NPC

OVERVIEW

The SM5304AV is a 75Ω terminating resistance drive video buffer with built-in analog filter. The filter cutoff frequency, controlled by the resistance connected to RFC pin, can be set to match any system resolution. The output buffer can be selected 0dB, 6dB, and 12dB. The feedback point occurs after the external coupling capacitors, and the coupling capacitances can be reduced.

FEATURES

- 5V ± 10% supply voltage
- Adjustable cutoff frequency using external resistor
- 0dB, 6dB, 12dB selectable gain using logic signal
- ± 0.5dB output gain error
- Two systems (two load resistances) can be driven
- 0.7% output signal harmonic distortion
- Sag compensation circuit built-in
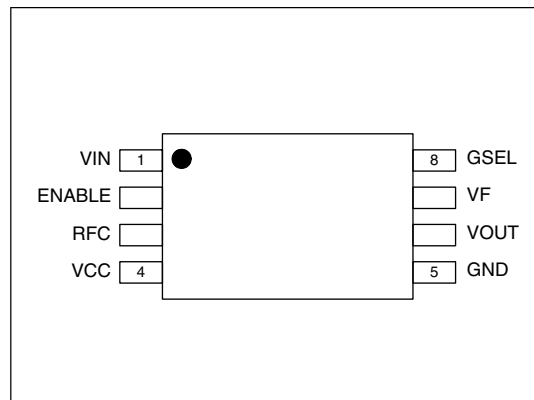- Package: 8-pin VSOP (Pb free)

APPLICATIONS

- DVD
- Digital still camera
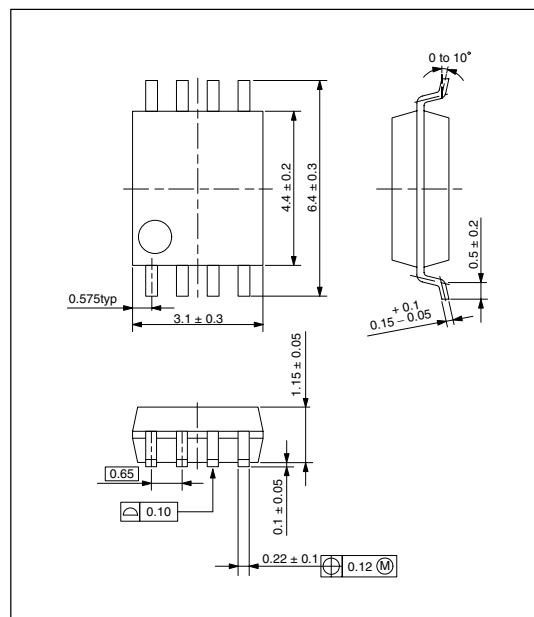- Digital VHS

ORDERING INFORMATION

Device	Package
SM5304AV	8-pin VSOP

PINOUT

(Top view)

PACKAGE DIMENSIONS

(Unit: mm)
Weight: 0.04g

BLOCK DIAGRAM
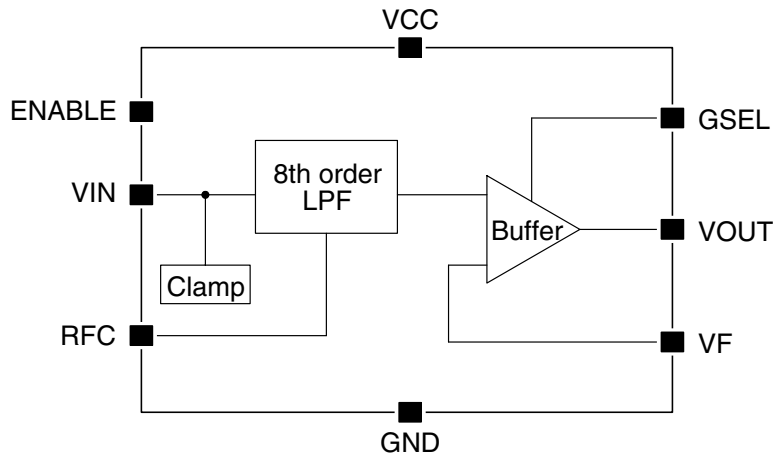
PIN DESCRIPTION

Number	Name	I/O[1]	A/D[2]	Description
1	VIN	I	A	Input signal pin
2	ENABLE	I	D	Enable signal input pin (with pull-down resistor)
3	RFC	O	A	LPF cutoff frequency set pin
4	VCC	–	–	5V supply pin
5	GND	–	–	Ground pin
6	VOUT	O	A	Output signal pin
7	VF	I	A	Output signal feedback pin for sag compensation circuit
8	GSEL	I	D	Gain set signal input pin

