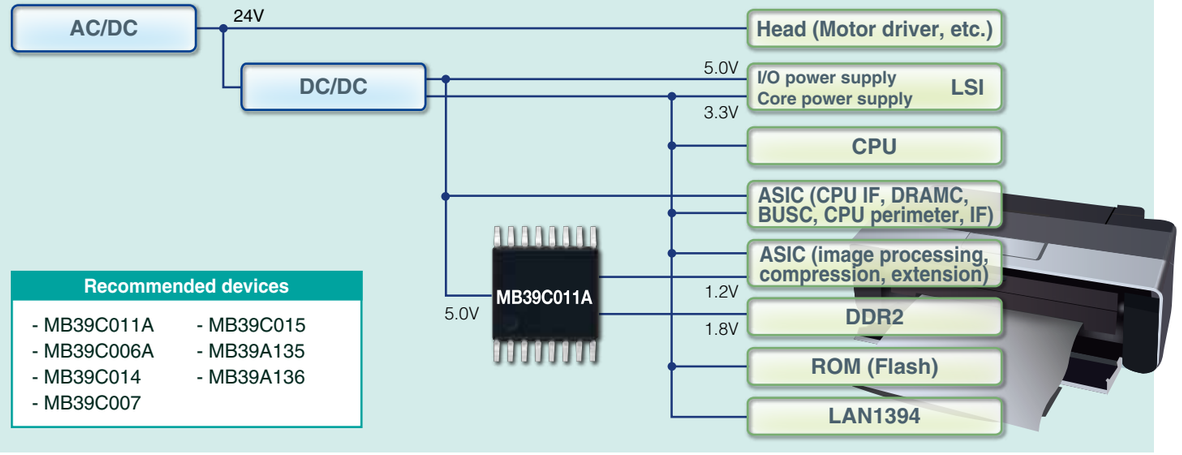
Application example



Recommended devices
- MB39A130A
- MB39A135
- MB39A136
- MB39A214

Printer power management IC

Application example

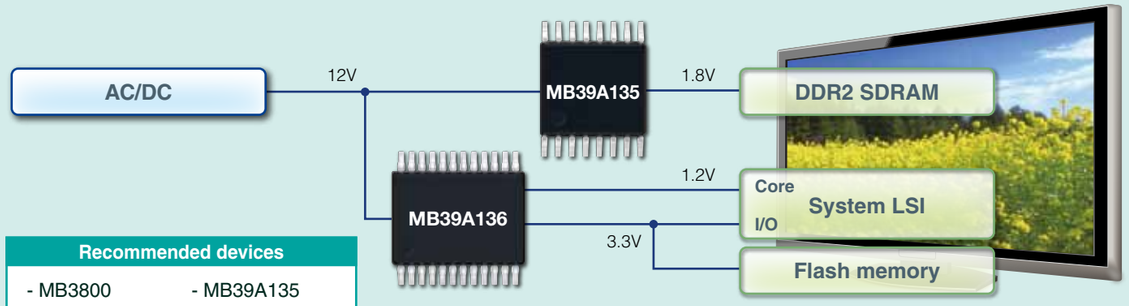


Recommended devices
- MB39C011A
- MB39C006A
- MB39C014
- MB39C007
- MB39C015
- MB39A135
- MB39A136

Lineup from Application

For digital home appliances

Application example



Recommended devices

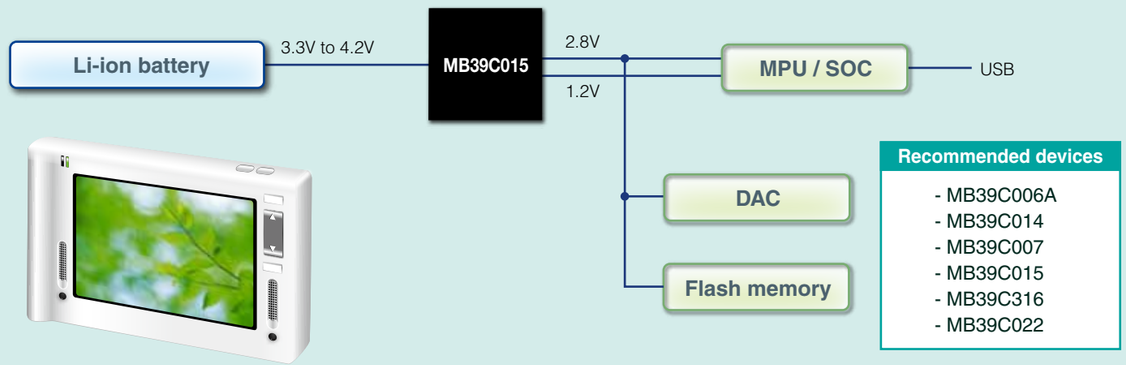
- MB3800
- MB39C011A
- MB39A104
- MB39A130A
- MB39A135
- MB39A136
- MB39A214
- MB39A202A

For LCD panel

- MB39C313A
- MB39C313B

For 1-Seg TV and Mobile TV

Application example

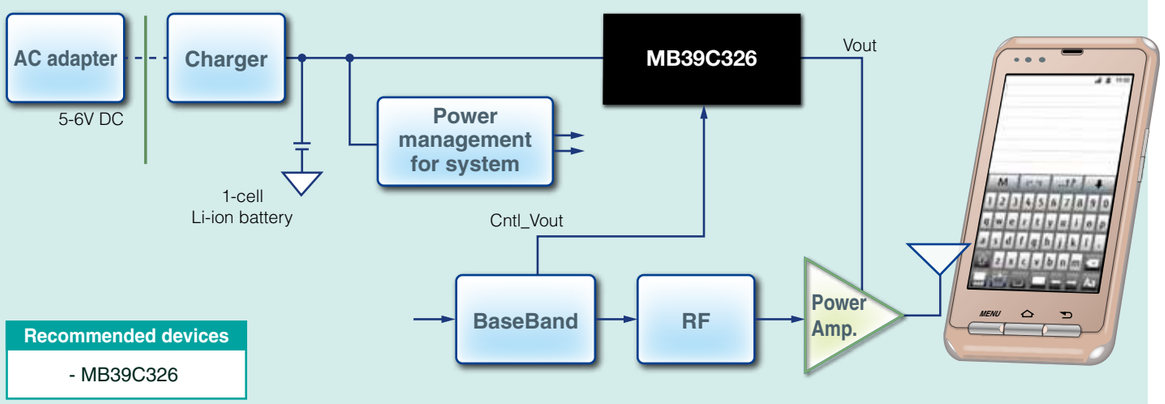


Recommended devices

- MB39C006A
- MB39C014
- MB39C007
- MB39C015
- MB39C316
- MB39C022

Smart phones and e-Books

Application example

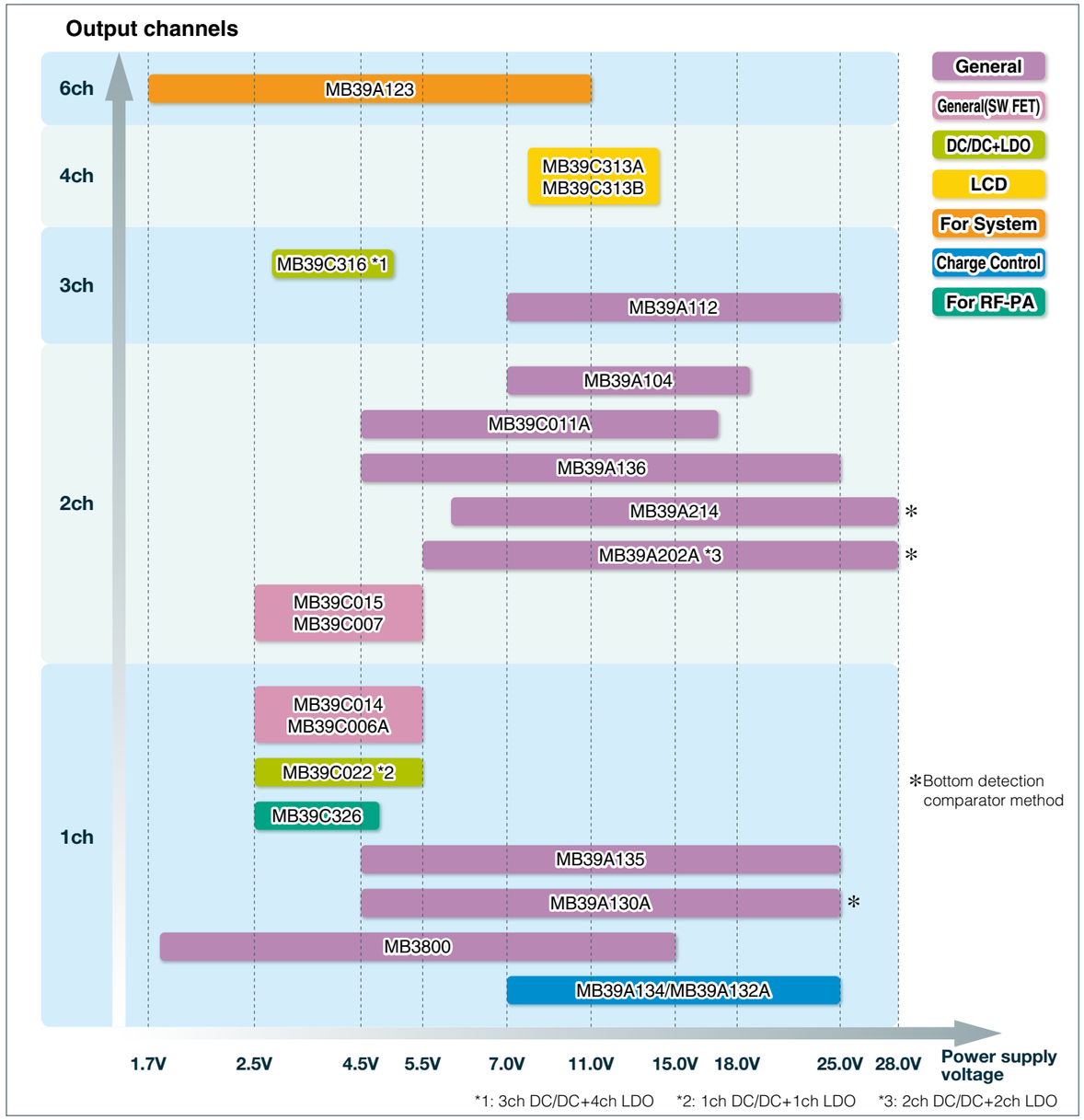


Recommended devices

- MB39C326

IC Lineup of DC/DC Converter

Fujitsu Semiconductor provides various power management IC covering a vast range of specifications: the number of output channels ranges from 1 to 6 and the input voltage from 1.7V to 28V.



Explanation of a Functional Display

(ex.) Buck SCP : Indication of function | Buck SCP : Indication of no function | 0.6A : Internal FET | 4A : External FET

1ch : Loading number of channels	Inv Inv : Invert-conv.	OTP OTP : Over-temperature protection circuit
Buck Buck : Buck-conv.	FET FET : Built-in switching FET	OVP OVP : Overvoltage protection circuit
B/B B/B : Buck/Boost-conv.	0.6A 4A : Maximum load current per one channel (Recommended)	OCP OCP : Overcurrent protection circuit
Boost Boost : Boost-conv.	SCP SCP : Short-circuit protection	UVP UVP : Under-voltage protection circuit

MB39A130A — Nch/Nch Synchronous Rectification 1-channel DC/DC Buck Converter IC

Ultra-rapid response, High efficiency

1ch	Buck	B/B	Boost	Inv	FET
20A	SCP	OTP	OVP	OCP	UVP

Description

MB39A130A is a 1ch DC/DC buck converter equipped with a bottom detection comparator and Nch/Nch synchronous rectification. It supports low on-duty operation, enabling stable low voltage output when there is a large difference between input and output voltages. It achieves ultra-rapid response and high efficiency with sufficient internal protection function, and is suitable for the power supply of a core circuit having low voltage and large current, such as the ASIC and FPGA made by 45nm or 65nm process technology.

