

6-Channel DC/DC Converter IC with Synchronous Rectification

MB39A123

MB39A123 is a 6-channel DC/DC converter IC with a synchronous rectification function based on the pulse-width modulation (PWM type). Each of the six channels built into a BCC-48++ or LQFP-48P package can be controlled and soft-started independently. MB39A123 is best suited for power supplies in high-performance portable devices such as digital still cameras.

Product Description

FUJITSU has been putting a great deal of effort into the development of ICs for power management in high-performance portable devices such as digital still cameras. Building on the technological foundation of ten predecessor series (MB3785A, MB3825A, MB3827, MB3881, MB3883, MB39A102, MB39A103, MB39A108, MB39A110, MB39A115, and MB39A121), the company has recently completed MB39A123,

a 6-channel DC/DC converter IC with synchronous rectification. MB39A123 is optimal for multi power-supply systems built into high-performance portable devices.

With the ongoing advancement of high functionality in portable devices, the demand for the miniaturization of built-in power supplies will continue to grow. This product is a 6-channel DC/DC converter IC with a synchronous rectification function based on the pulse-width modulation (PWM type). Up-conversion, down-conversion, and up/down-conversion are

Photo 1 External View (BCC)

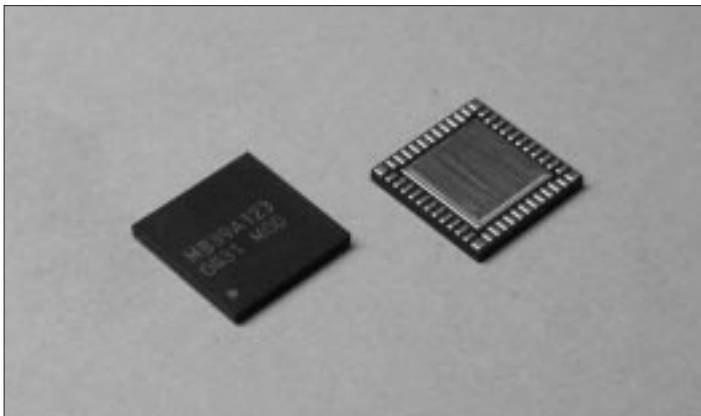
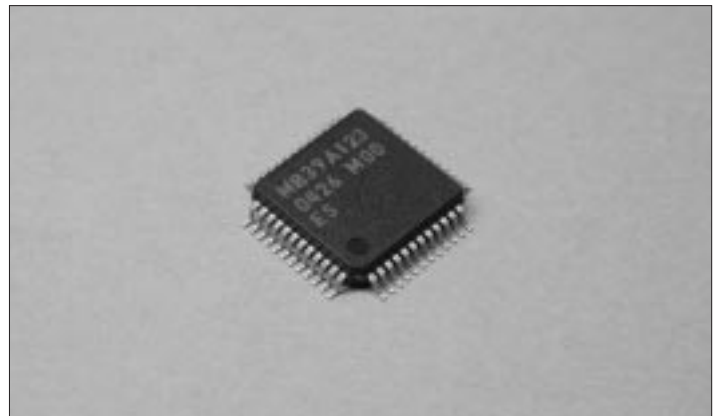


Photo 2 External View (LQFP)



all supported, and each of the six channels built into a BCC-48++ or LQFP-48P package can be controlled and soft-started independently. A soft-start circuit and timer latch short-circuit detection circuit are also mounted to prevent inrush current at power startup and overcurrent due to output short-circuits. These features make MB39A123 optimal for power supplies in high-performance portable devices such as digital still cameras.

Product Features

- Supports down-conversion (synchronous rectification) (CH1)
- Supports down-conversion and up/down Zeta conversion (CH2 to CH4)
- Supports up-conversion and up/down Sepic conversion (CH5 to CH6)
- Low start-up voltage: 1.7 V
- Power-supply voltage range: 2.5 V to 11 V
- Reference voltage: 2.0 V ± 1%
- Error amplifier threshold voltage: 1.0 V ± 1% (CH1)
1.23 V ± 1% (CH2 to CH6)
- Oscillation frequency range: 200 kHz to 2.0 MHz
- Standby current: 0 μA (Typ.)
- Built-in soft-start circuit independent of loads
- Built-in totem-pole-type output for MOS FET
- Short-circuit detection from short-circuit input possible using an external signal (-INS terminal)
- Package: BCC-48++, LQFP-48P

Circuit configuration

Figs.1 and **2** depict the pin assignments and **Fig.3** presents a block diagram.

