

HA1630S01/02/03 Series

Ultra-Small Low Voltage Operation CMOS Single Operational Amplifier

REJ03D0798-0100

Rev.1.00

Mar 10, 2006

Description

The HA1630S01/02/03 are single CMOS Operational Amplifiers realizing low voltage operation, low input offset voltage and low supply current. In addition to a low operating voltage from 1.8V, these device output can achieve full swing output voltage capability extending to either supply. Available in an ultra-small CMPAK-5 package that occupies only 1/8 the area of the SOP-8 package.

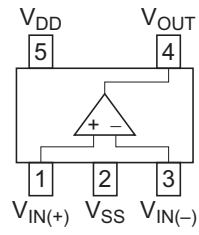
Features

- Low power and single supply operation $V_{DD} = 1.8$ to 5.5 V
- Low input offset voltage $V_{IO} = 4.0$ mV Max
- Low supply current $I_{DD} = 15$ μ A Typ (HA1630S01)
 $I_{DD} = 50$ μ A Typ (HA1630S02)
 $I_{DD} = 100$ μ A Typ (HA1630S03)
- Maximum output voltage $V_{OH} = 2.9$ V Min (at $V_{DD} = 3.0$ V)
- Low input bias current $I_{IB} = 1$ pA Typ

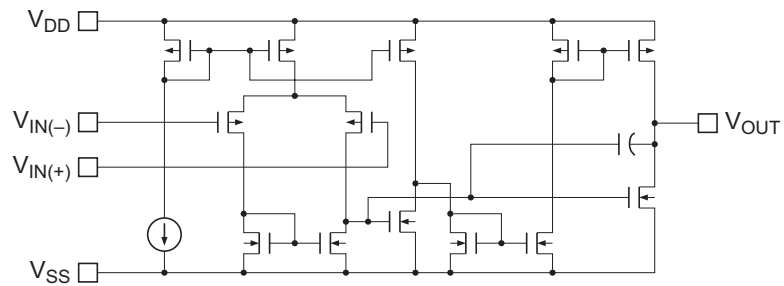
Ordering Information

Type No.	Package Name	Package Code
HA1630S01CM	CMPAK-5	PTSP0005ZC-A
HA1630S01LP	MPAK-5	PLSP0005ZB-A
HA1630S02CM	CMPAK-5	PTSP0005ZC-A
HA1630S02LP	MPAK-5	PLSP0005ZB-A
HA1630S03CM	CMPAK-5	PTSP0005ZC-A
HA1630S03LP	MPAK-5	PLSP0005ZB-A

Pin Arrangement



Equivalent Circuit



Absolute Maximum Ratings

(Ta = 25°C)

Items	Symbol	Ratings	Unit	Note
Supply voltage	V _{DD}	7	V	
Differential input voltage	V _{IN(diff)}	−V _{DD} to +V _{DD}	V	
Input voltage	V _{IN}	−0.3 to +V _{DD}	V	1
Power dissipation	P _T	200	mW	
Operating temp. Range	Topr	−40 to +85	°C	
Storage temp. Range	Tstg	−55 to +125	°C	

Note: 1. Do not apply Input Voltage exceeding V_{DD} or 7 V.

Electrical Characteristics

(V_{DD} = 3.0 V, Ta = 25°C)

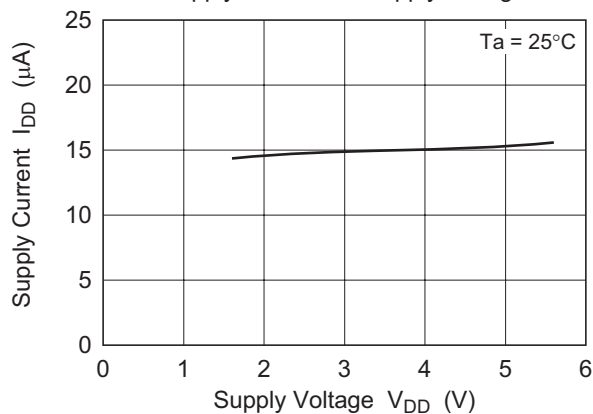
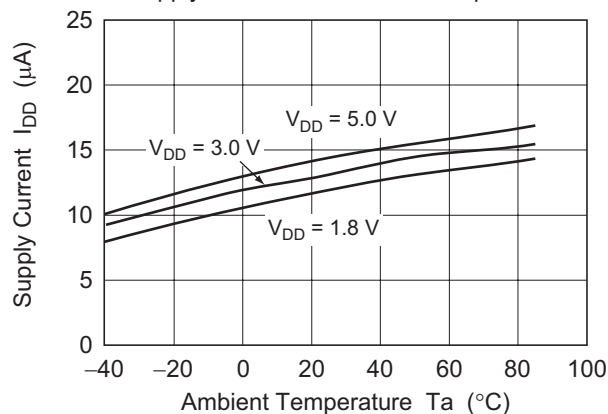
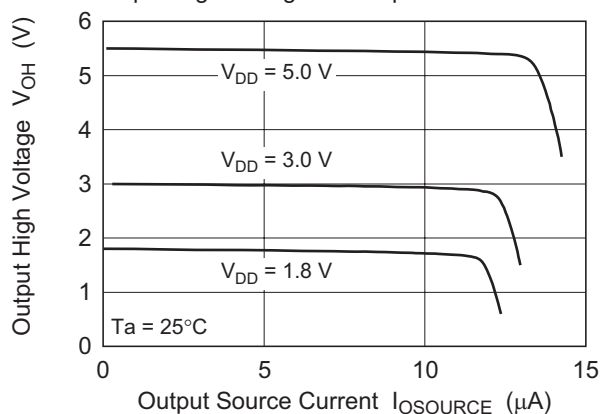
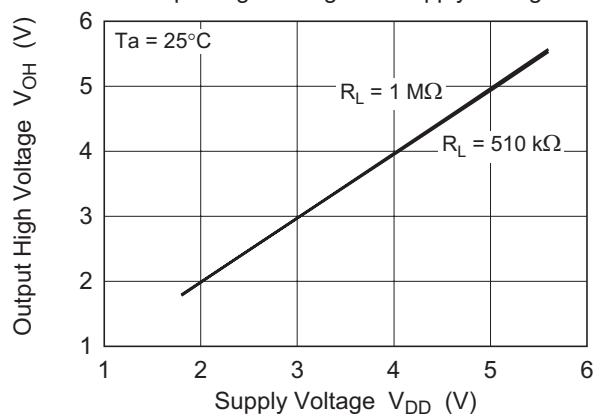
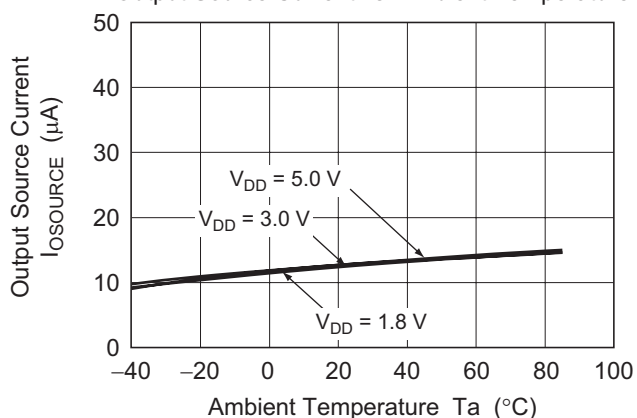
Items	Symbol	Min	Typ	Max	Unit	Test Condition
Input offset voltage	V _{IO}	—	—	4.0	mV	V _{in} = 1.5 V
Input offset current	I _{IO}	—	(1.0)	—	pA	V _{in} = 1.5 V
Input bias current	I _{IB}	—	(1.0)	—	pA	V _{in} = 1.5 V
Output high voltage	V _{OH}	2.9	—	—	V	R _L = 1 MΩ
Output source current	I _{O SOURCE}	6	12	—	μA	V _{OH} = 2.5 V (HA1630S01)
		25	50	—		V _{OH} = 2.5 V (HA1630S02)
		50	100	—		V _{OH} = 2.5 V (HA1630S03)
Output low voltage	V _{OL}	—	—	0.1	V	R _L = 1 MΩ
Output sink current	I _{O SINK}	—	(0.8)	—	mA	V _{OL} = 0.5 V (HA1630S01)
		—	(1.0)	—		V _{OL} = 0.5 V (HA1630S02)
		—	(1.2)	—		V _{OL} = 0.5 V (HA1630S03)
Common mode input voltage range	V _{CM}	−0.1 to 2.1	—	—	V	
Slew rate	SR	—	(0.125)	—	V/μs	C _L = 20 pF (HA1630S01)
		—	(0.50)	—		C _L = 20 pF (HA1630S02)
		—	(1.00)	—		C _L = 20 pF (HA1630S03)
Voltage gain	A _V	60	100	—	dB	
Gain bandwidth product	BW	—	(200)	—	kHz	C _L = 20 pF (HA1630S01)
		—	(680)	—		C _L = 20 pF (HA1630S02)
		—	(1200)	—		C _L = 20 pF (HA1630S03)
Power supply rejection ratio	PSRR	60	80	—	dB	
Common mode rejection ratio	CMRR	60	80	—	dB	
Supply current	I _{DD}	—	15	30	μA	R _L = ∞ (HA1630S01)
		—	50	100		R _L = ∞ (HA1630S02)
		—	100	200		R _L = ∞ (HA1630S03)