Features

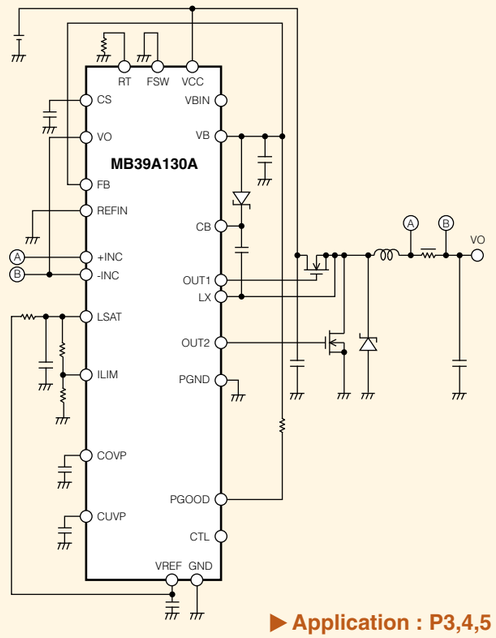
- Wide range of power supply voltage: 4.5V to 25V
- High efficiency of power conversion
- Adjustable frequency setting by an external resistor: 100kHz to 600kHz
- High accuracy reference voltage: ±1.0%
- Output voltage setting range : 0.7V to 5V or fixed to 1.2V / 2.5V
- Adjustable output voltages setting by the external control
- Inductor saturation detection function which can be set optional
- Standby current: 0μA (typ)
- Built-in soft-start circuit independent of loads
- Built-in discharge control circuit
- POWERGOOD detection function
- Synchronous rectification type output driver for N-ch MOS FET

Application

- Digital TV, Photocopiers, Projectors, STB
- Blu-ray, DVD players/recorders, Digital devices

TSSOP24

Application circuit example



▶ Application : P3,4,5

MB39A135 — Nch/Nch Synchronous Rectification 1-channel DC/DC Buck Converter IC

Substantial protective functions

1ch	Buck	B/B	Boost	Inv	FET
15A	SCP	OTP	OVP	OCP	UVP

Description

MB39A135 is a Current mode Nch/Nch synchronous rectification 1-channel DC/DC buck converter IC. This IC has realized the high-speed response, high efficiency and low ripple voltage by a current mode system. It supports ceramic capacitors. It is suitable for set miniaturization by using small package and compact coil design enabled by adopting high frequency operation.

Features

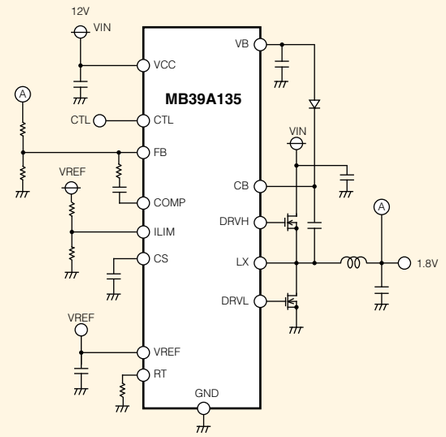
- Wide range of power supply voltage: 4.5V to 25V
- Selectable fixed PWM mode or automatic PFM/PWM mode
- High frequency operation: 100kHz to 1.0MHz
- Any output voltage setting by external resistor
- Requires no flyback diode
- Built-in soft-start circuit / Built-in soft-stop circuit
- Substantial protective functions

Application

- Digital TV, Digital AV devices etc.

TSSOP16

Application circuit example



▶ Application : P3,4,5

MB39A214 — Nch/Nch Synchronous Rectification 2-channel DC/DC Buck Converter IC

Ultra-rapid response, High efficiency

2ch	Buck	B/B	Boost	Inv	FET
20A	SCP	OTP	OVP	OCP	UVP

Description

MB39A214 is a 2ch DC/DC buck converter equipped with a bottom detection comparator for low output voltage ripple and Nch/Nch synchronous rectification. It supports low on-duty operation to allow stable output of low voltages when there is a large difference between input and output voltages. MB39A214 realizes ultra-rapid response and high efficiency with built-in enhanced protection features. The MB39A214 is suitable for the power supply of the core circuit which is low voltage and large current, such as the ASIC and FPGA made by 45nm or 65nm process technology.

Features

- Wide range of power supply voltage: 6V to 28V
- High efficiency of power conversion
- Frequency setting by internal preset function: 310kHz / 620kHz / 1000kHz
- High accuracy reference voltage: ±0.7%
- Output voltage setting range: 0.7V to 5.3V
- Possible to select the automatic PFM/PWM selection mode or PWM-fixed mode
- PAF frequency limitation function (Prohibit Audio Frequency) : > 30 kHz (Min)
- Built-in diode for boot strap
- Standby current: 0 μA (typ)
- Built-in soft-start circuit independent of loads
- Built-in discharge control circuit
- Synchronous rectification type output driver for N-ch MOS FET

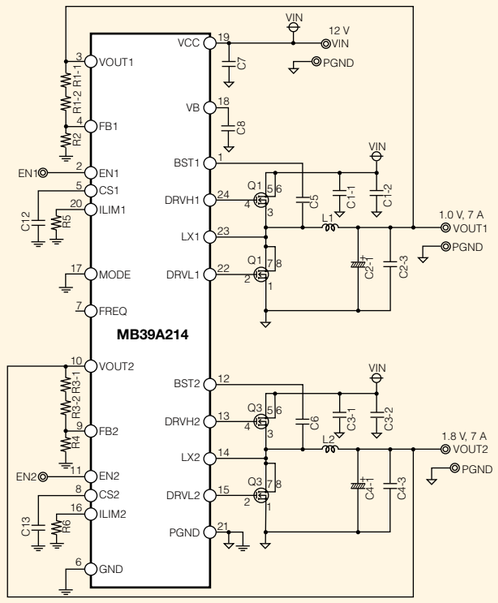
Application

- Digital TV, Photocopiers, Projectors, STB
- Blu-ray, DVD players/recorders, Digital devices

TSSOP24

＊ Technical Analysis of Bottom detection comparator method
···Refer from page 19 to page 20

Application circuit example



▶ Application : P3,4,5

MB39A136 — Nch/Nch Synchronous Rectification 2-channel DC/DC Buck Converter IC

Substantial protective functions

2ch	Buck	B/B	Boost	Inv	FET
15A	SCP	OTP	OVP	OCP	UVP

Description

MB39A136 is a Current mode Nch/Nch synchronous rectification 2-channel DC/DC buck converter IC. This IC has realized the high-speed response, high efficiency and low ripple voltage by a current mode system. It supports ceramic capacitors. It is suitable for set miniaturization by using small package and compact coil design enabled by adopting high frequency operation.

Features

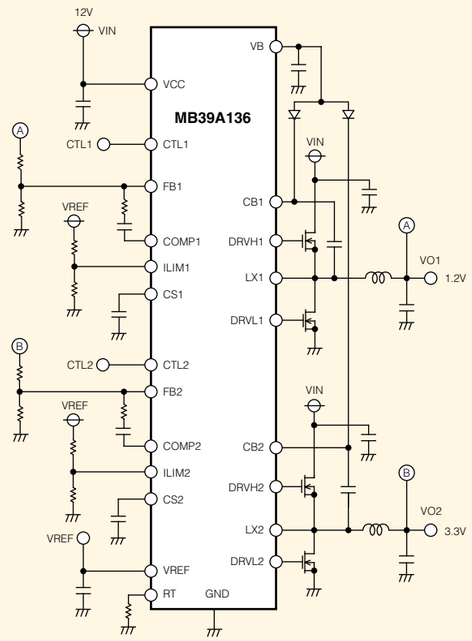
- Wide range of power supply voltage: 4.5V to 25V
- Selectable fixed PWM mode or automatic PFM/PWM mode
- High frequency operation: 100kHz to 1.0MHz
- Any output voltage setting by external resistor
- Requires no flyback diode
- Built-in soft-start circuit / Built-in soft-stop circuit
- Substantial protective functions

Application

- Digital TV, Digital AV devices etc.

TSSOP24

Application circuit example



▶ Application : P3,4,5

General-purpose DC/DC Converter

MB39C011A — Pch/Nch Synchronous Rectification 2-channel DC/DC Buck Converter IC

P/N synchronous, Pch asynchronous

2ch	Buck	B/B	Boost	Inv	FET
5A	SCP	OTP	OVP	OCP	UVP

Description

MB39C011A is a PWM-type Pch/Nch synchronous rectification 2-channel DC/DC buck converter IC. It has a wide power supply voltage range and supports ceramic capacitors.

Features

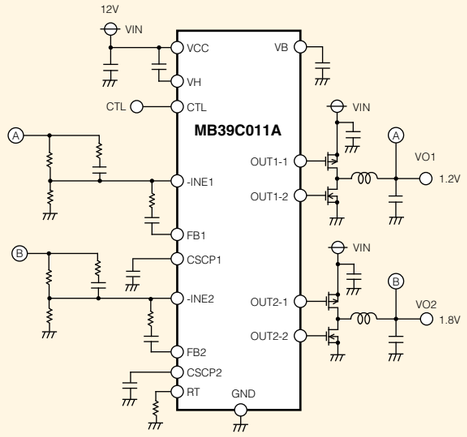
- Wide range of power supply voltage: 4.5V to 17V
- High frequency operation: 100kHz to 2.0MHz
- Any output voltage setting by external resistor
- Built-in soft-start circuit
- Supporting ceramic condensers

Application

- For various electronic devices including digital AV devices

TSSOP16

Application circuit example



▶ Application : P4,5

MB39A104 — Pch Asynchronous Rectification 2-channel DC/DC Buck Converter IC

Asynchronous, Overcurrent protection

2ch	Buck	B/B	Boost	Inv	FET
3A	SCP	OTP	OVP	OCP	UVP

Description

MB39A104 is a PWM-type Pch asynchronous rectification 2-channel DC/DC buck converter IC with overcurrent protection circuit (requiring no current sense resistor).
Operating at high frequency reduces the value of coil.

Features

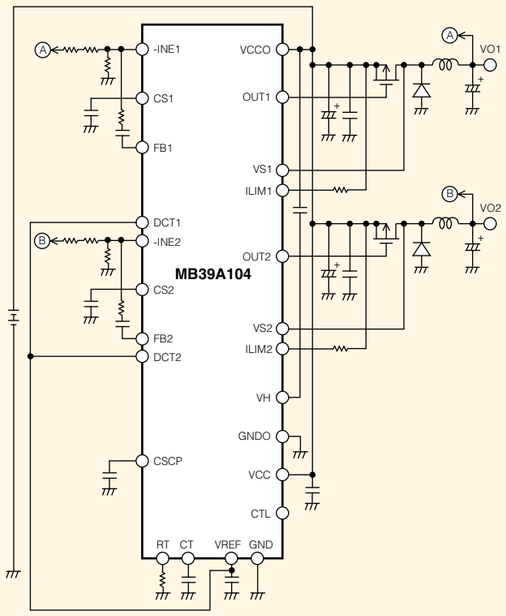
- Power supply voltage range : 7V to 19V
- Reference voltage : 5.0V±1%
- Error amplifier threshold voltage : 1.24V±1%
- High-frequency operation capability : 1.5MHz (max)
- Built-in standby function: 0μA (Typ)
- Built-in soft-start circuit independent of loads
- Built-in totem-pole type output for P-ch MOS FET

Application

- LCD monitor / panel
- ADSL terminal
- IP phone
- Printer
- Video capture etc.

SSOP24

Application circuit example



▶ Application : P4,5

MB39A112 — 3ch DC/DC Buck Converter IC

2.6MHz operation / 3ch

3ch	Buck	B/B	Boost	Inv	FET
2A	SCP	OTP	OVP	OCP	UVP

Description

MB39A112 is a PWM-type 3-channel DC/DC buck converter IC. 3 channels are installed in the TSSOP20 package. It is capable of implementing an efficient high frequency DC/DC converter.

