4-Channel DC/DC Converter IC for Large LCD Panels MB39C313A

A system power management IC capable of supplying the four types of voltages required in large LCD panels in a single chip. With built-in switching FET for large current operation, this product is suitable for applications such as large LCD TVs and monitors.

Overview

This product is a system power management IC with a built-in 4-channel power management control block. It consists of a 2-channel DC/DC converter with switching FET and a 2-channel charge pump type DC/DC converter. The DC/DC converter block offers excellent stability against input voltage fluctuations with the input voltage feed-forward method. The output voltage in the charge pump circuit block can be set by an external resistor using the output voltage feedback method.

This product contributes to a reduction in the parts cost as a result of the built-in switching FET and phase compensator.

Product Features

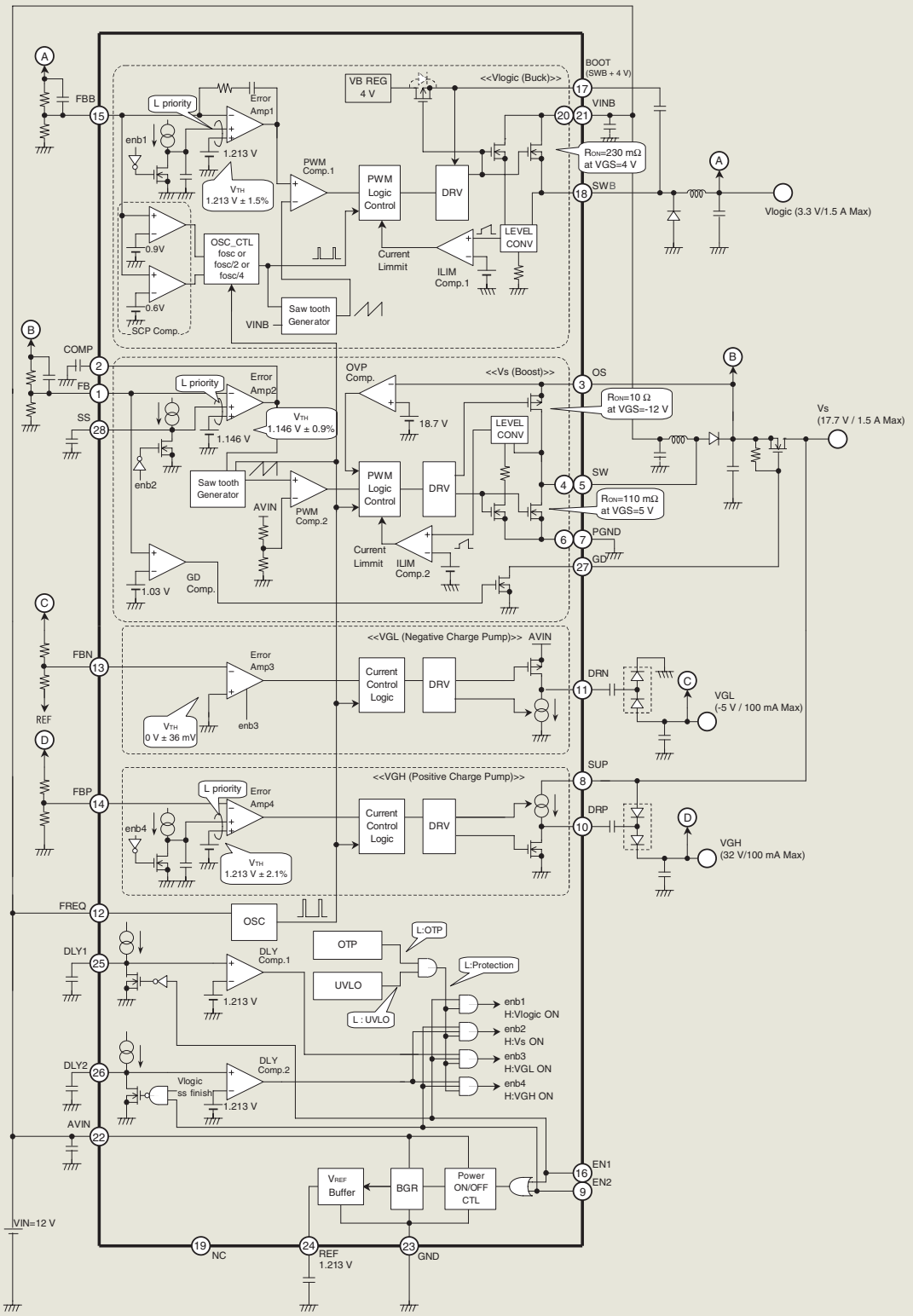
- Power supply voltage range: 8V to 14V
- DC/DC converter with built-in switching FET
- Step-down converter (Vlogic): Output 1.8V to 3.3V 1.5A (max.)
- Step-up converter (Vs): Output 17.7V 1.5A (max.)
- Charge pump with output voltage feedback method
- Inverting charge pump (VGL): 100mA (max.)
- Step-up charge pump (VGH): 100mA (max.)
- Excellent line regulation with feed-forward control (Vlogic, Vs)
- Built-in phase compensator (Vlogic)
- Built-in startup sequence control function
- Sufficient protective functions
  Short-circuit protection, overcurrent protection, overvoltage protection, undervoltage lockout, over temperature protection
- Built-in soft-start circuit independent of loads (Vlogic, Vs)
- Frequency setting by input pin: 500kHz/750kHz
- Package: TSSOP-28 (with exposed PAD)
- Lead-free/conforms to RoHS Directive