Note: 1. () : Design specification

Table of Graphs

Electrical Characteristics			HA1630S01 Figure	HA1630S02 Figure	HA1630S03 Figure	Test Circuit
Supply current	I_{DD}	vs Supply voltage	1-1	2-1	3-1	2
		vs Ambient temperature	1-2	2-2	3-2	
Output high voltage	V_{OH}	vs Output source current	1-3	2-3	3-3	4
		vs Supply voltage	1-4	2-4	3-4	
Output source current	$I_{O\ SOURCE}$	vs Ambient temperature	1-5	2-5	3-5	6
Output low voltage	V_{OL}	vs Output sink current	1-6	2-6	3-6	5
Output sink current	$I_{O\ SINK}$	vs Ambient temperature	1-7	2-7	3-7	6
Input offset voltage	V_{IO}	Distribution	1-8	2-8	3-8	1
		vs Supply voltage	1-9	2-9	3-9	
		vs Ambient temperature	1-10	2-10	3-10	
Common mode input voltage range	V_{CM}	vs Ambient temperature	1-11	2-11	3-11	7
Power supply rejection ratio	PSRR	vs Frequency	1-12	2-12	3-12	1
Common mode rejection ratio	CMRR	vs Frequency	1-13	2-13	3-13	7
Voltage gain & phase angle	A_v	vs Frequency	1-14	2-14	3-14	10
Input bias current	I_{IB}	vs Ambient temperature	1-15	2-15	3-15	3
		vs Input voltage	1-16	2-16	3-16	
Slew Rate (rising)	SRr	vs Ambient temperature	1-17	2-17	3-17	9
Slew Rate (falling)	SRf	vs Ambient temperature	1-18	2-18	3-18	
Slew rate		Large signal transient response	1-19	2-19	3-19	
		Small signal transient response	1-20	2-20	3-20	
Total harmonic distortion + noise	(0 dB)	vs. Output voltage p-p	—	2-21	3-21	8
	(40 dB)	vs. Output voltage p-p	—	2-22	3-22	
Maximum p-p output voltage		vs Frequency	1-21	2-23	3-23	
Voltage noise density		vs Frequency	1-22	2-24	3-24	

Main Characteristics (HA1630S01)

Figure 1-1. HA1630S01
Supply Current vs. Supply VoltageFigure 1-2. HA1630S01
Supply Current vs. Ambient TemperatureFigure 1-3. HA1630S01
Output High Voltage vs. Output Source CurrentFigure 1-4. HA1630S01
Output High Voltage vs. Supply VoltageFigure 1-5. HA1630S01
Output Source Current vs. Ambient Temperature

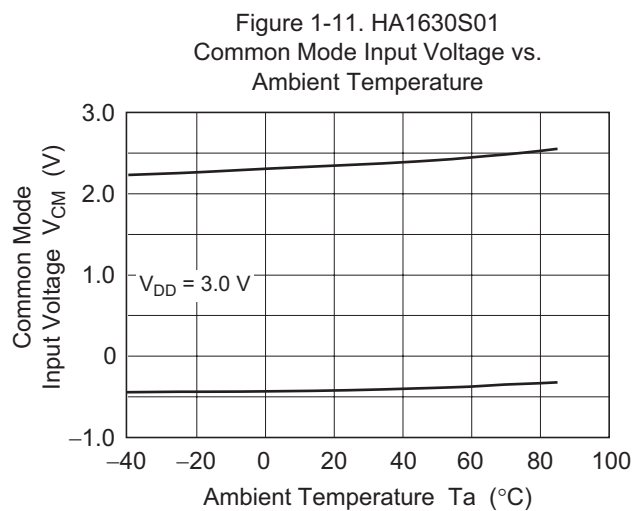
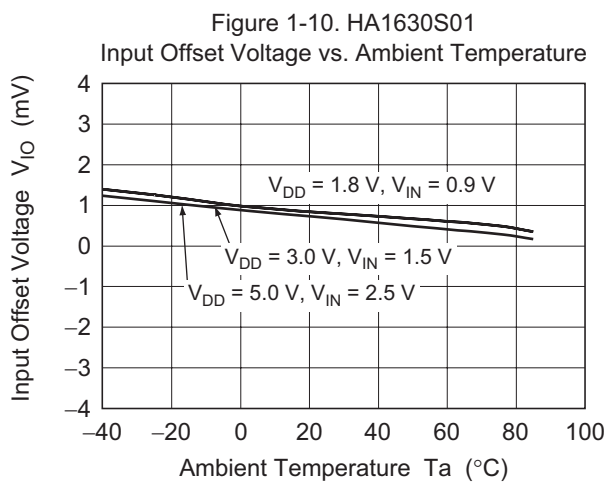
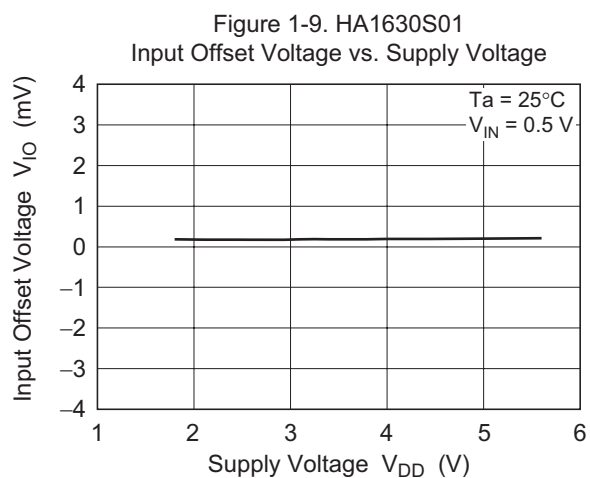
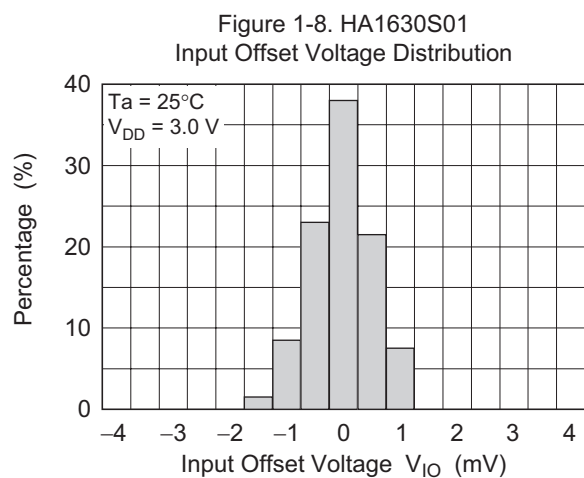
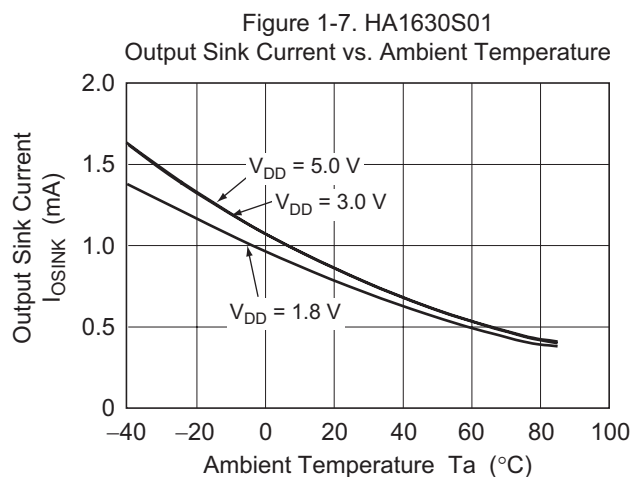
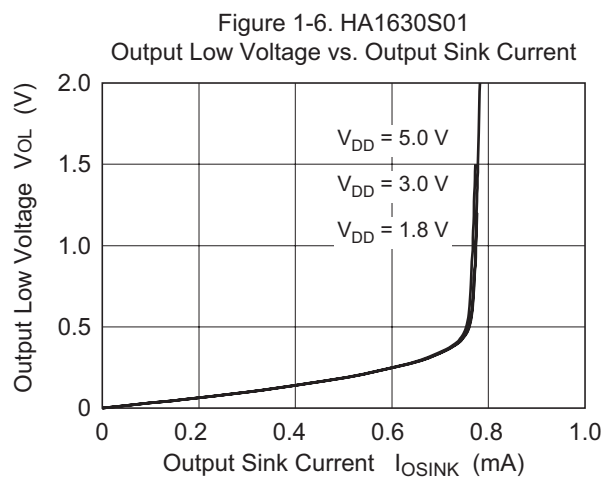


