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LED Drivers for LCD Backlights

Backlight LED Driver for Small LCD Panels (Charge Pump Type)



BD82103GWL

No.11040EBT34

●Description

BD82103GWL is charge pump type 2 light or 3 light parallel LED driver for the portable instruments.

This IC not only ensures efficient boost by automatically changing the boost rate but also works as a constant current driver in 16 steps, so that the driving current can be adjusted finely. This IC is best suited to turn on white LEDs that require high-accuracy LED brightness control.

●Features

- 1) 2light or 3light parallel LED driver is mounted
- 2) 16-step LED current adjust function
- 3) Inter-LED relative current accuracy: 5% or less
- 4) Driving control via a single-line digital control interface
- 5) Automatic transition charge pump type DC/DC converter ($\times 1, \times 1.5, \times 2$)
- 6) High efficiency achieved (Maximum over 93%)
- 7) It transits for the most suitable power operating by the LED terminal process of the 3rd light when 2 light driving
- 8) Various protection functions such as output voltage protection and thermal shutdown circuit are mounted.
- 9) Package : UCSP50L1 (Thick 0.55mm MAX, Pin pitch 0.4mm) CSP11pin package

●Absolute Maximum Ratings (Ta=25°C)

Parameter	Symbol	Ratings	Unit
Power supply voltage	VMAX	7	V
Input voltage (EN)	Vdin	GND-0.3 ~ VBAT+0.3	V
Power dissipation	Pd	730	mW
Operating temperature range	Topr	-30 ~ +85	°C
Storage temperature range	Tstg	-55 ~ +150	°C

Note 1) The measurement value which was mounted on the PCB by ROHM.

When a glass epoxy substrate (70mm × 70mm × 1.6mm) has been mounted, this loss will decrease 5.84mW/°C if Ta is higher than or equal to 25°C.

●Operating Conditions (Ta = -30 ~ 85 °C)

Parameter	Symbol	Ratings	Unit
Operating power supply voltage	VBAT	2.7 ~ 5.5	V

*This chip is not designed to protect itself against radioactive rays.

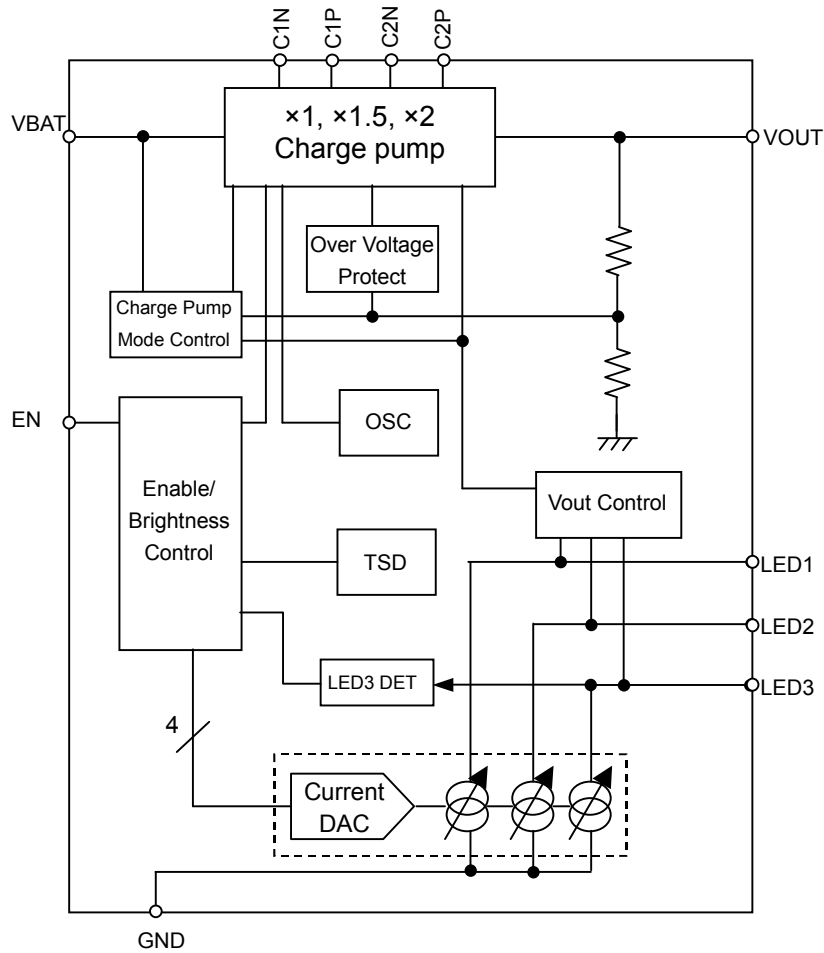
*This material may be changed on its way to designing.

