

High-performance Video Driver Series

Output Capacitor-less Video Drivers



BH76806FVM, BH76809FVM, BH76812FVM, BH76816FVM

No.09064EAT02

●Description

The BH768xx series video drivers are the optimum solution for high density integration systems such as, digital still cameras, mobile phones, and portable video devices. A built-in charge pump circuit eliminates the need for a large output coupling capacitor. Features include: a built-in LPF, low-voltage (2.5 V) operation, and 0 μ A current consumption during standby mode.

●Features

- 1) Select from four video driver amp gain settings: 6 dB, 9 dB, 12 dB, and 16 dB
- 2) Large-output video driver with maximum output voltage of 5.2 V_{pp}.
Supports wide and low-voltage operation range.
- 3) No output coupling capacitor is needed, which makes for a more compact design
- 4) Built-in standby function sets circuit current to 0 μ A (typ.) during standby mode
- 5) Clear image reproduction by on-chip 8-order 4.5-MHz LPF (Low Pass Filter)
- 6) Bias input method is used to support chroma, video, and RGB signals.
- 7) MSOP8 compact package

●Applications

Mobile telephones, DSCs (digital still cameras), DVCs (digital video cameras), portable game systems, portable media players, etc.

●Line up matrix

Part No.	Video driver amp gain	Recommended input level
BH76806FVM	6dB	1Vpp
BH76809FVM	9dB	0.7Vpp
BH76812FVM	12dB	0.5Vpp
BH76816FVM	16.5dB	0.3Vpp

●Absolute maximum ratings (T_a=25°C)

Parameter	Symbol	Ratings	Unit
Supply voltage	V _{cc}	3.55	V
Power dissipation	P _d	470	mW
Operating temperature range	T _{opr}	-40~+85	°C
Storage temperature range	T _{stg}	-55~+125	°C

* Reduce by 4.7 mW/°C over 25°C, when mounted on a 70mm × 70mm × 1.6mm PCB board.

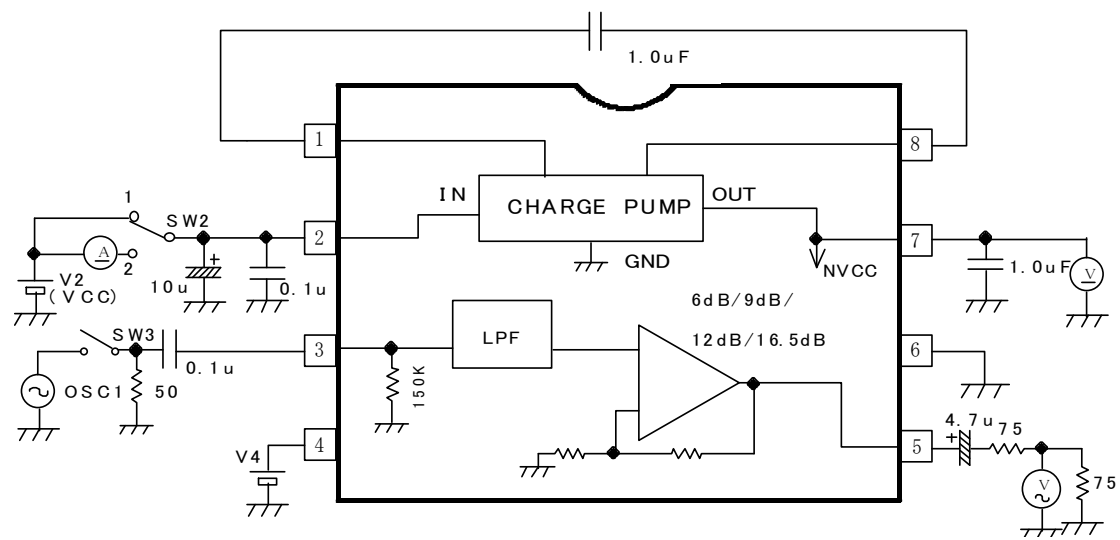
●Operating range (Ta=25°C)

Parameter	Symbol	Min.	TYP.	Max.	Unit
Supply voltage	V _{CC}	2.5	3.0	3.45	V

●Electrical characteristics (Unless otherwise noted, Typ.: Ta=25°C, VCC=3V)

Parameter	Symbol	Typical value				Unit	Conditions
		BH76806 FVM	BH76809 FVM	BH76812 FVM	BH76816 FVM		
Circuit current 1	I _{CC1}	16		15		mA	No signal
Circuit current 2	I _{CC2}	0.0				μA	Standby mode
Standby SW input current High-Level	I _{thH}	45				μA	When 3.0 V is applied to 4pin
Standby switching voltage High-Level	V _{thH}	1.2V _{min}				V	standby OFF
Standby Switching voltage Low-Level	V _{thL}	0.45V _{max}				V	standby ON
Voltage gain	G _V	6.0	9.0	12.0	16.5	dB	Vo=100KHz, 1.0V _{pp}
Maximum output level	V _{omv}	5.2				V _{pp}	f=1KHz,THD=1%
Frequency characteristic 1	G _{f1}	-0.45				dB	f=4.5MHz/100KHz
Frequency characteristic 2	G _{f2}	-3.0				dB	f=8.0MHz/100KHz
Frequency characteristic 3	G _{f3}	-32				dB	f=18MHz/100KHz
Frequency characteristic 4	G _{f4}	-51				dB	f=23.5MHz/100KHz
Differential Gain	D _G	0.5				%	Vo=1.0V _{p-p} Standard stair step signal
Differential Phase	D _P	1.0				deg	Vo=1.0V _{p-p} Standard stair step signal
Y signal output S/N	SN _Y	+74	+73	+70	+70	dB	Band = 100 kHz to 6 MHz 75 Ω termination 100% chroma video signal
C signal output S/N (AM)	SN _{CA}	+77	+76	+75	+75	dB	Band = 100~500KHz 75 Ω termination 100%chroma video signal
C signal output S/N (PM)	SN _{CP}	+65				dB	Band = 100~500KHz 75 Ω termination 100%chroma video signal
Output pin source current	I _{extin}	30				mA	4.5 V applied via 150 Ω to output pin
Output DC offset voltage	V _{off}	±50 _{max}				mV	75 Ω termination

●Measurement circuit



※ Test circuit is intended for shipment inspections, and differs from application circuit.

Fig. 1

●Control pin settings

Parameter	States	Note
Standby (4pin)	H	Active
	L	Standby
	OPEN	Standby

●Block diagram

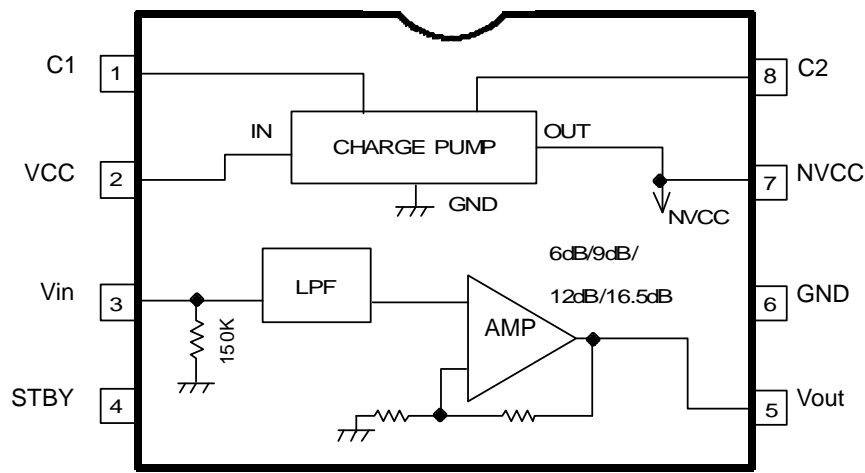
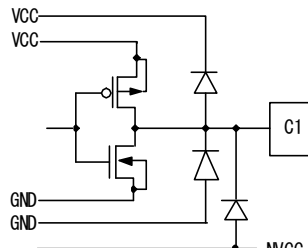
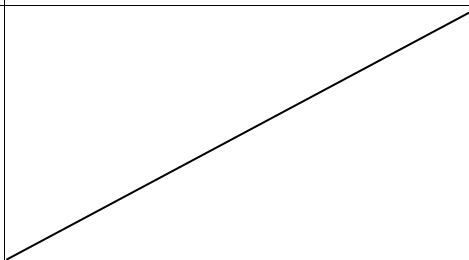
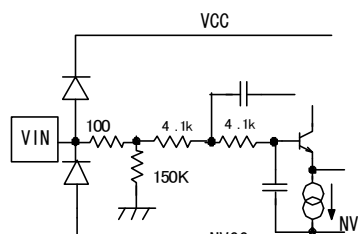
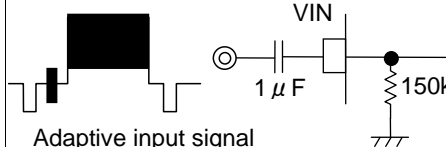
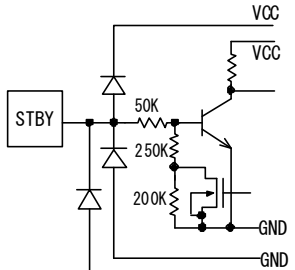
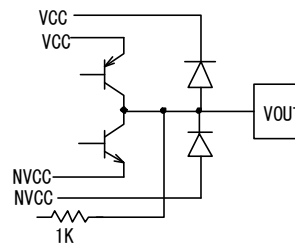
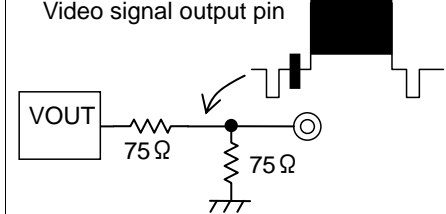
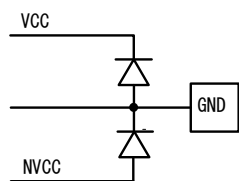


