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Tel: +86-755-8981 8866 Fax: +86-755-8427 6832
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Operational Amplifiers Series

Ground Sense Low Power General Purpose Operational Amplifiers

LMR321G, LMR358xxx, LMR324xxx

●General Description

LMR321, LMR358 and LMR324 are single, dual and quad low voltage operational amplifier with output full swing.
LMR321, LMR358 and LMR324 are the most effective solutions for applications where low supply current consumption and low voltage operation.

●Features

- Operable with low voltage
- Input Ground Sense, Output Full Swing
- High open loop voltage gain
- Low supply current
- Low input offset voltage

●Packages

	W(Typ.) x D(Typ.) x H(Max.)
SSOP5	2.90mm x 2.80mm x 1.25mm
SOP8	5.00mm x 6.20mm x 1.71mm
SOP-J8	4.90mm x 6.00mm x 1.65mm
SSOP-B8	3.00mm x 6.40mm x 1.35mm
TSSOP-B8	3.00mm x 6.40mm x 1.20mm
MSOP8	2.90mm x 4.00mm x 0.90mm
TSSOP-B8J	3.00mm x 4.90mm x 1.10mm
SOP14	8.70mm x 6.20mm x 1.71mm
SOP-J14	8.65mm x 6.00mm x 1.65mm
SSOP-B14	5.00mm x 6.40mm x 1.35mm
TSSOP-B14J	5.00mm x 6.40mm x 1.20mm

●Applications

- Portable equipment
- Low voltage application
- Active filter

●Key Specifications

- Operable with low voltage (single supply): +2.7V to +5.5V
- Low Supply Current:
  - LMR321 130µA(Typ.)
  - LMR358 210µA(Typ.)
  - LMR324 410µA(Typ.)
- High Slew Rate: 1.0V/µs(Typ.)
- Wide Temperature Range: -40°C to +85°C
- Low Input Offset Current: 5nA (Typ.)
- Low Input Bias Current: 15nA (Typ.)

●Simplified schematic

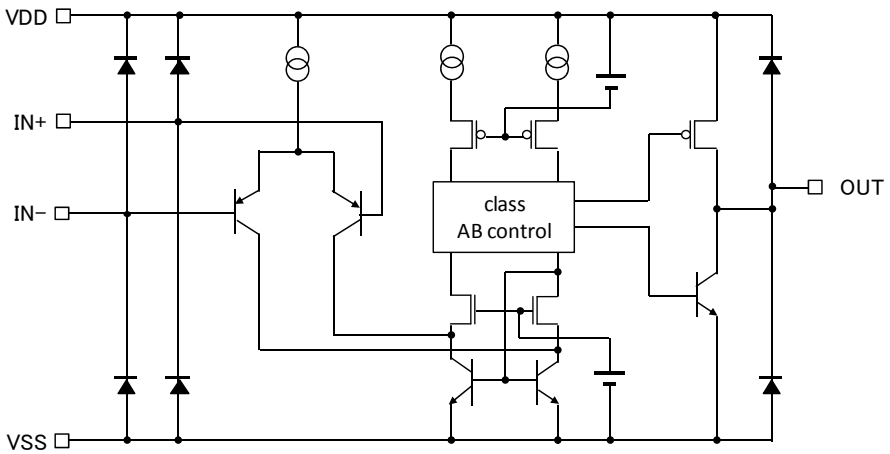
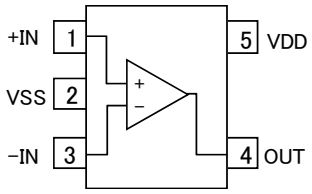


Figure 1. Simplified schematic

○Product structure : Silicon monolithic integrated circuit ○This product is not designed protection against radioactive rays.

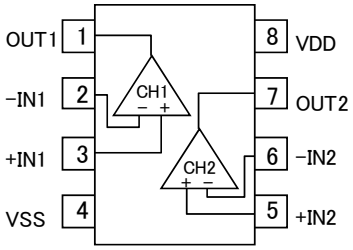
●Pin Configuration

SSOP5



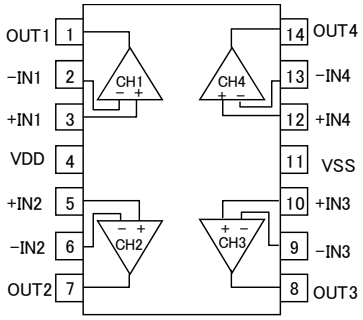
Pin No.	Symbol
1	+IN
2	VSS
3	-IN
4	OUT
5	VDD

SOP8, SOP-J8, SSOP-B8, TSSOP-B8, MSOP8, TSSOP-B8J



Pin No.	Symbol
1	OUT1
2	-IN1
3	+IN1
4	VSS
5	+IN2
6	-IN2
7	OUT2
8	VDD

SOP14, SOP-J14, SSOP-B14, TSSOP-B14J



Pin No.	Symbol
1	OUT1
2	-IN1
3	+IN1
4	VDD
5	+IN2
6	-IN2
7	OUT2
8	OUT3
9	-IN3
10	+IN3
11	VSS
12	+IN4
13	-IN4
14	OUT4

Package					
SSOP5	SOP8	SOP-J8	SSOP-B8	TSSOP-B8	MSOP8
LMR321G	LMR358F	LMR358FJ	LMR358FV	LMR358FVT	LMR358FVM
Package					
TSSOP-B8J	SOP14	SOP-J14	SSOP-B14	TSSOP-B14J	-
LMR358FVJ	LMR324F	LMR324FJ	LMR324FV	LMR324FVJ	-

●**Ordering Information**

L M R 3 x x x x x - x x

Part Number
LMR321G
LMR358xxx
LMR324xxx

Package
G : SSOP5
F : SOP8, SOP14
FV : SSOP-B8
SSOP-B14
FVM : MSOP8
FJ : SOP-J8
SOP-J14
FVJ : TSSOP-B8J
TSSOP-B14J
FVT : TSSOP-B8

Packaging and forming specification
E2: Embossed tape and reel
(SOP8/SOP-J8/SSOP-B8/TSSOP-B8/
TSSOP-B8J/SOP14/SOP-J14/SSOP-B14
TSSOP-B14J)
TR: Embossed tape and reel
(SSOP5/MSOP8)

●**Line-up**

Topr	Input type	V_{DD} (Min.)	Supply Current (Typ.)	Input Offset Voltage (Max.)	Package		Orderable Part Number
-40°C to + 85°C	Ground Sense	2.7V	130µA	±4mV	SSOP5	Reel of 3000	LMR321G-TR
			210µA	±5mV	SOP8	Reel of 2500	LMR358F-E2
					MSOP8	Reel of 3000	LMR358FVM-TR
					SOP-J8	Reel of 2500	LMR358FJ-E2
					SSOP-B8	Reel of 2500	LMR358FV-E2
					TSSOP-B8	Reel of 3000	LMR358FVT-E2
					TSSOP-B8J	Reel of 2500	LMR358FVJ-E2
			410µA	±9mV	SOP14	Reel of 2500	LMR324F-E2
					SOP-J14	Reel of 2500	LMR324FJ-E2
					SSOP-B14	Reel of 2500	LMR324FV-E2
					TSSOP-B14J	Reel of 2500	LMR324FVJ-E2

●**Absolute Maximum Ratings**(Ta=25℃)

Parameter	Symbol		Rating			Unit
			LMR321G	LMR358	LMR324	
Supply Voltage	VDD-VSS		+7			V
Power dissipation	Pd	SSOP5	675[*1*9]	-	-	mW
		SOP-J8	-	675[*1*9]	-	
		SOP8	-	690[*2*9]	-	
		SSOP-B8	-	625[*3*9]	-	
		TSSOP-B8	-	625[*3*9]	-	
		MSOP8	-	587[*4*9]	-	
		TSSOP-B8J	-	587[*4*9]	-	
		SOP-J14	-	-	1025[*5*9]	
		SSOP-B14	-	-	875[*6*9]	
		TSSOP-B14J	-	-	850[*7*9]	
		SOP14	-	-	562[*8*9]	
Differential Input Voltage[*10]	Vid		VDD - VSS			V
Input Common-mode Voltage Range	Vicm		(VSS-0.3) to (VDD+0.3)			V
Operable with low voltage	Vopr		+2.7 to +5.5			V
Operating Temperature	Topr		-40 to +85			℃
Storage Temperature	Tstg		-55 to +150			℃
Maximum Junction Temperature	Tjmax		+150			℃

Note: Absolute maximum rating item indicates the condition which must not be exceeded.
Application of voltage in excess of absolute maximum rating or use out absolute maximum rated temperature environment may cause deterioration of characteristics.

*1 To use at temperature above Ta=25℃ reduce 5.4mW/℃.
*2 To use at temperature above Ta=25℃ reduce 5.52mW/℃.
*3 To use at temperature above Ta=25℃ reduce 5mW/℃.
*4 To use at temperature above Ta=25℃ reduce 4.7mW/℃.
*5 To use at temperature above Ta=25℃ reduce 8.2mW/℃.
*6 To use at temperature above Ta=25℃ reduce 7mW/℃.
*7 To use at temperature above Ta=25℃ reduce 6.8mW/℃.
*8 To use at temperature above Ta=25℃ reduce 4.5mW/℃.
*9 Mounted on a glass epoxy PCB(70mm×70mm×1.6mm).
*10 The voltage difference between inverting input and non-inverting input is the differential input voltage. Then input terminal voltage is set to more than VSS.

●Electrical Characteristics

○LMR321 (Unless otherwise specified VDD=+5V, VSS=0V)

Parameter	Symbol	Temperature Range	Limits			Unit	Condition
			Min.	Typ.	Max.		
Input Offset Voltage *11	Vio	25℃	-	0.1	4	mV	VDD=2.7V to 5V
		Full range	-	-	5		
Input Offset Voltage drift	△Vio/△T	25℃	-	3	-	μV/℃	-
Input Offset Current *11	Iio	25℃	-	5	50	nA	-
Input Bias Current *11	Ib	25℃	-	15	100	nA	-
Supply Current *12	IDD	25℃	-	107	180	μA	VDD=2.7V, Av=0dB VIN=0.95V
		Full range	-	-	260		
		25℃	-	130	200		VDD=5V, Av=0dB VIN=2.1V
		Full range	-	-	280		
Maximum Output Voltage(High)	VOH	25℃	VDD-0.1	VDD-0.04	-	V	RL=2kΩ to 2.5V
Maximum Output Voltage(Low)	VOL	25℃	-	VSS+0.08	VSS+0.16	V	RL=2kΩ to 2.5V
Large Signal Voltage Gain	Av	25℃	78	110	-	dB	RL=2kΩ
Input Common-mode Voltage Range	Vicm	25℃	0	-	4.2	V	VSS to VDD-0.8V
Common-mode Rejection Ratio	CMRR	25℃	65	90	-	dB	-
Power Supply Rejection Ratio	PSRR	25℃	65	90	-	dB	-
Output Source Current *13	Isource	25℃	6	13	-	mA	OUT=VDD-0.4V
			-	70	-		OUT=0V, short current
Output Sink Current *13	Isink	25℃	30	60	-	mA	OUT=VSS+0.4V
			-	180	-		OUT=5V, short current
Slew Rate	SR	25℃	-	1.0	-	V/μs	CL=25pF
Unity Band width	f_T	25℃	-	2	-	MHz	CL=25pF, Av=40dB
			-	1	-		CL=200pF
Gain Band Width	GBW	25℃	-	3	-	MHz	f=100kHz
Phase Margin	θ	25℃	-	45	-	deg	CL=25pF, Av=40dB
Gain Margin	GM	25℃	-	10	-	dB	-
Input Referred Noise Voltage	Vn	25℃	-	5.5	-	μVrms	Av=40dB
			-	39	-	$nV/(Hz)^{1/2}$	Av=40dB, f=1kHz
Total Harmonic Distortion + Noise	THD+N	25℃	-	0.0015	-	%	OUT=0.4V_{P-P} f=1kHz

*11 Absolute value
*12 Full range: LMR321: Ta=-40℃ to +85℃
*13 Under the high temperature environment, consider the power dissipation of IC when selecting the output current.
When the terminal short circuits are continuously output, the output current is reduced to climb to the temperature inside IC.