Features

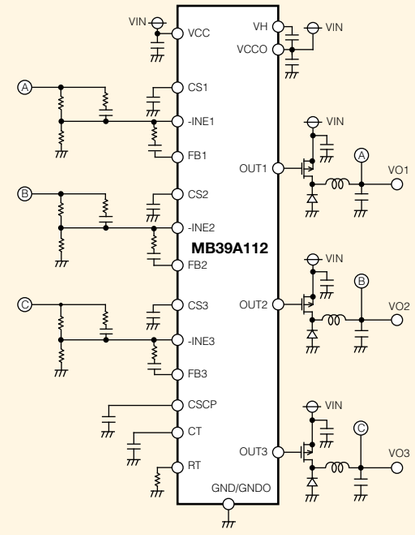
- Wide range of power supply voltage: 7V to 25V
- High frequency operation: 250kHz to 2.6MHz
- Any output voltage setting by external resistor
- Built-in soft-start circuit
- Supporting ceramic condensers

Application

- IP-STB, Surveillance camera, ADSL Modem etc.

TSSOP20

Application circuit example



MB39A202A — Nch/Nch Synchronous Rectification 2-channel DC/DC Buck Converter + 2-channel LDO

2ch DC/DC + 2ch LDO, High efficiency

2ch	Buck	B/B	Boost	Inv	FET
20A	SCP	OTP	OVP	OCP	UVP

Description

MB39A202A is a 2ch DC/DC buck converter IC equipped with a bottom detection comparator for low output voltage ripple and N-ch/N-ch synchronous rectification, and built-in 2ch LDO circuits. The built-in LDO (5.0V 100mA / 3.3V 50mA) is possible to slim of the system. The DC/DC buck converter supports low on-duty operation to allow stable output of low voltages when there is a large difference between input and output voltages. LDO is possible to operate alone at the DC/DC standby. MB39A202A is suitable for the power supply usage to various peripherals of Notebook PC and the built-in equipment.

Features

- Wide range of power supply voltage: 5.5V to 28V
- High efficiency of power conversion
- Adjustable frequency setting by an external resistor: 100kHz to 600kHz
- DC/DC Output voltage setting range :
  (preset VOUT1/VOUT2) : 5.0V/3.3V
  (adjustable) : 0.7V to 5.5V
- LDO Output voltage and current: 5V 100mA / 3.3V 50mA
  5V-LDO circuit has the function of automatic transition to DC/DC
- Possible to select the automatic PFM/PWM selection mode or PWM-fixed mode
- PAF frequency limitation function (Prohibit Audio Frequency): > 30 kHz (Min)
- High accuracy reference voltage: ±1.0% (+25°C)
- Built-in boost switch, Requires no flyback diode
- Standby current: 0 μA (typ)
- Built-in soft-start circuit / Built-in discharge control circuit
- POWERGOOD detection function

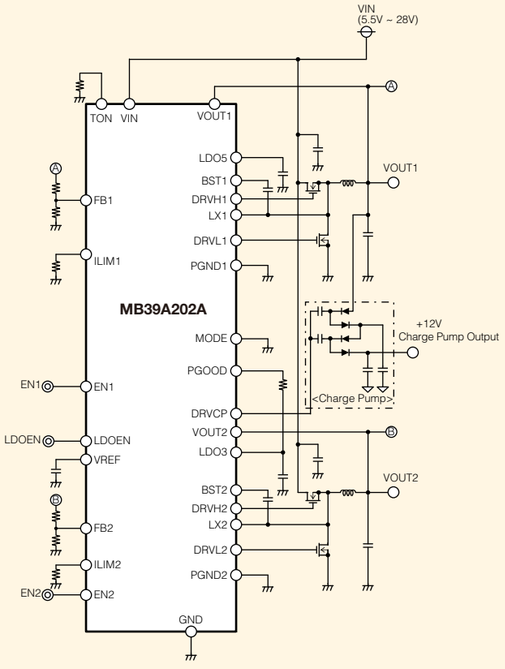
Application

- Notebook PC, Digital TV, Photocopiers, Projectors
- Blu-ray, DVD players/recorders, STB
- Power supply usage to various peripherals

＊ Technical Analysis of Bottom detection comparator method
···Refer from page 19 to page 20

QFN28

Application circuit example



▶ Application : P3,5

MB39C006A — 3.2MHz/2MHz, Output Current 800mA(max), 1-channel DC/DC Buck Converter IC

Internal FET, High efficiency

1ch | Buck | B/B | Boost | Inv | FET
0.8A | SCP | OTP | OVP | OCP | UVP

Description

MB39C006A is a current mode 1-channel DC/DC buck converter IC. The selection of operation frequency is possible at 3.2MHz or 2MHz. This IC has realized the high-speed response, high efficiency and low ripple voltage by a current mode system.
This product has built-in phase-compensation circuit and soft-start circuit,contributes to the reduction in total area including external parts.

Features

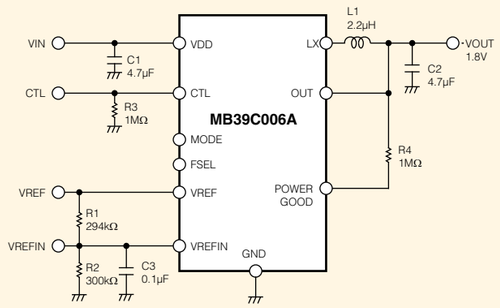
- PFM/PWM function
- High efficiency: 96% (max)
- Power supply voltage range: 2.5V to 5.5V
- Output voltage range: 0.45V to 3.6V
- Output current (DC/DC): 800mA (max)
- Operating frequency: 2.0MHz or 3.2MHz
- POWERGOOD Function

Application

- Surveillance camera, photograph printer etc.
- Portable device such as 1-seg TV & 3-seg Radio etc.
- DVD Recorder, Hard Disk Recorder etc.

SON10

Application circuit example



▶ Application : P3,4,5

MB39C007 — Output Current 800mA(max), 2-channel DC/DC Buck Converter IC built-in Voltage Detection

Internal FET, High efficiency

2ch | Buck | B/B | Boost | Inv | FET
0.8A | SCP | OTP | OVP | OCP | UVP

Description

MB39C007 is a 2-channel DC/DC buck converter IC built-in voltage detection. This IC has realized the high-speed response, high efficiency and low ripple voltage by a current mode system. A power supply starting sequence can be constituted using a voltage detection circuit and a soft-start circuit.

Features

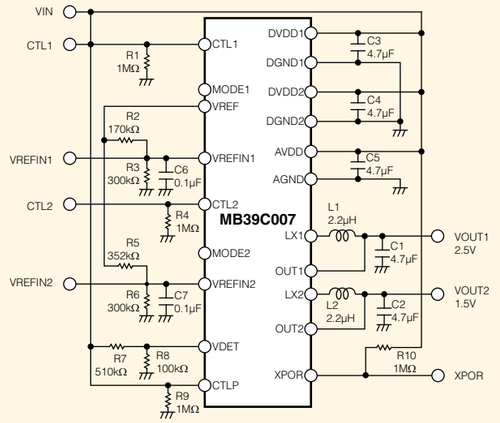
- PFM/PWM function
- High efficiency: 96% (max)
- Power supply voltage range: 2.5V to 5.5V
- Output voltage range: 0.45V to 3.9V
- Output current (DC/DC): 800mA/ch (max)
- Operating frequency: 2.0MHz

Application

- Portable device, DVD recorder
- IP-Phone, Equipment of PLC etc.

QFN24

Application circuit example



▶ Application : P3,4,5

MB39C014 — 3.2MHz/2MHz, Output Current 800mA(max), 1-channel DC/DC Buck Converter IC

Internal FET, High-speed response

1ch | Buck | B/B | Boost | Inv | FET
0.8A | SCP | OTP | OVP | OCP | UVP

Description

MB39C014 is a PWM-type 1-channel DC/DC buck converter IC. The selection of operation frequency is possible at 3.2MHz or 2MHz. This IC has realized the high-speed response, high efficiency and low ripple voltage by a current mode system.
This product has built-in phase-compensation circuit and soft-start circuit,contributes to the reduction in total area including external parts.

Features

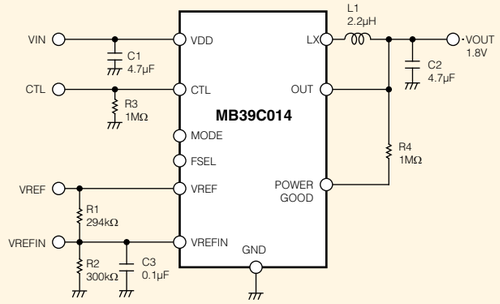
- High efficiency: 96% (max)
- Power supply voltage range: 2.5V to 5.5V
- Output voltage range: 0.45V to 3.6V
- Output current (DC/DC): 800mA (max)
- Operating frequency: 2.0MHz or 3.2MHz
- POWERGOOD Function

Application

- Surveillance camera, photograph printer etc.
- Portable device such as 1-seg TV & 3-seg Radio etc.
- DVD Recorder, Hard Disk Recorder etc.

SON10

Application circuit example



▶ Application : P3,4,5

MB39C015 — Output Current 800mA(max), 2-channel DC/DC Buck Converter IC built-in Voltage Detection

Internal FET, High-speed response

2ch | Buck | B/B | Boost | Inv | FET
0.8A | SCP | OTP | OVP | OCP | UVP

Description

MB39C015 is a 2-channel DC/DC buck converter IC built-in voltage detection. This IC has realized the high-speed response, high efficiency and low ripple voltage by a current mode system. A power supply starting sequence can be constituted using a voltage detection circuit and a soft-start circuit.

Features

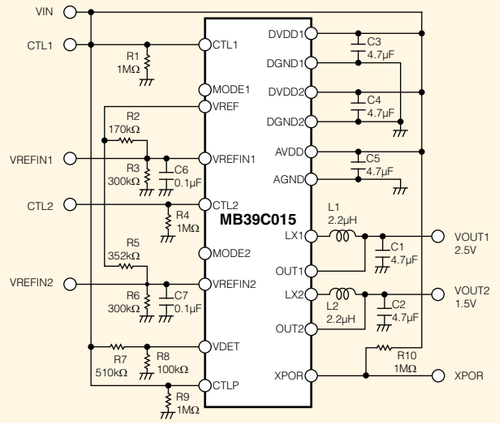
- High efficiency: 96% (max)
- Power supply voltage range: 2.5V to 5.5V
- Output voltage range: 0.45V to 3.9V
- Output current (DC/DC): 800mA/ch (max)
- Operating frequency: 2.0MHz

Application

- Portable device, DVD recorder
- IP-Phone, Equipment of PLC etc.