Figure 1-12. HA1630S01
Power Supply Rejection Ratio vs. Frequency

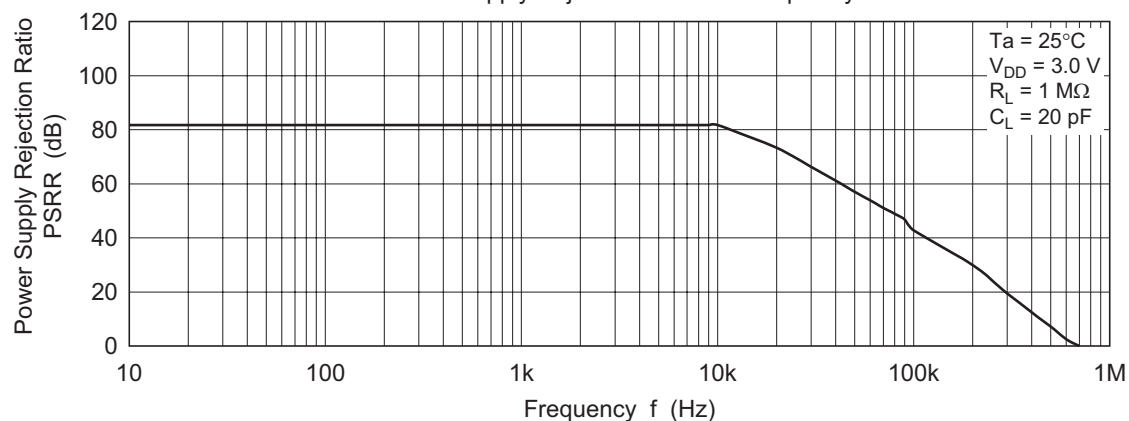


Figure 1-13. HA1630S01
Common Mode Rejection Ratio vs. Frequency

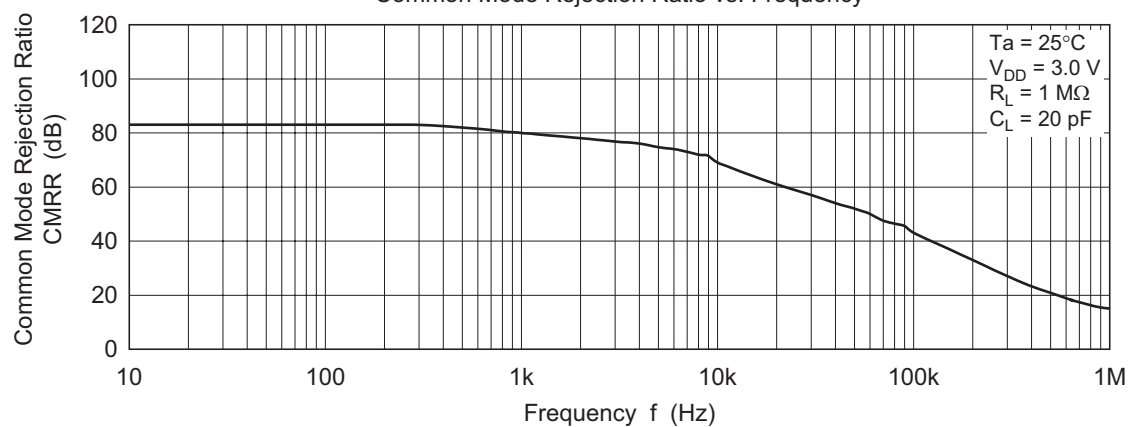


Figure 1-14. HA1630S01
Open Loop Voltage Gain and Phase Angle vs. Frequency

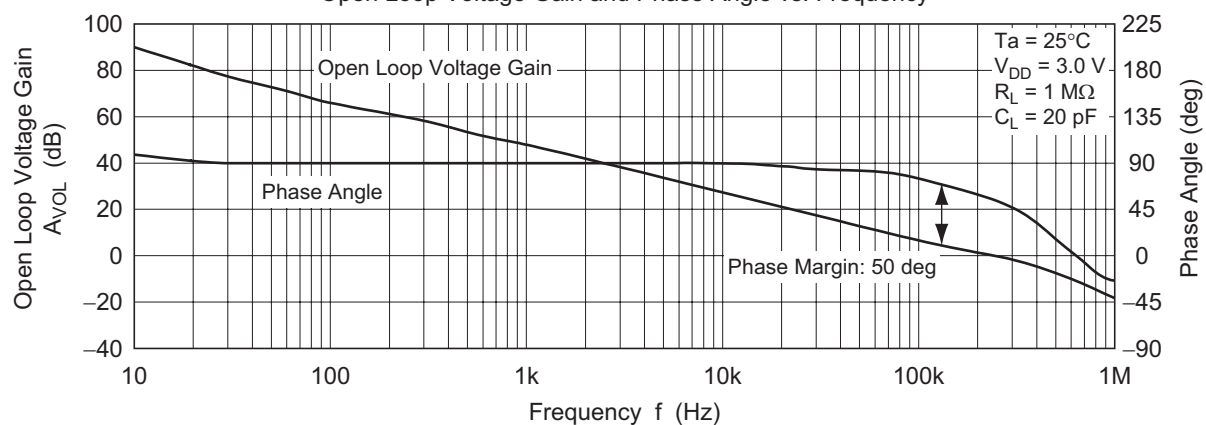


Figure 1-15. HA1630S01
Input Bias Current vs. Ambient Temperature

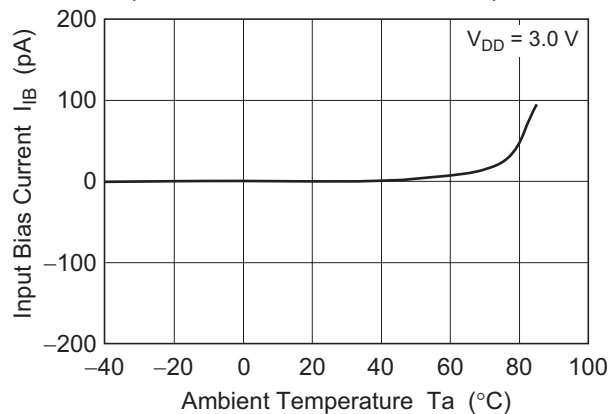


Figure 1-16. HA1630S01
Input Bias Current vs. Input Voltage

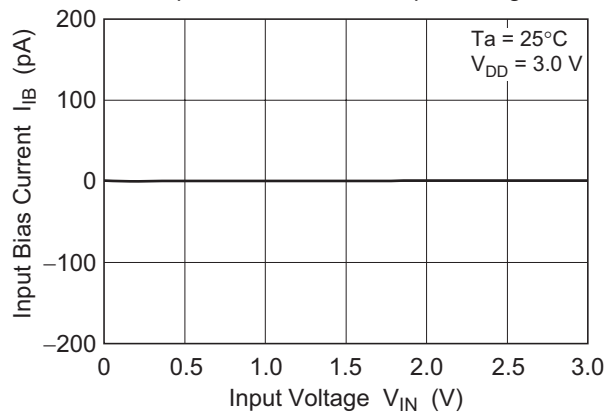


Figure 1-17. HA1630S01
Slew Rate (rising) vs. Ambient Temperature

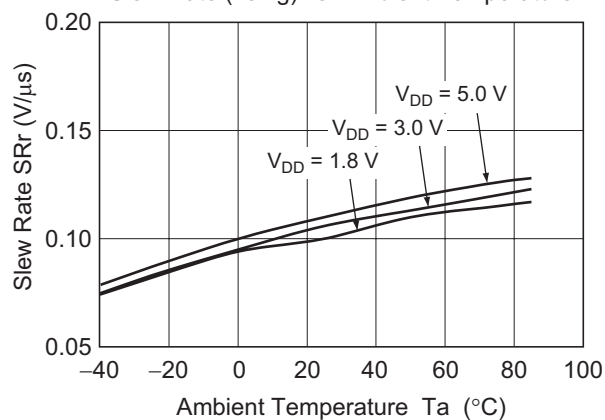


Figure 1-18. HA1630S01
Slew Rate (falling) vs. Ambient Temperature

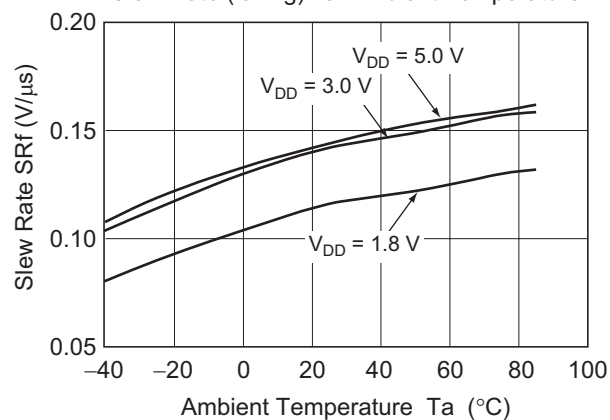


Figure 1-19. HA1630S01
Large Signal Transient Response

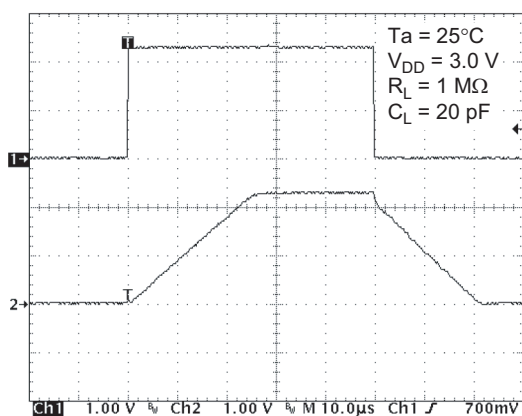


