5-Channel DC/DC Converter IC with Synchronous Rectification MB39A108

MB39A108 is a 5-channel DC/DC converter IC with a synchronous rectification function based on the pulse width modulation type (PWM type). Each of five channels built-in a TSSOP-38P package can be controlled and soft-started independently. MB39A108 is best suited for power supplies in high-performance portable devices such as digital still cameras.

Product Description

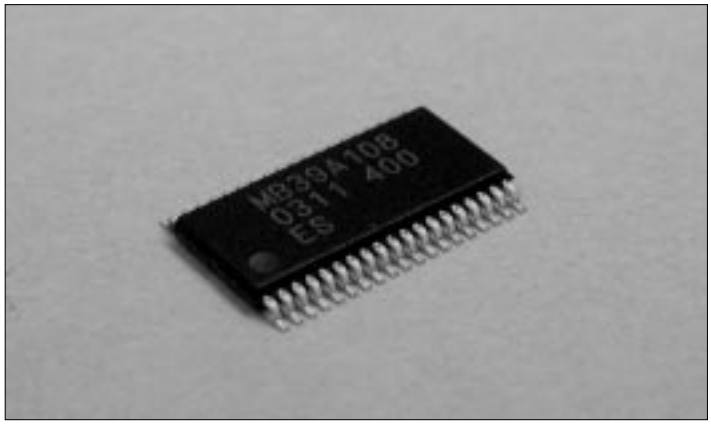
FUJITSU has been putting a great deal of effort into the development of ICs for power managements in high-performance portable devices such as digital still cameras. Building on the technological foundation of eight predecessor series (MB3785A, MB3825A, MB3827, MB3881, MB3883, MB39A102, MB39A103, and MB39A110), the company has recently completed "MB39A108", a 5-channel DC/DC converter IC with synchronous rectification. MB39A108 is optimal for multi power supply systems built-in 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 5-channel DC/DC converter IC with a synchronous rectification function based on the pulse width modulation type (PWM type). Up-conversion, down-conversion, and up/down conversion are all supported, and each of five channels built-in a TSSOP-38P 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 start-up and overcurrent due to output short-circuits. These features make MB39A108 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 CH3)**
- **Supports up-conversion and up/down SEPIC conversion (CH4 to CH5)**

Photo 1 External View



- **Supports the synchronous rectification method**
- **Lower starting voltage (CH4 to CH5) : 1.7V**
- **Power supply voltage range: 2.5V to 11V**
- **Reference voltage: 2.0V±1%**
- **Error amplifier threshold voltage: 1.0V±1% (CH1), 1.23V±1% (CH2 to CH5)**
- **Oscillating frequency range: 200kHz to 2.0MHz**
- **Standby current: 0μA (Typ.)**
- **Built-in soft-start circuit without load dependency**
- **Build-in totem-pole type output for MOS FET**
- **Short-circuit detection from short-circuit input possible using external signal (-INS terminal)**
- **Package: TSSOP-38P**

Circuit Configuration

Fig.1 shows the block diagram and **Fig.2** shows the pin assignments.

MB39A108 is configured with the following function blocks.

DC/DC Converter Function

Reference Voltage Generator Block (Ref)

The typical 2.0V reference voltage generated by the generator circuit is temperature compensated by the voltage supplied 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 0.4V to 0.9V) terminal by connecting the condenser 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 Amp)

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 condenser from the output terminal of the error amplifier to the inverted input terminal.

Possible inrush current at power start-up can be prevented by connection of a capacitor to the CS terminal of each channel. By detecting soft-start in the error amplifier, the device operates soft-start at a fixed timing independent from the DC/DC converter output load.

PWM Comparator Block (PWM Comp.)

