Composite Video Amplifier

Output Capacitor-less Video Drivers

Pb Free
ROHM Electronic Components

RoHS
Directive Compliance

BH76806FVM, BH76809FVM, BH76812FVM, BH76816FVM

No.14064EBT02

●Description

The BH768xxFVM 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 µA current consumption during standby mode.

●Features

1) Select from four video driver amp gain settings: 6 dB, 9 dB, 12 dB, and 16.5 dB
2) Large-output video driver with maximum output voltage of 5.2 V_{P-P}
   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 µA (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	1 V_{P-P}
BH76809FVM	9dB	0.7 V_{P-P}
BH76812FVM	12dB	0.5 V_{P-P}
BH76816FVM	16.5dB	0.3 V_{P-P}

●Absolute maximum ratings　（T_a=25℃）

Parameter	Symbol	Ratings	Unit
Supply voltage	VCC	3.55	V
Power dissipation	P_d	0.47	W
Operating temperature range	T_{opr}	-40 to +85	℃
Storage temperature range	T_{stg}	-55 to +125	℃

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

●Operating range (Ta=25℃)

Parameter	Symbol	Min.	TYP.	Max.	Unit
Supply voltage	VCC	2.5	3.0	3.45	V

●Electrical characteristics (Unless otherwise noted, Typ.: Ta=25℃, 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}	(min.) 1.2				V	standby OFF
Standby Switching voltage Low-Level	V_{thL}	(max.) 0.45				V	standby ON
Video driver amp gain	G_V	6.0	9.0	12.0	16.5	dB	Vo=100kHz, 1.0V_{P-P}
Maximum output level	V_{omv}	5.2				V_{P-P}	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 = 100k to 6MHz 75 Ω termination 100% chroma video signal
C signal output S/N (AM)	SN_{CA}	+77	+76	+75	+75	dB	Band = 100 to 500kHz 75Ωtermination 100%chroma video signal
C signal output S/N (PM)	SN_{CP}	+65				dB	Band = 100 to 500kHz 75Ωtermination 100%chroma video signal
Output pin source current	Iextin	30				mA	4.5 V applied via 150 Ω to output pin
Output DC offset voltage	Voff	(max.) ±50				mV	75 Ω termination

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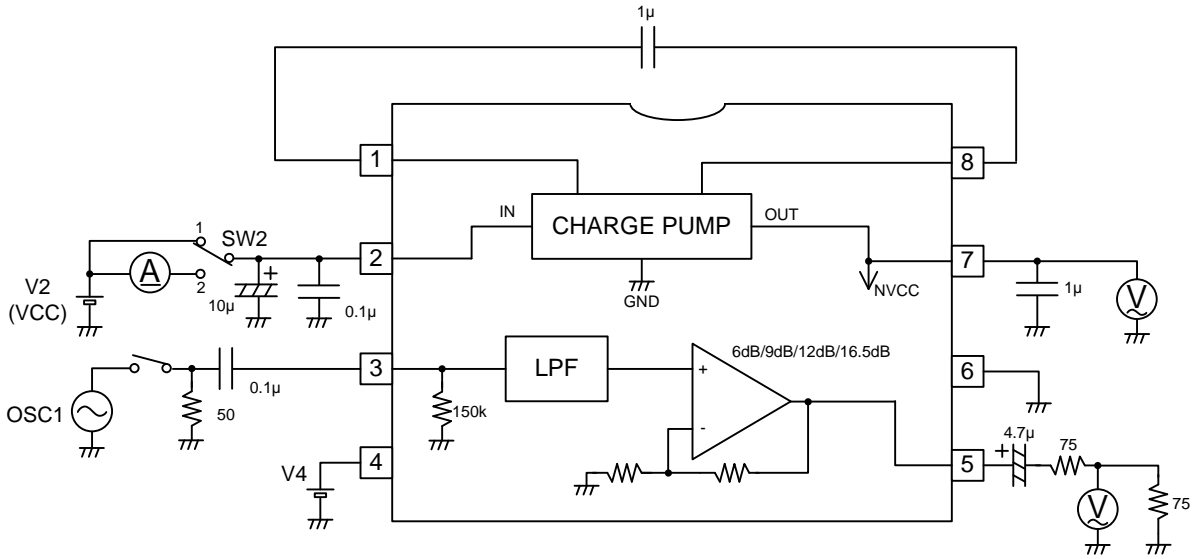
※ Test circuit is intended for shipment inspections, and differs from application circuit.

Fig. 1

●Control pin settings

Parameter	States	Note
Standby control	STBY(4pin)=H	STBY:OFF
	STBY(4pin)=L	STBY:ON
	STBY(4pin)=OPEN	STBY:ON

