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Power Management ICs



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.

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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.

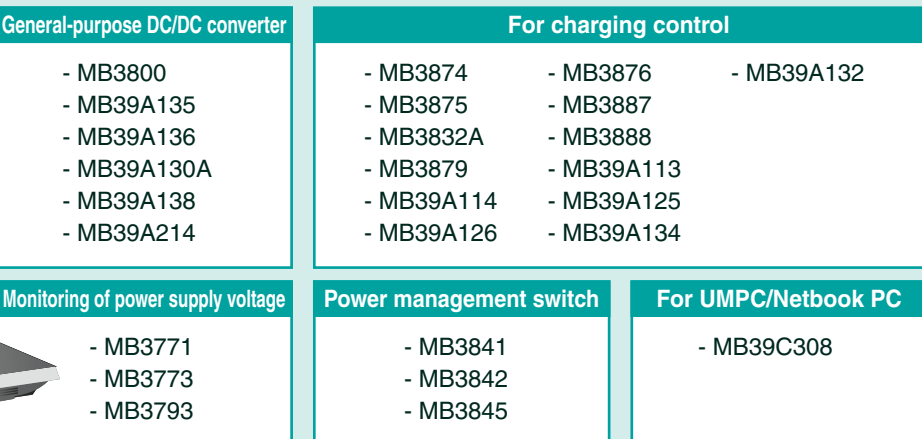


Notebook computer power management IC >>>

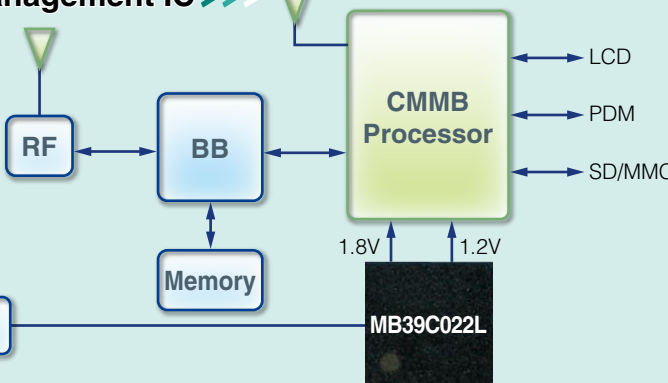
General-purpose DC/DC converter	For charging control		
- MB3800	- MB3874	- MB3876	- MB39A132
- MB39A135	- MB3875	- MB3887	
- MB39A136	- MB3832A	- MB3888	
- MB39A130A	- MB3879	- MB39A113	
- MB39A138	- MB39A114	- MB39A125	
- MB39A214	- MB39A126	- MB39A134	

Monitoring of power supply voltage	Power management switch	For UMPC/Netbook PC
- MB3771	- MB3841	- MB39C308
- MB3773	- MB3842	
- MB3793	- MB3845	