QFN24

Application circuit example



▶ Application : P3,4,5

General-purpose DC/DC Converter and DC/DC Converter with Switching FET

Lineup of General-purpose DC/DC Converter

Model	Number of channels ch		Switching frequency (max)kHz	Power supply voltage V	Reference voltage accuracy %	Package	Topology		FET compatible	Remarks
	D/D	LDO					Buck	Boost		
MB3800	1	-	1000	+1.8 to +15	±4	SOP8, SSOP8	○	◎	Not available	Soft-start circuit, timer-latch short-circuit protection
MB39A130A	1	-	600	+4.5 to +25	±1.5	TSSOP24	◎	–	Available	Bottom detection comparator, N/N synchronous rectification, soft-start circuit, discharge control circuit, overvoltage protection, under-voltage protection, overcurrent protection, over-temperature protection, POWERGOOD circuit
MB39A135	1	-	1000	+4.5 to +25	±1	TSSOP16	◎	–	Available	Selectable fixed PWM mode or automatic PFM/PWM mode, N/N synchronous rectification, current mode system, overvoltage protection, under-voltage protection, overcurrent control circuit, over-temperature protection, soft-start circuit, soft-stop circuit
MB39A104	2	-	1500	+7 to +19	±1	SSOP24	◎	–	Available	Soft-start circuit, timer-latch short-circuit protection, timer-latch overcurrent protection
MB39A136	2	-	1000	+4.5 to +25	±1	TSSOP24	◎	–	Available	Selectable fixed PWM mode or automatic PFM/PWM mode, N/N synchronous rectification, current mode system, overvoltage protection, under-voltage protection, overcurrent control circuit, over-temperature protection, soft-start circuit, soft-stop circuit
MB39A214	2	-	310/620/1000	+6.0 to +28.0	±0.7	TSSOP24	◎	–	Available	PFM/PWM, PAF, Bottom detection comparator, N/N synchronous rectification, soft-start circuit, discharge control circuit, overvoltage protection, under-voltage protection, overcurrent protection, over-temperature protection, built-in boot-strap diode
MB39A202A	2	2	100 to 600	+5.5 to +28	±1	QFN28	◎	–	Available	PFM/PWM, PAF, Bottom detection comparator, N/N synchronous rectification, soft-start circuit, discharge control circuit, overvoltage protection, under-voltage protection, overcurrent protection, over-temperature protection, built-in boot-switch, POWERGOOD circuit
MB39C011A	2	-	2000	+4.5 to +17	±1	TSSOP16	◎	–	Available	P/N synchronous rectification (Pch asynchronous rectification), timer-latch short-circuit protection, soft-start circuit, symmetrical-phase mode
MB39A112	3	-	2600	+7 to +25	±1	TSSOP20	◎	–	Available	Pch asynchronous rectification, individual channel control, soft-start circuit

For various types of power supplies such as LCD backlight, car navigation devices, audio devices, game consoles and portable devices.
* ◎ : Recommended ○ : Possible with the addition of outside parts
PAF=Prohibit Audio Freguency

Lineup of DC/DC Converter with Switching FET

Model	Number of channels ch	Switching frequency MHz	Output voltage (Typ) V	Output voltage Accuracy %	Power supply voltage V	Output current (max) mA	Switching FET Pch MOS (typ)Ω	Switching FET Nch MOS (typ)Ω	Package	Topology	Remarks
MB39C014	1	2000/3200 (fixed)	2.5	±4	+2.5 to +5.5	800	0.3	0.2	SON10	Buck	PWM, Current mode system, low-consumption current, synchronous rectification, POWERGOOD function, support for the input signal to DAC
MB39C006A	1	2000/3200 (fixed)	2.5	±4	+2.5 to +5.5	800	0.3	0.2	SON10	Buck	PFM/PWM, Current mode system, low-consumption current, synchronous rectification, POWERGOOD function, support for the input signal to DAC
MB39C015	2	2000 (fixed)	2.5	±4	+2.5 to +5.5	800/ch	0.3	0.2	QFN24	Buck	PWM, Current mode system, low-consumption current, synchronous rectification, voltage detection function included, support for the input signal to DAC
MB39C007	2	2000 (fixed)	2.5	±4	+2.5 to +5.5	800/ch	0.3	0.2	QFN24	Buck	PFM/PWM, Current mode system, low-consumption current, synchronous rectification, voltage detection function included, support for the input signal to DAC

Suitable for internal power supply in portable devices such as cellular phones, PDA, and in DVD, HDD, etc.

Memo

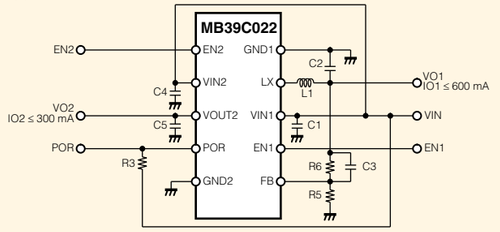
DC/DC Converter with Switching FET + LDO

MB39C022 Series 1-channel DC/DC Buck Converter IC + 1-channel Low-Noise LDO + POR

For Portable Devices with digital circuits and with analog circuits

1ch Buck B/B Boost Inv FET
0.6A SCP OTP OVP OCP UVP

Application circuit example



▶ Application : P3,5

Description

An optimal IC for power management systems in portable devices with one built-in channel of DC/DC step-down converter for digital circuits and one built-in channel of low-noise LDO for analog circuits. Two power management systems is in a 10-pin package of 3.0mm x 3.0mm.The built-in switching FET enable the construction of a power management system at a low BOM cost. There are four variations of the fixed output voltage in the LDO block.

Features

- Power supply voltage range: 2.5V to 5.5V
  Supporting 1-cell Li-ion Battery
- Function of DC/DC circuit:
  PFM/PWM mode: Improving efficiency under light load
  Current mode: High-speed load response
- Output voltage/current of DC/DC block:
  Voltage setting range: 0.8V to 4.5V
  Current: 600mA (Max.)
- Output voltage/current of LDO block:
  Output voltage (fixed): 3.3V (MB39C022G)
  2.85V (MB39C022J)
  1.8V (MB39C022L)
  1.2V (MB39C022N)
  Current: 300mA (Max.)
- Power on Reset (POR)
- Package: SON-10
  3.0mm×3.0mm×0.75mm (lead pitch 0.5mm)

Application

- Portable applications
- GPS, PND
- MP3, PMP
- Portable TV, USB dongle (CMMB, DVB-T, DMB-T)
- SMART-PHONE, etc.

SON10

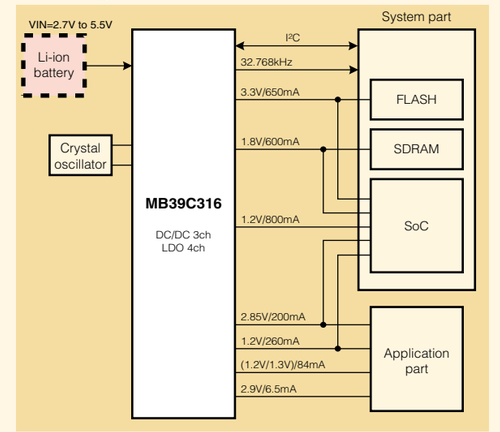
* Product Analysis of this product
···Refer from page 21 to page 22

MB39C316 3-channel DC/DC Converter + 4-channel LDO

Supporting 1-cell Li-ion Battery

3ch Buck B/B Boost Inv FET
0.8A SCP OTP OVP OCP UVP

System configuration of Mobile Terminals



▶ Application : P3,5

Description

MB39C316 is a power management IC equipped with 3ch DC/DC converter and the 4ch linear regulator (LDO). MB39C316 operate in the range of power supply voltage with 1-cell Li-ion power by 1ch buck boost DC/DC converter of high efficiency, and has 4ch LDO which is suitable to supply voltage for mobile terminals.

Features

- Power supply voltage range : 2.7V to 5.5V
- Sequence control: On/Off control of power supply voltage
- I²C bus interface: Control and notice of internal condition
- RTC: Possible to output the 32.768kHz clock by connecting crystal oscillator

Application

- Portable Products such as PDA
- Mobile WiMAX terminals

*:MB39C316 consist of the chipset for Mobile WiMAX terminals with MB86K22 (BaseBand) and MB86K52 (RF).

WL-CSP49
3.1×3.1×0.8(mm)

Lineup of DC/DC Converter with Switching FET + LDO

Model	Number of channels ch		Switching frequency kHz	Power supply voltage V	Output features					Package	Remarks
	DCDC	LDO			Pin name	Output voltage V	FET	Output current (max) mA	Topology		
MB39C022(Common)	1	1	2000	+2.5 to +5.5	DCDC	0.8 to 4.5	Internal	600	Buck	SON10	PFM/PWM, current mode system, synchronous rectification, short-circuit protection, overcurrent protection, over-temperature protection, under voltage lock out protection, POR(Power on Reset)
MB39C022G					LDO	3.3	–	300	–		
MB39C022J						2.85					
MB39C022L						1.8					
MB39C022N						1.2					
MB39C316	3	4	1700	+2.7 to +5.5	DCDC1	1.2	Internal	800	Buck	WL-CSP49	Current mode system, synchronous rectification, output short-circuit protection, over-temperature protection, overcurrent protection, under voltage lock out protection
					DCDC2	1.825		600	Buck		
					DCDC3	3.3		650	Buck/Boost		
					LDO1	2.875	–	200	–		
					LDO2	1.225		260			
					LDO3	1.20/1.30		6.5			
					LDO4	2.925		84			

Power Supply for RF Power Amplifier

MB39C326 — 6MHz Synchronous Buck-Boost DC/DC Converter IC

6MHz Buck-Boost, Reduced board space

1ch | Buck | B/B | Boost | Inv | FET
2A | SCP | OTP | OVP | OCP | UVP

■ Description

MB39C326 is a high efficiency, low noise synchronous, 6MHz buck-boost DC/DC converter designed for powering the radio frequency power amplifiers (RFPA) in mobile handsets or other mobile applications with single-cell Li-ion battery. MB39C326 DC/DC convertor switches at 6MHz compare to conventional DC/DC converters that have switching frequencies between 2 to 3MHz, allowing smaller inductor to be use and expect to reduce the overall board space of the power management circuits by half. Its buck boost operation switches automatically to extend the operating voltage of lithium battery while providing stable power supply to the power amplifier.

■ Features

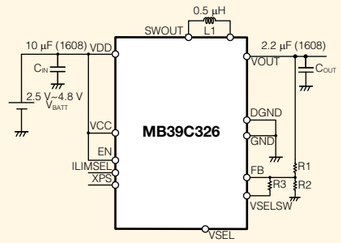
- High efficiency
- Power Supply voltage range : 2.5V to 4.8V
- Adjustable output voltage range : 0.4V to 4.5V
- Input current limit value : 2000mA
- 6MHz PWM operation allows 0.5 µH small form inductor
- Less than 20 µs step response for 3G
- Automatic Transition between buck mode and boost mode
- Selectable output voltage with external resistor

■ Application

- Mobile phones, Smart phones, e-Books, PDAs
- RF-PAs powered by 1cell Li-ion battery
- RF-PC cards

WL-CSP20
2.15×1.94×0.625(mm)

Application circuit example



▶ Application : P5

Power Supply for RF Power Amplifier

Model	Number of channels ch	Switching frequency (max)kHz	Outout voltage (Typ) V	Outout voltage Accuracy %	Power supply voltage V	Output current (max) mA	Input current limit value mA	FET	Package	Topology	Remarks
MB39C326	1	6000	+0.4 to +4.5	±3	+2.5 to +4.8	800	2000	Internal	WL-CSP20	Buck/Boost	PFM/PWM, synchronous rectification, over-temperature protection, overcurrent protection, under voltage lock out protection, Automatic Transition between buck mode and boost mode, Selectable output voltage with external resistor

DC/DC Converter IC for System Power Supply

MB39A123 — 6ch DC/DC Converter IC with Synchronous Rectification

System power management IC Supporting 2-cell Li-ion Battery

6ch | Buck | B/B | Boost | Inv | FET
0.6A | SCP | OTP | OVP | OCP | UVP

■ Description

MB39A123 is a 6-channel DC/DC converter IC using pulse width modulation (PWM), and it is suitable for boost conversion, buck conversion, and boost/buck conversion.