Fig.2

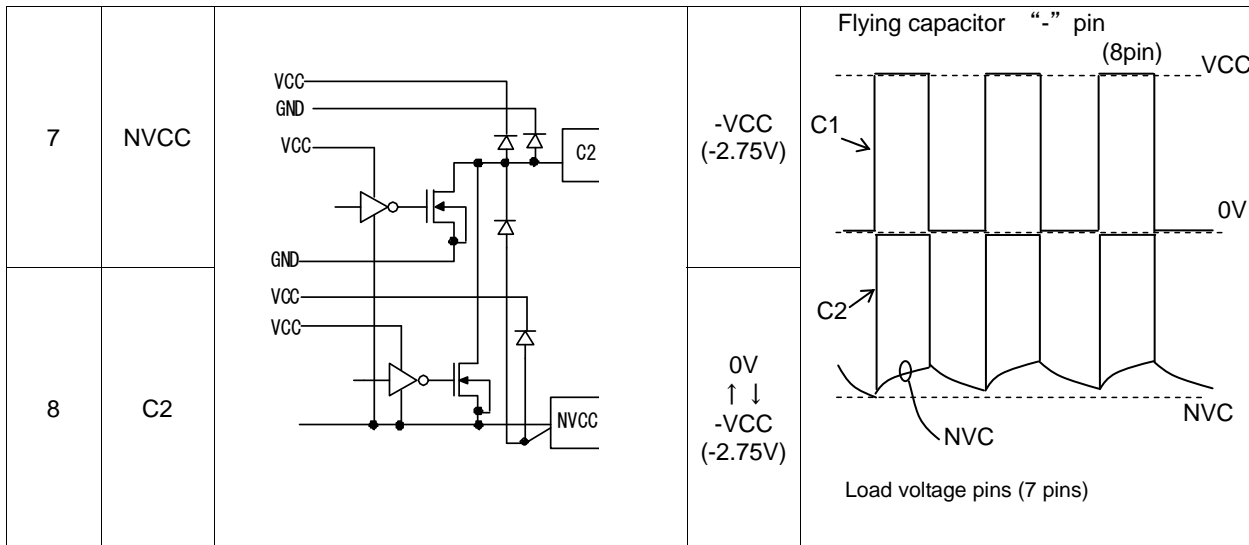
●Pin descriptions

Pin No.	Pin name	equivalent circuit	DC voltage	Functions						
1	C1		+VCC ↑ ↓ 0V	Flying capacitor "+" pin See function description for pins 7 and 8						
2	VCC									
3	VIN									
3	VIN		0V	Video signal input pin  Adaptive input signal Composite video signal/ chroma signal/RGB signal, etc.						
4	STBY		VCC to 0V	ACTIVE/STANBY Switching Pin <table data-bbox="970 1196 1378 1375"><tr><th>Terminal Votage</th><th>MODE</th></tr><tr><td>1.2V~VCC (H)</td><td>ACTIVE</td></tr><tr><td>0V~0.45V (L)</td><td>STANBY</td></tr></table>	Terminal Votage	MODE	1.2V~VCC (H)	ACTIVE	0V~0.45V (L)	STANBY
Terminal Votage	MODE									
1.2V~VCC (H)	ACTIVE									
0V~0.45V (L)	STANBY									
5	VOUT		0V	Video signal output pin  VOUT 75Ω 75Ω						
6	GND		0V	GND Pin						

* 1 The DC voltage in the figure is VCC = 3.0 V. These values are for reference only and are not guaranteed.

* 2 These values are for reference only and are not guaranteed.

●Pin descriptions



- * 1 The DC voltage in the figure is $V_{CC} = 3.0\text{ V}$. These values are for reference only and are not guaranteed.
 * 2 These values are for reference only and are not guaranteed.

●Description of operations

1) Principles of video driver with no output coupling capacitor

Amp (Single power supply)

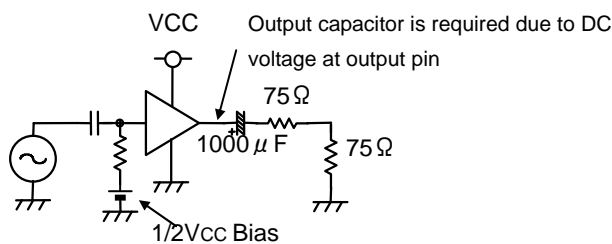


Fig.3

Amp (Dual power supply)

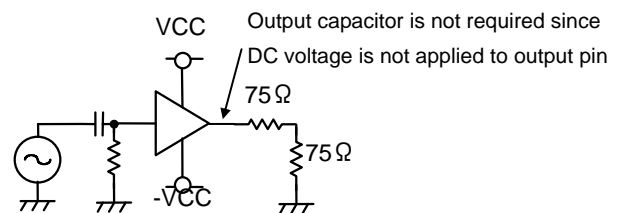


Fig.4

When the amplifier operates using single voltage power supply, the operating potential point is approximately $1/2 V_{CC}$. Therefore, a coupling capacitor is required to prevent DC output. For the video driver, the load resistance is $150\ \Omega$ ($75\ \Omega + 75\ \Omega$). Therefore, the coupling capacitor should be about $1000\ \mu\text{F}$ when a low bandwidth for transmission is considered. (See Figure 3.)

When the amplifier operates using a dual (\pm) power supply, the operating point can be set at GND level, and therefore, there is no need for a coupling capacitor to prevent DC output. Since a coupling capacitor is not needed, there is no sagging of low-frequency characteristics in output stage. (See Figure 4.)

2) Generation of negative voltage by charge pump circuit

As is shown in Figure 5, the charge pump consists of a pair of switches (SW1 and SW2) and a pair of capacitors (flying capacitor and load capacitor), generating a negative voltage. When $+3\text{ V}$ is applied to this IC, approximately -2.83 V of negative voltage is obtained.