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

Output Block (Drive)

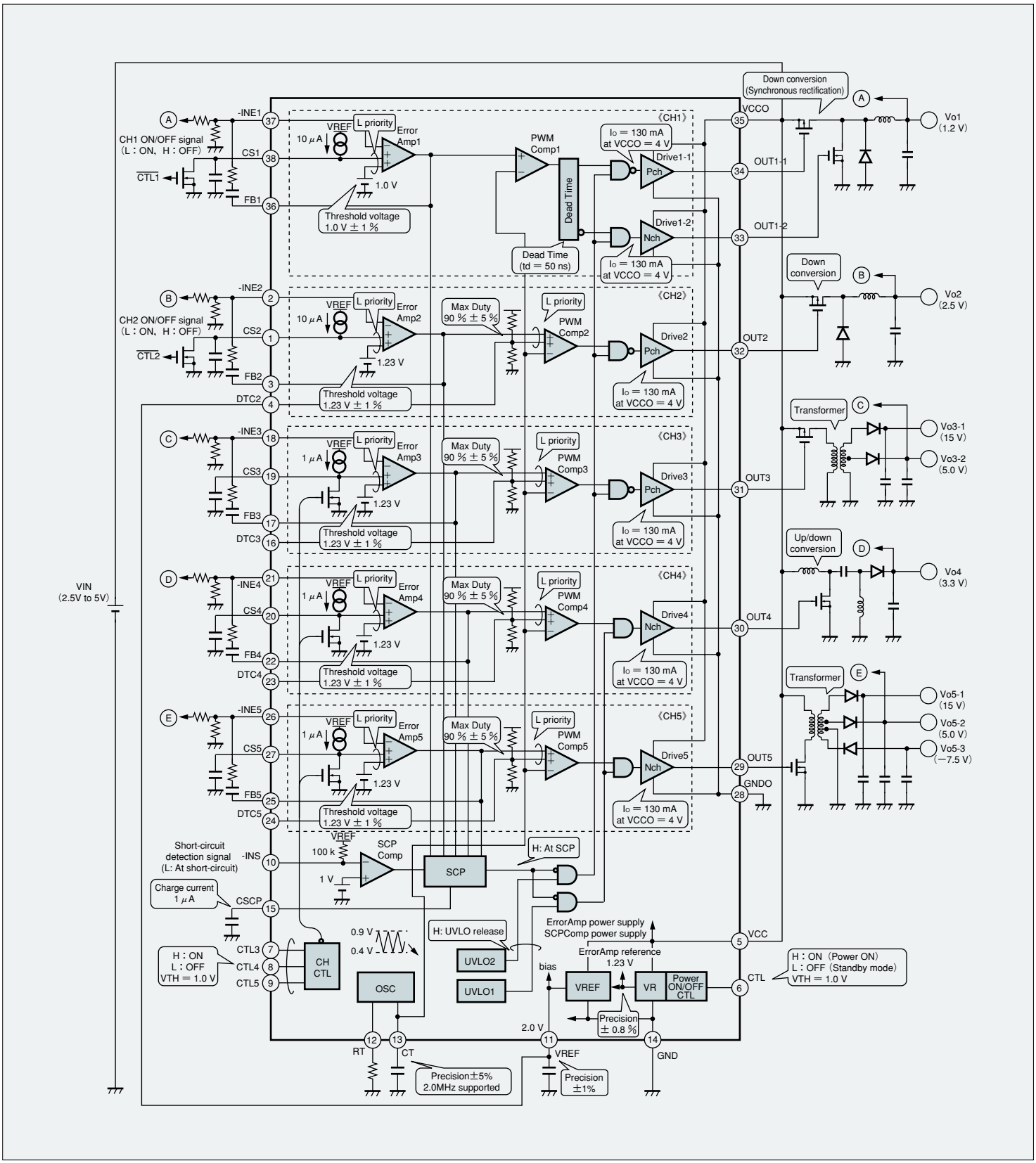
The output circuit adopts a totem-pole construction and is

Table 1 ON/OFF Setting Conditions for Each Channel

CTL	CS1	CS2	CTL3	CTL4	CTL5	Power	CH1	CH2	CH3	CH4	CH5
L	−*	−*	−*	−*	−*	OFF	OFF	OFF	OFF	OFF	OFF
H	GND	GND	L	L	L	ON	OFF	OFF	OFF	OFF	OFF
H	HiZ	GND	L	L	L	ON	ON	OFF	OFF	OFF	OFF
H	GND	HiZ	L	L	L	ON	OFF	ON	OFF	OFF	OFF
H	GND	GND	H	L	L	ON	OFF	OFF	ON	OFF	OFF
H	GND	GND	L	H	L	ON	OFF	OFF	OFF	ON	OFF
H	GND	GND	L	L	H	ON	OFF	OFF	OFF	OFF	ON
H	HiZ	HiZ	H	H	H	ON	ON	ON	ON	ON	ON

*: Undefined

Figure 1 Block Diagram



capable of driving an external Pch MOS FET (channel 1 main side, channels 2 and 3) and Nch MOS FET (channel 1 synchronous rectification side, channels 4 and 5).