■ Features

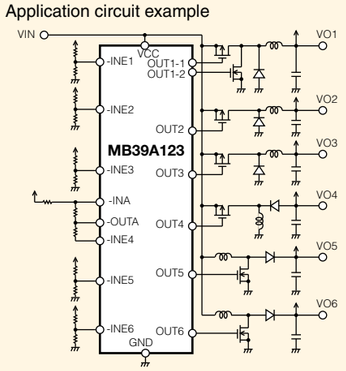
- Power supply voltage range: 1.7V to 11V
- Supports for buck converter with synchronous rectification
- Negative voltage output (Inverting amplifier)
- Low voltage start-up: 1.7V
- Support for the output voltage of 1.0V
- Support for control and soft-start of each channel
- Oscillation frequency range: 200kHz to 2.0MHz

■ Application

- Digital still camera
- Digital video camera
- Surveillance camera

LQFP48

Application circuit example



Lineup of DC/DC Converter IC for System Power Supply

Model	Number of channels ch	Switching frequency(max) kHz	Power supply voltage V	Reference voltage accuracy %	Package	Topology: Buck	Topology: Buck/Boost	Topology: Boost	Topology: Inverter	FET compatible	Remarks
MB39A123	6	2000	+1.7 to +11	±1	LQFP48	◎	◎	◎	◎	Available	Synchronous rectification, individual channel control, soft-start function, support for external input short-circuit detection

For portable devices such as DSC and DVC.

* ◎ : Recommended

DC/DC Converter for LCD Panels

MB39C313A/MB39C313B — 4-channel DC/DC Converter IC for LCD Panel

DC/DC + Charge pump

4ch | Buck | B/B | Boost | Inv | FET
1.5A | SCP | OTP | OVP | OCP | UVP

■ Description

MB39C313A/MB39C313B is a 4ch system power management IC. It consists of 2ch DC/DC converter and 2ch charge pump type DC/DC converter.

■ Features

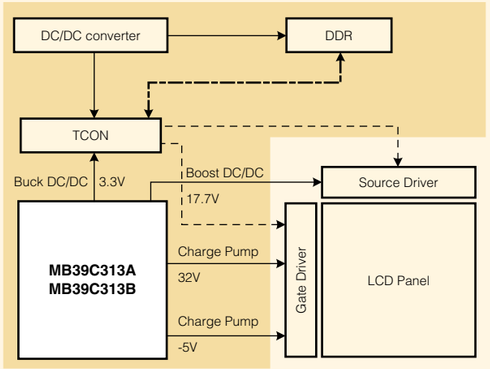
- Power supply voltage range: 8V to 14V
- Structure: Vlogic/Vs: voltage mode DC/DC converter included switching FET
  VGL/VGH: charge pump with output voltage feedback
- Built-in soft-start circuit independent of loads
- Excellent line regulation with the feed-forward method (Vlogic, Vs)
- Built-in phase compensator parts (Vlogic; buck DC/DC)
- Built-in sequence comparator for rising
- Frequency setting by input pin: 500kHz / 750kHz
- Over current protection (Vlogic, Vs): Vs Detection value: 3.5A (MB39C313A)
  4.6A (MB39C313B)

■ Application

- Large size LCD panel

TSSOP28
(Exposed PAD)

System configuration of LCD panel



VIN=8V to 14V

▶ Application : P5

Lineup of DC/DC Converter for LCD Panels

Model	Number of channels ch	Switching frequency (fixed)MHz	Power supply voltage V	Output features: Pin name	Output features: Structure	Output features: Error amplifier threshold voltage V	Output features: Accuracy %	Output features: Output voltage V	Output features: FET	Output features: Output current A	Package	Remarks
MB39C313A MB39C313B	4	500/750	+8 to +14	Vlogic	Buck DC/DC	1.213	1.5	1.8 to 3.3	Internal	1.5	TSSOP28 (Exposed PAD)	soft-start circuit, sequence comparator, short-circuit protection, overvoltage protection, over-temperature protection, over current protection (Vlogic, Vs): Vs Detection value: 3.5A(MB39C313A) 4.6A(MB39C313B)
				Vs	Boost DC/DC	1.146	0.9	18.1(max)		1.5 *1		
				VGL	Invert charge pump	0±36mV	–	–	–	100mA		
				VGH	Boost charge pump	1.213	2.1			100mA		

*: Conditions: Input voltage=12V, Output voltage=15V

Memo

Charge Control

MB39A134 DC/DC Converter IC for Charging Li-ion Battery

Preset output-voltage, CVM

1ch | Buck | B/B | Boost | Inv | FET
4A | SCP | OTP | OVP | OCP | UVP

■ Description

MB39A134 is a DC/DC converter IC for charging Li-ion battery, which is suitable for buck conversion, and uses pulse width modulation (PWM) for controlling the output voltage and current independently.

■ Features

- Power supply voltage range: 8V to 25V
- Support 2, 3 and 4 Cell battery pack
- Topology: Pch/Diode , asynchronous rectification
- AC adapter voltage detection function (ACOK terminal)
- Output voltage setting accuracy: ±0.7% (Ta=-10°C to +85°C)
- Charging voltage can be set without externally attached resistor
- Charging current can be set without externally attached resistor
- High accuracy current detection amplifier (±1%)
  (At input voltage difference 100mV)

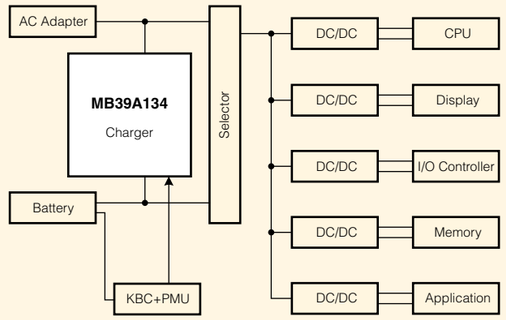
■ Application

- Charging device in products such as Notebook PC

＊ Technical Analysis of this product
···Refer from page 23 to page 24

TSSOP24

System configuration of Notebook PC



▶ Application : P3

MB39A132A DC/DC Converter IC for Charging Li-ion Battery

Nch/Nch synchronous, Preset output-voltage

1ch | Buck | B/B | Boost | Inv | FET
4A | SCP | OTP | OVP | OCP | UVP

■ Description

MB39A132A is a DC/DC converter IC for charging Li-ion battery, which is suitable for buck conversion, and uses pulse width modulation (PWM) for controlling the output voltage and current independently.

■ Features

- Power supply voltage range: 8V to 25V
- Support 2, 3 and 4 Cell battery pack
- Topology: Nch/Nch , synchronous rectification
- AC adapter voltage detection function (ACOK terminal)
- Output voltage setting accuracy: ±0.5% (Ta=+25°C to +85°C)
- Charging voltage can be set without externally attached resistor
- Charging current can be set without externally attached resistor
- High accuracy current detection amplifier (±1%)
  (At input voltage difference 100mV)

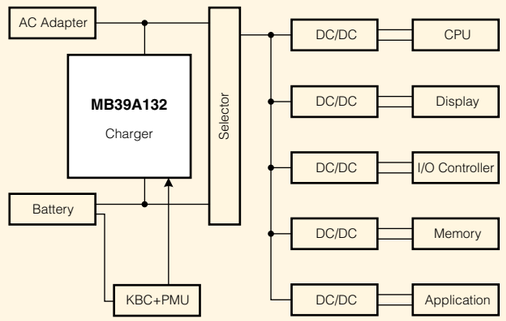
■ Application

- Charging device in products such as Notebook PC

＊ Technical Analysis of this product
···Refer from page 23 to page 24

QFN32

System configuration of Notebook PC



▶ Application : P3

Lineup of Charge Control

Model	Switching frequency (max)kHz	Power supply voltage V	Output voltage V	Accuracy % Ta=25°C	Accuracy % Ta=-30 to 85°C	Package	Topology	FET compatible	Remarks
MB39A134	2000	+8 to +25	4.2 or 4.1 /cell, Optional	±0.5	±0.7*1	TSSOP24	Buck	Available	2 to 4 cells, Charging voltage can be set without externally attached resistor, charging current can be set without externally attached resistor, dynamically controlled charging, ACOK function included, soft-start circuit
MB39A132A	2000	+8 to +25	4.0 or 4.2 or 4.35 /cell, Optional	±0.5	±0.5*2	QFN32	Buck	Available	2 to 4 cells, Charging voltage can be set without externally attached resistor, charging current can be set without externally attached resistor, dynamically controlled charging, ACOK function included, soft-start circuit

For portable devices using Li-ion battery, such as Notebook PC, Netbook PC etc.

*1: Ta=-10 to +85°C
*2: Ta=25 to +85°C

Power Voltage Monitoring Applications

MB3793 Power voltage monitoring IC with dual-system watchdog timer

Built-in Watchdog timer

■ Description

MB3793 is a power voltage monitoring IC with dual-system watchdog timer. A reset signal is output at transient power cut-off or power fall. When the power resumes, the IC outputs a power-on reset signal to MPU to monitor power voltage. Using this IC in an MCU system can provide such system with a fail-safe function.

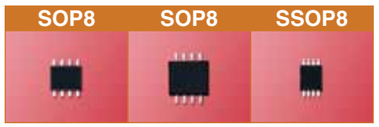
■ Features

- Detection voltage: 4.5V/4.2V/3.7V/3.4V/3.0V/2.8V/2.7V 7type
- Precise detection of power voltage fall: ±2.5%
- Detection voltage with hysteresis
- Internal dual-input watchdog timer
- Watchdog-timer halt function (by inhibition pin)
- Independently-set watchdog and reset times

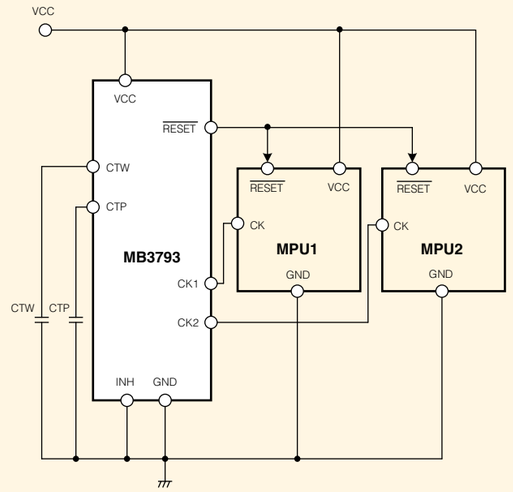
■ Application

- Arcade Amusement
- PBX and base stations
- Vending machines etc.

SOP8 | SOP8 | SSOP8



System configuration



▶ Application : P3

Lineup of Power Voltage Monitoring Application

Model	Function	Detection voltage V	Power supply voltage V	Package	Remarks
MB3771	Power supply voltage monitor	Voltages other than 4.2V optionally available	+3.5 to +18	SOP8	–
MB3773	MB3771+ watchdog timer	Voltages other than 4.2V optionally available	+3.5 to +16	SOP8	–
MB3793-XX	Power supply voltage monitor with dual-system watchdog timer	4.5(-45), 4.2(-42), 3.7(-37A), 3.4(-34A), 3.0(-30A)	6(max)	SOP8, SSOP8	–
		2.7(-27A), 2.8(-28A) *: "( )" corresponds to "-XX" of a product name.	4(max)		

Used in power supplies for various applications, including automobiles, hot water systems, copiers, VCRs, hard-disk drives, general OA equipment, measuring instruments, and pachinko parlor pinball machines.

Lineup of Power Management Switches

Model	Consumption current (Sw OFF) A	On resistance Ω	Drive current (max) A	Switching voltage (max) V	Package	Remarks
MB3841	0	0.045	2	5.5	SOP8	1 channel USB
MB3842 MB3845	0	0.1	0.6	5.5	SSOP20	2 channel USB Switching changeover logic differs for the MB3842 and MB3845.

Lineup of AC/DC Converter

Model	oscillation frequency (max)kHz	Power supply voltage V	Maximum output current mA	Package	Remarks
MB3759	300	+7 to +32	200	SOP16	TL494 pin-compatible
MB3769A	700	+12 to +18	DC 100, peak 600	SOP16	Power MOS FET

Noteworthy Non-linear Hysteresis Control Method As a DC/DC Converter Control Method

MB39A214

"Bottom detection comparator method" is the best method for the power supply to the Core of system LSI with the severe demand of the power-supply voltage accuracy, to the memory, to the power-supply specification with the large I/O voltage difference. MB39A214 achieved a low output ripple operation by adding our improved new circuit to a past bottom detection comparator method.

