**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* device solution**

- Saving Power
  - High efficiency
- Miniaturize
  - Small packaging
  - Reduce external components
- Control topology
  - Ultra fast transient response
  - Low voltage output

---

*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**

- **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

**Recommended devices**

- MB3800
- MB39A135
- MB39A136
- MB39A214
- MB39A202A
- MB39A134
- MB39A132A
- MB3771
- MB3773
- MB3793
- MB3841
- MB3842
- MB3845

**Mobile phone power management IC**

- **Recommended device**
  - MB39C022
- **Li-ion battery**

**Recommended devices**

- MB39C022
- MB39C006A
- MB39C007
- MB39C014
- MB39C015
- MB39C316
- MB39C022
- MB39C022L

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

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

**Game machines power management IC**

- **Recommended devices**
  - MB39A130A
  - MB39A135
  - MB39A214

**Printer power management IC**

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

---

**FUJITSU Power Management IC**
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.

**Output channels**

- **6ch**: MB39A123
- **4ch**: MB39C316A, MB39C316B
- **3ch**: MB39A132, MB39A134
- **2ch**: MB39C015, MB39C006
- **1ch**: MB39C326, MB39A135, MB39A136

**Recommended devices**

- MB39C006A
- MB39C014
- MB39C007
- MB39C015
- MB39C316
- MB39C326

**Explanation of a Functional Display**

- **Buck SCP**: Indication of function
- **Buck SCP**: Indication of no function
- **CSA**: Internal FET
- **4A**: External FET

**Tech**

- Loading number of channels
- Built-in switching FET
- Maximum load current per one channel
- Short-circuit protection

**Bottom detection comparator method**
General-purpose DC/DC Converter

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

**Ultra-rapid response, High efficiency**

**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 features, 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 5.5V 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 discharge control circuit
- POWERGOOD detection function
- Built-in soft-start circuit independent of loads
- Adjustable output voltages setting by the external control
- Built-in soft-start circuit independent of loads
- 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**

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

**Substantial protective functions**

**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 PF/PM 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.

**Application circuit example**

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

**Ultra-rapid response, High efficiency**

**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 a 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 5.5V
- Possible to select the automatic PF/PM mode or PWM fixed mode
- PAF frequency limitation function (Prohibit Audio Frequency): > 30 kHz (Min)
- Built-in diode for boot strap
- Standby current: 0μA (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**

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

**Substantial protective functions**

**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 PF/PM 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.

**Application circuit example**
**MB39C011A** Pch/Nch Synchronous Rectification 2-channel DC/DC Buck Converter IC

**P/N synchronous, Pch asynchronous**

- **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 capacitors

- **Application**
  - For various electronic devices including digital AV devices

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

**Asynchronous, Overcurrent protection**

- **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.

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

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

- **Description**
  MB39A202A is a 2ch DC/DC buck converter IC equipped with a bottom detection comparator method, 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: 5.0V 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
  - LDO circuit has the function of automatic transition to DC/DC
  - Possible to select the automatic PWM/PWM selection mode or PWM-fixed mode
  - PAF frequency limitation function (Pch/Nch Audio Frequency) : > 30 kHz (Min)
  - High accuracy reference voltage: ±1.0% (+35°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

---

**MB39A112** 3ch DC/DC Buck Converter IC

**2.6MHz operation / 3ch**

- **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 capacitors

- **Application**
  - IP-SPB, Surveillance camera, ADSL Modem etc.
DC/DC Converter with Switching FET

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

**Description**
- Internal FET, High efficiency
- 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**
- Voltage detection circuit and a soft-start circuit.
- Power supply starting sequence can be constituted using a high efficiency and low ripple voltage by a current mode system.
- Voltage detection circuit, contributes to the reduction in total area including external parts.

**Application**
- IP-Phone, Equipment of PLC etc.
- Portable device, DVD recorder
- Application : P3,4,5

**Application circuit example**

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

**Description**
- Internal FET, High efficiency
- 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**
- Voltage detection circuit, contributes to the reduction in total area including external parts.

**Application**
- Surveillance camera, photograph printer etc.
- Portable device such as 1-seg TV & 3-seg Radio etc.
- DVD Recorder, Hard Disk Recorder etc.
- Application : P3,4,5

**Application circuit example**

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

**Description**
- Internal FET, High-speed response
- 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**
- Voltage detection circuit, contributes to the reduction in total area including external parts.

