

ROHM's Selection Operational Amplifier/Comparator Series



# Operational Amplifiers: Low Noise

**BA4558F,BA4558RF/FV/FVM,BA4560F,BA4560RF/FV/FVM,BA4580RF/FVM  
BA2115F/FVM,BA15218F,BA14741F,BA15532FBA4510F/FV**

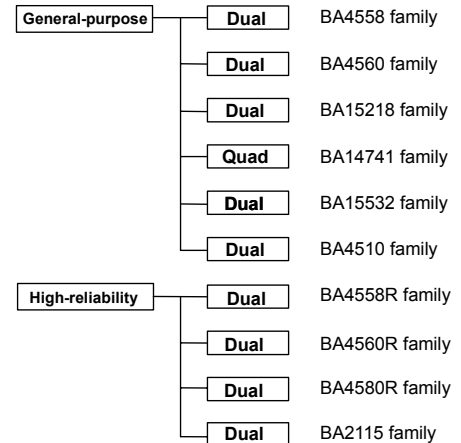
No.09049EAT02

●Description

General-purpose BA4558 / BA4560 / BA15218 / BA14741 / BA15532 / BA4510 family and high-reliability BA4558R / BA4560R / BA4580R / BA2115 family integrate two or four independent Op-Amps on a single chip.

Especially, this series is suitable for any audio applications due to low noise and low distortion characteristics and are usable for other many applications by wide operating supply voltage range.

BA4558R/BA4560R/BA4580R/BA2115 are high-reliability products with extended operating temperature range and high ESD tolerance.



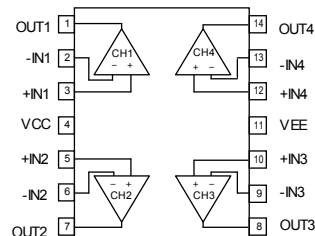
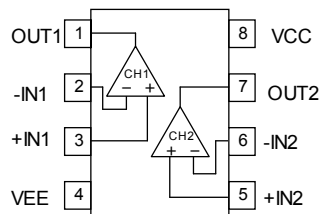
●Features

- 1) High voltage gain, low noise, low distortion
- 2) Internal phase compensation
- 3) No latch up immunity
- 4) Wide operating supply voltage
 

|                                |  |
|--------------------------------|--|
| ±4.0[V]~±15.0[V](split supply) | (BA4558/BA4560/BA4558R/BA4560R family) |
| ±2.0[V]~±16.0[V](split supply) | (BA4580R/BA15218 family)               |
| ±2.0[V]~±18.0[V](split supply) | (BA14741 family)                       |
| ±3.0[V]~±20.0[V](split supply) | (BA15532 family)                       |
| ±1.0[V]~±3.5[V](split supply)  | (BA4510 family)                        |
| ±1.0[V]~±7.0[V](split supply)  | (BA2115 family)                        |
- 5) Internal ESD protection  
Human body mode (HBM) ±5000[V](Typ.) (BA4558R/BA4560R/BA4580R/BA2115 family)
- 6) Wide temperature range
 

|                  |   |
|------------------|---|
| -40[°C]~+85[°C]  | (BA4558/BA4560/BA15218/BA14741/BA2115 family) |
| -40[°C]~+105[°C] | (BA4558R/BA4560R/BA4580R family)              |

●Pin Assignments



| SOP8     |           | SSOP-B8    |             | MSOP8      |             | SOP14    |  |
|----------|-----------|------------|-------------|------------|-------------|----------|--|
| BA4558F  | BA4558R F | BA4558R FV | BA4558R FVM | BA4558R FV | BA4558R FVM | BA14741F |  |
| BA4560F  | BA4560R F | BA4560R FV | BA4560R FVM | BA4560R FV | BA4560R FVM |          |  |
| BA15218F | BA4580R F | BA4510FV   | BA4580R FVM | BA4580R FV | BA4580R FVM |          |  |
| BA15532F | BA2115F   |            | BA2115FVM   |            |             |          |  |
| BA4510F  |           |            |             |            |             |          |  |

●Absolute maximum rating (Ta=25[°C])

OBA4558/BA4560 family,BA4558R/BA4560R/BA4580R family

| Parameter                                 | Symbol  | Rating        |               |                  |                |                | Unit |
|---|---------|---------------|---------------|------------------|----------------|----------------|------|
|   |         | BA4558 family | BA4560 family | BA4558R family   | BA4560R family | BA4580R family |      |
| Supply Voltage                            | VCC-VEE | +36           |               |                  |                |                | V    |
| Differential Input Voltage <sup>(*)</sup> | Vid     | (VCC-VEE)     |               | 36               |                |                | V    |
| Input Common-mode voltage range           | Vicm    | VEE~VCC       |               | (VEE-0.3)~VEE+36 |                |                | V    |
| Operating Supply Voltage                  | Vopr    | 8~30 (±4~±15) |               | 8~30 (±4~±15)    |                | 4~32(±2~±16)   | V    |
| Output Current                            | Io      | -             |               | -                |                | ±50            | mA   |
| Operating Temperature                     | Topr    | -40~+85       |               | -40~+105         |                |                | °C   |
| Storage Temperature                       | Tstg    | -55~+125      |               | -55~+150         |                |                | °C   |
| Maximum Junction Temperature              | Tjmax   | +125          |               | +150             |                |                | °C   |

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.

(\*) The voltage difference between inverting input and non-inverting input is the differential input voltage. Then input terminal voltage is set to more than VEE.

●Electrical characteristics

OBA4558/BA4560 family (Unless otherwise specified VCC=+15[V], VEE=-15[V], Ta=25[°C])

| Parameter                           | Symbol | Temperature Range | Guaranteed limit |      |      |               |      |      | Unit | Condition                                 |
|-------------------------------------|--------|-------------------|------------------|------|------|---------------|------|------|------|---|
|                                     |        |                   | BA4558 family    |      |      | BA4560 family |      |      |      |   |
|                                     |        |                   | Min.             | Typ. | Max. | Min.          | Typ. | Max. |      |   |
| Input Offset Voltage <sup>(*)</sup> | Vio    | 25°C              | -                | 0.5  | 6    | -             | 0.5  | 6    | mV   | Rs ≤ 10[kΩ]                               |
| Input Offset Current <sup>(*)</sup> | Iio    | 25°C              | -                | 5    | 200  | -             | 5    | 200  | nA   | -   |
| Input Bias Current <sup>(*)</sup>   | Ib     | 25°C              | -                | 60   | 500  | -             | 50   | 500  | nA   | -   |
| Supply Current                      | ICC    | 25°C              | -                | 3    | 6    | -             | 4    | 7.5  | mA   | RL = ∞ All Op-Amps                        |
| Maximum Output Voltage              | VOM    | 25°C              | ±12              | ±14  | -    | ±12           | ±14  | -    | V    | RL ≥ 10[kΩ]                               |
|                                     |        |                   | ±10              | ±13  | -    | ±10           | ±13  | -    |      | RL ≥ 2[kΩ]                                |
| Large Single Voltage Gain           | AV     | 25°C              | 86               | 100  | -    | 86            | 100  | -    | dB   | RL ≥ 2[kΩ], VOUT = ±10[V]                 |
| Input Common-mode Voltage Range     | Vicm   | 25°C              | ±12              | ±14  | -    | ±12           | ±14  | -    | V    | -   |
| Common-mode Rejection Ratio         | CMRR   | 25°C              | 70               | 90   | -    | 70            | 90   | -    | dB   | Rs ≤ 10[kΩ]                               |
| Power Supply Rejection Ratio        | PSRR   | 25°C              | 76.3             | 90   | -    | 76.3          | 90   | 150  | dB   | Rs ≤ 10[kΩ]                               |
| Channel Separation                  | CS     | 25°C              | -                | 105  | -    | -             | -    | -    | dB   | f = 1[kHz] Input referred                 |
| Slew Rate                           | SR     | 25°C              | -                | 1.0  | -    | -             | 4    | -    | V/μs | AV = 0[dB], RL ≥ 2[kΩ]                    |
| Gain Bandwidth Product              | GBW    | 25°C              | -                | -    | -    | -             | 10   | -    | MHz  | f = 10[kHz]                               |
| Input Referred Noise Voltage        | Vn     | 25°C              | -                | -    | -    | -             | -    | 2.2  | μV   | Rs = 2.2[kΩ], BW = 10[Hz] ~ 30[kHz], RIAA |

(\*) Absolute value

(\*) Current direction: Since first input stage is composed with PNP transistor, input bias current flows out of IC.

●Electrical characteristics

OBA4558R/BA4560R family (Unless otherwise specified VCC=+15[V], VEE=-15[V], Full range -40[°C]~+105[°C])

| Parameter                       | Symbol | Temperature Range | Guaranteed limit |       |      |                |       |      | Unit   | Condition                                      |
|---------------------------------|--------|-------------------|------------------|-------|------|----------------|-------|------|--------|--|
|                                 |        |                   | BA4558R family   |       |      | BA4560R family |       |      |        |  |
|                                 |        |                   | Min.             | Typ.  | Max. | Min.           | Typ.  | Max. |        |  |
| Input Offset Voltage (*4)       | Vio    | 25°C              | -                | 0.5   | 6    | -              | 0.5   | 6    | mV     | VOUT=0[V]                                      |
|                                 |        | Full range        | -                | -     | 7    | -              | -     | 7    |        |  |
| Input Offset Current (*4)       | Iio    | 25°C              | -                | 5     | 200  | -              | 5     | 200  | nA     | VOUT=0[V]                                      |
|                                 |        | Full range        | -                | -     | 200  | -              | -     | 200  |        |  |
| Input Bias Current (*5)         | Ib     | 25°C              | -                | 60    | 500  | -              | 50    | 500  | nA     | VOUT=0[V]                                      |
|                                 |        | Full range        | -                | -     | 800  | -              | -     | 800  |        |  |
| Supply Current                  | ICC    | 25°C              | -                | 3     | 6    | -              | 3     | 7    | mA     | RL=∞ All Op-Amps<br>VIN+=0[V]                  |
|                                 |        | Full range        | -                | -     | 6.5  | -              | -     | 7.5  |        |  |
| Maximum Output Voltage          | VOM    | 25°C              | ±10              | ±13   | -    | ±12            | ±14   | -    | V      | RL ≥ 2[kΩ]                                     |
|                                 |        | Full range        | ±10              | -     | -    | -              | -     | -    |        | Io=25[mA]                                      |
|                                 |        | 25°C              | -                | -     | -    | ±10            | ±11.5 | -    |        | RL ≥ 10[kΩ]                                    |
|                                 |        | Full range        | ±12              | ±14   | -    | -              | -     | -    |        |  |
| Large Single Voltage Gain       | AV     | 25°C              | 86               | 100   | -    | 86             | 100   | -    | dB     | RL ≥ 2[kΩ], VO=±10[V],<br>Vicm=0[V]            |
|                                 |        | Full range        | 83               | -     | -    | 83             | -     | -    |        |  |
| Input Common-mode Voltage Range | Vicm   | 25°C              | ±12              | ±14   | -    | ±12            | ±14   | -    | V      | VOUT=±12[V]                                    |
|                                 |        | Full range        | ±12              | -     | -    | ±12            | -     | -    |        |  |
| Common-mode Rejection Ratio     | CMRR   | 25°C              | 70               | 90    | -    | 70             | 90    | -    | dB     | VOUT=±12[V]                                    |
| Power Supply Rejection Ratio    | PSRR   | 25°C              | 76.5             | 90    | -    | 76.5           | 90    | -    | dB     | Ri ≤ 10[kΩ]                                    |
| Channel Separation              | CS     | 25°C              | -                | 105   | -    | -              | 105   | -    | dB     | f=1[kHz]                                       |
| Slew Rate                       | SR     | 25°C              | -                | 1     | -    | -              | 4     | -    | V/μs   | AV=0[dB], RL=10[kΩ]<br>CL=100[pF]              |
| Unity Gain Frequency            | ft     | 25°C              | -                | 2     | -    | -              | 4     | -    | MHz    | RL=2[kΩ]                                       |
| Total Harmonic Distortion       | THD    | 25°C              | -                | 0.005 | -    | -              | 0.003 | -    | %      | AV=20[dB], RL=10[kΩ]<br>VOUT=5[Vrms], f=1[kHz] |
| Input Referred Noise Voltage    | Vn     | 25°C              | -                | 12    | -    | -              | 8     | -    | nV/√Hz | RS=100[Ω], Vi=0[V]<br>f=1[kHz]                 |

(\*4) Absolute value

(\*5) Current direction: Since first input stage is composed with PNP transistor, input bias current flows out of IC.

●Electrical characteristics

OBA4580R family (Unless otherwise specified VCC=+15[V], VEE=-15[V], Ta=25[°C])

| Parameter                       | Symbol | Temperature Range | Guaranteed limit |        |      | Unit  | Condition   |
|---------------------------------|--------|-------------------|------------------|--------|------|-------|---|
|                                 |        |                   | BA4580R family   |        |      |       |   |
|                                 |        |                   | Min.             | Typ.   | Max. |       |   |
| Input Offset Voltage (*6)       | Vio    | 25°C              | -                | 0.3    | 3    | mV    | Rs ≤ 10[kΩ]   |
| Input Offset Current (*6)       | Iio    | 25°C              | -                | 5      | 200  | nA    | -   |
| Input Bias Current (*7)         | Ib     | 25°C              | -                | 100    | 500  | nA    | -   |
| Large Single Voltage Gain       | AV     | 25°C              | 90               | 110    | -    | dB    | RL ≥ 10[kΩ], VOUT=±10[V]  |
| Maximum Output Voltage          | VOM    | 25°C              | ±12              | ±13.5  | -    | V     | RL ≥ 2[kΩ]  |
| Input Common-mode Voltage Range | Vicm   | 25°C              | ±12              | ±13.5  | -    | V     | -   |
| Common-mode Rejection Ratio     | CMRR   | 25°C              | 80               | 110    | -    | dB    | Rs ≤ 10[kΩ]   |
| Power Supply Rejection Ratio    | PSRR   | 25°C              | 80               | 110    | -    | dB    | Rs ≤ 10[kΩ]   |
| Supply Current                  | ICC    | 25°C              | -                | 6      | 9    | mA    | RL=∞ All Op-Amps, VIN+=0[V]                                       |
| Slew Rate                       | SR     | 25°C              | -                | 5      | -    | V/μs  | RL ≥ 2[kΩ]  |
| Unity Gain Frequency            | ft     | 25°C              | -                | 5      | -    | MHz   | RL=2[kΩ]  |
| Total Harmonic Distortion       | THD    | 25°C              | -                | 0.0005 | -    | %     | Av=20[dB], VOUT=5[Vrms], RL=2[kΩ]<br>f=1[kHz], 20[Hz]~20[kHz] BPF |
| Input Referred Noise Voltage    | Vni    | 25°C              | -                | 0.8    | -    | μVrms | RIAA, Rs=2.2 [kΩ], 30[kHz] LPF                                    |

(\*6) Absolute value

(\*7) Current direction: Since first input stage is composed with PNP transistor, input bias current flows out of IC.

●Absolute maximum rating (Ta=25[°C])  
OBA15218/BA14741F/BA15532 family

| Parameter                       | Symbol  | Rating                  |                               |                      | Unit |
|---------------------------------|---------|-------------------------|-------------------------------|----------------------|------|
|                                 |         | BA15218 family          | BA14741 family                | BA15532 family       |      |
| Supply Voltage                  | VCC-VEE | 36                      | 36                            | 42                   | V    |
| Differential Input Voltage      | Vid     | VCC-VEE <sup>(*8)</sup> |                               | ±0.5 <sup>(*9)</sup> | V    |
| Input Common-mode voltage range | Vicm    | VEE~VCC                 |                               |                      | V    |
| Operating Supply Voltage        | Vopr    | 4~32 (±2~±16)           | 4~36 (±2~±18)                 | 6~40 (±3~±20)        | V    |
| Input Current                   | li      | -                       | -                             | ±10                  | mA   |
| Operating Temperature           | Topr    | -40~+85                 |                               | -20~+75              | °C   |
| Storage Temperature             | Tstg    | -55~+125                |                               |                      | °C   |
| Maximum junction Temperature    | Tjmax   | 125                     |                               |                      | °C   |
| Output Short Current (*10)      | Iomax   | ±50                     | -                             | -                    | mA   |
| Output Short Time (*10)         | Ts      | -                       | unlimited<br>(only 1CH short) | unlimited            | Sec  |

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.

(\*8) The voltage difference between inverting input and non-inverting input is the differential input voltage. Then input terminal voltage is set to more than VEE.

(\*9) Don't over input current ±10mA. Built-in resistor for protection because of over current with differential input voltage above 0.5V.

(\*10) Limit within Pd

●Electrical characteristics

OBA15218 family (Unless otherwise specified VCC=+15[V], VEE=-15[V], Ta=25[°C])

| Parameter                             | Symbol | Temperature Range | Guaranteed limit |      |      | Unit  | Condition                         |
|---------------------------------------|--------|-------------------|------------------|------|------|-------|-----------------------------------|
|                                       |        |                   | Min.             | Typ. | Max. |       |                                   |
| Input Offset Voltage <sup>(*11)</sup> | Vio    | 25°C              | -                | 0.5  | 5.0  | mV    | Rs ≤ 10[kΩ]                       |
| Input Offset Current <sup>(*11)</sup> | Iio    | 25°C              | -                | 5    | 200  | nA    | -                                 |
| Input Bias Current <sup>(*12)</sup>   | Ib     | 25°C              | -                | 50   | 500  | nA    | -                                 |
| Large Single Voltage Gain             | Av     | 25°C              | 86               | 110  | -    | dB    | RL ≥ 2[kΩ], Vo = ±10[V]           |
| Input Common-mode Voltage Range       | Vicm   | 25°C              | ±12              | ±14  | -    | V     | -                                 |
| Common-mode Rejection Ratio           | CMRR   | 25°C              | 70               | 90   | -    | dB    | Rs ≤ 10[kΩ]                       |
| Power Supply Rejection Ratio          | PSRR   | 25°C              | 76               | 90   | -    | dB    | Rs ≤ 10[kΩ]                       |
| Supply Current                        | ICC    | 25°C              | -                | 5.0  | 8.0  | mA    | Vin=0, RL=∞                       |
| Maximum Output Voltage                | VOH    | 25°C              | ±12              | ±14  | -    | V     | RL ≥ 10[kΩ]                       |
|                                       | VOL    | 25°C              | ±10              | ±13  | -    | V     | RL ≥ 2[kΩ]                        |
| Slew Rate                             | SR     | 25°C              | -                | 3.0  | -    | V/μs  | GV=0[dB], RL=2[kΩ]                |
| Gain Bandwidth Product                | GBW    | 25°C              | -                | 10   | -    | MHz   | f=10[kHz]                         |
| Input Referred Noise Voltage          | Vn     | 25°C              | -                | 1.0  | -    | μVrms | RS=1[kΩ], BW=20[Hz]~30[kHz], RIAA |
| Channel Separation                    | CS     | 25°C              | -                | 120  | -    | dB    | f=1[kHz] input referred           |

(\*11) Absolute value

(\*12) Current direction: Since first input stage is composed with PNP transistor, input bias current flows out of IC.

●Electrical characteristics

OBA14741 family (Unless otherwise specified VCC=+15[V], VEE=-15[V], Ta=25[°C])

| Parameter                             | Symbol | Temperature Range | Guaranteed limit |       |       | Unit  | Condition                        |                                |
|---------------------------------------|--------|-------------------|------------------|-------|-------|-------|----------------------------------|--------------------------------|
|                                       |        |                   | Min.             | Typ.  | Max.  |       |                                  |                                |
| Input Offset Voltage <sup>(*13)</sup> | Vio    | 25°C              | -                | 1.0   | 5.0   | mV    | Rs ≤ 10[kΩ]                      |                                |
| Input Offset Current <sup>(*13)</sup> | Iio    | 25°C              | -                | 10    | 50    | nA    | -                                |                                |
| Input Bias Current <sup>(*14)</sup>   | Ib     | 25°C              | -                | 60    | 300   | nA    | -                                |                                |
| Large Single Voltage Gain             | Av     | 25°C              | 20               | 100   | -     | V/mV  | RL ≥ 2[kΩ], Vo=±10[V]            |                                |
| Common-mode Rejection Ratio           | CMRR   | 25°C              | 80               | 100   | -     | dB    | -                                |                                |
| Input Common-mode Voltage Range       | Vicm   | 25°C              | ±12              | ±13.5 | -     | V     | -                                |                                |
| Power Supply Rejection Ratio          | PSRR   | 25°C              | 80               | 100   | -     | dB    | -                                |                                |
| Supply Current                        | ICC    | 25°C              | -                | 3.0   | 7.0   | mA    | RL=∞, on all OpAmp               |                                |
| Maximum Output Voltage                | High   | VOH               | 25°C             | 10    | 12.5  | -     | V                                | Vin+=1[V], Vin-=0[V], RL=2[kΩ] |
|                                       | Low    | VOL               | 25°C             | -10   | -12.5 | -     | V                                | Vin+=0[V], Vin-=1[V], RL=2[kΩ] |
| Maximum Output Current                | Source | IOH               | 25°C             | 10    | 20    | -     | mA                               | Vin+=1[V], Vin-=0[V], VO=0[V]  |
|                                       | Sink   | IOL               | 25°C             | 5     | 10    | -     | mA                               | Vin+=0[V], Vin-=1[V], VO=0[V]  |
| Slew Rate                             | SR     | 25°C              | -                | 1.0   | -     | V/μs  | Av=1, RL=2[kΩ]                   |                                |
| Input Referred Noise Voltage          | Vn     | 25°C              | -                | 2.0   | 4.0   | μVrms | RIAA, Rs=2.2[kΩ], 10[Hz]~30[kHz] |                                |
| Channel Separation                    | CS     | 25°C              | -                | 100   | -     | dB    | f=1[kHz] input referred          |                                |

(\*13) Absolute value

(\*14) Current direction: Since first input stage is composed with PNP transistor, input bias current flows out of IC.

●Electrical characteristics

OBA15532 family (Unless otherwise specified VCC=+15[V], VEE=-15[V], Ta=25[°C])

| Parameter                             | Symbol      | Temperature Range | Guaranteed limit |      |      | Unit  | Condition                            |
|---------------------------------------|-------------|-------------------|------------------|------|------|-------|--------------------------------------|
|                                       |             |                   | Min.             | Typ. | Max. |       |                                      |
| Input Offset Voltage <sup>(*15)</sup> | Vio         | 25°C              | -                | 0.5  | 4.0  | mV    | Rs=50[Ω], RL ≥ 10[kΩ]                |
| Input Offset Current <sup>(*15)</sup> | Iio         | 25°C              | -                | 10   | 150  | nA    | RL ≥ 10[kΩ]                          |
| Input Bias Current <sup>(*16)</sup>   | Ib          | 25°C              | -                | 200  | 800  | nA    | RL ≥ 10[kΩ]                          |
| Large Single Voltage Gain             | Av          | 25°C              | 80               | 94   | -    | dB    | RL ≥ 600[Ω], Vo=±10[V]               |
| Common-mode Rejection Ratio           | CMRR        | 25°C              | 70               | 100  | -    | dB    | RL ≥ 10[kΩ]                          |
| Input Common-mode Voltage Range       | Vicm        | 25°C              | ±12              | ±13  | -    | V     | RL ≥ 10[kΩ]                          |
| Power Supply Rejection Ratio          | PSRR        | 25°C              | 80               | 100  | -    | dB    | Rs=50[Ω], RL ≥ 10[kΩ]                |
| Supply Current                        | Icc         | 25°C              | -                | 8.0  | 16.0 | mA    | RL=∞, on all OpAmp                   |
| Maximum Output Voltage -1             | VOH/<br>VOL | 25°C              | ±12              | ±13  | -    | V     | RL ≥ 600[Ω]                          |
| Maximum Output Voltage -2             |             | 25°C              | ±15              | ±16  | -    | V     | RL ≥ 600[Ω]<br>VCC=18[V], VEE=-18[V] |
| Output Short Current                  | IOS         | 25°C              | -                | 38   | -    | mA    | (*17)                                |
| Slew Rate                             | SR          | 25°C              | -                | 8.0  | -    | V/μs  | Av=1, RL=600[Ω], CL=100[pF]          |
| Gain Bandwidth Product                | GBW         | 25°C              | -                | 20   | -    | MHz   | f=10[kHz], RL=600[Ω], CL=100[pF]     |
| Input Referred Noise Voltage          | Vn          | 25°C              | -                | 0.7  | 1.5  | μVrms | RIAA, Rs=100[Ω], 20[Hz]~30[kHz]      |
| Channel Separation                    | CS          | 25°C              | -                | 110  | -    | dB    | RIAA Input referred                  |

(\*15) Absolute value

(\*16) Current direction: Since first input stage is composed with NPN transistor, input bias current flows out of IC.

(\*17) In the case of output pin shorting with VCC or VEE. But never over the maximum power dissipation

●Absolute maximum rating (Ta=25[°C])  
OBA4510/BA2115 family

| Parameter                                   | Symbol  | Rating        |                  | Unit |
|---|---------|---------------|------------------|------|
|   |         | BA4510 family | BA2115 family    |      |
| Supply Voltage                              | VCC-VEE | 10            | 14               | V    |
| Differential Input Voltage <sup>(*18)</sup> | Vid     | VCC-VEE       | 14               | V    |
| Input Common-mode Voltage Range             | Vicm    | VEE~VCC       | (VEE-0.3)~VEE+14 | V    |
| Operating Supply Voltage                    | Vopr    | 2~7(±1~±3.5)  | 2~14(±1~±7)      | V    |
| Operating Temperature                       | Topr    | -20~+75       | -40~+85          | °C   |
| Storage Temperature                         | Tstg    | -55~125       | -55~150          | °C   |
| Maximum Junction Temperature                | Tjmax   | 125           | 150              | °C   |

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.

(\*18) The voltage difference between inverting input and non-inverting input is the differential input voltage. Then input terminal voltage is set to more than VEE.