Figure 1-20. HA1630S01
Small Signal Transient Response

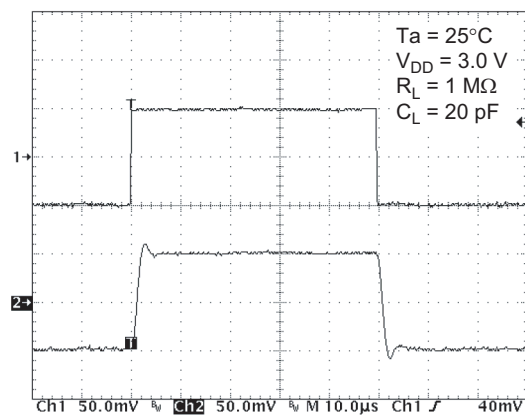


Figure 1-21. HA1630S01
Voltage Output p-p vs. Frequency

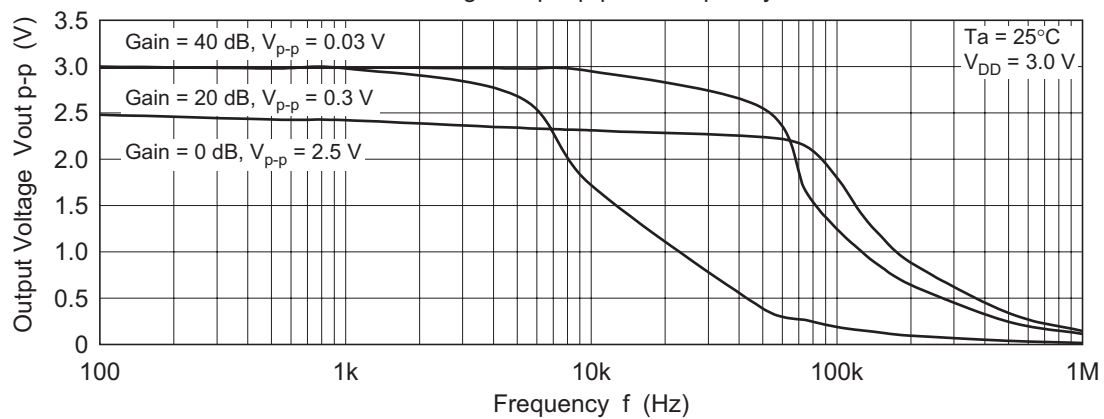
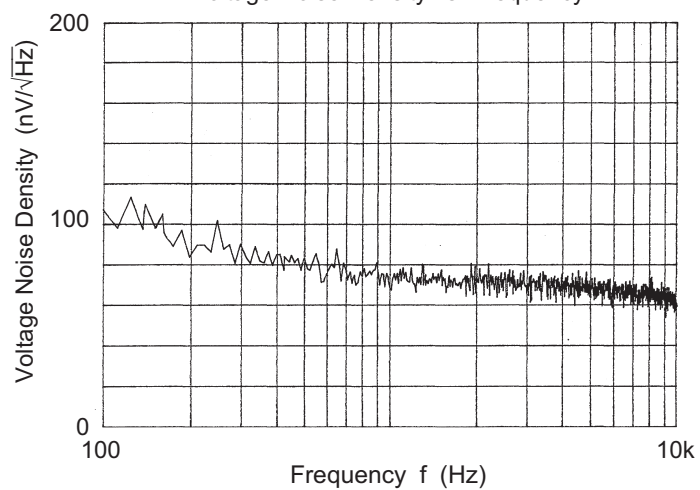
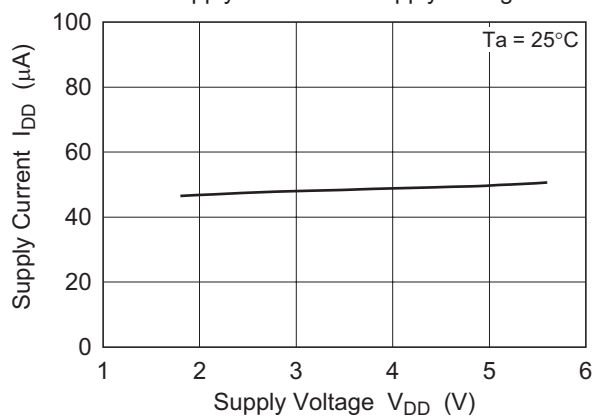
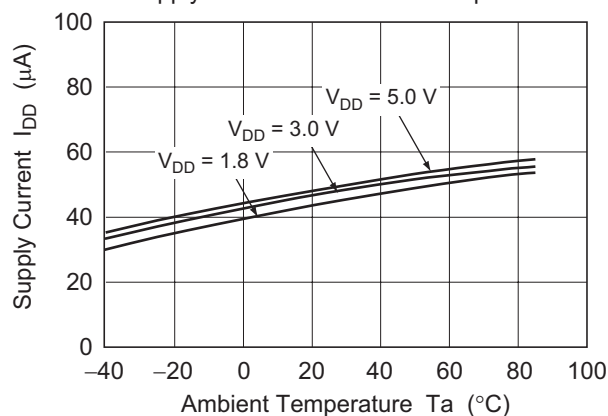
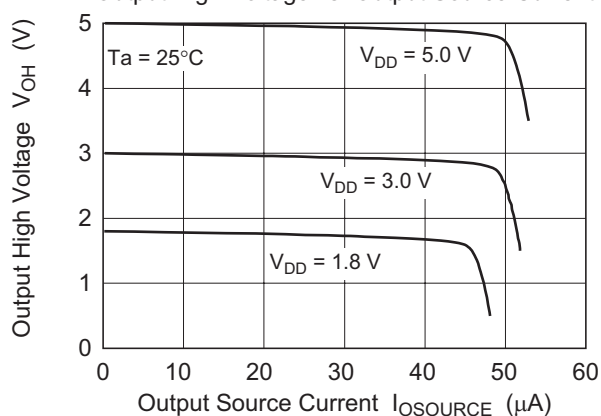
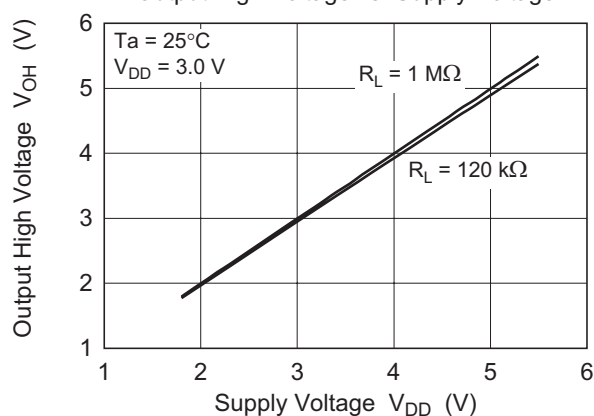
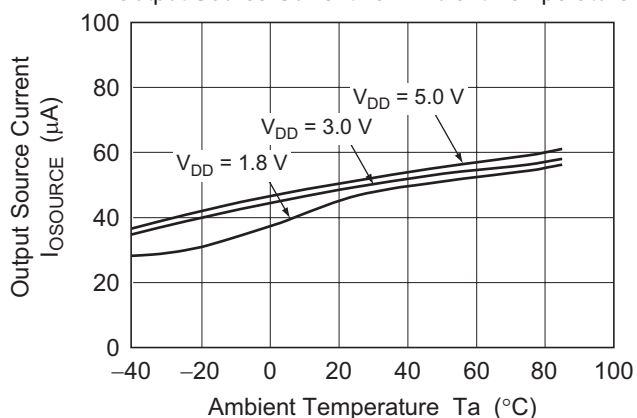


Figure 1-22. HA1630S01
Voltage Noise Density vs. Frequency



Main Characteristics (HA1630S02)

Figure 2-1. HA1630S02
Supply Current vs. Supply VoltageFigure 2-2. HA1630S02
Supply Current vs. Ambient TemperatureFigure 2-3. HA1630S02
Output High Voltage vs. Output Source CurrentFigure 2-4. HA1630S02
Output High Voltage vs. Supply VoltageFigure 2-5. HA1630S02
Output Source Current vs. Ambient Temperature

