2-Channel DC/DC Converter IC with Overcurrent Protection MB39A104

This 2-channel DC/DC converter IC utilizes the pulse width modulation type (PWM method) and features a built-in timer latch overcurrent protection circuit (no current sense resistor is necessary). Since it is capable of operation at high frequency, the coil value can be relatively small.
This converter is optimal for the built-in power supply such as LCD monitors.

Product Description

FUJITSU has recently developed a 2-channel DC/DC converter IC with timer latch overcurrent protection, MB39A104, which is optimal for the built-in power supply such as LCD monitors.

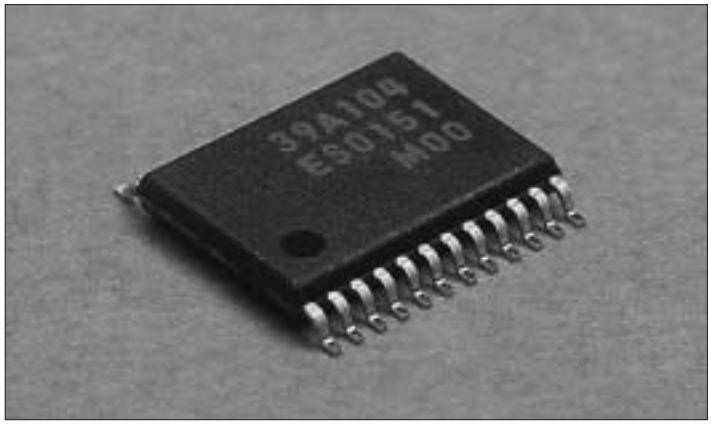
The LCD monitor market is growing dramatically, with an expected worldwide production of approximately 30 million devices in 2003, and 50 million devices in 2005. And for these LCD monitors, there is a demand for a built-in power supply with overcurrent protection.

This product is a pulse width modulation (PWM) type 2-channel DC/DC converter IC with a built-in timer latch overcurrent protection circuit (no current sense resistor is necessary), and it is optimal for down conversion. Since it can operate at high frequency, the coil value can be relatively small. In addition, a soft-start circuit and a timer latch short-circuit detection circuit are built in to prevent an inrush current at power start-up or an overcurrent in the case of output short-circuit.

Product Features

- **Built-in Timer Latch Overcurrent Protection Circuit (no current sense resistor is necessary)**
- **Power Supply Voltage Range: 7V to 19V**
- **Reference Voltage: 5.0V±1%**
- **Error Amplifier Threshold Voltage: 1.24V±1%**

Photo 1 External View



- **High Frequency Operation Possible: 1MHz (Max.)**
- **Built-in Standby Function: 1 μA (Typ.)**
- **Built-in Load Independent Soft-Start Circuit**
- **Built-in Totem-Pole-Type Output for Pch MOS FET**
- **Package: SSOP-24P**

Circuit Configuration

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

The function blocks used to build this product are described below.

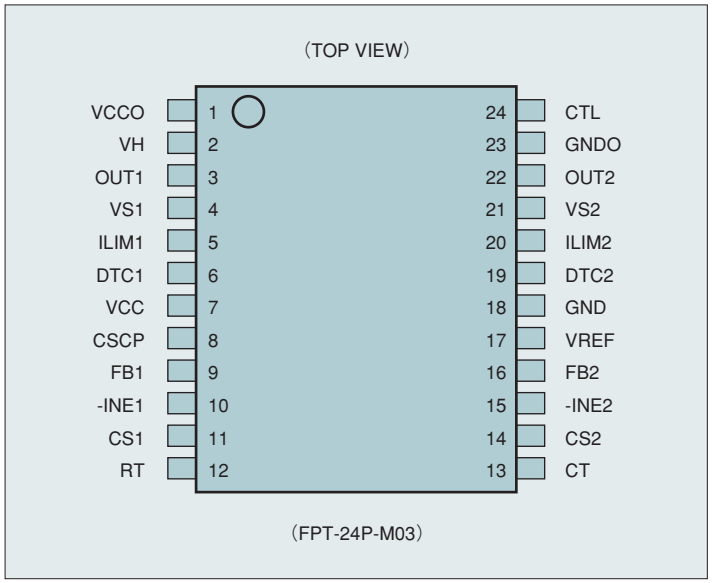
DC/DC Converter Function

Reference Voltage Block (REF)

The reference voltage circuit generates a temperature — compensated reference voltage (5.0V typ.) using the voltage supplied from the power supply terminal, and this is used as the reference voltage for the IC's internal circuit.