○LMR358 (Unless otherwise specified VDD=+5V, VSS=0V)

Parameter	Symbol	Temperature Range	Limits			Unit	Condition
			Min.	Typ.	Max.		
Input Offset Voltage *14	Vio	25℃	-	0.1	5	mV	VDD=2.7V to 5.0V
		Full range	-	-	5		
Input Offset Voltage drift	△Vio/△T	25℃	-	3	-	μV/℃	-
Input Offset Current *14	Iio	25℃	-	5	50	nA	-
Input Bias Current *14	Ib	25℃	-	15	100	nA	-
Supply Current *15	IDD	25℃	-	210	360	μA	VDD=2.7V, Av=0dB VIN=0.95V
		Full range	-	-	520		
		25℃	-	210	380		VDD=5V, Av=0dB VIN=2.1V
		Full range	-	-	540		
Maximum Output Voltage(High)	VOH	25℃	VDD-0.1	VDD-0.04	-	V	RL=2kΩ to 2.5V
Maximum Output Voltage(Low)	VOL	25℃	-	VSS+0.08	VSS+0.16	V	RL=2kΩ to 2.5V
Large Signal Voltage Gain	Av	25℃	78	110	-	dB	RL=2kΩ
Input Common-mode Voltage Range	Vicm	25℃	0	-	4.2	V	VSS to VDD-0.8V
Common-mode Rejection Ratio	CMRR	25℃	65	90	-	dB	-
Power Supply Rejection Ratio	PSRR	25℃	65	90	-	dB	-
Output Source Current *16	Isource	25℃	6	13	-	mA	OUT=VDD-0.4V
			-	70	-		OUT=0V, short current
Output Sink Current *16	Isink	25℃	30	60	-	mA	OUT=VSS+0.4V
			-	180	-		OUT=5V, short current
Slew Rate	SR	25℃	-	1.0	-	V/μs	CL=25pF
Unity Band Width	f_T	25℃	-	2	-	MHz	CL=25F, Av=40dB
			-	1	-		CL=200pF
Gain Band Width	GBW	25℃	-	3	-	MHz	f=100kHz
Phase Margin	θ	25℃	-	45	-	°	CL=25pF, Av=40dB
Gain Margin	GM	25℃	-	10	-	dB	-
Input Referred Noise Voltage	Vn	25℃	-	5.5	-	μVrms	Av=40dB
			-	39	-	nV/(Hz)$^{1/2}$	Av=40dB, f=1kHz
Total Harmonic Distortion + Noise	THD+N	25℃	-	0.0015	-	%	OUT=0.4V_{P-P} f=1kHz
Channel Separation	CS	25℃	-	100	-	dB	Av=40dB

*14 Absolute value
*15 Full range: LMR358: Ta=-40℃ to +85℃
*16 Under the high temperature environment, consider the power dissipation of IC when selecting the output current.
When the terminal short circuits are continuously output, the output current is reduced to climb to the temperature inside IC.

○LMR324 (Unless otherwise specified VDD=+5V, VSS=0V)

Parameter	Symbol	Temperature Range	Limits			Unit	Condition
			Min.	Typ.	Max.		
Input Offset Voltage *17	Vio	25℃	-	1.0	9	mV	VDD=2.7V to 5.0V
		Full range	-	-	9		
Input Offset Voltage drift	△Vio/△T	25℃	-	3	-	μV/℃	-
Input Offset Current *17	Iio	25℃	-	5	50	nA	-
Input Bias Current *17	Ib	25℃	-	15	100	nA	-
Supply Current *18	IDD	25℃	-	410	720	μA	VDD=2.7V, Av=0dB VIN=0.95V
		Full range	-	-	880		
		25℃	-	410	800		VDD=5V, Av=0dB VIN=2.1V
		Full range	-	-	900		
Maximum Output Voltage(High)	VOH	25℃	VDD-0.1	VDD-0.04	-	V	RL=2kΩ to 2.5V
Maximum Output Voltage(Low)	VOL	25℃	-	VSS+0.08	VSS+0.16	V	RL=2kΩ to 2.5V
Large Signal Voltage Gain	Av	25℃	78	110	-	dB	RL=2kΩ
Input Common-mode Voltage Range	Vicm	25℃	0	-	4.2	V	VSS to VDD-0.8V
Common-mode Rejection Ratio	CMRR	25℃	65	90	-	dB	-
Power Supply Rejection Ratio	PSRR	25℃	65	90	-	dB	-
Output Source Current *19	Isource	25℃	6	13	-	mA	OUT=VDD-0.4V
			-	70	-		OUT=0V, short current
Output Sink Current *19	Isink	25℃	30	60	-	mA	OUT=VSS+0.4V
			-	180	-		OUT=5V, short current
Slew Rate	SR	25℃	-	1.0	-	V/μs	CL=25pF
Unity Gain Frequency	f_T	25℃	-	2	-	MHz	CL=25pF, Av=40dB
			-	1	-		CL=200pF
Gain Band width	GBW	25℃	-	3	-	MHz	f=100kHz
Phase Margin	θ	25℃	-	45	-	deg	CL=25pF, Av=40dB
Gain Margin	GM	25℃	-	10	-	dB	-
Input Referred Noise Voltage	Vn	25℃	-	5.5	-	μVrms	Av=40dB
			-	39	-	$nV/(Hz)^{1/2}$	Av=40dB, f=1kHz
Total Harmonic Distortion + Noise	THD+N	25℃	-	0.0015	-	%	OUT=0.4V_{P-P} f=1kHz
Channel Separation	CS	25℃	-	100	-	dB	Av=40dB

*17 Absolute value
*18 Full range: LMR324: Ta=-40℃ to +85℃
*19 Under the high temperature environment, consider the power dissipation of IC when selecting the output current.
When the terminal short circuits are continuously output, the output current is reduced to climb to the temperature inside IC.

Description of electrical characteristics

Described here are the terms of electric characteristics used in this datasheet. Items and symbols used are also shown. Note that item name and symbol and their meaning may differ from those on another manufacture's document or general document.

1. Absolute maximum ratings

Absolute maximum rating item indicates the condition which must not be exceeded. Application of voltage in excess of absolute maximum rating or use out of absolute maximum rated temperature environment may cause deterioration of characteristics.

1.1 Power supply voltage (VDD/VSS)
Indicates the maximum voltage that can be applied between the positive power supply terminal and negative power supply terminal without deterioration or destruction of characteristics of internal circuit.

1.2 Differential input voltage (Vid)
Indicates the maximum voltage that can be applied between non-inverting terminal and inverting terminal without deterioration and destruction of characteristics of IC.

1.3 Input common-mode voltage range (Vicm)
Indicates the maximum voltage that can be applied to non-inverting terminal and inverting terminal without deterioration or destruction of characteristics. Input common-mode voltage range of the maximum ratings not assures normal operation of IC. When normal Operation of IC is desired, the input common-mode voltage of characteristics item must be followed.

1.4 Power dissipation (Pd)
Indicates the power that can be consumed by specified mounted board at the ambient temperature 25℃(normal temperature).
As for package product, Pd is determined by the temperature that can be permitted by IC chip in the package (maximum junction temperature) and thermal resistance of the package.

2.Electrical characteristics item

2.1 Input offset voltage (Vio)
Indicates the voltage difference between non-inverting terminal and inverting terminal. It can be translated into the input voltage difference required for setting the output voltage at 0 V.

2.2 Input offset voltage drift (△Vio/△T)
Denotes the ratio of the input offset voltage fluctuation to the ambient temperature fluctuation.

2.3 Input offset current (Iio)
Indicates the difference of input bias current between non-inverting terminal and inverting terminal.

2.4 Input bias current (Ib)
Indicates the current that flows into or out of the input terminal. It is defined by the average of input bias current at non-inverting terminal and input bias current at inverting terminal.

2.5 Circuit current (IDD)
Indicates the IC current that flows under specified conditions and no-load steady status.

2.6 Maximum Output Voltage(High) / Maximum Output Voltage(Low) (VOH/VOL)
Indicates the voltage range that can be output by the IC under specified load condition. It is typically divided into maximum output voltage High and low. Maximum output voltage high indicates the upper limit of output voltage. Maximum output voltage low indicates the lower limit.

2.7 Large signal voltage gain (Av)
Indicates the amplifying rate (gain) of output voltage against the voltage difference between non-inverting terminal and inverting terminal. It is normally the amplifying rate (gain) with reference to DC voltage.
Av = (Output voltage fluctuation) / (Input offset fluctuation)

2.8 Input common-mode voltage range (Vicm)
Indicates the input voltage range where IC operates normally.

2.9 Common-mode rejection ratio (CMRR)
Indicates the ratio of fluctuation of input offset voltage when in-phase input voltage is changed. It is normally the fluctuation of DC.
CMRR = (Change of Input common-mode voltage)/(Input offset fluctuation)

2.10 Power supply rejection ratio (PSRR)
Indicates the ratio of fluctuation of input offset voltage when supply voltage is changed. It is normally the fluctuation of DC. PSRR= (Change of power supply voltage)/(Input offset fluctuation)

2.11 Output source current/ output sink current (Isource/Isink)
The maximum current that can be output under specific output conditions, it is divided into output source current and output sink current. The output source current indicates the current flowing out of the IC, and the output sink current the current flowing into the IC.

2.12 Channel separation (CS)
Indicates the fluctuation of output voltage with reference to the change of output voltage of driven channel.

2.13 Slew Rate (SR)
SR is a parameter that shows movement speed of operational amplifier. It indicates rate of variable output voltage as unit time.

2.14 Unity gain frequency (f_T)
Indicates a frequency where the voltage gain of Op-Amp is 1.

2.15 Gain Band Width (GBW)

Indicates to multiply by the frequency and the gain where the voltage gain decreases 6dB/octave.

2.16 Phase Margin (θ)

Indicates the margin of phase from 180 degree phase lag at unity gain frequency.

2.17 Gain Margin (GM)

Indicates the difference between 0dB and the gain where operational amplifier has 180 degree phase delay.

2.18 Total harmonic distortion + Noise (THD+N)

Indicates the fluctuation of input offset voltage or that of output voltage with reference to the change of output voltage of driven channel.

2.19 Input referred noise voltage (Vn)

Indicates a noise voltage generated inside the operational amplifier equivalent by ideal voltage source connected in series with input terminal.