●Block diagram
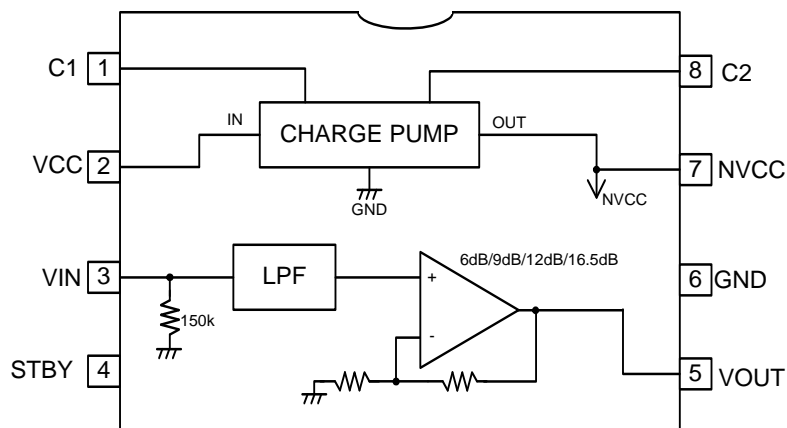
Fig. 2

●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		VCC	VCC Pin
3	VIN		0V	Video signal input pin Adaptive input signal Composite video signal/ chroma signal/RGB signal, etc.
4	STBY		VCC to 0V	STANBY control Pin | Terminal Voltage	MODE | |---|---|
1.2V to VCC (H)	STBY:OFF
0V to 0.45V (L)	STBY:ON	
5	VOUT		0V	Video signal output pin
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
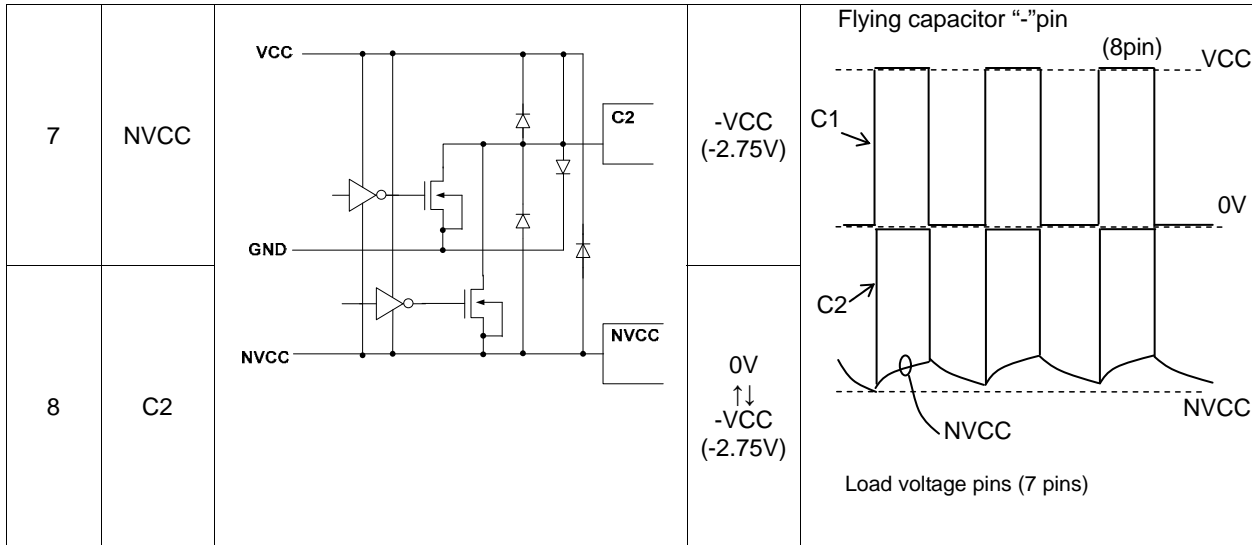
7	NVCC		-VCC (-2.75V)	
8	C2		0V ↑↓ -VCC (-2.75V)	

∗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.

●Description of operations

1)   Principles of video driver with no output coupling capacitor

Amp (Single power supply)

Output capacitor is required due to DC voltage at output pin
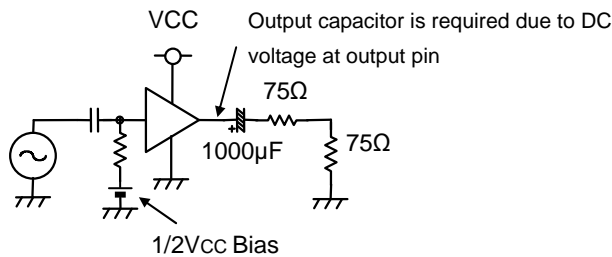
Fig.3

Amp (Dual power supply)

Output capacitor is not required since DC voltage is not applied to output pin
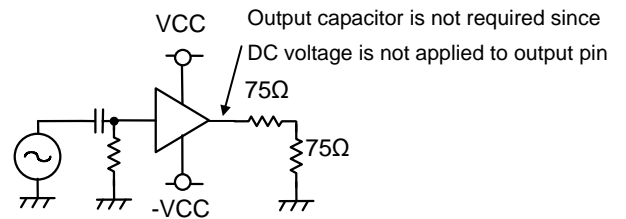
Fig.4

When the amplifier operates using single voltage power supply, the operating potential point is approximately 1/2 Vcc.
Therefore, a coupling capacitor is required to prevent DC output.   For the video driver, the load resistance is 150 Ω (75 Ω + 75 Ω). Therefore, the coupling capacitor should be about 1000 μF when a low bandwidth for transmission is considered. (See Figure 3.)

When the amplifier operates using a dual (±) 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 V is applied to this IC, approximately -2.83 V of negative voltage is obtained.
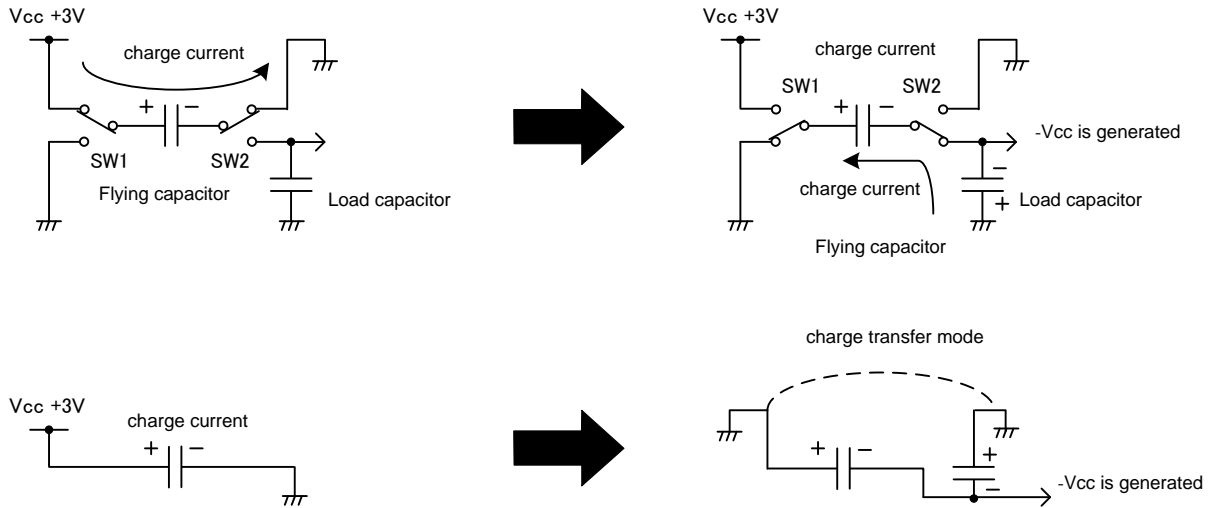
Fig. 5   Principles of Charge Pump Circuit