In addition, the reference voltage can be used to supply a load current of up to 1mA to an external device via the VREF terminal.

Figure 1 Pin Assignments



Triangular Wave Oscillator Block (OSC)

A triangular wave form with amplitude 1.5V to 2.5V is generated from CT terminal by connecting capacitor and resistor for timing on CT and RT terminals respectively.

The triangular wave oscillation waveform 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 the PWM control signal. Since optional loop gain can be specified through connection of the feedback resistor and capacitor to the inverted input terminal from the output terminal of the error amplifier, a stable phase compensation against the system is ensured.

Connection of a capacitor for soft-start to the CS1 and CS2 terminals, the non-inverted input terminals of the error amplifier, prevents an inrush current at power start-up. Performing soft-start detection with an error amplifier enables soft-start operation over a constant period of time independent of the DC/DC converter output load.

PWM Comparator Block (PWM Comp.)

This voltage-pulse width modulator controls the output duty depending on the input/output voltage. The output transistor is turned ON when the error amplifier output voltage and DTC voltage are higher than the triangular wave voltage.

Output Block (Drive)

The output circuit is constructed in totem-pole style and is capable of driving an external Pch MOS FET.

Channel Control Function

The ON/OFF status of each channel is specified by voltage specification at the CTL terminal and each CS terminal.

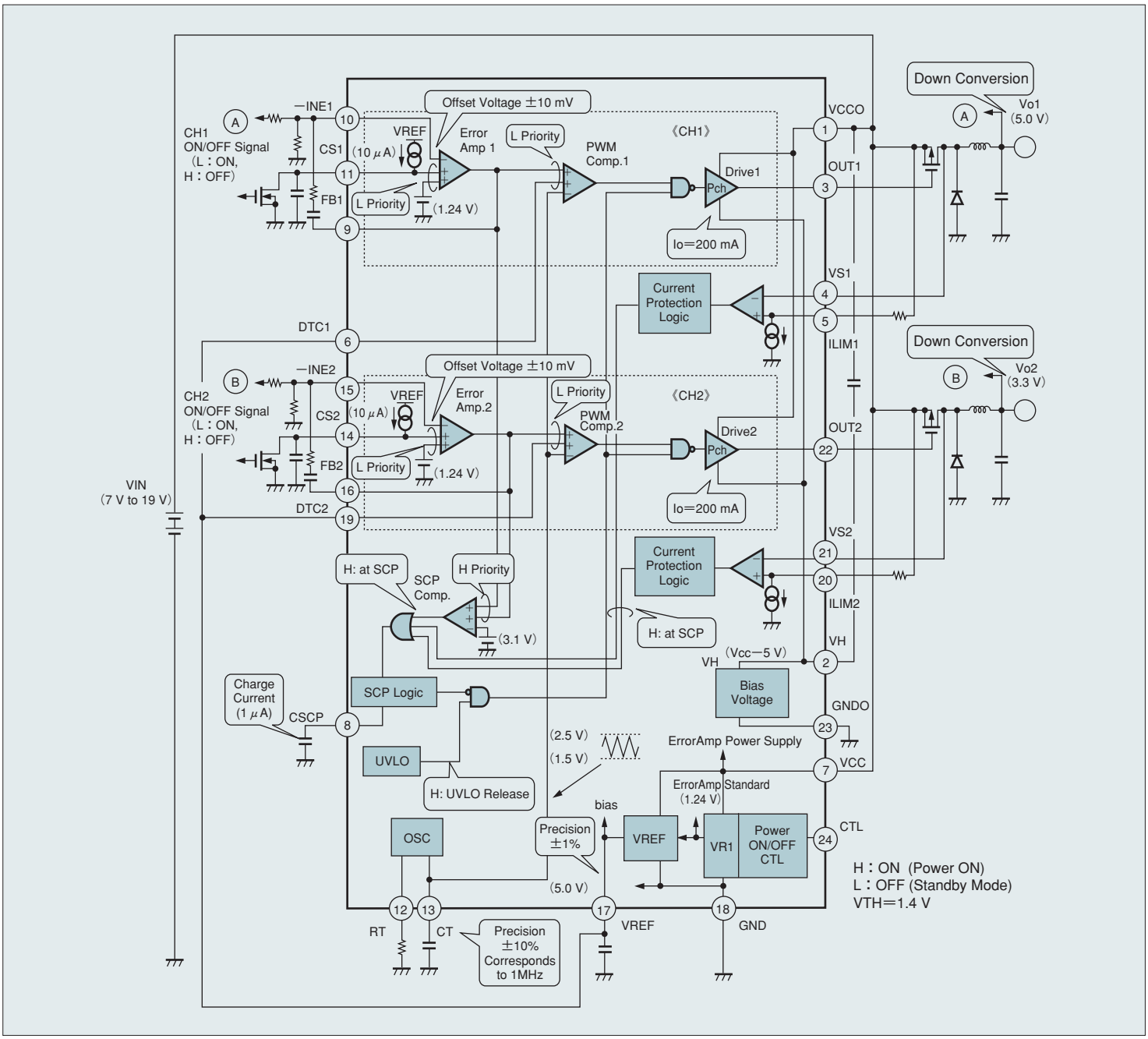
Table 1 shows the ON/OFF setting conditions.

