

# PFM/PWM Synchronous Rectification Step-down DC/DC Converter IC

## MB39A135 (1-channel)

## MB39A136 (2-channel)

PFM/PWM synchronous rectification step-down DC/DC converter ICs “MB39A135 (1-channel)” and “MB39A136 (2-channel)” have been developed to supply power voltage to image processing LSIs, microcontrollers, and so forth in digital TVs, HDD recorders, and game machines.

### Overview

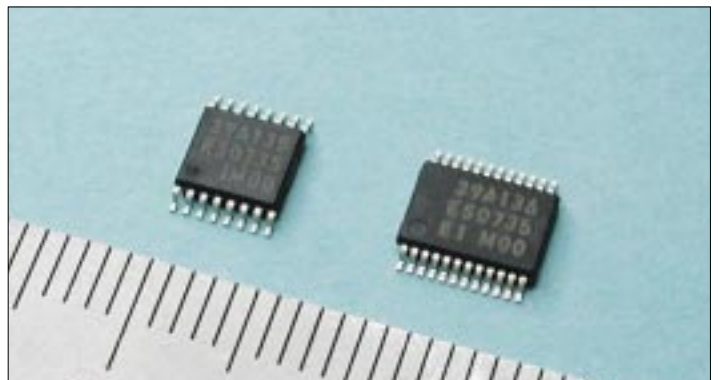
As markets for digital TVs and game machines are growing increasingly active, the need for power-supply ICs to supply power voltage to image processing LSIs, microcontrollers, and so forth has been increasing. There are particularly strong demands for high efficiency, high precision, excellent transient response characteristics, and reduction in peripheral parts to realize cost reduction.

To address these demands, this product offers high efficiency operation in all load ranges through built-in PFM functions and high speed transient load response characteristics that surpass those of the conventional voltage mode by adopting the current mode. Its substantial protective functions allow the elimination of external protective elements. In addition, the miniaturization of the coil and input and output capacitors through increasing frequency, and the package size contributes to the reduction of total PCB area including external parts. It also realizes power-supply sequence control such as soft-start and soft-stop functions that are required for use as a core supply or I/O supply for systems.

### Product Features

- Current mode Nch/Nch synchronous rectification
- Built-in PFM function
- Input power-supply voltage range: 4.5V to 25V
- Operating frequency: 100kHz to 1MHz
- High-precision reference voltage:  $0.7V \pm 1\%$  (25°C)

Photo 1 External View



- Output voltage setting range: 0.7V to (maximum ON duty 80%)
- Substantial protective functions (overcurrent protection, overvoltage protection, undervoltage protection, overtemperature protection)
- Requires no flyback diode
- Built-in load-independent soft-start/soft-stop function
- Small package: TSSOP-16-pin (MB39A135 1 channel)  
TSSOP-24-pin (MB39A136 2 channels)
- Conforms to the lead-free/RoHS directive

Fig.1 presents the conversion efficiency of MB39A135/136 and Fig.2 the excess response.

## Description of Functions

### Main control type

This product adopts current mode Nch/Nch synchronous rectification. The current mode conducts on duty control by detecting the coil current (IL) and output voltage (VO).

### PFM function

This product has a built-in PFM function with a unique method. Using the MODE terminal, the user can select between PWM mode and automatic PFM/PWM switching mode. In automatic PFM/PWM switching mode, the product will operate on PFM mode when the load is light and automatically switch to PWM mode when the load increases. This function enables high efficiency operation for the entire load range.

### Load-independent soft-start/soft-stop function

The soft-start function prevents the inrush current and overshooting of output voltage. This function also allows the setting of output voltage startup timing. For shutdown with CTL OFF, undervoltage protection, or overtemperature protection, the soft-stop function stops the output independently from the load.

Fig.3 presents soft-start/soft-stop function examples of MB39A136.