MB39A123 is configured with the following function blocks.

DC/DC Converter Function

Reference Voltage Generator Block (VREF)

The typical 2.0 V reference voltage generated by the generator circuit is temperature-compensated by the voltage supplied

Figure 1 Pin Assignments (BCC-48++)

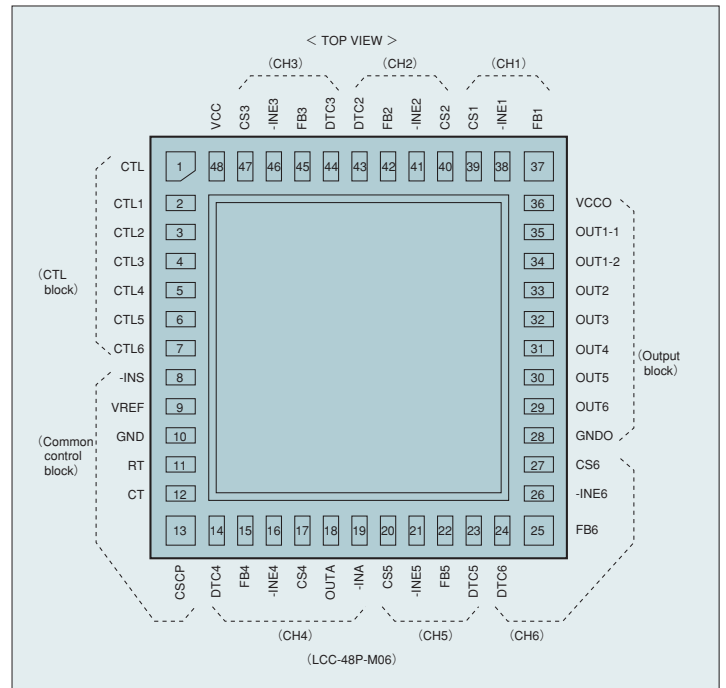
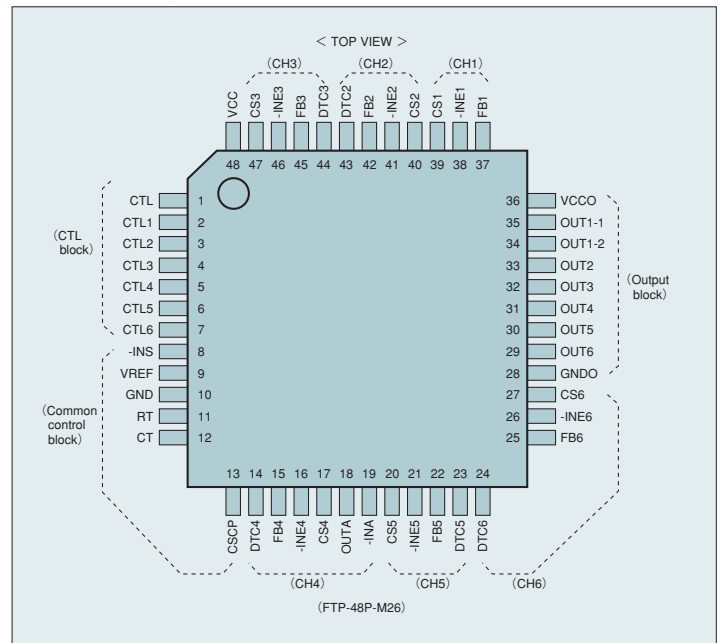


Figure 2 Pin Assignments (LQFP-48P)



from the power-supply terminal and used as the reference voltage for internal IC circuits. The reference voltage can supply a load current of up to 1mA to an external device through the VREF terminal.

Triangular Wave Oscillator Block

The triangular wave oscillator block generates triangular wave oscillation waveforms from the CT (amplitude 0.4 V to 0.9 V) terminal by connecting the capacitor for timing and the resistor at the CT and RT terminals, respectively. The generated triangular wave is input to the PWM comparator in the IC.