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.
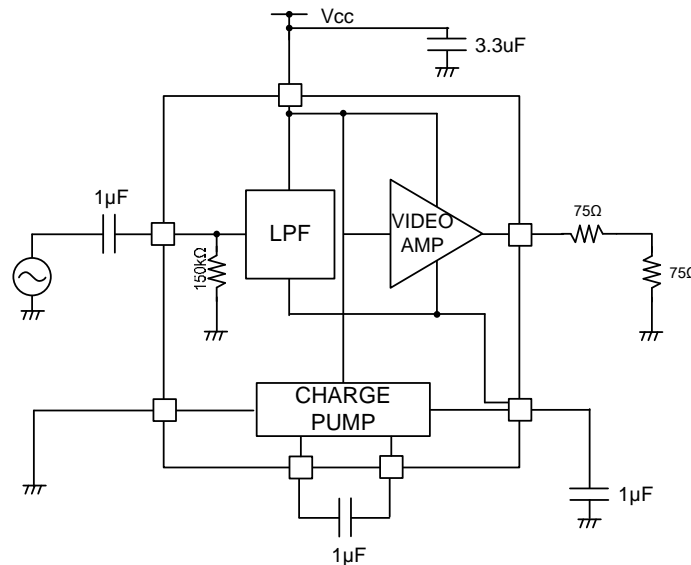

Fig. 6   BH768xxFVM Configuration Diagram

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 V_{P-P}).
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.)

Sag is determined by input capacitor and input resistance only.

Cut-off frequency for input capacitor and input impedance is the same as when the output capacitor is set at 1000 μF with an ordinary 75 Ω driver.

1 μF X 150 KΩ = 1000 μF X 150 Ω
(Input terminal time constant) (Output terminal time constant)

1μF

150k

Sag
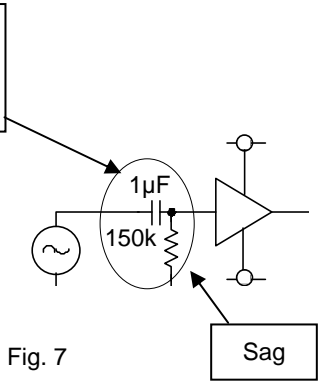
Fig. 7

a) Sag-free TV Test Signal Generator Output(Sibasoku TG-7/1 , H-bar)
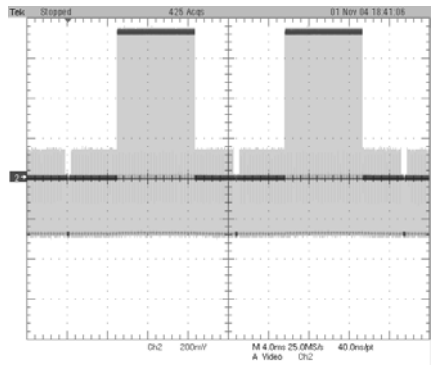
H-bar signal's TV screen output image

Fig. 8

b) BH768xxFVM output (input = 1.0 μF, output, H-bar)

VCC

1μF   75Ω   Monitor

TG-7/1   75Ω

150k

-VCC

BH768xxFVM
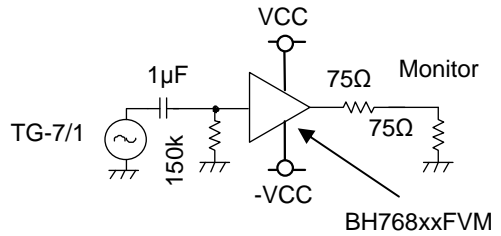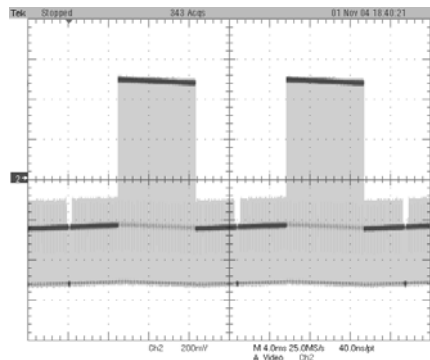
Fig. 9

Nearly identical sag characteristics

c) 1000 μF + 150 Ω sag waveform
   (TV Test Signal Generator Sibasoku TG-7/1 output, H-bar)

Monitor

75Ω

1000μF   75Ω

TG-7/1
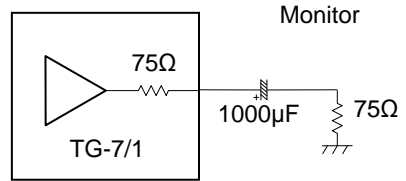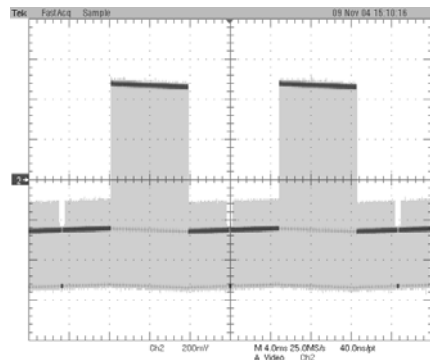
Fig. 10

●Application circuit

Although ROHM is confident that the example application circuit reflects the best possible recommendations, be sure to verify circuit characteristics for your particular application.

Fig. 11

※   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.