●Typical Performance Curves

○LMR321

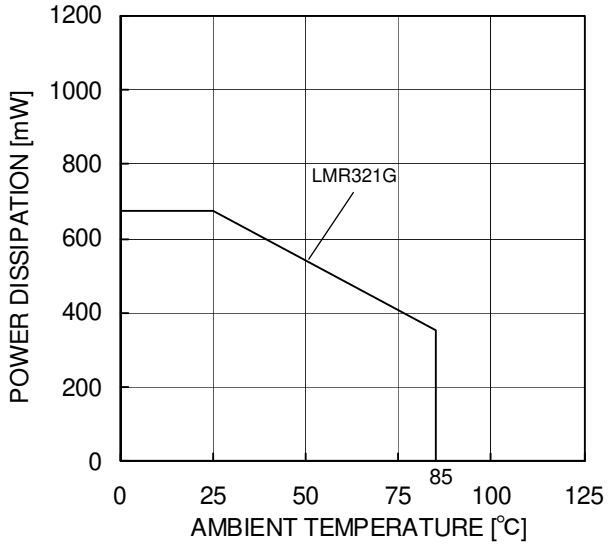


Figure 2.
Derating curve

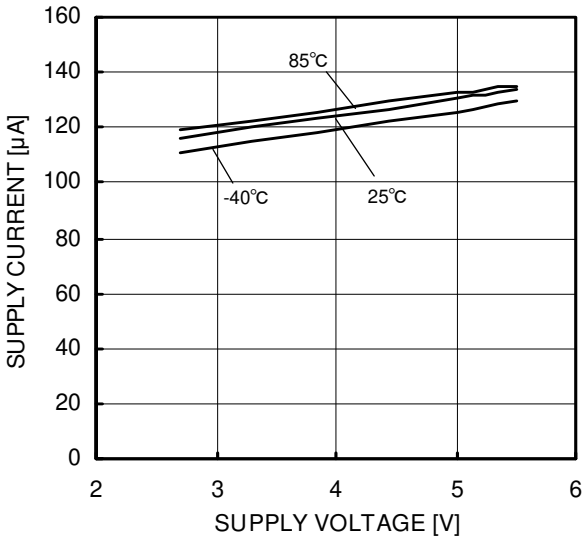


Figure 3.
Supply Current – Supply Voltage

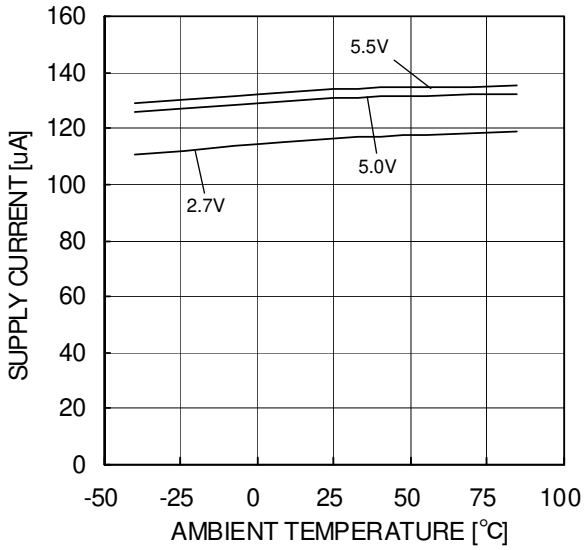


Figure 4.
Supply Current – Ambient Temperature

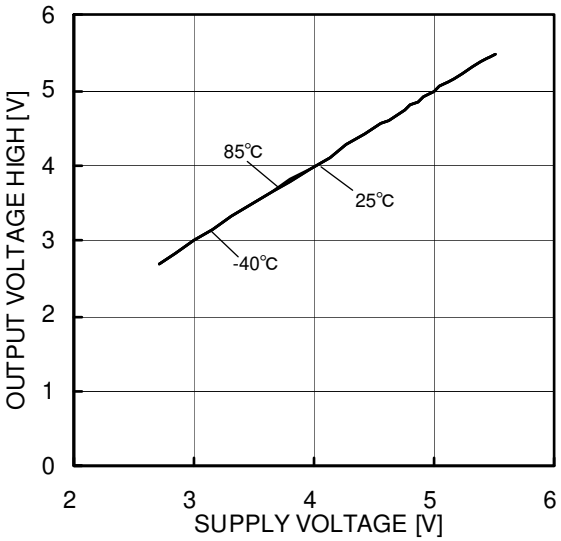


Figure 5.
Maximum Output Voltage(High)
– Supply Voltage
(RL=2kΩ)

(*)The data above is measurement value of typical sample, it is not guaranteed.

○LMR321

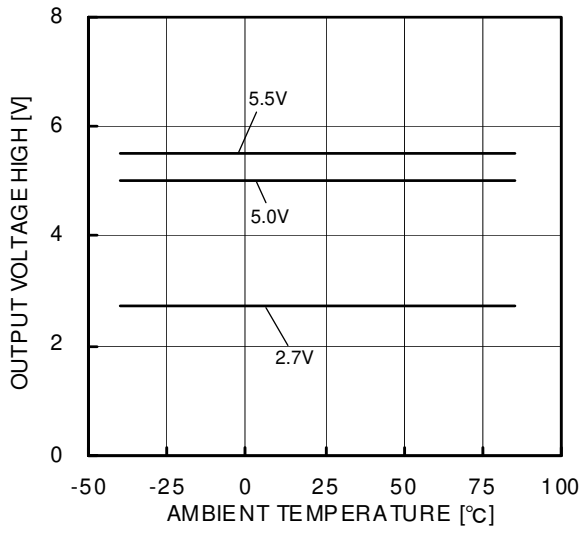


Figure 6.
Maximum Output Voltage(High)
– Ambient Temperature
(RL=2kΩ)

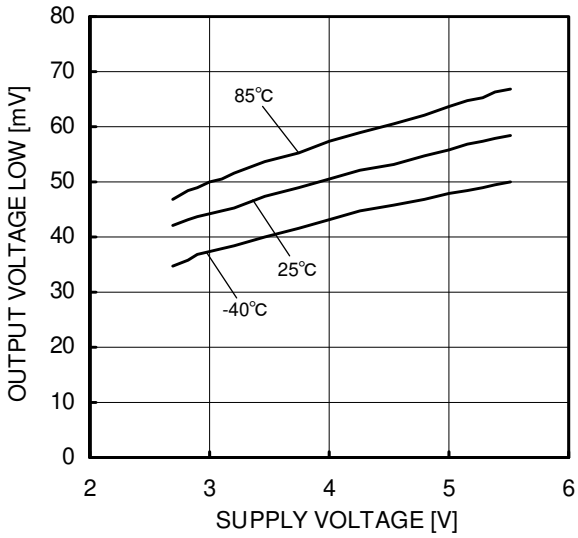


Figure 7.
Maximum Output Voltage(Low)
– Supply Voltage
(RL=2kΩ)

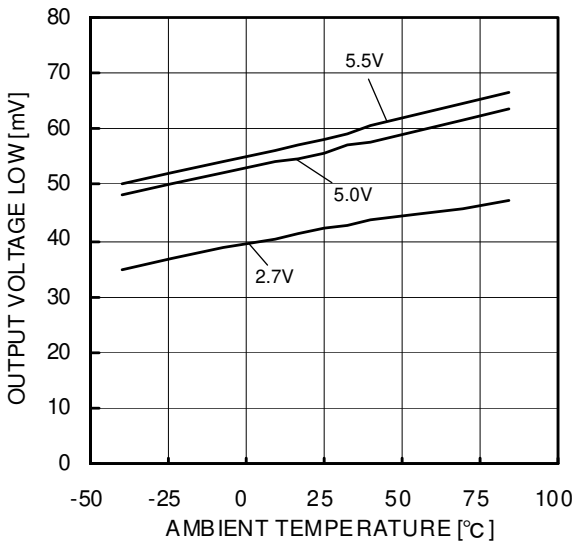


Figure 8.
Maximum Output Voltage(Low)
– Ambient Temperature
(RL=2kΩ)

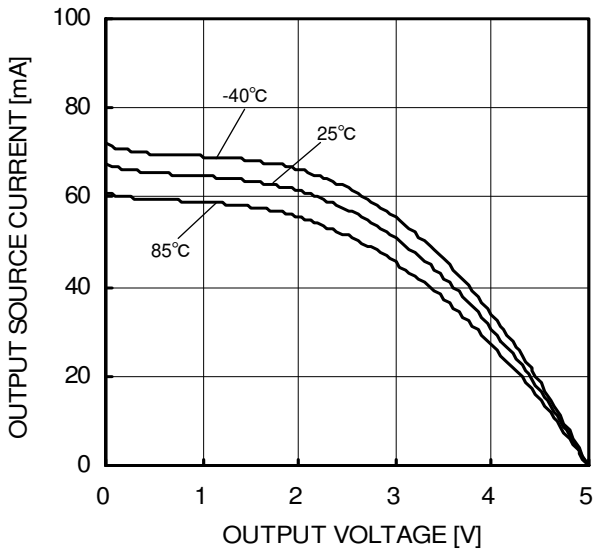


Figure 9.
Output Source Current – Output Voltage
(VDD=5V)

(*)The data above is measurement value of typical sample, it is not guaranteed.

○LMR321

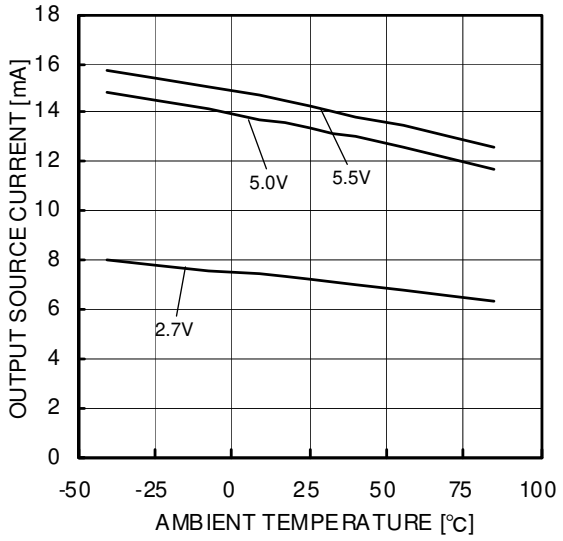


Figure 10.
Output Source Current – Ambient Temperature
(OUT=VDD-0.4V)

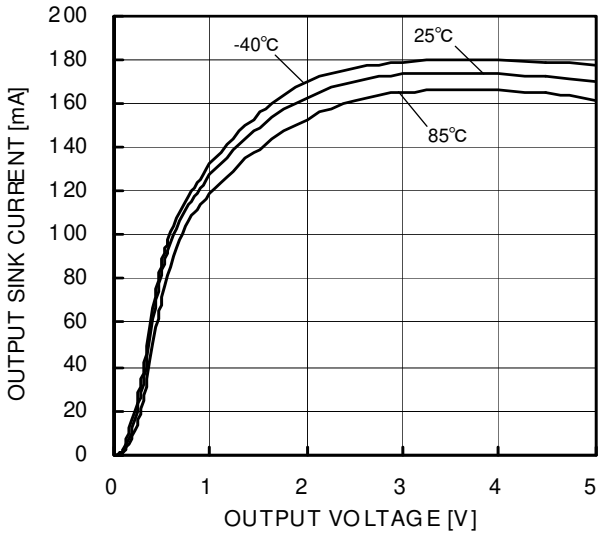


Figure 11.
Output Sink Current – Output Voltage
(VDD=5V)

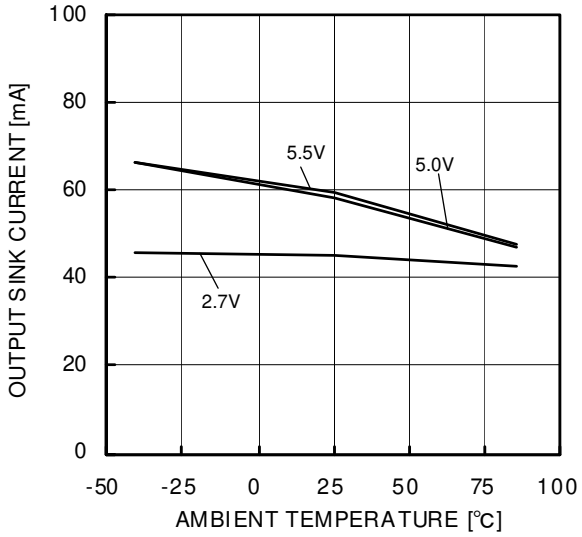


Figure 12.
Output Sink Current – Ambient Temperature
(OUT=VSS+0.4V)

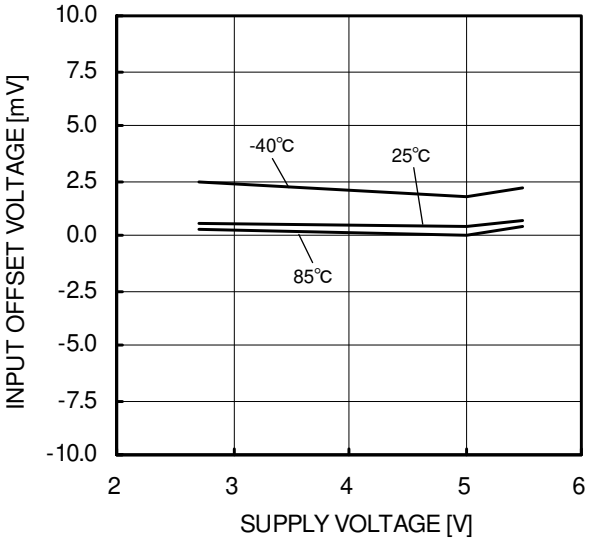


Figure 13.
Input Offset Voltage – Supply Voltage
(Vicm= VDD, OUT= 0.1V)

(*)The data above is measurement value of typical sample, it is not guaranteed.