*This material is not the official specification.

● **Electrical Characteristics** (Unless otherwise noted, Ta = +25°C, VBAT=3.6V)

Parameter	Symbol	Limits			Unit	Condition
		Min.	Typ.	Max.		
Current Consumption						
Quiescent Current	Iq	-	0.1	1	μA	EN=0V
Current Consumption1	Idd1	-	1.0	2.4	mA	x1.0 Mode, Except LED current
Current Consumption2	Idd2	-	2.0	3.5	mA	x2.0 Mode, Except LED current
Charge Pump						
Oscillator frequency	fOSC	0.56	0.85	1.14	MHz	
Current Source						
LED maximum current	ILED-max	18	20	22	mA	VBAT≥3.0V
LED current accuracy	ILED-diff	-	-	10.0	%	When LED current 10.0mA setting and LED terminal voltage 1.0V
LED current matching	ILED-match	-	0.5	5.0	%	When LED current 10.0mA setting and LED terminal voltage 1.0V
LED control voltage	VLED	-	0.15	0.25	V	minimum voltage at LED1~LED3 pins
Logic control terminal						
Low threshold voltage	VIL	-	-	0.4	V	EN
High threshold voltage	VIH	1.4	-	-	V	EN
High level Input current	IiH	-	0	1	μA	EN=Vin
Low level Input current	IiL	-1	0	-	μA	EN=0V
Minimum EN High time	THI	0.05	-	100	μsec	Described in Fig.5
Minimum EN Low time	TLO	0.3	-	100	μsec	Described in Fig.5
EN Off Timeout	TOFF	1	-	-	msec	Described in Fig.5
Latch time	TLAT	1	-	-	msec	Described in Fig.5
Access available time	Tacc	1	-	-	msec	Described in Fig.5

●Block Diagram



Pin number 11pin
Fig. 1 Block Diagram

●Pin Configuration [Bottom View]

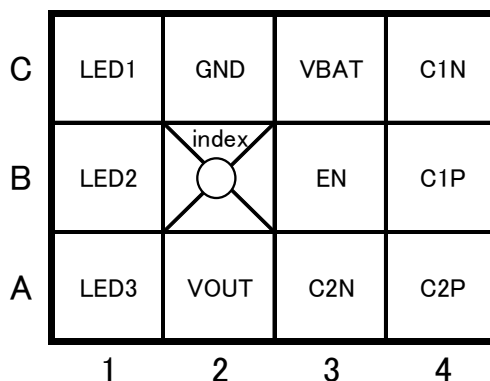


Fig. 2 Pin Configuration

●Pin Descriptions

Pin No.	Terminal No.	Pin name	In/Out	Type	Function
1	C3	VBAT	-	A	Power supply
2	B4	C1P	In/Out	A	Flying capacitor pin positive (+) side
3	C4	C1N	In/Out	B	Flying capacitor pin negative (-) side
4	A4	C2P	In/Out	A	Flying capacitor pin positive (+) side
5	A3	C2N	In/Out	B	Flying capacitor pin negative (-) side
6	A2	VOUT	Out	A	Charge pump output
7	B3	EN	In	C	ON/OFF and dimming control
8	C1	LED1	Out	A	LED current driver output 1
9	B1	LED2	Out	A	LED current driver output 2
10	A1	LED3	Out	A	LED current driver output 3
11	C2	GND	-	D	GND