●Electrical characteristics

OBA4510 family (Unless otherwise specified VCC=+2.5[V], VEE=-2.5[V], Ta=25[°C])

| Parameter                             | Symbol | Temperature Range | Guaranteed limit |      |      | Unit | Condition        |
|---------------------------------------|--------|-------------------|------------------|------|------|------|------------------|
|                                       |        |                   | Min.             | Typ. | Max. |      |                  |
| Input Offset Voltage <sup>(*19)</sup> | Vio    | 25°C              | -                | 1    | 6    | mV   | Rs=50[Ω]         |
| Input Offset Current <sup>(*19)</sup> | Iio    | 25°C              | -                | 2    | 200  | nA   | -                |
| Input Bias Current <sup>(*20)</sup>   | Ib     | 25°C              | -                | 80   | 500  | nA   | -                |
| Supply Current                        | ICC    | 25°C              | 2.5              | 5.0  | 7.5  | mA   | RL=∞ All Op-Amps |
| Maximum Output Voltage                | VOH    | 25°C              | +2.0             | +2.4 | -    | V    | RL=10[kΩ]        |
|                                       | VOL    | 25°C              | -                | -2.4 | -2.0 | V    | RL=10[kΩ]        |
| Large Single Voltage Gain             | Av     | 25°C              | 60               | 90   | -    | dB   | RL≥10[kΩ]        |
| Input Common-mode Voltage Range       | Vicm   | 25°C              | -1.3             | -    | +1.5 | V    | -                |
| Common-mode Rejection Ratio           | CMRR   | 25°C              | 60               | 80   | -    | dB   | -                |
| Power Supply Rejection Ratio          | PSRR   | 25°C              | 60               | 80   | -    | dB   | Rs=50[Ω]         |
| Slew Rate                             | SR     | 25°C              | -                | 5.0  | -    | V/μs | Av=1             |

(\*19) Absolute value

(\*20) Current direction: Since first input stage is composed with PNP transistor, input bias current flows out of IC.

●Electrical characteristics

OBA2115 family (Unless otherwise specified VCC=+2.5[V], VEE=-2.5[V], Ta=25[°C])

| Parameter                             | Symbol | Temperature Range | Guaranteed limit |      |      | Unit | Condition                        |
|---------------------------------------|--------|-------------------|------------------|------|------|------|----------------------------------|
|                                       |        |                   | Min.             | Typ. | Max. |      |                                  |
| Input Offset Voltage <sup>(*21)</sup> | Vio    | 25°C              | -                | 1    | 6    | mV   | VOUT=0[V], Vicm=0[V]             |
| Input Offset Current <sup>(*21)</sup> | Iio    | 25°C              | -                | 2    | 200  | nA   | VOUT=0[V], Vicm=0[V]             |
| Input Bias Current <sup>(*22)</sup>   | Ib     | 25°C              | -                | 150  | 400  | nA   | VOUT=0[V], Vicm=0[V]             |
| Supply Current                        | ICC    | 25°C              | -                | 3.5  | 5    | mA   | RL=∞ All Op-Amps, VIN+=0[V]      |
| Maximum Output Voltage                | VOM    | 25°C              | ±2.0             | ±2.2 | -    | V    | RL≥2.5[kΩ]                       |
| Large Single Voltage Gain             | AV     | 25°C              | 60               | 80   | -    | dB   | RL≥10[kΩ], VOUT=±2[V], Vicm=0[V] |
| Input Common-mode Voltage Range       | Vicm   | 25°C              | ±1.5             | -    | -    | V    | -                                |
| Common-mode Rejection Ratio           | CMRR   | 25°C              | 60               | 74   | -    | dB   | Vicm=-1.5[V]~+1.5[V]             |
| Power Supply Rejection Ratio          | PSRR   | 25°C              | 60               | 80   | -    | dB   | VCC=+2[V]~+14[V]                 |
| Slew Rate                             | SR     | 25°C              | -                | 4    | -    | V/μs | AV=0[dB], VIN=±1[V]              |
| Gain Bandwidth Product                | GB     | 25°C              | -                | 12   | -    | MHz  | f=10[kHz]                        |

(\*21) Absolute value

(\*22) Current direction: Since first input stage is composed with PNP transistor, input bias current flows out of IC.

● Example of electrical characteristics

○ BA4558 family

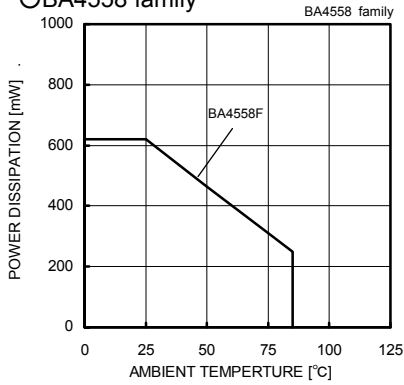


Fig. 1  
Derating Curve

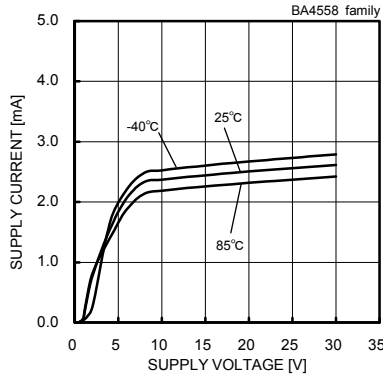


Fig. 2  
Supply Current - Supply Voltage

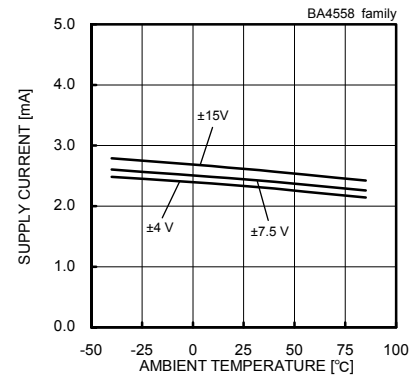


Fig. 3  
Supply Current - Ambient Temperature

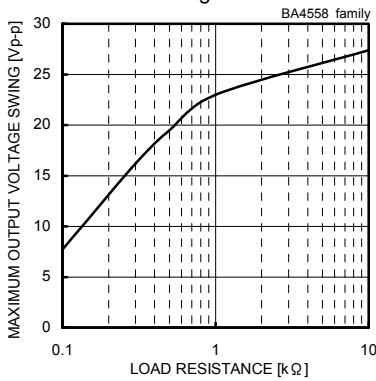


Fig. 4  
Maximum Output Voltage Swing  
- Load Resistance  
(VCC/VEE=+15[V]/-15[V], Ta=25[°C])

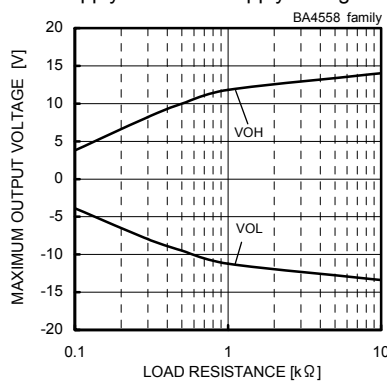


Fig. 5  
Maximum Output Voltage  
- Load Resistance  
(VCC/VEE=+15[V]/-15[V], Ta=25[°C])

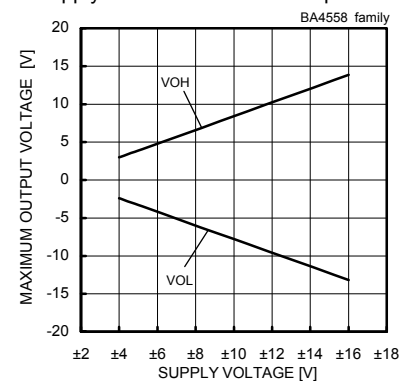


Fig. 6  
Maximum Output Voltage  
- Supply Voltage  
(RL=2[kΩ], Ta=25[°C])

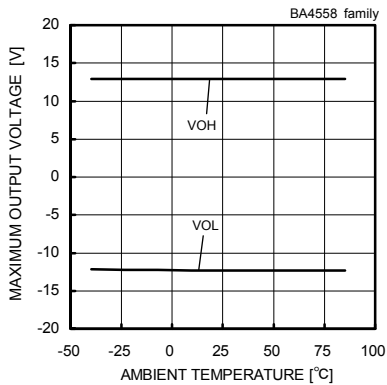


Fig. 7  
Maximum Output Voltage  
- Ambient Temperature  
(VCC/VEE=+15[V]/-15[V], RL=2[kΩ])

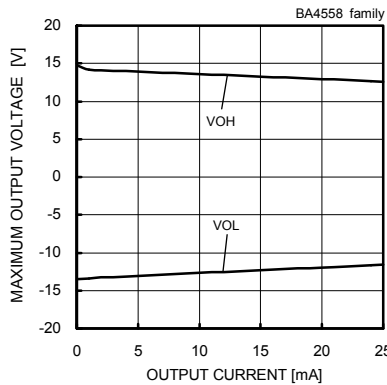


Fig. 8  
Maximum Output Voltage  
- Output Current  
(VCC/VEE=+15[V]/-15[V], Ta=25[°C])

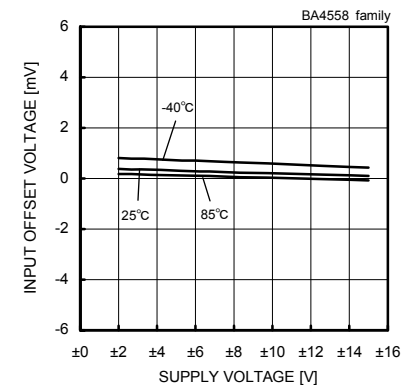


Fig. 9  
Input Offset Voltage - Supply Voltage  
(Vicm=0[V], Vout=0[V])

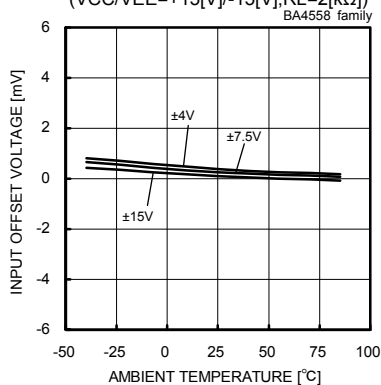


Fig. 10  
Input Offset Voltage - Ambient Temperature  
(Vicm=0[V], Vout=0[V])

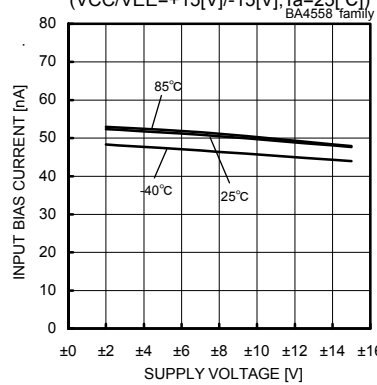


Fig. 11  
Input Bias Current - Supply Voltage  
(Vicm=0[V], Vout=0[V])

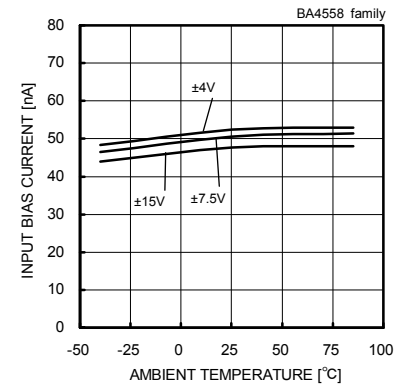


Fig. 12  
Input Bias Current - Ambient Temperature  
(Vicm=0[V], Vout=0[V])

(\*) The above data is ability value of sample, it is not guaranteed.



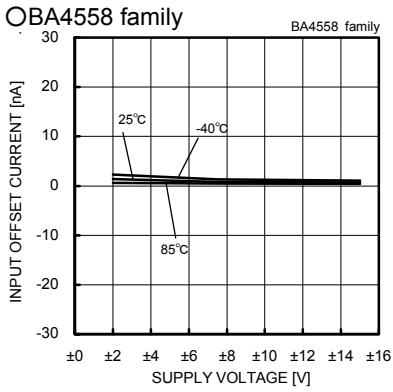


Fig. 13  
Input Offset Current – Supply Voltage  
( $V_{icm}=0[V]$ ,  $V_{out}=0[V]$ )

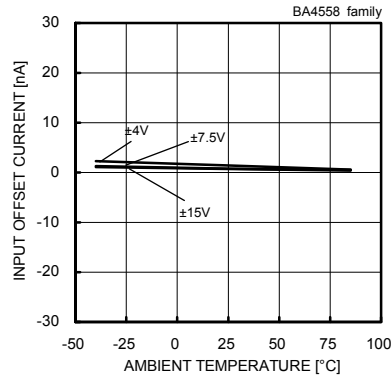


Fig. 14  
Input Offset Current – Ambient Temperature  
( $V_{icm}=0[V]$ ,  $V_{out}=0[V]$ )

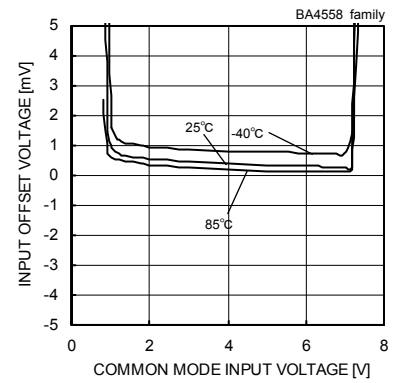


Fig. 15  
Input Offset Voltage  
– Common Mode Input Voltage  
( $V_{CC}=8[V]$ ,  $V_{out}=4[V]$ )

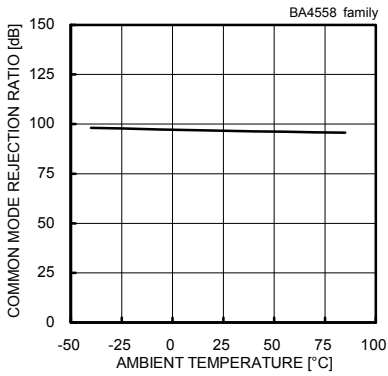


Fig. 16  
Common Mode Rejection Ratio  
– Ambient Temperature  
( $V_{CC}/V_{EE}=+15[V]/-15[V]$ ,  $V_{icm}=-12[V]$  to  $+12[V]$ )

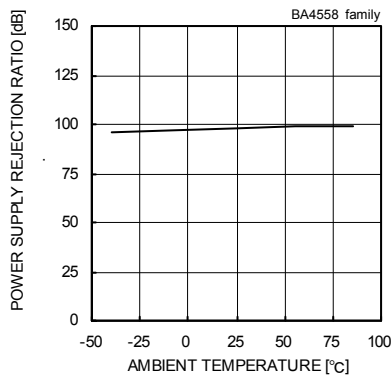


Fig. 17  
Power Supply Rejection Ratio  
– Ambient Temperature  
( $V_{CC}/V_{EE}=+4[V]/-4[V]$  to  $+15[V]/-15[V]$ )

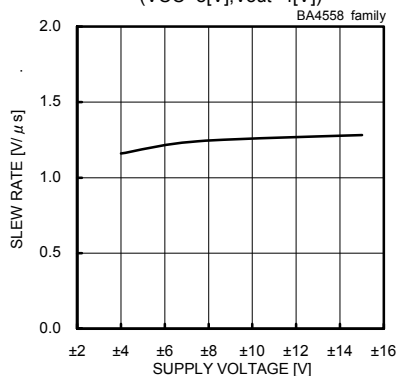


Fig. 18  
Slew Rate – Supply Voltage  
( $C_L=100[pF]$ ,  $R_L=2[k\Omega]$ ,  $T_a=25[^\circ C]$ )

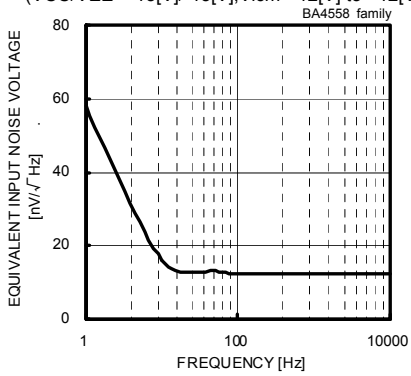


Fig. 19  
Equivalent Input Noise Voltage – Frequency  
( $V_{CC}/V_{EE}=+15[V]/-15[V]$ ,  $R_s=100[\Omega]$ ,  $T_a=25[^\circ C]$ )

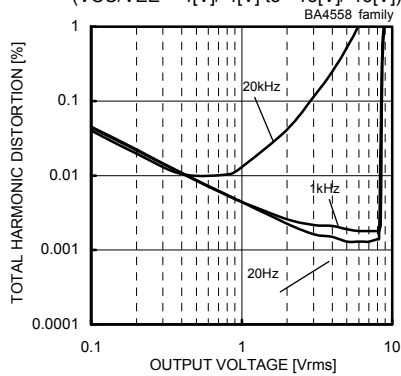


Fig. 20  
Total Harmonic Distortion – Output Voltage  
( $V_{CC}/V_{EE}=+15[V]/-15[V]$ ,  $A_v=20[dB]$ ,  $R_L=2[k\Omega]$ ,  $80[kHz]$ -LPF,  $T_a=25[^\circ C]$ )

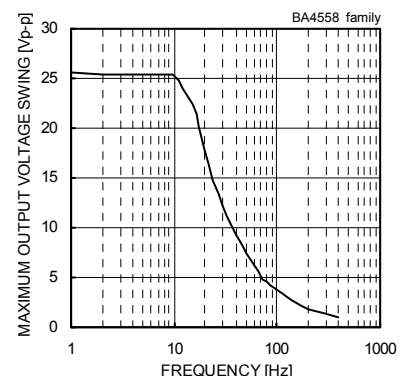


Fig. 21  
Maximum Output Voltage Swing – Frequency  
( $V_{CC}/V_{EE}=+15[V]/-15[V]$ ,  $R_L=2[k\Omega]$ ,  $T_a=25[^\circ C]$ )

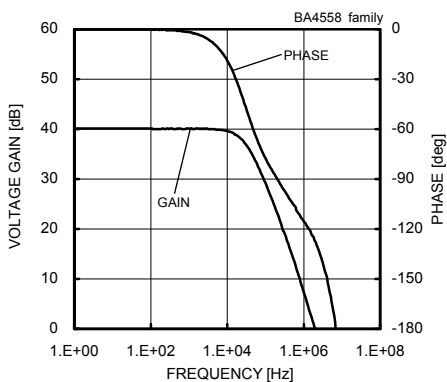


Fig. 22  
Voltage Gain – Frequency  
( $V_{CC}/V_{EE}=+15[V]/-15[V]$ ,  $A_v=40[dB]$ ,  $R_L=2[k\Omega]$ ,  $T_a=25[^\circ C]$ )

(\*) The above data is ability value of sample, it is not guaranteed.



OBA4560 family

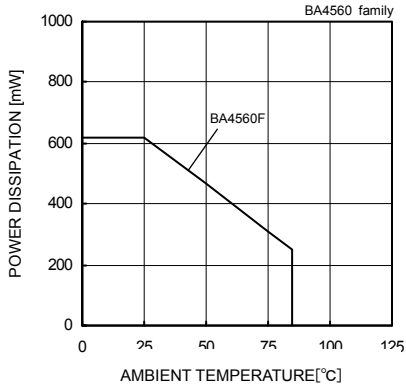


Fig. 23

Derating Curve

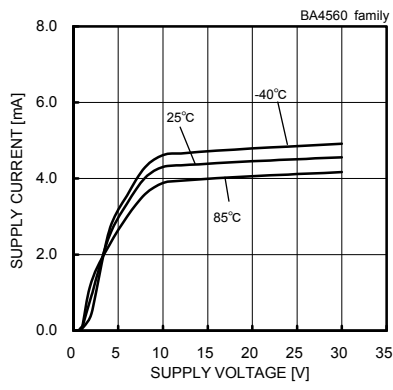


Fig. 24

Supply Current – Supply Voltage

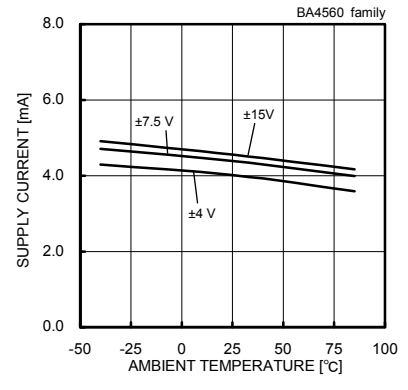


Fig. 25

Supply Current – Ambient Temperature

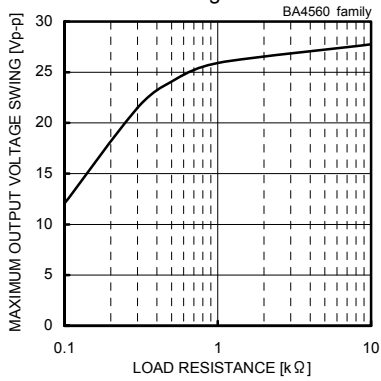


Fig. 26

Maximum Output Voltage Swing – Load Resistance

(VCC/VEE=+15[V]/-15[V], Ta=25[°C])

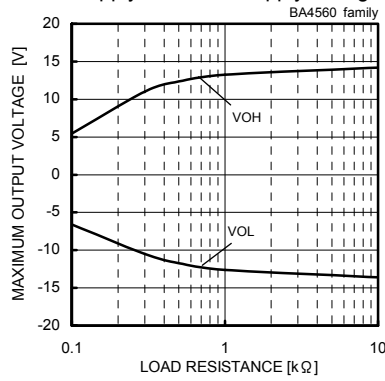


Fig. 27

Maximum Output Voltage – Load Resistance

(VCC/VEE=+15[V]/-15[V], Ta=25[°C])

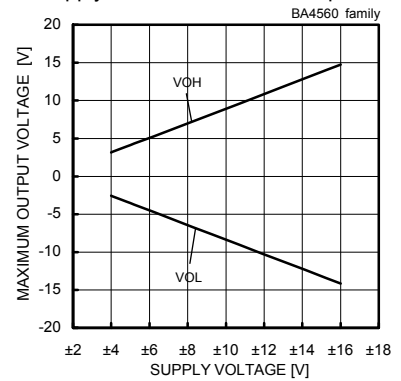


Fig. 28

Maximum Output Voltage – Supply Voltage

(RL=2[kΩ], Ta=25[°C])

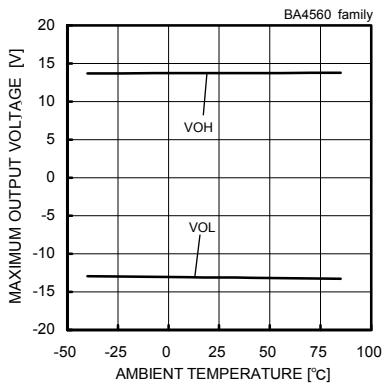


Fig. 29

Maximum Output Voltage – Ambient Temperature

(VCC/VEE=+15[V]/-15[V], RL=2[kΩ])

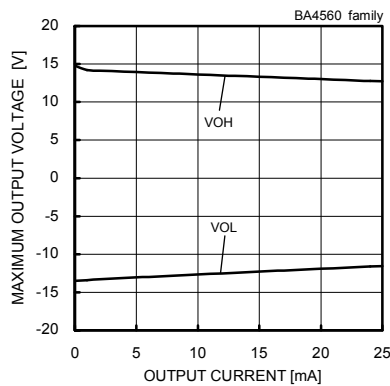


Fig. 30

Maximum Output Voltage – Output Current

(VCC/VEE=+15[V]/-15[V], Ta=25[°C])

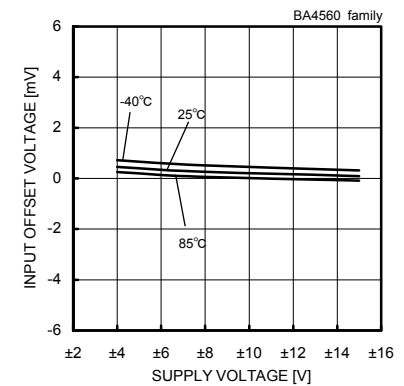


Fig. 31

Input Offset Voltage – Supply Voltage

(Vcm=0[V], Vout=0[V])

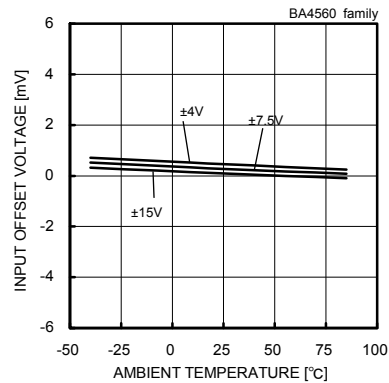


Fig. 32

Input Offset Voltage – Ambient Temperature

(Vcm=0[V], Vout=0[V])

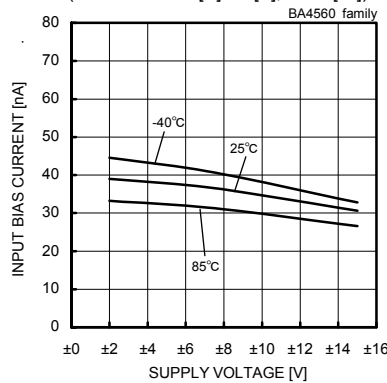


Fig. 33

Input Bias Current – Supply Voltage

(Vcm=0[V], Vout=0[V])

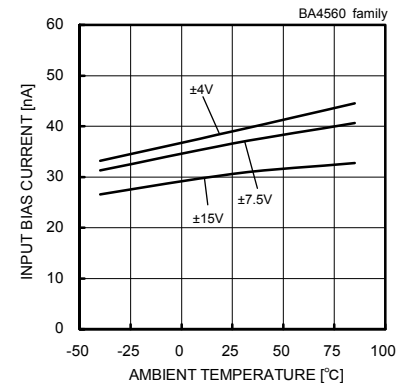


Fig. 34

Input Bias Current – Ambient Temperature

(Vcm=0[V], Vout=0[V])

(\*) The above data is ability value of sample, it is not guaranteed.