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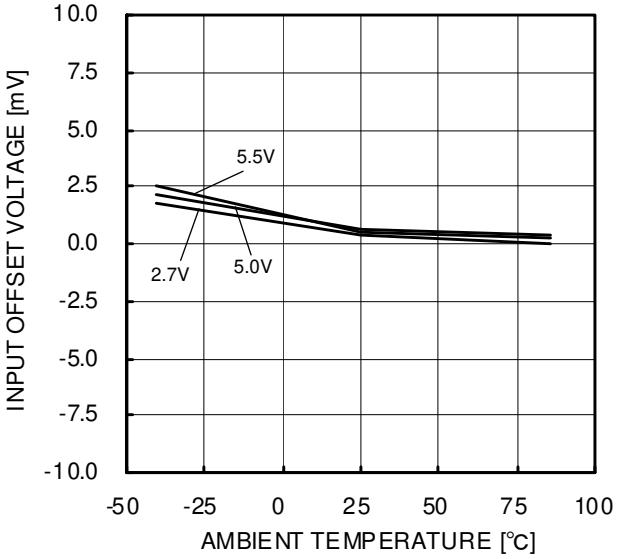

Figure 14.
Input Offset Voltage – Ambient Temperature
(Vicm= VDD, OUT= 0.1V)

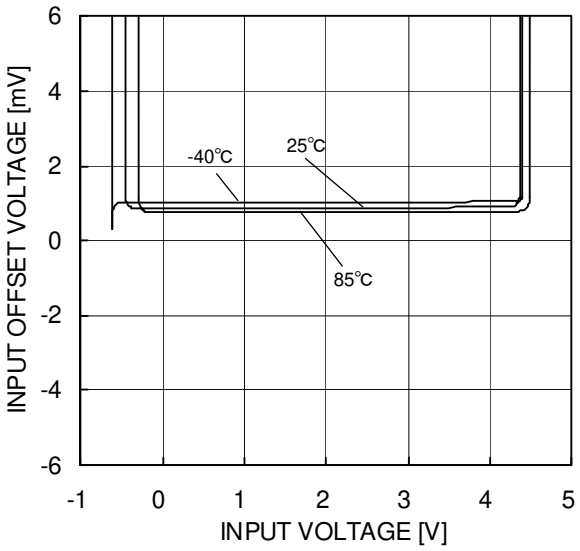

Figure 15.
Input Offset Voltage – Input Voltage
(VDD=5V)

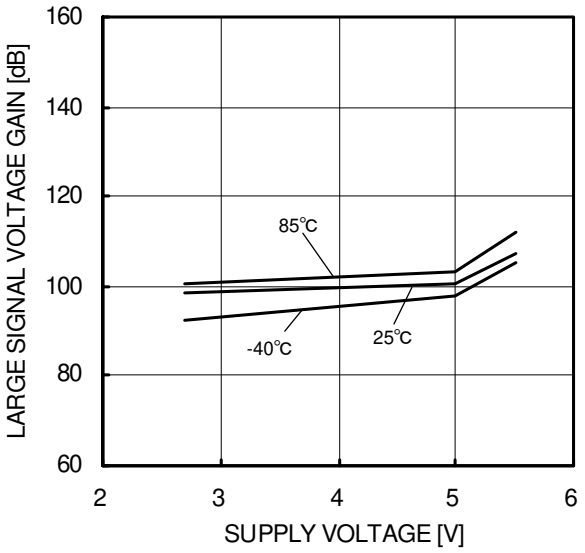

Figure 16.
Large Signal Voltage Gain – Supply Voltage

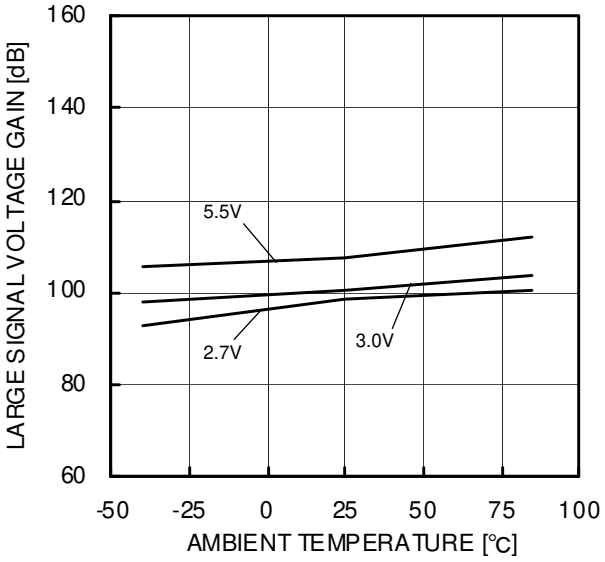

Figure 17.
Large Signal Voltage Gain – Ambient Temperature

(*)The data above is measurement value of typical sample, it is not guaranteed.

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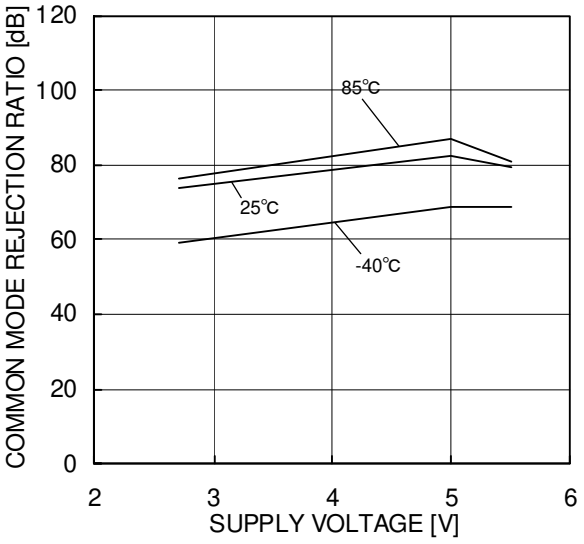

Figure 18.
Common Mode Rejection Ratio – Supply Voltage
(VDD=5V)

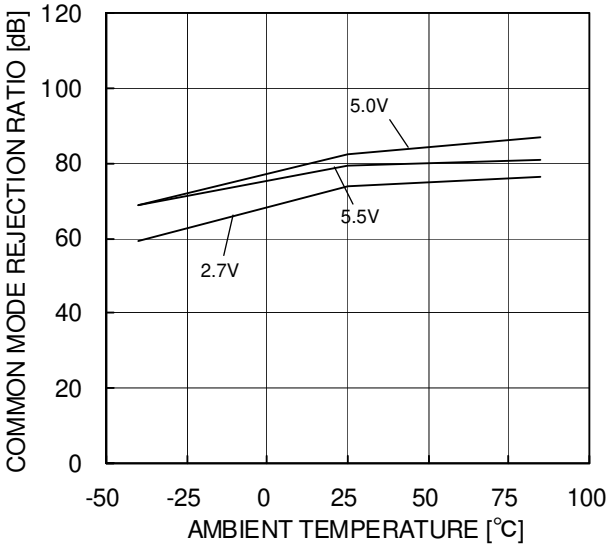

Figure 19.
Common Mode Rejection Ratio – Ambient Temperature
(VDD=3V)

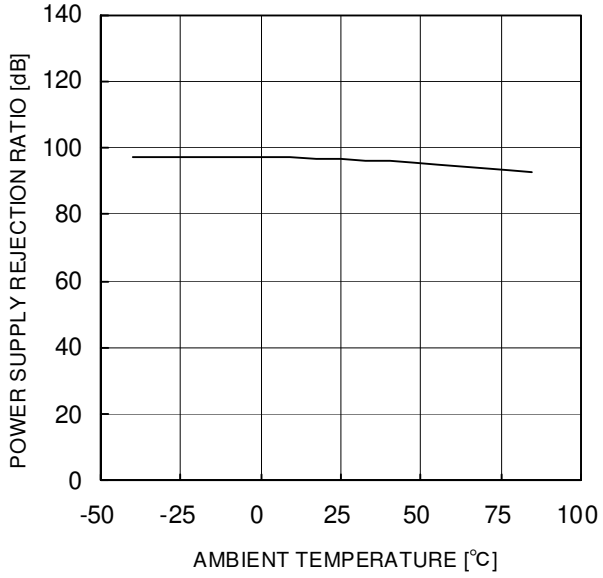

Figure 20.
Power Supply Rejection Ratio – Ambient Temperature

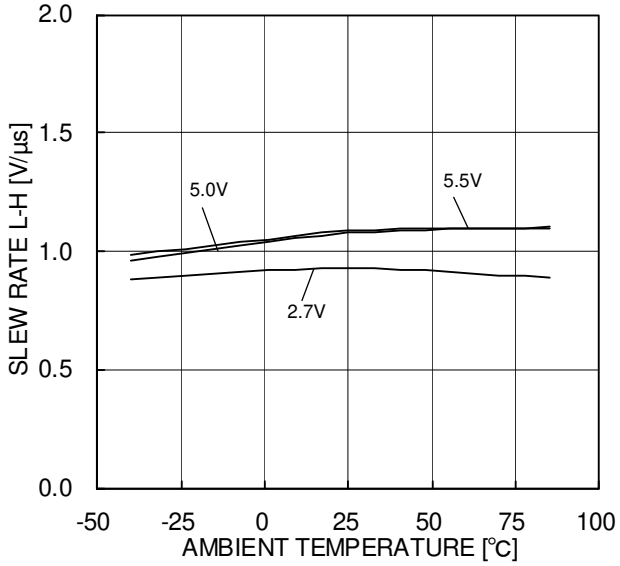

Figure 21.
Slew Rate L-H – Ambient Temperature

(*)The data above is measurement value of typical sample, it is not guaranteed.

○LMR321

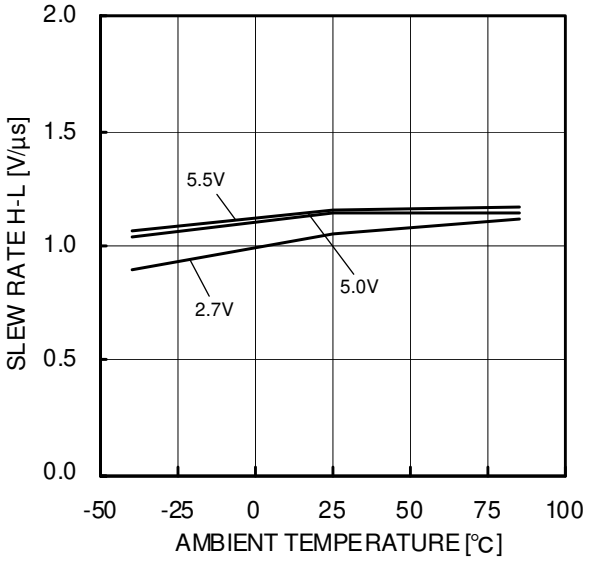

Figure 22.
Slew Rate H-L – Ambient Temperature

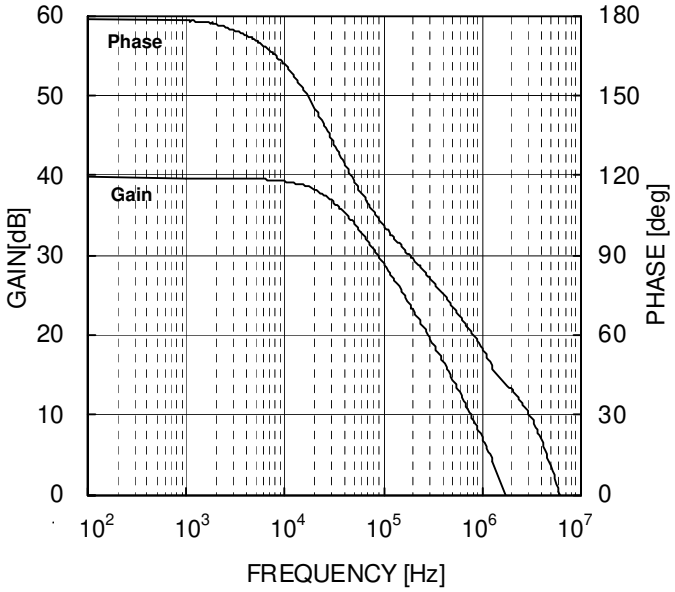

Figure 23.
Voltage Gain・Phase – Frequency

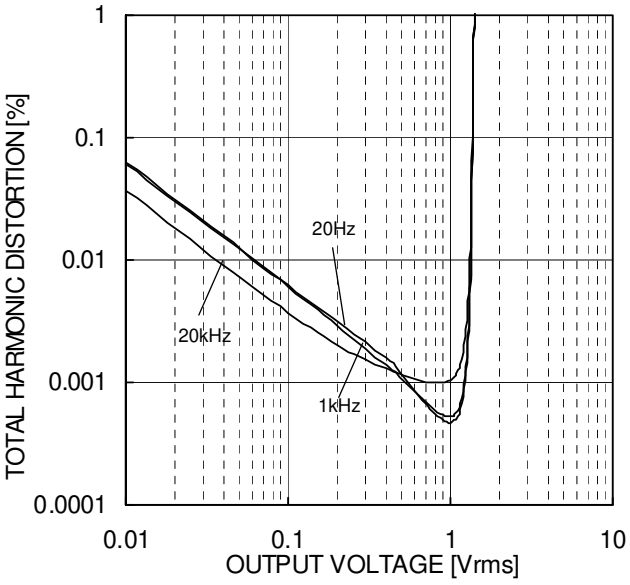

Figure 24.
Total Harmonic Distortion－Output Voltage
(VDD/VSS=+2.5V/-2.5V, Av=0dB,
RL=2kΩ, DIN-AUDIO, Ta=25℃)

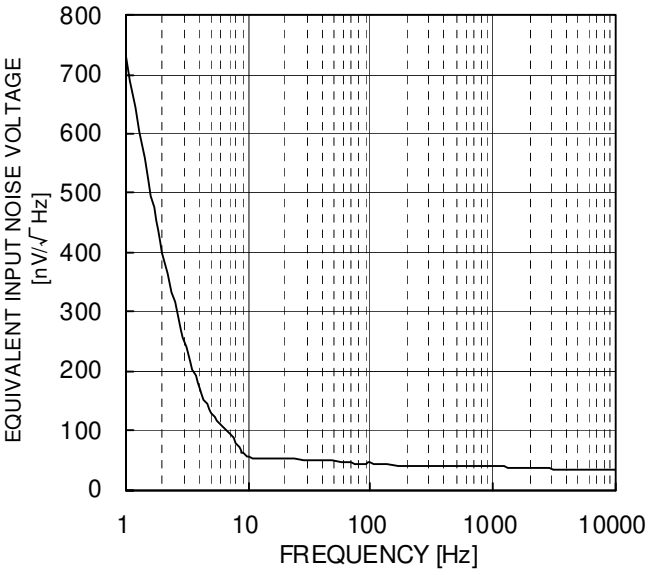

Figure 25.
Input Referred Noise Voltage－Frequency
(VDD/VSS=+2.5V/-2.5V, Av=0dB, Ta=25℃)

(*)The data above is measurement value of typical sample, it is not guaranteed.