### Clock generation block

The oscillation frequency can be set up at 100kHz to 1MHz by connecting a resistor at the RT terminal. MB39A136

Figure 1 Conversion Efficiency of MB39A135/136

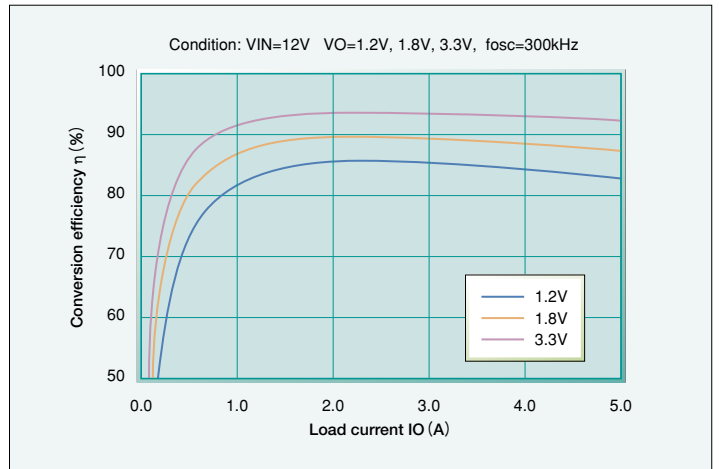


Figure 2 Transient Load Response by MB39A135/136

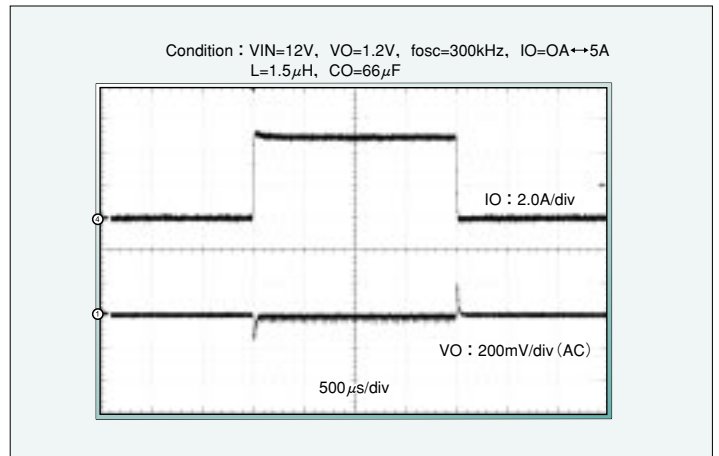
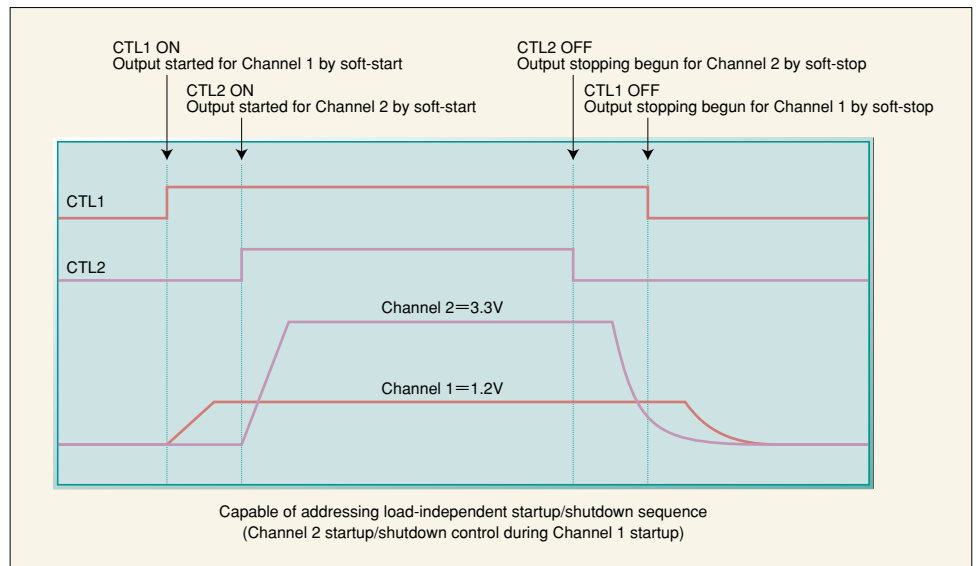


Figure 3 Soft-start/Soft-stop Function Examples of MB39A136



(2-channel) operates on the clock shifted in phase by 180°.

**Overcurrent protection circuit (OCP function)**

Overcurrent status is detected by cyclically comparing the current converted into voltage that runs when the High side FET turns ON and the voltage set for the ILIM terminal. When overcurrent status is detected, the High side FET is turned OFF to let the output voltage drop. This function prevents overcurrent status.