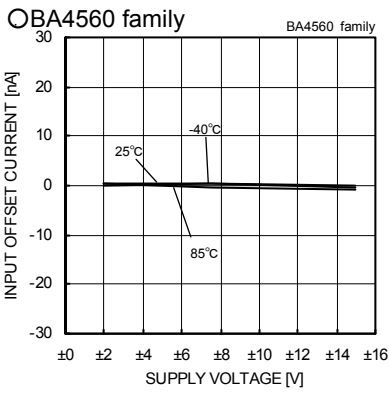


Fig. 35  
Input Offset Current – Supply Voltage  
( $V_{icm}=0[V]$ ,  $V_{out}=0[V]$ )

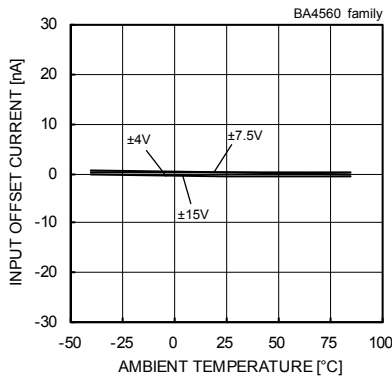


Fig. 36  
Input Offset Current – Ambient Temperature  
( $V_{icm}=0[V]$ ,  $V_{out}=0[V]$ )

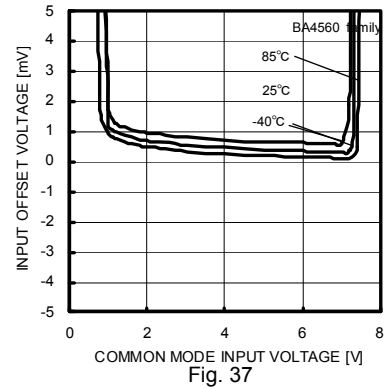


Fig. 37  
Input Offset Voltage  
– Common Mode Input Voltage  
( $V_{CC}=8[V]$ ,  $V_{out}=4[V]$ )

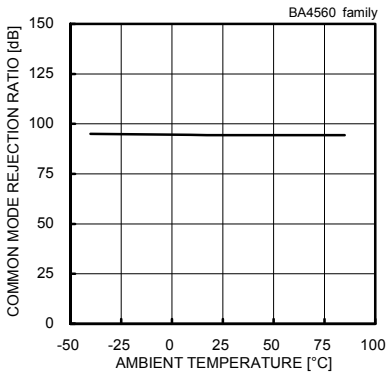


Fig. 38  
Common Mode Rejection Ratio  
– Ambient Temperature  
( $V_{CC}/V_{EE}=+15[V]/-15[V]$ ,  $V_{icm}=-12[V]$  to  $+12[V]$ )

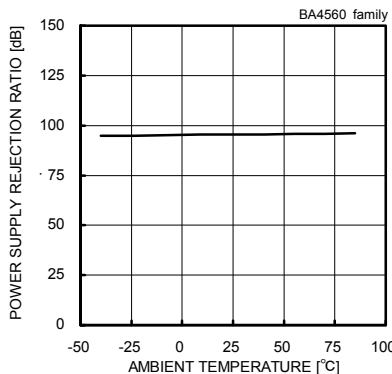


Fig. 39  
Power Supply Rejection Ratio  
– Ambient Temperature  
( $V_{CC}/V_{EE}=+4[V]/-4[V]$  to  $+15[V]/-15[V]$ )

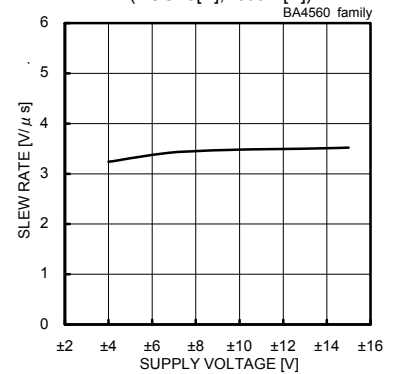


Fig. 40  
Slew Rate – Supply Voltage  
( $C_L=100[pF]$ ,  $R_L=2[k\Omega]$ ,  $T_a=25[^\circ C]$ )

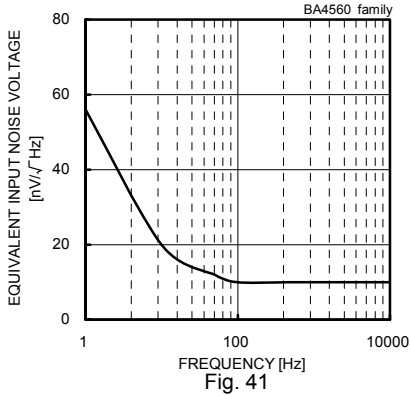


Fig. 41  
Equivalent Input Noise Voltage – Frequency  
( $V_{CC}/V_{EE}=+15[V]/-15[V]$ ,  $R_s=100[\Omega]$ ,  $T_a=25[^\circ C]$ )

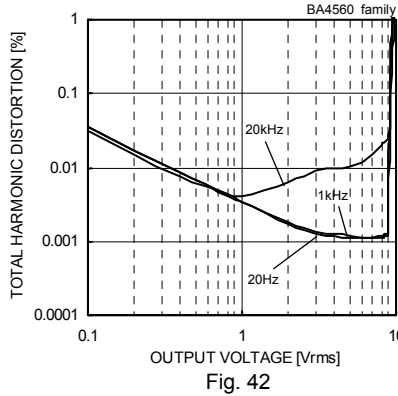


Fig. 42  
Total Harmonic Distortion – Output Voltage  
( $V_{CC}/V_{EE}=+15[V]/-15[V]$ ,  $A_v=20[dB]$ ,  
 $R_L=2[k\Omega]$ ,  $80[kHz]$ -LPF,  $T_a=25[^\circ C]$ )

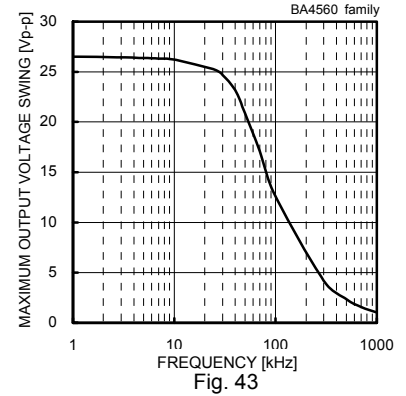


Fig. 43  
Maximum Output Voltage Swing – Frequency  
( $V_{CC}/V_{EE}=+15[V]/-15[V]$ ,  $R_L=2[k\Omega]$ ,  $T_a=25[^\circ C]$ )

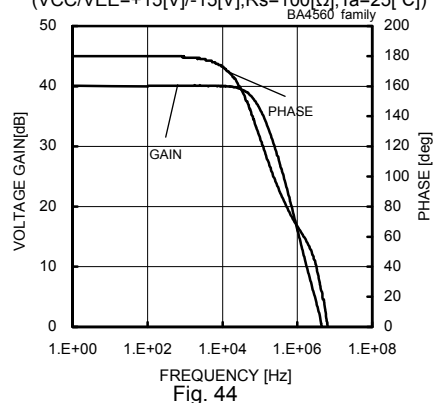


Fig. 44  
Voltage Gain – Frequency  
( $V_{CC}/V_{EE}=+15[V]/-15[V]$ ,  $A_v=40[dB]$ ,  $R_L=2[k\Omega]$ ,  $T_a=25[^\circ C]$ )

(\*) The above data is ability value of sample, it is not guaranteed.

OBA4558R family

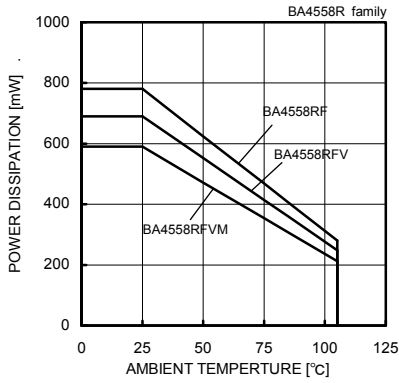


Fig. 45  
Derating Curve

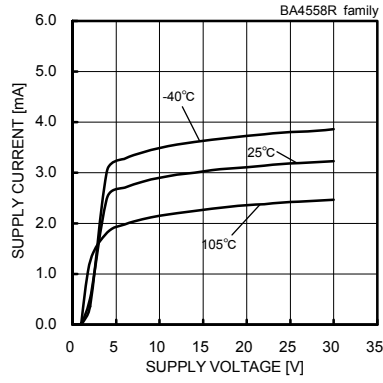


Fig. 46  
Supply Current - Supply Voltage

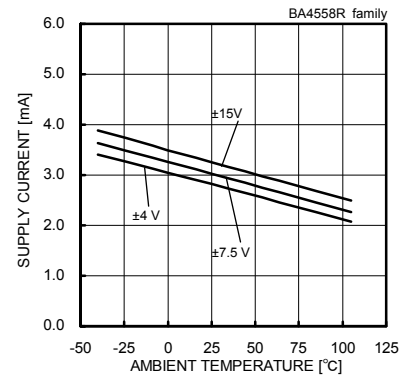


Fig. 47  
Supply Current - Ambient Temperature

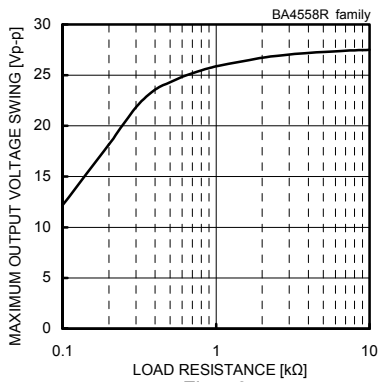


Fig. 48  
Maximum Output Voltage Swing  
- Load Resistance  
(VCC/VEE=+15[V]/-15[V], Ta=25[°C])

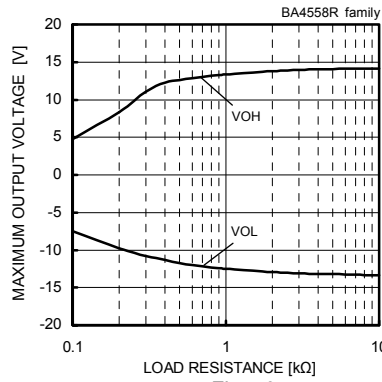


Fig. 49  
Maximum Output Voltage  
- Load Resistance  
(VCC/VEE=+15[V]/-15[V], Ta=25[°C])

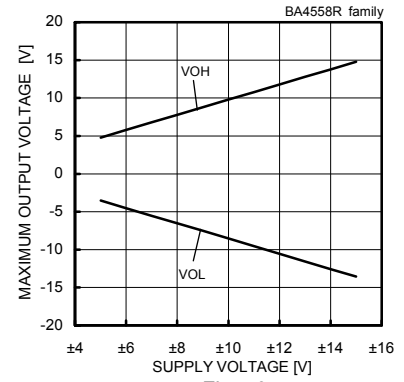


Fig. 50  
Maximum Output Voltage  
- Supply Voltage  
(RL=2[kΩ], Ta=25[°C])

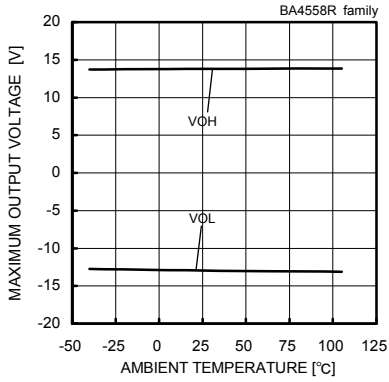


Fig. 51  
Maximum Output Voltage  
- Ambient Temperature  
(VCC/VEE=+15[V]/-15[V], RL=2[kΩ])

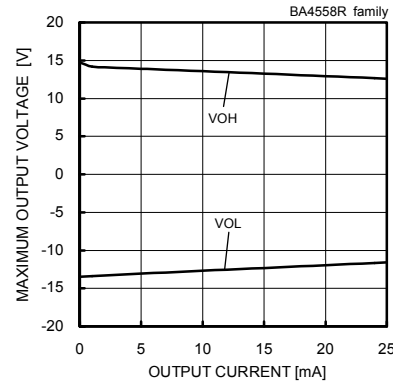


Fig. 52  
Maximum Output Voltage  
- Output Current  
(VCC/VEE=+15[V]/-15[V], Ta=25[°C])

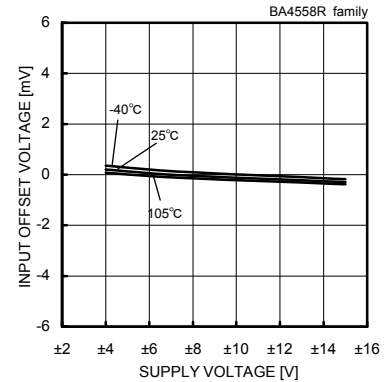


Fig. 53  
Input Offset Voltage - Supply Voltage  
(Vicm=0[V], Vout=0[V])

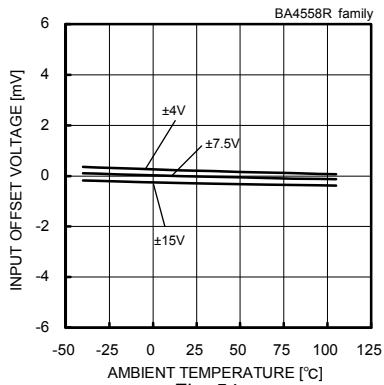


Fig. 54  
Input Offset Voltage - Ambient Temperature  
(Vicm=0[V], Vout=0[V])

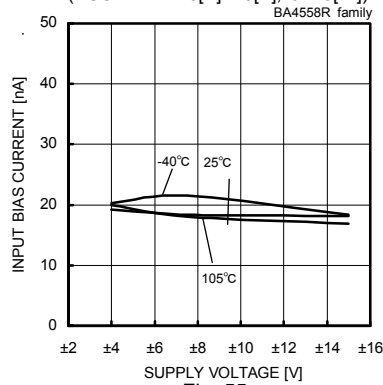


Fig. 55  
Input Bias Current - Supply Voltage  
(Vicm=0[V], Vout=0[V])

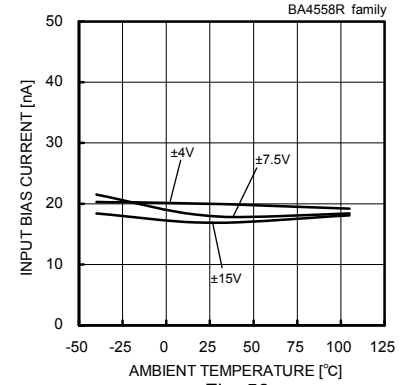


Fig. 56  
Input Bias Current - Ambient Temperature  
(Vicm=0[V], Vout=0[V])

(\* The above data is ability value of sample, it is not guaranteed.)

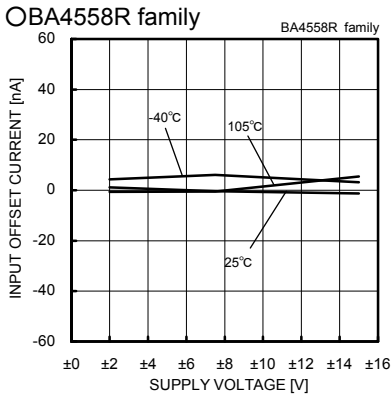


Fig. 57

Input Offset Current – Supply Voltage  
( $V_{icm}=0[V]$ ,  $V_{out}=0[V]$ )

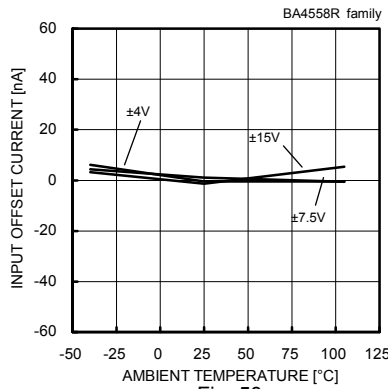


Fig. 58

Input Offset Current – Ambient Temperature  
( $V_{icm}=0[V]$ ,  $V_{out}=0[V]$ )

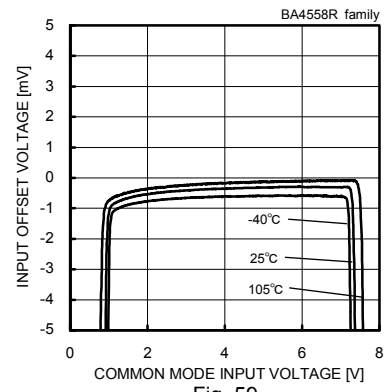


Fig. 59

Input Offset Voltage – Common Mode Input Voltage  
( $V_{CC}=8[V]$ ,  $V_{out}=4[V]$ )

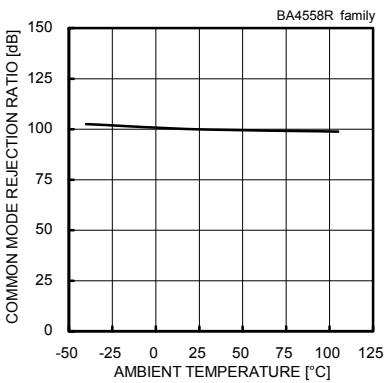


Fig. 60

Common Mode Rejection Ratio – Ambient Temperature  
( $V_{CC}/V_{EE}=+15[V]/-15[V]$ ,  $V_{icm}=-12[V]$  to  $+12[V]$ )

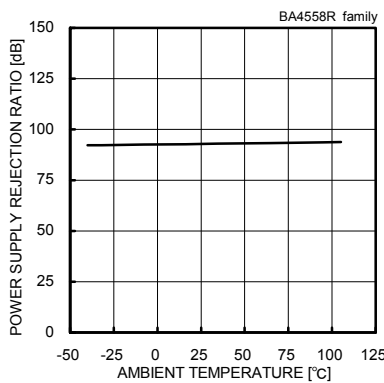


Fig. 61

Power Supply Rejection Ratio – Ambient Temperature  
( $V_{CC}/V_{EE}=+4[V]/-4[V]$  to  $+15[V]/-15[V]$ )

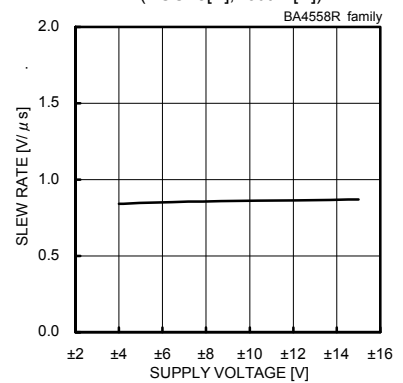


Fig. 62

Slew Rate – Supply Voltage  
( $C_L=100[pF]$ ,  $R_L=2[k\Omega]$ ,  $T_a=25[^\circ C]$ )

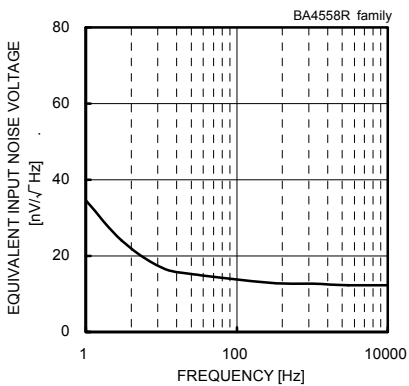


Fig. 63

Equivalent Input Noise Voltage – Frequency  
( $V_{CC}/V_{EE}=+15[V]/-15[V]$ ,  $R_s=100[\Omega]$ ,  $T_a=25[^\circ C]$ )

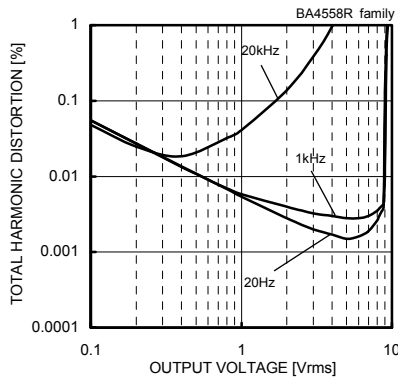


Fig. 64

Total Harmonic Distortion – Output Voltage  
( $V_{CC}/V_{EE}=+15[V]/-15[V]$ ,  $A_v=20[dB]$ ,  $R_L=2[k\Omega]$ ,  $80[kHz]$ -LPF,  $T_a=25[^\circ C]$ )

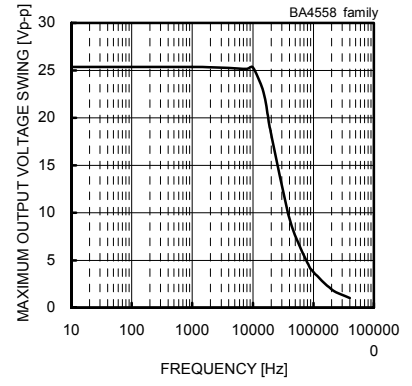


Fig. 65

Maximum Output Voltage Swing – Frequency  
( $V_{CC}/V_{EE}=+15[V]/-15[V]$ ,  $R_L=2[k\Omega]$ ,  $T_a=25[^\circ C]$ )

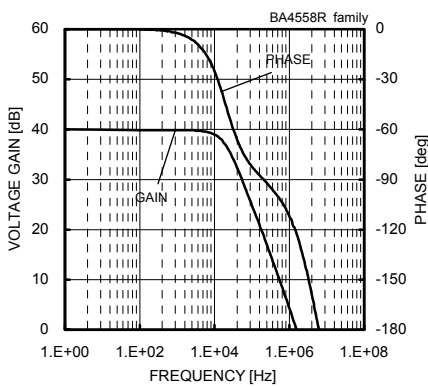


Fig. 66

Voltage Gain – Frequency  
( $V_{CC}/V_{EE}=+15[V]/-15[V]$ ,  $A_v=40[dB]$ ,  $R_L=2[k\Omega]$ ,  $T_a=25[^\circ C]$ )

(\*) The above data is ability value of sample, it is not guaranteed.

OBA4560R family

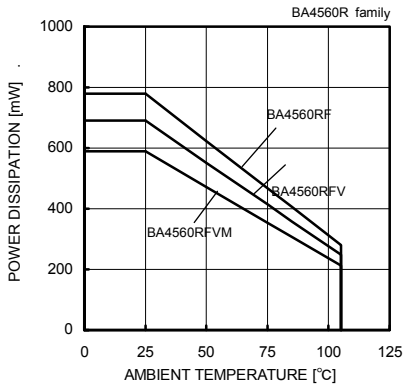


Fig. 67  
Derating Curve

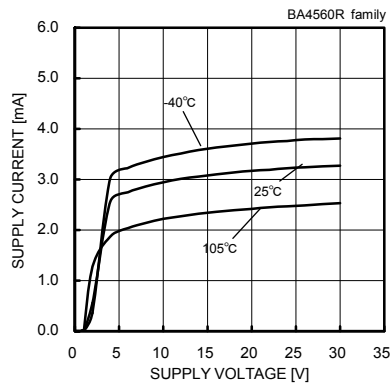


Fig. 68  
Supply Current – Supply Voltage

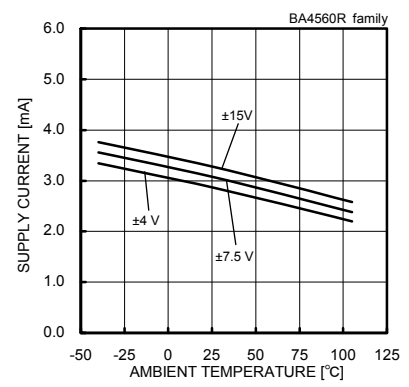


Fig. 69  
Supply Current – Ambient Temperature

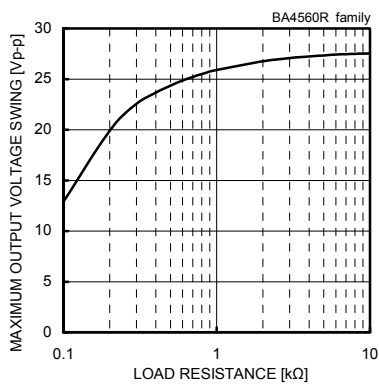


Fig. 70  
Maximum Output Voltage Swing  
– Load Resistance  
(VCC/VEE=+15[V]/-15[V], Ta=25°C)

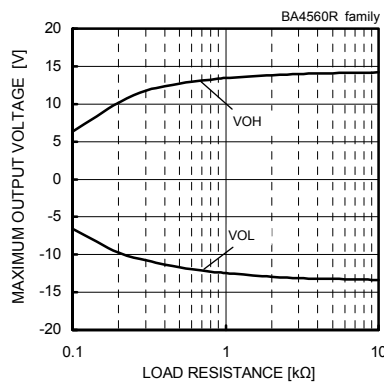


Fig. 71  
Maximum Output Voltage  
– Load Resistance  
(VCC/VEE=+15[V]/-15[V], Ta=25°C)

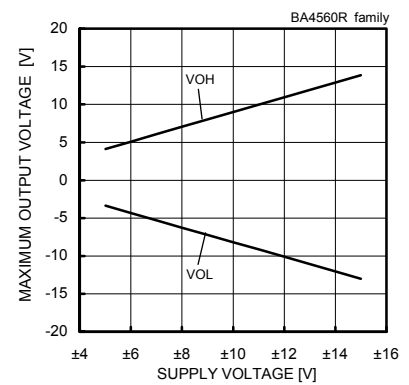


Fig. 72  
Maximum Output Voltage  
– Supply Voltage  
(RL=2[kΩ], Ta=25°C)

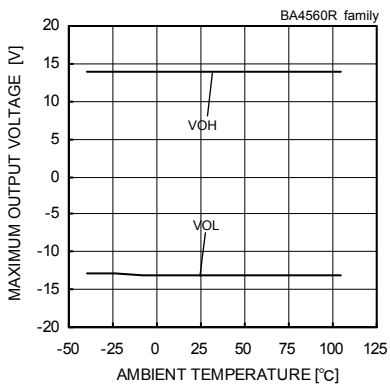


Fig. 73  
Maximum Output Voltage  
– Ambient Temperature  
(VCC/VEE=+15[V]/-15[V], RL=2[kΩ])

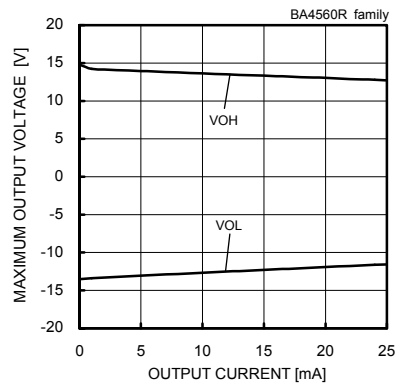


Fig. 74  
Maximum Output Voltage  
– Output Current  
(VCC/VEE=+15[V]/-15[V], Ta=25°C)

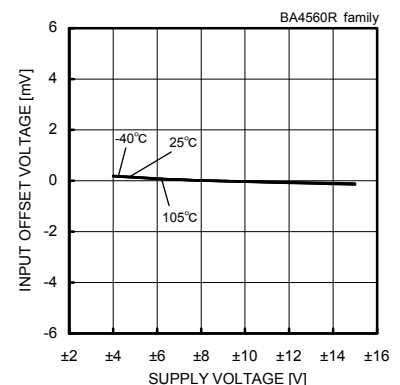


Fig. 75  
Input Offset Voltage – Supply Voltage  
(Vicm=0[V], Vout=0[V])

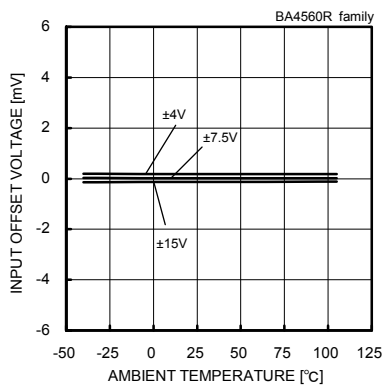


Fig. 76  
Input Offset Voltage – Ambient Temperature  
(Vicm=0[V], Vout=0[V])

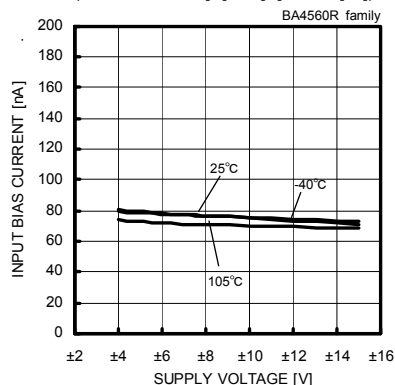


Fig. 77  
Input Bias Current – Supply Voltage  
(Vicm=0[V], Vout=0[V])

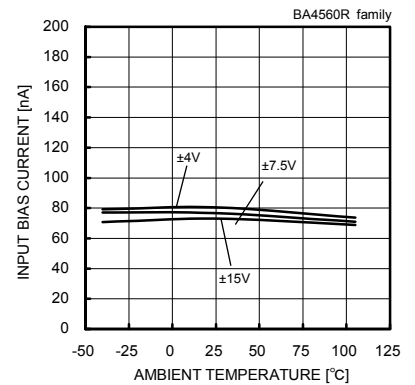


Fig. 78  
Input Bias Current – Ambient Temperature  
(Vicm=0[V], Vout=0[V])

(\*) The above data is ability value of sample, it is not guaranteed.