Application example



Mobile phone power management IC >>>



Application example

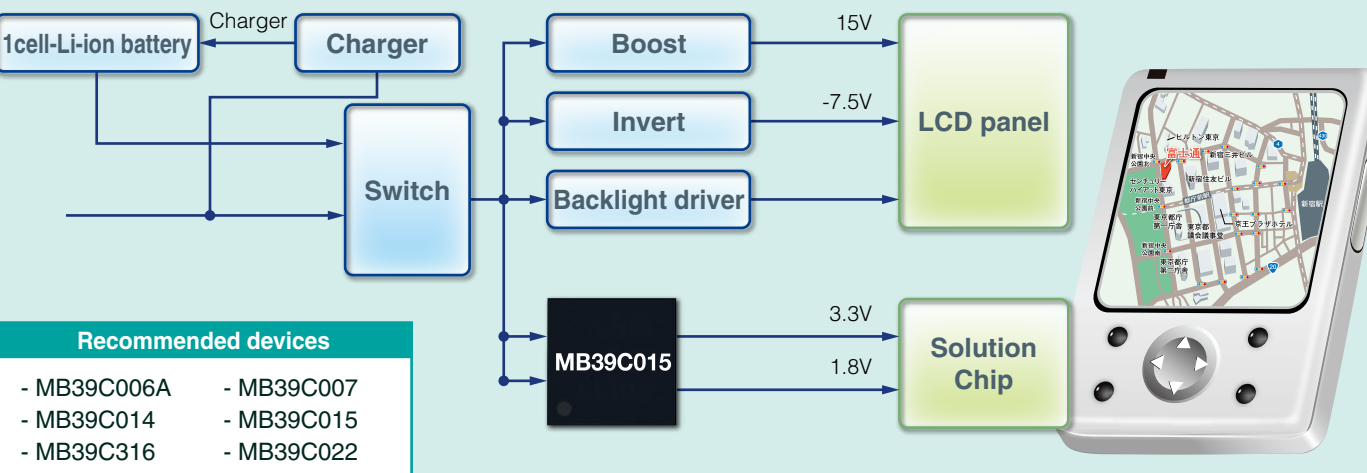


Recommended device


- MB39C022

PDM: Pulse Density Modulation

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



Application example

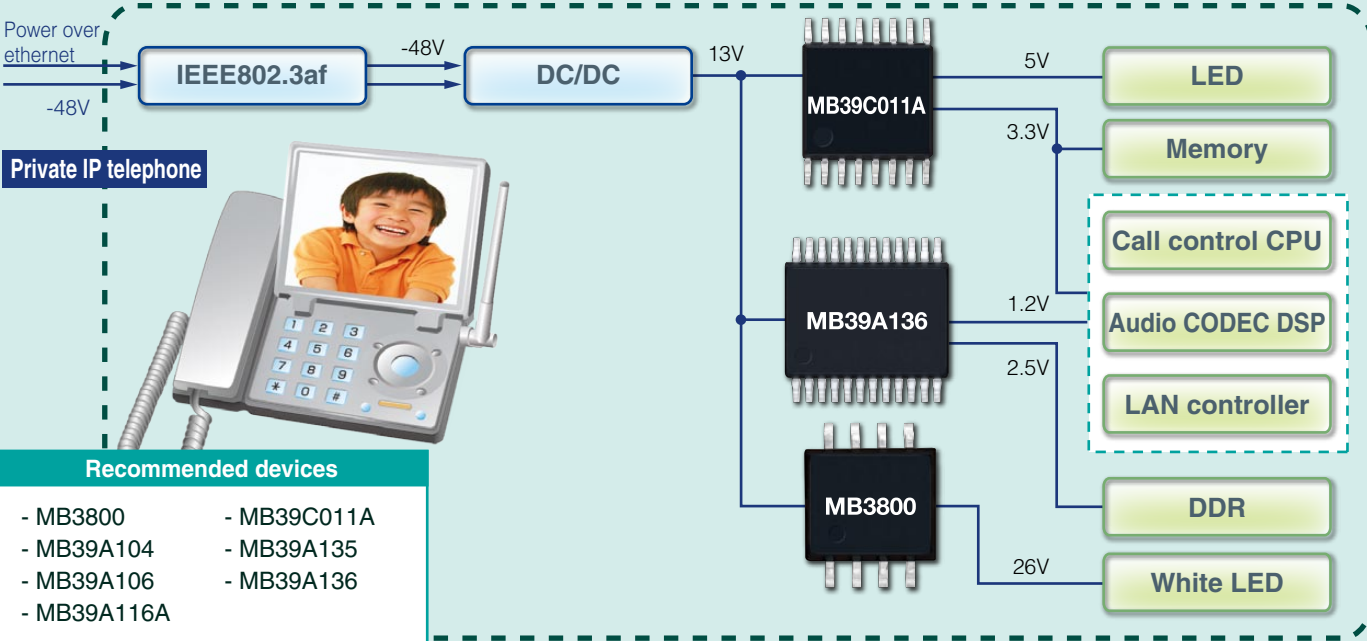


Recommended devices


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

PND: Personal Navigation Device, PMP: Portable Media Player

IP telephone power management IC >>>



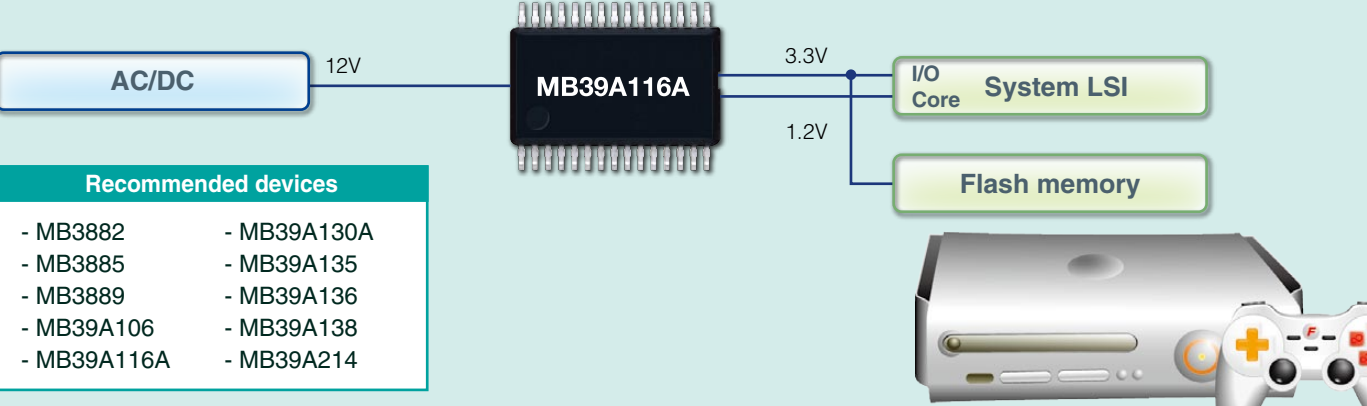
Application example




Recommended devices

- MB3800	- MB39C011A
- MB39A104	- MB39A135
- MB39A106	- MB39A136
- MB39A116A	

Game machines power management IC >>>



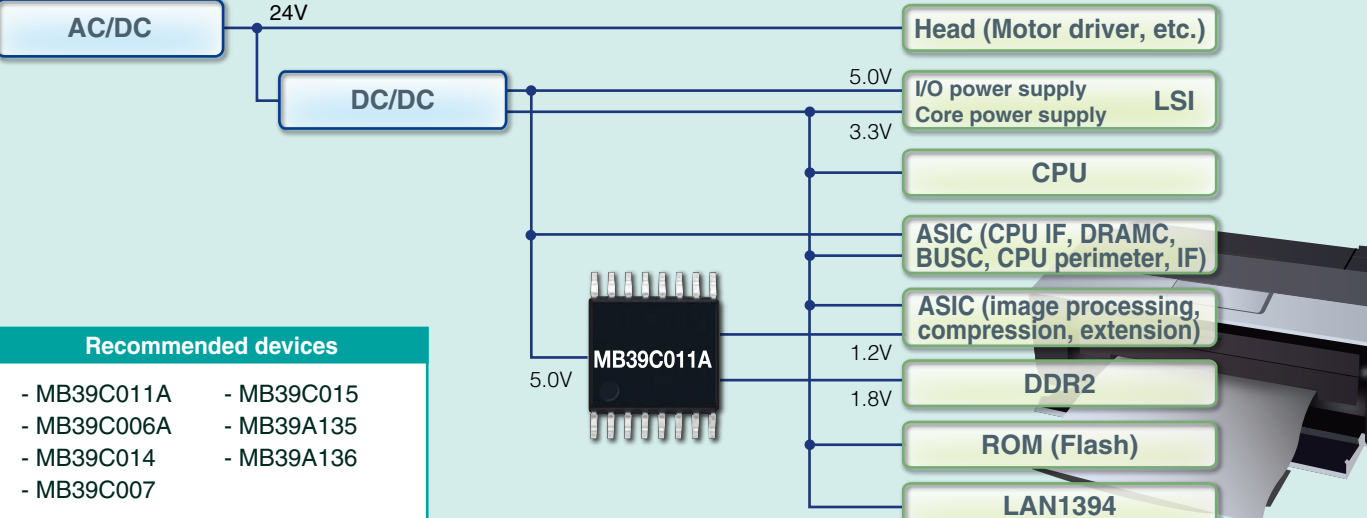
Application example




Recommended devices

- MB3882	- MB39A130A
- MB3885	- MB39A135
- MB3889	- MB39A136
- MB39A106	- MB39A138
- MB39A116A	- MB39A214

Printer power management IC >>>



Application example

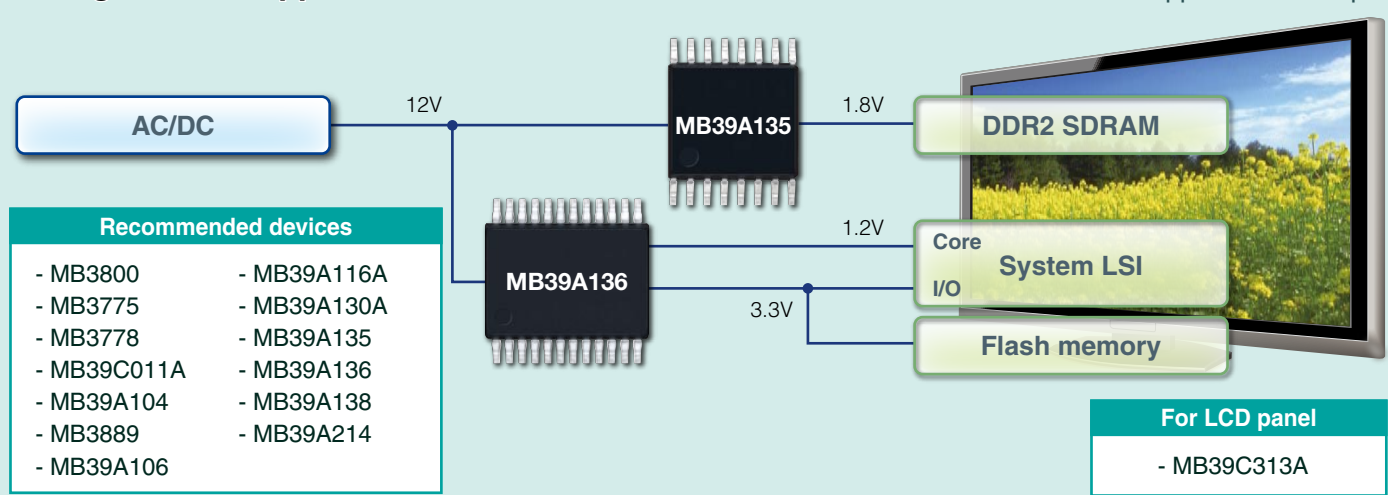


Recommended devices

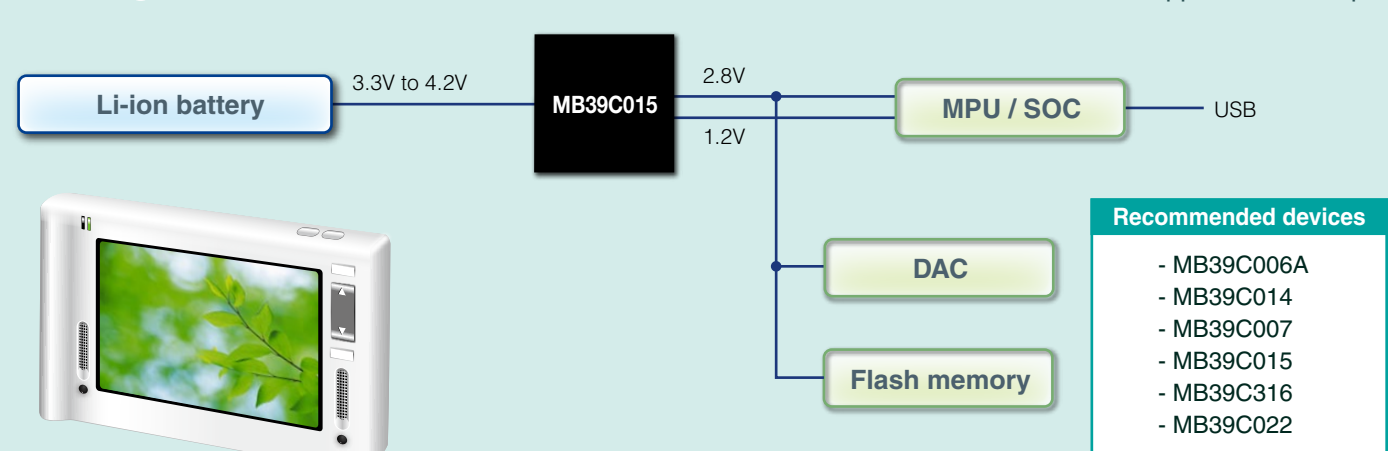
- MB39C011A	- MB39C015
- MB39C006A	- MB39A135
- MB39C014	- MB39A136
- MB39C007	

Lineup from Application

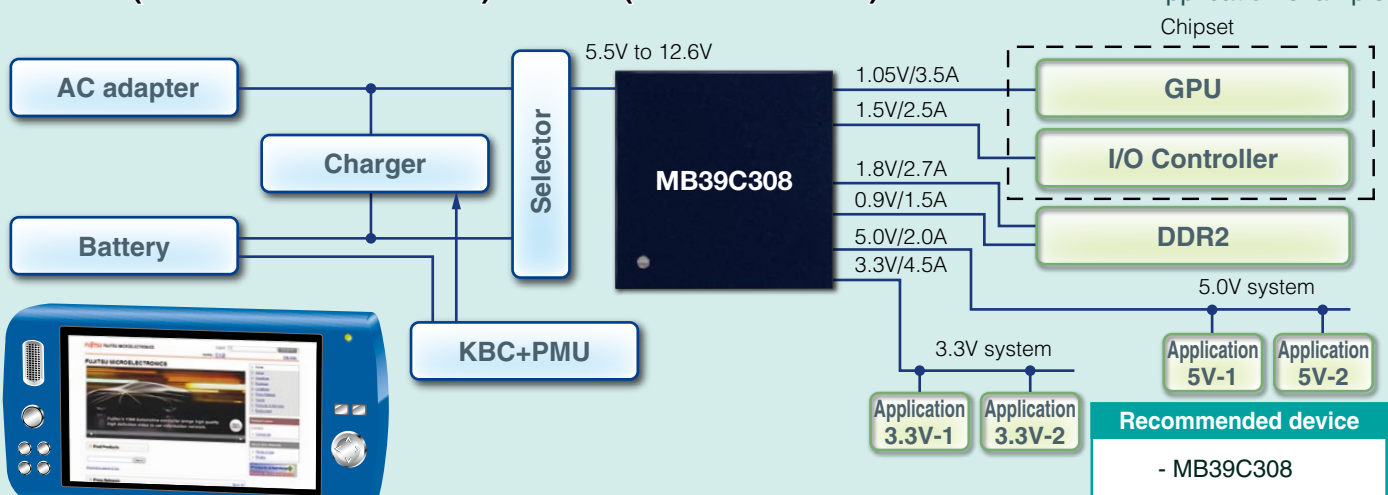
For digital home appliances >>>



For 1-Seg TV and Mobile TV >>>



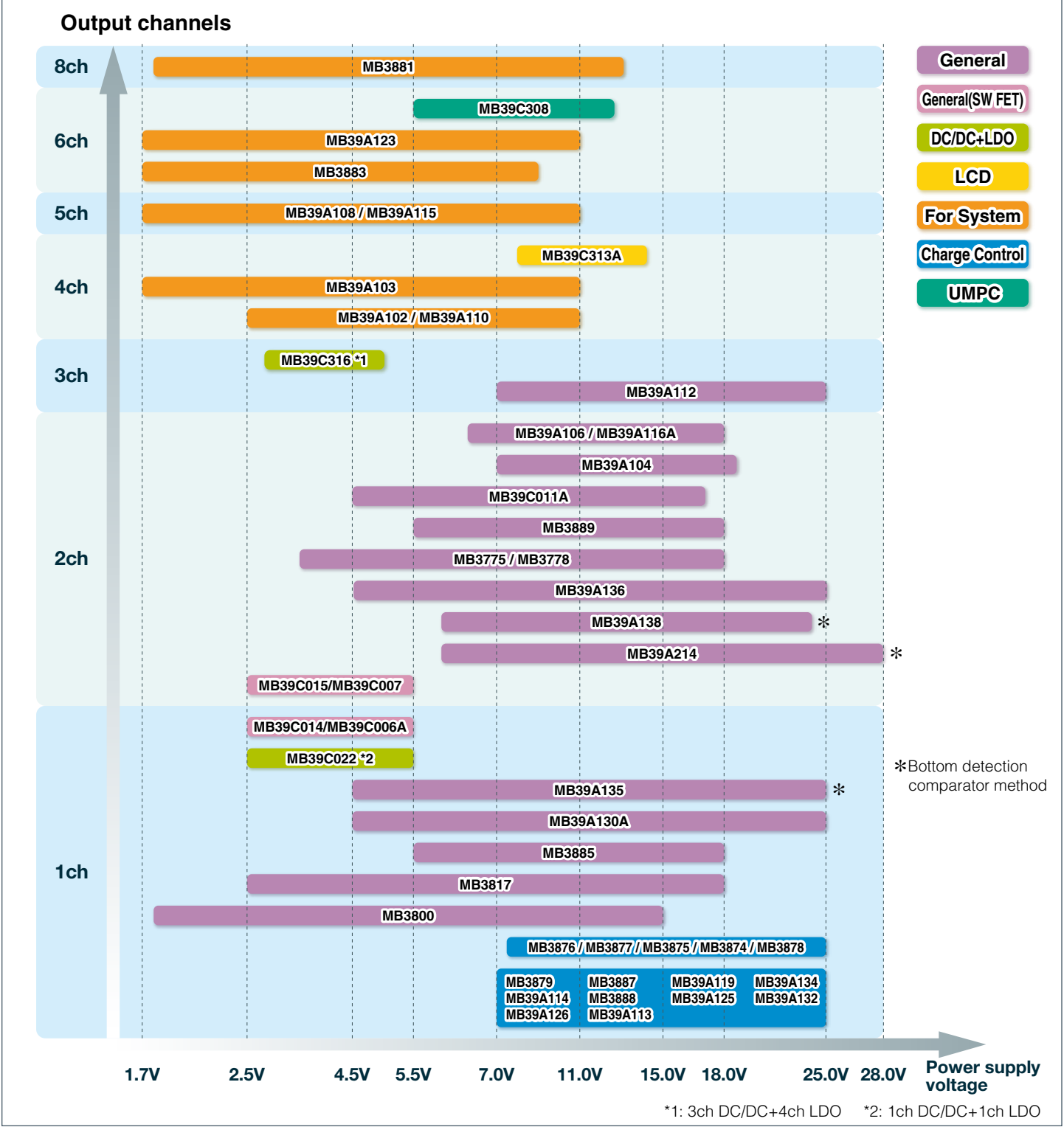
For MID (Mobile Internet Device) / UMPC (Ultra Mobile PC) >>>



PMU: Power Management Unit
GPU: Graphic Processing Unit

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 8 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)	OC OC : Overcurrent protection circuit
Boost Boost : Boost-conv.	SCP SCP : Short-circuit protection	UVP UVP : Under-voltage protection circuit

General-purpose DC/DC Converter

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	OC	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

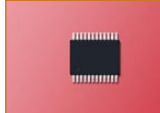
- Wide range of power supply voltage: 4.5V to 25V
- High efficiency of power conversion
- Adjustable frequency setting by an external resistor: 100kHz to 600kHz
- High accuracy reference voltage: $\pm 1.0\%$
- Output voltage setting range : 0.7V to 5V or fixed to 1.2V / 2.5V
- Adjustable output voltages setting by the external control
- Inductor saturation detection function which can be set optional
- Standby current: 0 μ A (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

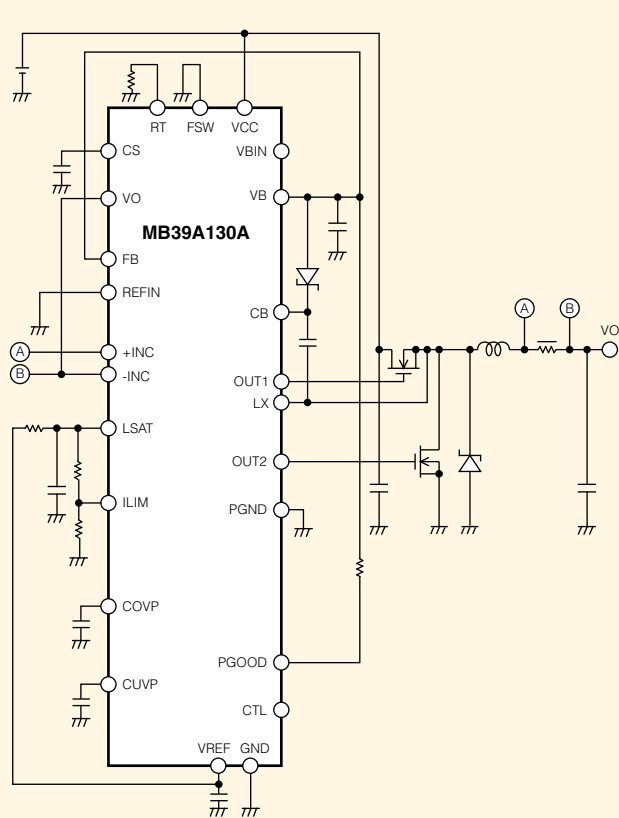
- Digital TV, Photocopiers, Projectors, STB
- Blu-ray, DVD players/recorders, Digital devices

* Technical Analysis of Bottom detection comparator method
...Refer from page 21 to page 22

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	OC	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.