●Pin ESD Type

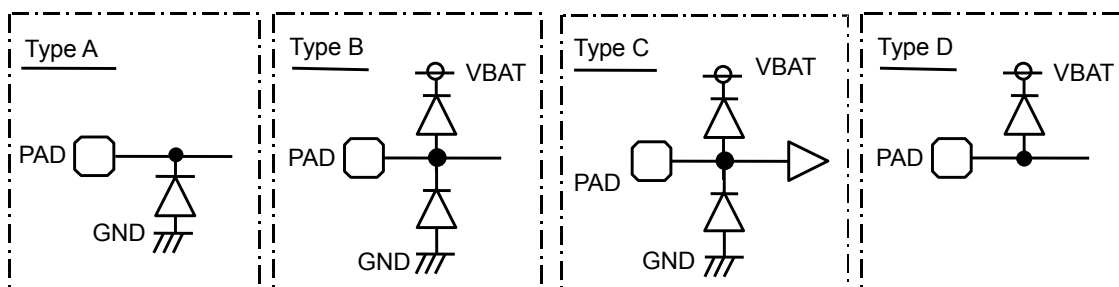


Fig. 4 Pin ESD Type

●Separate Function Description

(1) LED driver

• Register access control protocol

LED current is controlled by only EN terminal. It is possible to access the register inside of this chip by using the protocol below. LED driver ON/OFF, selecting the mode is operated by accessing the registers with using this protocol.

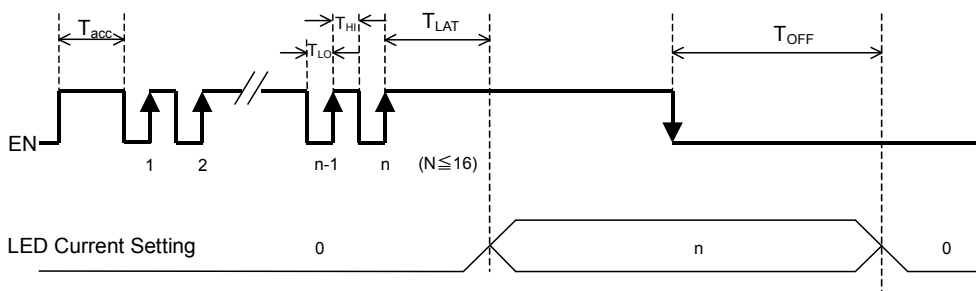


Fig.5 Register access protocol

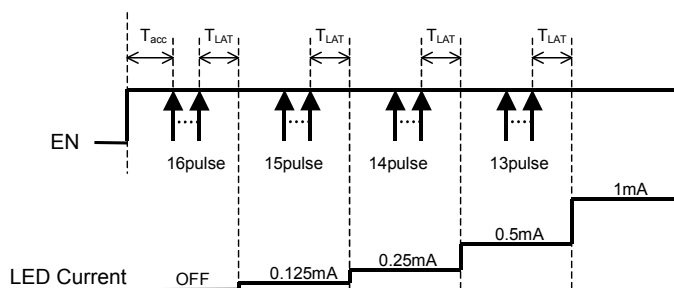


Fig.6 Slope control example

(Note)

- In the case of $N > 16$, BD82103GWL selects the mode of $N = 16$.
- LED current is changed by the pulse of EN pin.
Be careful to noise of EN signal.
- Reset BD82103GWL when the set is unusual. (Keep EN=L over Toff time.)

• LED current level

The interface records rising edges of the EN pin and decodes them into 16 different indicated in following table.

Data	Output current [mA]	Data	Output current [mA]
1	20.0	9	5.0
2	17.0	10	4.0
3	14.0	11	3.0
4	12.0	12	2.0
5	10.0	13	1.0
6	8.5	14	0.5
7	7.0	15	0.25
8	6.0	16	0.125

(2) Charge pump

a) Description of operations

Pin voltage comparison takes place at Vout control section, and then Vout generation takes place so that the LED cathode voltage with the highest Vf is set to 0.2V. A boost rate is changed automatically to a proper one at the Charge Pump Mode Control section so that operation can take place at possible low boost rate. In addition, if the output voltage falls below 1.5V, this IC is reset for short-circuit at output.

b) Soft start function

BD82103GWL have a soft start function that prevents the rush current.

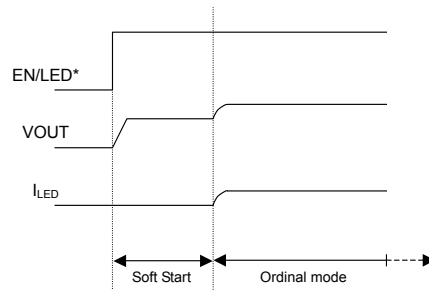


Fig.7 Soft Start

c) Automatic boost rate change

The boost rate automatically switches to the best mode.