OBA4560R family

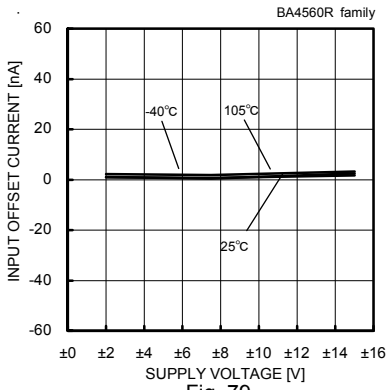


Fig. 79  
Input Offset Current – Supply Voltage  
( $V_{icm}=0[V]$ ,  $V_{out}=0[V]$ )

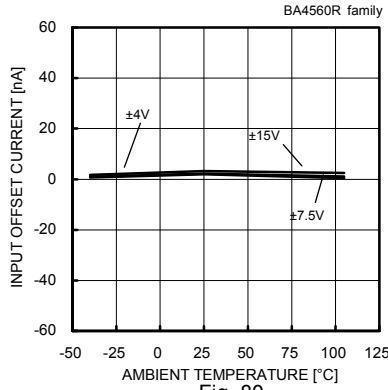


Fig. 80  
Input Offset Current – Ambient Temperature  
( $V_{icm}=0[V]$ ,  $V_{out}=0[V]$ )

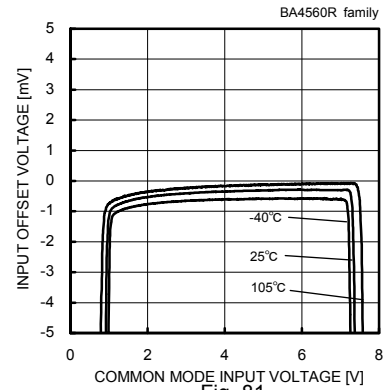


Fig. 81  
Input Offset Voltage  
– Common Mode Input Voltage  
( $V_{CC}=8[V]$ ,  $V_{out}=4[V]$ )

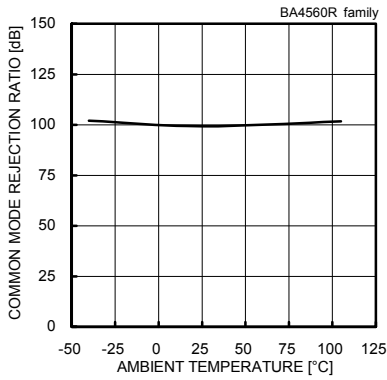


Fig. 82  
Common Mode Rejection Ratio  
– Ambient Temperature  
( $V_{CC}/V_{EE}=+15[V]/-15[V]$ ,  $V_{icm}=-12[V]$  to  $+12[V]$ )

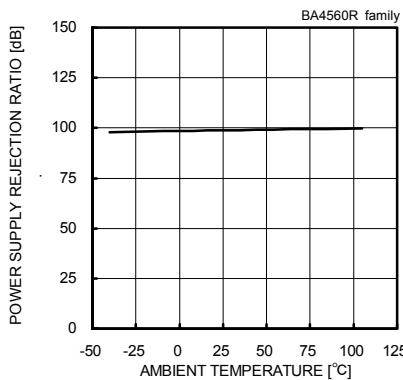


Fig. 83  
Power Supply Rejection Ratio  
– Ambient Temperature  
( $V_{CC}/V_{EE}=+4[V]/-4[V]$  to  $+15[V]/-15[V]$ )

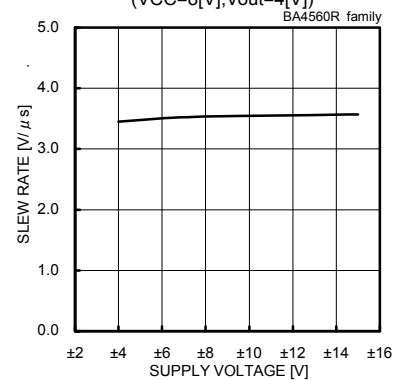


Fig. 84  
Slew Rate – Supply Voltage  
( $C_L=100[pF]$ ,  $R_L=2[k\Omega]$ ,  $T_a=25[^\circ C]$ )

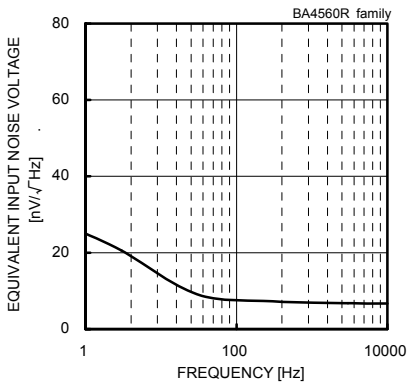


Fig. 85  
Equivalent Input Noise Voltage – Frequency  
( $V_{CC}/V_{EE}=+15[V]/-15[V]$ ,  $R_s=100[\Omega]$ ,  $T_a=25[^\circ C]$ )

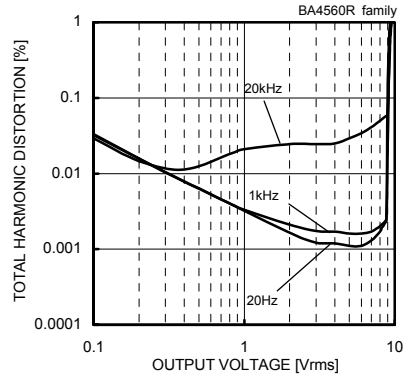


Fig. 86  
Total Harmonic Distortion – Output Voltage  
( $V_{CC}/V_{EE}=+15[V]/-15[V]$ ,  $A_v=20[dB]$ ,  
 $R_L=2[k\Omega]$ , 80[kHz]-LPF,  $T_a=25[^\circ C]$ )

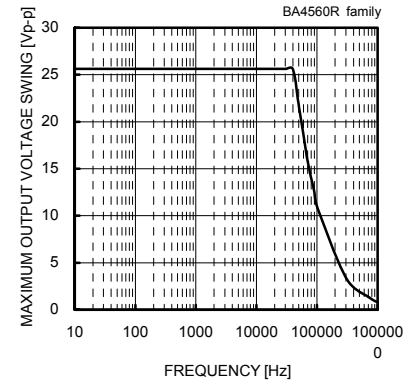


Fig. 87  
Maximum Output Voltage Swing – Frequency  
( $V_{CC}/V_{EE}=+15[V]/-15[V]$ ,  $R_L=2[k\Omega]$ ,  $T_a=25[^\circ C]$ )

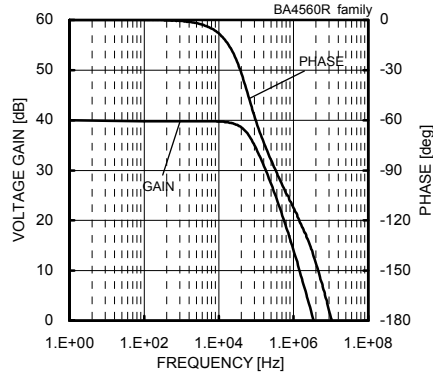


Fig. 88  
Voltage Gain – Frequency  
( $V_{CC}/V_{EE}=+15[V]/-15[V]$ ,  $A_v=40[dB]$ ,  $R_L=2[k\Omega]$ ,  $T_a=25[^\circ C]$ )

(\*) The above data is ability value of sample, it is not guaranteed.

OBA4580R family

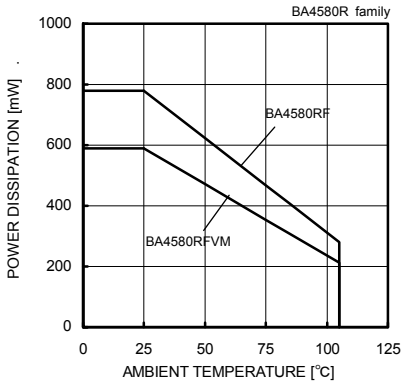


Fig. 89  
Derating Curve

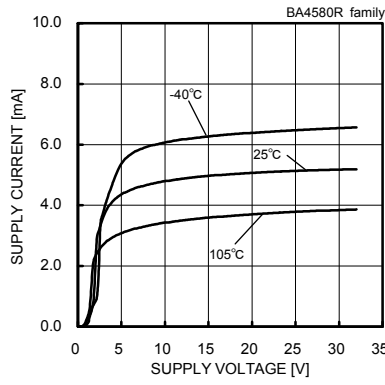


Fig. 90  
Supply Current - Supply Voltage

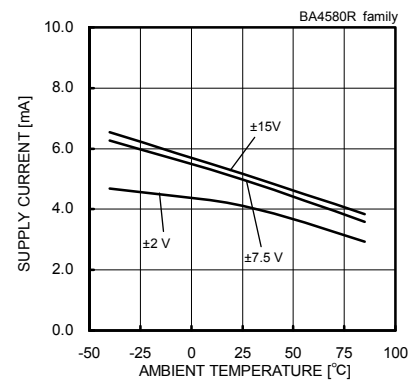


Fig. 91  
Supply Current - Ambient Temperature

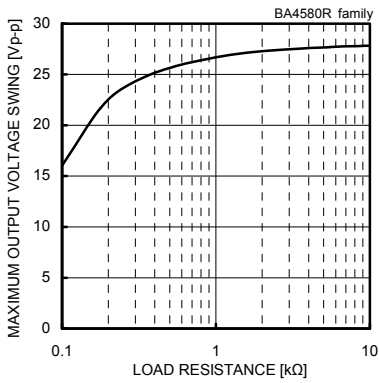


Fig. 92  
Maximum Output Voltage Swing  
- Load Resistance  
(VCC/VEE=+15[V]/-15[V], Ta=25[°C])

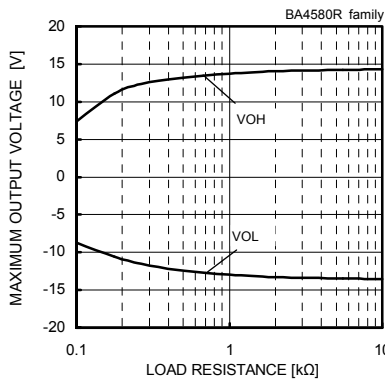


Fig. 93  
Maximum Output Voltage  
- Load Resistance  
(VCC/VEE=+15[V]/-15[V], Ta=25[°C])

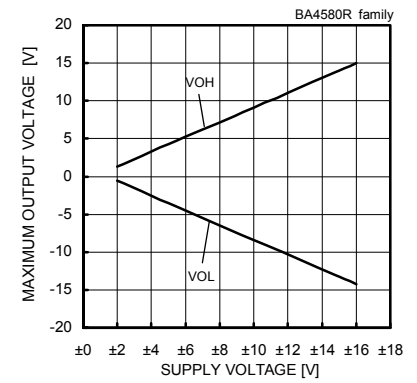


Fig. 94  
Maximum Output Voltage  
- Supply Voltage  
(RL=2[kΩ], Ta=25[°C])

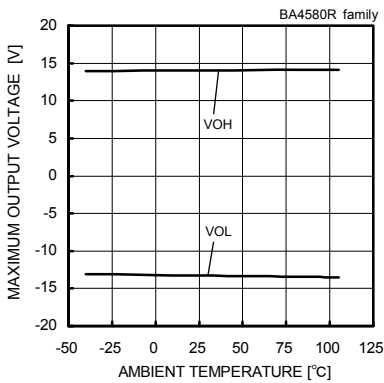


Fig. 95  
Maximum Output Voltage  
- Ambient Temperature  
(VCC/VEE=+15[V]/-15[V], RL=2[kΩ])

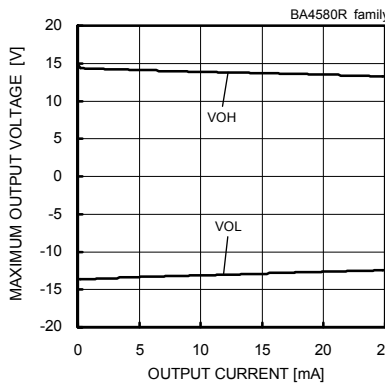


Fig. 96  
Maximum Output Voltage  
- Output Current  
(VCC/VEE=+15[V]/-15[V], Ta=25[°C])

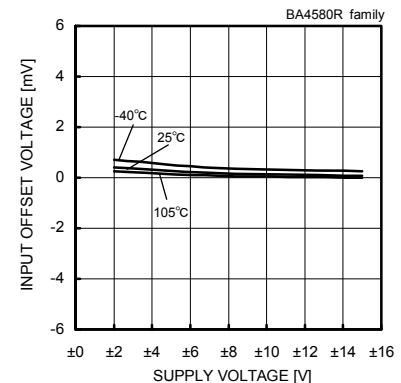


Fig. 97  
Input Offset Voltage - Supply Voltage  
(Vicm=0[V], Vout=0[V])

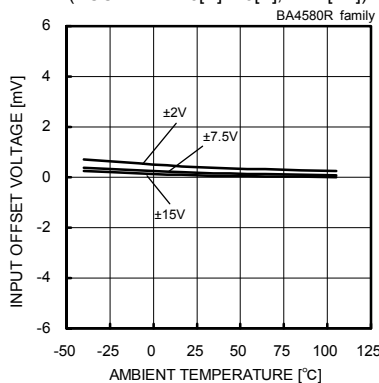


Fig. 98  
Input Offset Voltage - Ambient Temperature  
(Vicm=0[V], Vout=0[V])

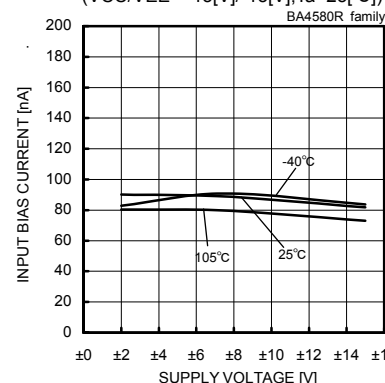


Fig. 99  
Input Bias Current - Supply Voltage  
(Vicm=0[V], Vout=0[V])

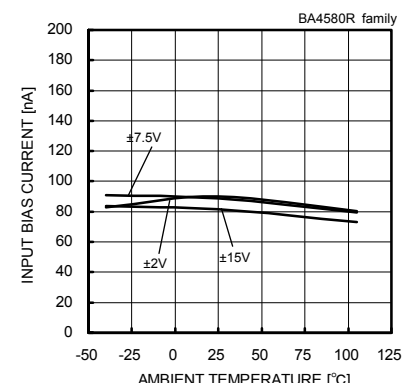


Fig. 100  
Input Bias Current - Ambient Temperature  
(Vicm=0[V], Vout=0[V])

(\* The above data is ability value of sample, it is not guaranteed.



OBA4580R family

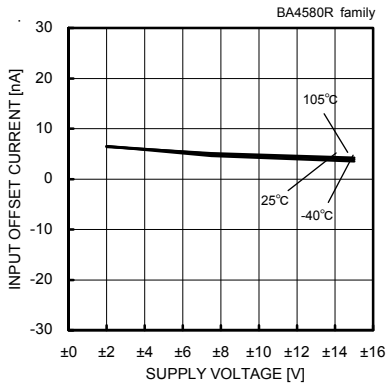


Fig. 101

Input Offset Current – Supply Voltage  
( $V_{icm}=0[V]$ ,  $V_{out}=0[V]$ )

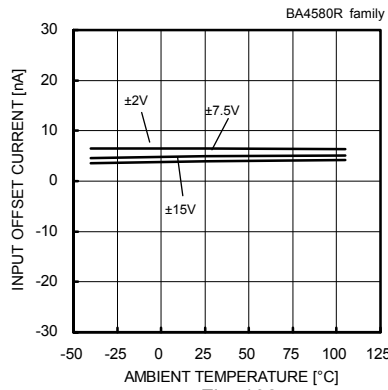


Fig. 102

Input Offset Current – Ambient Temperature  
( $V_{icm}=0[V]$ ,  $V_{out}=0[V]$ )

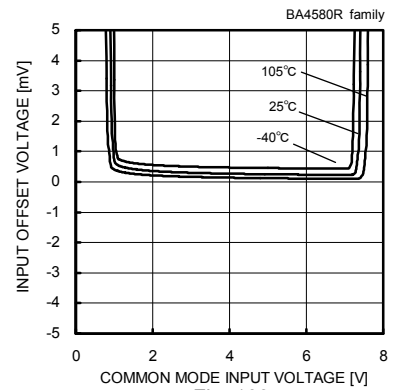


Fig. 103

Input Offset Voltage – Common Mode Input Voltage  
( $V_{CC}=8[V]$ ,  $V_{out}=4[V]$ )

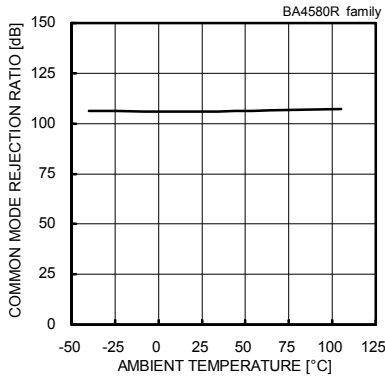


Fig. 104

Common Mode Rejection Ratio – Ambient Temperature  
( $V_{CC}/V_{EE}=+15[V]/-15[V]$ ,  $V_{icm}=-12[V]$  to  $+12[V]$ )

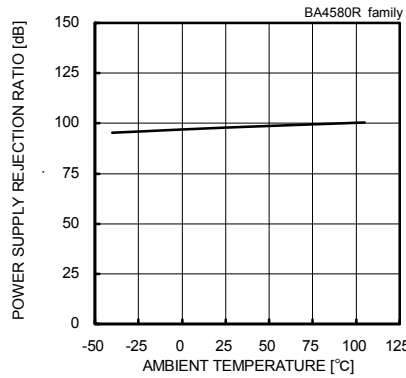


Fig. 105

Power Supply Rejection Ratio – Ambient Temperature  
( $V_{CC}/V_{EE}=+2[V]/-2[V]$  to  $+15[V]/-15[V]$ )

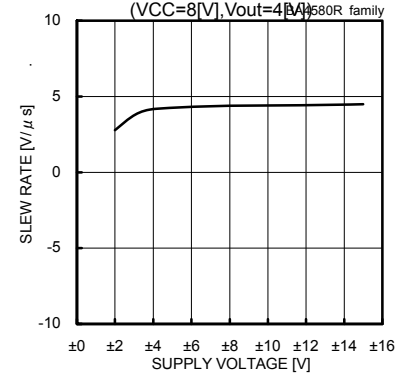


Fig. 106

Slew Rate – Supply Voltage  
( $C_L=100[pF]$ ,  $R_L=2[k\Omega]$ ,  $T_a=25[^\circ C]$ )

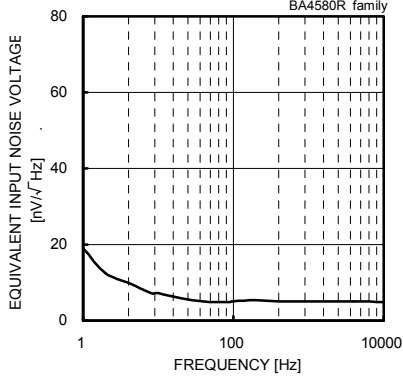


Fig. 107

Equivalent Input Noise Voltage – Frequency  
( $V_{CC}/V_{EE}=+15[V]/-15[V]$ ,  $R_s=100[\Omega]$ ,  $T_a=25[^\circ C]$ )

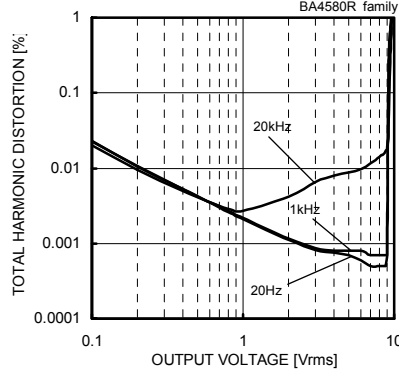


Fig. 108

Total Harmonic Distortion – Output Voltage  
( $V_{CC}/V_{EE}=+15[V]/-15[V]$ ,  $A_v=20[dB]$ ,  $R_L=2[k\Omega]$ ,  $80[kHz]$ -LTPF,  $T_a=25[^\circ C]$ )

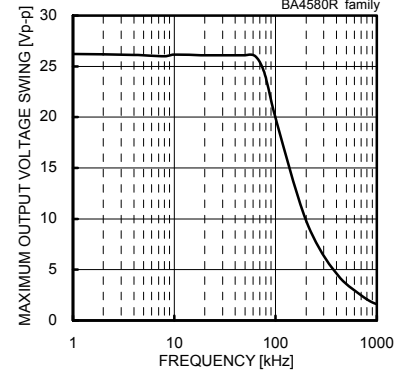


Fig. 109

Maximum Output Voltage Swing – Frequency  
( $V_{CC}/V_{EE}=+15[V]/-15[V]$ ,  $R_L=2[k\Omega]$ ,  $T_a=25[^\circ C]$ )

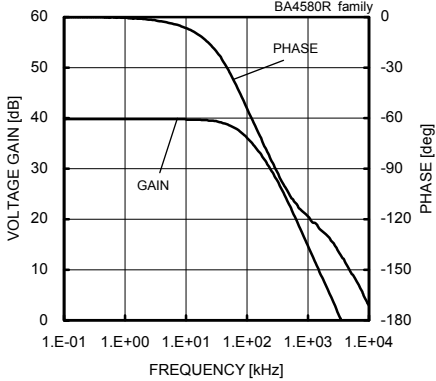


Fig. 110

Voltage Gain – Frequency  
( $V_{CC}/V_{EE}=+15[V]/-15[V]$ ,  $A_v=40[dB]$ ,  $R_L=2[k\Omega]$ ,  $T_a=25[^\circ C]$ )

(\* The above data is ability value of sample, it is not guaranteed.)