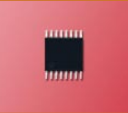
Features

- 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

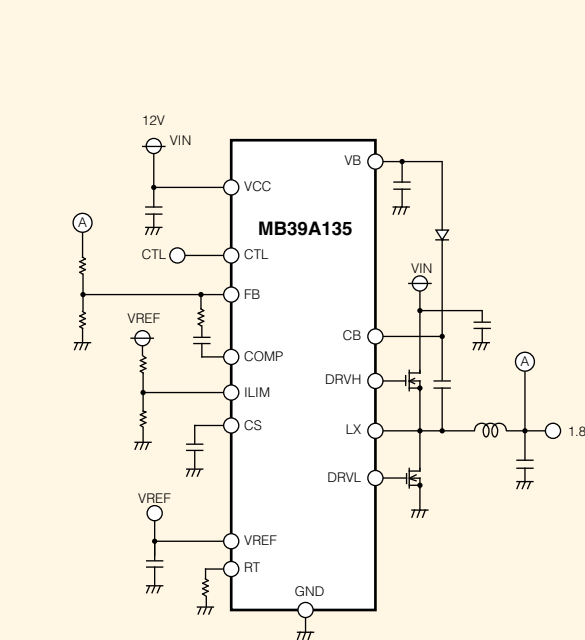
Application

- Digital TV, Digital AV devices etc.

TSSOP16



Application circuit example



► Application : P3,4,5

MB39A138 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	OC	UVP

Description

MB39A138 is a 2ch DC/DC buck converter equipped with a bottom detection comparator and N-ch/N-ch 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. MB39A138 realizes ultra-rapid response and high efficiency with built-in enhanced protection features. The MB39A138 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 24V
- High efficiency of power conversion
- Adjustable frequency setting by an external resistor: 310kHz / 465kHz
- High accuracy reference voltage: $\pm 1.0\%$
- Output voltage setting range : 0.7V to 5.2V / 2.0V to 5.2V
- Adjustable output voltages setting by the external control
- Built-in diode for boot strap
- Built-in soft-start circuit independent of loads
- Synchronous rectification type output driver for N-ch MOS FET
- Standby current: 0 μ A (typ)
- Built-in discharge control circuit

Application

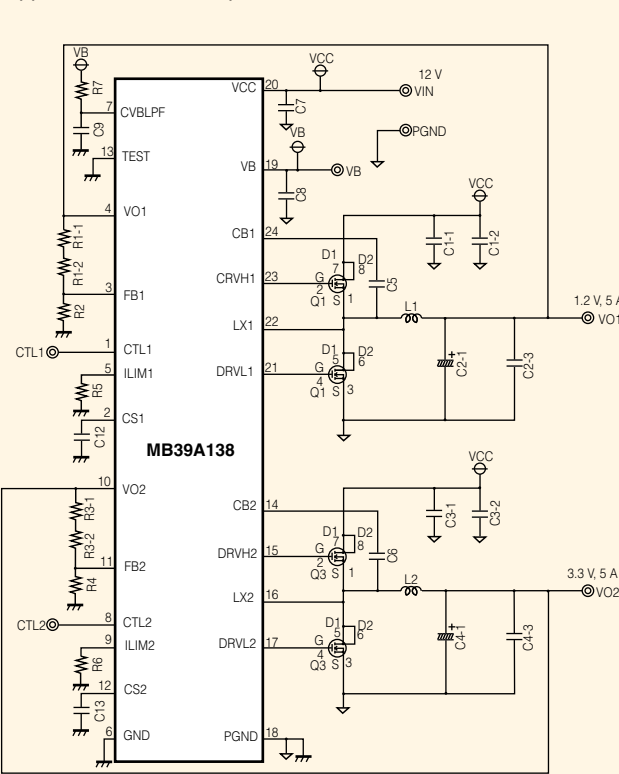
- Digital TV, Photocopiers, Projectors, STB
- Blu-ray, DVD players/recorders, Digital devices

* Technical Analysis of Bottom detection comparator method
...Refer from page 21 to page 22

TSSOP24



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	OC	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

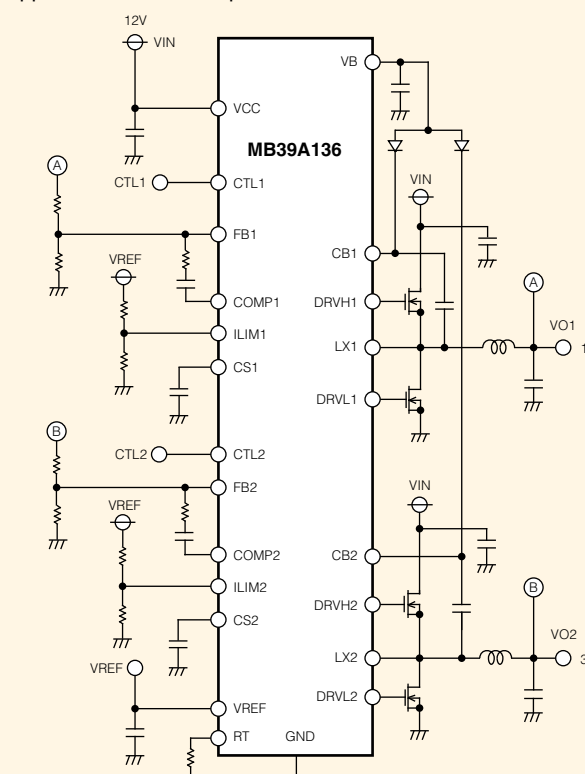
Application

- Digital TV, Digital AV devices etc.

TSSOP24



Application circuit example



► Application : P3,4,5

General-purpose DC/DC Converter

MB39C011A Nch/Pch 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	OCF	UVP

Description

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

Features

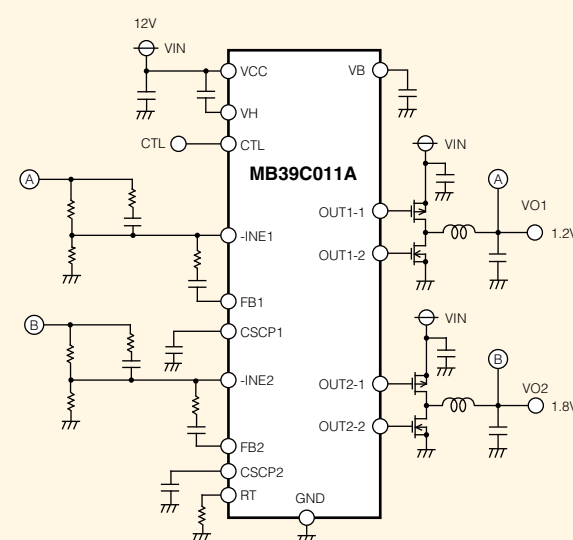
- Wide range of power supply voltage: 4.5V to 17V
- High frequency operation: 100kHz to 2.0MHz
- Any output voltage setting by external resistor
- Built-in soft-start circuit
- Supporting ceramic condensers

Application

- For various electronic devices including digital AV devices



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	OCF	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

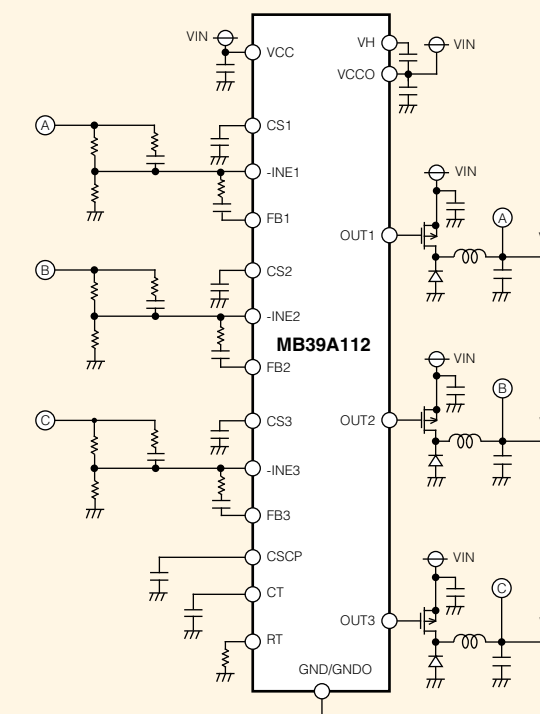
- Wide range of power supply voltage: 7V to 25V
- High frequency operation: 250kHz to 2.6MHz
- Any output voltage setting by external resistor
- Built-in soft-start circuit
- Supporting ceramic condensers

Application

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



Application circuit example



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	OCF	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

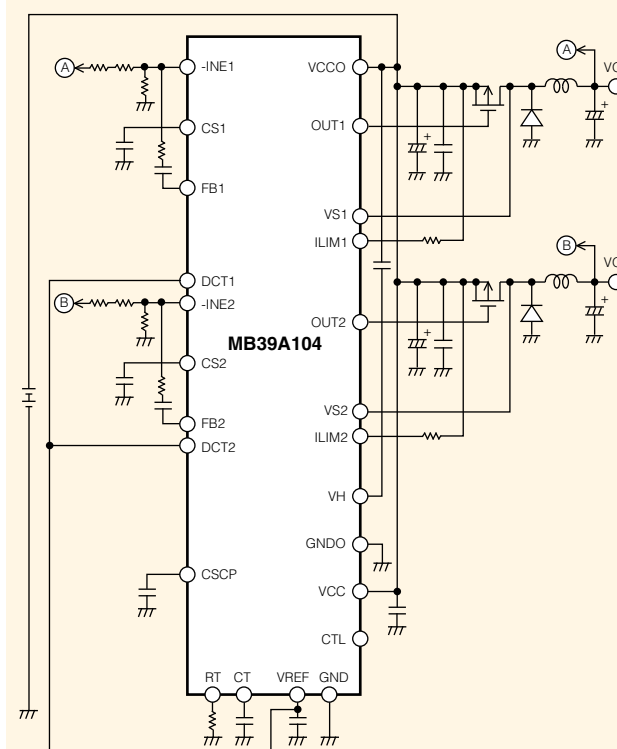
- Power supply voltage range : 7V to 19V
- Reference voltage : 5.0V±1%
- Error amplifier threshold voltage : 1.24V±1%
- High-frequency operation capability : 1.5MHz (max)
- Built-in standby function: 0μA (Typ)
- Built-in soft-start circuit independent of loads
- Built-in totem-pole type output for P-ch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