Error Amplifier Block (Error Amp1 to Error Amp6)

The error amplifier detects the DC/DC converter output voltage and outputs PWM control signals. Stable phase compensation against the system can be attained by setting up the optional loop gain through connections of the feedback resistor and capacitor from the output terminal of the error amplifier to the inverted input terminal.

Possible inrush current at power start-up can be prevented by connecting a capacitor for soft-start at the CS1 to CS6 which is non-inverted input terminals of error amplifier. The soft-start operates at a fixed timing independent from the DC/DC converter output load.

PWM Comparator Block (PWM Comp.1 to PWM Comp.6)

This is a voltage-pulse-width modulator that controls the output duty according to the input voltage. The output transistor turns ON for as long as the error amplifier output voltage and DTC voltage exceed the triangular wave voltage.

Output Block (Drive1 to Drive6)

The output circuit adopts a totem-pole-type construction and is capable of driving an external Pch MOS FET (channel 1 main side, channels 2 to 4) and Nch MOS FET (channel 1 synchronous

rectification side, channels 5 to 6).

Channel Control Function

The ON/OFF status for each channel is set via the voltage setup at the CTL terminal or the CTL1 to CTL6 terminals.

Table 1 presents the ON/OFF setup conditions for each channel.

Protection Circuit Functions

Timer latch short-circuit protection circuit block (SCP, SCP Comp.)

The short-circuit detection comparator (SCP Comp.) detects the output voltage level of the error amplifier of each channel. If the output voltage in any channel drops below the short-circuit detection voltage, the timer circuit is activated and starts charging the capacitor Cscp connected to the CSCP terminal. When the capacitor Cscp voltage reaches approximately 0.7 V, the output transistor is turned OFF and the dead time is set to 100%. It is also possible to detect a short-circuit from the external input at the short-circuit detection comparator (SCP Comp.) using the -INS terminal.

When the protection circuit is activated, it can be reset by turning the power ON or by switching the CTL terminal to the "L" level and lowering the VREF terminal voltage to 1.27 V (Min.) or less.

Undervoltage Lockout Circuit Block (UVLO)

The transient state at normal power start-up and momentary drops in the power-supply voltage may lead to malfunctions in the control IC; in the worst cases, this may result in system deterioration or destruction. To prevent these types of malfunctions, the undervoltage lockout circuit block detects the internal reference voltage level by monitoring the power-supply voltage, turns the output transistor OFF, and sets the dead time to 100% while simultaneously maintaining the CSCP terminal at the "L" level. The system restores itself once the power-supply voltage exceeds the threshold voltage of the undervoltage lockout circuit.

Soft-Start Function

Soft-Start Block (CS1 to CS6)

Possible inrush current at power start-up can be prevented by the connection of a capacitor to the CS terminal of each channel. Performing soft-start detection in the error amplifier enables fixed timing soft-start operation that is independent of the DC/DC converter output load.*

Table 1 ON/OFF Setup Conditions for Each Channel

CTL	CTL1	CTL2	CTL3	CTL4	CTL5	CTL6	Power	CH1	CH2	CH3	CH4	CH5	CH6
L	—*	—*	—*	—*	—*	—*	OFF	OFF	OFF	OFF	OFF	OFF	OFF
H	L	L	L	L	L	L	ON	OFF	OFF	OFF	OFF	OFF	OFF
H	H	L	L	L	L	L	ON	ON	OFF	OFF	OFF	OFF	OFF
H	L	H	L	L	L	L	ON	OFF	ON	OFF	OFF	OFF	OFF
H	L	L	H	L	L	L	ON	OFF	OFF	ON	OFF	OFF	OFF
H	L	L	L	H	L	L	ON	OFF	OFF	OFF	ON	OFF	OFF
H	L	L	L	L	H	L	ON	OFF	OFF	OFF	OFF	ON	OFF
H	L	L	L	L	L	H	ON	OFF	OFF	OFF	OFF	OFF	ON
H	H	H	H	H	H	H	ON	ON	ON	ON	ON	ON	ON

* : Undefined

Figure 3 Block Diagram