●The effect of the resister inserted in the VCC line
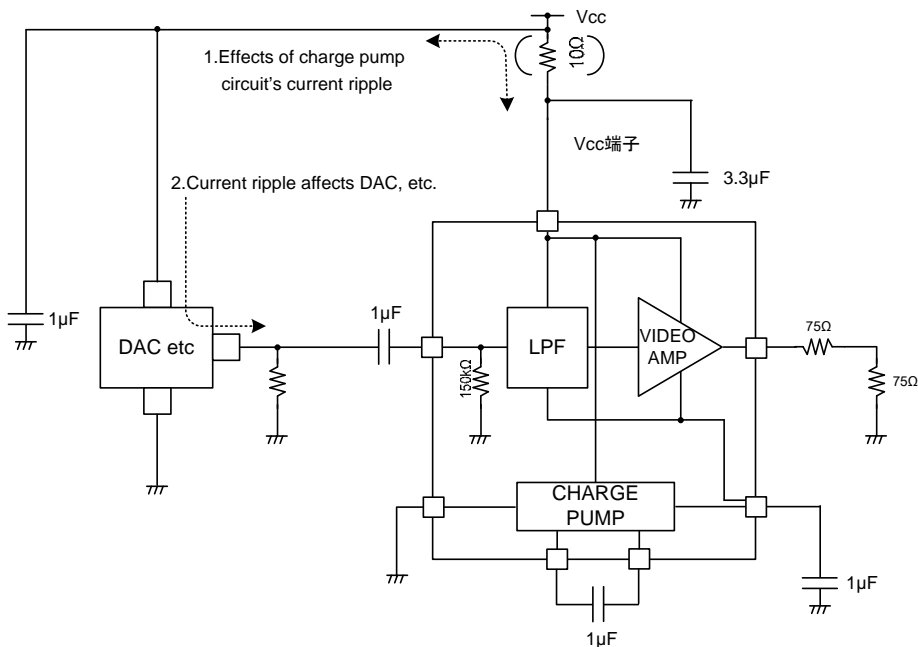
Fig. 12   Effect of Charge Pump Circuit's Current Ripple on External Circuit

1) Decoupling capacitor only
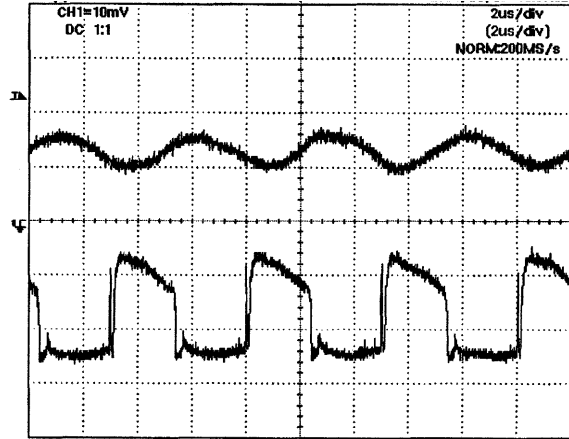
Fig.13

Current waveform (A)
between single power supply and C2
10mA/div

Current waveform (B)
between C2 and IC
10mA/div
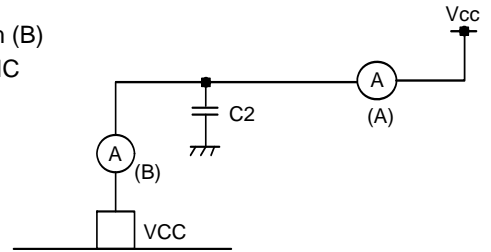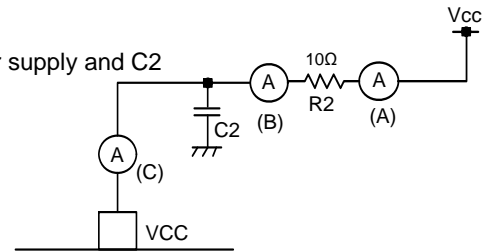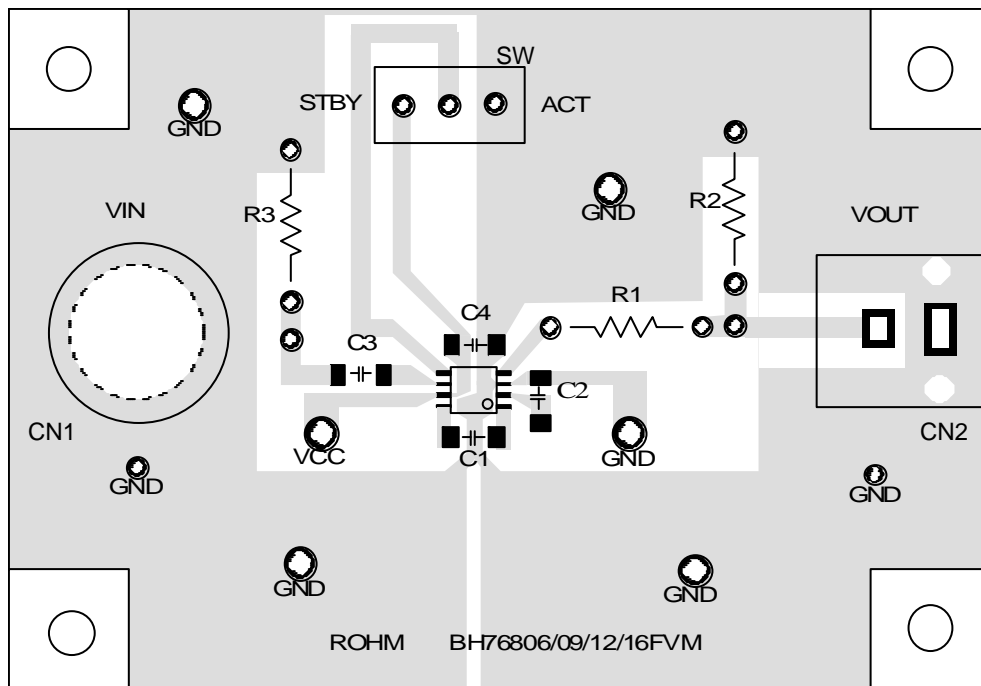