OBA15218 family

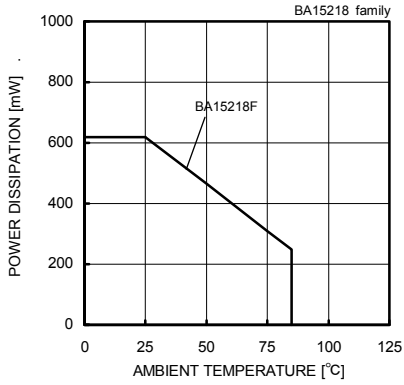


Fig. 111  
Derating Curve

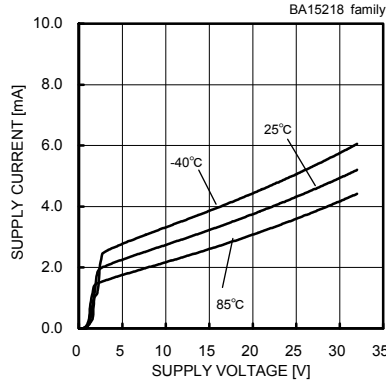


Fig. 112  
Supply Current - Supply Voltage

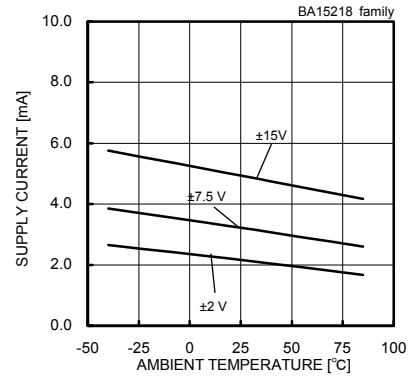


Fig. 113  
Supply Current - Ambient Temperature

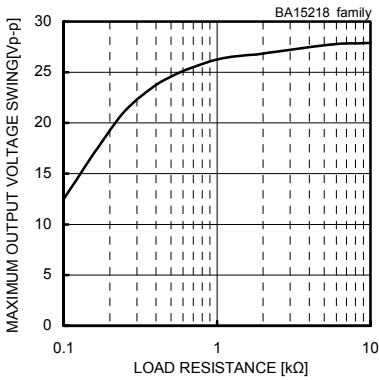


Fig. 114  
Maximum Output Voltage Swing - Load Resistance  
(VCC/VEE=+15[V]/-15[V], Ta=25[°C])

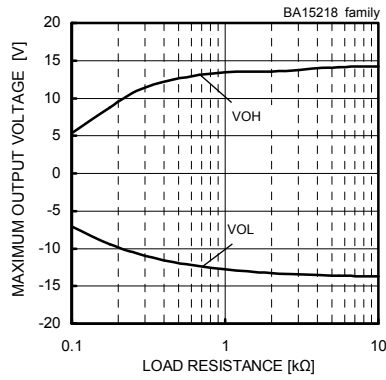


Fig. 115  
Maximum Output Voltage - Load Resistance  
(VCC/VEE=+15[V]/-15[V], Ta=25[°C])

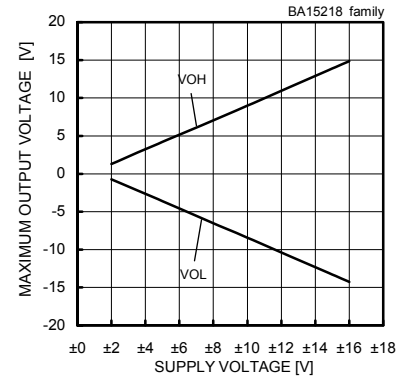


Fig. 116  
Maximum Output Voltage - Supply Voltage  
(RL=2[kΩ], Ta=25[°C])

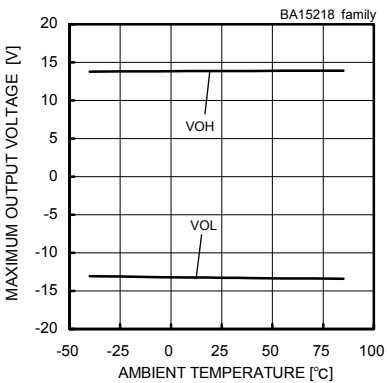


Fig. 117  
Maximum Output Voltage - Ambient Temperature  
(VCC/VEE=+15[V]/-15[V], RL=2[kΩ])

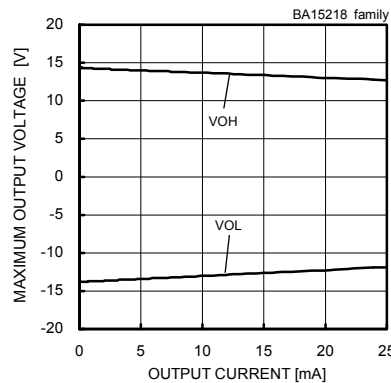


Fig. 118  
Maximum Output Voltage - Output Current  
(VCC/VEE=+15[V]/-15[V], Ta=25[°C])

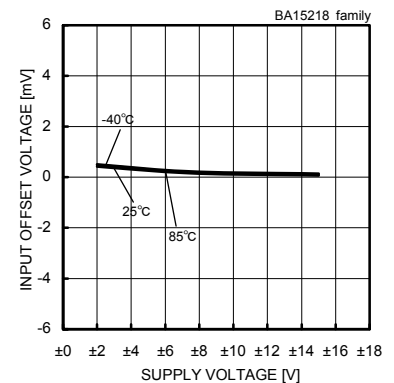


Fig. 119  
Input Offset Voltage - Supply Voltage  
(Vicm=0[V], Vout=0[V])

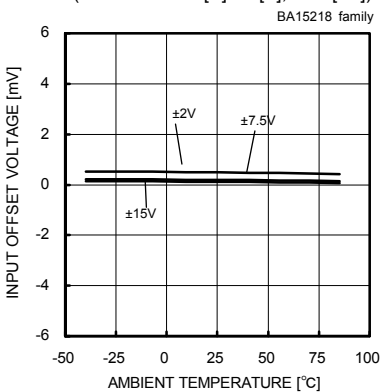


Fig. 120  
Input Offset Voltage - Ambient Temperature  
(Vicm=0[V], Vout=0[V])

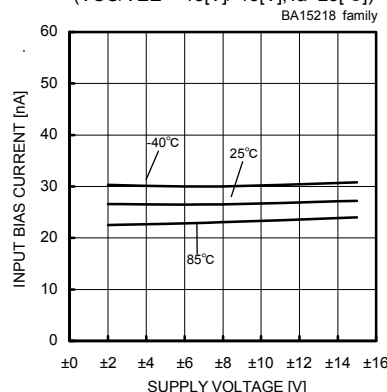


Fig. 121  
Input Bias Current - Supply Voltage  
(Vicm=0[V], Vout=0[V])

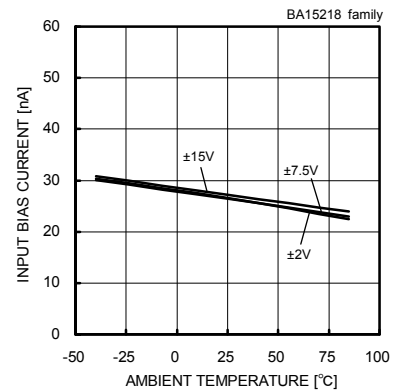


Fig. 122  
Input Bias Current - Ambient Temperature  
(Vicm=0[V], Vout=0[V])

(\*) The above data is ability value of sample, it is not guaranteed.

○BA15218 family

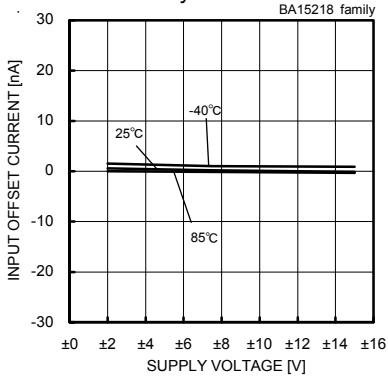


Fig. 123  
Input Offset Current – Supply Voltage  
( $V_{icm}=0[V]$ ,  $V_{out}=0[V]$ )

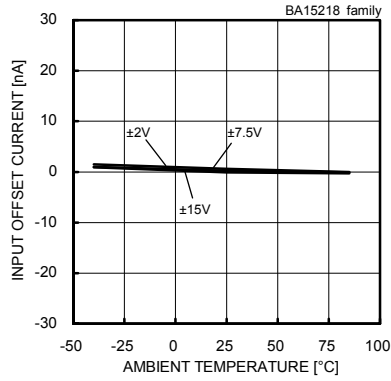


Fig. 124  
Input Offset Current – Ambient Temperature  
( $V_{icm}=0[V]$ ,  $V_{out}=0[V]$ )

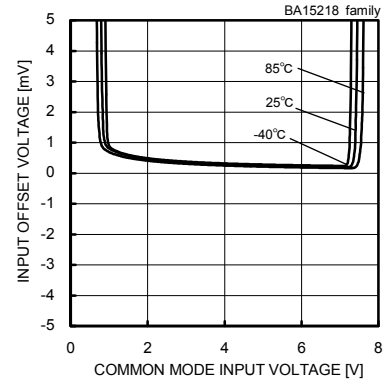


Fig. 125  
Input Offset Voltage  
– Common Mode Input Voltage  
( $V_{CC}=8[V]$ ,  $V_{out}=4[V]$ )

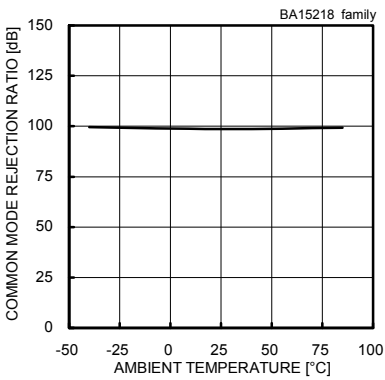


Fig. 126  
Common Mode Rejection Ratio  
– Ambient Temperature  
( $V_{CC}/V_{EE}=+15[V]/-15[V]$ ,  $V_{icm}=-12[V]$  to  $+12[V]$ )

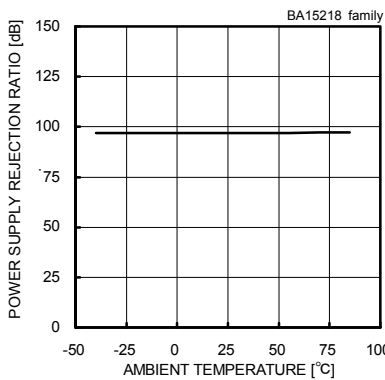


Fig. 127  
Power Supply Rejection Ratio  
– Ambient Temperature  
( $V_{CC}/V_{EE}=+2[V]/-2[V]$  to  $+15[V]/-15[V]$ )

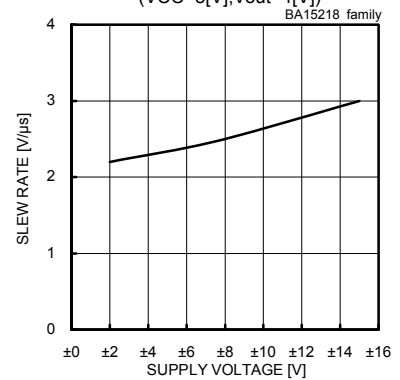


Fig. 128  
Slew Rate – Supply Voltage  
( $C_L=100[pF]$ ,  $R_L=2[k\Omega]$ ,  $T_a=25[^\circ C]$ )

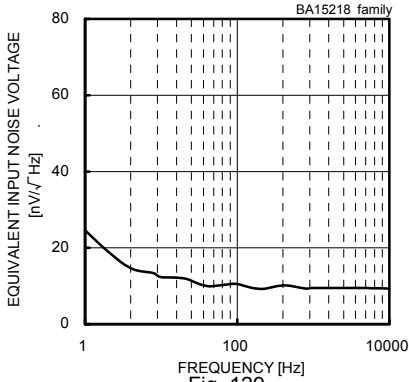


Fig. 129  
Equivalent Input Noise Voltage – Frequency  
( $V_{CC}/V_{EE}=+15[V]/-15[V]$ ,  $R_s=100[\Omega]$ ,  $T_a=25[^\circ C]$ )

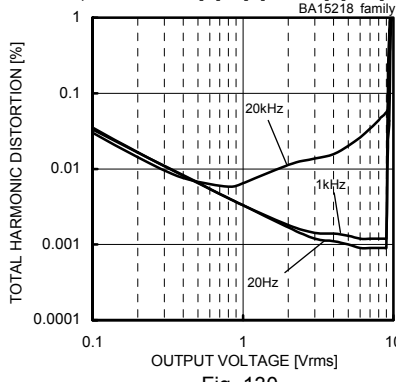


Fig. 130  
Total Harmonic Distortion – Output Voltage  
( $V_{CC}/V_{EE}=+15[V]/-15[V]$ ,  $A_v=20[dB]$ ,  
 $R_L=2[k\Omega]$ ,  $80[kHz]$ -LPF,  $T_a=25[^\circ C]$ )

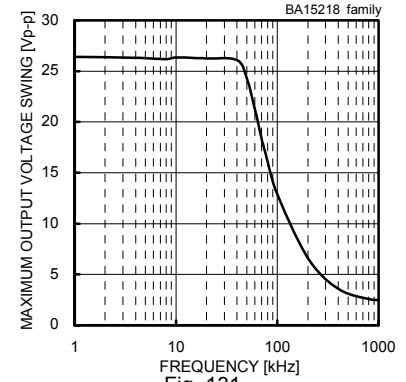


Fig. 131  
Maximum Output Voltage Swing – Frequency  
( $V_{CC}/V_{EE}=+15[V]/-15[V]$ ,  $R_L=2[k\Omega]$ ,  $T_a=25[^\circ C]$ )

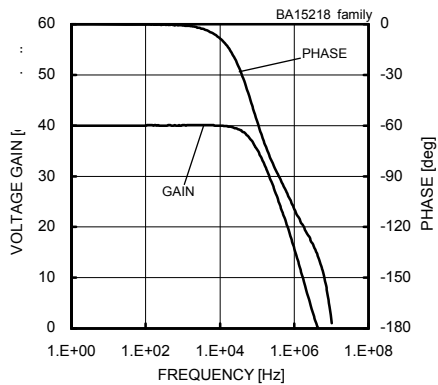


Fig. 132  
Voltage Gain – Frequency  
( $V_{CC}/V_{EE}=+15[V]/-15[V]$ ,  $A_v=40[dB]$ ,  $R_L=2[k\Omega]$ ,  $T_a=25[^\circ C]$ )

(\*) The above data is ability value of sample, it is not guaranteed.

OBA14741 family

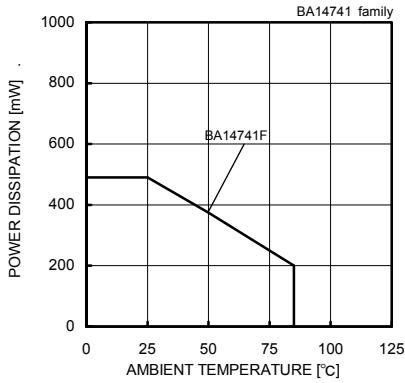


Fig. 133

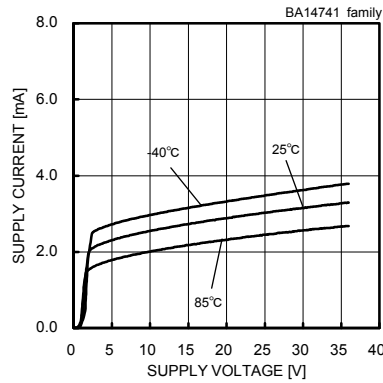


Fig. 134

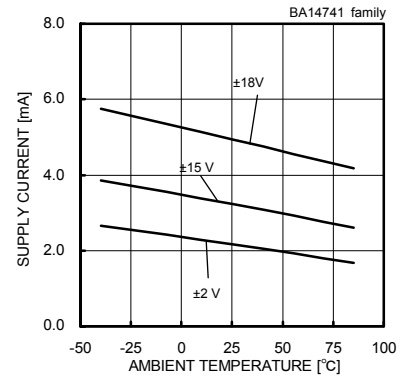


Fig. 135

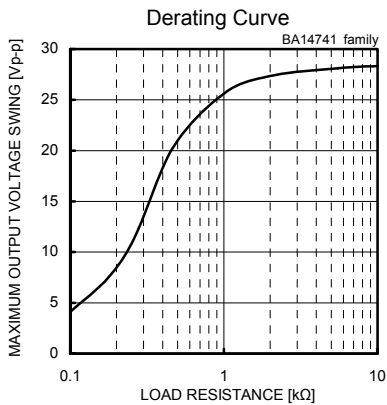


Fig. 136  
Derating Curve  
Maximum Output Voltage Swing – Load Resistance  
(VCC/VEE=+15[V]/-15[V], Ta=25[°C])

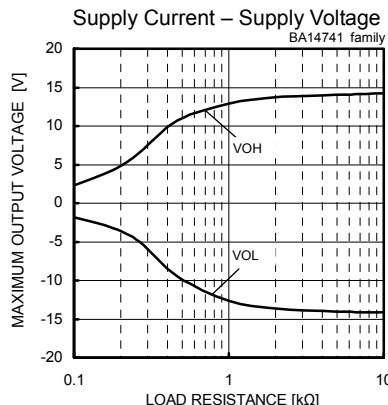


Fig. 137  
Supply Current – Supply Voltage  
Maximum Output Voltage – Load Resistance  
(VCC/VEE=+15[V]/-15[V], Ta=25[°C])

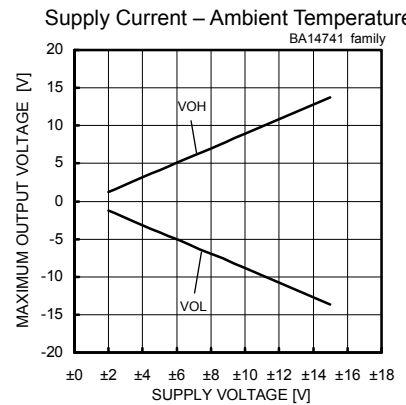


Fig. 138  
Supply Current – Ambient Temperature  
Maximum Output Voltage – Supply Voltage  
(RL=2[kΩ], Ta=25[°C])

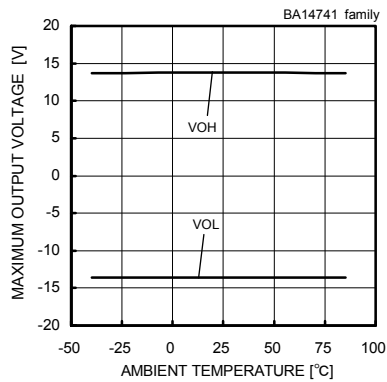


Fig. 139  
Maximum Output Voltage – Ambient Temperature  
(VCC/VEE=+15[V]/-15[V], RL=2[kΩ])

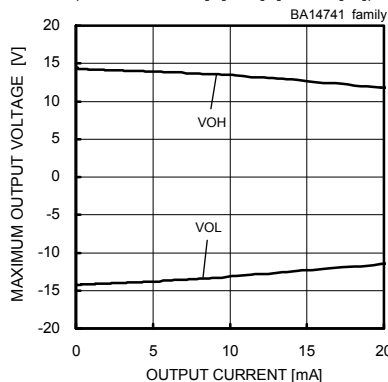


Fig. 140  
Maximum Output Voltage – Output Current  
(VCC/VEE=+15[V]/-15[V], Ta=25[°C])

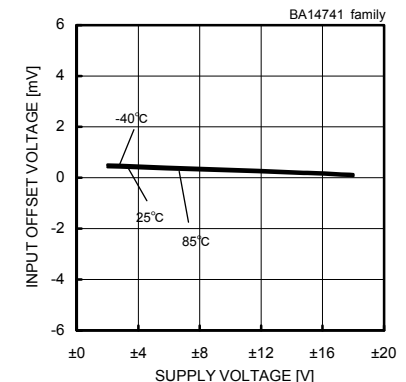


Fig. 141  
Input Offset Voltage – Supply Voltage  
(Vicm=0[V], Vout=0[V])

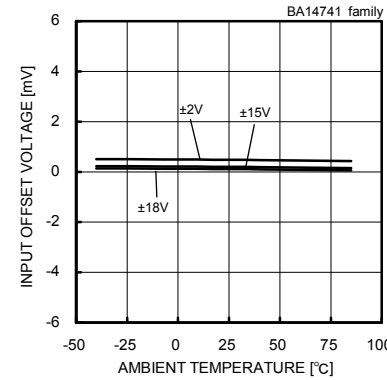


Fig. 142  
Input Offset Voltage – Ambient Temperature  
(Vicm=0[V], Vout=0[V])

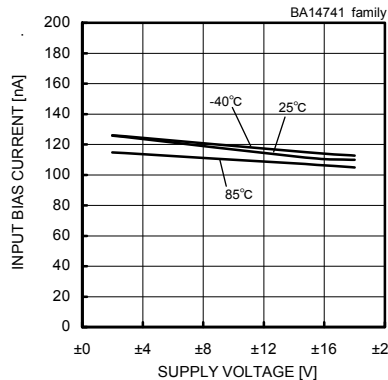


Fig. 143  
Input Bias Current – Supply Voltage  
(Vicm=0[V], Vout=0[V])

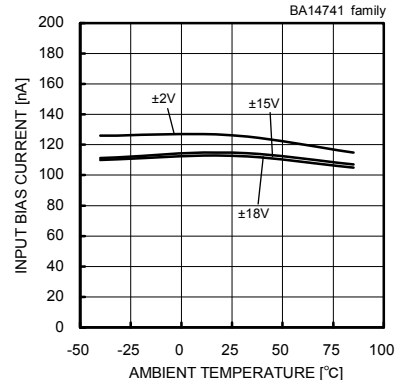


Fig. 144  
Input Bias Current – Ambient Temperature  
(Vicm=0[V], Vout=0[V])

(\*) The above data is ability value of sample, it is not guaranteed.

○BA14741 family

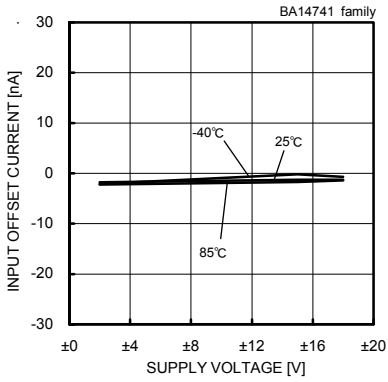


Fig. 145

Input Offset Current – Supply Voltage  
( $V_{icm}=0[V]$ ,  $V_{out}=0[V]$ )

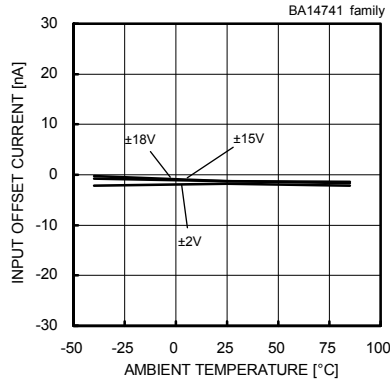


Fig. 146

Input Offset Current – Ambient Temperature  
( $V_{icm}=0[V]$ ,  $V_{out}=0[V]$ )

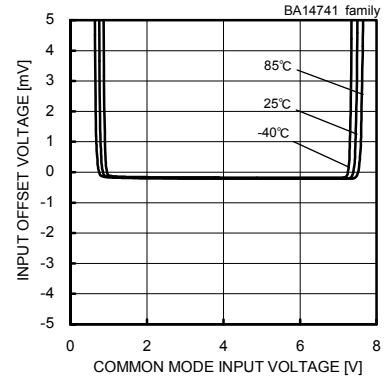


Fig. 147

Input Offset Voltage – Common Mode Input Voltage  
( $V_{CC}=8[V]$ ,  $V_{out}=4[V]$ )

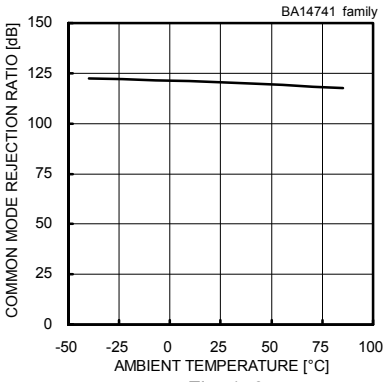


Fig. 148

Common Mode Rejection Ratio – Ambient Temperature  
( $V_{CC}/V_{EE}=+15[V]/-15[V]$ ,  $V_{icm}=-12[V]$  to  $+12[V]$ )

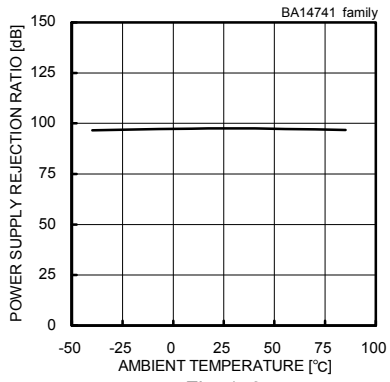


Fig. 149

Power Supply Rejection Ratio – Ambient Temperature  
( $V_{CC}/V_{EE}=+2[V]/-2[V]$  to  $+15[V]/-15[V]$ )

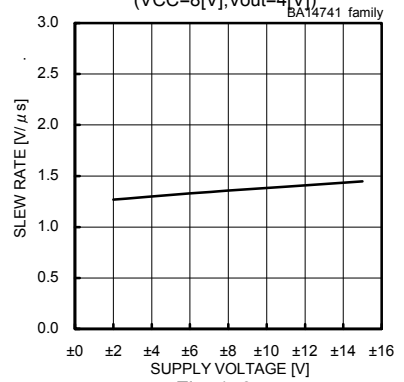


Fig. 150

Slew Rate – Supply Voltage  
( $C_L=100[pF]$ ,  $R_L=2[k\Omega]$ ,  $T_a=25[^\circ C]$ )

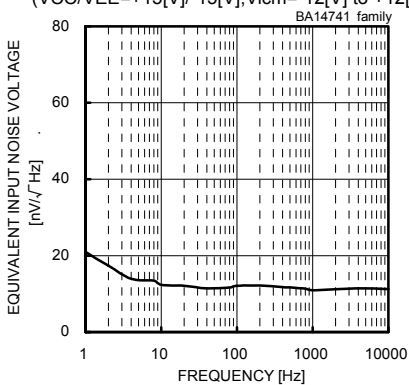


Fig. 151

Equivalent Input Noise Voltage – Frequency  
( $V_{CC}/V_{EE}=+15[V]/-15[V]$ ,  $R_s=100[\Omega]$ ,  $T_a=25[^\circ C]$ )

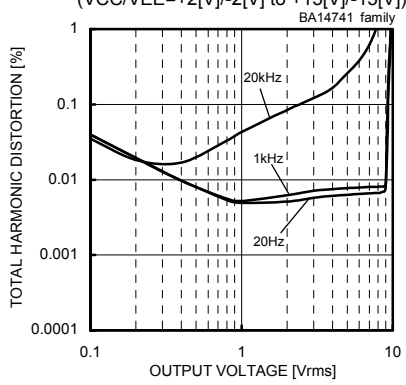


Fig. 152

Total Harmonic Distortion – Output Voltage  
( $V_{CC}/V_{EE}=+15[V]/-15[V]$ ,  $A_v=20[dB]$ ,  $R_L=2[k\Omega]$ ,  $80[kHz]$ -LPF,  $T_a=25[^\circ C]$ )

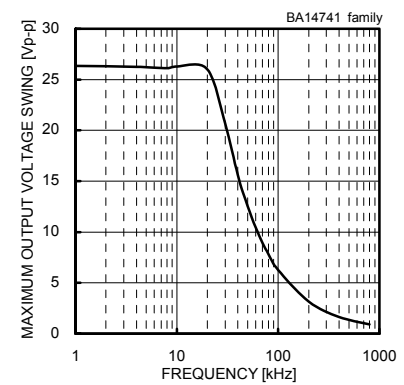


Fig. 153

Maximum Output Voltage Swing – Frequency  
( $V_{CC}/V_{EE}=+15[V]/-15[V]$ ,  $R_L=2[k\Omega]$ ,  $T_a=25[^\circ C]$ )

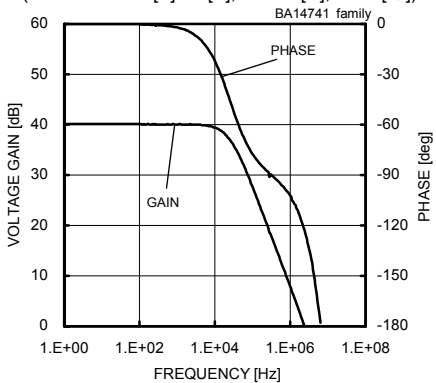


Fig. 154

Voltage Gain – Frequency

( $V_{CC}/V_{EE}=+15[V]/-15[V]$ ,  $A_v=40[dB]$ ,  $R_L=2[k\Omega]$ ,  $T_a=25[^\circ C]$ )

(\*) The above data is ability value of sample, it is not guaranteed.