**Overvoltage protection circuit (OVP function)**

When the product detects output voltage higher than the set voltage, it turns OFF the High side FET and turns ON the Low side FET. This function protects the devices on later stages from overvoltage.

**Undervoltage protection circuit (UVP function)**

When the product detects output voltage lower than the set voltage, it will stop the voltage output using the soft-stop function. This function detects output errors and protects the devices on later stages by stopping the output.

**Overtemperature protection circuit (OTP function)**

When the junction temperature reaches 160°C, this product stops the voltage output using the soft-stop function. When the junction temperature decreases to 135°C, it resumes the voltage output using the soft-start function. This function prevents overheat of the IC.

**Figs.4** and **5** present the block diagrams of MB39A135 and MB39A136, respectively.

**Application Examples**

**Fig.6** presents an application example.

**Evaluation Board and Package**

**Photos 2** and **3** present the evaluation boards for MB39A135 and MB39A136. These products are offered with the following package sizes:

- TSSOP-16: 4.4mm×5.0mm×1.10mm (lead pitch 0.65mm)
- TSSOP-24: 4.4mm×6.5mm×1.10mm (lead pitch 0.5mm)



**NOTES**

\* Other company names and brand names are the trademarks or registered trademarks of their respective owners.

**Figure 4** MB39A135 Block Diagram

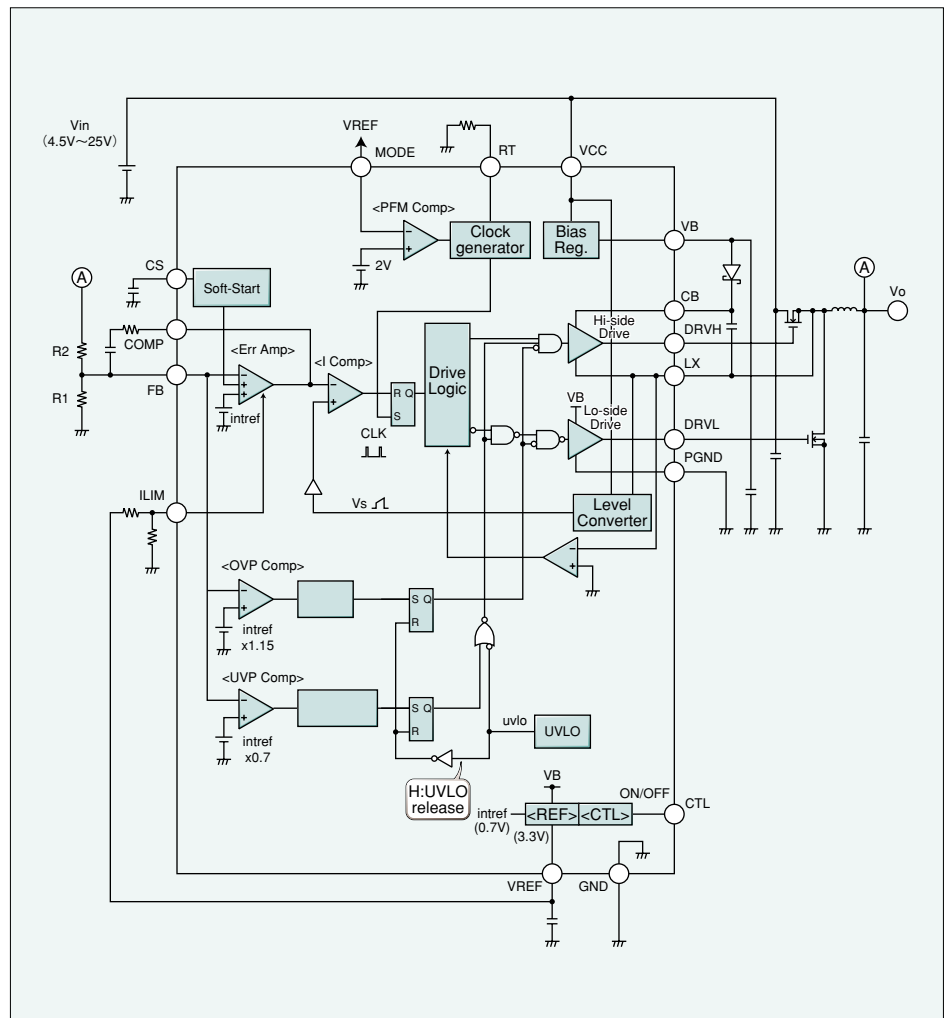


Figure 5 MB39A136 Block Diagram

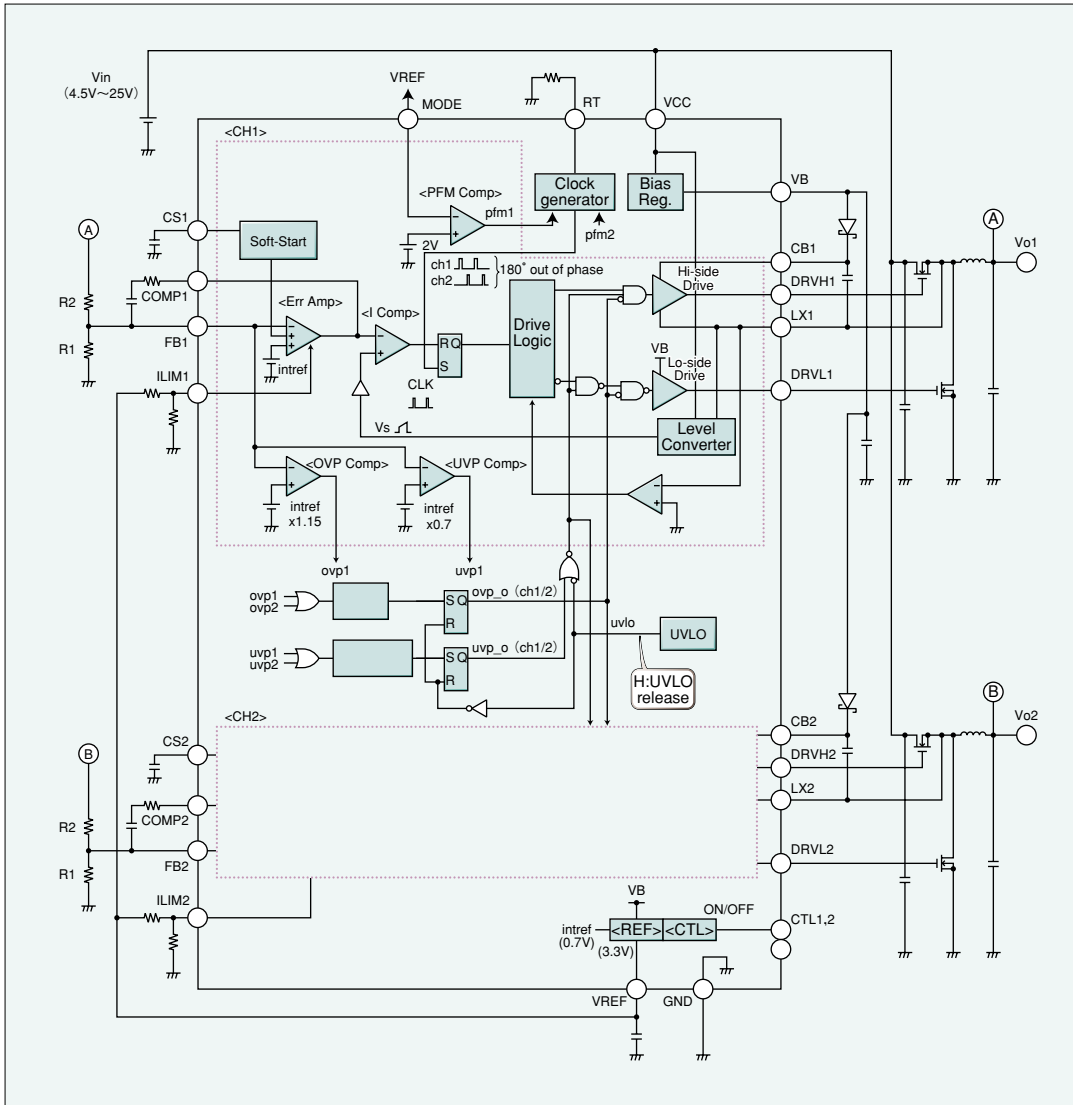


Photo 2 MB39A135 Evaluation Board (6.5cm×6.5cm)



Photo 3 MB39A136 Evaluation Board (6.5cm×6.5cm)



Figure 6 Application Example