1. I: input, O: output
2. A: analog, D: digital

SPECIFICATIONS

Absolute Maximum Ratings

Parameter	Symbol	Condition	Rating	Unit
Supply voltage range	V_{CC}		− 0.3 to 7	V
Storage temperature range	T_{STG}		− 55 to + 125	°C
Power dissipation	P_D	θja = 214°C/W (Note 1)	300	mW
Junction temperature	T_j		125	°C

(Note 1) T_j is calculated by $T_j = P_D \times$ θja + Ta (P_D: Power dissipation (= $V_{CC} \times I_{CC}$), θja: Thermal resistance, Ta: Ambient temperature).
θja is measured value in the mounting condition which NPC specified. (glass epoxy board, board size: 40mm × 40mm, wiring density: 10%, still air)

Recommended Operating Conditions

Parameter	Symbol	Condition	Rating	Unit
Supply voltage range	V_{CC}		4.5 to 5.5	V
Operating temperature range	Ta		− 40 to 85	°C

Digital Characteristics

V_{CC} = 5.0V, Ta = 25°C, unless otherwise noted.

Parameter	Symbol	Condition	Rating min	typ	max	Unit	Test level
HIGH-level input voltage 1	V_{IH1}	ENABLE pin	2.4	–	–	V	I
LOW-level input voltage 1	V_{IL1}	ENABLE pin	–	–	0.8	V	I
HIGH-level input voltage 2	V_{IH2}	GSEL pin	V_{CC} − 0.5	–	–	V	I
LOW-level input voltage 2	V_{IL2}	GSEL pin	–	–	0.5	V	I
Open-circuit input voltage	V_{OPEN}	GSEL pin	$V_{CC}/2 - 0.5$	–	$V_{CC}/2 + 0.5$	V	I
HIGH-level input current 1	I_{IH1}	ENABLE pin, $V_{IN} = V_{CC}$	–	100	200	µA	I
Input leakage current 1	I_{LL1}	ENABLE pin, $V_{IN} = 0V$	–	–	1	µA	I
Input leakage current 2	I_{LL2}	GSEL pin, ENABLE = "LOW", $V_{IN} = 0V$	–	–	1	µA	I
HIGH-level input current 2	I_{IH2}	GSEL pin, ENABLE = "HIGH", $V_{IN} = V_{CC}$	–	250	400	µA	I
LOW-level input current 2	I_{IL2}	GSEL pin, ENABLE = "HIGH", $V_{IN} = 0V$	–	250	400	µA	I
Pull-down resistance 1	R_{PD1}	ENABLE pin	40	50	60	kΩ	I
Pull-down resistance 2	R_{PD2}	GSEL pin when ENABLE = "LOW"	16	20	24	kΩ	I

Electrical Characteristics

V_{CC} = 5.0V, Ta = 25°C, unless otherwise noted, See Measurement circuit.