2) Decoupling capacitor + Resistance 10Ω
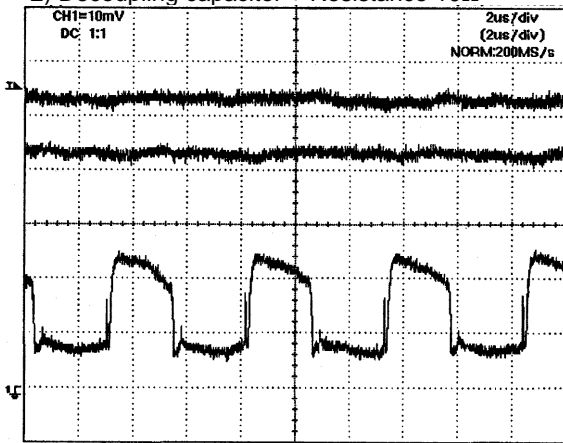
Fig.14

Current waveform (A)
between single power supply and R2
10mA/div

Current waveform (B)
between R2 and C2
10mA/div

Current waveform (C)
between single power supply and C2
10mA/div

●Pattern diagram of evaluation board

●List of external components   Fig. 15

Symbol	Function	Recommended value	Remark
C1	Flying capacitor	1μF	B characteristics are recommended
C2	Tank capacitor	1μF	B characteristics are recommended
C3	Input coupling capacitor	1μF	B characteristics are recommended
C4	Decoupling capacitor	3.3μF	B characteristics are recommended
R1	Output resistor	75Ω	—
R2	Output terminating resistance	75Ω	Not required when connecting to TV or video signal test equipment.
R3	Input terminating resistance	75Ω	Required when connecting to video signal test equipment.
CN1	Input connector	BNC	
CN2	Output connector	RCA (pin jack)	
SW	STBY control	SW	

●Reference data
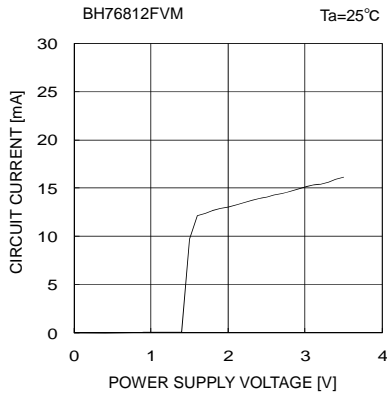
Fig. 16 Circuit current vs. Supply voltage
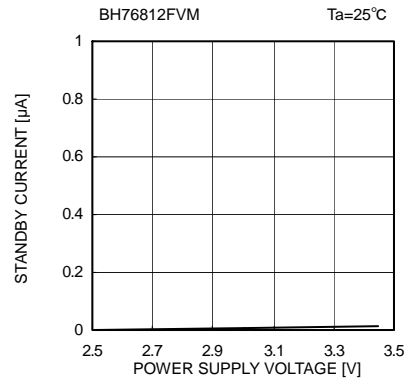
Fig. 17   Circuit Current (Standby) vs. Supply Voltage
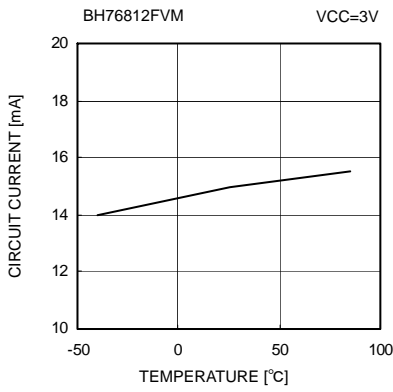

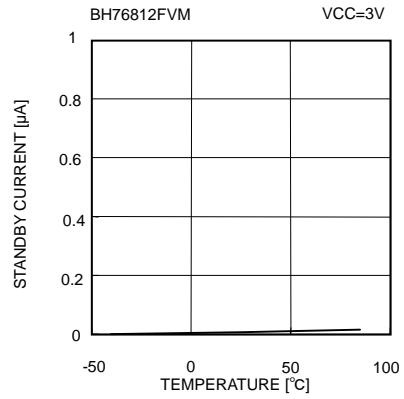Fig. 18 Circuit current vs. Temperature

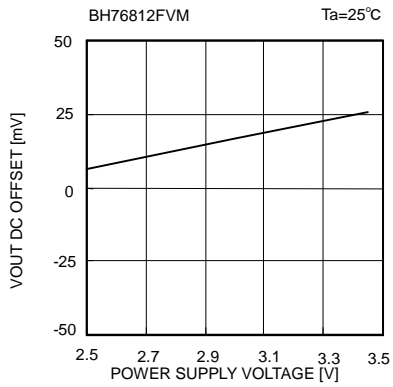Fig. 19   Circuit Current (Standby) vs. Temperature

Fig. 20   VOUT DC offset voltage
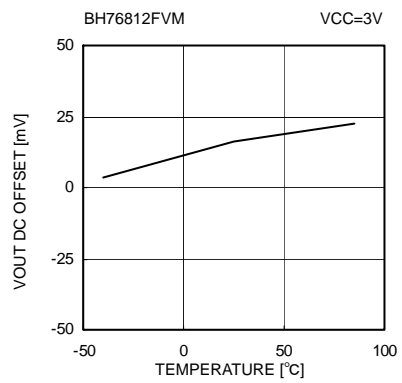vs. Supply voltage
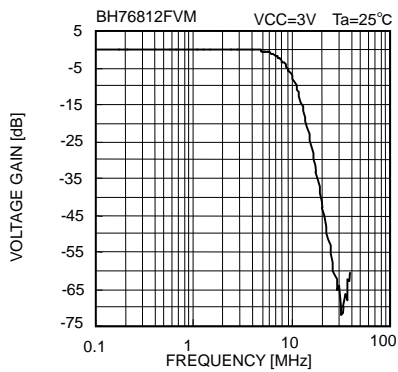