*** (×1 mode → ×1.5 mode) or (×1.5 mode → ×2 mode)**

If a battery voltage drop occurs BD82103GWL cannot maintain the LED constant current, and then mode transition begins.

*** (×1.5 mode → ×1 mode) or (×2 mode → ×1.5 mode)**

If a battery voltage rise occurs, VOUT and VBAT detection are activated, and then mode transition begins.

(3) UVLO (Under Voltage Lock Out)

If the input voltage falls below 2.2V, BD82103GWL is shut down to prevent malfunction due to ultra-low voltage.

(4) OVP (Over Voltage Protection)

This circuit protects this IC against damage when the C/P output voltage (VOUT) rises extremely for some external factors.

(5) Thermal shutdown (TSD)

To protect this IC against thermal damage or heat-driven uncontrolled operations, this circuit turns off the output if the chip temperature rises over 175°C. In addition, it turns on the output if the temperature returns to the normal temperature. Because the built-in thermal protection circuit is intended to protect the IC itself, the thermal shutdown detection temperature must be set to below 175°C in thermal design.

(6) Power sequence

EN signal must be released after VBAT voltage enough rise up.

Prohibit the VBAT rise up during EN="H".

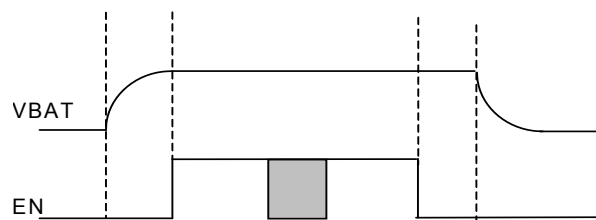


Fig.8 Power sequence

●Application Circuit Example (3 light)

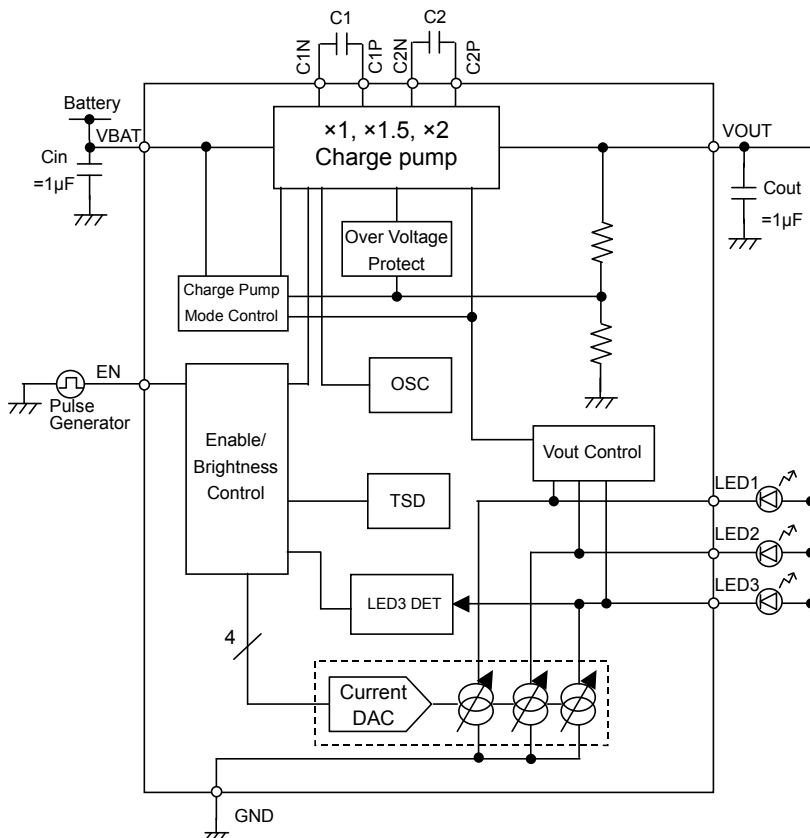


Fig.9 Application Circuit Example 1

●Application Circuit Example (2 light)