Parameter	Symbol	Condition	Rating			Unit	Test level
			min	typ	max		
Current consumption 1	I_{CC1}	V_{CC} = 4.5 to 5.5V, R_{FC} = 2.7kΩ, Ta = – 40 to 85°C, ENABLE = "HIGH"	–	41	52	mA	II
Current consumption 2	I_{CC2}	V_{CC} = 4.5 to 5.5V, R_{FC} = 4.3kΩ, Ta = – 40 to 85°C, ENABLE = "HIGH"	–	39	49	mA	II
Current consumption 3	I_{CC3}	ENABLE = "LOW", GSEL = "LOW"	–	–	10	μA	I
Signal gain 1	A_{V1}	GSEL = "LOW", R_{FC} = 4.3kΩ, f = 1MHz	5.7	6.2	6.7	dB	I
Signal gain 2	A_{V2}	GSEL = "Open cct", R_{FC} = 4.3kΩ, f = 1MHz	– 0.3	0.2	0.7	dB	I
Signal gain 3	A_{V3}	GSEL = "HIGH", R_{FC} = 4.3kΩ, f = 1MHz	11.5	12.0	12.5	dB	I
Input voltage range	V_{IN}	AC-coupled input, f = 100kHz	1.4	–	–	Vp-p	I
Maximum output voltage	V_{out}	Output conditions shown in Typical Connection	2.4	–	–	Vp-p	I
Clamp voltage	V_{CLMP}		0.9	1.2	1.45	V	I
Overshoot/ Undershoot[1]	V_{OS}		–	4.0	–	%	III
Output harmonic distortion	T_{HD}	f = 1MHz, Vout = 2Vp-p, R_{FC} = 4.3kΩ	–	0.7	–	%	III
Cutoff frequency control range	f_C		2	–	10	MHz	I
Resistor (R_{FC}) value range[2]	R_{FC}		2.7	–	18	kΩ	I
Cutoff frequency error	ΔF_C		–	–	± 15	%	I
4fc attenuation	f_{SB}	f ≥ 4fc	–	– 70	–	dB	III
Group delay variation	ΔT_{PD}	R_{FC} = 4.3kΩ, 100kHz and 5MHz group delay difference	–	12	–	ns	III

1. The percentage output pulse overshoot when R_{FC} = 4.3kΩ, gain = 6dB, and input pulse = 1Vp-p (rise and fall times = 100ns).
2. Refer to "R_{FC} Frequency Control" for the Cutoff frequency vs. R_{FC} characteristics.

Test level

I : Valid for 100% product tests conducted at Ta = 25°C

II : 100% valid for alternative tests conducted at Ta = 25°C

III: Guaranteed based on design and characteristics evaluation

Measurement circuit
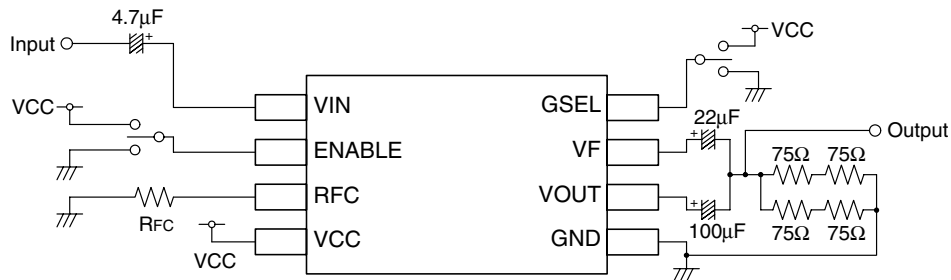
FUNCTIONAL DESCRIPTION

R$_{FC}$ Frequency Control

Characteristics

The cutoff frequency (fc) is controlled by the resistor connected to RFC pin (R$_{FC}$). The characteristics about fc versus R$_{FC}$ is shown in table 1.

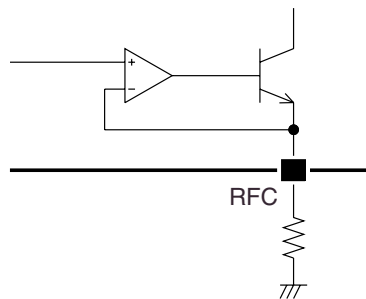Table 1. R$_{FC}$ and frequency control range

R$_{FC}$ [kΩ]	Cutoff frequency [MHz]
18	1.9
15	2.3
12	2.8
10	3.3
8.2	3.9
6.8	4.6
5.6	5.5
4.7	6.4
4.3	6.9
3.9	7.5
3.3	8.7
2.7	10.5

Adjustment methods

It can set up by the following methods. Since resistance affects cutoff frequency, please use a high precise thing.

■ Fixed resistor

The frequency can be adjusted using an external resistor connected to RFC.