Application

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



Application circuit example



► Application : P4,5

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	OCF	UVP

Description

MB39A214 is a 2ch DC/DC buck converter equipped with a bottom detection comparator for low output voltage ripple and N-ch/N-ch 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

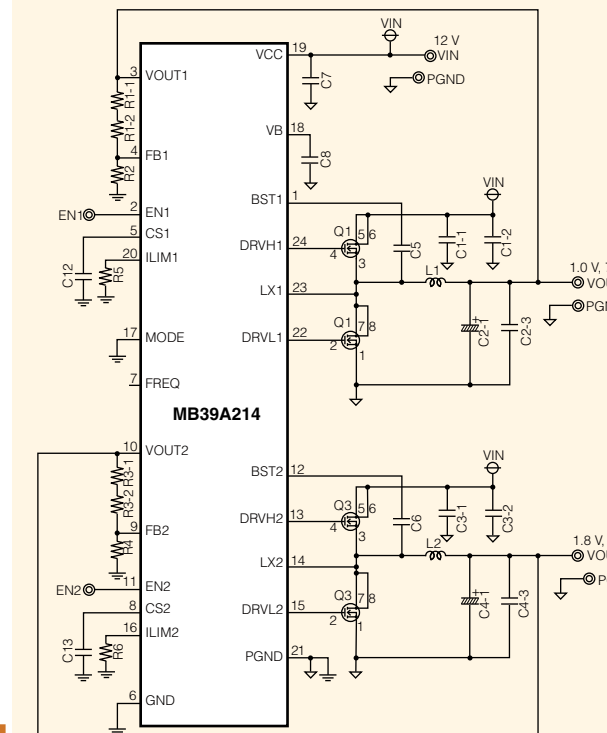
- Wide range of power supply voltage: 6V to 28V
- High efficiency of power conversion
- Frequency setting by internal preset function: 310kHz / 620kHz / 1000kHz
- High accuracy reference voltage: ±0.7%
- Output voltage setting range: 0.7V to 5.3V
- Possible to select the automatic PFM/PWM selection mode 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



Application circuit example



► Application : P3,4,5

DC/DC Converter with Switching FET

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	OC	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

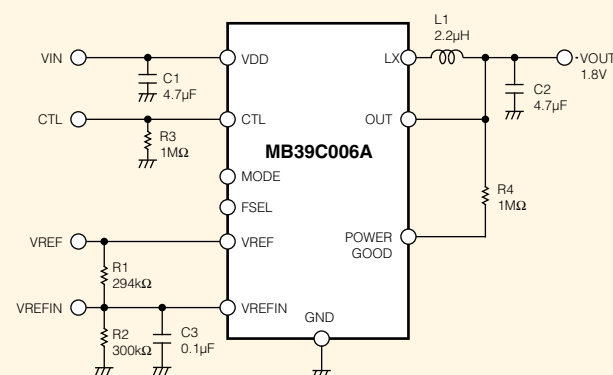
- Surveillance camera, photograph printer etc.
- Portable device such as 1-seg TV & 3-seg Radio etc.
- DVD Recorder, Hard Disk Recorder etc.

SON10



► Application : P3,4,5

Application circuit example



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	OC	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

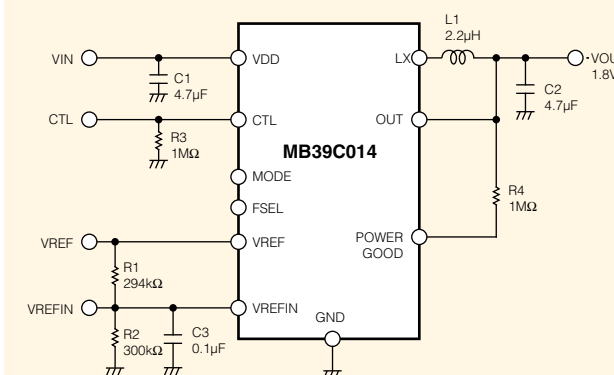
- Surveillance camera, photograph printer etc.
- Portable device such as 1-seg TV & 3-seg Radio etc.
- DVD Recorder, Hard Disk Recorder etc.

SON10



► Application : P3,4,5

Application circuit example



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	OC	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

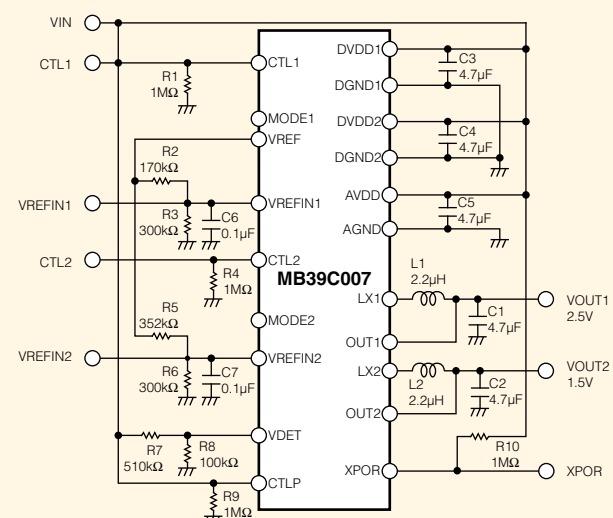
- Portable device, DVD recorder
- IP-Phone, Equipment of PLC etc.

QFN24



► Application : P3,4,5

Application circuit example



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	OC	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

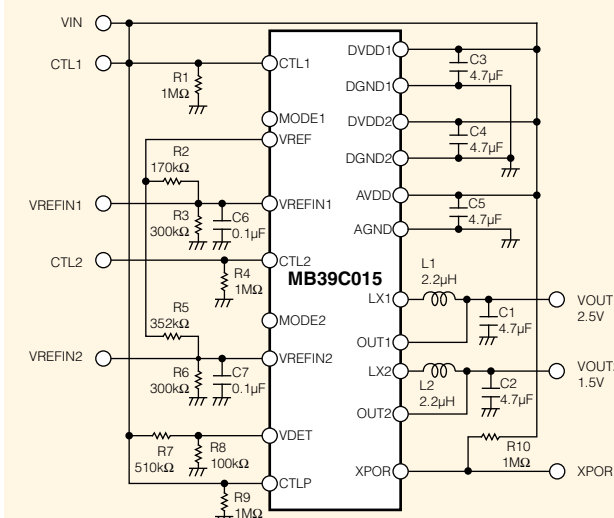
- Portable device, DVD recorder
- IP-Phone, Equipment of PLC etc.

QFN24



► Application : P3,4,5

Application circuit example



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
						Buck	Boost	Invert		
MB3817	1	500	+2.5 to +18	±2	SSOP16	⊙	○	⊙	Not available	Soft-start circuit, timer-latch short-circuit protection
MB3885	1	500	+5.5 to +18	±1	SSOP20	⊙	—	—	Available	N/N synchronous rectification, overvoltage protection, soft-start circuit, timer-latch short-circuit protection
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, low-voltage protection, overcurrent control circuit, over-temperature protection, soft-start circuit, soft-stop circuit
MB3775	2	500	+3.6 to +18	±1.5	SOP16, SSOP16	⊙	○	⊙	Not available	Open corrector, timer-latch short-circuit protection
MB3778	2	500	+3.6 to +18	±2	SOP16, SSOP16	⊙	○	⊙	Not available	Open corrector, timer-latch short-circuit protection
MB3882	2	500	+5.5 to +18	±1	SSOP24	⊙	—	—	Not available	N/N synchronous rectification, soft-start circuit, timer-latch short-circuit protection, overvoltage protection
MB3889	2	500	+5.5 to +18	±1	TSSOP30	⊙	—	—	Available	N/N synchronous rectification, timer-latch overvoltage protection, timer-latch overcurrent protection, soft-start circuit, soft-stop circuit, POWERGOOD circuit, symmetrical-phase mode
MB39A106	2	500	+6.5 to +18	±1	TSSOP30	⊙	—	—	Available	N/N synchronous rectification, built-in boot-strap diode, timer-latch overvoltage protection, timer-latch overcurrent protection, soft-start circuit, soft-stop circuit, POWERGOOD circuit, symmetrical-phase mode
MB39A116A	2	500	+6.5 to +18	±1	TSSOP30	⊙	—	—	Available	N/N synchronous rectification, built-in boot-strap diode, overvoltage protection, timer-latch overcurrent protection, soft-start circuit, soft-stop circuit, POWERGOOD circuit, symmetrical-phase mode
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, low-voltage protection, overcurrent control circuit, over-temperature protection, soft-start circuit, soft-stop circuit
MB39A138	2	310/465	+6.0 to +24.0	±1	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, built-in boot-strap diode
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
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 Frequency

Lineup of DC/DC Converter with Switching FET

Model	Number of channels ch	Switching frequency MHz	Output voltage		Power supply voltage V	Output current (max) mA	Switching FET		Package	Topology	Remarks
			(Typ) V	Accuracy %			Pch MOS (typ)Ω	Nch MOS (typ)Ω			
MB39C014	1	2/3.2 (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	2/3.2 (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	2 (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	2 (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.

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	OCF	UVP

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

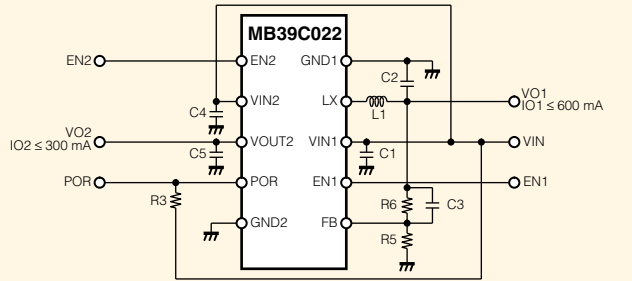
- Power supply voltage range: 2.5V to 5.5V
Supporting 1-cell Li-ion Battery
- Function of DC/DC circuit:
PFM/PWM mode: Improving efficiency under light load
Current mode: High-speed load response
- Output voltage/current of DC/DC block:
Voltage setting range: 0.8V to 4.5V
Current: 600mA (Max.)
- Output 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
3.0mmx3.0mmx0.75mm (lead pitch 0.5mm)

Application

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

* Product Analysis of this product
...Refer from page 23 to page 24

Application circuit example



Application : P3,5

SON10



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	OCF	UVP

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

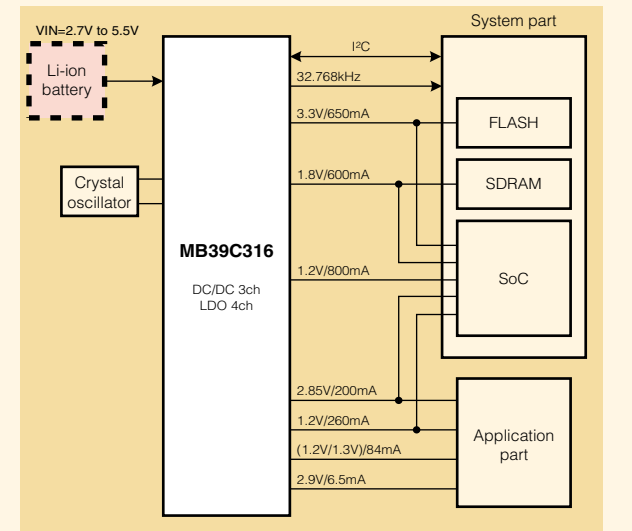
Application

- 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)