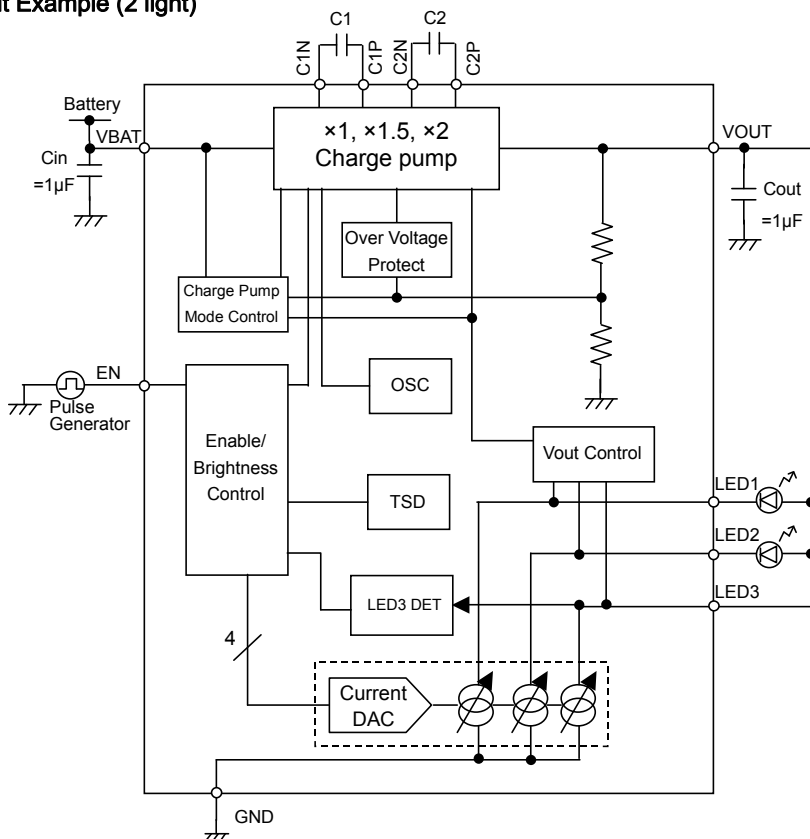
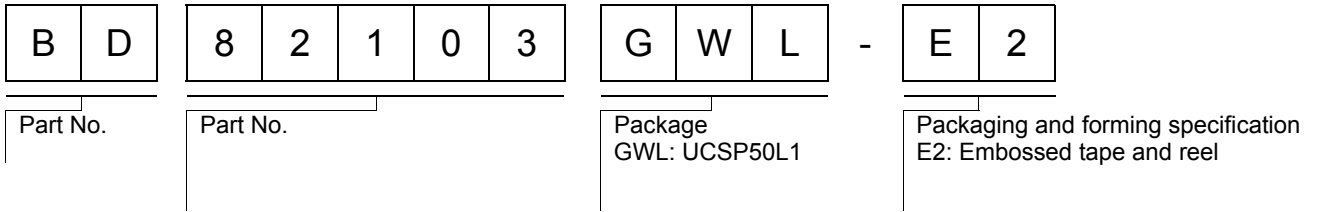


Fig.10 Application Circuit Example 2

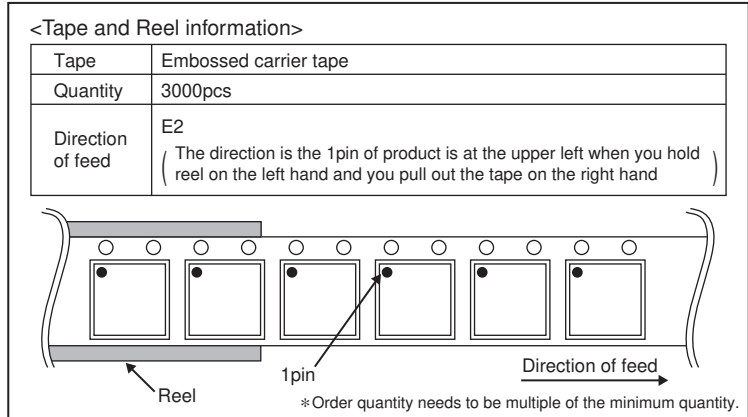
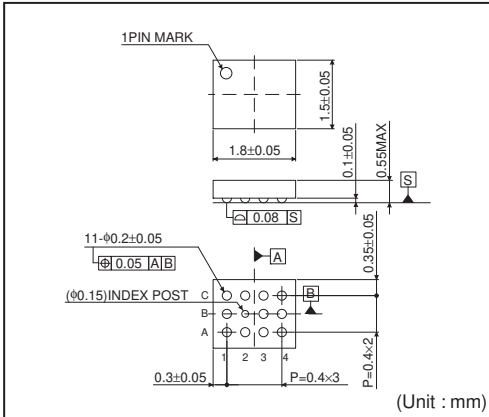
●Notes for use