Functions

Figure 1 presents the block diagram of this product.

Photo 1 External View

Figure 1 MB39C313A Block Diagram



Power management voltage functions

Generates the voltages for the controller (Vlogic), source driver (Vs), and gate driver (VGL, VGH) required in general LCD panels.

Vlogic (Vo1): Step-down converter

The step-down converter uses pulse width modulation (PWM) with built-in N-channel switching FET. The input voltage feed-forward method ensures excellent line regulation. Phase compensation constant is set by a built-in compensation circuit and an external ceramic capacitor. The main switch of the converter is an N-channel FET with 3.2A peak current rating and the gate drive circuit is referenced to the SWB pin (source terminal of N-channel switching FET). An external capacitor connected between SWB pin and BOOT pin is charged to 4V by the built-in 4V regulator during the period when N-channel FET is off cycle. Since this capacitor turns ON the N-channel FET fully, it bootstraps the gate driving voltage higher than the power supply voltage along with the N-channel FET. As a consequence, the gate-source voltage reaches 4V while the N-channel FET is on.

Vs (Vo2): Step-up converter

The step-up converter containing a build-in N-channel switching FET and an external diode operates as a pulse width modulated (PWM) asynchronous DC/DC converter. It adopts the input voltage feed-forward method to ensure excellent line regulation under voltage mode. Phase compensation is set by external parts. It operates in continuous conduction mode independent of loading current due to the operation of the built-in P-channel switching FET (ON resistance 10Ω) connected between the SW pin and the OS pin along with the external flyback diode.

VGL (Vo3): Inverting charge pump

The inverting charge pump operates at a fixed frequency and the output voltage can be set by the divider ratio of the external resistor divider. When the charge pump driver is connected to the supply voltage (VIN), the maximum output voltage is −VIN+ Vloss. Vloss includes voltage drops in the output diode and driver transistors. The addition of more charge pump stages can increase the maximum negative voltage value.

VGH (Vo4): Step-up charge pump

Like the inverting charge pump, the step-up charge pump operates at a fixed frequency and the output voltage can be set by the divider ratio of the external resistor divider. By connecting the step-up converter output (Vs) or MB39C313A input (VIN) to the charge pump input (SUP), the maximum output voltage becomes Vsup+Vs. The addition of more charge pump stages can increase the maximum output voltage.

Startup sequence

The startup sequence can be set using EN1 and EN2. The startup sequence timing can be adjusted by the capacitors connected to DLY1 and DLY2.

When EN1 is set at "H" with EN2 fixed at "H," Vlogic starts up first and VGL starts up after delay time DLY1. Vs and VGH start up simultaneously after delay time DLY2 (**Figure 2**). When EN2 is set at "H" with Vlogic already operating and with EN1 at "H," the delay time DLY2 starts from the EN2 rising edge (**Figure 3**). If EN2 is set to "H" before Vlogic operates, DLY2 starts after Vlogic finishes start up.

Soft-start function

Vlogic and Vs are equipped with a soft-start function to prevent inrush current at startup. The soft-start period is approximately 1ms for Vlogic (fixed) and is set by the external capacitor for Vs.