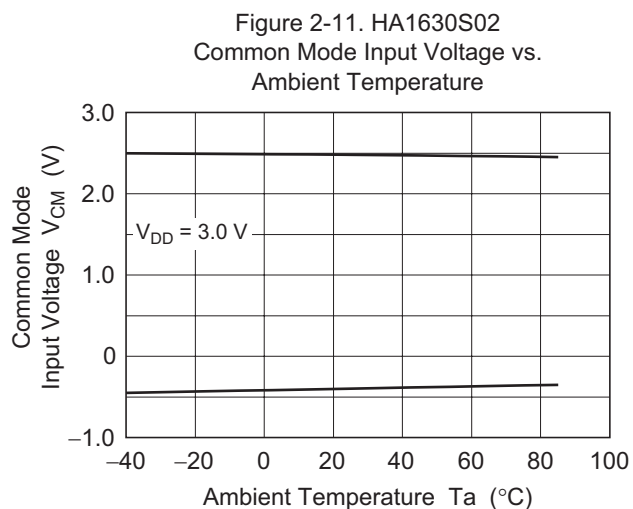
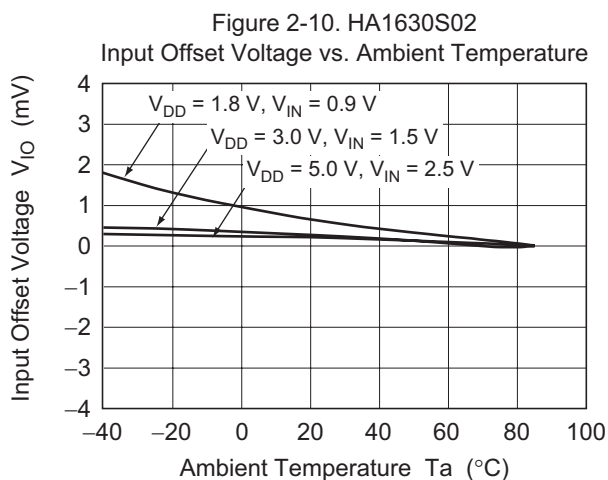
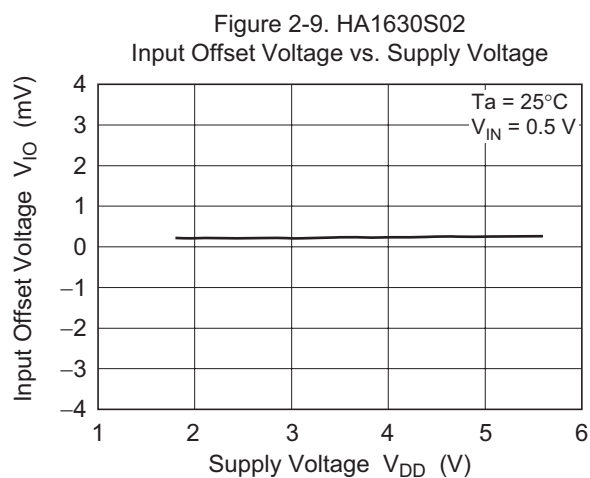
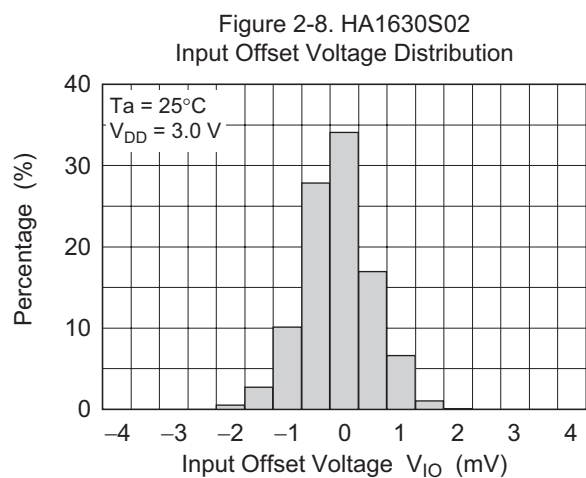
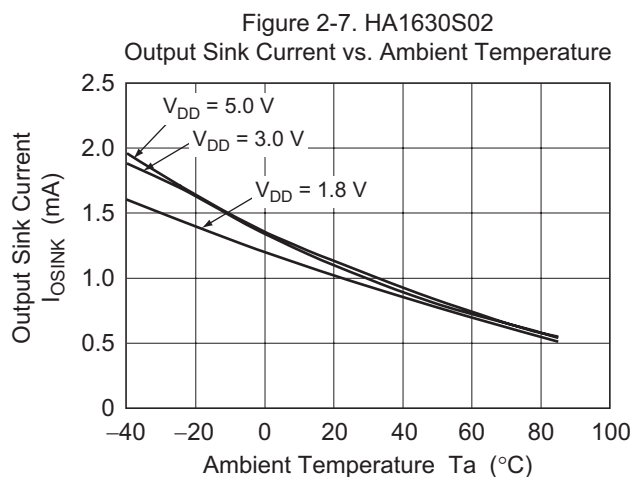
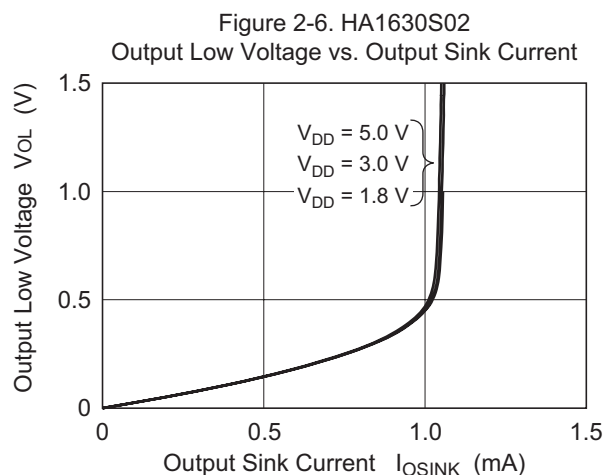