- (1) Absolute Maximum Ratings
An excess in the absolute maximum ratings, such as supply voltage, temperature range of operating conditions, etc., can break down devices, thus making impossible to identify breaking mode such as a short circuit or an open circuit. If any special mode exceeding the absolute maximum ratings is assumed, consideration should be given to take physical safety measures including the use of fuses, etc.
- (2) Power supply and ground line
Design PCB pattern to provide low impedance for the wiring between the power supply and the ground lines. Pay attention to the interference by common impedance of layout pattern when there are plural power supplies and ground lines. Especially, when there are ground pattern for small signal and ground pattern for large current included the external circuits, please separate each ground pattern. Furthermore, for all power supply pins to ICs, mount a capacitor between the power supply and the ground pin. At the same time, in order to use a capacitor, thoroughly check to be sure the characteristics of the capacitor to be used present no problem including the occurrence of capacity dropout at a low temperature, thus determining the constant.
- (3) Ground voltage
Make setting of the potential of the ground pin so that it will be maintained at the minimum in any operating state. Furthermore, check to be sure no pins are at a potential lower than the ground voltage including an actual electric transient.
- (4) Short circuit between pins and erroneous mounting
In order to mount ICs on a set PCB, pay thorough attention to the direction and offset of the ICs. Erroneous mounting can break down the ICs. Furthermore, if a short circuit occurs due to foreign matters entering between pins or between the pin and the power supply or the ground pin, the ICs can break down.
- (5) Operation in strong electromagnetic field
Be noted that using ICs in the strong electromagnetic field can malfunction them.
- (6) Input pins
In terms of the construction of IC, parasitic elements are inevitably formed in relation to potential. The operation of the parasitic element can cause interference with circuit operation, thus resulting in a malfunction and then breakdown of the input pin. Therefore, pay thorough attention not to handle the input pins, such as to apply to the input pins a voltage lower than the ground respectively, so that any parasitic element will operate. Furthermore, do not apply a voltage to the input pins when no power supply voltage is applied to the IC. In addition, even if the power supply voltage is applied, apply to the input pins a voltage lower than the power supply voltage or within the guaranteed value of electrical characteristics.
- (7) External capacitor
In order to use a ceramic capacitor as the external capacitor, determine the constant with consideration given to a degradation in the nominal capacitance due to DC bias and changes in the capacitance due to temperature, etc.
- (8) Thermal shutdown circuit (TSD)
This IC builds in a thermal shutdown (TSD) circuit. When junction temperatures become detection temperature or higher, the thermal shutdown circuit operates and turns a switch OFF. The thermal shutdown circuit, which is aimed at isolating the IC from thermal runaway as much as possible, is not aimed at the protection or guarantee of the IC. Therefore, do not continuously use the IC with this circuit operating or use the IC assuming its operation.
- (9) Thermal design
Perform thermal design in which there are adequate margins by taking into account the permissible dissipation (Pd) in actual states of use.
- (10) LDO
Use each output of LDO by the independence. Don't use under the condition that each output is short-circuited because it has the possibility that an operation becomes unstable.
- (11) About the pin for the test, the un-use pin
Prevent a problem from being in the pin for the test and the un-use pin under the state of actual use. Please refer to a function manual and an application notebook. And, as for the pin that doesn't specially have an explanation, ask our company person in charge.
- (12) About the rush current
For ICs with more than one power supply, it is possible that rush current may flow instantaneously due to the internal powering sequence and delays. Therefore, give special consideration to power coupling capacitance, power wiring, width of ground wiring, and routing of wiring.
- (13) About the function description or application note or more.
The function description and the application notebook are the design materials to design a set. So, the contents of the materials aren't always guaranteed. Please design application by having fully examination and evaluation include the external elements.

● Ordering part number



UCSP50L1 (BD82103GWL)



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