○LMR358

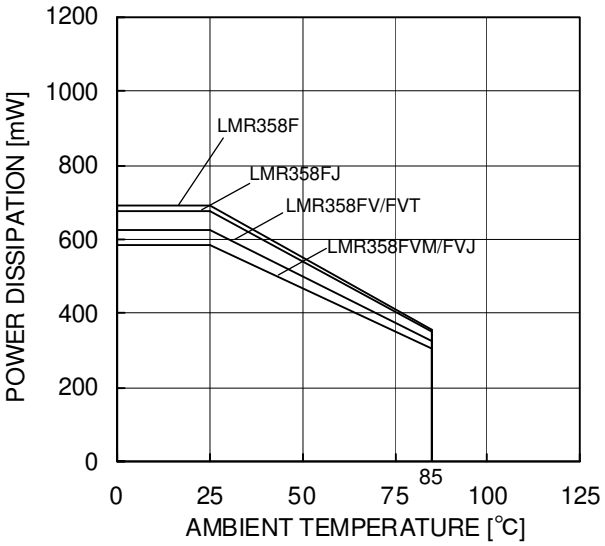

Figure 26.
Derating curve

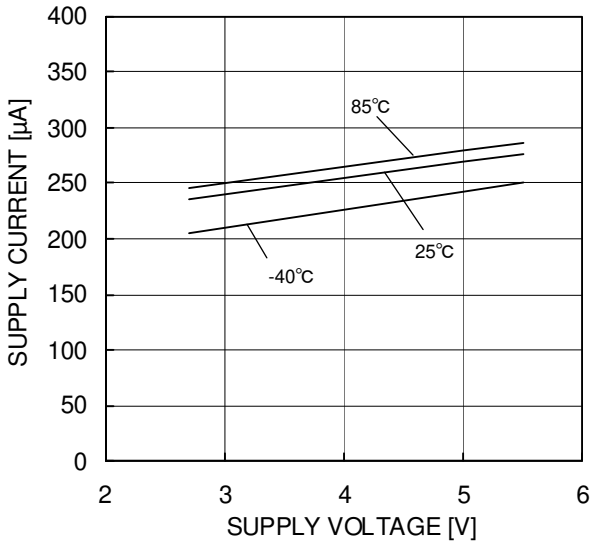

Figure 27.
Supply Current – Supply Voltage

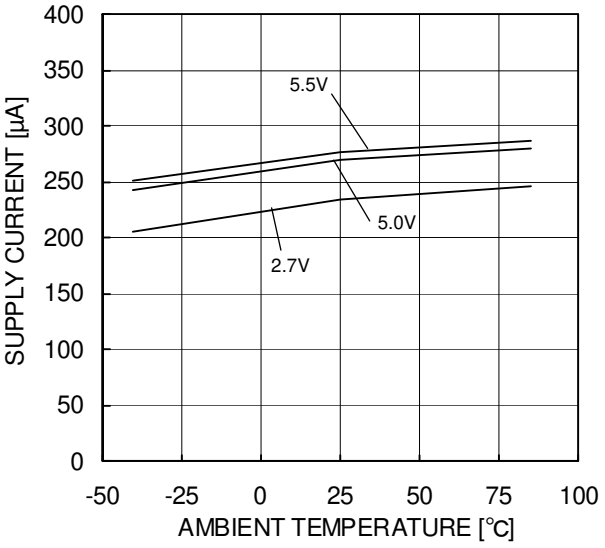

Figure 28.
Supply Current – Ambient Temperature

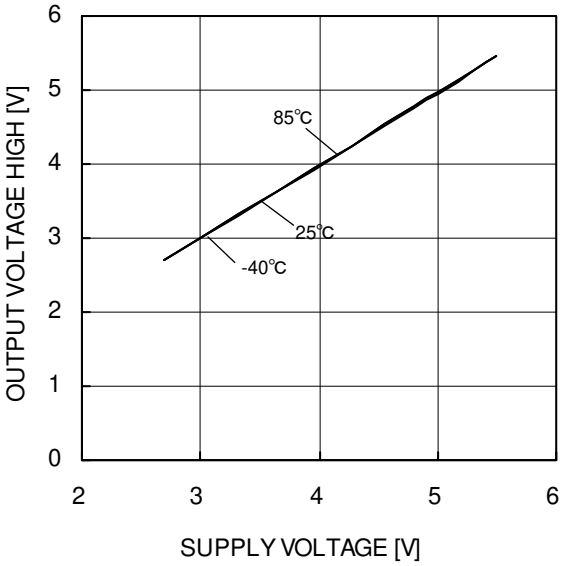

Figure 29.
Maximum Output Voltage(High)
– Supply Voltage
(RL=2kΩ)

(*)The data above is measurement value of typical sample, it is not guaranteed.

○LMR358

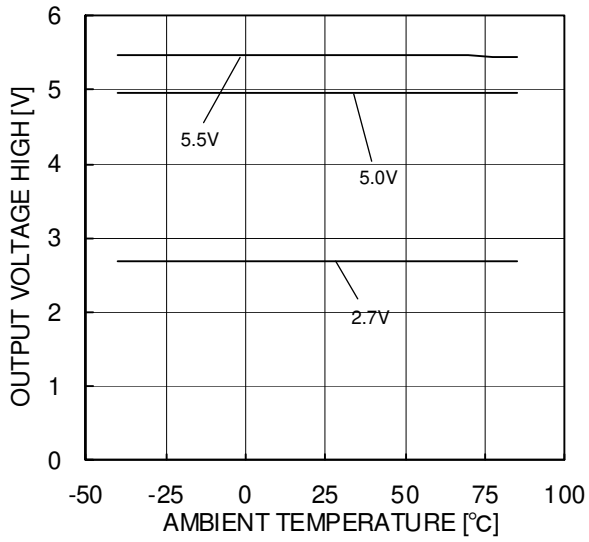

Figure 30.
Maximum Output Voltage(High)
– Ambient Temperature
(RL=2kΩ)

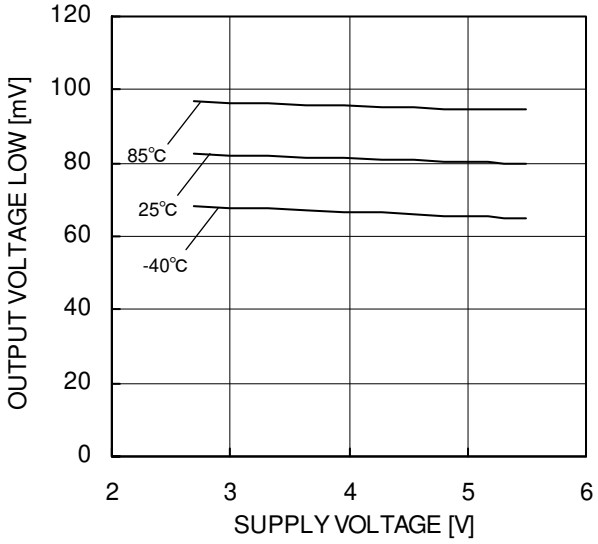

Figure 31.
Maximum Output Voltage(Low)
– Supply Voltage
(RL=2kΩ)

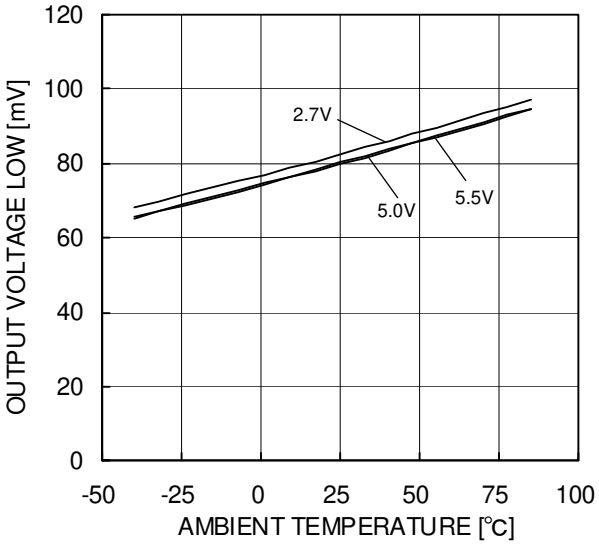

Figure 32.
Maximum Output Voltage(Low)
– Ambient Temperature
(RL=2kΩ)

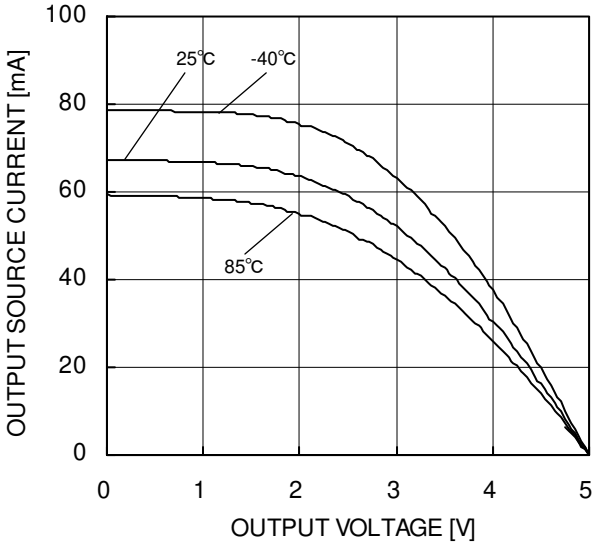

Figure 33.
Output Source Current – Output Voltage
(VDD=5V)

(*)The data above is measurement value of typical sample, it is not guaranteed.