**Application**
- Surveillance camera, photograph printer etc.
- Portable device such as 1-seg TV & 3-seg Radio etc.
- DVD Recorder, Hard Disk Recorder etc.
- Application : P3,4,5

**Application circuit example**

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

**Description**
- Internal FET, High-speed response
- 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**
- Voltage detection circuit, contributes to the reduction in total area including external parts.

**Application**
- Surveillance camera, photograph printer etc.
- Portable device such as 1-seg TV & 3-seg Radio etc.
- DVD Recorder, Hard Disk Recorder etc.
- Application : P3,4,5

**Application circuit example**
### General-purpose DC/DC Converter and DC/DC Converter with Switching FET

#### Lineup of General-purpose DC/DC Converter

<table>
<thead>
<tr>
<th>Model</th>
<th>Number of channels</th>
<th>Switching frequency (kHz)</th>
<th>Power supply voltage (V)</th>
<th>Reference voltage (V)</th>
<th>Package</th>
<th>Topology</th>
<th>FET compatible</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>MB39A014</td>
<td>1</td>
<td>1000</td>
<td>+1.8 to +5.5</td>
<td>a4</td>
<td>SOP8</td>
<td>SSOP8</td>
<td>Back</td>
<td>Not available</td>
</tr>
<tr>
<td>MB39A015B</td>
<td>1</td>
<td>1000</td>
<td>+4.5 to +25</td>
<td>a4</td>
<td>TSOP8</td>
<td>SSOP8</td>
<td>Back</td>
<td>Available: Soft-start circuit, timer-latch, short-circuit protection</td>
</tr>
<tr>
<td>MB39A016</td>
<td>2</td>
<td>1500</td>
<td>+4.5 to +25</td>
<td>a4</td>
<td>TSOP8</td>
<td>SSOP8</td>
<td>Back</td>
<td>Available: Soft-start circuit, timer-latch, short-circuit protection</td>
</tr>
<tr>
<td>MB39A020</td>
<td>2</td>
<td>1000</td>
<td>+4.5 to +25</td>
<td>a4</td>
<td>TSOP8</td>
<td>SSOP8</td>
<td>Back</td>
<td>Available: Soft-start circuit, timer-latch, short-circuit protection</td>
</tr>
<tr>
<td>MB39C015</td>
<td>2</td>
<td>1000</td>
<td>+4.5 to +25</td>
<td>a4</td>
<td>TSOP8</td>
<td>SSOP8</td>
<td>Back</td>
<td>Available: Soft-start circuit, timer-latch, short-circuit protection</td>
</tr>
<tr>
<td>MB39A025A</td>
<td>2</td>
<td>1000</td>
<td>+4.5 to +25</td>
<td>a4</td>
<td>TSOP8</td>
<td>SSOP8</td>
<td>Back</td>
<td>Available: Soft-start circuit, timer-latch, short-circuit protection</td>
</tr>
</tbody>
</table>

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

### DC/DC Converter with Switching FET + LDO

#### MB39C022 Series

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

**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 enables 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 range of DC/DC block**: Voltage setting range: 0.8V to 4.5V
- **Current**: 600mA (Max.)

#### MB39C316

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

**Description**

MB39C316 is a power management IC equipped with 3ch DC/DC converter and the 4th line regulator (LDO). MB39C316 operates 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
- **PC bus interface**: Control and notice of internal condition
- **RTC**: Possible to output the 32.768kHz clock by connecting crystal oscillator

#### Application

- **Portable applications**
- **GPS, PND, MP3, MP4, Portable TV, USB dongle**
- **SMART-PHONE,** etc.

#### System configuration of Mobile Terminals

Refer from page 21 to page 22

### Lineup of DC/DC Converter with Switching FET

<table>
<thead>
<tr>
<th>Model</th>
<th>Number of channels</th>
<th>Switching frequency (kHz)</th>
<th>Power supply voltage (V)</th>
<th>Reference voltage (V)</th>
<th>Package</th>
<th>Topology</th>
<th>FET compatible</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>MB39C014</td>
<td>1</td>
<td>1000</td>
<td>+2.5 ±4</td>
<td>800</td>
<td>0.3</td>
<td>0.2</td>
<td>SON10</td>
<td>Back</td>
</tr>
<tr>
<td>MB39C022L</td>
<td>2</td>
<td>2000</td>
<td>+2.5 ±4</td>
<td>800</td>
<td>0.3</td>
<td>0.2</td>
<td>SON10</td>
<td>Back</td>
</tr>
<tr>
<td>MB39C022N</td>
<td>2</td>
<td>2000</td>
<td>+2.5 ±4</td>
<td>800</td>
<td>0.3</td>
<td>0.2</td>
<td>SON10</td>
<td>Back</td>
</tr>
</tbody>
</table>