Figure 2-12. HA1630S02
Power Supply Rejection Ratio vs. Frequency

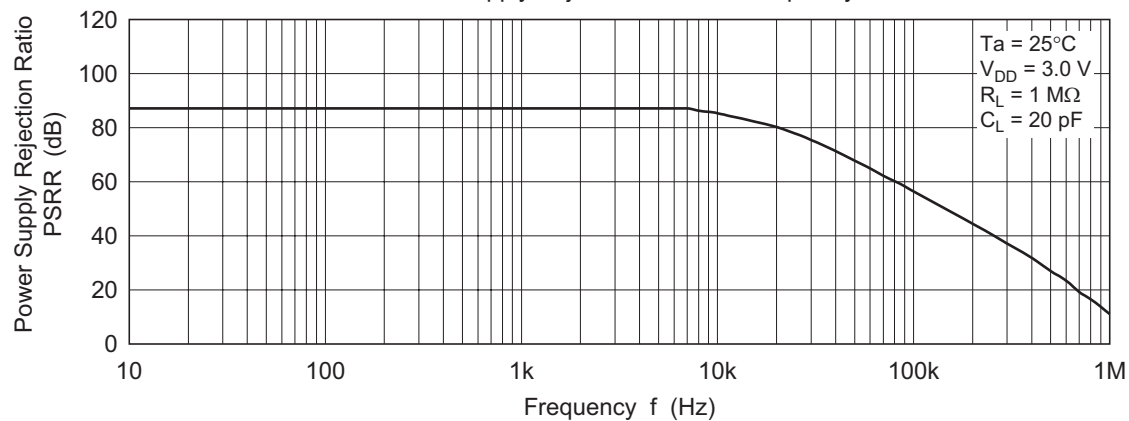


Figure 2-13. HA1630S02
Common Mode Rejection Ratio vs. Frequency

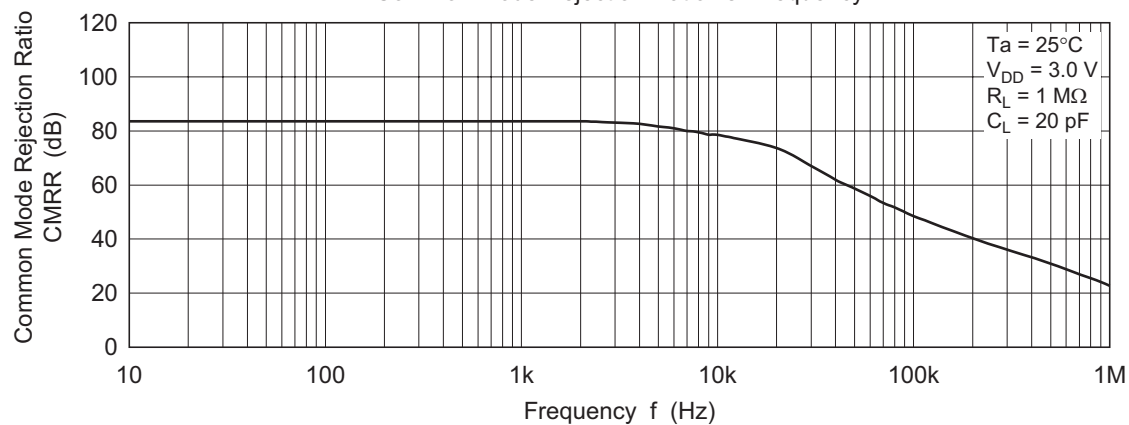


Figure 2-14. HA1630S02
Open Loop Voltage Gain and Phase Angle vs. Frequency

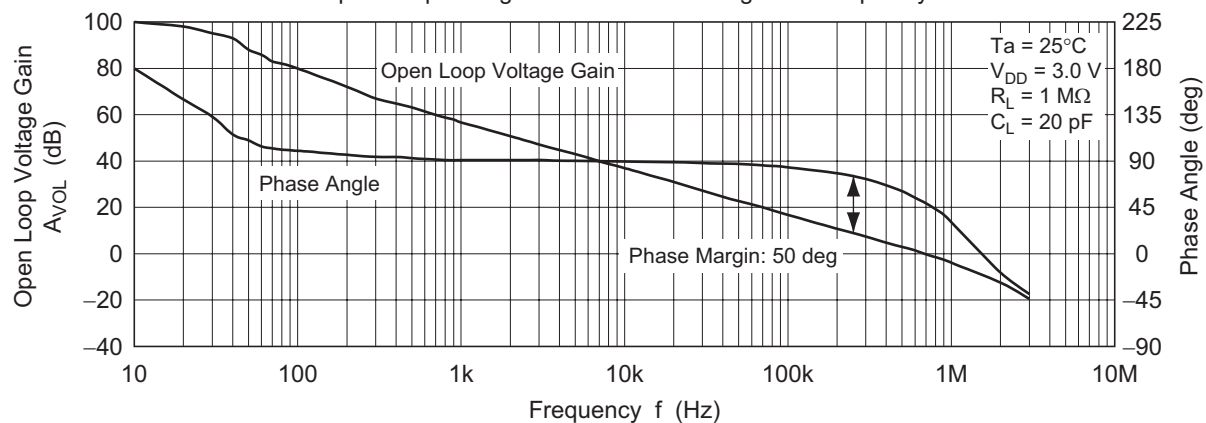


Figure 2-15. HA1630S02
Input Bias Current vs. Ambient Temperature

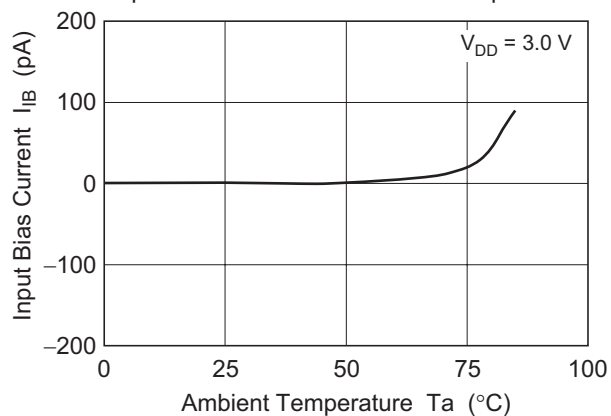


Figure 2-16. HA1630S02
Input Bias Current vs. Input Voltage

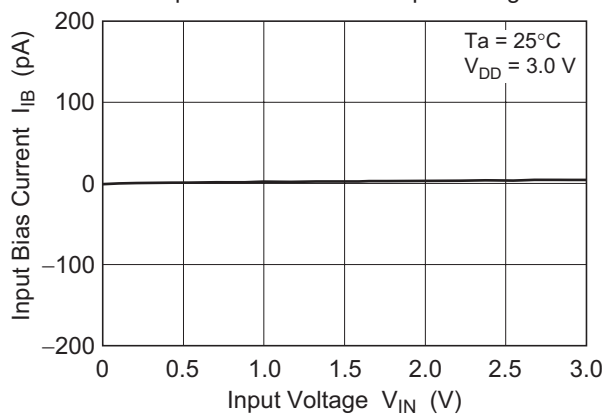


Figure 2-17. HA1630S02
Slew Rate (rising) vs. Ambient Temperature

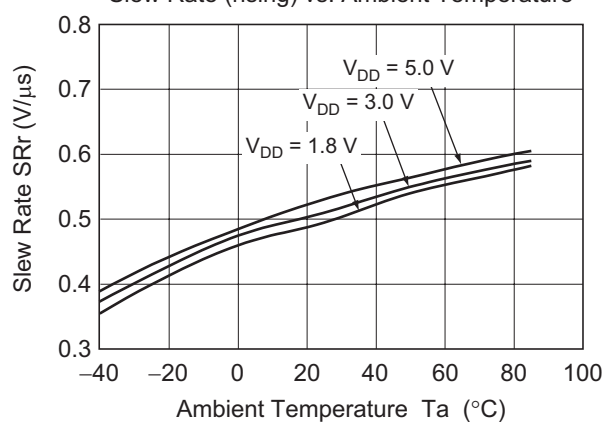


Figure 2-18. HA1630S02
Slew Rate (falling) vs. Ambient Temperature

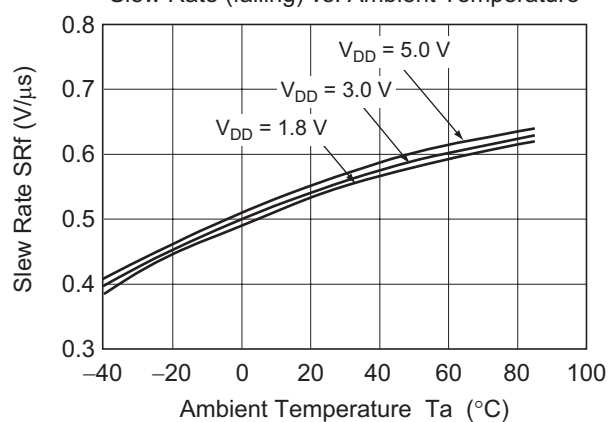


Figure 2-19. HA1630S02
Large Signal Transient Response

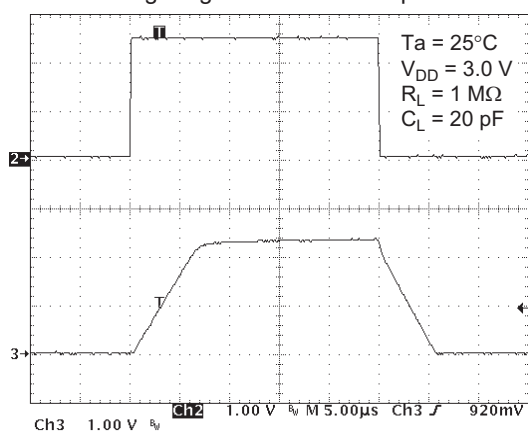


Figure 2-20. HA1630S02
Small Signal Transient Response

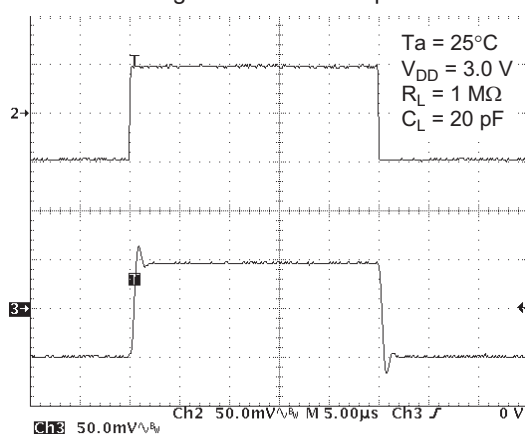


Figure 2-21. HA1630S02
Total Harmonic Distortion + Noise vs.
Output Voltage p-p

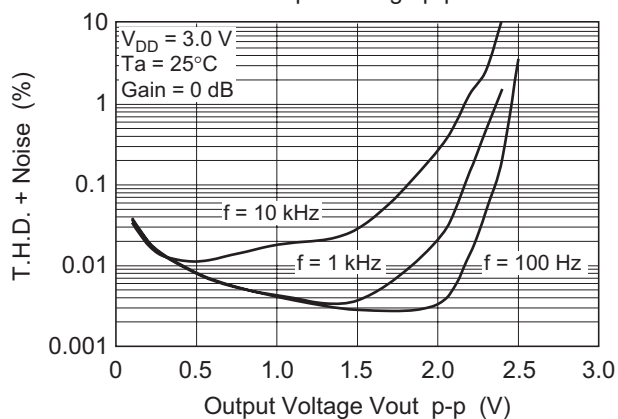


Figure 2-22. HA1630S02