■ Variable resistor

The frequency can be adjusted using a preset variable resistor VR connected to RFC.
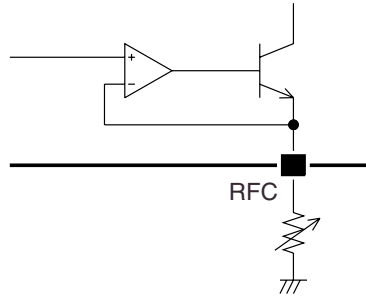
■ Voltage control

The frequency can be adjusted by voltage control of the resistor connected to RFC using a DC voltage supply (for example, using a DAC). In this case, the adjusting voltage must be controlled such that it does not exceed the RFC pin voltage (1.5V typ).
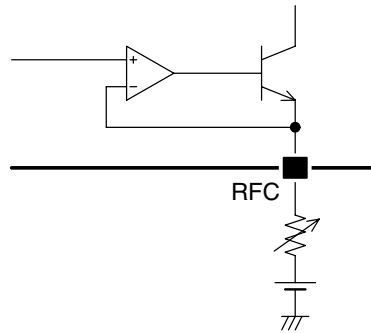
■ Resistor switch control

The frequency can be adjusted by switching the resistance connected to RFC using logic voltage control.
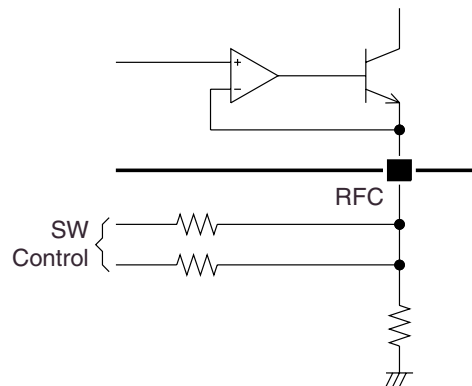
Gain Control Function and Enable Function

ENABLE pin	GSEL pin	Gain setting
HIGH (Enable)	LOW	6dB
	Open	0dB
	HIGH	12dB
LOW (Disable)	LOW	High impedance output
	Open	
	HIGH	

When setting GSEL pin to open, in order to prevent incorrect operation by the external noise, it recommends connecting a capacitor between GSEL pin and GND pin.

Equivalent circuit

The equivalent circuit of GSEL pin and ENABLE pin is shown in figure. GSEL pin is connected only to pull-down resistor in the state of disable.
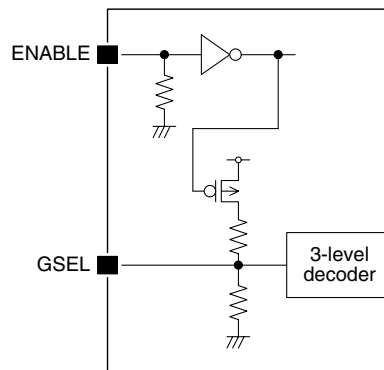
TYPICAL CHARACTERISTICS