Fig. 21   VOUT DC offset voltage
vs. Temperature

Fig. 22   Frequency characteristic

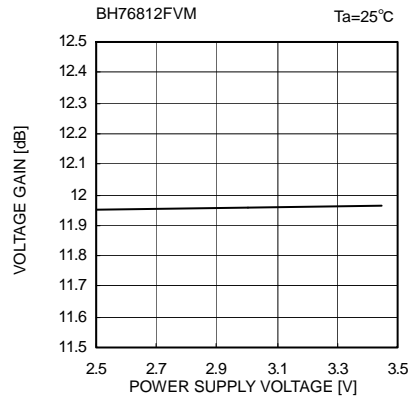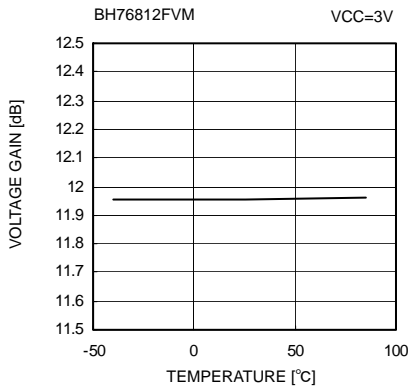Fig. 23   Voltage gain vs. Supply voltage

BH76812FVM   VCC=3V

Fig. 24 Voltage gain vs. Temperature

BH76812FVM   Ta=25℃
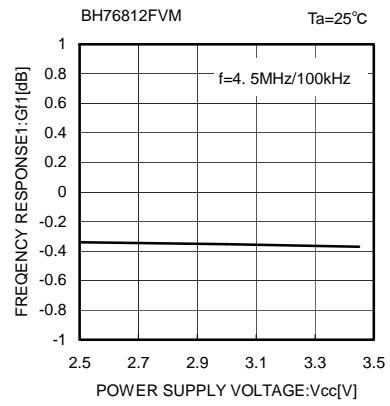
Fig. 25 Frequency response 1 vs. Supply voltage

BH76812FVM   VCC=3V
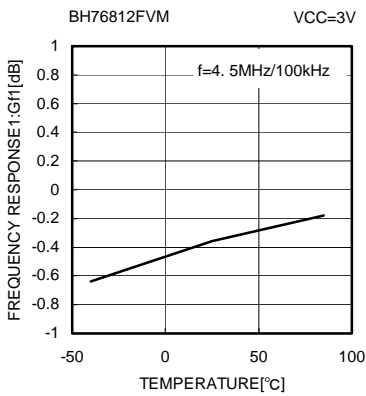
Fig. 26   Frequency response 1 vs. Temperature

BH76812FVM   Ta=25℃
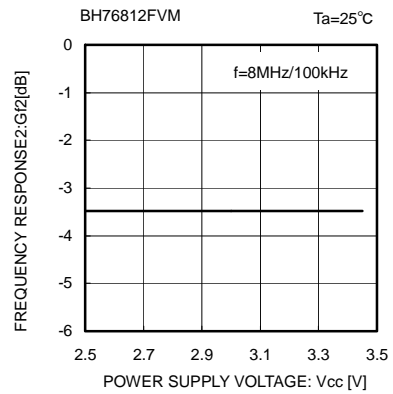
Fig. 27   Frequency response 2 vs. Supply voltage

BH76812FVM   VCC=3V
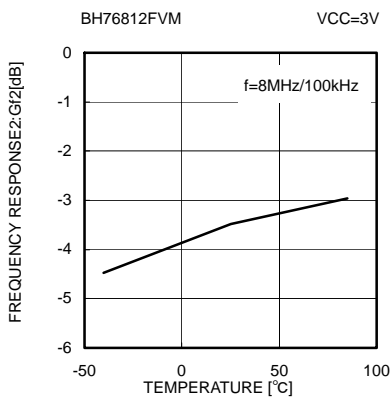
Fig. 28 Frequency response 2 vs. Temperature

BH76812FVM   Ta=25℃
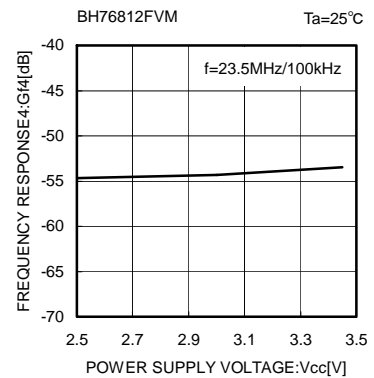
Fig.29   Frequency response 4 vs. Supply voltage

BH76812FVM   VCC=3V
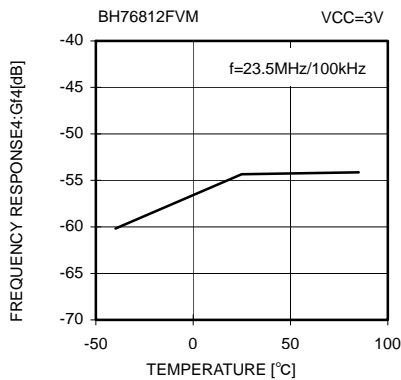
Fig. 30   Frequency response 4 vs. Temperature

BH76812FVM   Ta=25℃

Fig. 31   Maximum output voltage level vs. Supply voltage

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Fig. 32   Maximum output level vs. Temperature