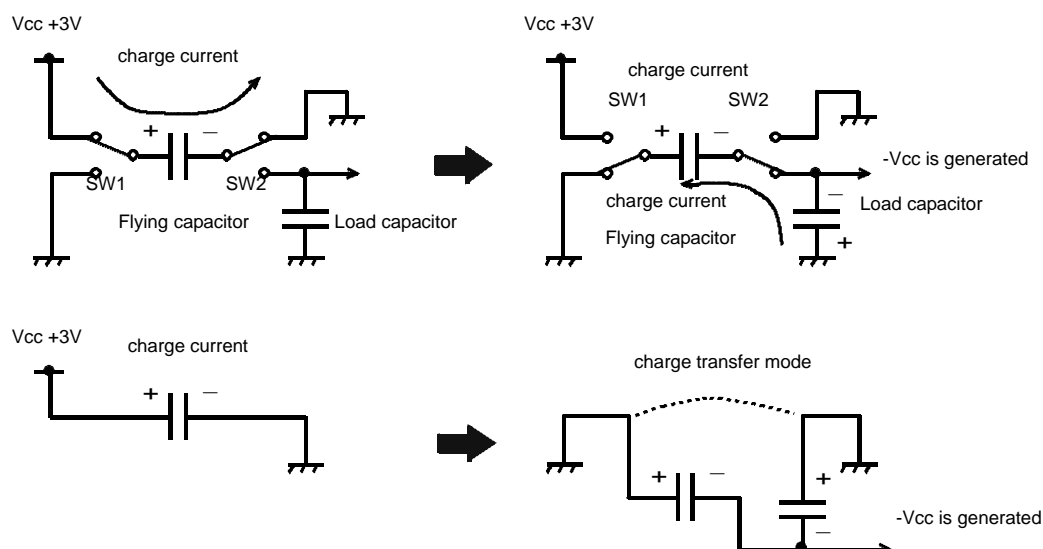


Fig. 5 Principles of Charge Pump Circuit

1) Configuration of BH768xxFVM Series

As is shown in Figure 6, in the BH768xxFVM Series, a dual power supply amplifier is integrated with a charge pump circuit in the same IC. This enables operation using a +3V single power supply while also using a dual power supply amplifier, which eliminates the need for an output coupling capacitor.

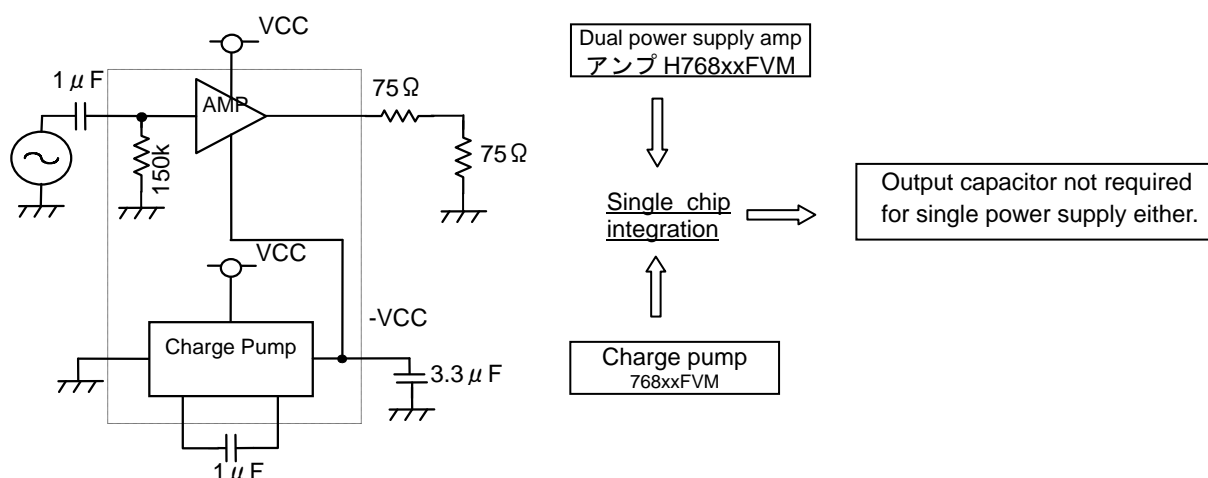


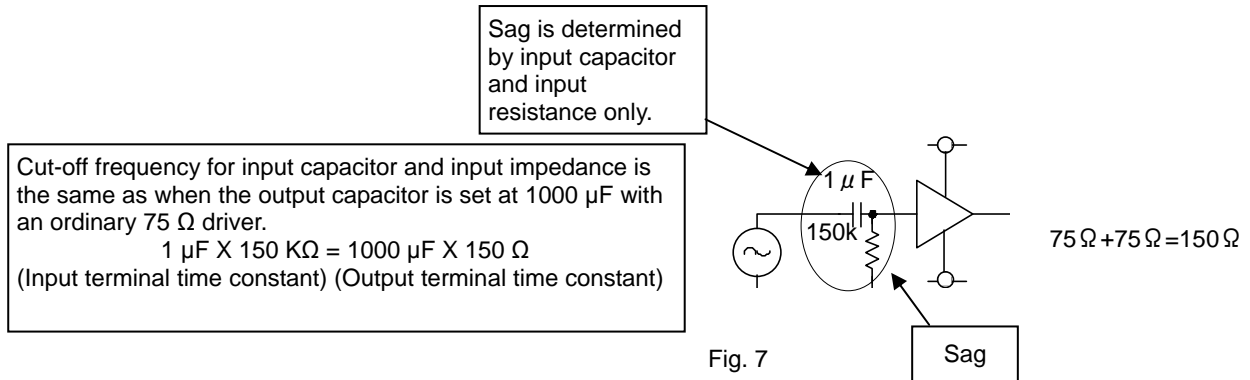
Fig. 6 BH768xxFVM Configuration Diagram

2) Input terminal type and sag characteristics

BH768xxFVM Series devices provide both a low-voltage video driver and a large dynamic range (approximately 5.2 Vpp). A resistance termination method (150 kΩ termination) is used instead of the clamp method, which only supports video signals, since it supports various signal types.

The BH768xxFVM series supports a wide range of devices such as, video signals, chroma signals, and RGB signals that can operate normally even without a synchronization signal.

In addition, input terminating resistance (150 kΩ) can use a small input capacitor without reducing the sag low-band. It is recommended to use a H-bar signal when evaluating sag characteristics, since it makes sag more noticeable. (See Figures 7 to 10.)



a) Sag-free video signal (TG-7/1 output, H-bar)

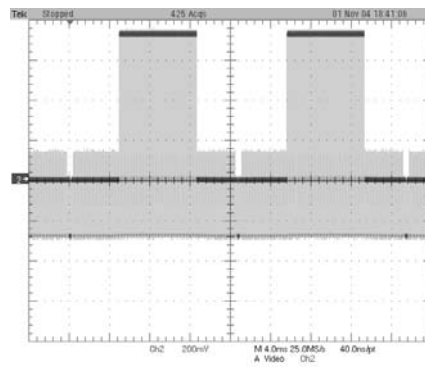


Fig. 8



H-bar signal's TV screen output image

b) BH768xxFVM output (input = 1.0 μF , TG-7/1 output, H-bar)

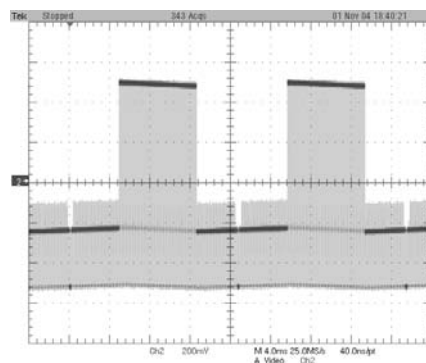
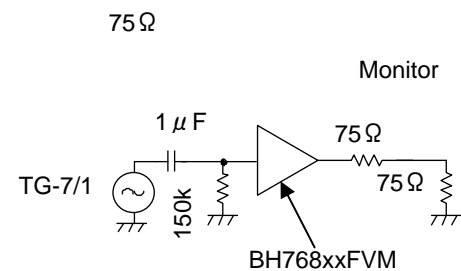


Fig. 9



Nearly identical sag characteristics

c) 1000 μF + 150 Ω sag waveform (TG-7/1 output, H-bar)

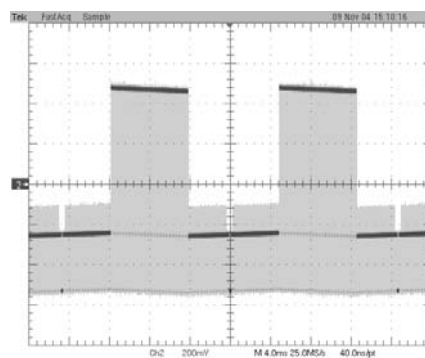
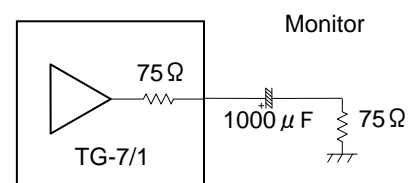