○LMR358

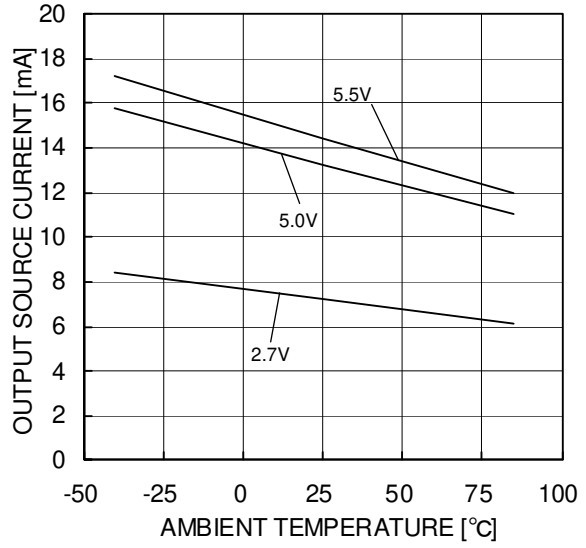

Figure 34.
Output Source Current – Ambient Temperature
(OUT=VDD-0.4V)

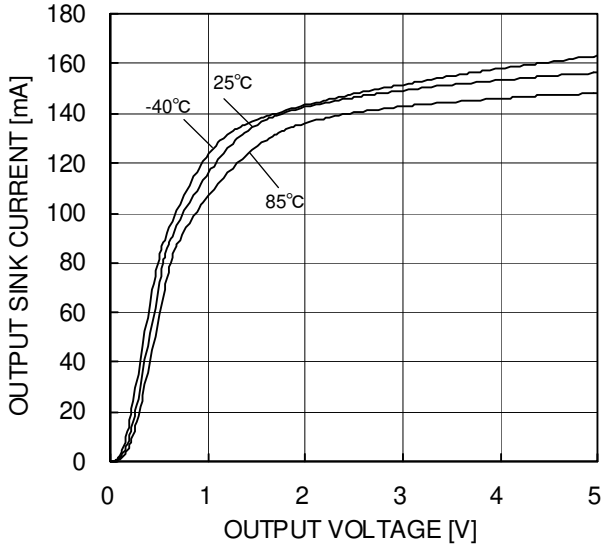

Figure 35.
Output Sink Current – Output Voltage
(VDD=5V)

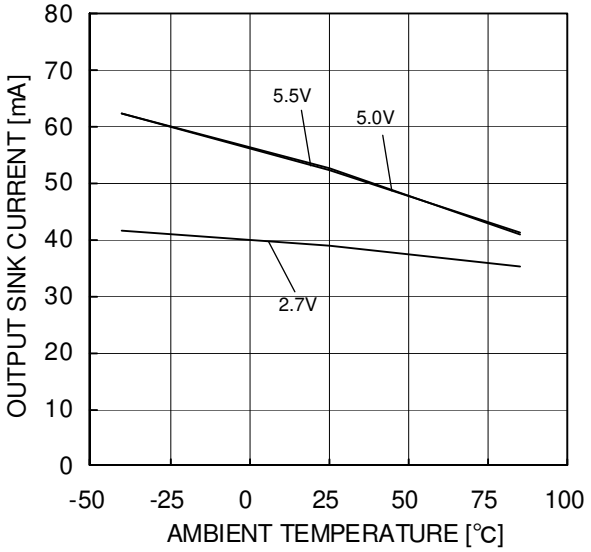

Figure 36.
Output Sink Current – Ambient Temperature
(OUT=VSS+0.4V)

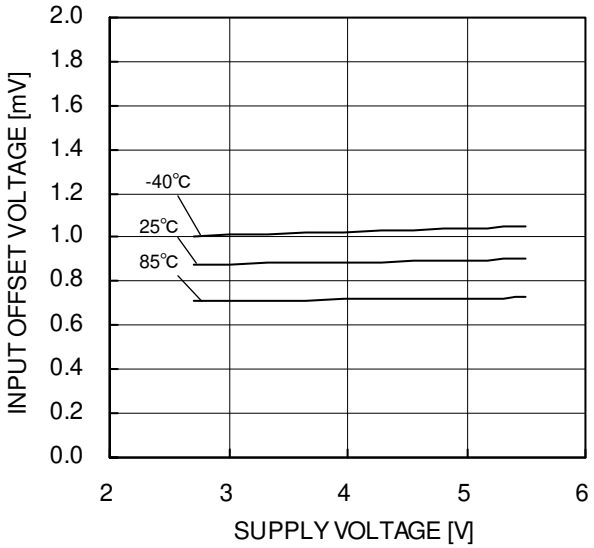

Figure 37.
Input Offset Voltage – Supply Voltage
(Vicm= VDD, OUT= 0.1V)

(*)The data above is measurement value of typical sample, it is not guaranteed.

○LMR358

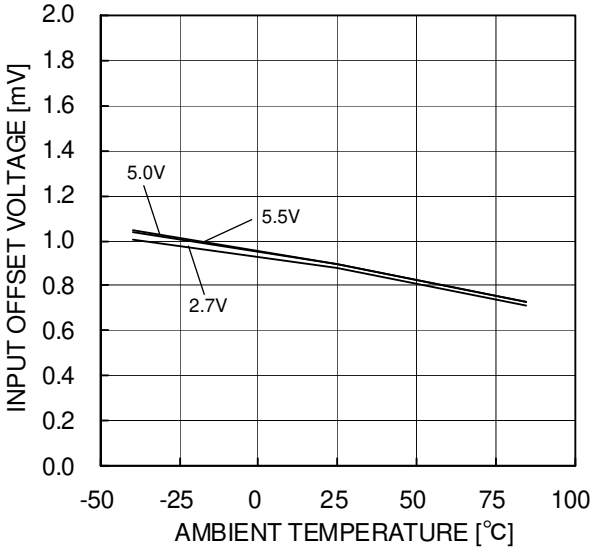

Figure 38.
Input Offset Voltage – Ambient Temperature
(Vicm= VDD, OUT= 0.1V)

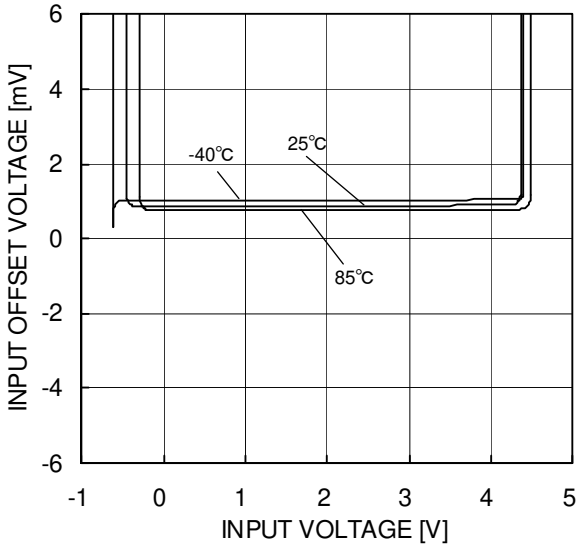

Figure 39.
Input Offset Voltage – Input Voltage
(VDD=5V)

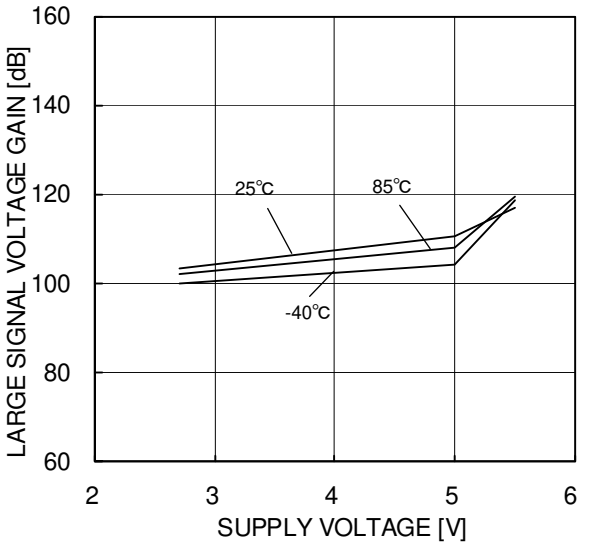

Figure 40.
Large Signal Voltage Gain – Supply Voltage

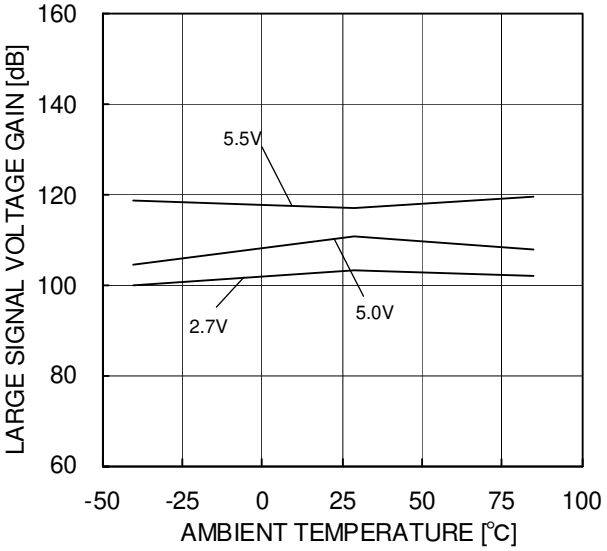

Figure 41.
Large Signal Voltage Gain – Ambient Temperature

(*)The data above is measurement value of typical sample, it is not guaranteed.

○LMR358

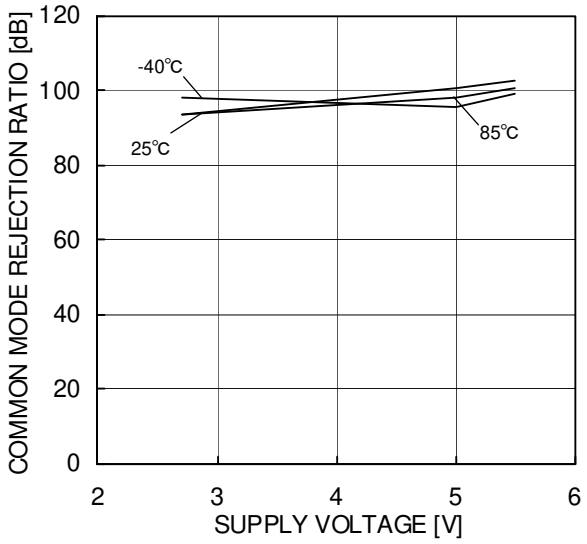

Figure 42.
Common Mode Rejection Ratio – Supply Voltage
(VDD=5V)

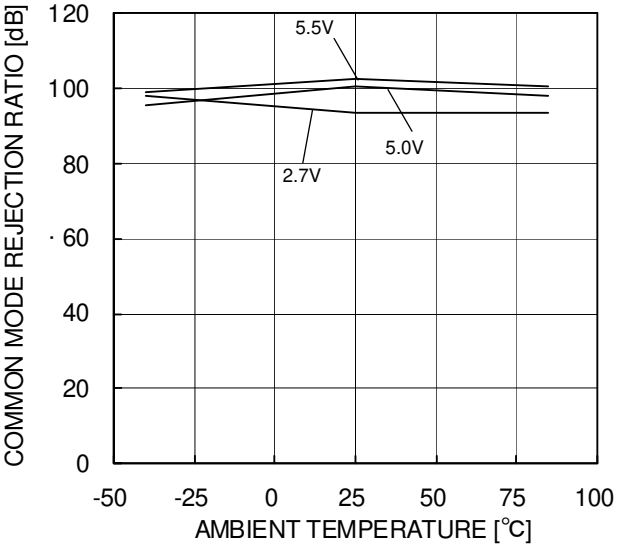

Figure 43.
Common Mode Rejection Ratio – Ambient Temperature
(VDD=3V)

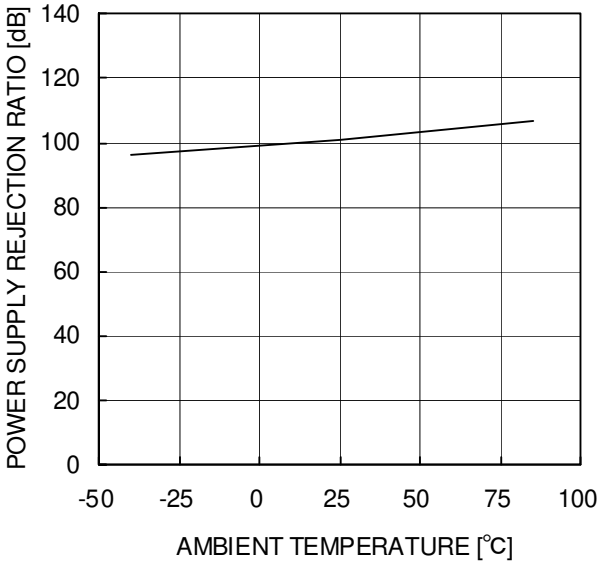

Figure 44.
Power Supply Rejection Ratio – Ambient Temperature

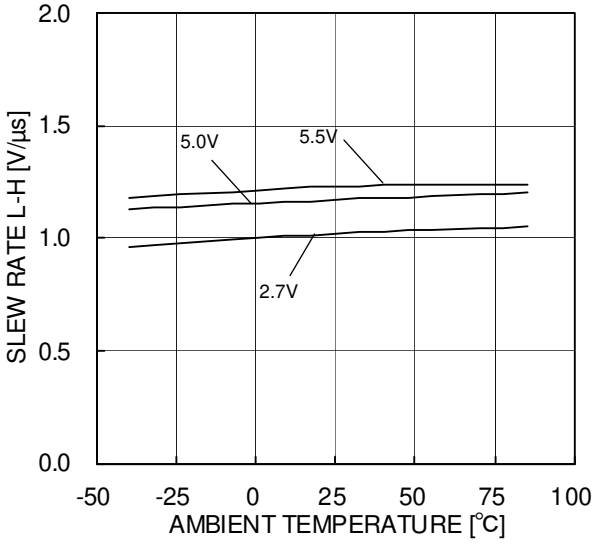

Figure 45.
Slew Rate L-H – Ambient Temperature

(*)The data above is measurement value of typical sample, it is not guaranteed.