System configuration of Mobile Terminals



Application : P3,5

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			

DC/DC Converter for LCD Panels

MB39C313A 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

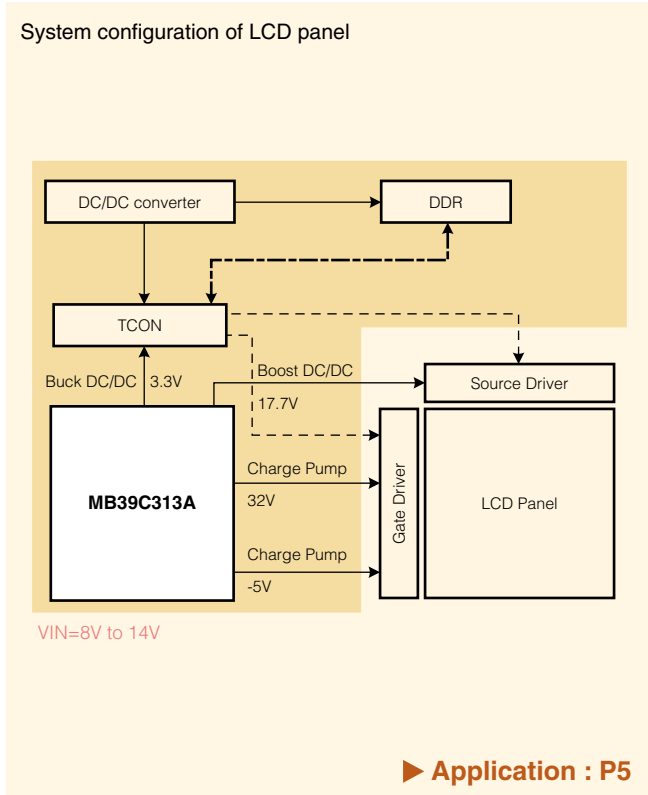
OCF

UVP

Description
MB39C313A 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

- Application**
- Large size LCD panel

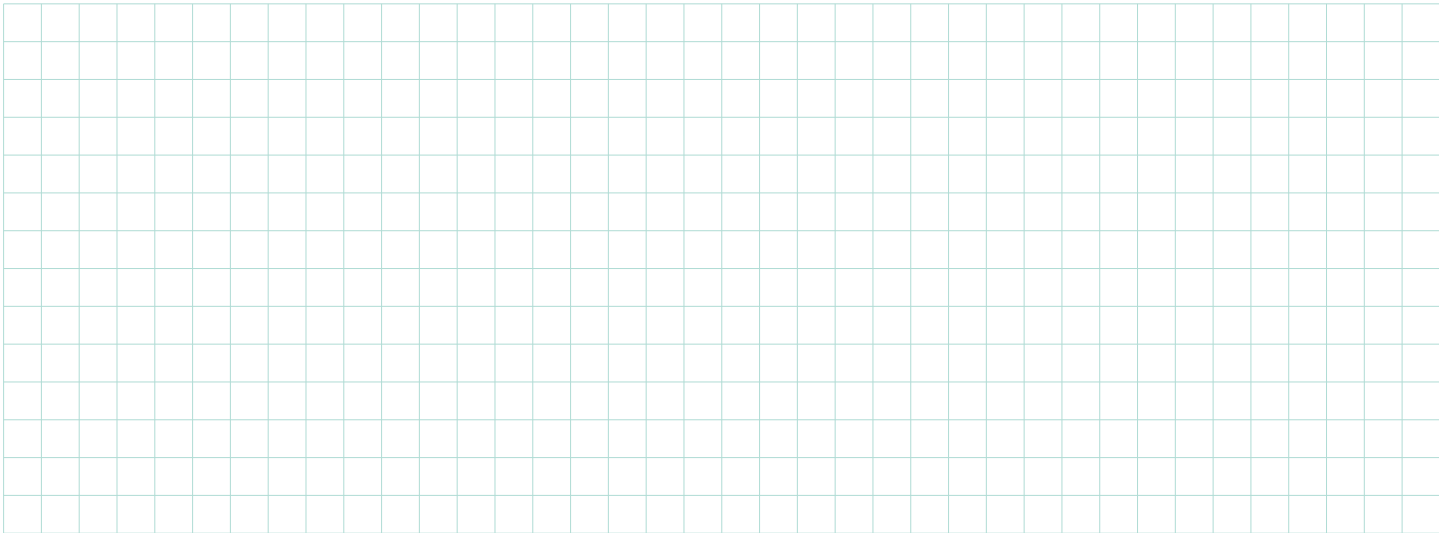


Lineup of DC/DC Converter for LCD Panels

Model	Number of channels ch	Switching frequency (fixed)MHz	Power supply voltage V	Output features						Package	Remarks
				Pin name	Structure	Error amplifier threshold voltage V	Accuracy %	Output voltage V	FET	Output current A	
MB39C313A	4	500/750	+8 to +14	Vlogic	Buck DC/DC	1.213	1.5	1.8 to 3.3	Internal	1.5	soft-start circuit, sequence comparator, short-circuit protection, overvoltage protection, overcurrent protection, over-temperature protection
				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



DC/DC Converter for UMPC

MB39C308 6ch DC/DC Buck Converter IC for LPIA Platform

High efficiency

6ch

Buck

B/B

Boost

Inv

FET

3.5A

SCP

OTP

OVP

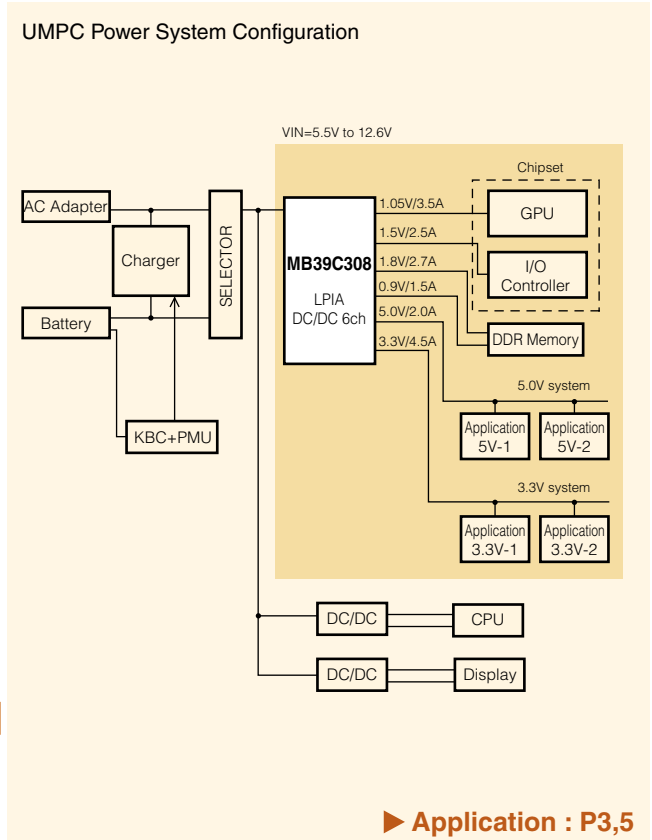
OCF

UVP

Description
MB39C308 is a 6ch DC/DC buck converter LSI supporting the 2008 version of LPIA platform. This LSI supplies power to the system(*), memory, and chipsets in UMPCs, and minimizes the PCB area of power solution. The increased efficiency of power supply of this LSI can contribute to extending the UMPC's battery life.
*: Various applications, such as wireless LAN

- Features**
- Intel conformity (LPIA)
 - Current mode topology with Nch/Nch synchronous rectification
 - High efficiency: 90% (max)
 - Power supply voltage range: 5.5V to 12.6V
 - Preset output voltage
 - Integrated FET Driver for external MOS FETs (2ch)
 - Internal switching FET (4ch)

- Application**
- Ultra Mobile PC (UMPC)
 - Mobile Internet Device (MID)
 - Mobile equipment

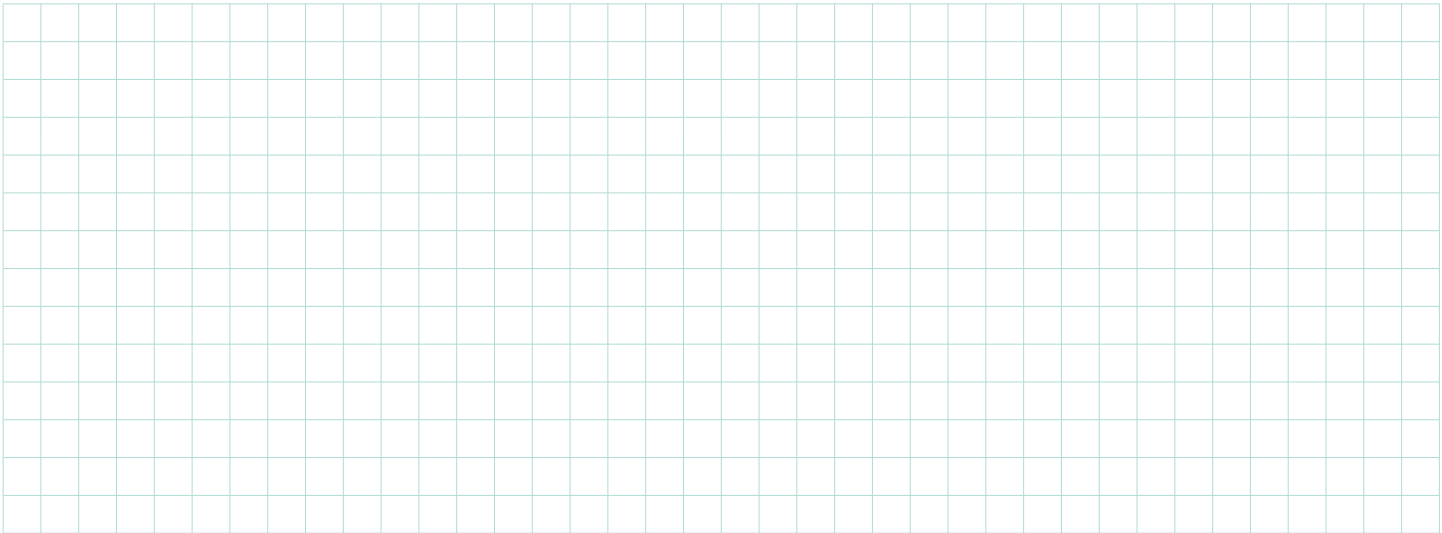


DC/DC Converter for UMPC

Model	Number of channels ch	Operating oscillation frequency kHz	Power supply voltage V	Output features				Topology	Package	Remarks
				Pin name	Preset voltage V	FET	Drive current/output current A(max)			
MB39C308	6	700 (fixed)	+5.5 to +12.6	CH1	5	External	2	Buck	PFBGA208	Support for LPIA platform, Current mode topology with Nch/Nch synchronous rectification, soft start function/soft stopfunction, POWERGOOD function, substantial protective functions (SCP/OTP/OVP/OCF/UVLO/IVP)
				CH2	3.3		4.5			
				CH3	1.8/1.5		2.7			
				CH4	0.9/0.75	Internal	1.5			
				CH8	1.5		2.5			
				CH6	1.1/1.05		3.5			

LPIA=Low Power Intel Architecture®

Memo



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.

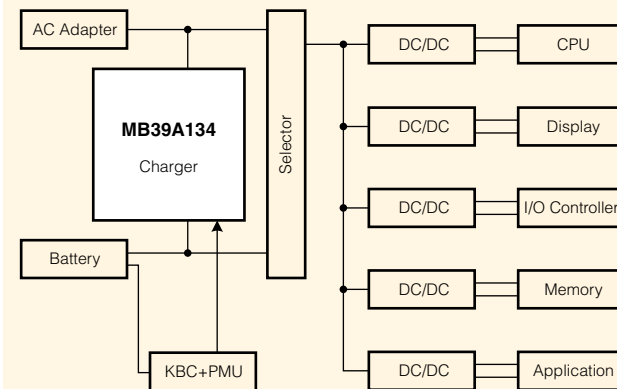
■ Features

- 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: $\pm 0.7\%$ ($T_a = -10^\circ\text{C}$ to $+85^\circ\text{C}$)
- Charging voltage can be set without externally attached resistor
- Charging current can be set without externally attached resistor
- High accuracy current detection amplifier ($\pm 1\%$)
(At input voltage difference 100mV)

Application TSSOP24

- Charging device in products such as Notebook PC

* Technical Analysis of this product
 ...Refer from page 25 to page 26



► Application : P3



MB39A132 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

MB39A132 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.