Fig. 33   Output DC voltage – Input DC voltage
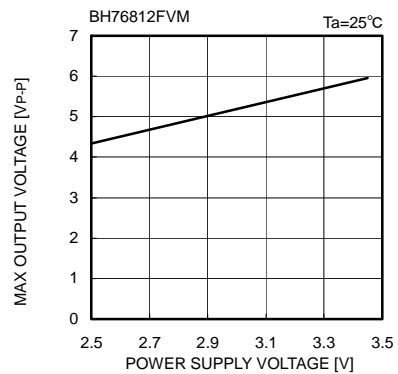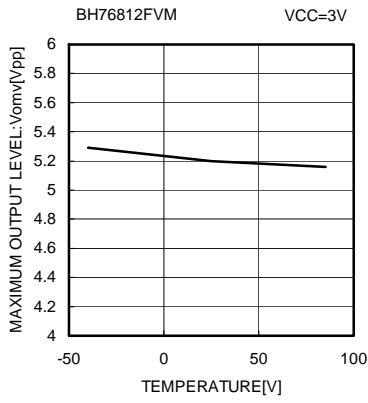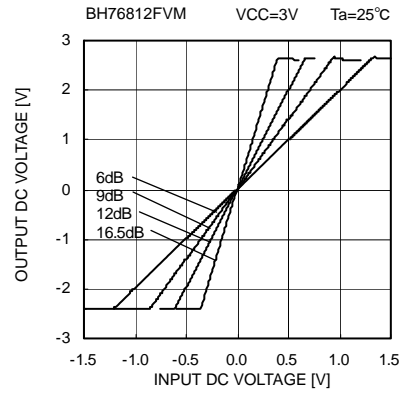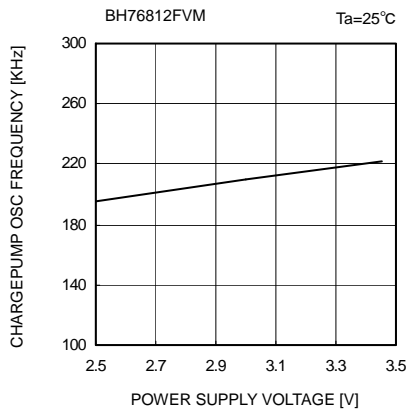

Fig. 34   Charge pump oscillation frequency
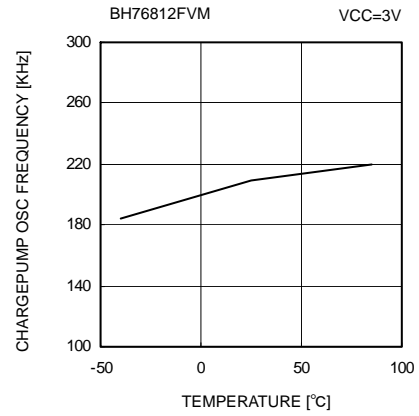vs. Supply voltage

Fig. 35   Charge pump oscillation frequency
vs. Temperature
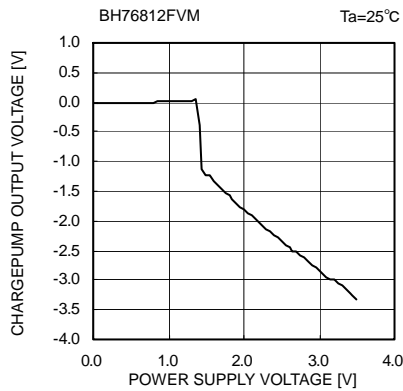
Fig. 36   Charge pump output voltage
vs. Supply voltage
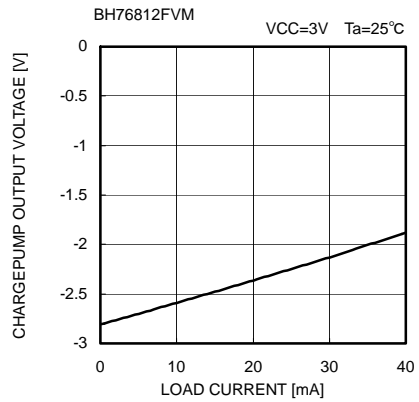
Fig. 37   Charge pump load regulation
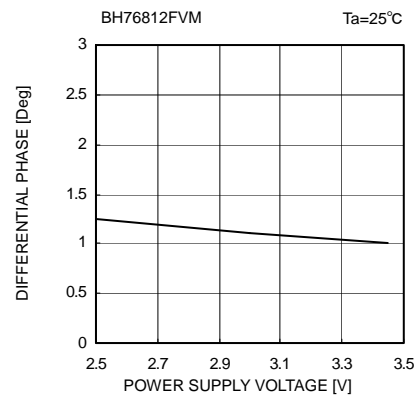
Fig. 38 Differential phase vs. Supply voltage
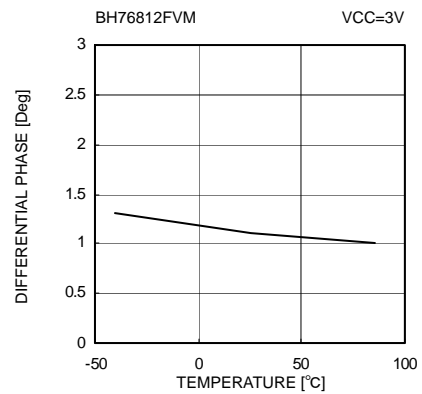
Fig. 39 Differential phase vs. Temperature

BH76812FVM   Ta=25℃
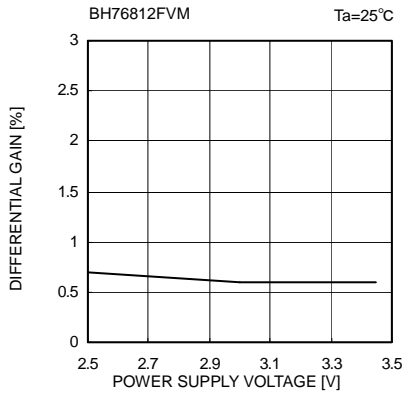
Fig. 40 Differential gain vs. Supply voltage

BH76812FVM   VCC=3V
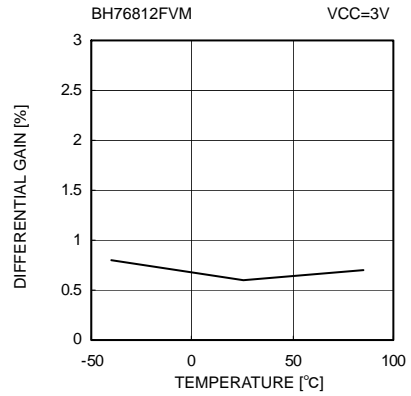
Fig. 41 Differential gain vs. Temperature