Various protective functions

- Vlogic: Step-down converter
  Short-circuit protection:
  Protective circuit active at FBB pin<0.9V.
  Overcurrent protection:
  Protective circuit active at Vlogic output current≧3.2A.
- Vs: Step-up converter
  Overvoltage protection:
  Protective circuit active at Vs output≧18.7V.
  Overcurrent protection:
  Protective circuit active at SW pin current≧3.5A.
- VGL: Inverting charge pump: No protection circuit
- VGH: Step-up charge pump: No protection circuit
- Undervoltage lockout protection (UVLO)
  All channels shut down at AVIN≦6V.
- Over temperature protection (OTP)
  Switching is stopped when the junction temperature reaches 150℃ .
  Switching is resumed when the junction temperature drops to 135℃ .

Switching frequency

Table 1 presents the switching frequency.

Table 1 Switching Frequency

Terminal	Setting	Switching frequency
FREQ	H	750kHz
	L	500kHz

Application Examples

Figure 4 presents application examples of this product.

Evaluation Board

We offer an evaluation board to aid evaluation of this product (**Photo 2**).

Difference from MB39C313

The charge pump current for VGL and VGH has been expanded to 100mA (max.).

Future Development

FUJITSU has developed system power management ICs for LCD panels by integrating D/A converters and DC/DC converters using the core of our power management IC analog technology. In the future, we will continue to realize developments that address our customer needs in order to enable the further integration of peripheral functions as well as cost reduction. ✱

Figure 2 Startup Sequence when EN2 is always set to "H"

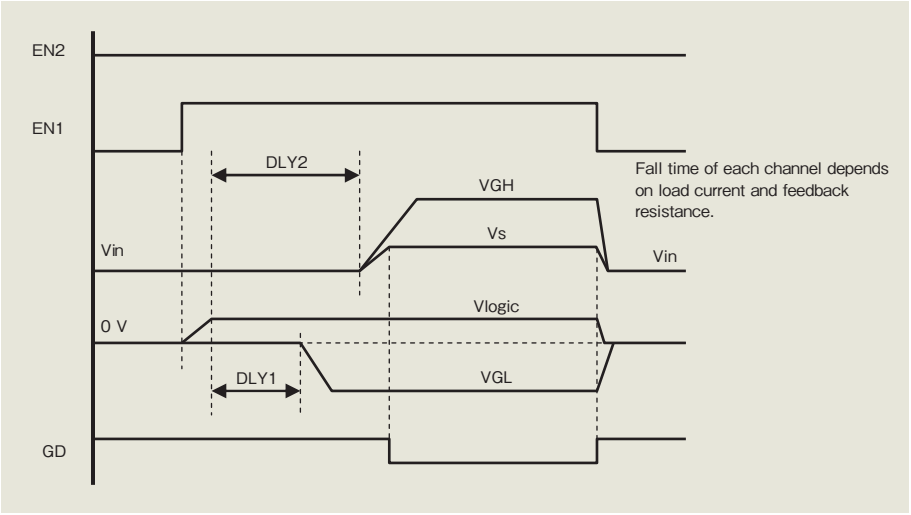


Figure 3 Startup Sequence when EN1 and EN2 are set to "H" separately

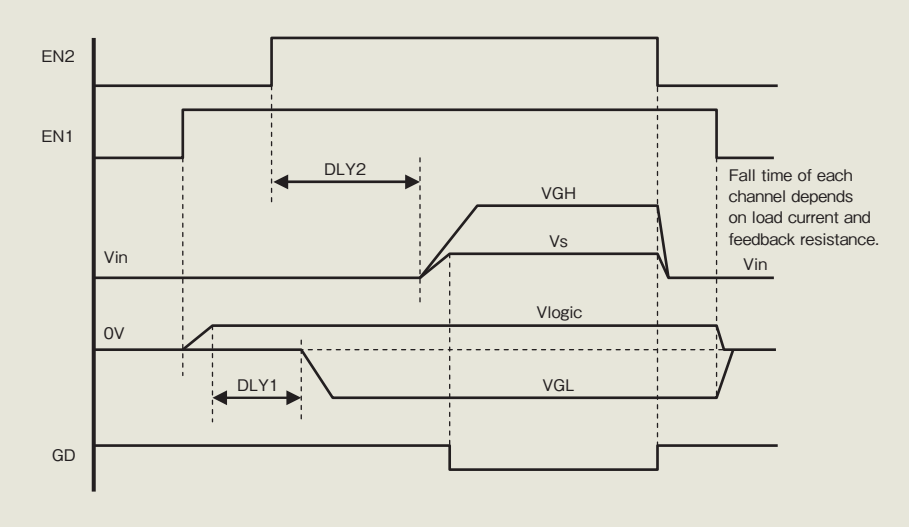


Photo 2 Evaluation Board

Figure 4 Application Examples