○LMR358

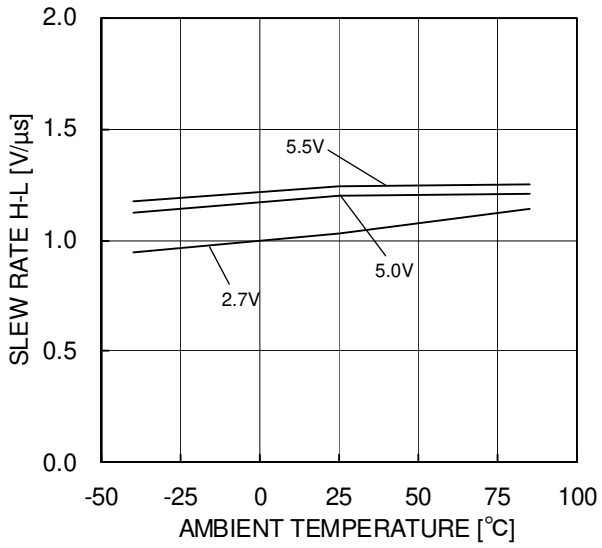

Figure 46.
Slew Rate H-L – Ambient Temperature

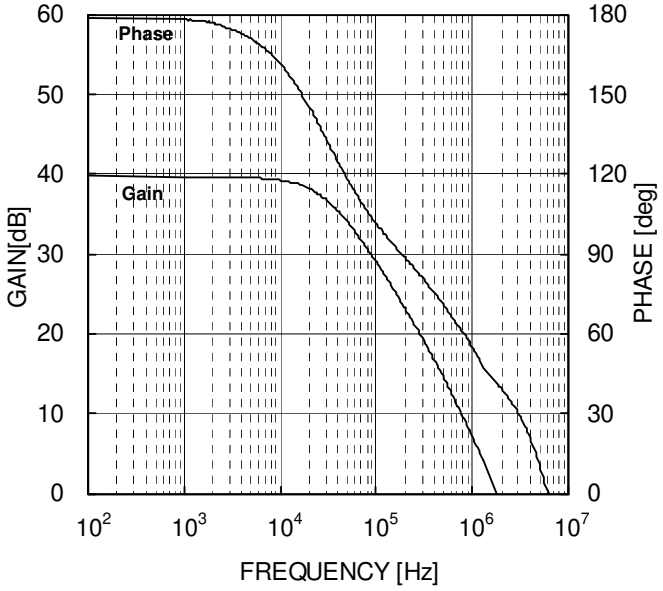

Figure 47.
Voltage Gain・Phase – Frequency

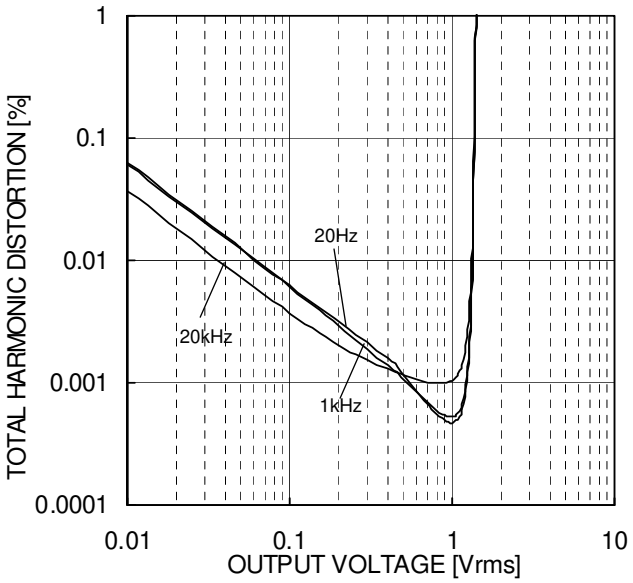

Figure 48.
Total Harmonic Distortion－Output Voltage
(VDD/VSS=+2.5V/-2.5V, Av=0dB,
RL=2kΩ, DIN-AUDIO, Ta=25℃)

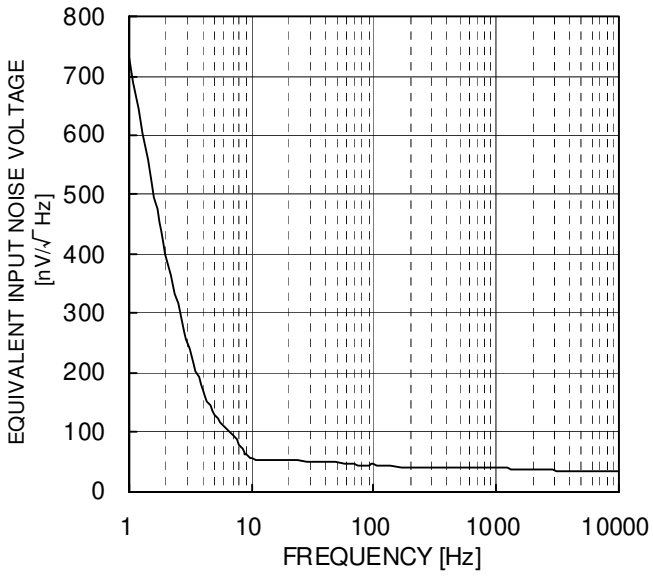

Figure 49.
Input Referred Noise Voltage－Frequency
(VDD/VSS=+2.5V/-2.5V, Av=0dB, Ta=25℃)

(*)The data above is measurement value of typical sample, it is not guaranteed.

○LMR324

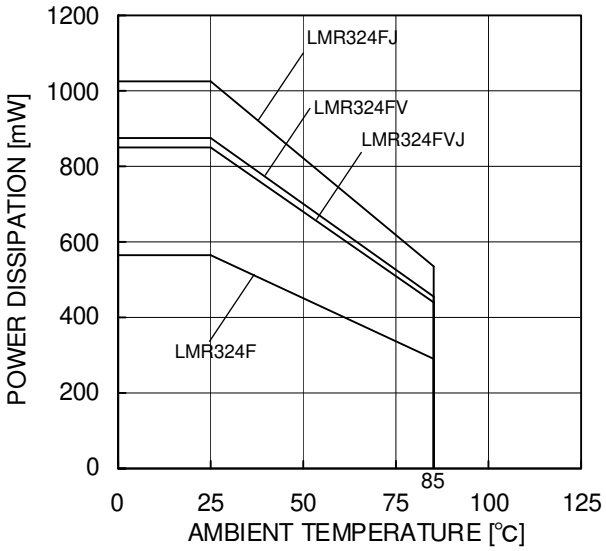

Figure 50.
Derating curve

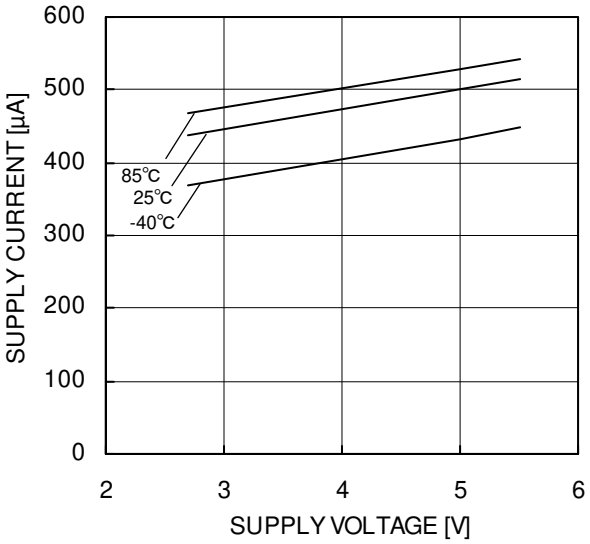

Figure 51.
Supply Current – Supply Voltage

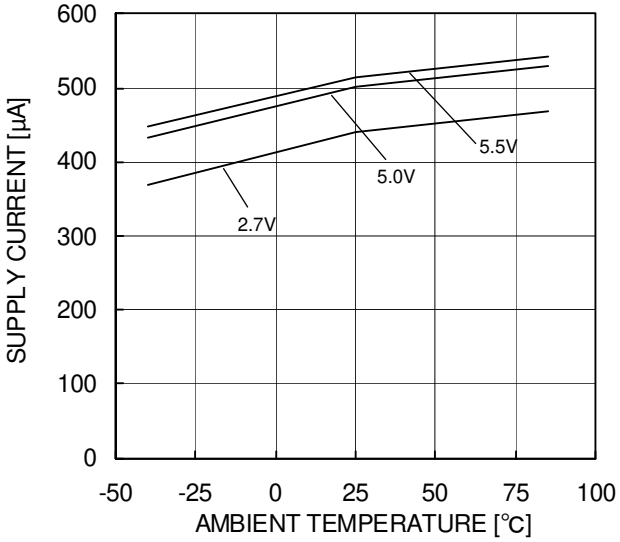

Figure 52.
Supply Current – Ambient Temperature

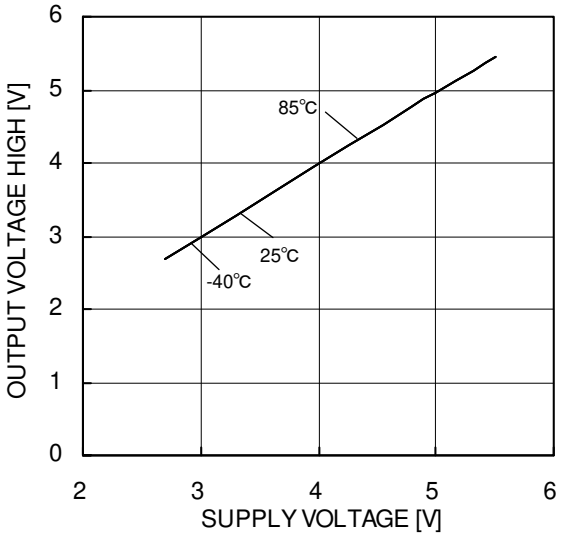

Figure 53.
Maximum Output Voltage(High)
– Supply Voltage
(RL=2 kΩ)

(*)The data above is measurement value of typical sample, it is not guaranteed.