Outline of Bottom detection comparator method

Although the conventional mainstream DC/DC converter control methods were voltage control or current control, recently the non-linear hysteresis control method attracts attention along with the lowering the voltage of the power-supply voltage of system LSI.
Since 2005, FUJITSU has shipped more than 100 million DC/DC converter ICs that adopt the bottom detection comparator method (a type of hysteresis control method), mainly to the commercial market.
The reason why this method attracts attention is an excellent point in "High-speed load transition response characteristic" and "Low on-duty operation with stability". Moreover, the power supply design is easy.

Feature 1: High-speed load transition response characteristic

The bottom detection comparator method compares with the comparator of a feedback voltage and a reference voltage always, and keeps the output voltage by off-time control and the fixed on-time.
Therefore, when the output voltage changes by a rapid change in the load, this method rapidly stabilizes the output voltage by controlling the off-time and changing the switching frequency. (Refer to Fig.2)
This method is best for the system that the low voltage power supply is especially necessary, because the voltage stability is more excellent than the voltage control and the current control method using a conventional error amplifier.
In addition, this method can reduce the output capacitor for smoothness, because the voltage stability is excellent. This point contributes to the part cost reduction in the entire set.

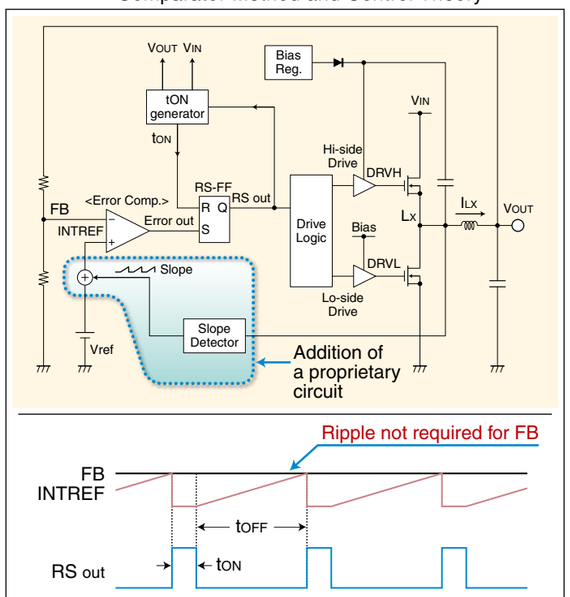
Feature 2: No phase compensation circuit required

In the voltage control and the current control method, the phase compensation circuit is necessary to prevent the oscillation of the DC/DC converter output. This circuit is a circuit to adjust the phase delay of a feedback system and the gain of the error amplifier.
The bottom detection comparator method has little phase delay for feedback-loop-system. This method uses a comparator without an error amplifier, it therefore requires no phase compensation circuit.
Therefore, it is possible to greatly shorten the period of power supply design, without preparing a special measurement environment and without requirement to adjust the circuit at the power supply design.

Feature 3: For low on-duty (Secure on-time switching control)

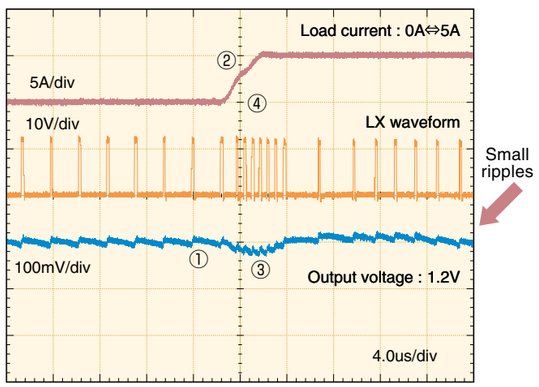
The bottom detection comparator method does switching control by fixing the on-time and by controlling off-time.
It is therefore possible to supply stable output voltage without becoming unstable, even under conditions of large input-output voltage difference.
Direct conversion is easy to the low voltage power supply from the first power supply. Therefore, the energy-saving effect by the decrease of the conversion loss can be expected compared with the case to use the second or third power supplies.

■ Figure 1 Block Diagram for the Bottom Detection Comparator Method and Control Theory



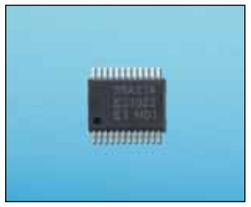
INTREF is the voltage that the slope was added to a reference voltage (Vref) by the new original circuit. When the value of INTREF becomes equal to FB, the high-side FET is turned on.

■ Figure 2 Load Fluctuation Waveform for the Bottom Detection Comparator Method



① Stationary state: Stable load current and output voltage
② Load fluctuation: Rapid increase in load current
③ Output voltage fluctuation: Undershooting of output voltage due to rapid load fluctuation
④ Switching control: Output voltage is recovered by changing the off period and implementing switching control in succession depending on the output voltage fluctuation

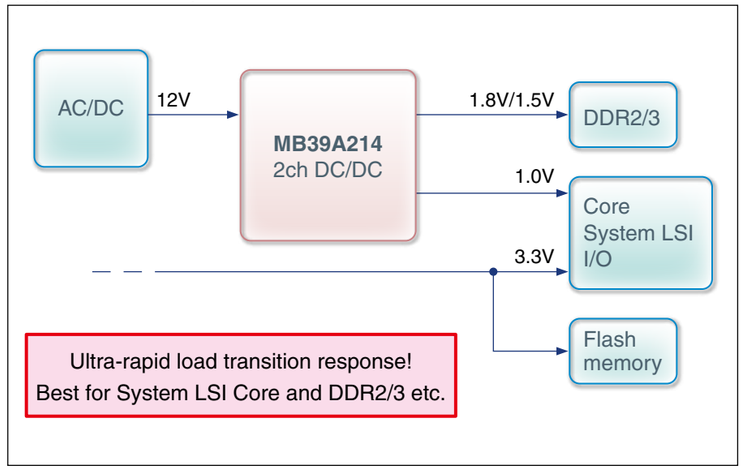
■ MB39A214 External View



4.4×6.5×1.2mm
(0.5mm Lead Pitch)

■ Evaluation Board MB39A214

■ Application Example



■ Table of Bottom detection comparator method DC/DC converter IC

Specification Item		MB39A214
Topology		Synchronous Rectification Buck Converter
External FET		Nch/Nch
Number of output channels		2-channel
Maximum Ratings		30V
Power supply voltage		6.0V to 28V
Output voltage		0.7V to 5.3V Setting by an external resistor
Reference voltage and accuracy		0.7V±0.7%
Applicable output condenser		Aluminum Solid Capacitors with Organic Semiconductive Electrolyte Conductive Polymer
Switching frequency		310kHz/620kHz/1MHz selected
Startup / Shutdown		Soft-Start/ Internal FET for Discharge
Protection Function	Under Voltage Lock Out Protection	○
	Over Current Protection	○
	Over Voltage Protection	○
	Under Voltage Protection	○
	Over Temperature Protection	○
Package		TSSOP-24 4.4×6.5×1.2mm (0.5mm Lead Pitch)

・MB39A214(2-channel) ··· Refer to page 7

∗ The DC/DC part of MB39A202A(refer to page 10) adopts "Bottom detection comparator method for the low output voltage ripple" in this page.

Power Management IC for Portable Devices 1-Channel DC/DC Converter + 1-Channel Low-Noise LDO + POR

MB39C022G / MB39C022J / MB39C022L / MB39C022N

An optimal IC for power management systems in portable devices with one built-in channel of DC/DC step-down converter for digital circuits and one built-in channel of low-noise LDO for analog circuits. It can also be used in products adopting one cell of Li-ion battery as the power supply. Two power management systems in a 3.0mm×3.0mm, 10-pin package and the built-in switching FET enable the construction of a power management system at a low BOM cost. There are four versions of the fixed output voltage in the LDO block.

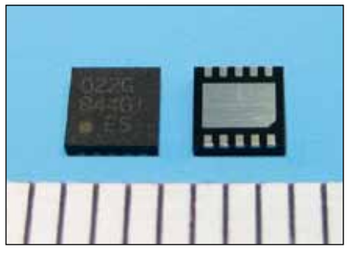
Introduction

The MB39C022 Series are optimal power management ICs for the construction of systems for ARM architecture-based system ICs, GPSs, and portable TVs.
Low-noise LDO is demanded for power supplies for RF, PLL, and analog functions. This product is a 2-channel power management IC combining a DC/DC converter and a low-noise LDO. It is useful in electronic devices with mixed analog and digital components.

Product Features

- Input voltage range: 2.5V to 5.5V
- Output voltage/current
  - DC/DC block (CH1): Voltage setting range: 0.8V to 4.5V
    Current: 600mA (Max.)
  - LDO block (CH2): Output voltage (fixed):
    3.3V, 2.85V, 1.8V and 1.2V
    Current: 300mA (Max.)
  - The DC/DC circuit adopts the PFM/PWM mode to improve efficiency under light load. The current mode architecture is also adopted to achieve high-speed load response.
  - The LDO circuit is optimal for power supplies of analog circuits such as RF as it satisfies the low-noise requirement.
  - The built-in Power on Reset (POR) function enables the construction of the power startup sequence without signals from an MCU.
- Rich protective functions
  Short-circuit protection (SCP), over-current protection (OCP), over-temperature protection (OTP), and under voltage lock out protection (UVLO) are provided.
- Package: SON-10 (Photo 1)
  Adoption of the SON package contributes to the reduction in the board area of power management circuit.
  3.0mm×3.0mm×0.75mm (lead pitch 0.5mm)

■ Photo 1 External View



Functions

PFM/PWM control circuit (CH1)

The frequency (2.0MHz) set up by the built-in oscillator (square wave oscillating circuit) is used to enable synchronous rectification operation of the built-in P channel MOS FET and N channel MOS FET. PFM operation is executed under light loads.

Iout comparator circuit

This circuit detects the current flowing from the built-in P channel MOS FET to the external inductor (ILX). It compares VIDET obtained by I-V conversion of the ILX peak current and the Error Amp. output to turn OFF the built-in P channel MOS FET through the PFM/PWM logic Control circuit.

Error Amp.(CH1) phase compensation circuit

This circuit compares the VREF reference voltage and the output voltage. The phase compensation circuit of this product is realized by externally attaching a feedback resistor and a capacitor for phase compensation to the FB terminal.

LDO circuit (CH2)

The built-in low-noise LDO can output currents up to 300mA. A capacitor is required on the VOUT2 pin for stability.
Table 1 presents the output settings and power supply rejection ratio (PSRR) of the LDO block of this product.

Power on Reset (POR) circuit

This circuit monitors the VO1 terminal voltage (CH1 output voltage) via the FB terminal. The POR pin has open drain output. It is normally used in pull-up with an external resistor. While the POR pin reaches H level when VO1 reaches the set output voltage, it is set to L level when the output voltage drops due to over current and so forth.

VREF circuit

It generates a highly precise reference voltage using a BGR (band-gap reference) circuit.

Protection circuit

The over-temperature protection circuit (OTP) stops the entire output operation at CH1 and CH2 when the junction temperature reaches +135°C. It restores CH1 and CH2 to normal operation when the junction temperature drops to +110°C. Since the PFM/PWM control circuit adopts the current mode architecture for its control method, the current peak value is constantly monitored and controlled.

Control circuit

Table 2 presents the function control by EN1 and EN2 pins.
Figure 1 presents the block diagram for this product.