Total Harmonic Distortion + Noise vs.
Output Voltage p-p

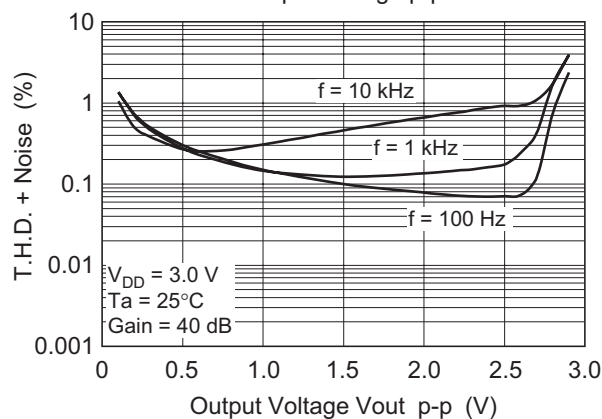


Figure 2-23. HA1630S02
Voltage Output p-p vs. Frequency

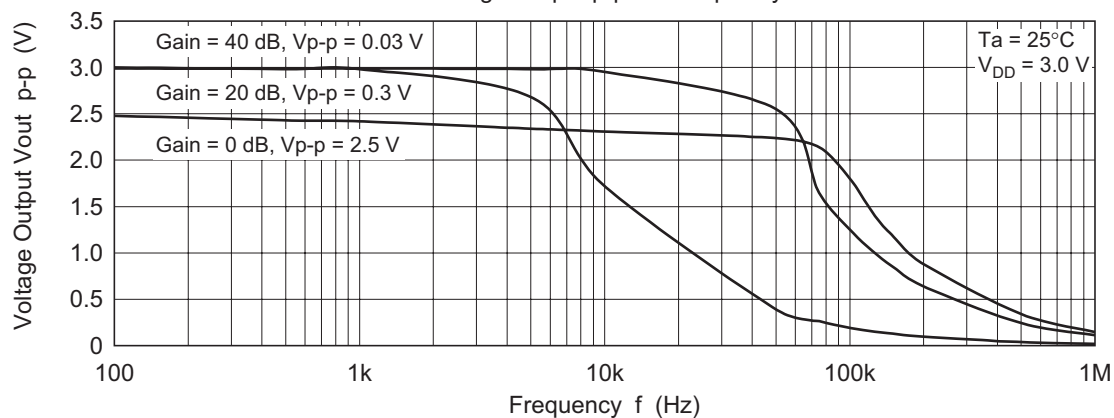
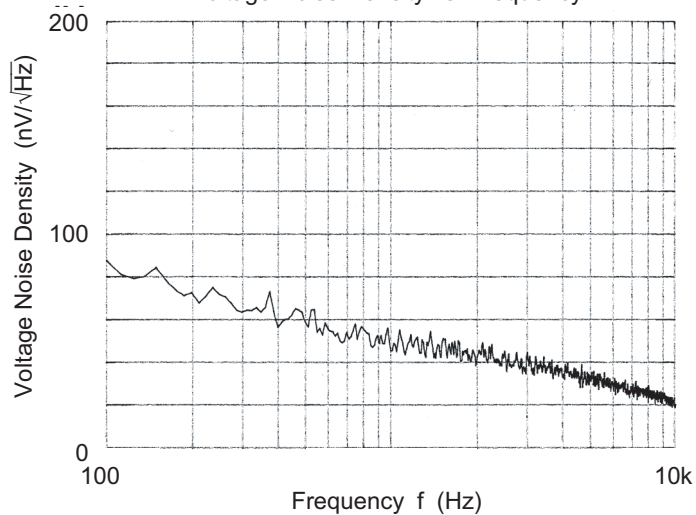
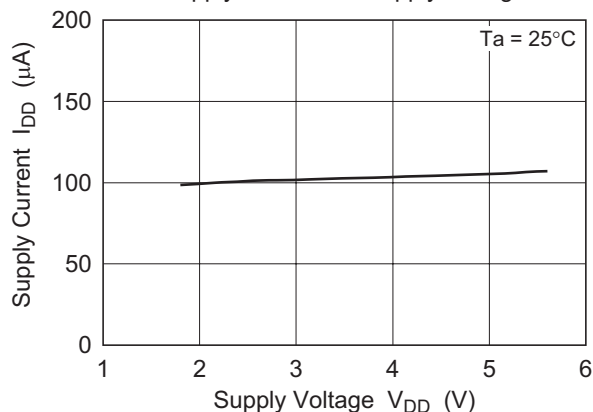
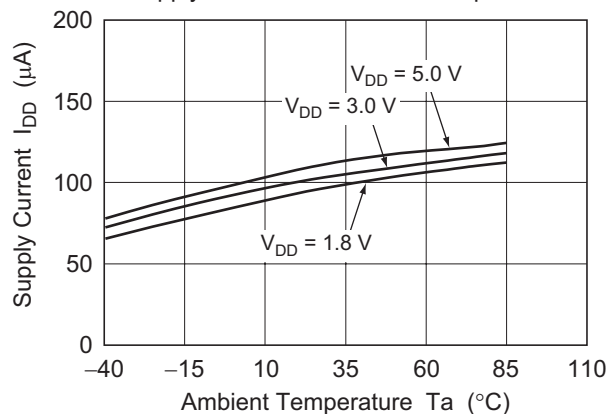
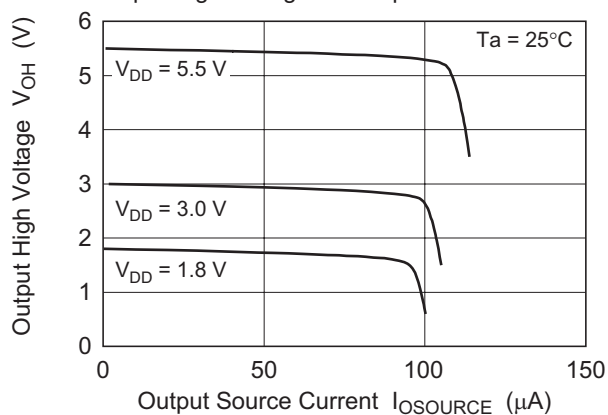
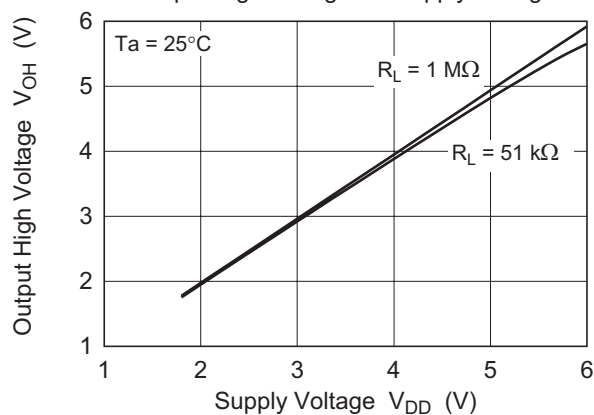
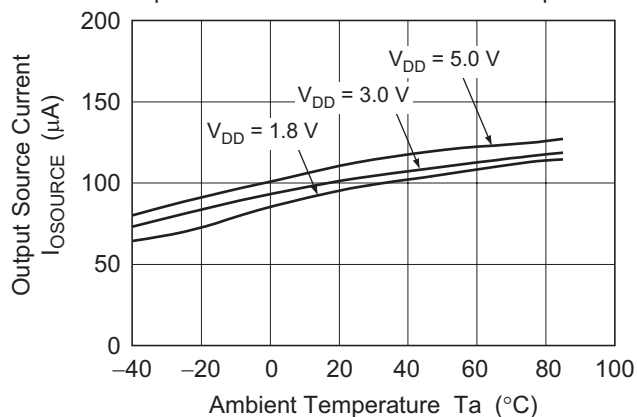


Figure 2-24. HA1630S02
Voltage Noise Density vs. Frequency



Main Characteristics (HA1630S03)

Figure 3-1. HA1630S03
Supply Current vs. Supply VoltageFigure 3-2. HA1630S03
Supply Current vs. Ambient TemperatureFigure 3-3. HA1630S03
Output High Voltage vs. Output Source CurrentFigure 3-4. HA1630S03
Output High Voltage vs. Supply VoltageFigure 3-5. HA1630S03
Output Source Current vs. Ambient Temperature

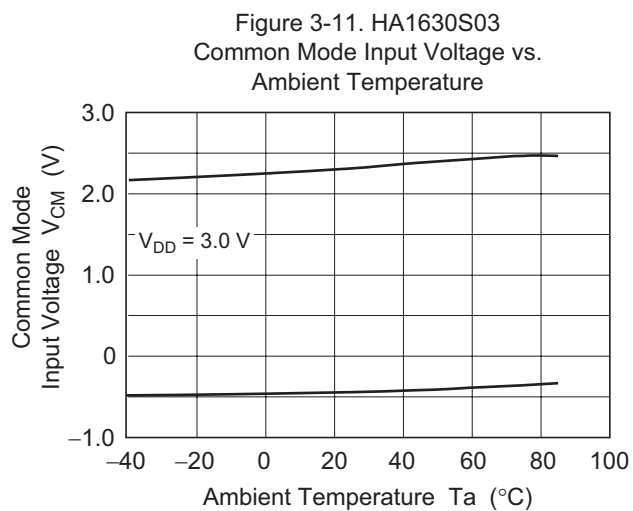
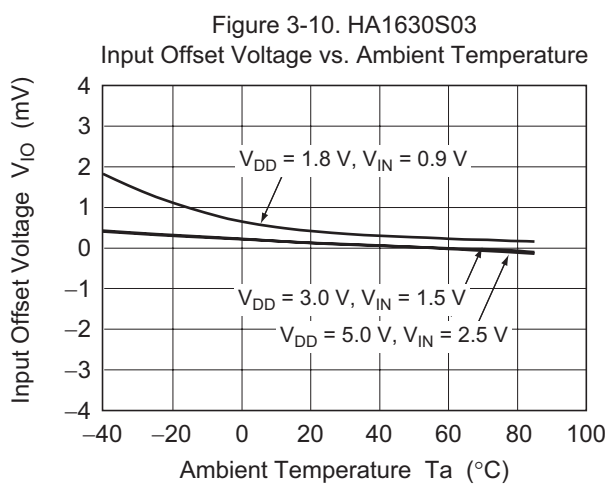
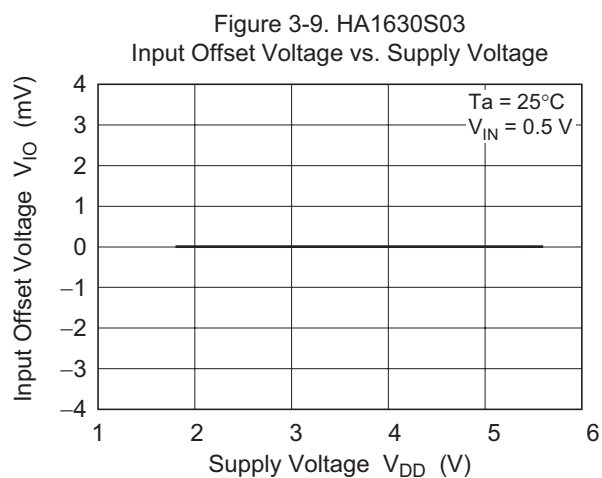
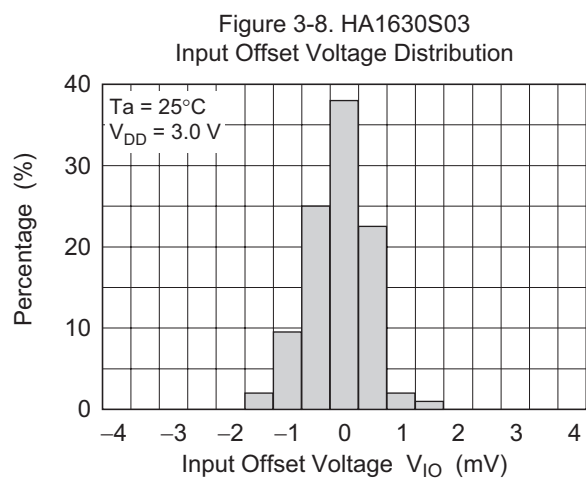
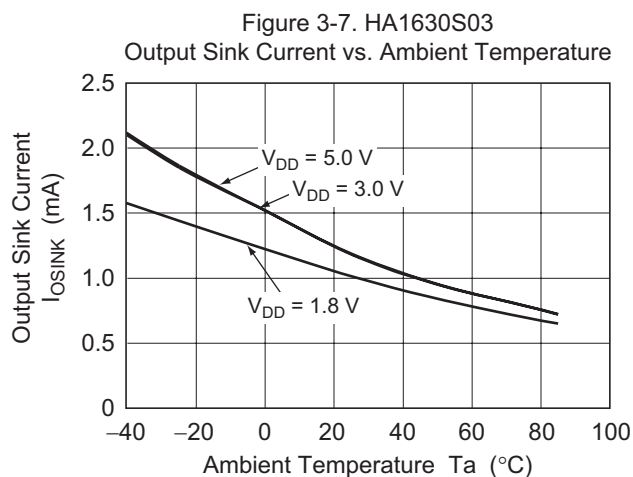
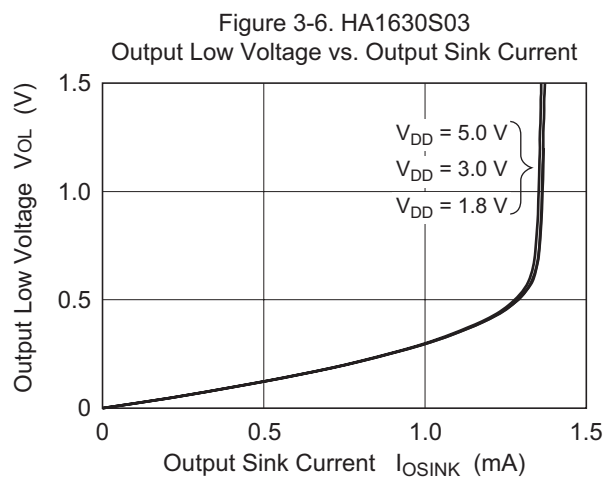