Protection Circuit Functions

Timer Latch Short-Circuit Protection Circuit Block (SCP)

The short-circuit detection comparator detects the level of error amplifier output voltage. When the error amplifier output voltage on any channel exceeds the short-circuit detection voltage, the timer circuit operates and begins to charge the

Figure 2 Block Diagram



capacitor Cscp that is externally connected to the CSCP terminal. When the capacitor voltage reaches approximately 0.73V, the output FET is turned OFF and the dead time is set to 100%. If the protection circuit is activated, the latch is released when the power supply is turned OFF and ON again or when the CTL terminal is set to the "L" level and the VREF terminal voltage becomes 2.4V (min.) or less.

Undervoltage Lockout Circuit Block (UVLO)

In the transient state at normal power start-up or during momentary drops in the power supply voltage, control IC malfunction may be induced, which can lead to system damage or deterioration. To prevent these types of malfunction, the undervoltage lockout circuit detects any decrease in the internal reference voltage level and turns the output FET to OFF, thereby setting the dead time to 100% while maintaining the CSCP terminal at the "L" level. If the power supply voltage exceeds the threshold voltage of the undervoltage lockout circuit, the system will restore itself.

Table 1 ON/OFF Setting Conditions for Each Channel

CTL	CS1	CS2	Power	CH1	CH2
L	—*	—*	OFF	OFF	OFF
H	GND	GND	ON	OFF	OFF
H	HiZ	GND	ON	ON	OFF
H	GND	HiZ	ON	OFF	ON
H	HiZ	HiZ	ON	ON	ON

*: Undefined

Overcurrent Protection Circuit Block (OCP)

The overcurrent protection circuit starts operating when the soft-start period ends. If an overcurrent flows, the timer circuit is activated as soon as it detects the increase in the voltage between the drain and the source on the FET by the on-resistor on the external FET. Once the circuit is activated, it begins to charge the external capacitor Cscp connected to the CSCP terminal. If the overcurrent continues for more than the set time, the circuit sets the latch and turns the output FET on each channel to OFF.

The OCP can also be used for overcurrent detection with the current sense resistor if the connection is modified.

Soft-Start Function

Soft-Start Circuit Block (CS)

By connecting capacitors for soft-start to the CS1 and CS2 terminals, which are the non-inverted input terminals of the error amplifier, an inrush current at power start-up can be prevented. Performing soft-start detection with the error amplifier enables soft-start operation over a constant period of time independent of the DC/DC converter output load. ✱