○LMR324

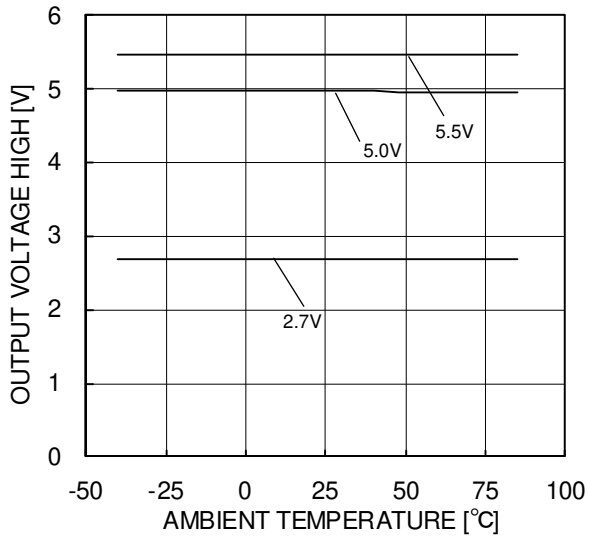

Figure 54.
Maximum Output Voltage(High)
– Ambient Temperature
(RL=2kΩ)

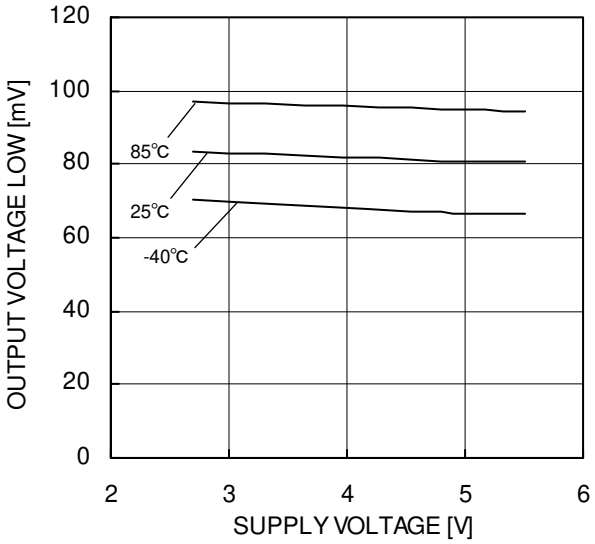

Figure 55.
Maximum Output Voltage(Low)
– Supply Voltage
(RL=2kΩ)

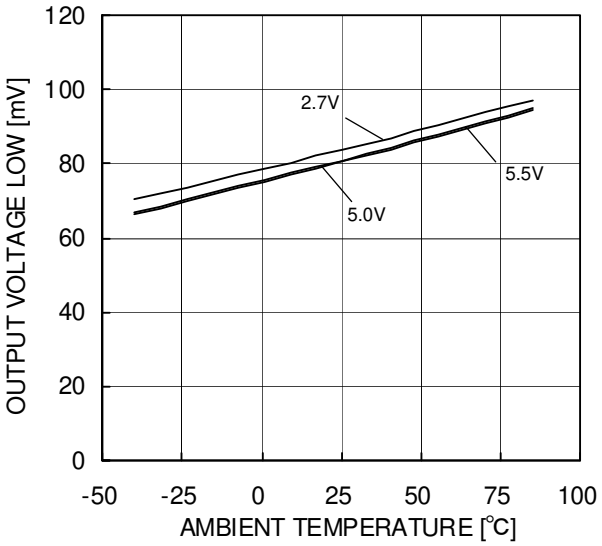

Figure 56.
Maximum Output Voltage(Low)
– Ambient Temperature
(RL=2kΩ)

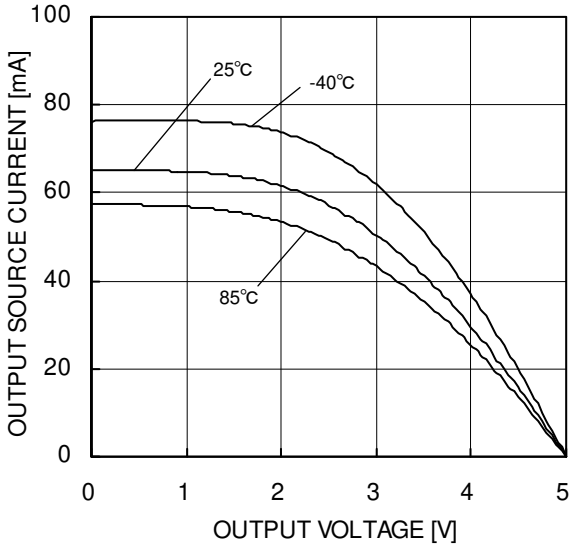

Figure 57.
Output Source Current – Output Voltage
(VDD=5V)

(*)The data above is measurement value of typical sample, it is not guaranteed.

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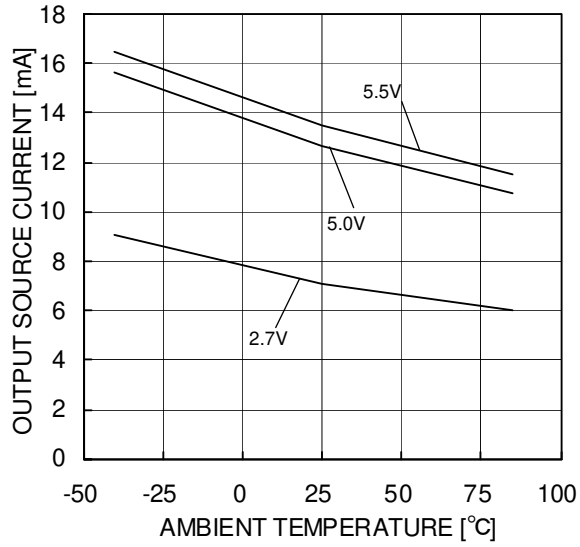

Figure 58.
Output Source Current – Ambient Temperature
(OUT=VDD-0.4V)

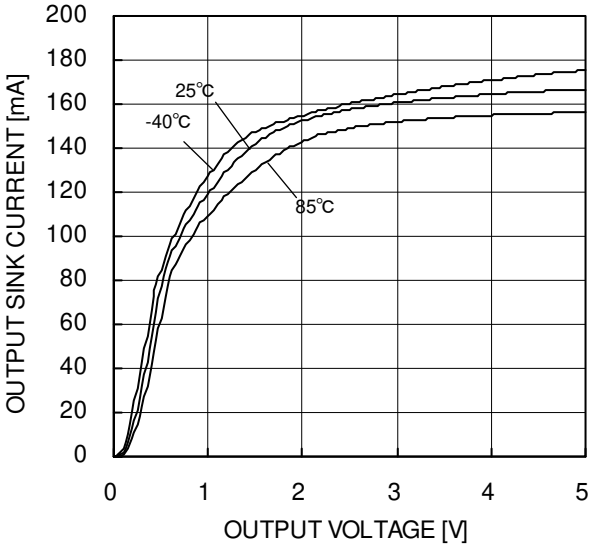

Figure 59.
Output Sink Current – Output Voltage
(VDD=5V)

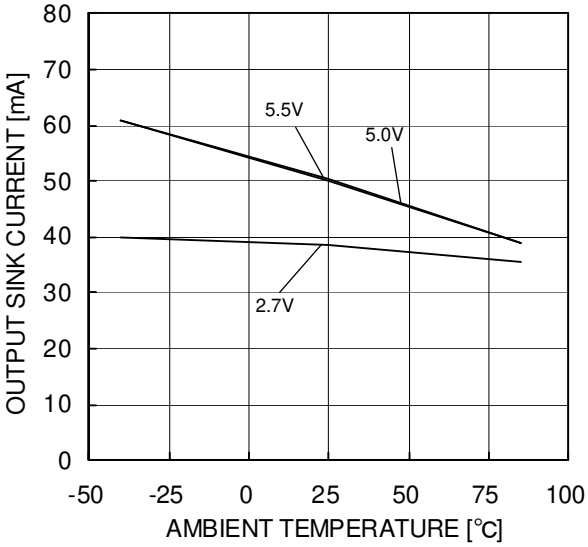

Figure 60.
Output Sink Current – Ambient Temperature
(OUT=VSS+0.4V)

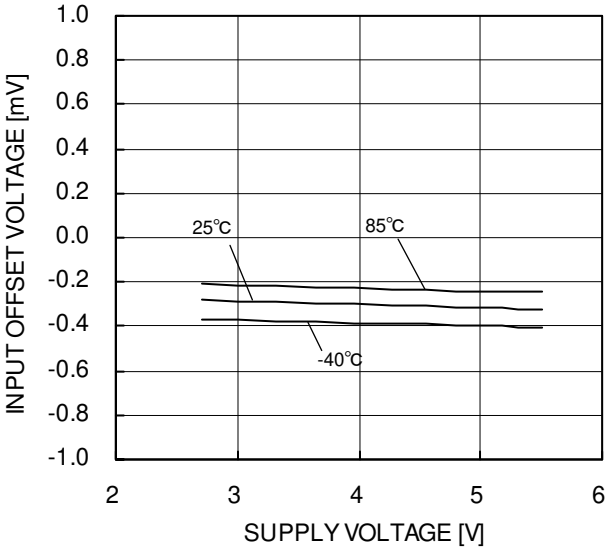

Figure 61.
Input Offset Voltage – Supply Voltage
(Vicm= VDD, OUT= 0.1V)

(*)The data above is measurement value of typical sample, it is not guaranteed.

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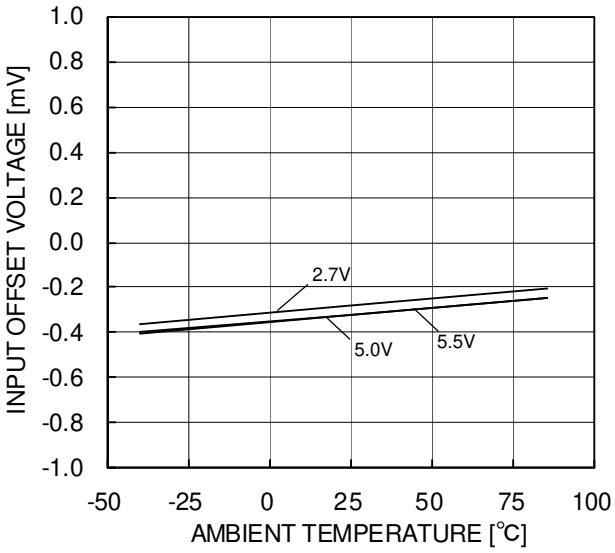

Figure 62.
Input Offset Voltage – Ambient Temperature
(Vicm= VDD, OUT= 0.1V)

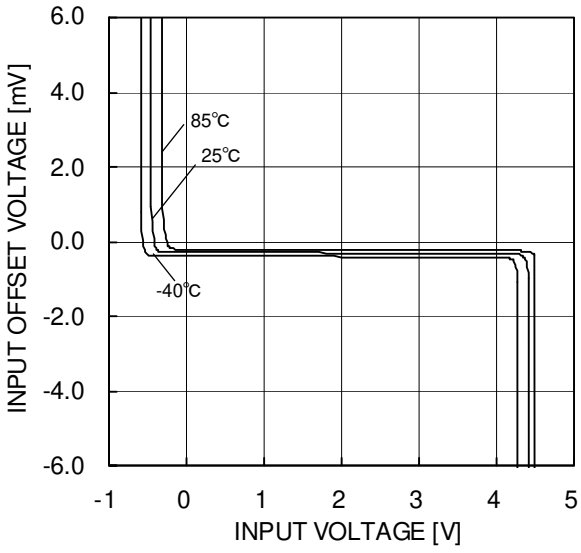

Figure 63.
Input Offset Voltage – Input Voltage
(VDD=5V)

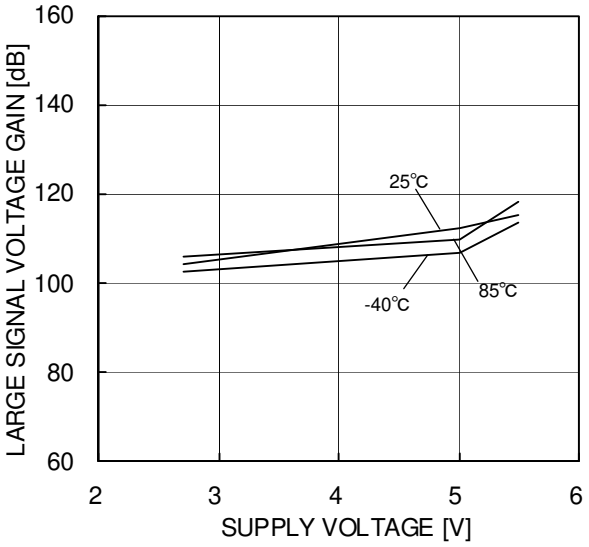

Figure 64.
Large Signal Voltage Gain – Supply Voltage

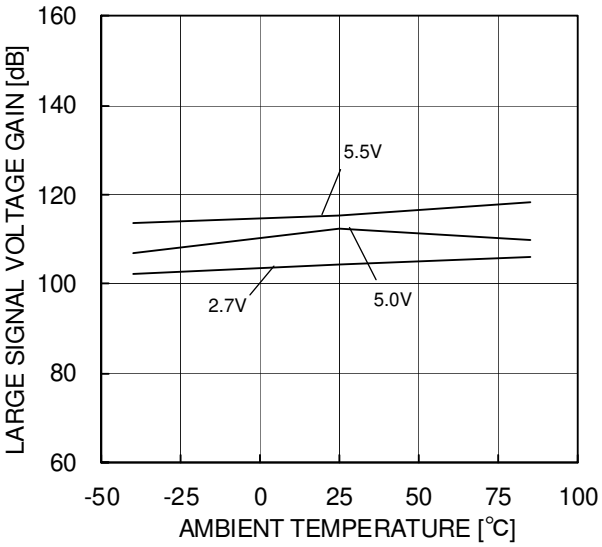

Figure 65.
Large Signal Voltage Gain – Ambient Temperature

(*)The data above is measurement value of typical sample, it is not guaranteed.