V_{CC} = 5.0V, R_{FC} = 4.3kΩ, Ta = 25°C, unless otherwise noted.
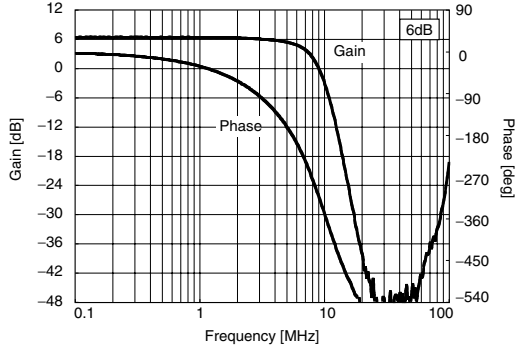
Figure 1. Phase vs Frequency
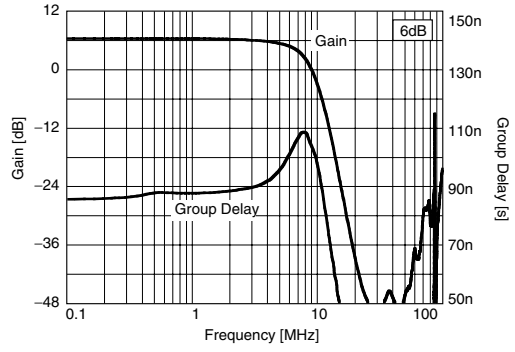
Figure 2. Group Delay vs Frequency
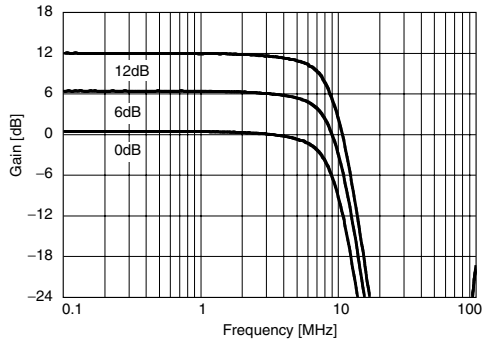
Figure 3. Gain vs Frequency (Rfc = 4.3kΩ)
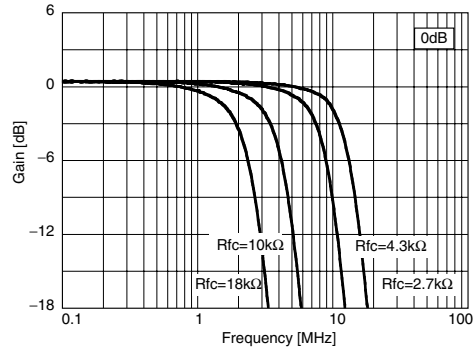
Figure 4. Gain vs Frequency (0dB)
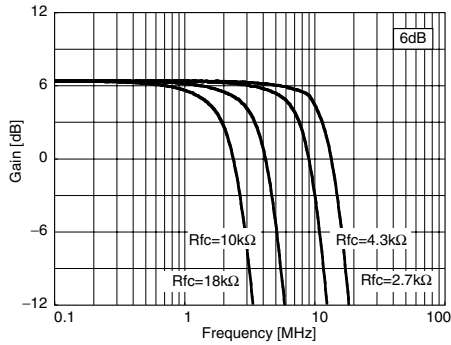
Figure 5. Gain vs Frequency (6dB)
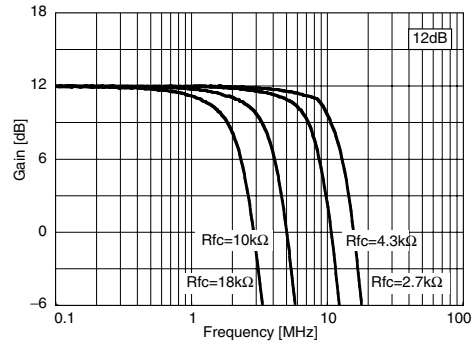
Figure 6. Gain vs Frequency (12dB)

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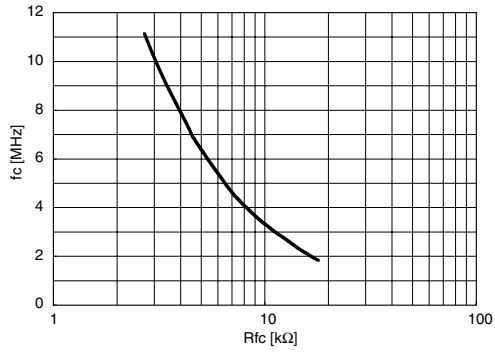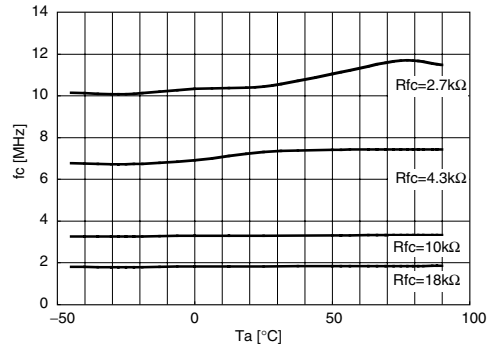
Figure 7. fc vs Rfc