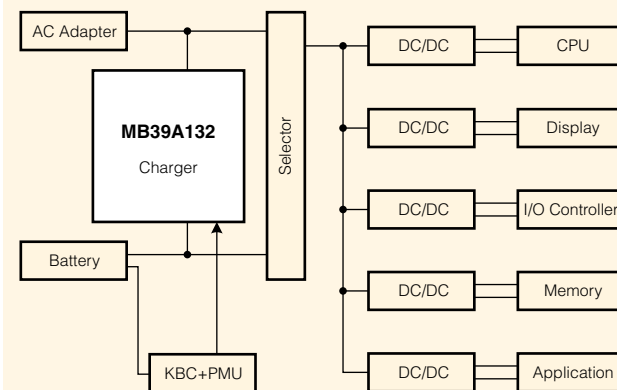
■ Features

- 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: $\pm 0.5\%$ ($T_a = +25^\circ\text{C}$ to $+85^\circ\text{C}$)
- Charging voltage can be set without externally attached resistor
- Charging current can be set without externally attached resistor
- High accuracy current detection amplifier ($\pm 1\%$)
(At input voltage difference 100mV)

■ Application QFN32

- Charging device in products such as Notebook PC

* Technical Analysis of this product
 ...Refer from page 25 to page 26



► Application : P3



Lineup of Charge Control

Model	Switching frequency (max)kHz	Power supply voltage V	Output voltage V	Accuracy %		Package	Topology	FET compatible	Remarks
				Ta=25°C	Ta=30 to 85°C				
MB3876	500	+7 to +25	16.8	±0.8	±1.0	SSOP24	Buck	Available	4-cell, parallel charging, dynamically controlled charging
MB3877	500	+7 to +25	16.8	±0.8	±1.0	SSOP24	Buck	Available	4-cell, dynamically controlled charging
MB3879	500	+8 to +25	12.6/16.8 12.3/16.4	±0.8 ±0.9	±1.0 ±1.1	LQFP48	Buck	Available	Supports 3/4 cells, 2-mode charging possible (dynamically controlled charging, differential charging)
MB39A114	500	+8 to +25	12.6/16.8	±0.5	±0.74*1	SSOP24	Buck	Available	3/4 cells, 2-mode constant current control circuit, under-voltage protection function, constant voltage control function enables detection of false full charge, built-in function to detect overvoltage in charging voltage, built-in output setting resistor, built-in function to switch output setting voltage
MB39A126	500	+8 to +25	12.6/16.8	±0.6	±0.8*1	SSOP24, QFN28	Buck	Available	3/4 cells, dynamically controlled charging, ACOK function included
MB3875	500	+7 to +25	12.6	±0.8	±1.0	SSOP24	Buck	Available	3-cell, dynamically controlled charging
MB3874	500	+7 to +25	12.6	±0.8	±1.0	SSOP24	Buck	Available	3-cell, parallel charging, dynamically controlled charging
MB3832A	500	+3.6 to +18	Optional	±0.5	±1.0*1	SSOP20	Buck	Available	1 to 3 cells, Output voltage can be set externally
MB3878	500	+7 to +25	4.2/cell	±0.8	±1.0	SSOP24	Buck	Available	1 to 4 cells, dynamically controlled charging
MB3887	500	+8 to +25	4.2/cell	+0.6 -0.4	±0.74*1	SSOP24	Buck	Available	1 to 4 cells, dynamically controlled charging, high-charging current accuracy
MB3888	500	+8 to +25	Optional	±0.5	±0.74*1	SSOP20	Buck	Available	1 to 4 cells, high-charging current accuracy
MB39A113	500	+8 to +25	4.2/cell	±0.5	±0.74*1	SSOP24	Buck	Available	1 to 4 cells, built-in 2-mode constant current control circuit, built-in low-voltage protection function, constant voltage control function enables detection of false full charge, built-in function to detect overvoltage in charging voltage
MB39A119	1000	+8 to +25	4.2/cell	±0.5	±0.74*1	QFN28	Buck	Available	1 to 4 cells, built-in 2 mode constant current control circuit, built-in AC adaptor detection function, built-in off time control function, constant voltage control function enables detection of false full charge, synchronous rectification for Nch MOS FET
MB39A125	500	+8 to +25	4.2/cell	±0.5	±0.74*1	SSOP24, QFN28P	Buck	Available	1 to 4 cells, dynamically controlled charging, ACOK function included
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
MB39A132	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: $T_a = 25$ to $+85^\circ\text{C}$

Memo

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

OCF

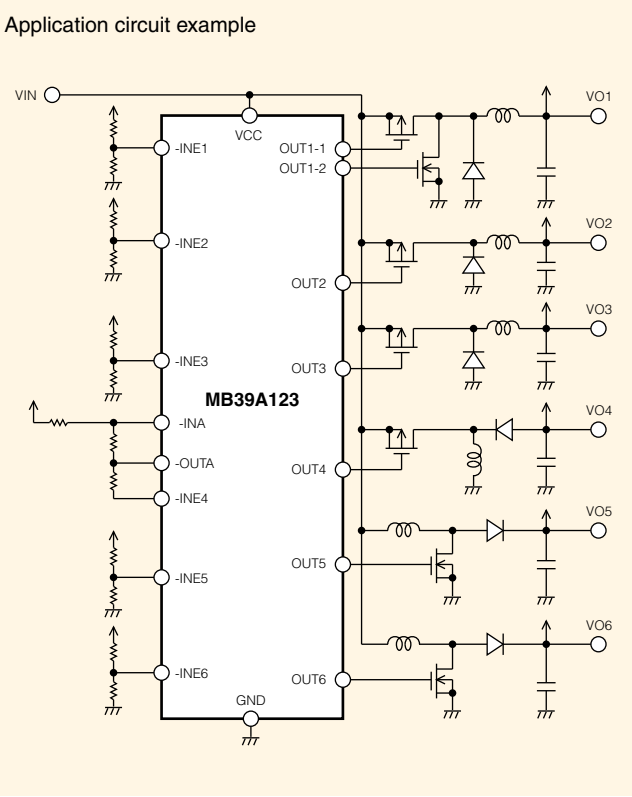
UVP

- 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



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				FET compatible	Remarks
						Buck	Buck/Boost	Boost	Inverter		
MB39A102	4	1500	+2.5 to +11	±1	TSSOP30	○	○	○	—	Available	Individual channel control, soft-start function, support for external input short-circuit detection
MB39A103	4	1500	+1.7 to +11	±1	TSSOP30	○	○	○	—	Available	Low-voltage operation possible, individual channel control, soft-start function, support for external input short-circuit detection
MB39A110	4	2000	+2.5 to +11	±1	TSSOP38	○	○	○	—	Available	Synchronous rectification, individual channel control, soft-start function, support for external input short-circuit detection
MB39A108	5	2000	+1.7 to +11	±1	TSSOP38	○	○	○	—	Available	Low-voltage operation possible, synchronous rectification, individual channel control, soft-start function, support for external input short-circuit detection
MB39A115	5	2000	+1.7 to +11	±1	TSSOP38	○	○	○	—	Available	Low-voltage operation possible, synchronous rectification, individual channel control, soft-start function, support for external input short-circuit detection
MB3883	6	1000	+1.7 to +9	±1	LQFP48	○	○	○	—	Available	Low-voltage operation possible, synchronous rectification
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
MB3881	8	800	+1.8 to +13	±1	LQFP64	○	○	—	○	Available	Synchronous rectification, external synchronization support possible

For portable devices such as DSC and DVC.
* ○ : Recommended ○ : Possible with the addition of outside parts

Power Voltage Monitoring Applications

MB3793 Power voltage monitoring IC with dual-system watchdog timer

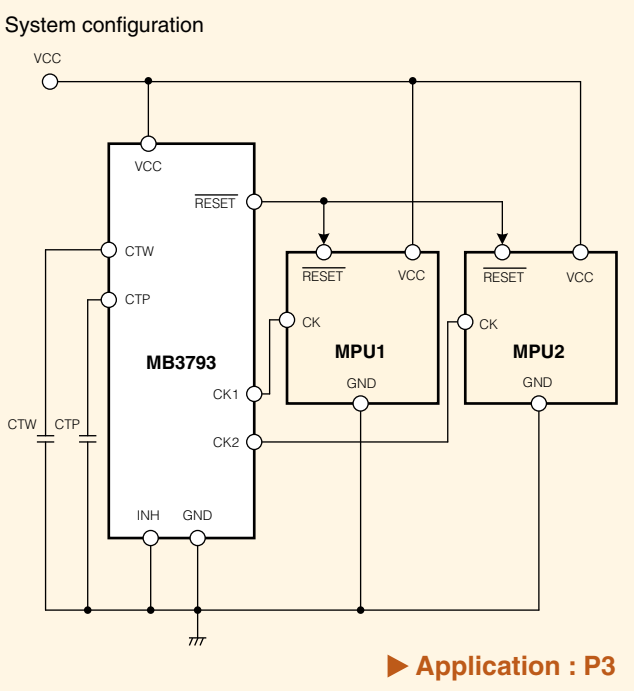
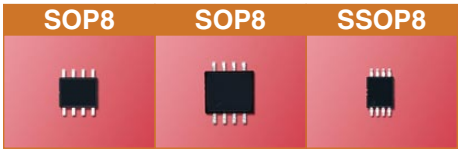
Built-in Watchdog timer

- 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.



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)	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

MB39A130A,MB39A138

"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. There are two products "MB39A130A and MB39A138" as a product that adopts this 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

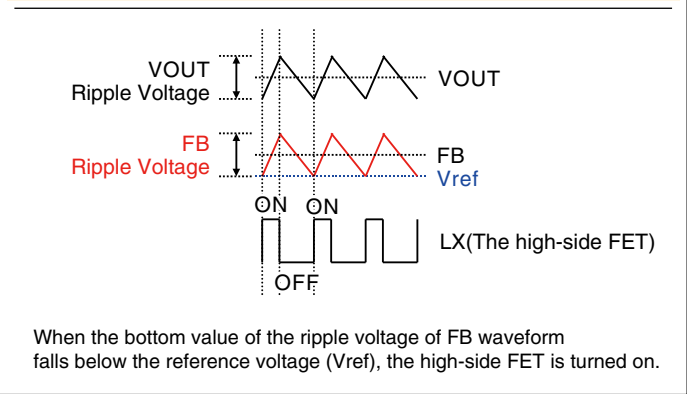
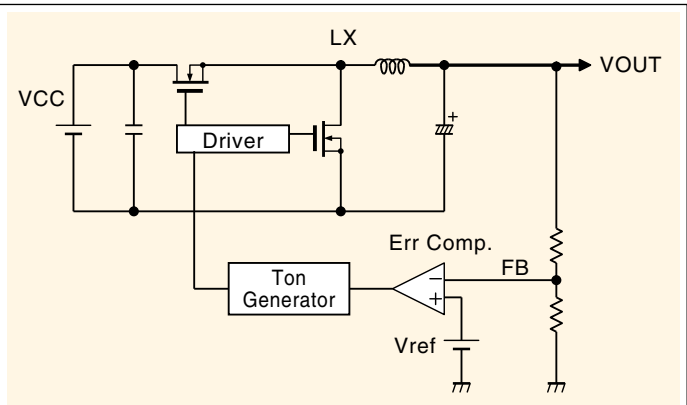
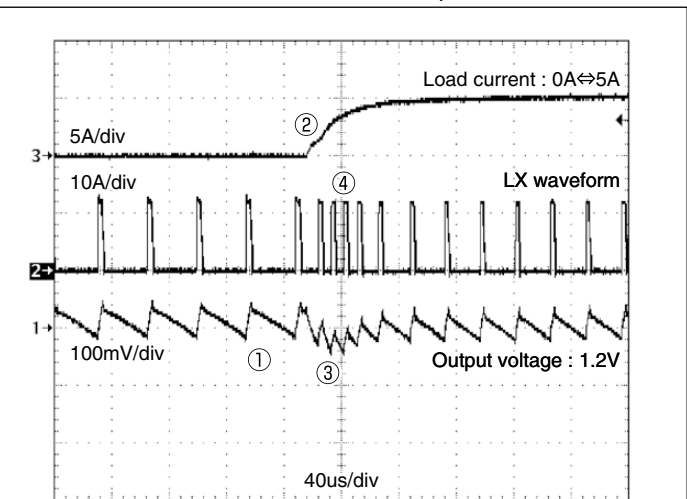
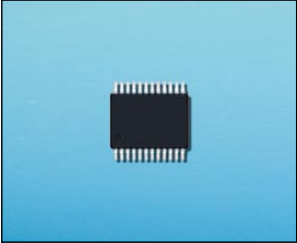