OBA15532 family

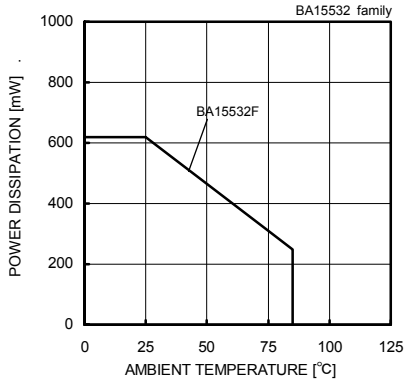


Fig. 155

Derating Curve

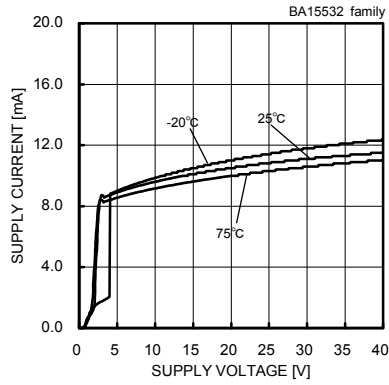


Fig. 156

Supply Current - Supply Voltage

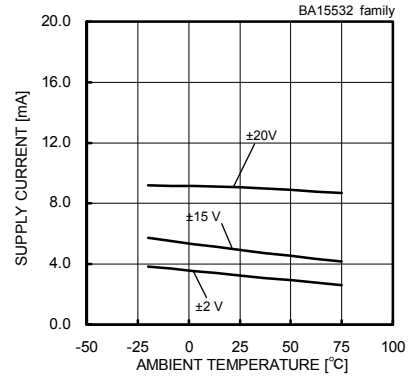


Fig. 157

Supply Current - Ambient Temperature

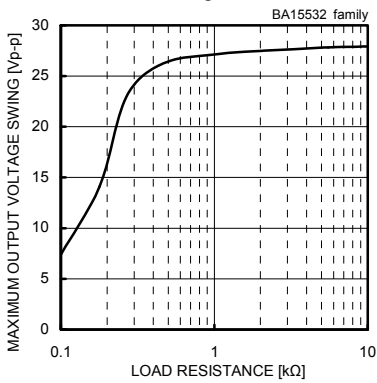


Fig. 158

Maximum Output Voltage Swing - Load Resistance  
(VCC/VEE=+15[V]/-15[V], Ta=25[°C])

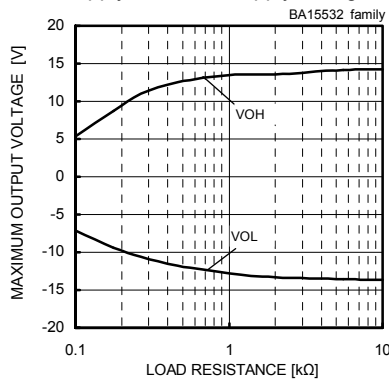


Fig. 159

Maximum Output Voltage - Load Resistance  
(VCC/VEE=+15[V]/-15[V], Ta=25[°C])

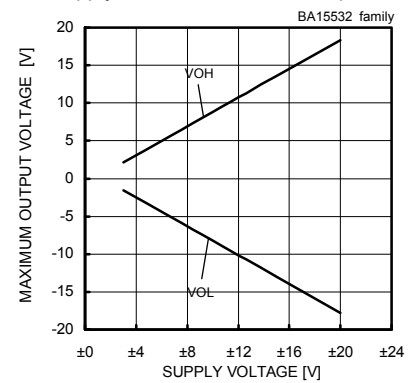


Fig. 160

Maximum Output Voltage - Supply Voltage  
(RL=2[kΩ], Ta=25[°C])

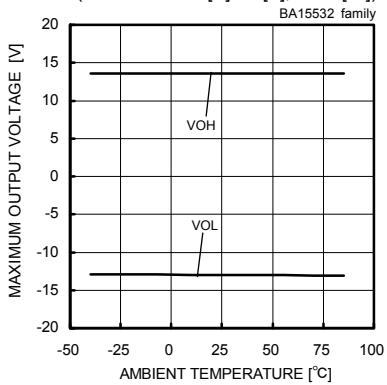


Fig. 161

Maximum Output Voltage - Ambient Temperature  
(VCC/VEE=+15[V]/-15[V], RL=2[kΩ])

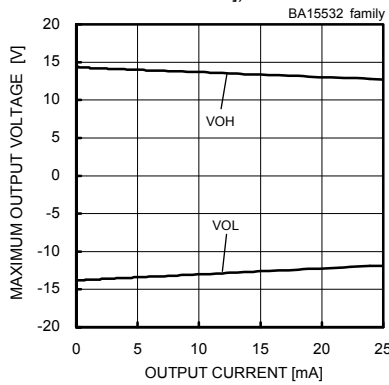


Fig. 162

Maximum Output Voltage - Output Current  
(VCC/VEE=+15[V]/-15[V], Ta=25[°C])

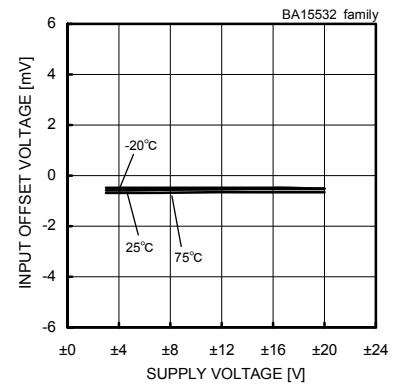


Fig. 163

Input Offset Voltage - Supply Voltage  
(Vicm=0[V], Vout=0[V])

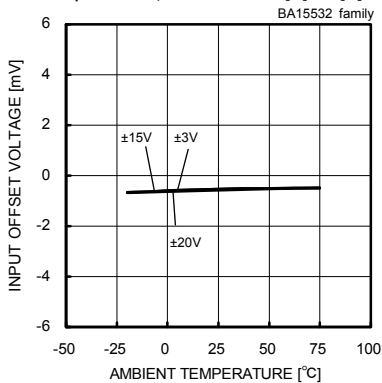


Fig. 164

Input Offset Voltage - Ambient Temperature  
(Vicm=0[V], Vout=0[V])

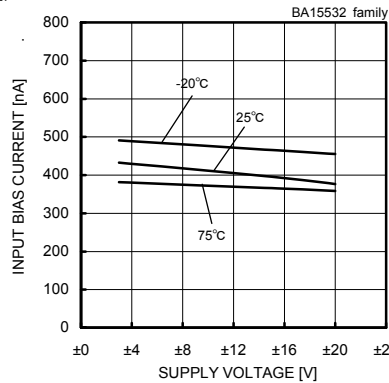


Fig. 165

Input Bias Current - Supply Voltage  
(Vicm=0[V], Vout=0[V])

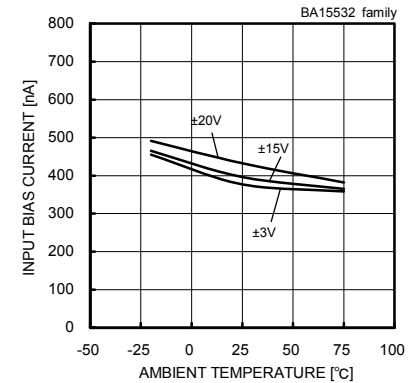


Fig. 166

Input Bias Current - Ambient Temperature  
(Vicm=0[V], Vout=0[V])

(\*) The above data is ability value of sample, it is not guaranteed.

BA15532 family

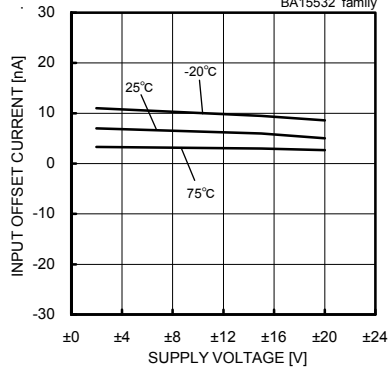


Fig. 167

Input Offset Current – Supply Voltage  
( $V_{icm}=0[V]$ ,  $V_{out}=0[V]$ )

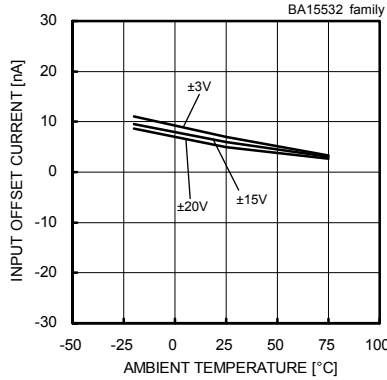


Fig. 168

Input Offset Current – Ambient Temperature  
( $V_{icm}=0[V]$ ,  $V_{out}=0[V]$ )

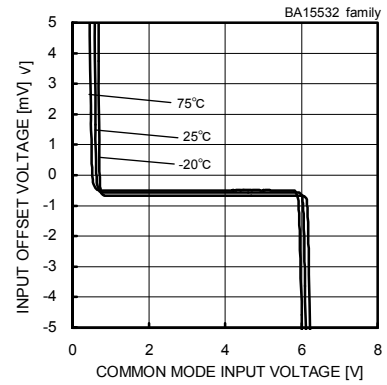


Fig. 169

Input Offset Voltage – Common Mode  
Input Voltage ( $V_{CC}=8[V]$ ,  $V_{out}=4[V]$ )

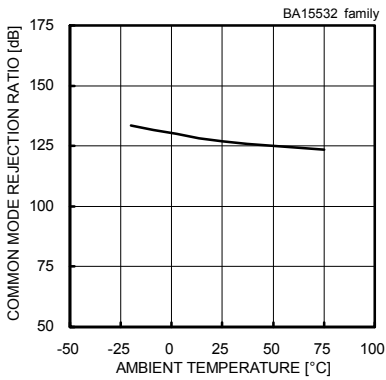


Fig. 170

Common Mode Rejection Ratio  
– Ambient Temperature  
( $V_{CC}/V_{EE}=+15[V]/-15[V]$ ,  $V_{icm}=-12[V]$  to  $+12[V]$ )

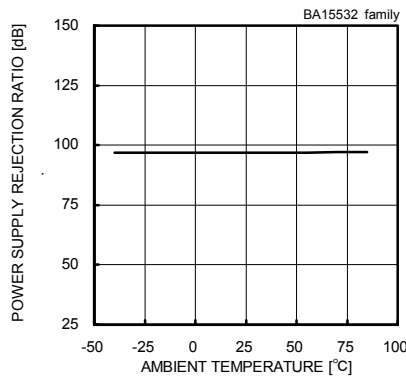


Fig. 171

Power Supply Rejection Ratio  
– Ambient Temperature  
( $V_{CC}/V_{EE}=+3[V]/-3[V]$  to  $+15[V]/-15[V]$ )

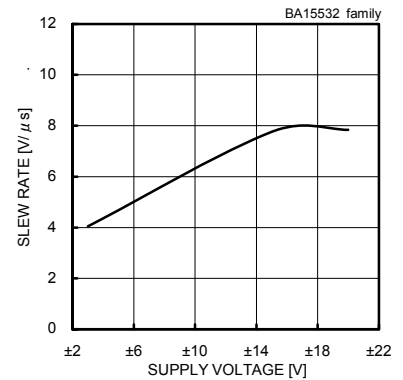


Fig. 172

Slew Rate – Supply Voltage  
( $C_L=100[pF]$ ,  $R_L=2[k\Omega]$ ,  $T_a=25[^\circ C]$ )

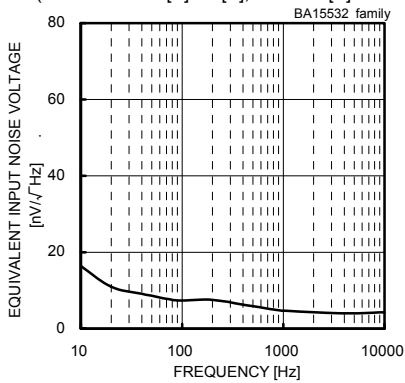


Fig. 173

Equivalent Input Noise Voltage – Frequency  
( $V_{CC}/V_{EE}=+15[V]/-15[V]$ ,  $R_s=100[\Omega]$ ,  $T_a=25[^\circ C]$ )

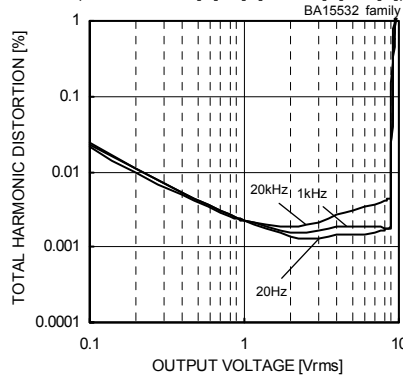


Fig. 174

Total Harmonic Distortion – Output Voltage  
( $V_{CC}/V_{EE}=+15[V]/-15[V]$ ,  $A_v=20[dB]$ ,  $R_L=600[\Omega]$ ,  $80[kHz]$ -LPPF,  $T_a=25[^\circ C]$ )

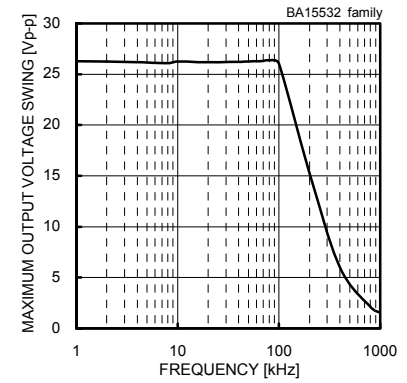


Fig. 175

Maximum Output Voltage Swing – Frequency  
( $V_{CC}/V_{EE}=+15[V]/-15[V]$ ,  $R_L=600[\Omega]$ ,  $T_a=25[^\circ C]$ )

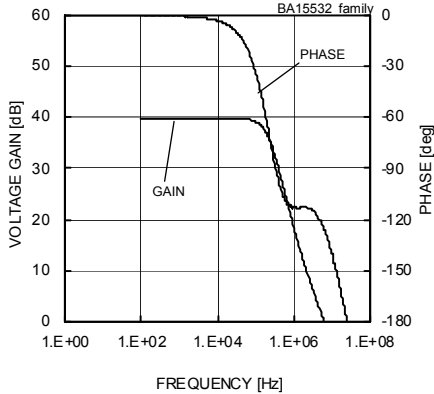


Fig. 176

Voltage Gain – Frequency ( $V_{CC}/V_{EE}=+15[V]/-15[V]$ ,  $A_v=40[dB]$ ,  $R_L=2[k\Omega]$ ,  $T_a=25[^\circ C]$ )

(\*) The above data is ability value of sample, it is not guaranteed.



OBA4510 family

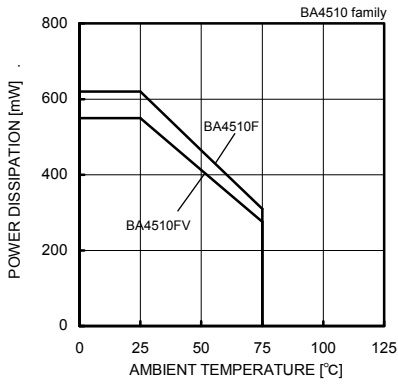


Fig. 177

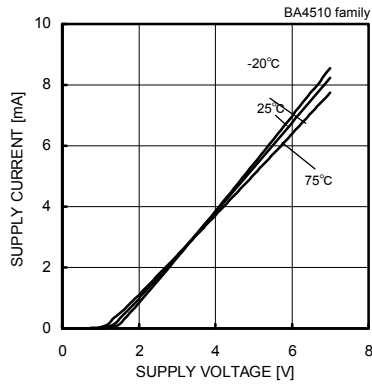


Fig. 178

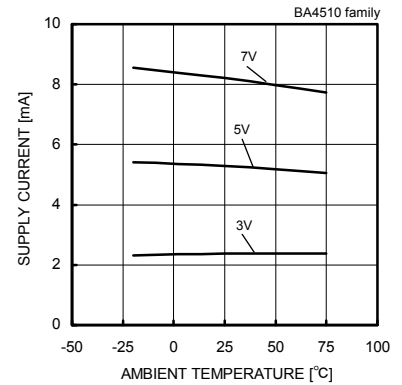


Fig. 179

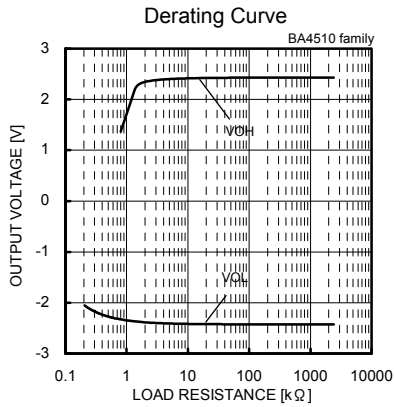


Fig. 180

Output Voltage – Load Resistance  
(VCC/VEE=2.5[V]/-2.5[V], Ta=25[°C])

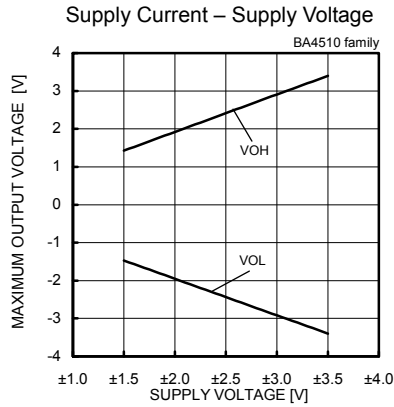


Fig. 181

Maximum Output Voltage – Supply Voltage  
(RL=10[kΩ], Ta=25[°C])

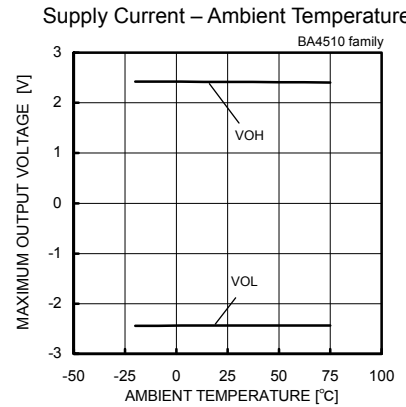


Fig. 182

Maximum Output Voltage – Ambient Temperature  
(VCC/VEE=2.5[V]/-2.5[V], RL=10[kΩ])

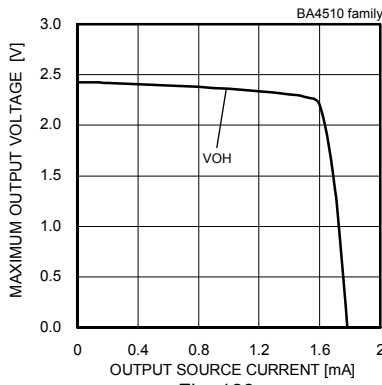


Fig. 183

Maximum Output Voltage– Output Source Current  
(VCC/VEE=2.5[V]/-2.5[V], Ta=25[°C])

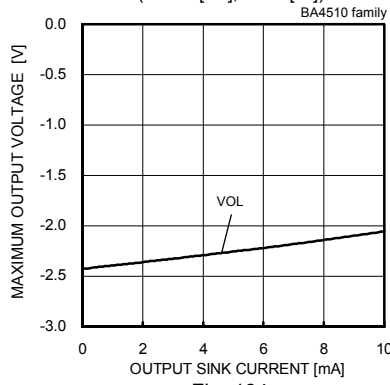


Fig. 184

Maximum Output Voltage– Output Sink Current  
(VCC/VEE=2.5[V]/-2.5[V], Ta=25[°C])

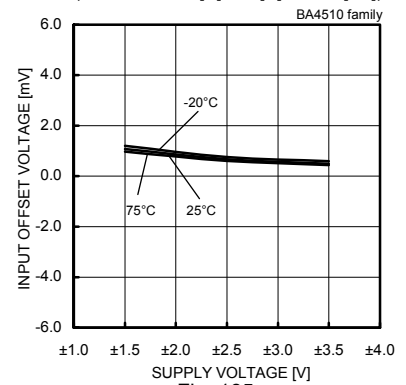


Fig. 185

Input Offset Voltage – Supply Voltage  
(Vicm=0[V], Vout=0[V])

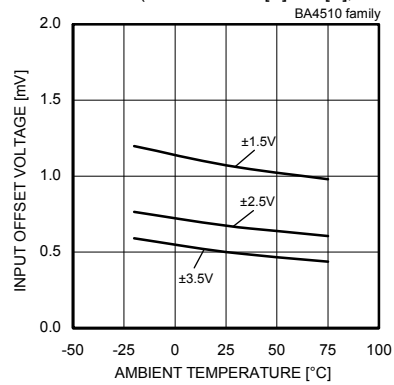


Fig. 186

Input Offset Voltage – Ambient Temperature  
(Vicm=0[V], Vout=0[V])

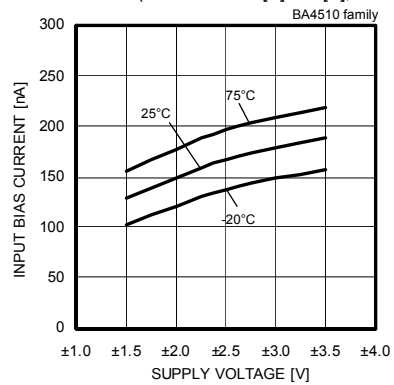


Fig. 187

Input Bias Current – Supply Voltage  
(Vicm=0[V], Vout=0[V])

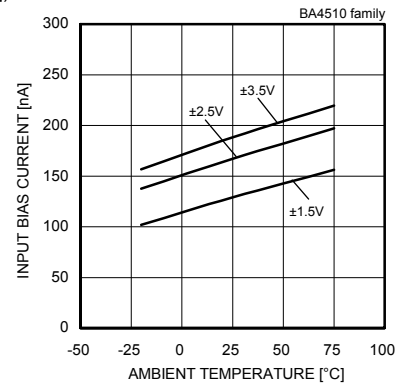


Fig. 188

Input Bias Current – Ambient Temperature  
(Vicm=0[V], Vout=0[V])

(\*) The above data is ability value of sample, it is not guaranteed.