Fig. 10



●Application circuit

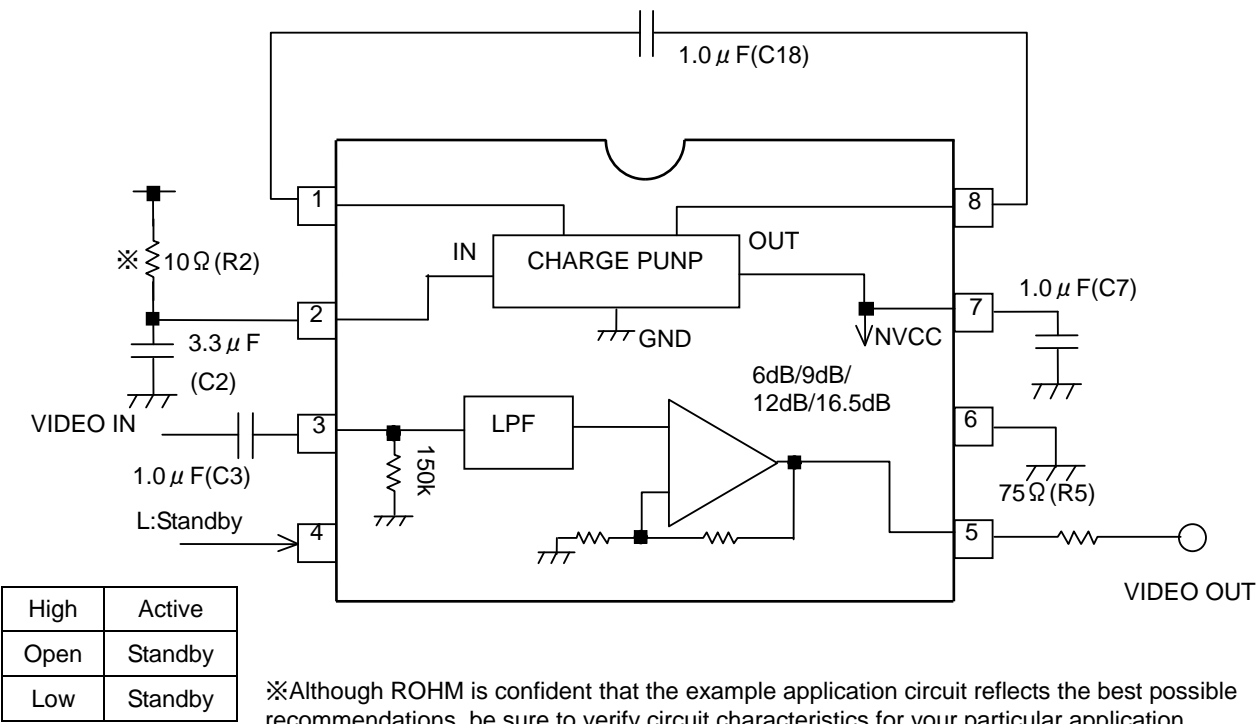


Fig. 11

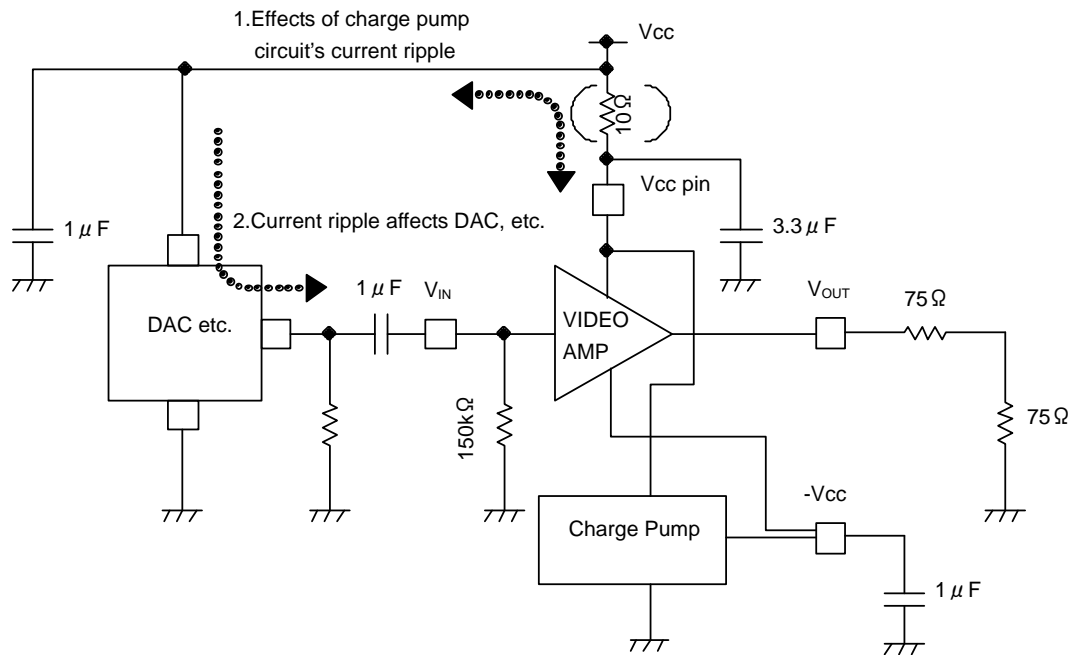


Fig. 12 Effect of Charge Pump Circuit's Current Ripple on External Circuit

1) Decoupling capacitor only

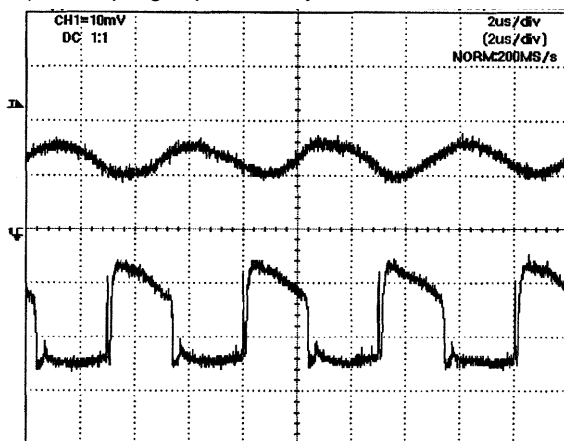
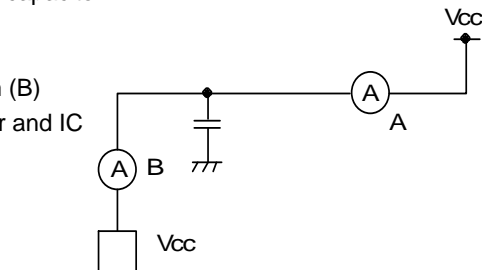


Fig.13

Current waveform (A) between single power supply and capacitor
10mA/div

Current waveform (B) between capacitor and IC
10mA/div



2) Decoupling capacitor + Resistance 10Ω

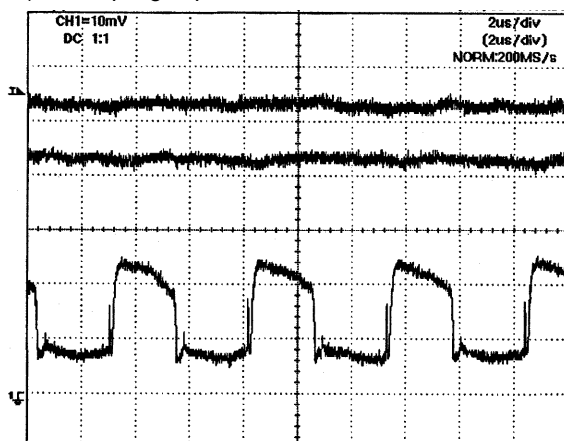
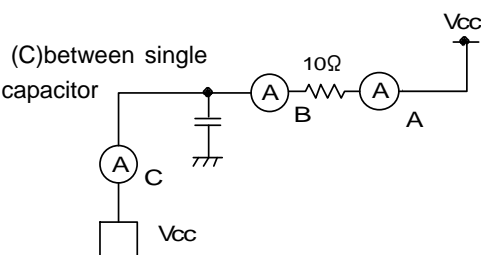