Figure 8. fc vs Ta
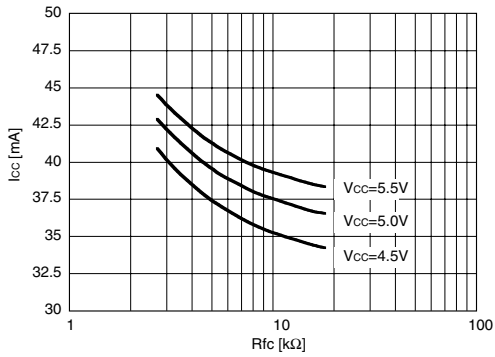
Figure 9. I_{CC} vs Rfc
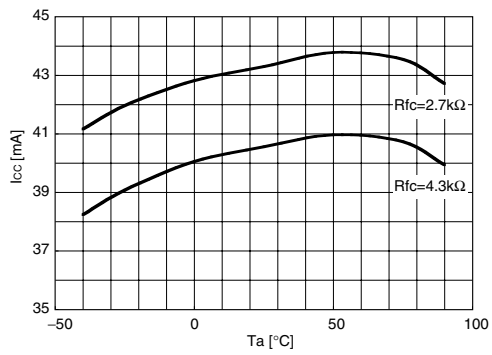
Figure 10. I_{CC} vs Ta
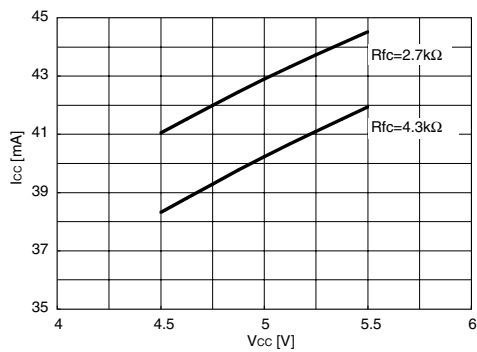
Figure 11. I_{CC} vs V_{CC}
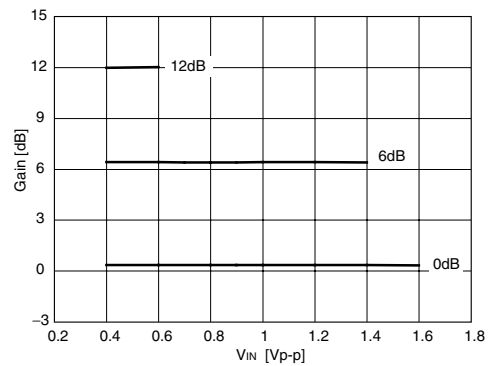
Figure 12. Gain vs V_{IN}
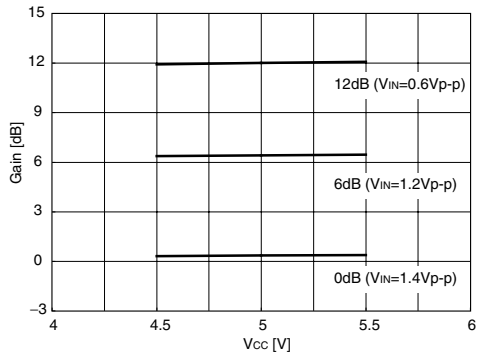
Figure 13. Gain vs V_{CC}
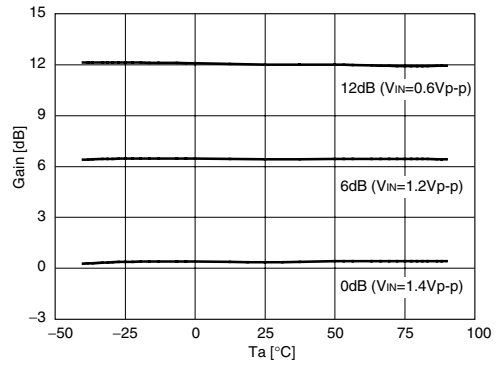
Figure 14. Gain vs Ta
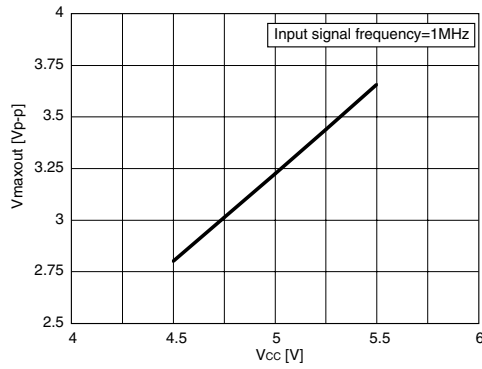
Figure 15. Vmaxout vs V_{CC}