Figure 2 Load Fluctuation Waveform for the Bottom Detection Comparator Method



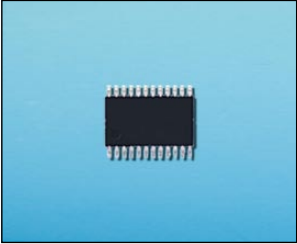
- ① Stationary state: Stable load current and output voltage
- ② Load fluctuation: Rapid increase in load current
- ③ Output voltage fluctuation: Undershooting of output voltage due to rapid load fluctuation
- ④ Switching control: Output voltage is recovered by changing the off period and implementing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

MB39A130A External View



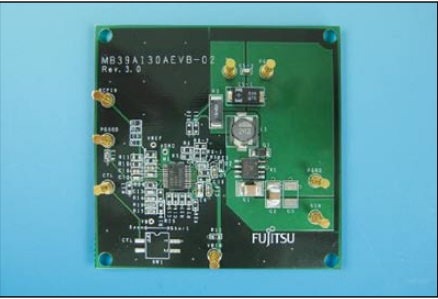
4.4×6.5×1.1mm
(0.5mm Lead Pitch)

MB39A138 External View



4.4×7.8×1.2mm
(0.65mm Lead Pitch)

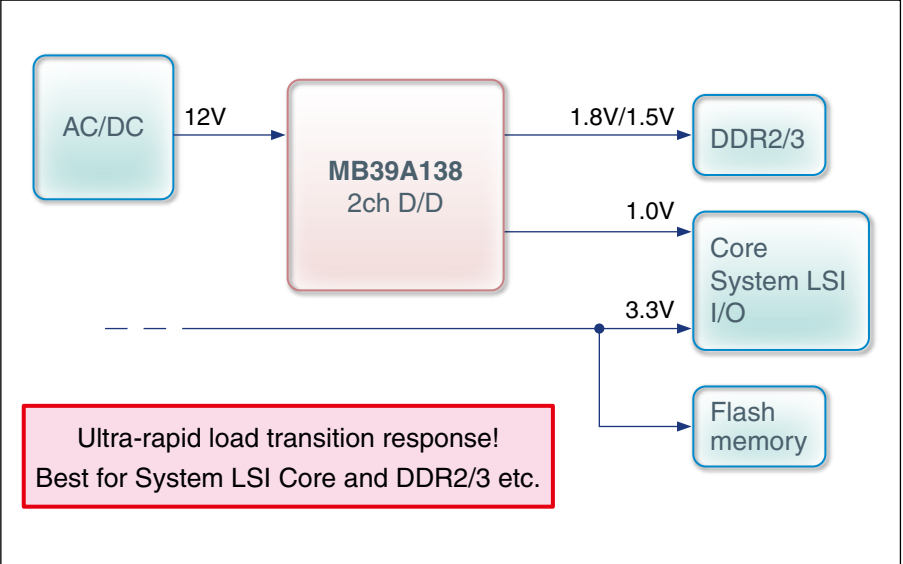
Evaluation Board MB39A130A



Evaluation Board MB39A138



Application Example



Comparison table of Bottom detection comparator method DC/DC converter IC

Specification Item	MB39A130A	MB39A138
Topology	Synchronous Rectification Buck Converter	
External FET	Nch/Nch	
Number of output channels	1-channel	2-channel
Maximum Ratings	27V	26V
Power supply voltage	4.5V to 25V	6.0V to 24V
Output voltage	0.7V to 5.0V Setting by an external resistor or 1.2V/2.5V	CH1 : 0.7V to 5.2V CH2 : 2.0V to 5.2V Setting by an external resistor
Reference voltage and accuracy	0.7V±1%	CH1 : 0.7V±1.0% CH2 : 2.0V±1.0%
Applicable output condenser	Aluminum Solid Capacitors with Organic Semiconductive Electrolyte Conductive Polymer	
Switching frequency	100kHz to 600kHz Setting by an external resistor	CH1 : 310kHz CH2 : 465 kHz fixed
POWERGOOD	○	-
Startup / Shutdown	Soft-Start/ Internal FET for Discharge	
Protection Function	UVLO	○
	Over Current Protection	○
	Over Voltage Protection	○
	Under Voltage Protection	○
	Inductor saturation detection	-
Package	TSSOP-24 4.4×6.5×1.1mm (0.5mm Lead Pitch)	TSSOP-24 4.4×7.8×1.2mm (0.65mm Lead Pitch)

·MB39A130A (1-channel)/ MB39A138(2-channel) ... Refer to page 7

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.

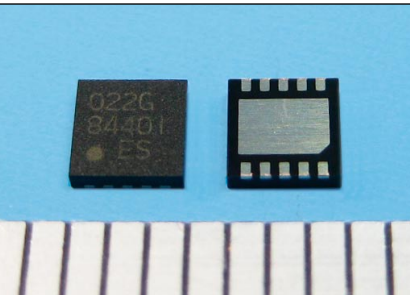
Introduction

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 lockout (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.

Output 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.

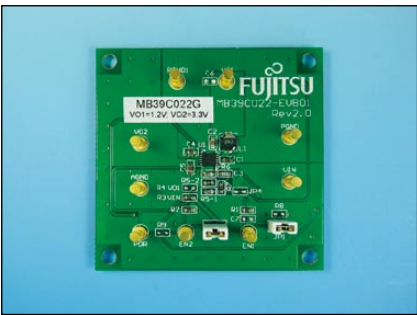
■ Table 1 Output Settings and Power Supply Rejection Ratio (PSRR) of the LDO block

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



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

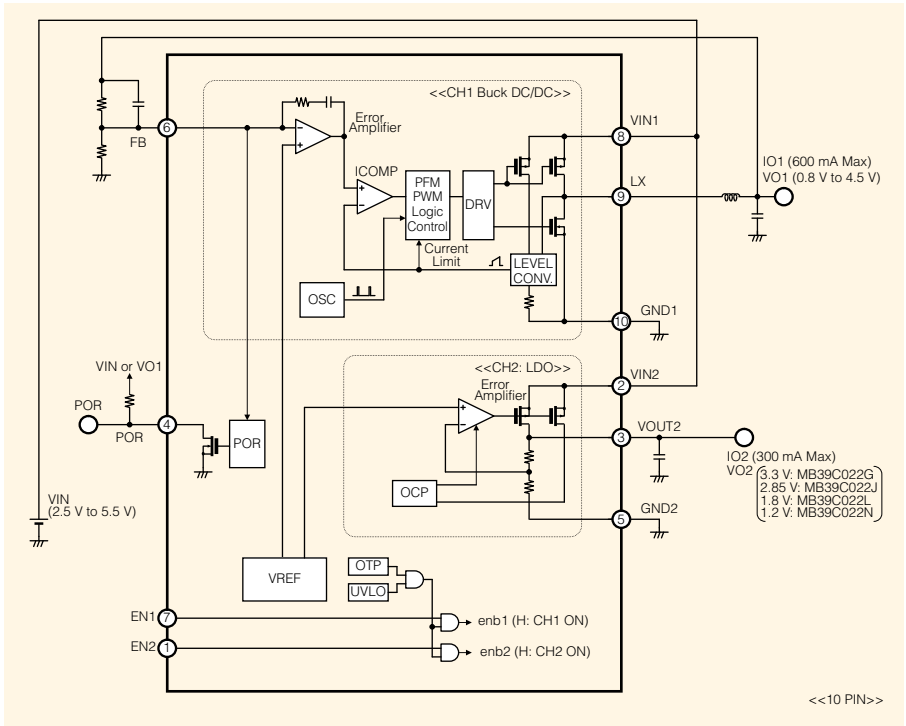
Evaluation Board

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

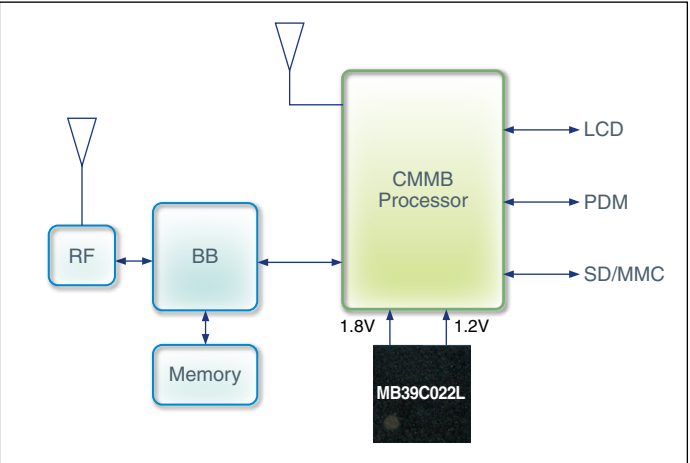
Future Development

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 1 Block Diagram

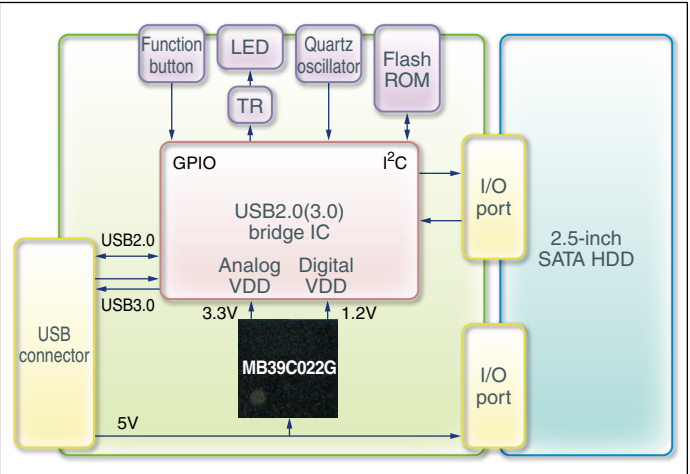


■ Figure 2 Application Example (CMMB, DVB-T, DMB-T)



PDM : Pulse Density Modulation

■ Figure 3 Application Example (USB-SATA Bridge)



MB39A132/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.

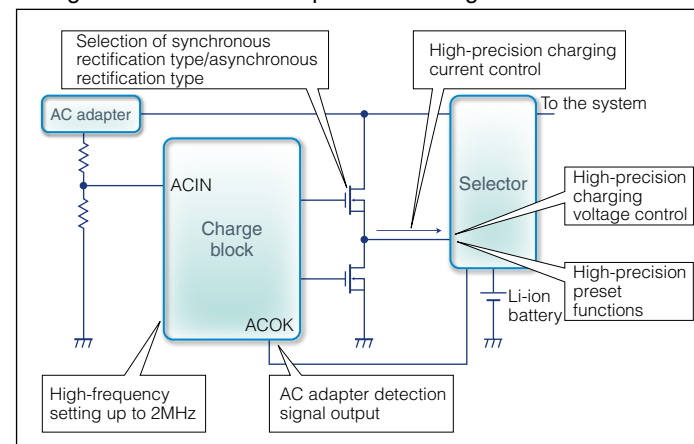
Functions Required in Li-ion Chargers

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.