Fig.14

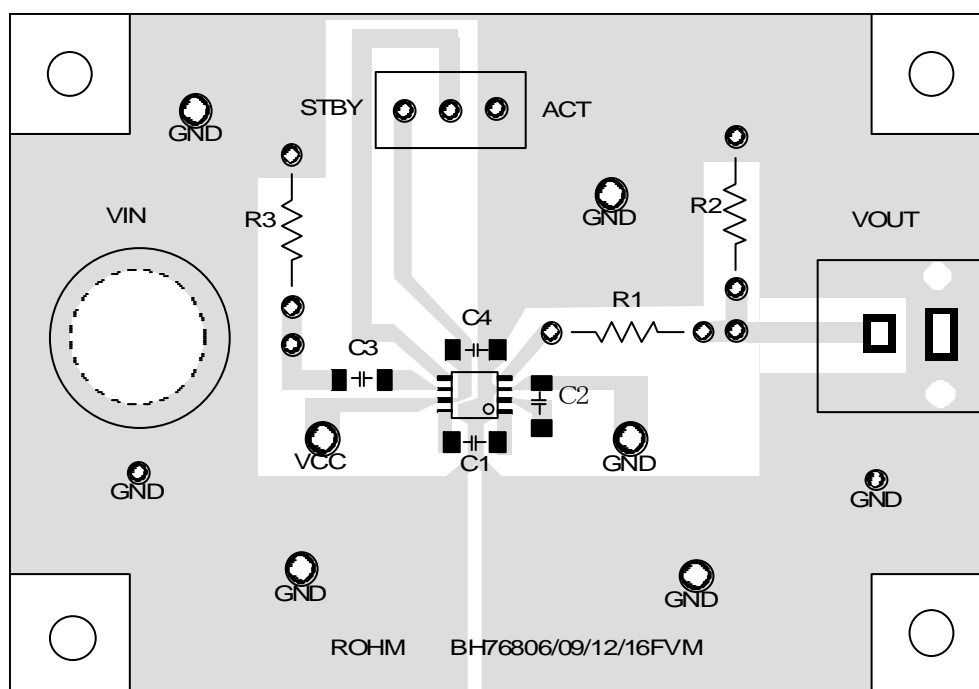
Current waveform (A) between single power supply and capacitor
10mA/div

Current waveform (B) between single power supply and capacitor
10mA/div

Current waveform (C) between single power supply and capacitor
10mA/div



•Pattern diagram of evaluation board



•List of external components

Fig. 15

Symbol	Function	Recommended value	Remark
C1	Flying capacitor	1 μ F	B characteristics are recommended
C2	Tank capacitor	1 μ F	B characteristics are recommended
C3	Input coupling capacitor	1 μ F	B characteristics are recommended
C4	Decoupling capacitor	3.3 μ F	B characteristics are recommended
R1	Output resistor	75 Ω	—
R2	Output terminating resistance	75 Ω	Not required when connecting to TV or video signal test equipment.
R3	Input terminating resistance	75 Ω	Required when connecting to video signal test equipment.
	Input connector	BNC	
	Output connector	RCA (pin jack)	