■ Table 1 Output Settings and Power Supply Rejection Ratio (PSRR) of the LDO block

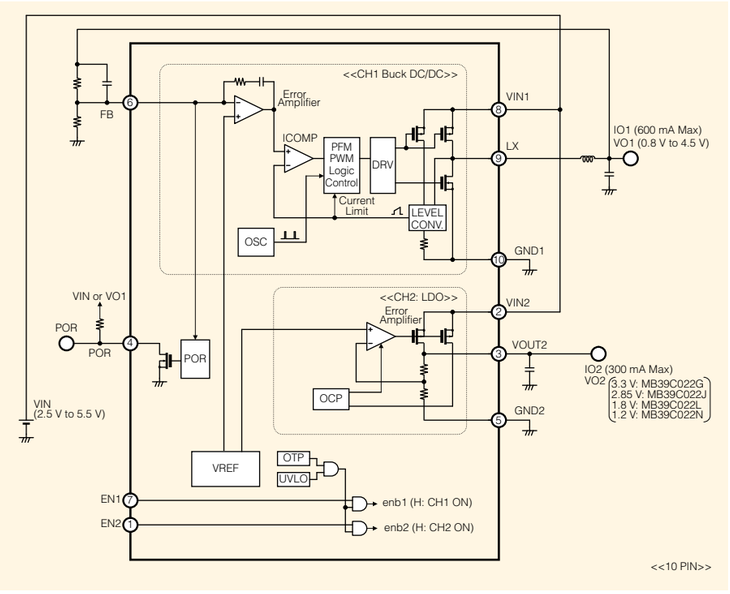
Product name	Output voltage setting in LDO block	PSRR (typical)
MB39C022G	3.3V	-70dB
MB39C022J	2.85V	-65dB
MB39C022L	1.8V	-60dB
MB39C022N	1.2V	-55dB

■ Table 2 Function Control by EN1 and EN2 Pins

EN1	EN2	CH1 and POR	CH2	VREF, UVLO, OTP
L	L	OFF	OFF	OFF
H	L	ON	OFF	ON
L	H	OFF	ON	ON
H	H	ON	ON	ON

■ Photo 2 Evaluation Board

■ Figure 1 Block Diagram



Applications

Figures 2 and 3 present application examples. This product is optimal for the following applications:
- Portable applications
- GPS, PND
- MP3, PMP
- Portable TV, USB dongle (CMMB, DVB-T, DMB-T)
- SMART-PHONE, etc.

CMMB=China Multimedia Mobile Broadcasting
DVB-T=Digital Video Broadcasting - Terrestrial
DMB-T=Digital Multimedia Broadcasting - Terrestrial

Evaluation Board

We offer an evaluation board (Photo 2) to simplify the single unit evaluation of this product.

Future Development

We plan to successively introduce product versions that offer fixed output voltage of the LDO block in the future. We will continue development to meet our customer needs, aiming to address further miniaturization and cost reduction.

■ Figure 2 Application Example (CMMB, DVB-T, DMB-T)

PDM : Pulse Density Modulation

■ Figure 3 Application Example (USB-SATA Bridge)

DC/DC Converter ICs for Charging Li-ion Batteries in Notebook PCs

MB39A132A/MB39A134

FUJITSU's Li-ion battery chargers come with a rich set of useful functions for our customers. ICs with two different operation methods (Nch/Nch synchronous rectification type and Pch/Di asynchronous rectification type) are included in the lineup; our customers can select the optimal product for their applications. This article introduces the technologies required in Li-ion battery charge control in notebook PCs.

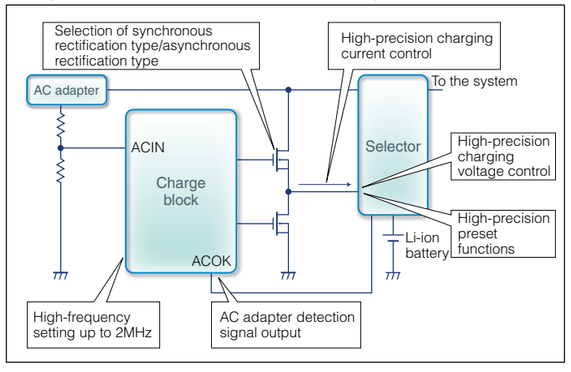
Functions Required in Li-ion Chargers

Li-ion batteries are charged in different ways depending on the battery condition. When the battery voltage is low, it must be charged rapidly with constant-current charging; when the voltage is high, it must be safely charged with constant-voltage charging so that the battery voltage will not exceed the set value. Using our charger ICs, constant-current charging and constant-voltage charging can be switched between automatically, enabling safe charge control.

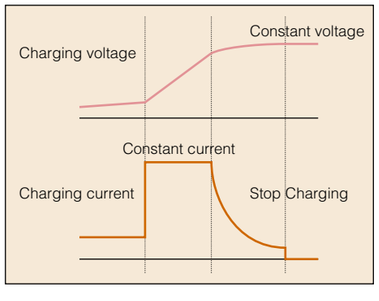
In notebook PCs, power is supplied to the system from the AC adapter when it is connected. The charge control IC controls the charging of the battery by converting the voltage input from the AC adapter at the same time. When the AC adapter is disconnected, power is supplied to the system from the battery. At this point, the system power source must be switched automatically as soon as there is no more external power supply—the ACOK function of MB39A132A/MB39A134 is used for this purpose. This product has a standby current as low as 6μA (standard) and is capable of suppressing power loss and extending the standby time for notebook PCs.

Figure 1 presents the functions required in charge control ICs and Figure 2 examples of charging characteristics.

■ Figure 1 Functions Required in Charge Control ICs



■ Figure 2 Examples of Charging Characteristics



Main Features of MB39A132A/MB39A134

MB39A132A/MB39A134 is equipped with 1 constant-voltage control loop and 2 constant-current control loops. It controls the charging by automatically switching the charge mode depending on the remaining voltage in the battery. It is also equipped with the ACOK function, which independently operates during IC standby, and the presetting function, which sets the charging current and voltage without an external resistor.

High-precision charge control

The operation time of a notebook PC's battery depends on the battery voltage at full charge. It can be extended when the battery voltage is high and it is therefore advantageous to complete charging at the highest possible voltage. In order to ensure safe charging, however, the charging voltage needs to be restricted so as not to exceed the tolerable voltage of the Li-ion battery. When setting the allowance of the charging voltage, consideration must be given to precision so that the upper limit of the safety value is not exceeded.

In general, the battery capacity changes by ±10% with ±100mV fluctuations in charging setting voltage. MB39A132A can set the charging voltage with high precision of ±0.5% (Ta=+25°C to +85°C) and it is thus capable of maximizing the battery capacity, thereby contributing to the miniaturization of devices.

High-precision presetting function

The presetting function using high-precision trimming technology in MB39A132A/MB39A134 can set the charging voltage to 2 to 4 cells without any external resistors. Furthermore, this product can simply address other options using different battery voltages. For example, it can switch between 4 cells and 3 cells for each set by changing just one circuit connection. These functions can eliminate the wasteful design costs involved in preparing a new circuit.

It also has a convenient specification that allows a wide range of voltage setting and supports various different types of batteries when an external resistor is used.

High-frequency setting up to 2MHz

The switching frequency can be set to a high frequency between 100kHz and 2MHz depending on the value of the external resistor. It has a useful specification that allows a high degree of design freedom, which suits the requirements of our customers, by setting the operating frequency high so that the external inductor can be small or by setting the operating frequency low when the charging current is large to improve efficiency.

Synchronous Rectification Type and Asynchronous Rectification Type

FUJITSU offers Nch/Nch synchronous rectification type MB39A132A, which is capable of charging with high efficiency while suppressing heat generation even under large currents, and Pch/Di asynchronous rectification type MB39A134, which is a simple external solution that reduces costs. Customers can select the IC that best suits their needs.

Figures 3 and 4 present simplified block diagrams of these products and Figure 5 their conversion efficiency characteristics.

For large currents (MB39A132A)

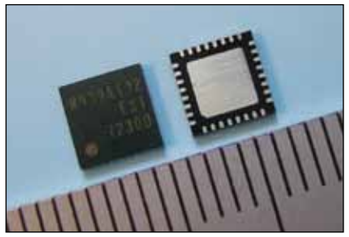
As shown in Figure 5, the Nch/Nch synchronous rectification type uses FET on the low-side and realizes high efficiency even under low duty with low output voltage compared to the input voltage. MB39A132A is optimal for suppressing heat generation when a large current is run during constant-current charging, which may heat the PC case.

Simple configuration (MB39A134)

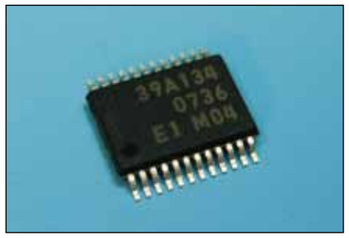
The difference in efficiency is nearly eliminated between the Pch/Di asynchronous rectification type and the Nch/Nch synchronous rectification type when there is little difference between the input voltage and the output voltage and the product operates with high duty. Unlike the synchronous rectification type, the asynchronous rectification type does not have a boost circuit and it thus requires no CB capacitance or boost diode. It can be constructed with a simple external circuit and its layout arrangement is uncomplicated.

These products come in different packages and package/pin numbers. MB39A132A comes in a small 5-mm-square QFN32 package and MB39A134 comes in a TSSOP-24 package, which allows simple built-in applications. Each delivers unique functions.

■ External View (MB39A132A)



■ External View (MB39A134)

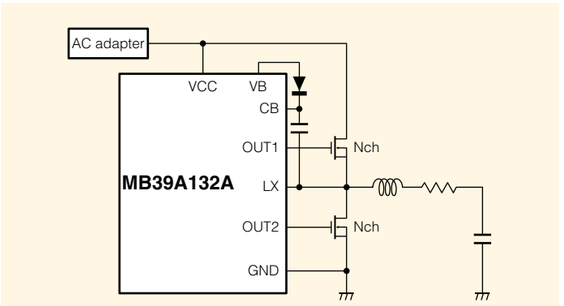


Other Features

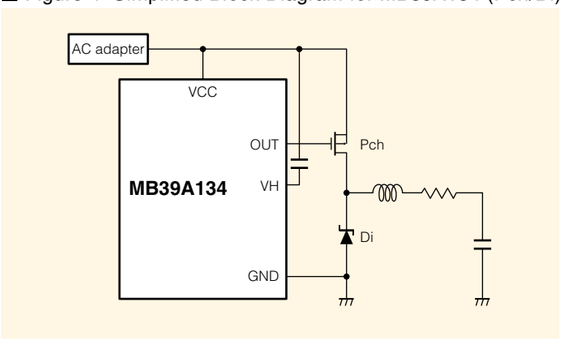
Fast response (MB39A132A)

Since the negative input terminal Error Amp3 to control the charging voltage is projected, it is possible to execute phase compensation by 3pole-2zero. The bandwidth for constant-voltage control can be set to an extended range and it is thus capable of fast response even for load response to a large current, preventing overshooting or undershooting of the output voltage.