Channel Control Function

The ON/OFF status for each channel is set via the voltage setup at the CTL terminals or the CTL1 to CTL5 terminals.

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

Protection Circuit Functions

Timer Latch Short-circuit Protection Circuit Block (SCP)

The short-circuit detection comparator (SCP Comp.) constantly compares the output level of the error amplifier and the reference voltage in each channel.

When the DC/DC converter load condition is stable in all channels, the CSCP terminal and output from the short-circuit detection comparator both stay at the "L" level. When the load condition changes rapidly due to a load short-circuit, etc. and the output voltage drops, the output from the short-circuit detection comparator climbs to the "H" level. At this point, charging commences in the short-circuit protection capacitor Cscp externally attached to the CSCP terminal. When the capacitor Cscp charge reaches the threshold voltage ($V_{TH} \fallingdotseq 0.70V$), it sets the latch and turns OFF the external FET (sets the dead time to 100%). The latch input then closes and the CSCP terminal is maintained at the "L" level. The latch on the timer latch short-circuit protection circuit can be canceled by cutting off the power supply (VCC) or turning the CTL terminal to the "L" level.

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 a control IC, and in worse cases system deterioration or destruction. To prevent these types of malfunction, the undervoltage lockout circuit block detects the internal reference voltage level by monitoring the power supply voltage, turns OFF the output FET, 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 (CS)

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

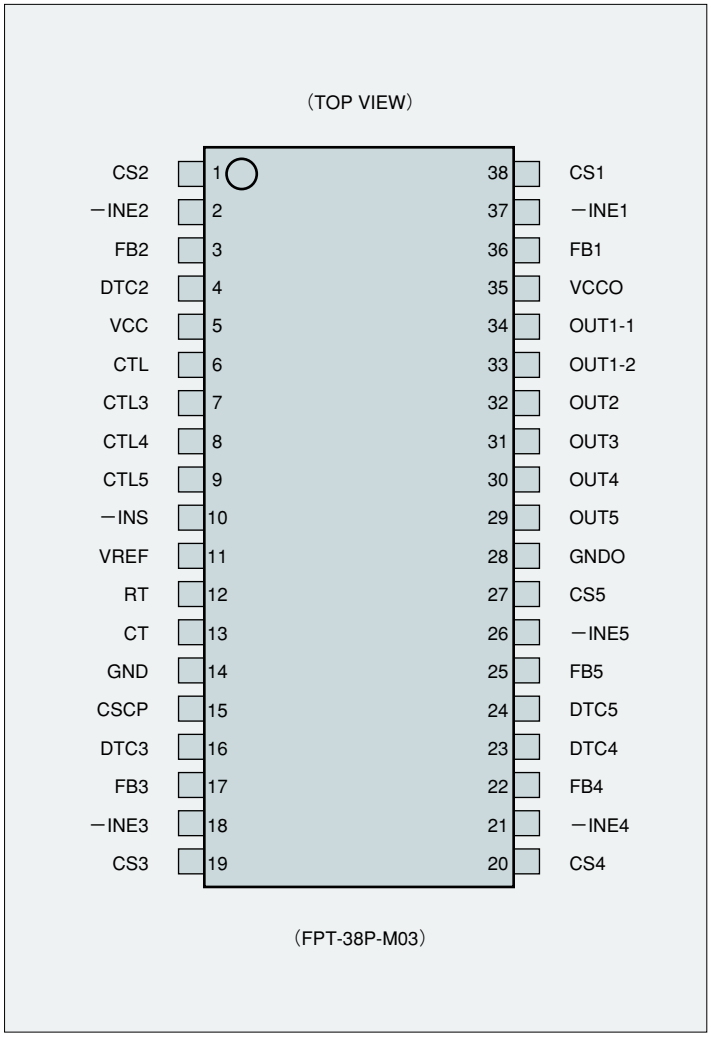



Figure 2 Pin Assignments