●Reference data

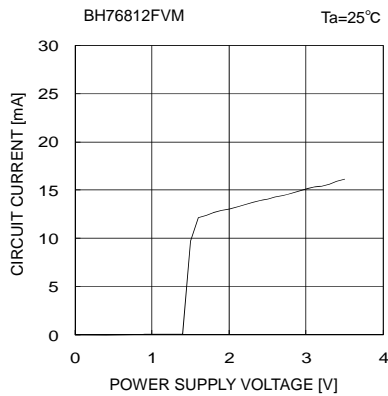


Fig. 16 Circuit current vs. Supply voltage

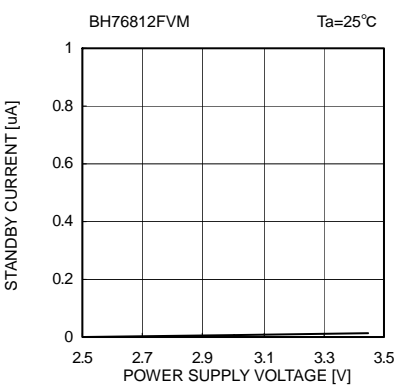


Fig. 17 Circuit Current (Standby) vs. Supply Voltage

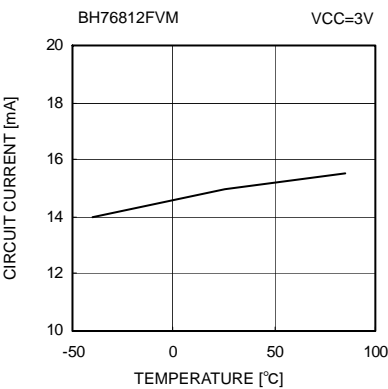


Fig. 18 Circuit current vs. Temperature

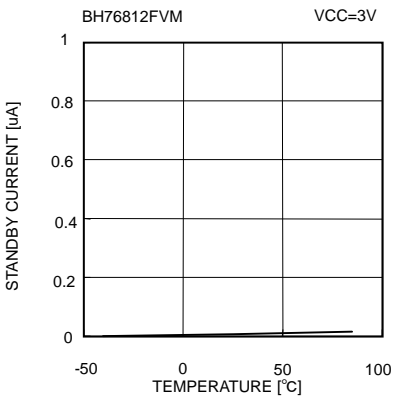


Fig. 19 Circuit Current (Standby) vs. Temperature

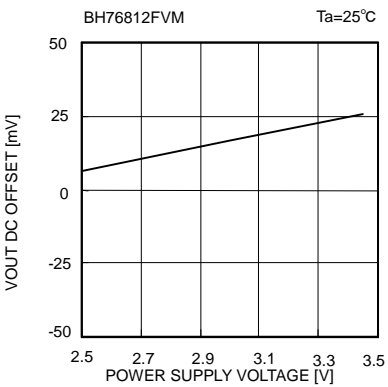


Fig. 20 Vout DC offset voltage vs. Supply voltage

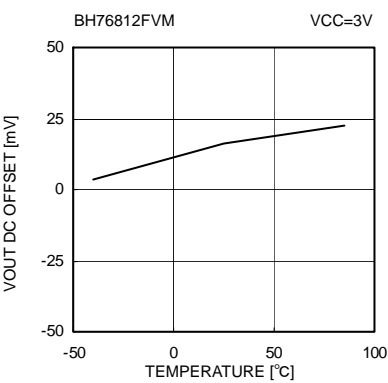


Fig. 21 Vout DC offset voltage vs. Temperature

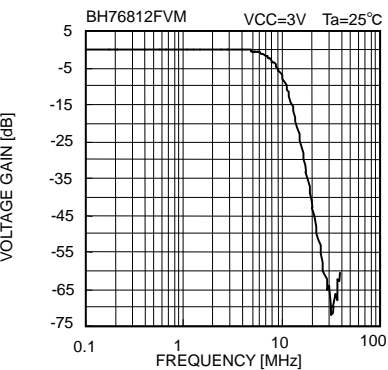


Fig. 22 Frequency characteristic

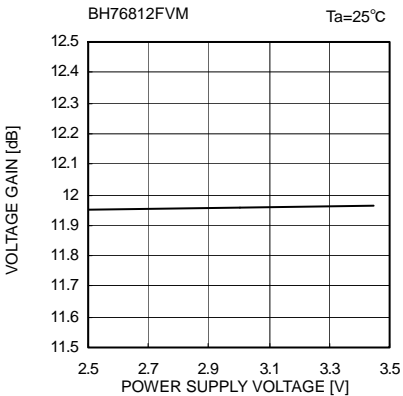


Fig. 23 Voltage gain vs. Supply voltage

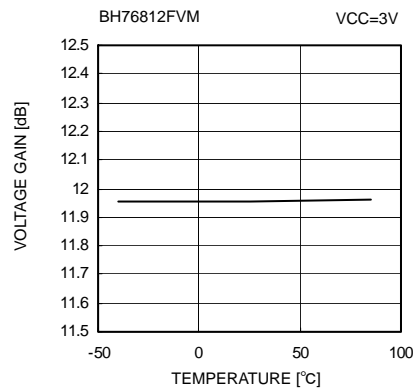


Fig. 24 Voltage gain vs. Temperature

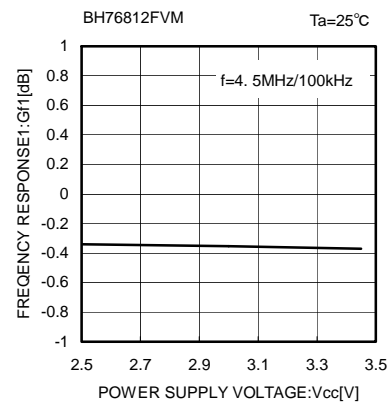


Fig. 25 Frequency response 1 vs. Supply voltage

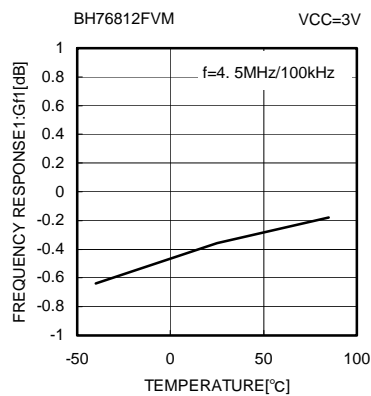


Fig. 26 Frequency response 1 vs. Temperature

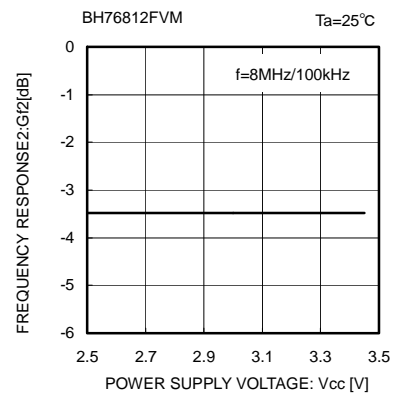


Fig. 27 Frequency response 2 vs. Supply voltage

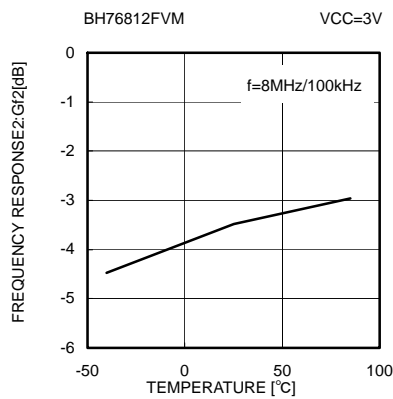


Fig. 28 Frequency response 2 vs. Temperature

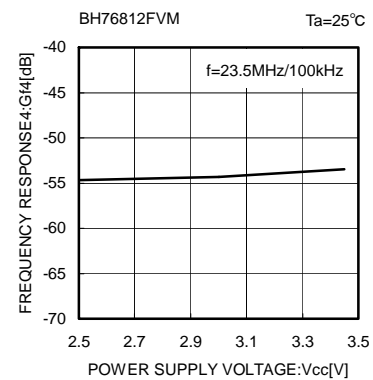


Fig.29 Frequency response 4 vs. Supply voltage

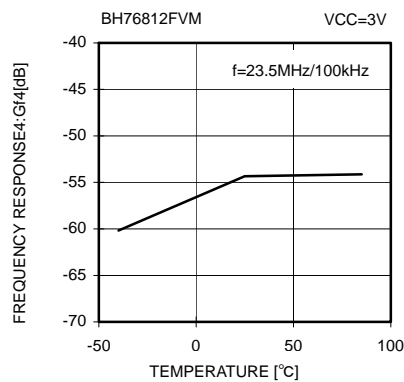


Fig. 30 Frequency response 4 vs. Temperature

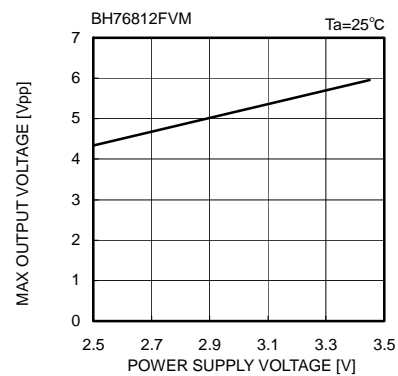


Fig. 31 Maximum output voltage level vs. Supply voltage