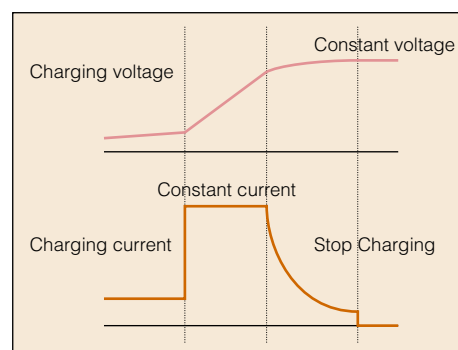
In notebook PCs, power is supplied to the system from the AC adapter when it is connected. The charge control IC controls the charging of the battery by converting the voltage input from the AC adapter at the same time. When the AC adapter is disconnected, power is supplied to the system from the battery. 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 MB39A132/MB39A134 is used for this purpose. This product has a standby current as low as 6 μ A (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 MB39A132/MB39A134

MB39A132/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 $\pm 10\%$ with $\pm 100\text{mV}$ fluctuations in charging setting voltage. MB39A132 can set the charging voltage with high precision of $\pm 0.5\%$ ($T_a = +25^\circ\text{C}$ to $+85^\circ\text{C}$) 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 MB39A132/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 MB39A132, 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 (MB39A132)

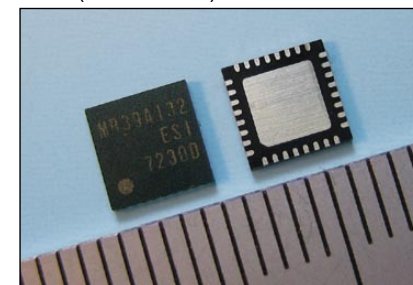
As shown in Figure 5, the Nch/Nch synchronous rectification type uses FET on the low-side and realizes high efficiency even under low duty with low output voltage compared to the input voltage. MB39A132 is optimal for suppressing heat generation when a large current is run during constant-current charging, 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. MB39A132 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 (MB39A132)



■ External View (MB39A134)

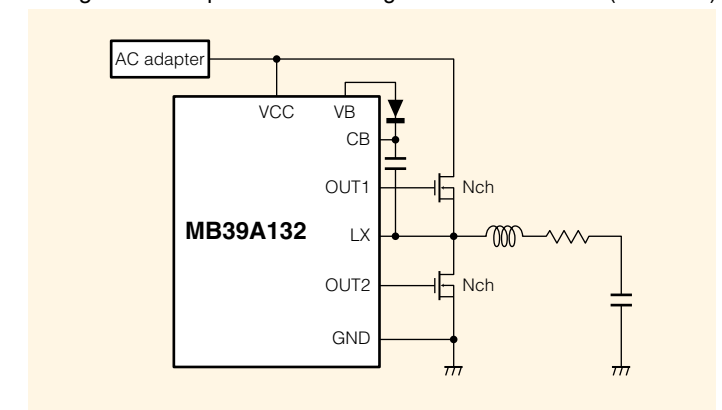


Other Features

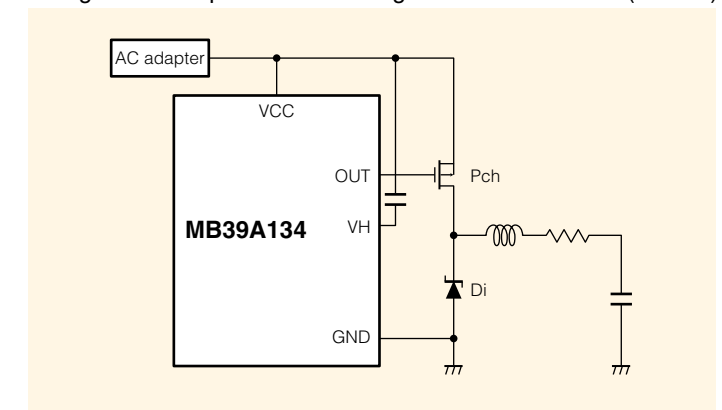
Fast response (MB39A132)

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.

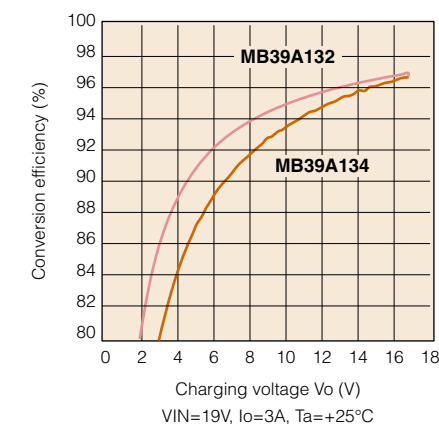
■ Figure 3 Simplified Block Diagram for MB39A132 (Nch/Nch)



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



■ Figure 5 Conversion Efficiency for MB39A132/MB39A134



Package

Package Lineup

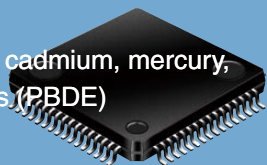
SOP Series											
SOP8		SOP8		SOP16		SOP20					
											
Body Size	Lead Pitch	Body Size	Lead Pitch	Body Size	Lead Pitch	Body Size	Lead Pitch				
3.9X5.05X1.75mm	1.27mm	5.3X6.35X2.25mm	1.27mm	5.3X10.15X2.25mm	1.27mm	5.3X12.7X2.25mm	1.27mm				
SSOP Series											
SSOP8		SSOP16		SSOP20		SSOP24					
											
Body Size	Lead Pitch	Body Size	Lead Pitch	Body Size	Lead Pitch	Body Size	Lead Pitch				
4.2X3.5X1.45mm	0.80mm	4.40X5.00X1.45mm	0.65mm	4.40X6.50X1.45mm	0.65mm	5.6X7.75X1.45mm	0.65mm				
TSSOP Series											
TSSOP16		TSSOP20		TSSOP24		TSSOP24		TSSOP30		TSSOP38	
											
Body Size	Lead Pitch	Body Size	Lead Pitch	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	4.40X7.80X1.20mm	0.65mm	4.40X7.80X1.10mm	0.50mm	4.40X9.70X1.10mm	0.50mm
TSSOP Series											
TSSOP28											
											
Body Size	Lead Pitch										
4.40X9.70X1.20mm	0.65mm										
SON Series		LQFP Series									
SON10		LQFP48		LQFP64		LQFP64					
											
Body Size	Lead Pitch	Body Size	Lead Pitch	Body Size	Lead Pitch	Body Size	Lead Pitch				
3.00X3.00X0.75mm	0.50mm	7.00X7.00X1.70mm	0.50mm	7.0X7.0X1.60mm	0.40mm	10.0X10.0X1.70mm	0.50mm				
QFN Series						PFBGA Series					
QFN24		QFN28		QFN32		PFBGA82		PFBGA103		PFBGA208	
											
Body Size	Lead Pitch	Body Size	Lead Pitch	Body Size	Lead Pitch	Body Size	Lead Pitch	Body Size	Lead Pitch	Body Size	Lead Pitch
4.00X4.00X0.85mm	0.50mm	5.00X5.00X0.85mm	0.50mm	5.00X5.00X0.85mm	0.50mm	6.00X6.00X1.30mm	0.50mm	6.00X6.00X1.30mm	0.50mm	9.00X9.00X1.30mm	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)

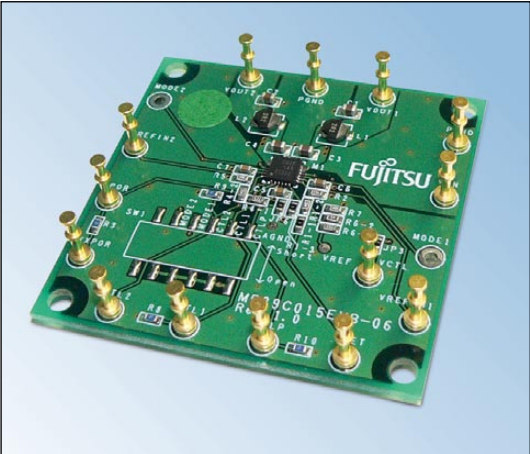
An RoHS-compliant product is indicated by trailing characters "E1" in its part number.



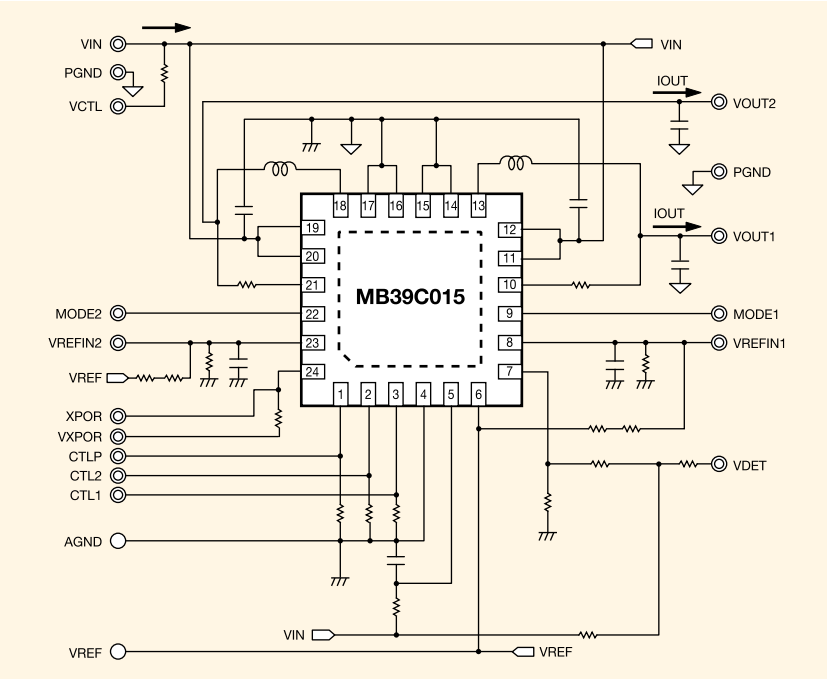
Evaluation Board

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

Example: MB39C015 evaluation board



Example: MB39C015 connection diagram



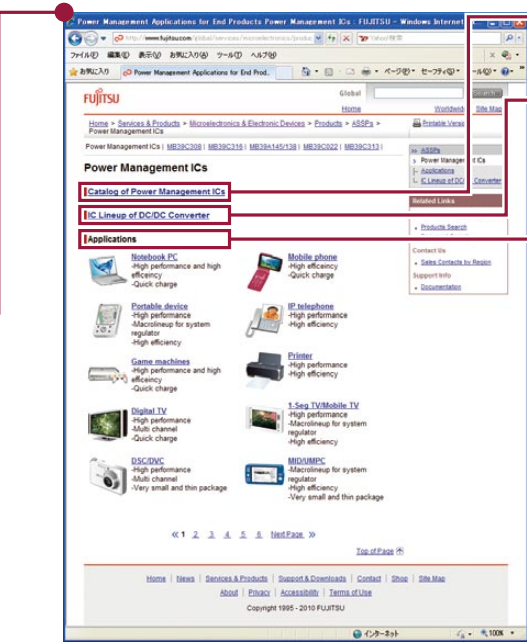
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ASSP Power Management ICs

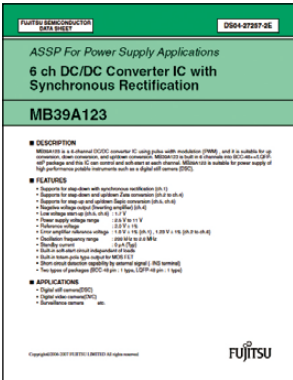


Catalog of Power Management ICs IC Lineup of DC/DC Converter → Data sheets

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.



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 - Fujitsu Semiconductor Embedded Solutions Austria GmbH (FEAT)
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Singapore/Penang/Bangalore
 - Fujitsu Semiconductor Design (Chengdu) Co. Ltd.
Chengdu
 - Nantong Fujitsu Microelectronics Co., Ltd. (NFME)
Nantong



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Sunnyvale (CA)



■ Fujitsu Semiconductor Europe GmbH (FSEU)
Langen



■ Fujitsu Semiconductor Asia Pte. Ltd. (FSAL)
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■ Fujitsu Semiconductor (Shanghai) Co., Ltd. (FSS)
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■ Fujitsu Semiconductor Limited (FSL)
Yokohama