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

### Lineup of DC/DC Converter with Switching FET + LDO

<table>
<thead>
<tr>
<th>Model</th>
<th>Number of channels</th>
<th>Switching frequency (kHz)</th>
<th>Power supply voltage (V)</th>
<th>Reference voltage (V)</th>
<th>Package</th>
<th>Topology</th>
<th>FET compatible</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>MB39C022Channel</td>
<td>1</td>
<td>2000</td>
<td>+2.5 ±4</td>
<td>800</td>
<td>0.3</td>
<td>0.2</td>
<td>SON10</td>
<td>Back</td>
</tr>
<tr>
<td>MB39C022G</td>
<td>1</td>
<td>2000</td>
<td>+2.5 ±4</td>
<td>800</td>
<td>0.3</td>
<td>0.2</td>
<td>SON10</td>
<td>Back</td>
</tr>
<tr>
<td>MB39C022L</td>
<td>1</td>
<td>2000</td>
<td>+2.5 ±4</td>
<td>800</td>
<td>0.3</td>
<td>0.2</td>
<td>SON10</td>
<td>Back</td>
</tr>
<tr>
<td>MB39C022N</td>
<td>1</td>
<td>2000</td>
<td>+2.5 ±4</td>
<td>800</td>
<td>0.3</td>
<td>0.2</td>
<td>SON10</td>
<td>Back</td>
</tr>
</tbody>
</table>

**Memo**

For Portable Devices with digital circuits and with analog circuits

- **Application**
  - PBS, PND, MP3, MP4, Portable TV, USB dongle
  - SMART-PHONE, etc.
  - Product Analysis of this product
  - Refer from page 21 to page 22
Power Supply for RF Power Amplifier

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

- **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 converter 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 boost buck 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 11V
  - Adjustable output voltage range : 0.4V to 4.5V
  - Input current limit value : 2000mA
  - Low voltage start-up: 1.7V
  - Synchronous rectification
  - Supports for buck converter with switching frequency 2 to 3MHz
  - Oscillation frequency range: 200kHz to 2.0MHz

- **Application**
  - Mobile phones, Smart phones, e-Books, PADs
  - RF-3G cards
  - Supports for the output voltage of 1.0V
  - 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

- **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
  - Supports 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**
  - MB39C315A
  - MB39C315B

- **Power supply voltage**
  - Vin=8V to 14V

- **Output features**
  - SCP
  - OCP
  - OTP
  - Over voltage
  - VCC

- **Application**
  - Large size LCD panel

DC/DC Converter for LCD Panels

MB39C313A/MB39C313B 4-channel DC/DC Converter IC for LCD Panels

- **Description**
  MB39C313A/MB39C313B is a 4 channel 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
  - 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): Detection value: 3.5A (MB39C313A) 4.6A (MB39C313B)

- **Application**
  - Large size LCD panel

System configuration of LCD panel

- **Application circuit example**

DC/DC Converter + Charge pump

- **Model**
  - MB39C315A
  - MB39C315B

- **Switching frequency (max)**
  - 500kHz

- **Output voltage**
  - 1V to 3.3V

- **Application**
  - Surveillance camera

Lineup of DC/DC Converter for LCD Panels

- **Model**
  - MB39C315A
  - MB39C315B

- **Power supply voltage**
  - Vin=8V to 14V

- **Output features**
  - SCP
  - OCP
  - OTP
  - VCC

- **Application**
  - Surveillance camera

Memo

- **Application**
  - P5

For portable devices such as DSC and DVC.

* By Recommended
MB39A134 DC/DC Converter IC for Charging Li-ion Battery

**Preset output-voltage, CVM**

- **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%)
  - High accuracy current detection amplifier (+1%)
  - All 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

---

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

**Nch/Nch synchronous, Preset output-voltage**

- **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%)
  - High accuracy current detection amplifier (+1%)
  - All 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

---

**Charge Control**

---

**Power Voltage Monitoring Applications**

MB3793 Power voltage monitoring IC with dual-system watchdog timer

- **Built-in Watchdog timer**
  - MB3793 is a power voltage monitoring IC with dual-system watchdog timer. A reset signal is output at transient power cut-off or power fail. 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, 2.3V, 3.7V, 4.0V, 3.0V, 2.7V
  - Precise detection of power voltage fail: ±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**
  - MB3771
  - MB3773
  - MB3750-X

- **Function**
  - Power supply voltage monitor
  - MB3771: Power supply voltage monitor
  - MB3773: Charging voltage monitor
  - MB3750-X: Dual-system power supply monitoring IC