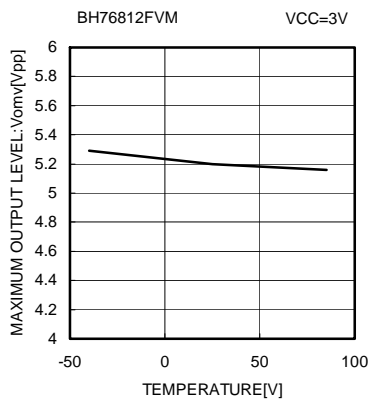


Fig. 32 Maximum output level vs. Temperature

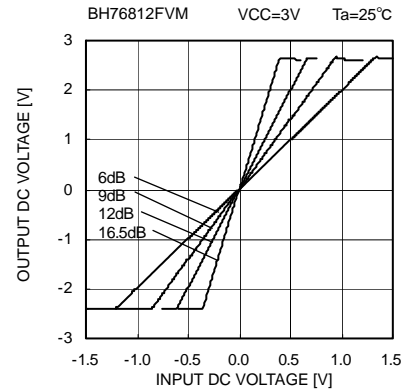


Fig. 33 Output DC voltage – Input DC voltage

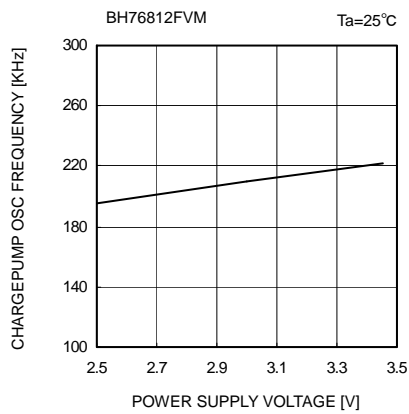


Fig. 34 Charge pump oscillation frequency vs. Supply voltage

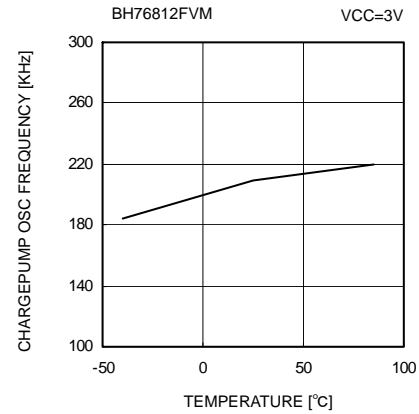


Fig. 35 Charge pump oscillation frequency vs. Temperature

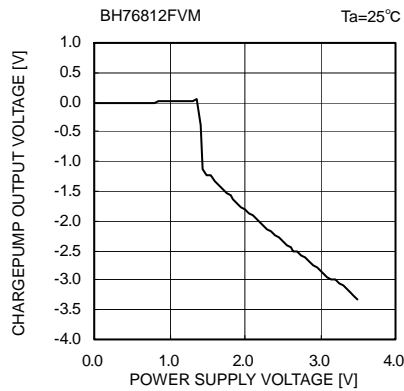


Fig. 36 Charge pump output voltage vs. Supply voltage

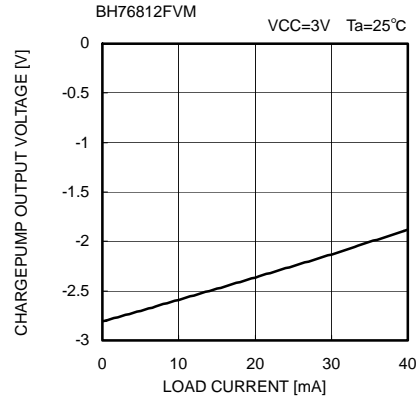


Fig. 37 Charge pump load regulation

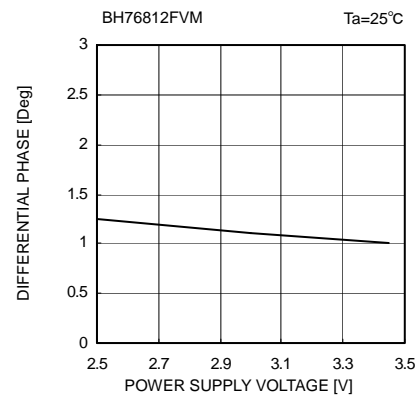


Fig. 38 Differential phase vs. Supply voltage

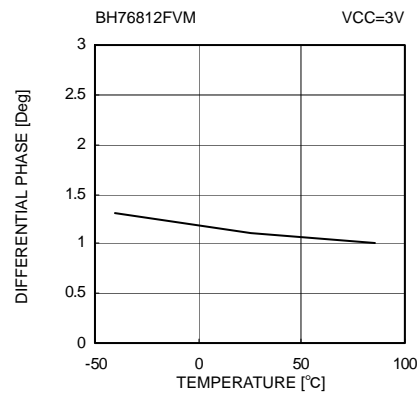


Fig. 39 Differential phase vs. Temperature

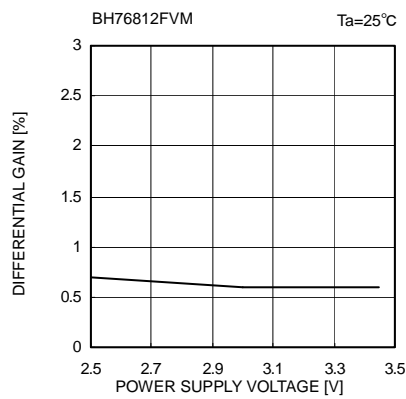


Fig. 40 Differential gain vs. Supply voltage

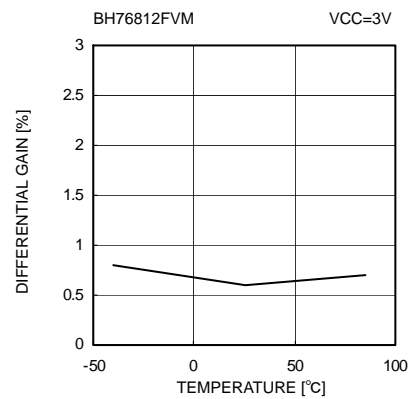


Fig. 41 Differential gain vs. Temperature

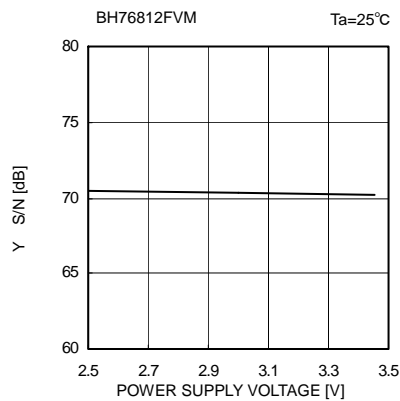


Fig. 42 S/N(Y) vs. Supply Voltage

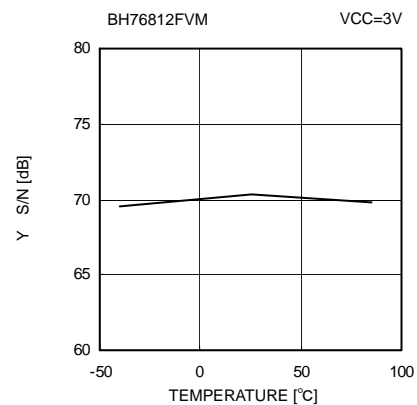


Fig.43 S/N(Y) vs. Temperature

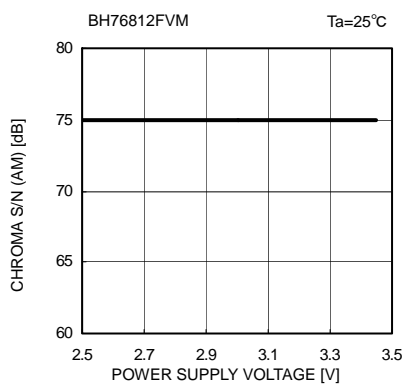


Fig. 44 S/N(C-AM) vs. Supply Voltage

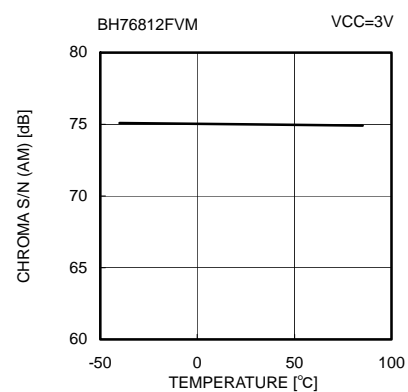


Fig. 45 S/N(C-AM) vs. Temperature

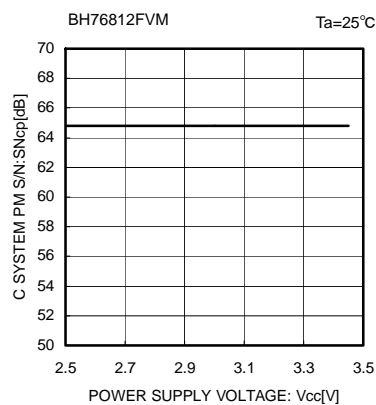


Fig. 46 S/N(C-PM) vs. Supply Voltage

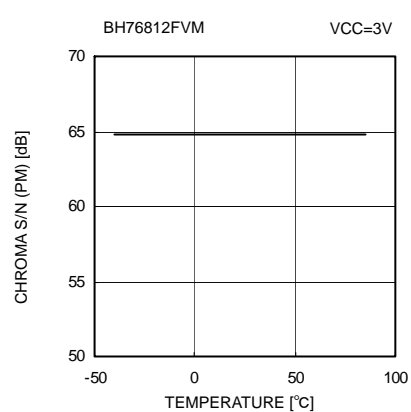


Fig. 47 S/N(C-PM) vs. Temperature

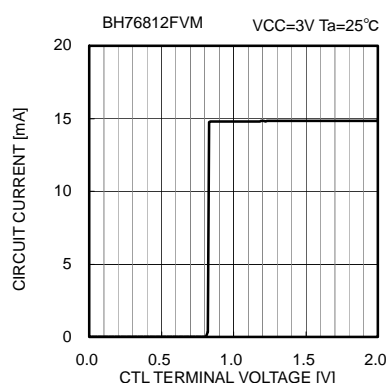
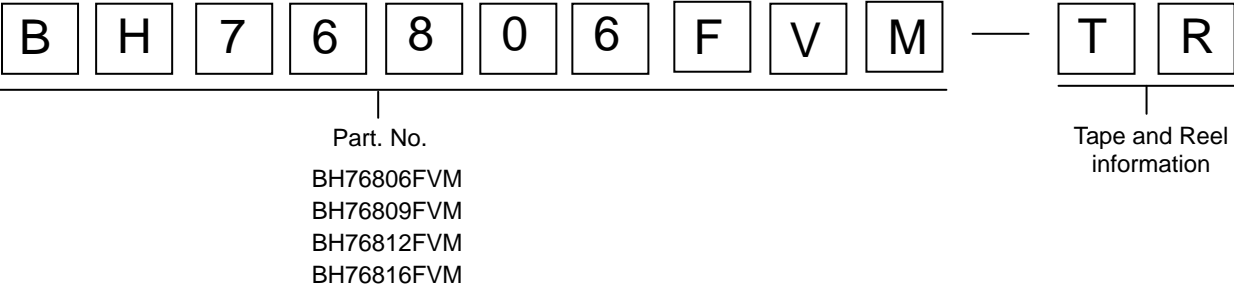