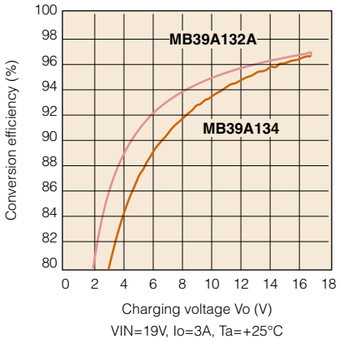
■ Figure 3 Simplified Block Diagram for MB39A132A (Nch/Nch)



■ Figure 4 Simplified Block Diagram for MB39A134 (Pch/Di)



■ Figure 5 Conversion Efficiency for MB39A132A/MB39A134



Package

Package Lineup

SOP Series

SOP8		SOP8		SOP16	
Body Size	Lead Pitch	Body Size	Lead Pitch	Body Size	Lead Pitch
3.9X5.05X1.75mm	1.27mm	5.3X6.35X2.25mm	1.27mm	5.3X10.15X2.25mm	1.27mm

SSOP Series

SSOP8		SSOP20		SSOP24	
Body Size	Lead Pitch	Body Size	Lead Pitch	Body Size	Lead Pitch
4.2X3.5X1.45mm	0.80mm	4.40X6.50X1.45mm	0.65mm	5.6X7.75X1.45mm	0.65mm

TSSOP Series

TSSOP16		TSSOP20		TSSOP24		TSSOP28	
Body Size	Lead Pitch	Body Size	Lead Pitch	Body Size	Lead Pitch	Body Size	Lead Pitch
4.40X5.00X1.10mm	0.65mm	4.40X6.50X1.10mm	0.65mm	4.40X6.50X1.20mm	0.50mm	4.40X9.70X1.20mm	0.65mm

SON Series

SON10	
Body Size	Lead Pitch
3.00X3.00X0.75mm	**0.50mm**

LQFP Series

LQFP48	
Body Size	Lead Pitch
7.00X7.00X1.70mm	0.50mm

QFN Series

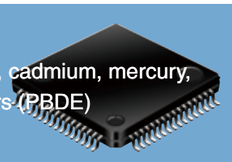
QFN24		QFN28		QFN32	
Body Size	Lead Pitch	Body Size	Lead Pitch	Body Size	Lead Pitch
4.00X4.00X0.85mm	0.50mm	4.0X4.0X0.8mm	0.4mm	5.00X5.00X0.85mm	0.50mm

RoHS Compliance Information

Lead (Pb) Free Version

Fujitsu LSI products are compliant with RoHS Directive, and observe the standards of lead, cadmium, mercury, hexavalent chromium, polybrominated biphenyls (PBB), and polybrominated diphenyl ethers (PBDE)

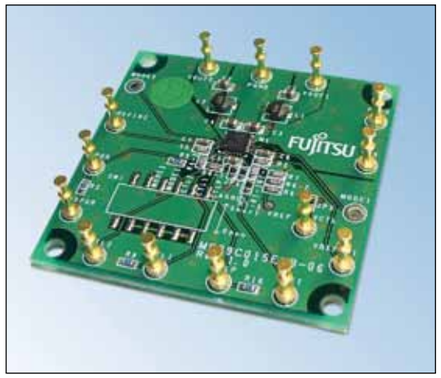
An RoHS-compliant product is indicated by trailing characters "E1" in its part number.



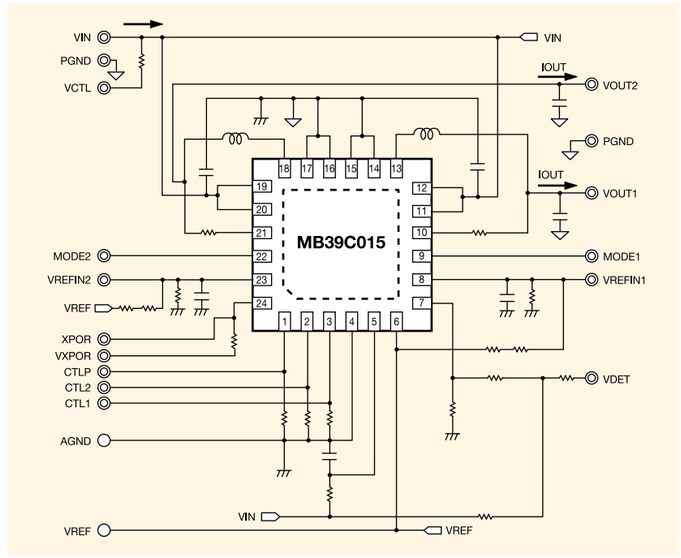
Evaluation Board

Fujitsu Semiconductor provides evaluation boards for you to evaluate our semiconductor devices.

■ **Example: MB39C015 evaluation board**



■ **Example: MB39C015 connection diagram**



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URL : http://www.fujitsu.com/global/services/microelectronics/

Catalog of Power Management ICs

IC Lineup of DC/DC Converter Data sheets

After the list is displayed, you can choose your desired products.

Applications

It can search from the Application.

For detailed electric properties and operating conditions, refer to the data sheet of each product.

Global Network

Global Network

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  Tempe-AZ

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  Singapore/Penan/Bangalore/Delhi
- Fujitsu Semiconductor Design (Chengdu) Co. Ltd. (FSDC)
  Chengdu
- Nantong Fujitsu Microelectronics Co., Ltd. (NFME)
  Nantong

- Fujitsu Semiconductor America, Inc. (FSA)
  Sunnyvale (CA)

- Fujitsu Semiconductor Europe GmbH (FSEU)
  Langen

- Fujitsu Semiconductor Asia Pte. Ltd. (FSAL)
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- Fujitsu Semiconductor (Shanghai) Co., Ltd. (FSS)
  Shanghai

- Fujitsu Semiconductor Limited (FSL)
  Yokohama

Table of Power Management ICs

Product category	Model	Number of channels (ch)	Topology	Power supply voltage (V)	Output voltage (V)	Output voltage accuracy (%) *5	Maximum output current (A) *2	Output driver	Oscillation frequency (Hz)(Max)	Switching type	Frequency control	Protection function	On/Off	Others	Charge control function	Sales promotion tool	Package (numeric value shows the number of pins)	Datasheet	Evaluation Board *3
General-purpose DC/DC Converter (External FET)	MB3800	1	Buck	1.8 to 15.0	*1	± 4.0	1	FET compatible	1M	Nch/Nch synchronous rectification		Over input current protection	Soft stop	External voltage detection function	Built-in AC adaptor detection function		SOP8, SSOP8	○	-
	MB39A130A	1	Buck	4.5 to 25.0	0.7 to 5.0 or 1.2/2.5	± 1.52/ ± 1.49	20	FET (internal)	600K	Pch/Nch synchronous rectification (Pch asynchronous rectification selectable)		Overcurrent protection	Soft start	Number of battery cells (cell)	Charge control function		TSSOP24	○	○
	MB39A135	1	Boost	4.5 to 25.0	0.7 and above	± 1.0	15	Open corrector	1M	Pch asynchronous rectification	PFM/PWM automatic shift	Short-circuit protection	Control pin	Under input voltage charging stop function	Constant voltage mode indication to monitor full charging		TSSOP16	○	○
	MB39A104	2	Invert	7.0 to 19.0	1.2 and above	± 1.05	3		1.5M			Over input voltage protection	On/Off		Preset charging voltage without external resistor		SSOP24	○	○
	MB39A136	2	Invert	4.5 to 25.0	0.7 and above	± 1.0	15		1M			Overvoltage protection	Soft stop		Built-in AC adaptor detection function		TSSOP24	○	○
	MB39C011A	2	Buck/Boost	4.5 to 17.0	1.0 and above	± 1.0	5		2M			Under voltage protection	Soft start				TSSOP16	○	○
	MB39A214	CH1 CH2 2	Buck/Boost	6.0 to 28.0	0.7 to 5.3	± 0.7	20		230k/460k/ 750k			Under voltage lock out protection	Soft start				TSSOP24	○	○
									310k/620k/ 1M										
	MB39A212	CH1 CH2 CH3 3	Buck/Boost	7.0 to 25.0	1.0 and above	± 1.0	1.5		600k			Over temperature protection	Soft start				TSSOP20	○	○
					1.23 and above	± 0.98	1.5												
						± 0.98	1.5		2.6M										
	MB39A202A	DCDC1 DCDC2 LDO5 LDO3 2	Buck/Boost	5.5 to 28	0.7 to 5.5	± 1.0	20		600k			Over temperature protection	Soft start	POWERGOOD			QFN28	Nov.2011	
					0.7 to 5.5	± 1.0	20												
					0.7 to 5.3	± 1.6	0.1												
					3.3	± 2.0*6	0.05*7												
	MB39C316	LDO1 LDO2 LDO3 LDO4 4	DC/DC+LDO	2.7 to 5.5	2.875	-2.7 to +4.4	0.2		1.7M (fix)			Under voltage lock out protection	Soft start				WL-CSP49	○	○
					1.225	± 6.2	0.26												
					1.2/1.3	± 8.4/ ± 7.7	0.084												
					2.925	± 2.6	0.0065												
	MB39C022N	DC/DC LDO 2		2.5 to 5.5	0.8 to 4.5	± 2.5	0.6		2M(fix)								SON10		○
					1.2		0.3												
	MB39C022L	DC/DC LDO 2		2.5 to 5.5	0.8 to 4.5	± 2.5	0.6		2M(fix)								SON10		
					1.8		0.3												
	MB39C022J	DC/DC LDO 2		2.5 to 5.5	0.8 to 4.5	± 2.5	0.6		2M(fix)								SON10		
					2.85		0.3												
	MB39C022G	DC/DC LDO 2		2.5 to 5.5	0.8 to 4.5	± 2.5	0.6		2M(fix)								SON10		
					3.3		0.3												
General-purpose DC/DC Converter (External FET)	MB39A123	CH1 CH2 CH3 CH4 CH5 CH6 6	DC/DC Converter for System Power Supply	1.7 to 11.0	1.0 and above	± 1.5	1.5		2M								LQFP48	○	○
					1.23 and above	± 1.0	1.5												
							1.5												
							1.5												
							1.5												
							1.5												
	MB39A112	CH1 CH2 CH3 3	DC/DC Converter for LCD Panels	7.0 to 25.0	1.0 and above	± 1.0	1.5		2.6M								TSSOP28 (with heat dissipation pad)	○	○
					1.23 and above	± 0.98	1.5												
						± 0.98	1.5												
	MB39A202A	DCDC1 DCDC2 LDO5 LDO3 2		5.5 to 28	0.7 to 5.5	± 1.0	20		600k								-	Nov.2011	
					0.7 to 5.5	± 1.0	20												
					5.0	± 1.6	0.1												
					3.3	± 2.0*6	0.05*7												
	MB39C011	VLOGIC VGL VS VGH 4	DC/DC Converter for LCD Panels	8.0 to 14.0	1.8 to 3.3	± 1.5	1.5		500K/ 750K (fix)								TSSOP28 (with heat dissipation pad)	○	○
					*1	0±35mV	0.1												
					18.1max	± 0.9	1.5												
					*1	± 2.1	0.1												
	MB39C313A MB39C313B																		
	MB39A106	Vlogic VGL VS VGH 4		8.0 to 14.0	1.8 to 3.3	± 1.5	1.5		500K/ 750K (fix)								TSSOP28 (with heat dissipation pad)	○	○
					*1	0±35mV	0.1												
					18.1max	± 0.9	1.5												
					*1	± 2.1	0.1												
	MB39C313																		
General-purpose DC/DC Converter (Internal FET)	MB39C014	1	Buck	2.5 to 5.5	0.45 to 3.6	± 4.0	0.8		2M/3.2M (fix)								SON10		○
	MB39C006A	1	Buck	2.5 to 5.5	0.45 to 3.6	± 4.0	0.8		2M/3.2M (fix)								SON10		○
	MB39C015	2	Buck	2.5 to 5.5	0.45 to 3.9	± 4.0	0.8		2M(fix)								QFN24	○	○
	MB39C007	2	Buck	2.5 to 5.5	0.45 to 3.9	± 4.0	0.8		2M(fix)								QFN24	○	○
	MB39C326	1	Buck	2.5 to 4.8	0.4 to 4.5	± 3.0	0.8		6M(fix)								WL-CSP20	Sep.2011	
Charge Control	MB39A132A	1	Buck	8.0 to 26.0	4.0 or 4.2 or Optional *4	± 0.5	4		2M								QFN32	○	○
	MB39A134	1	Buck	8.0 to 25.0	4.2 or 4.1 Optional *4	± 0.5	3		2M								TSSOP24	○	○

*1 Depends on external setting.
*2 As the current value when an external FET is attached is merely a rough guide, contact the Fujitsu Semiconductor technical department if you are exceeding the written value.
*3 Check with the sales representative for the stock status.
*4 Outputs the preset (reference voltage × cell multiplier) value from a preset function.
*5 The MB39C316 output voltage accuracy is the value in the range of Ta=-30 to 85 (°C) and output current = 0 to 30mA.
*6 The MB39A202A LDO3 output voltage accuracy is the value in the range of Ta=-5 to 85 (°C) and LDO3=0.1A(at LDO5=0A)
*7 LDO3=0.1A(at LDO5=0A)