- **Detection voltage**
  - MB3771: ±4.2V
  - MB3773: ±4.5V
  - MB3750-X: ±4.5V, ±3.7V, ±2.3V (3A), ±4.0V (3A)

- **Switching voltage**
  - MB3771, MB3773, MB3750-X: ±4.5V, ±3.7V, ±2.3V

- **Power supply voltage**
  - MB3771: ±3.5V, ±18V
  - MB3773: ±3.5V, ±16V
  - MB3750-X: ±3.5V, ±18V

- **Remarks**
  - SOP8
  - SSOP8

- **Application**
  - P3

---

**Lineup of Power Management Switches**

- **Model**
  - MB3841
  - MB3845

- **Consumption Current (ID) ±45 mA**
  - MB3841: 0 ±45 mA
  - MB3845: 0 ±45 mA

- **On resistance (max)**
  - MB3841: 0.045 Ω
  - MB3845: 0.06 Ω

- **Package**
  - SOP8

- **Remarks**
  - SOP8

---

**Lineup of AC/DC Converter**

- **Model**
  - MB3795
  - MB3786A

- **Input frequency (Hz)**
  - MB3795: 50 ±2Hz
  - MB3786A: 50 ±2Hz

- **Power supply voltage**
  - MB3795: ±60V
  - MB3786A: ±60V

- **Maximum output current (mA)**
  - MB3795: ±1A
  - MB3786A: ±1A

- **Remarks**
  - SOP16
  - SOP16

---

For portable devices using Li-ion battery, such as Notebook PC, Notebook PC etc.
**Noteworthy Non-linear Hysteresis Control Method As a DC/DC Converter Control Method**

“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 of 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 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.

---

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

### 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.

**Lout comparator circuit**

This circuit detects the current flowing from the built-in P channel MOS FET to the external inductor (IXL). It compares VIDET obtained by I-V conversion of the IXL 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 VDD 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 L 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.

### 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.

**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.
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 standby voltage setting and supports various different types of batteries in preparing a new circuit. The presetting function using high-precision trimming resistor 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.

### 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 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 voltage fluctuations in charging setting voltage. MB39A132A can set the charging voltage with high precision of ±0.5% (±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.

### Main Features of MB39A132A/MB39A134

- **Selection of synchronous rectification type**: Allows simple built-in applications. Each delivers unique functions.
- **High-precision charge control**: High-precision charging and voltage control can be set to an extended range and it is thus capable of suppressing power loss and extending the standby time for notebook PCs.
- **External View (MB39A132A)**
- **External View (MB39A134)**
- **High-precision presetting function**: Provides high-precision trimming function using high-precision trimming resistor.
- **Stop Charging**: The charging is set to stop by setting the charging current to 0.
- **Constant current**: The charging current is constant until the charging voltage reaches the preset value.
- **Constant voltage**: The charging voltage is constant until the charging current becomes zero.
- **High-precision charging current control**: The charging current is controlled with high precision.
- **High-precision charging voltage control**: The charging voltage is controlled with high precision.
- **High-precision signal output**: Provides high-precision signal output.
- **VCC**: Supplies power to the IC.
- **AC adapter**: Supplies power to the IC.
- **Selector**: Selects the synchronous rectification type.
- **MB39A132A**: Charges with high efficiency at 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.

### 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.

### Figures

- **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

---

**FUJITSU Power Management IC**

Don’t forget to check out the latest updates and the full range of products in our catalog.
Fujitsu Semiconductor provides evaluation boards for you to evaluate our semiconductor devices. Examples: MB39C015 evaluation board, MB39C015 connection diagram.

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

The details shown above may change without notice. Please contact our sales division for inquiries.

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.

Search of Product and Document

You can search our products at the following homepage.
URL: http://www.fujitsu.com/global/services/microelectronics/
Global Network

**EUROPE**
- Fujitsu Semiconductor Europe GmbH (FSEU)
  - Germany-Langen, Munich/UK/Maidenhead/Paris/Italy/Milan
- Fujitsu Semiconductor Embedded Solutions Austria GmbH (FEAT)
  - Linz

**AMERICA**
- Fujitsu Semiconductor America, Inc. (FSA)
  - Sunnyvale-CA/San Diego-CA/Spring Hill-TN/Detroit-MI/Boston-MA/
  - Sunnyvale-CA/San Diego-CA/Spring Hill-TN/Detroit-MI/Boston-MA/
- Fujitsu Semiconductor Wireless Products, Inc. (FSWP)
  - Tempa-AZ