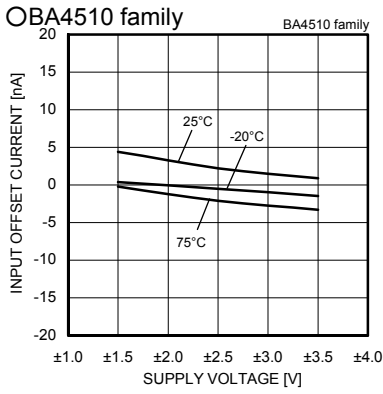


Fig. 189

Input Offset Current – Supply Voltage  
( $V_{icm}=0[V]$ ,  $V_{out}=0[V]$ )

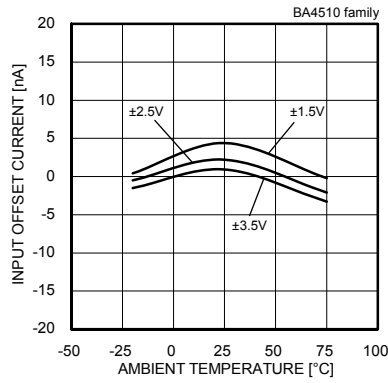


Fig. 190

Input Offset Current – Ambient Temperature  
( $V_{icm}=0[V]$ ,  $V_{out}=0[V]$ )

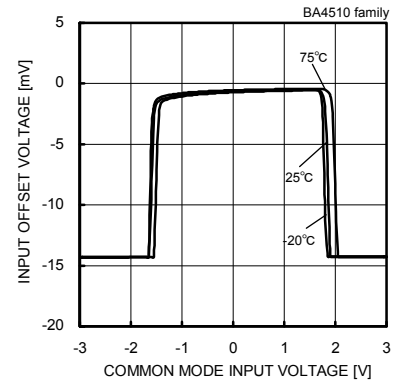


Fig. 191

Input Offset Voltage – Common Mode  
Input Voltage ( $V_{CC}/V_{EE}=2.5[V]/-2.5[V]$ )

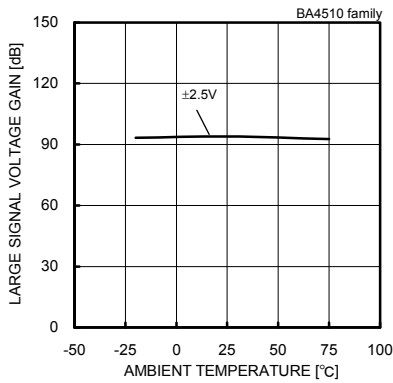


Fig. 192

Large Signal Voltage Gain  
– Ambient Temperature

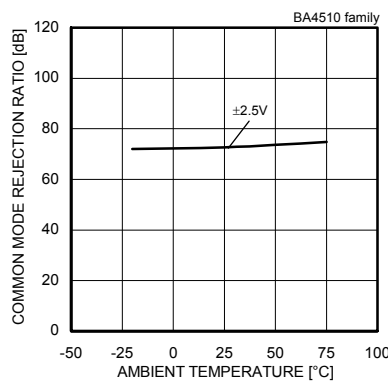


Fig. 193

Common Mode Rejection Ratio  
– Ambient Temperature

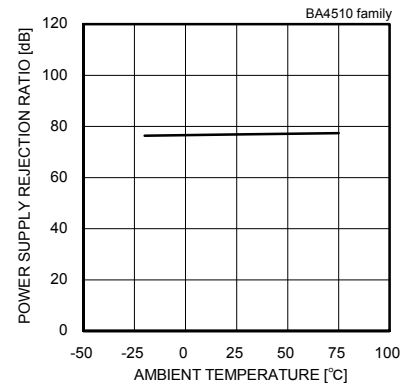


Fig. 194

Power Supply Rejection Ratio  
– Ambient Temperature

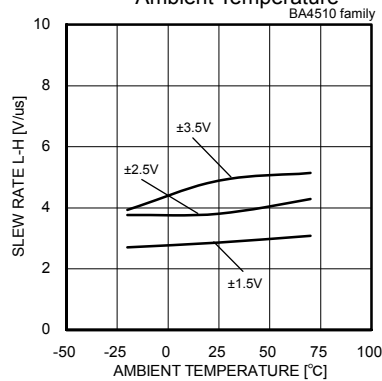


Fig. 195

Slew Rate L-H – Ambient Temperature

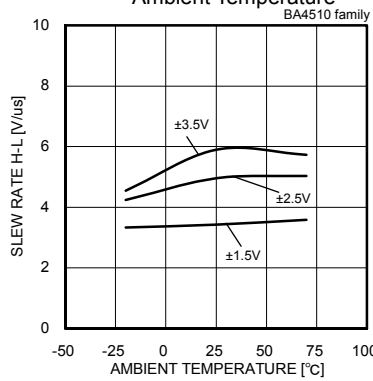


Fig. 196

Slew Rate H-L – Ambient Temperature

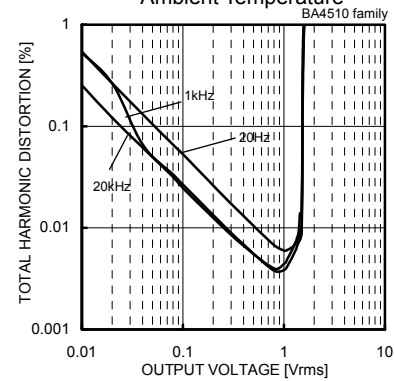


Fig. 197

Total Harmonic Distortion – Output Voltage  
( $V_{CC}/V_{EE}=2.5[V]/-2.5[V]$ ,  $R_L=3[k\Omega]$ ,  
80[kHz]-LPF,  $T_a=25[^\circ C]$ )

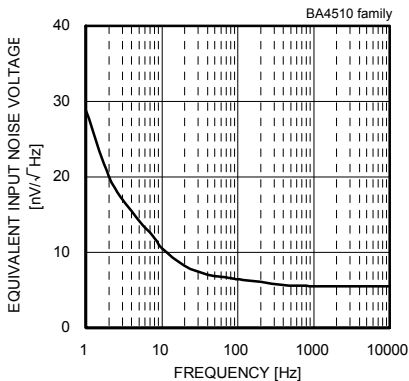


Fig. 198

Equivalent Input Noise Voltage – Frequency  
( $V_{CC}/V_{EE}=2.5[V]/-2.5[V]$ )

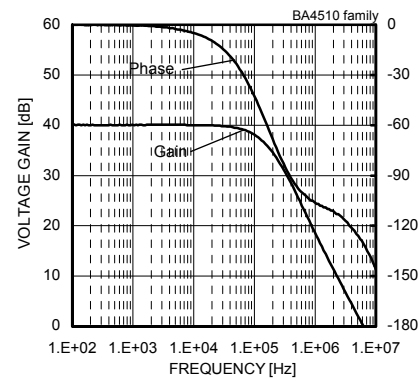


Fig. 199

Voltage Gain – Frequency  
( $V_{CC}/V_{EE}=2.5[V]/-2.5[V]$ ,  $A_v=40[dB]$ ,  $R_L=10[k\Omega]$ )

(\*) The above data is ability value of sample, it is not guaranteed.

OBA2115 family

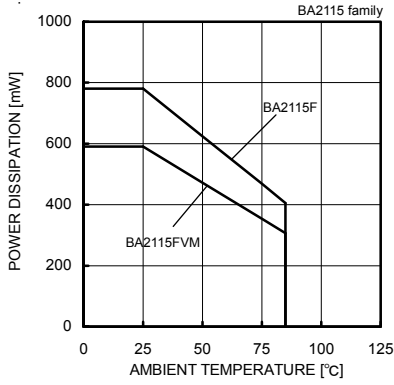


Fig. 200

Derating Curve

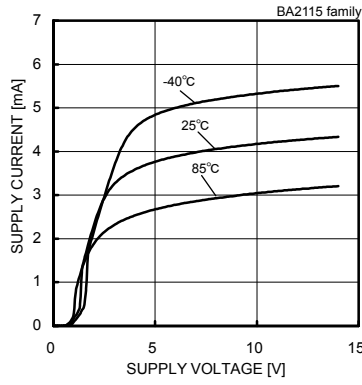


Fig. 201

Supply Current - Supply Voltage

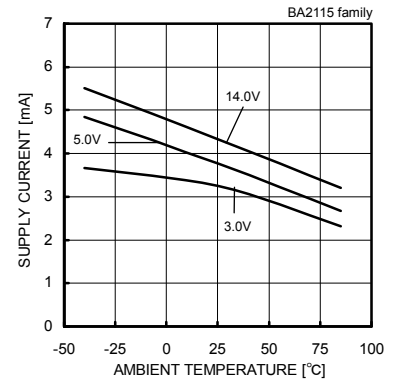


Fig. 202

Supply Current - Ambient Temperature

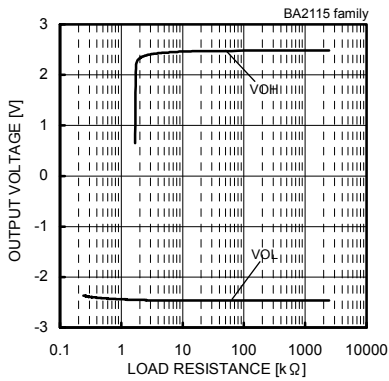


Fig. 203

Output Voltage - Load Resistance  
(VCC/VEE=+2.5[V]/-2.5[V])

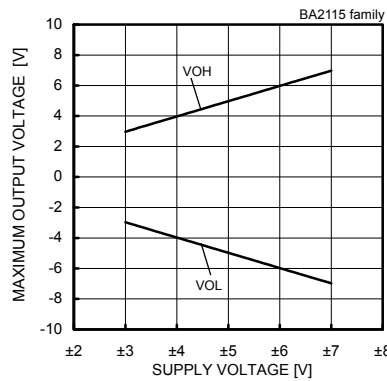


Fig. 204

Maximum Output Voltage - Supply Voltage  
(RL=10[kΩ])

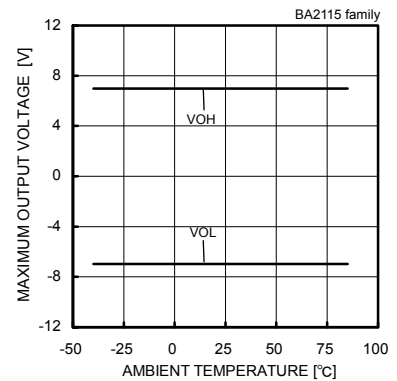


Fig. 205

Maximum Output Voltage - Ambient Temperature  
(VCC/VEE=+7.5[V]/-7.5[V], RL=10[kΩ])

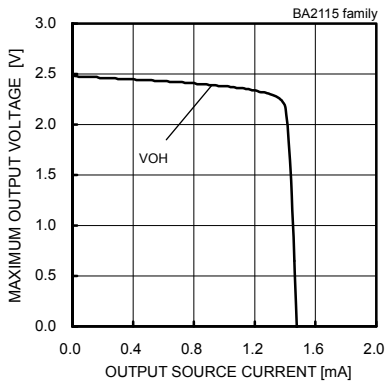


Fig. 206

Maximum Output Voltage - Output Source Current  
(VCC/VEE=+2.5[V]/-2.5[V])

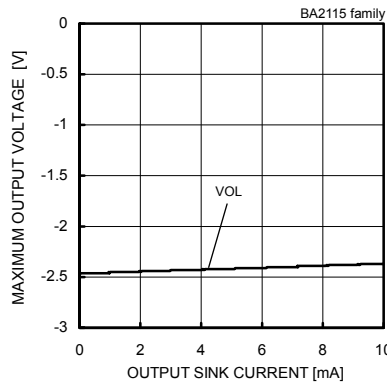


Fig. 207

Maximum Output Voltage - Output Sink Current  
(VCC/VEE=+2.5[V]/-2.5[V])

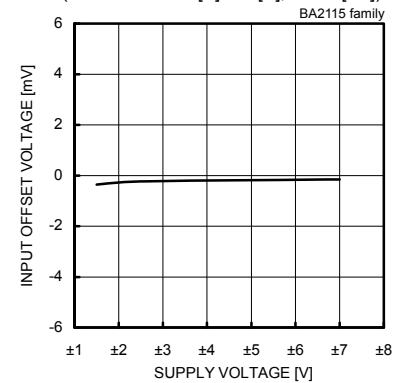


Fig. 208

Input Offset Voltage - Supply Voltage  
(Vcm=0[V], Vout=0[V])

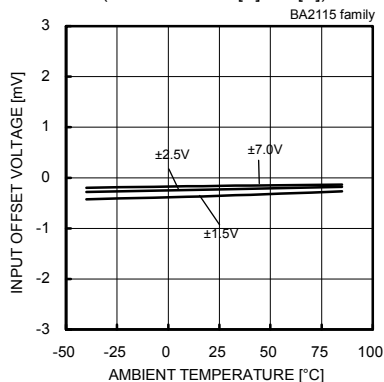


Fig. 209

Input Offset Voltage - Ambient Temperature  
(Vcm=0[V], Vout=0[V])

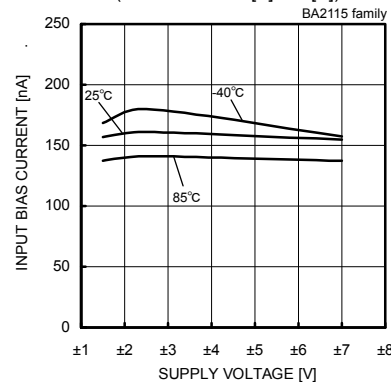


Fig. 210

Input Bias Current - Supply Voltage  
(Vcm=0[V], Vout=0[V])

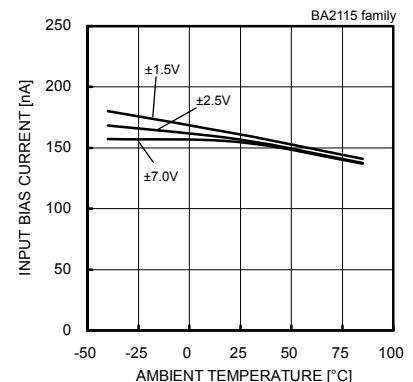


Fig. 211

Input Bias Current - Ambient Temperature  
(Vcm=0[V], Vout=0[V])

(\*) The above data is ability value of sample, it is not guaranteed.

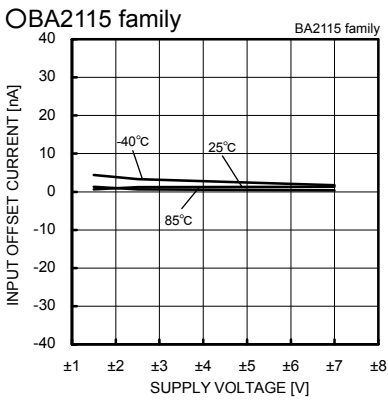


Fig. 212  
Input Offset Current – Supply Voltage  
( $V_{icm}=0[V]$ ,  $V_{out}=0[V]$ )

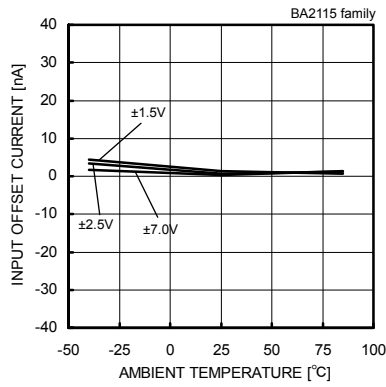


Fig. 213  
Input Offset Current – Ambient Temperature  
( $V_{icm}=0[V]$ ,  $V_{out}=0[V]$ )

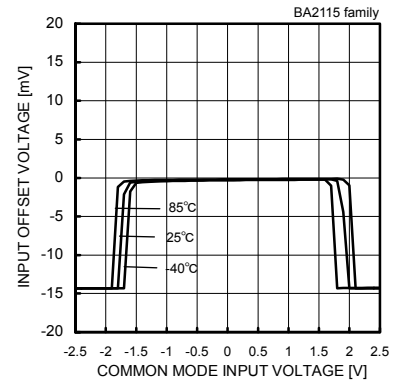


Fig. 214  
Input Offset Voltage  
– Common Mode Input Voltage  
( $V_{CC}/V_{EE}=+2.5[V]/-2.5[V]$ ,  $V_{out}=0[V]$ )

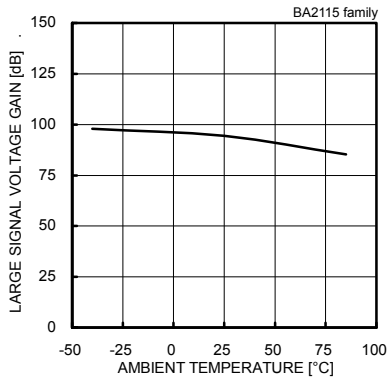


Fig. 215  
Large Signal Voltage Gain  
– Ambient Temperature  
( $V_{CC}/V_{EE}=+2.5[V]/-2.5[V]$ )

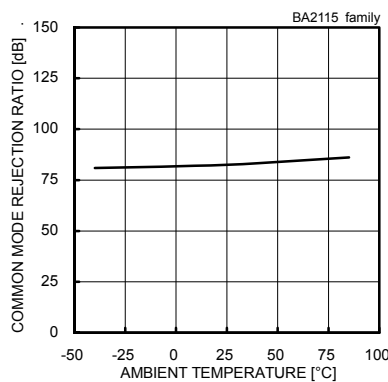


Fig. 216  
Common Mode Rejection Ratio  
– Ambient Temperature  
( $V_{CC}/V_{EE}=+2.5[V]/-2.5[V]$ )

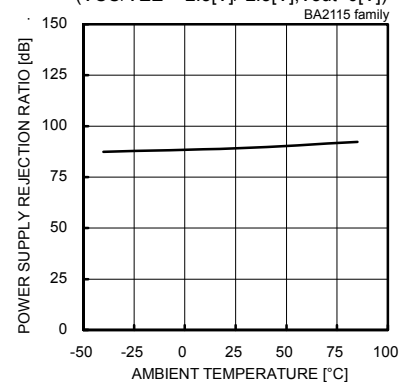


Fig. 217  
Power Supply Rejection Ratio  
– Ambient Temperature  
( $V_{CC}/V_{EE}=+2.5[V]/-2.5[V]$ )

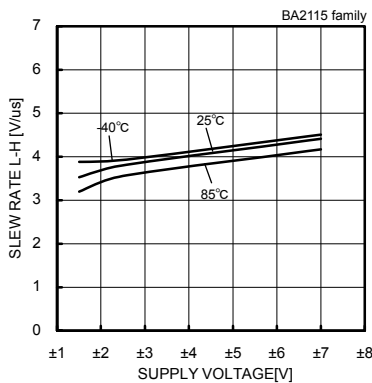


Fig. 218  
Slew Rate L-H – Supply Voltage

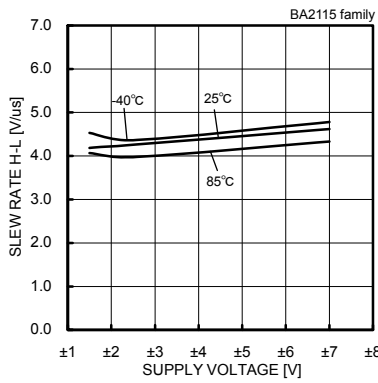


Fig. 219  
Slew Rate H-L – Supply Voltage

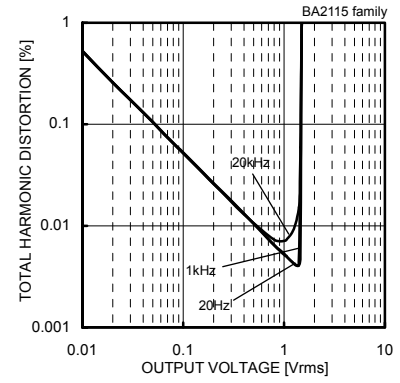


Fig. 220  
Total Harmonic Distortion – Output Voltage  
( $V_{CC}/V_{EE}=2.5[V]/-2.5[V]$ ,  $R_L=3[k\Omega]$   
80[kHz]-LPF,  $T_a=25[^\circ C]$ )

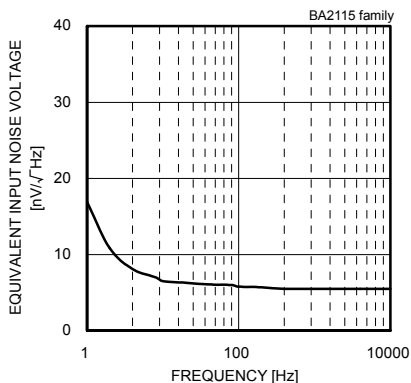


Fig. 221  
Equivalent Input Noise Voltage – Frequency  
( $V_{CC}/V_{EE}=2.5[V]/-2.5[V]$ )

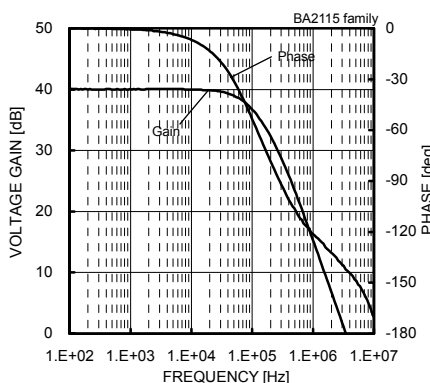


Fig. 222  
Voltage Gain – Frequency  
( $V_{CC}/V_{EE}=2.5[V]/-2.5[V]$ ,  $A_v=40[dB]$ ,  $R_L=10[k\Omega]$ )

Fig. 223

(\*) The above data is ability value of sample, it is not guaranteed.

● Schematic diagram

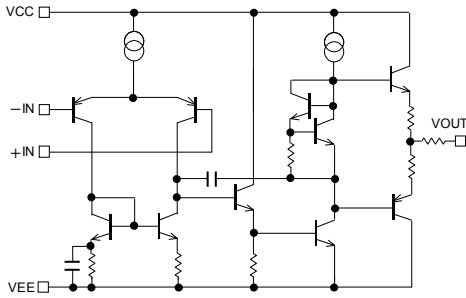


Fig. 224 Simplified schematic (BA4558/BA4558R/BA15218/  
BA4560/BA4560R/BA4580R)

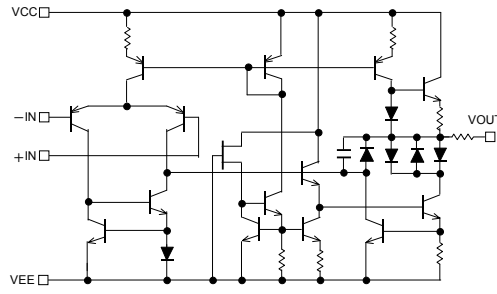


Fig. 225 Simplified schematic (BA14741)

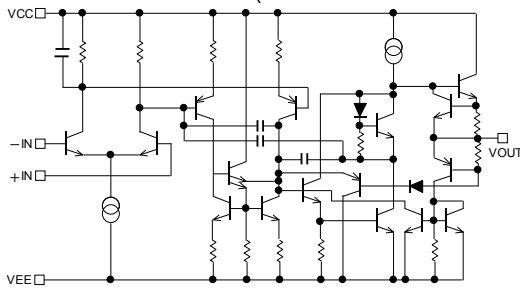


Fig. 226 Simplified schematic (BA15532)

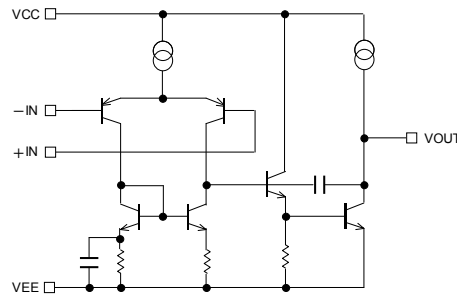


Fig. 227 Simplified schematic (BA4510/BA2115)

● Test circuit1 NULL method

VCC,VEE,EK, Vicm Unit : [V], Vicm=0[V] For all parameter

| Parameter   | VF   | S1  | S2  | S3 <sup>(*23)</sup> | BA4558/BA4558R<br>BA4560/BA4560R |     |     | BA4580R<br>BA15218/BA14741 |     |     | BA15532 |     |     | BA4510 |       |      | BA2115 |       |      | Calculation |
|---|------|-----|-----|---------------------|----------------------------------|-----|-----|----------------------------|-----|-----|---------|-----|-----|--------|-------|------|--------|-------|------|-------------|
|   |      |     |     |                     | Vcc                              | VEE | EK  | Vcc                        | VEE | EK  | Vcc     | VEE | EK  | Vcc    | VEE   | EK   | Vcc    | VEE   | EK   |             |
| Input Offset Voltage  | VF1  | ON  | ON  | OFF                 | 15                               | -15 | 0   | 15                         | -15 | 0   | 15      | -15 | 0   | 2.5    | 2.5   | 0    | 2.5    | 2.5   | 0    | 1           |
| Input Offset Current  | VF2  | OFF | OFF | OFF                 | 15                               | -15 | 0   | 15                         | -15 | 0   | 15      | -15 | 0   | 2.5    | 2.5   | 0    | 2.5    | 2.5   | 0    | 2           |
| Input Bias Current  | VF3  | OFF | ON  | OFF                 | 15                               | -15 | 0   | 15                         | -15 | 0   | 15      | -15 | 0   | 2.5    | 2.5   | 0    | 2.5    | 2.5   | 0    | 3           |
|   | VF4  | ON  | OFF |                     | 15                               | -15 | 0   | 15                         | -15 | 0   | 15      | -15 | 0   | 2.5    | 2.5   | 0    | 2.5    | 2.5   | 0    |             |
| Large Signal Voltage Gain                                     | VF5  | ON  | ON  | ON                  | 15                               | -15 | -10 | 15                         | -15 | -10 | 15      | -15 | -10 | 2.5    | 2.5   | -1.0 | 2.5    | 2.5   | -1.0 | 4           |
|   | VF6  |     |     |                     | 15                               | -15 | 10  | 15                         | -15 | 10  | 15      | -15 | 10  | 2.5    | 2.5   | 1.0  | 2.5    | 2.5   | 1.0  |             |
| Common-mode Rejection Ratio (Input Common-mode Voltage Range) | VF7  | ON  | ON  | OFF                 | 3                                | -27 | 12  | 3                          | -27 | 12  | 3       | -27 | 12  | 1.5    | 1.5   | -1.0 | 1.5    | 1.5   | -1.0 | 5           |
|   | VF8  |     |     |                     | 27                               | -3  | -12 | 27                         | -3  | -12 | 27      | -3  | -12 | 3.5    | 3.5   | 1.0  | 3.5    | 3.5   | 1.0  |             |
| Power Supply Rejection Ratio                                  | VF9  | ON  | ON  | OFF                 | 4                                | -4  | 0   | 2                          | -2  | 0   | 3       | -3  | 0   | 1.25   | -1.25 | 0    | 0.75   | -1.25 | 0    | 6           |
|   | VF10 |     |     |                     | 15                               | -15 | 0   | 16                         | -16 | 0   | 20      | -20 | 0   | 3.0    | -3.0  | 0    | 7.0    | 7.0   | 0    |             |

(\*23) S3 is always ON for BA15532.