TYPICAL CONNECTION
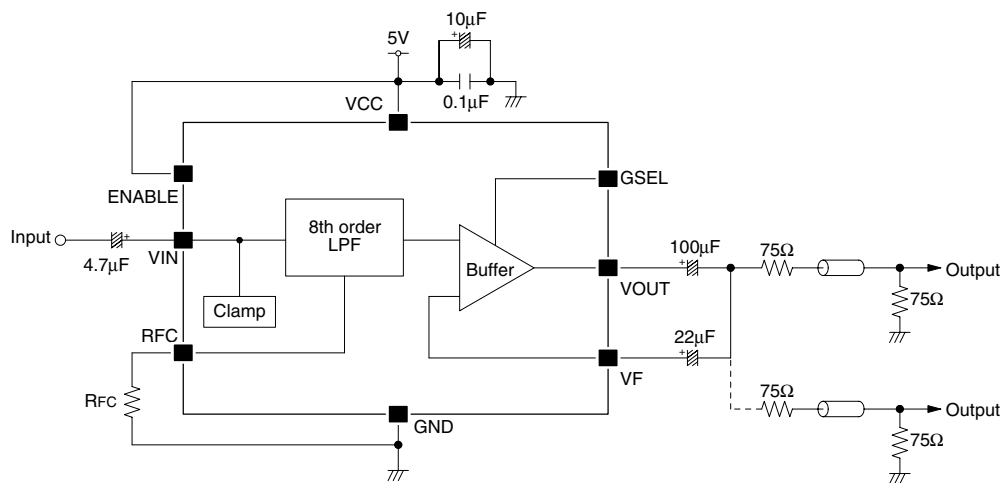
NOTES ON USE

Capacitors Between Power Supply Pin

Please be sure to connect a capacitor between power supply pin (VCC, GND) for preventing the oscillation of an output and supplying a power supply stable. Electrolytic capacitor about 1µF to 10µF and ceramic capacitor about 0.01µF to 0.1µF are recommended. Please connect a ceramic capacitor to near between power supply pin, shown in a figure.
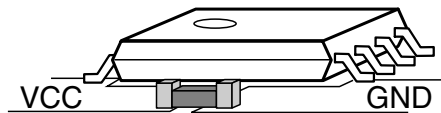
Range of Power Dissipation and Ambient Temperature

Operating condition range (power supply and ambient temperature) which is not exceeded package power dissipation and package junction temperature shown in the item of Absolute Maximum Rating are shown in a figure. However this range is calculated from the package thermal resistance under the mounting conditions which NPC specified, and when mounting conditions differ from this condition, it does not become such.

$$PD = (Tjmax - Ta) / \theta ja$$
$$Tjmax = 125℃, \theta ja = 214℃/W$$
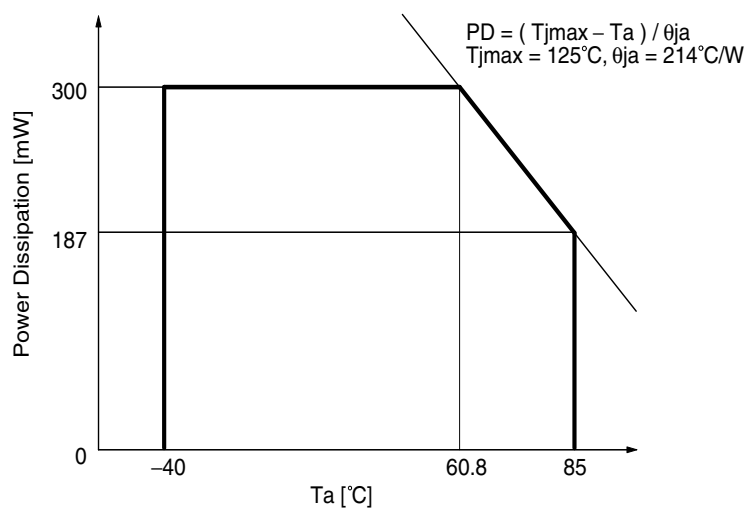
Mounting conditions

- glass epoxy board
- board size: 40mm × 40mm
- wiring density: 10%
- still air

The following method is effective, in order to lower thermal resistance and to prevent the rise of junction temperature.

- Wiring area connected to the pin of SM5304AV is made widely.
- To cool down, use the cooling fan etc.

Please pay your attention to the following points at time of using the products shown in this document.