BH76812FVM   Ta=25℃
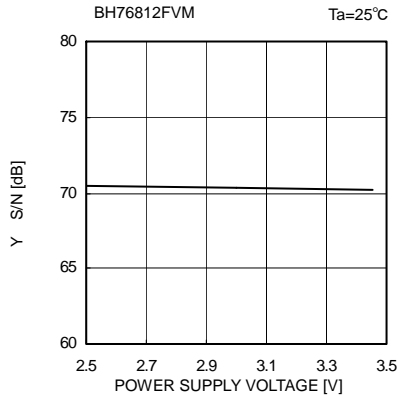
Fig. 42 S/N(Y) vs. Supply Voltage

BH76812FVM   VCC=3V
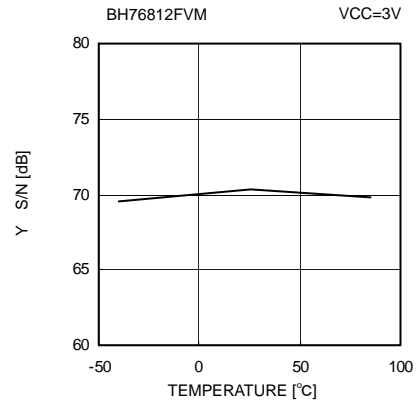
Fig.43 S/N(Y) vs. Temperature

BH76812FVM   Ta=25℃
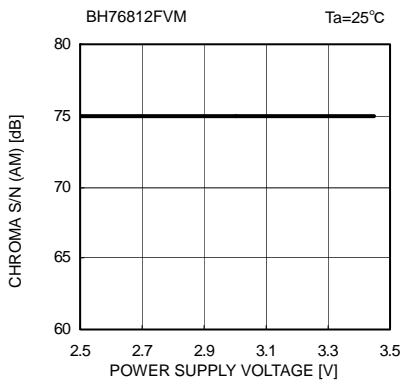
Fig. 44 S/N(C-AM) vs. Supply Voltage

BH76812FVM   VCC=3V
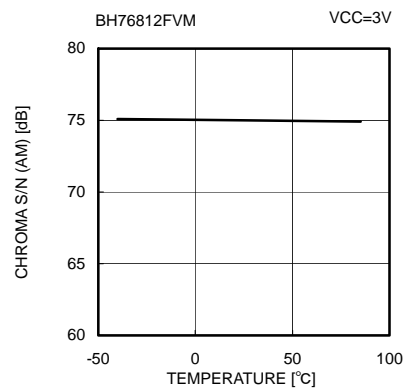
Fig. 45 S/N(C-AM) vs. Temperature

BH76812FVM   Ta=25℃
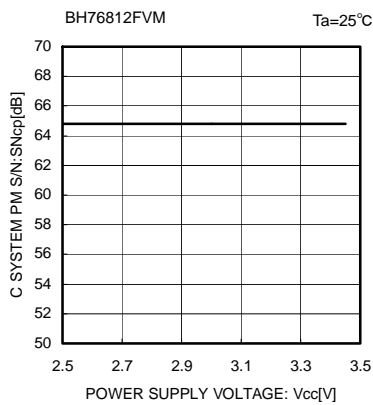
Fig. 46 S/N(C-PM) vs. Supply Voltage

BH76812FVM   VCC=3V

Fig. 47　S/N(C-PM) vs. Temperature

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Fig. 48 Circuit current vs. STBY 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. Assu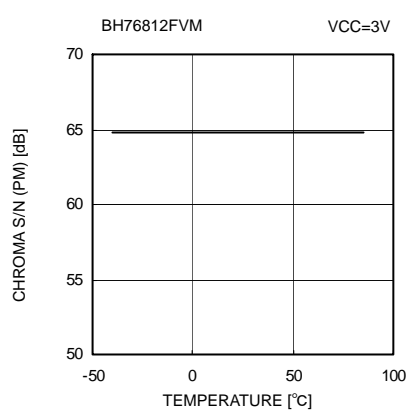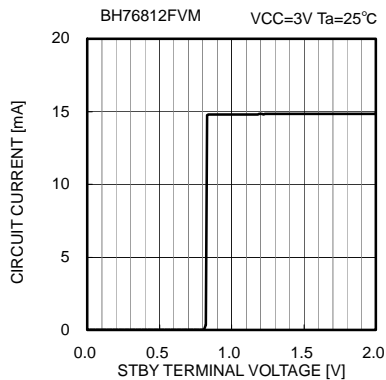mptions should not be made regarding the state of the IC (short mode or open mode) when such damage is suffered. A physical safety measure, such as a fuse, should be implemented when using the IC at times where the absolute maximum ratings may be exceeded.

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 µF, 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 µF; C2: 3.3 µF, B characteristics, 6.3 V or higher maximum voltage)

11. The HPF consists of input coupling capacitor C3 and 150 kΩ of the internal input.

    Be sure to check for video signal sag before determining the C3 value.

    The cut-off frequency fc can be calculated using the following formula.

    $fc = 1/(2\pi \times C3 \times 150 \text{ k}\Omega)$ (Recommendations: 1.0 µF, 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**

| B | H | 7 | 6 | 8 | 0 | 6 | F | V | M | — | T | R |

Part. No.

BH76806FVM
BH76809FVM
BH76812FVM
BH76816FVM

Tape and Reel
information

MSOP8

<Dimension>

(Unit:mm)

<Tape and Reel information>

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

1pin

Direction of feed

Reel

＊Order quantity needs to be multiple of the minimum quantity.

N o t e s

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3) Although ROHM is continuously working to improve product reliability and quality, semiconductors can break down and malfunction due to various factors.
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M ADV7280KCPZ-M ADV7280WBCPZ ADV7180KCP32Z-RL ADV7282AWBCPZ ADV7182AWBCPZ AD723ARUZ ADV7611BSWZ
 ADV7181DWBCPZ-RL ADV7173KSTZ-REEL ADV7180WBST48Z-RL ADA4411-3ARQZ ADA4411-3ARQZ-R7 ADA4417-3ARMZ
ADA4417-3ARMZ-R7 ADA4424-6ARUZ ADA4431-1YCPZ-R7