Fig. 48 Circuit current vs. CTL terminal voltage

•Cautions on use

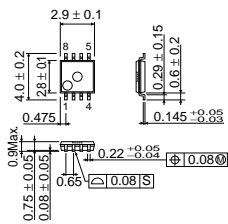
1. Numbers and data in entries are representative design values and are not guaranteed values of the items.
2. Although ROHM is confident that the example application circuit reflects the best possible recommendations, be sure to verify circuit characteristics for your particular application. Modification of constants for other externally connected circuits may cause variations in both static and transient characteristics for external components as well as this Rohm IC. Allow for sufficient margins when determining circuit constants.
3. Absolute maximum ratings
Use of the IC in excess of absolute maximum ratings, such as the applied voltage or operating temperature range (Topr), may result in IC damage. Assumptions should not be made regarding the state of the IC (short mode or open mode) when such damage is suffered. A physical safety measure, such as a fuse, should be implemented when using the IC at times where the absolute maximum ratings may be exceeded.
4. Thermal design
Perform thermal design, in which there are adequate margins, by taking into account the permissible dissipation (Pd) in actual states of use.
5. Short circuit between terminals and erroneous mounting
Pay attention to the assembly direction of the ICs. Wrong mounting direction or shorts between terminals, GND, or other components on the circuits, can damage the IC.
6. Operation in strong electromagnetic field
Using the ICs in a strong electromagnetic field can cause operation malfunction.
7. Wiring from the decoupling capacitor C2 to the IC should be kept as short as possible.
This capacitance value may have ripple effects on the IC, and may affect the S-N ratio. It is recommended to use as large a decoupling capacitor as possible. (Recommendations: 3.3 μ F, B characteristics, 6.3 V or higher)
8. Target capacitor
It is recommended to use a ceramic capacitor with good temperature characteristics (B).
9. The NVCC (7 pin) terminal generates a voltage that is used within the IC, so it should not be connected to a load unless necessary. This capacitor (C7) has a large capacitance value with low negative voltage ripple.
10. Capacitors C18 and C2 should be placed as close as possible to the IC. If the wire length to the capacitor is too long, it can lead to switching noise. (Recommended C18: 1.0 μ F; C2: 3.3 μ F, B characteristics, 6.3 V or higher maximum voltage)
11. The HPF consists of input coupling capacitor C3 and 150 k Ω of the internal input.
Be sure to check for video signal sag before determining the C3 value.
The cut-off frequency f_c can be calculated using the following formula.
$$f_c = 1/(2\pi \times C3 \times 150 \text{ k}\Omega)$$
 (Recommendations: 1.0 μ F, B characteristics, 6.3 V or higher maximum voltage)
12. The output resistor R5 should be placed close to the IC.
13. Improper mounting may damage the IC.
14. A large current transition occurs in the power supply pin when the charge pump circuit is switched. If this affects other ICs (via the power supply line), insert a resistor (approximately 10 Ω) in the VCC line to improve the power supply's ripple effects. Although inserting a 10 Ω resistor lowers the voltage by about 0.2 V, this IC has a wide margin for low-voltage operation, so dynamic range problems or other problems should not occur. (See Figures 12 to 14.)

●Selection of order type



MSOP8

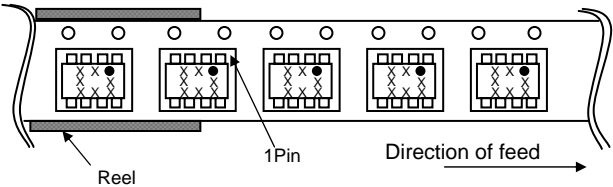
<Dimension>



(Unit:mm)

<Tape and Reel information>

Tape	Embossed carrier tape
Quantity	3000pcs
Direction of feed	TR (Correct direction: 1pin of product should be at the upper left when you hold reel on the left hand, and you pull out the tape on the right hand)



※Orders are available in complete units only.

Notice

Precaution on using ROHM Products

- Our Products are designed and manufactured for application in ordinary electronic equipments (such as AV equipment, OA equipment, telecommunication equipment, home electronic appliances, amusement equipment, etc.). If you intend to use our Products in devices requiring extremely high reliability (such as medical equipment ^(Note 1), transport equipment, traffic equipment, aircraft/spacecraft, nuclear power controllers, fuel controllers, car equipment including car accessories, safety devices, etc.) and whose malfunction or failure may cause loss of human life, bodily injury or serious damage to property ("Specific Applications"), please consult with the ROHM sales representative in advance. Unless otherwise agreed in writing by ROHM in advance, ROHM shall not be in any way responsible or liable for any damages, expenses or losses incurred by you or third parties arising from the use of any ROHM's Products for Specific Applications.

(Note1) Medical Equipment Classification of the Specific Applications

JAPAN	USA	EU	CHINA
CLASS III	CLASS III	CLASS II b	CLASS III
CLASS IV		CLASS III	

- ROHM designs and manufactures its Products subject to strict quality control system. However, semiconductor products can fail or malfunction at a certain rate. Please be sure to implement, at your own responsibilities, adequate safety measures including but not limited to fail-safe design against the physical injury, damage to any property, which a failure or malfunction of our Products may cause. The following are examples of safety measures:
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 - Installation of redundant circuits to reduce the impact of single or multiple circuit failure
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 - Use of our Products in any types of liquid, including water, oils, chemicals, and organic solvents
 - Use of our Products outdoors or in places where the Products are exposed to direct sunlight or dust
 - Use of our Products in places where the Products are exposed to sea wind or corrosive gases, including Cl₂, H₂S, NH₃, SO₂, and NO₂
 - Use of our Products in places where the Products are exposed to static electricity or electromagnetic waves
 - Use of our Products in proximity to heat-producing components, plastic cords, or other flammable items
 - Sealing or coating our Products with resin or other coating materials
 - Use of our Products without cleaning residue of flux (even if you use no-clean type fluxes, cleaning residue of flux is recommended); or Washing our Products by using water or water-soluble cleaning agents for cleaning residue after soldering
 - Use of the Products in places subject to dew condensation
- The Products are not subject to radiation-proof design.
- Please verify and confirm characteristics of the final or mounted products in using the Products.
- In particular, if a transient load (a large amount of load applied in a short period of time, such as pulse. is applied, confirmation of performance characteristics after on-board mounting is strongly recommended. Avoid applying power exceeding normal rated power; exceeding the power rating under steady-state loading condition may negatively affect product performance and reliability.
- De-rate Power Dissipation (Pd) depending on Ambient temperature (Ta). When used in sealed area, confirm the actual ambient temperature.
- Confirm that operation temperature is within the specified range described in the product specification.
- ROHM shall not be in any way responsible or liable for failure induced under deviant condition from what is defined in this document.

Precaution for Mounting / Circuit board design

- When a highly active halogenous (chlorine, bromine, etc.) flux is used, the residue of flux may negatively affect product performance and reliability.
- In principle, the reflow soldering method must be used; if flow soldering method is preferred, please consult with the ROHM representative in advance.

For details, please refer to ROHM Mounting specification

Precautions Regarding Application Examples and External Circuits

1. If change is made to the constant of an external circuit, please allow a sufficient margin considering variations of the characteristics of the Products and external components, including transient characteristics, as well as static characteristics.
2. You agree that application notes, reference designs, and associated data and information contained in this document are presented only as guidance for Products use. Therefore, in case you use such information, you are solely responsible for it and you must exercise your own independent verification and judgment in the use of such information contained in this document. ROHM shall not be in any way responsible or liable for any damages, expenses or losses incurred by you or third parties arising from the use of such information.

Precaution for Electrostatic

This Product is electrostatic sensitive product, which may be damaged due to electrostatic discharge. Please take proper caution in your manufacturing process and storage so that voltage exceeding the Products maximum rating will not be applied to Products. Please take special care under dry condition (e.g. Grounding of human body / equipment / solder iron, isolation from charged objects, setting of ionizer, friction prevention and temperature / humidity control).

Precaution for Storage / Transportation

1. Product performance and soldered connections may deteriorate if the Products are stored in the places where:
 - [a] the Products are exposed to sea winds or corrosive gases, including Cl₂, H₂S, NH₃, SO₂, and NO₂
 - [b] the temperature or humidity exceeds those recommended by ROHM
 - [c] the Products are exposed to direct sunshine or condensation
 - [d] the Products are exposed to high Electrostatic
2. Even under ROHM recommended storage condition, solderability of products out of recommended storage time period may be degraded. It is strongly recommended to confirm solderability before using Products of which storage time is exceeding the recommended storage time period.
3. Store / transport cartons in the correct direction, which is indicated on a carton with a symbol. Otherwise bent leads may occur due to excessive stress applied when dropping of a carton.
4. Use Products within the specified time after opening a humidity barrier bag. Baking is required before using Products of which storage time is exceeding the recommended storage time period.

Precaution for Product Label

QR code printed on ROHM Products label is for ROHM's internal use only.

Precaution for Disposition

When disposing Products please dispose them properly using an authorized industry waste company.

Precaution for Foreign Exchange and Foreign Trade act

Since our Products might fall under controlled goods prescribed by the applicable foreign exchange and foreign trade act, please consult with ROHM representative in case of export.

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