-Calculation-

1. Input Offset Voltage (Vio)

$$V_{io} = \frac{|VF1|}{1 + R_f / R_s} [V]$$

2. Input Offset Current (Iio)

$$I_{io} = \frac{|VF2 - VF1|}{R_i \times (1 + R_f / R_s)} [A]$$

3. Input Bias Current (Ib)

$$I_b = \frac{|VF4 - VF3|}{2 \times R_i \times (1 + R_f / R_s)} [A]$$

4. Large Signal Voltage Gain (Av)  $A_v = 20 \times \text{Log} \frac{\Delta E_k \times (1 + R_f / R_s)}{|VF5 - VF6|} [dB]$

5. Common-mode Rejection Ratio (CMRR)  $CMRR = 20 \times \text{Log} \frac{\Delta V_{icm} \times (1 + R_f / R_s)}{|VF8 - VF7|} [dB]$

6. Power Supply Rejection Ratio (PSRR)  $PSRR = 20 \times \text{Log} \frac{\Delta V_{cc} \times (1 + R_f / R_s)}{|VF10 - VF9|} [dB]$

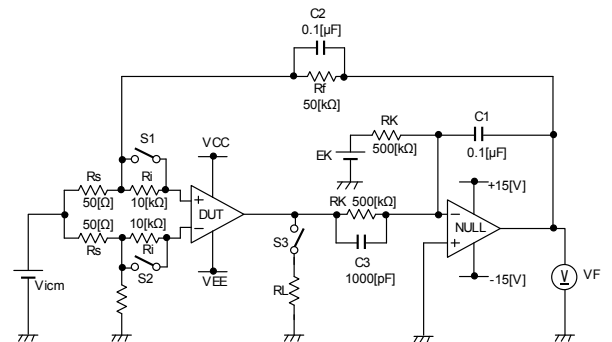


Fig. 228 Test circuit 1 (one channel only)

● Test circuit2 switch condition

| SW No.                    | SW 1            | SW 2 | SW 3 | SW 4 | SW 5 | SW 6 | SW 7 | SW 8 | SW 9 | SW 10 | SW 11 | SW 12 | SW 13 | SW 14 |
|---------------------------|-----------------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|-------|
| Supply Current            | OFF             | OFF  | OFF  | ON   | OFF  | ON   | OFF  | OFF  | OFF  | OFF   | OFF   | OFF   | OFF   | OFF   |
| Maximum Output Voltage    | Load Resistance | OFF  | OFF  | ON   | OFF  | OFF  | OFF  | ON   | OFF  | ON    | OFF   | OFF   | OFF   | ON    |
|                           | Output Current  | OFF  | OFF  | ON   | OFF  | OFF  | OFF  | ON   | OFF  | OFF   | OFF   | OFF   | ON    | ON    |
| Slew Rate                 | OFF             | OFF  | OFF  | ON   | OFF  | OFF  | OFF  | ON   | ON   | ON    | OFF   | OFF   | OFF   | OFF   |
| Gain Bandwidth Product    | OFF             | ON   | OFF  | OFF  | ON   | ON   | OFF  | OFF  | ON   | ON    | ON    | OFF   | OFF   | OFF   |
| Total Harmonic Distortion | ON              | OFF  | OFF  | OFF  | ON   | OFF  | ON   | OFF  | ON   | ON    | ON    | OFF   | OFF   | OFF   |
| Input Noise Voltage (*24) | ON              | OFF  | OFF  | OFF  | ON   | ON   | OFF  | OFF  | OFF  | OFF   | ON    | OFF   | OFF   | OFF   |

(\*24) this condition refers only to BA4558Rfamily, BA4560Rfamily

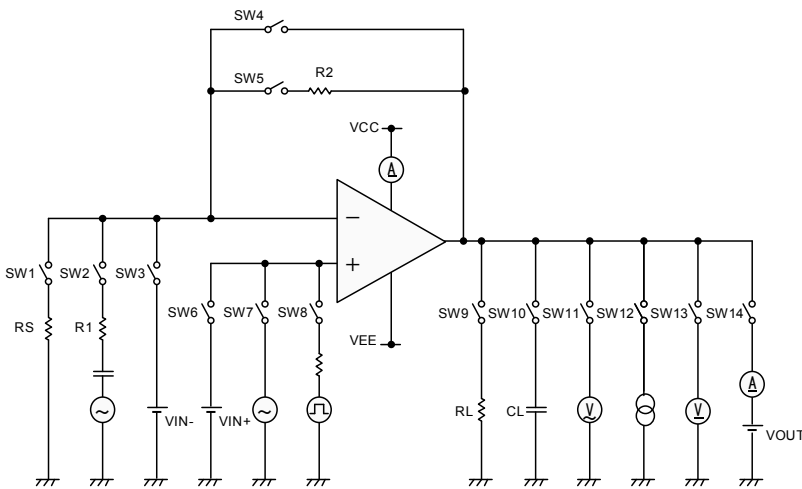


Fig. 229. Test circuit2 (one channel only)

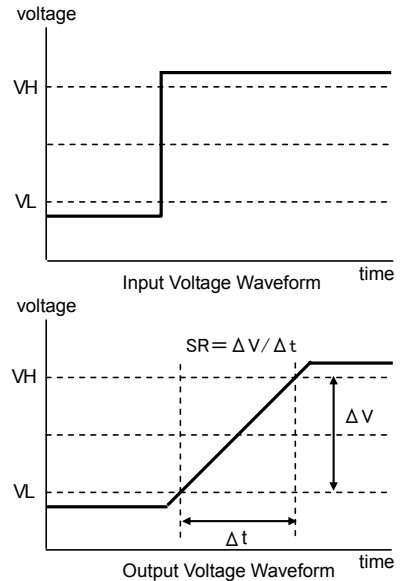
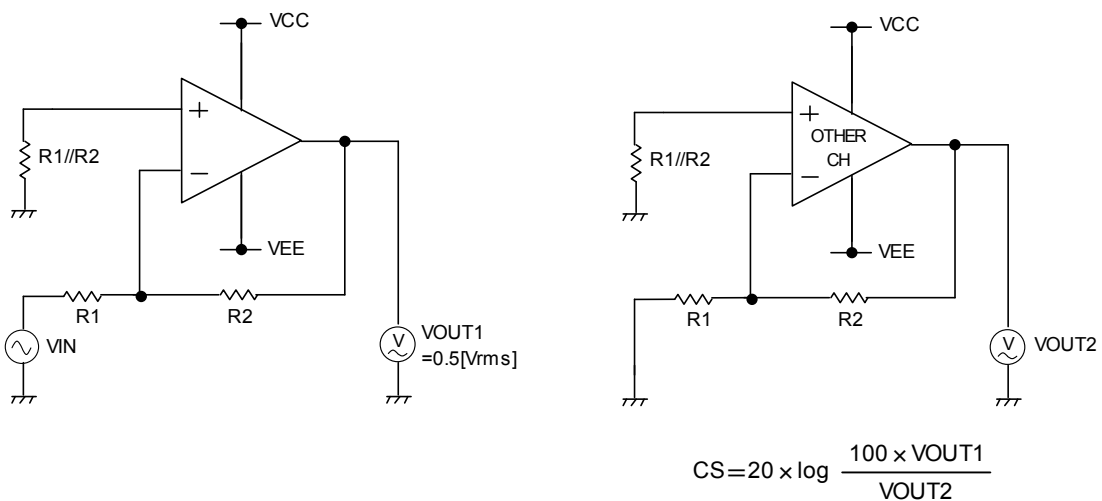


Fig. 230 Slew rate input output wave

● Test circuit3 Channel separation



$$CS = 20 \times \log \frac{100 \times VOUT1}{VOUT2}$$

Fig. 231 Test circuit3  
(VCC=+15[V],VEE=-15[V],R1=1[kΩ],R2=100[kΩ])

**●Description of electrical characteristics**

Described here are the terms of electric characteristics used in this technical note. 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(VCC-VEE)**

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 assure 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°C(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] .

**2.3 Input offset current(Iio)**

Indicates the difference of input bias current between non-inverting terminal and inverting terminal.

**2.5 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.

**2.6 Circuit current(ICC)**

Indicates the IC current that flows under specified conditions and no-load steady status.

**2.7 High level output voltage / Low level output voltage(VOH/VOL)**

Indicates the voltage range that can be output by the IC under specified load condition. It is typically divided into high-level output voltage and low-level output voltage. High-level output voltage indicates the upper limit of output voltage. Low-level output voltage indicates the lower limit.

**2.8 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.

$A_v = (\text{Output voltage fluctuation}) / (\text{Input offset fluctuation})$

**2.9 Input common-mode voltage range(Vicm)**

Indicates the input voltage range where IC operates normally.

**2.10 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.

$CMRR = (\text{Change of Input common-mode voltage}) / (\text{Input offset fluctuation})$

**2.11 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.

$PSRR = (\text{Change of power supply voltage}) / (\text{Input offset fluctuation})$

**2.13 Channel separation(CS)**

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

**2.14 Slew rate(SR)**

Indicates the time fluctuation ratio of voltage output when step input signal is applied.

**2.12 Unity gain frequency(ft)**

Indicates a frequency where the voltage gain of Op-Amp is 1.

**2.13 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.

**2.14 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.



● Derating curve

Power dissipation (total loss) indicates the power that can be consumed by IC at Ta=25°C(normal temperature). IC is heated when it consumed power, and the temperature of IC chip becomes higher than ambient temperature. The temperature that can be accepted by IC chip depends on circuit configuration, manufacturing process, and consumable power is limited. Power dissipation is determined by the temperature allowed in IC chip (maximum junction temperature) and thermal resistance of package (heat dissipation capability). The maximum junction temperature is typically equal to the maximum value in the storage temperature range. Heat generated by consumed power of IC radiates from the mold resin or lead frame of the package. The parameter which indicates this heat dissipation capability (hardness of heat release) is called thermal resistance, represented by the symbol  $\theta_{j-a}$  [°C/W]. The temperature of IC inside the package can be estimated by this thermal resistance. Fig.232 (a) shows the model of thermal resistance of the package. Thermal resistance  $\theta_{ja}$ , ambient temperature Ta, junction temperature Tj, and power dissipation Pd can be calculated by the equation below :

$$\theta_{ja} = (T_j - T_a) / P_d \quad [^{\circ}\text{C}/\text{W}] \quad \dots \dots \quad (I)$$

Derating curve in Fig.232 (b) indicates power that can be consumed by IC with reference to ambient temperature. Power that can be consumed by IC with reference to attenuate at certain ambient temperature. This gradient, is determined by thermal resistance  $\theta_{ja}$ . Thermal resistance  $\theta_{ja}$  depends on chip size, power consumption, package, ambient temperature, package condition, wind velocity, etc even when the same of package is used. Thermal reduction curve indicates a reference value measured at a specified condition. Fig.233(a), (b), (c), (d) show a derating curve for an example of BA4558, BA4560, BA4558R, BA4560R, BA4580R, BA15218, BA14741, BA15532, BA4510, BA2115.

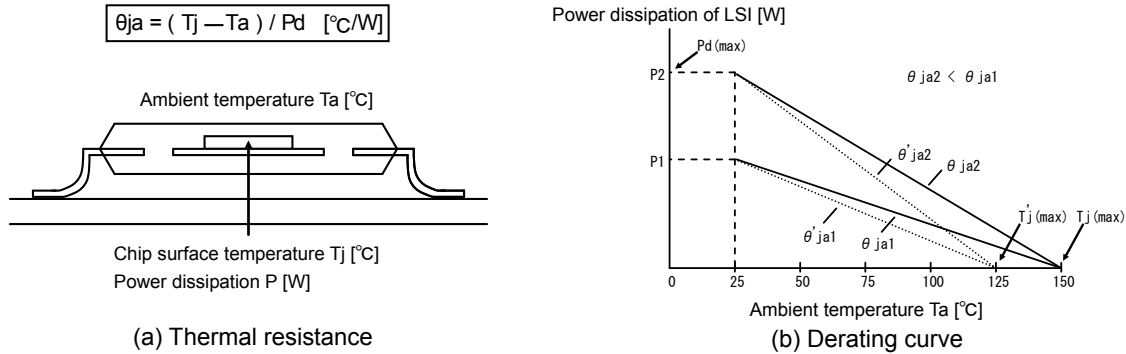
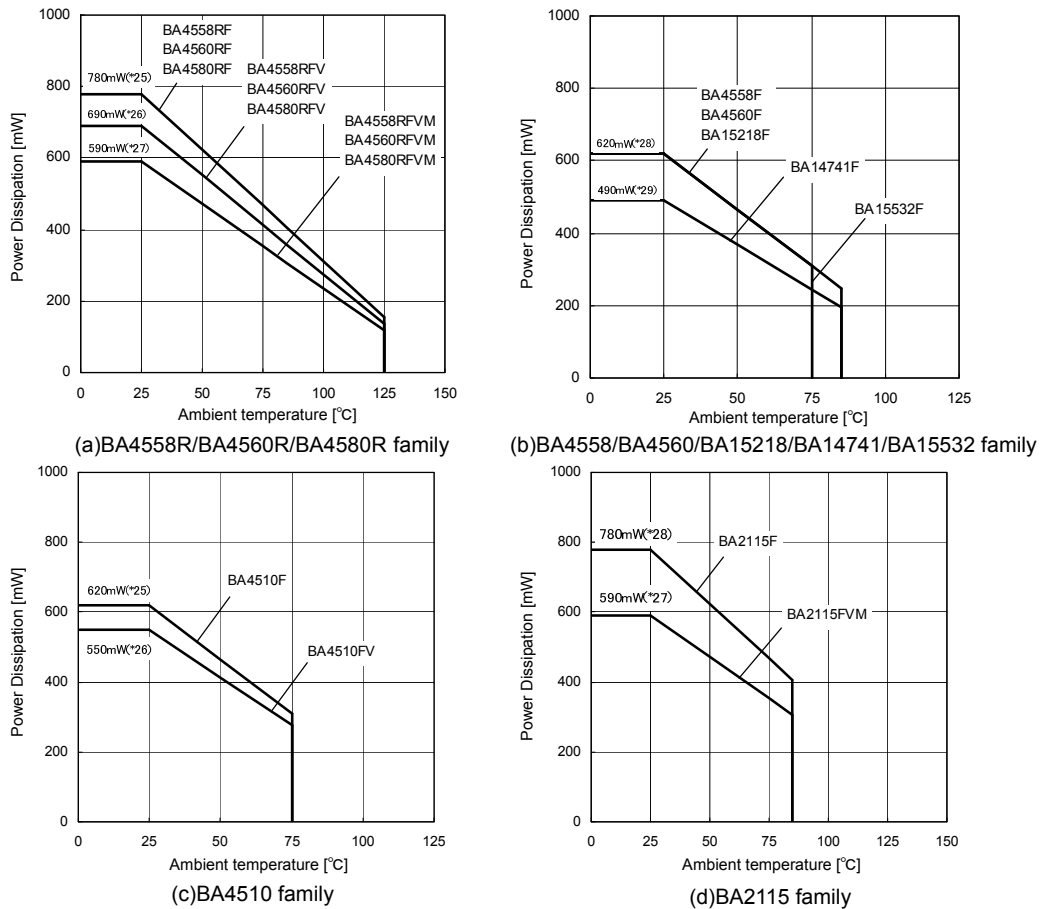


Fig. 232 Thermal resistance and derating curve



| (*25) | (*26) | (*27) | (*28) | (*29) | Unit    |
|-------|-------|-------|-------|-------|---------|
| 6.2   | 5.5   | 4.7   | 6.2   | 4.9   | [mW/°C] |

When using the unit above Ta=25[°C], subtract the value above per degree[°C]. Permissible dissipation is the value when FR4 glass epoxy board 70[mm]×70[mm]×1.6[mm] (cooper foil area below 3[%]) is mounted.

Fig. 233 Derating curve

●Cautions on use

1) Processing of unused circuit

It is recommended to apply connection (see the Fig.234) and set the noninverting input terminal at the potential within input common-mode voltage range (V<sub>icm</sub>), for any unused circuit.

2) Input voltage

Applying VEE+36[V](BA4550R,BA4560R,BA4580R family), VEE+14[V] (BA2115 family) to the input terminal is possible without causing deterioration of the electrical characteristics or destruction, irrespective of the supply voltage. However, this does not ensure normal circuit operation.

Please note that the circuit operates normally only when the input voltage is within the common mode input voltage range of the electric characteristics.

3) Maximum output voltage

Because the output voltage range becomes narrow as the output current increases, design the application with margin by considering changes in electrical characteristics and temperature characteristics.

4) Short-circuit of output terminal

When output terminal and VCC or VEE terminal are shorted, excessive Output current may flow under some conditions, and heating may destroy IC. It is necessary to connect a resistor as shown in Fig.2, thereby Protecting against load shorting.

5) Power supply (split supply / single supply) in used

Op-amp operates when specified voltage is applied between VCC and VEE. Therefore, the single supply Op-Amp can be used for double supply Op-Amp as well.

6) Power dissipation (Pd)

Use a thermal design that allows for a sufficient margin in light of the power dissipation (Pd) in actual operating conditions.

7) Short-circuit between pins and wrong 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.

8) Use in strong electromagnetic field

Using the ICs in strong electromagnetic field can cause operation malfunction.

9) Radiation

This IC is not designed to be radiation-resistant.

10) Handling of IC

When stress is applied to IC because of deflection or bend of board, the characteristics may fluctuate due to piezoelectric (piezo) effect.

11) Inspection on set board

During testing, turn on or off the power before mounting or dismounting the board from the test Jig.

Do not power up the board without waiting for the output capacitors to discharge. The capacitors in the low output impedanceterminal can stress the device. Pay attention to the electro static voltages during IC handling, transportation, and storage.

12) Output capacitor

When VCC terminal is shorted to VEE (GND) potential and an electric charge has accumulated on the external capacitor, connected to output terminal, accumulated charge may be discharged VCC terminal via the parasitic element within the circuit or terminal protection element. The element in the circuit may be damaged (thermal destruction). When using this IC for an application circuit where there is oscillation, output capacitor load does not occur, as when using this IC as a voltage comparator. Set the capacitor connected to output terminal below 0.1[μF] in order to prevent damage to IC.

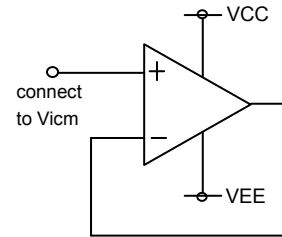


Fig. 234The example of application circuit for unused op-amp

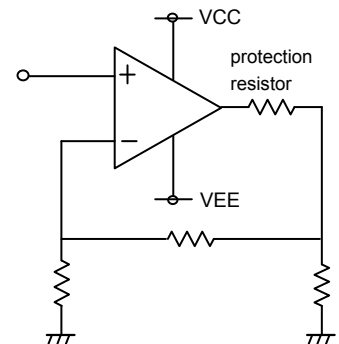


Fig. 235The example of output short protection

●Ordering part number

|   |   |
|---|---|
| B | A |
|---|---|

Part No.

|   |   |   |   |
|---|---|---|---|
| 4 | 5 | 6 | 0 |
|---|---|---|---|

Part No.

|       |       |
|-------|-------|
| 4558  | 4558R |
| 4560  | 4560R |
| 4510  | 4580R |
| 14741 | 15218 |
| 15532 | 2115  |

|   |   |
|---|---|
| F | V |
|---|---|

Package

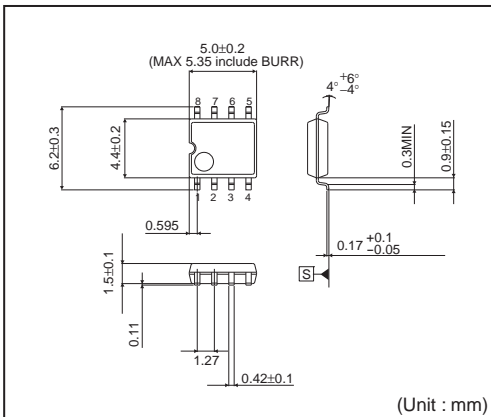
|             |
|-------------|
| F: SOP8     |
| SOP14       |
| FV: SSOP-B8 |
| FVM: MSOP8  |

|   |   |
|---|---|
| E | 2 |
|---|---|

Packaging and forming specification

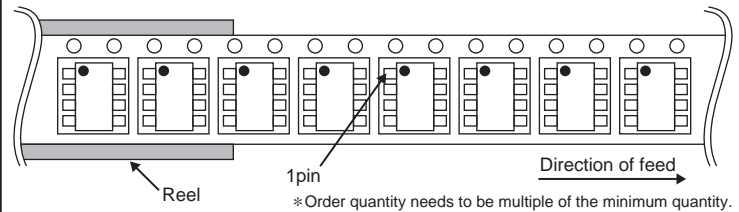
|  |
|--|
| E2: Embossed tape and reel<br>(SOP8/SOP14/SSOP-B8) |
| TR: Embossed tape and reel<br>(MSOP8)              |

SOP8

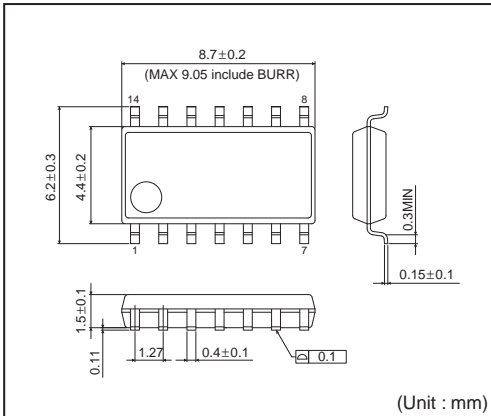


<Tape and Reel information>

|                   |   |
|-------------------|---|
| Tape              | Embossed carrier tape   |
| Quantity          | 2500pcs   |
| Direction of feed | E2<br>(The direction is the 1pin of product is at the upper left when you hold reel on the left hand and you pull out the tape on the right hand) |

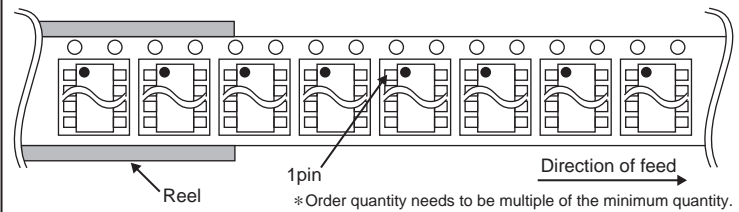


SOP14

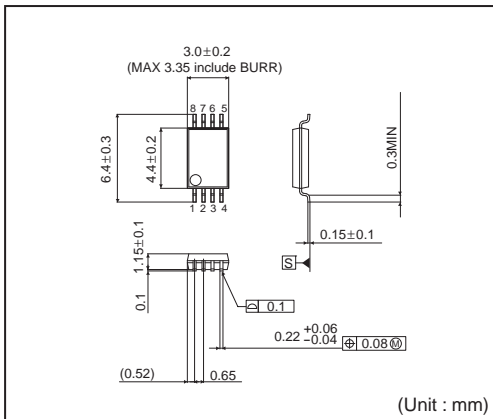


<Tape and Reel information>

|                   |   |
|-------------------|---|
| Tape              | Embossed carrier tape   |
| Quantity          | 2500pcs   |
| Direction of feed | E2<br>(The direction is the 1pin of product is at the upper left when you hold reel on the left hand and you pull out the tape on the right hand) |

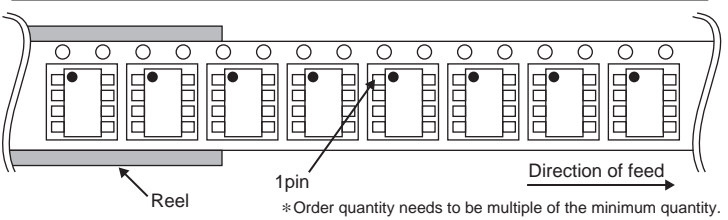


**SSOP-B8**

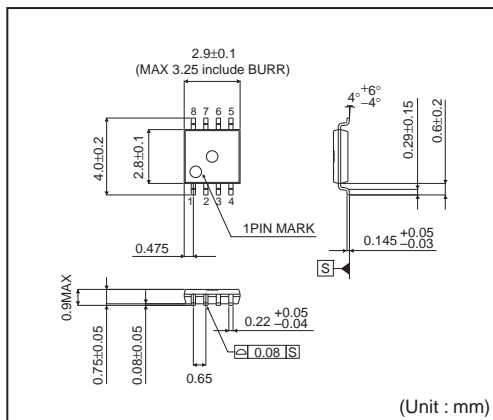


<Tape and Reel information>

|                   |   |
|-------------------|---|
| Tape              | Embossed carrier tape   |
| Quantity          | 2500pcs   |
| Direction of feed | E2<br>(The direction is the 1 pin of product is at the upper left when you hold reel on the left hand and you pull out the tape on the right hand ) |

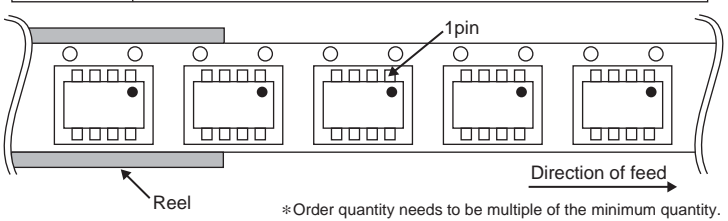


**MSOP8**



<Tape and Reel information>

|                   |  |
|-------------------|--|
| Tape              | Embossed carrier tape  |
| Quantity          | 3000pcs  |
| Direction of feed | TR<br>(The direction is the 1 pin 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 ) |



## Notes

No copying or reproduction of this document, in part or in whole, is permitted without the consent of ROHM Co.,Ltd.

The content specified herein is subject to change for improvement without notice.

The content specified herein is for the purpose of introducing ROHM's products (hereinafter "Products"). If you wish to use any such Product, please be sure to refer to the specifications, which can be obtained from ROHM upon request.

Examples of application circuits, circuit constants and any other information contained herein illustrate the standard usage and operations of the Products. The peripheral conditions must be taken into account when designing circuits for mass production.

Great care was taken in ensuring the accuracy of the information specified in this document. However, should you incur any damage arising from any inaccuracy or misprint of such information, ROHM shall bear no responsibility for such damage.

The technical information specified herein is intended only to show the typical functions of and examples of application circuits for the Products. ROHM does not grant you, explicitly or implicitly, any license to use or exercise intellectual property or other rights held by ROHM and other parties. ROHM shall bear no responsibility whatsoever for any dispute arising from the use of such technical information.

The Products specified in this document are intended to be used with general-use electronic equipment or devices (such as audio visual equipment, office-automation equipment, communication devices, electronic appliances and amusement devices).

The Products specified in this document are not designed to be radiation tolerant.

While ROHM always makes efforts to enhance the quality and reliability of its Products, a Product may fail or malfunction for a variety of reasons.

Please be sure to implement in your equipment using the Products safety measures to guard against the possibility of physical injury, fire or any other damage caused in the event of the failure of any Product, such as derating, redundancy, fire control and fail-safe designs. ROHM shall bear no responsibility whatsoever for your use of any Product outside of the prescribed scope or not in accordance with the instruction manual.

The Products are not designed or manufactured to be used with any equipment, device or system which requires an extremely high level of reliability the failure or malfunction of which may result in a direct threat to human life or create a risk of human injury (such as a medical instrument, transportation equipment, aerospace machinery, nuclear-reactor controller, fuel-controller or other safety device). ROHM shall bear no responsibility in any way for use of any of the Products for the above special purposes. If a Product is intended to be used for any such special purpose, please contact a ROHM sales representative before purchasing.

If you intend to export or ship overseas any Product or technology specified herein that may be controlled under the Foreign Exchange and the Foreign Trade Law, you will be required to obtain a license or permit under the Law.



Thank you for your accessing to ROHM product informations.  
More detail product informations and catalogs are available, please contact us.

## ROHM Customer Support System

<http://www.rohm.com/contact/>