**JAPAN**
- Fujitsu Semiconductor Limited (FSL)
  - Yokohama
- Fujitsu Semiconductor (Shanghai) Co., Ltd. (FSS)
  - Shanghai/Beijing/Shenzhen/Dalian
- Fujitsu Semiconductor Korea Limited (FSK)
  - Seoul/Daejeon
- Fujitsu Semiconductor Pacific Asia Limited (FSP)
  - Hong Kong/Taipei
- Fujitsu Semiconductor Asia Pte. Ltd. (FSAL)
  - Singapore/Perum/Bangalore/Thailand
- 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)
  - Singapore
- Fujitsu Semiconductor (Shanghai) Co., Ltd. (FSS)
  - Shanghai
- Fujitsu Semiconductor Limited (FSL)
  - Yokohama
- Fujitsu Semiconductor (Shanghai) Co., Ltd. (FSS)
  - Shanghai
<table>
<thead>
<tr>
<th>Model</th>
<th>Number of channels (Ch)</th>
<th>Buck</th>
<th>Boost</th>
<th>BuckBoost</th>
<th>Charge</th>
<th>LDO</th>
<th>Power supply voltage (V)</th>
<th>Output voltage (V)</th>
<th>Minimum output current (mA)</th>
<th>Output current accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>MB39A112</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
<td></td>
<td>0.7 to 3.3</td>
<td>±0.08</td>
<td>1.5 mA</td>
<td>±0.8%</td>
</tr>
</tbody>
</table>

**Switching**:
- **Driver Control**
- **On/Off Protection**
- **Others**: Charge control

**Control pin**: Buck/Boost

**Power supply voltage (V)**
- **Evaluation Board**
- **Under voltage protection**
- **Constant voltage mode indication**
- **Under input voltage charging stop function**
- **Asynchronous rectification selectable**
- **Over input current protection**
- **Pch/Nch synchronous rectification (Pch: ○, Nch: -)**

**General-purpose DC/DC Converter (Buck/Boost FET)**
- **MB39A130A**: 4.5 to 25 V, ±1.0 mA, ±1.3 mA, ±1.4 mA, ±1.6 mA
- **MB39A130B**: 4.5 to 25 V, ±0.7 mA, ±1.0 mA, ±1.3 mA, ±1.4 mA
- **MB39A131A**: 4.5 to 25 V, ±1.0 mA, ±1.3 mA, ±1.4 mA, ±1.6 mA

**Datasheet**
- **MB39A130A**: TSSOP24
- **MB39A130B**: TSSOP24

**General-purpose DC/DC**
- **MB39C014**: 4.5 to 3.3 V, ±0.8 mA
- **MB39C016**: 4.5 to 3.3 V, ±0.8 mA
- **MB39C018**: 4.5 to 3.3 V, ±0.8 mA
- **MB39C020**: 4.5 to 3.3 V, ±0.8 mA

**General-purpose LDO**
- **MB39C012**: 1.8 to 3.3 V, ±0.8 mA
- **MB39C014**: 1.8 to 3.3 V, ±0.8 mA
- **MB39C016**: 1.8 to 3.3 V, ±0.8 mA

**Package**: TSSOP24

**Evaluation Board**: WLCSP20

**Charge**:
- **MB39A152A**: 8.0 to 28 V, ±0.5 mA, ±0.5 mA
- **MB39A154**: 8.0 to 28 V, ±0.5 mA, ±0.5 mA

**Charge LDO**:
- **MB39C132A**: 1.8 to 3.3 V, ±1.5 mA, ±0.8 mA
- **MB39C132B**: 1.8 to 3.3 V, ±1.5 mA, ±0.8 mA

**Charge LDO**:
- **MB39C313A**: 1.8 to 3.3 V, ±1.5 mA, ±0.8 mA
- **MB39C313B**: 1.8 to 3.3 V, ±1.5 mA, ±0.8 mA

**Evaluation Board**: WLCSP20

**Datasheet**: TSSOP24

**Buck/Boost LDO**:
- **MB39A132A**: 1.8 to 3.3 V, ±1.5 mA, ±0.8 mA
- **MB39A134**: 1.8 to 3.3 V, ±1.5 mA, ±0.8 mA

**Evaluation Board**: LQFP48

*1: Depends on external settings.
*2: As the current value when the 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 multiplying value from a preset function.

f*5: The MB39A134 output voltage accuracy is the value in the range of -25°C to 85°C (C).
*6: The MB39A134/313B output voltage accuracy is the value in the range of 0°C to 85°C (C) and output current: ±0.5 mA.
*7: LD03 is 1.8 at LD05 = 0.4A.