Figure 3-12. HA1630S03
Power Supply Rejection Ratio vs. Frequency

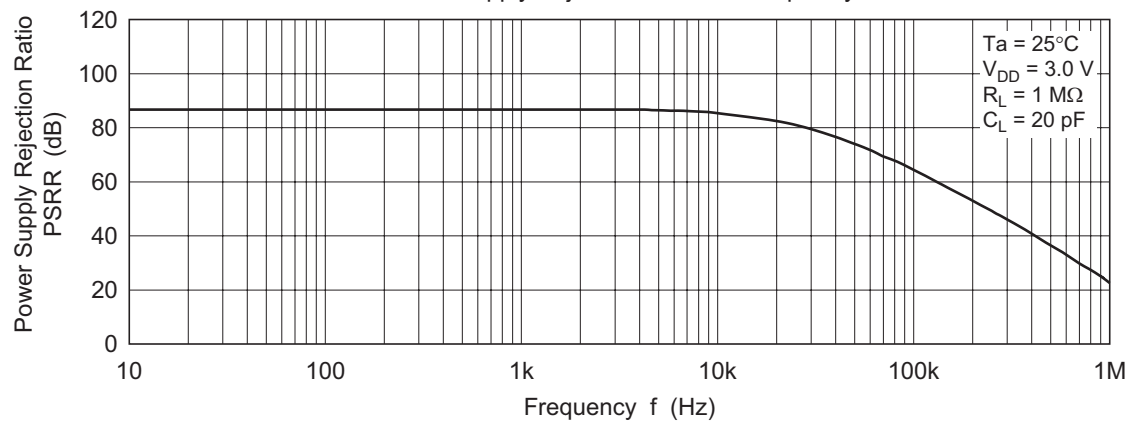


Figure 3-13. HA1630S03
Common Mode Rejection Ratio vs. Frequency

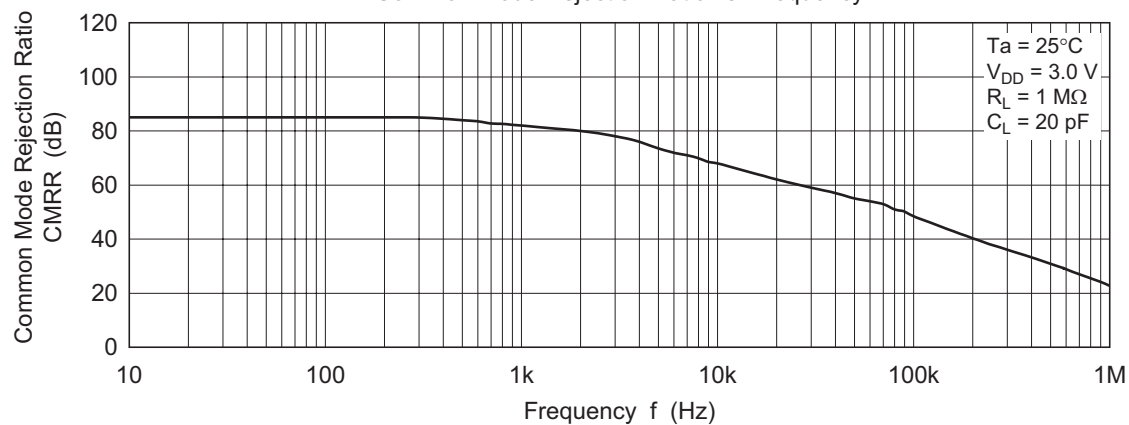
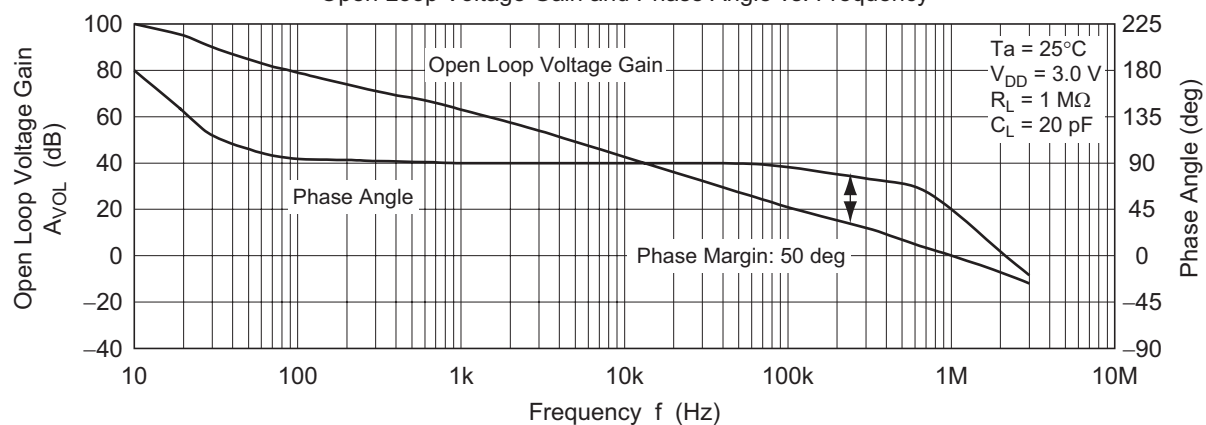


Figure 3-14. HA1630S03
Open Loop Voltage Gain and Phase Angle vs. Frequency



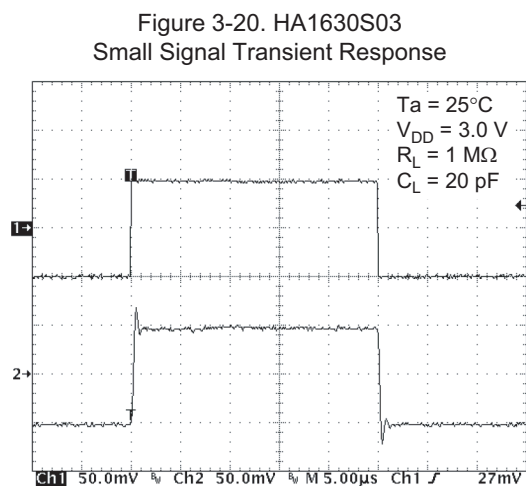
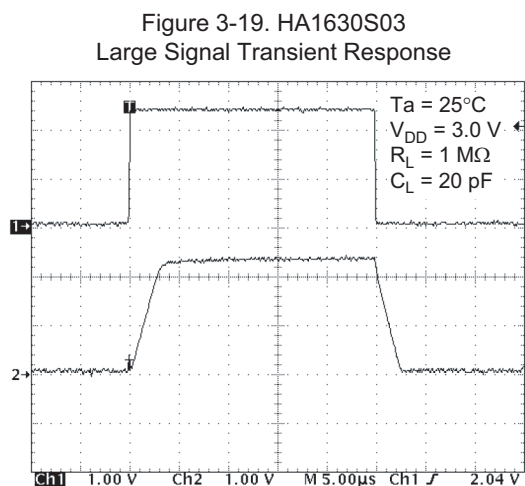
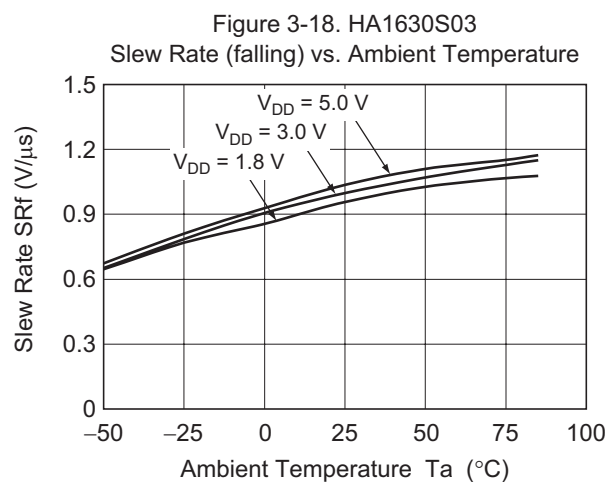
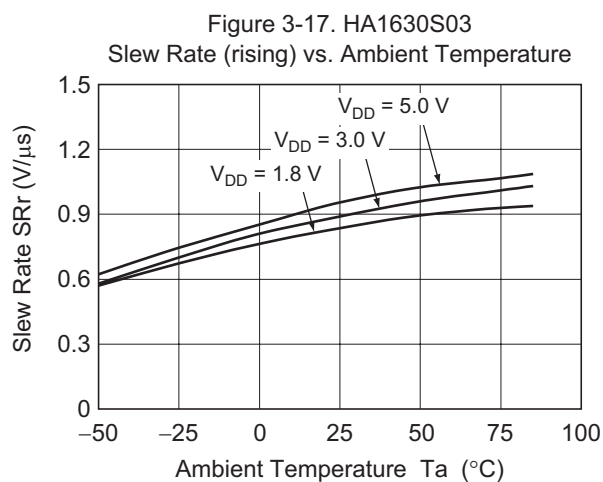
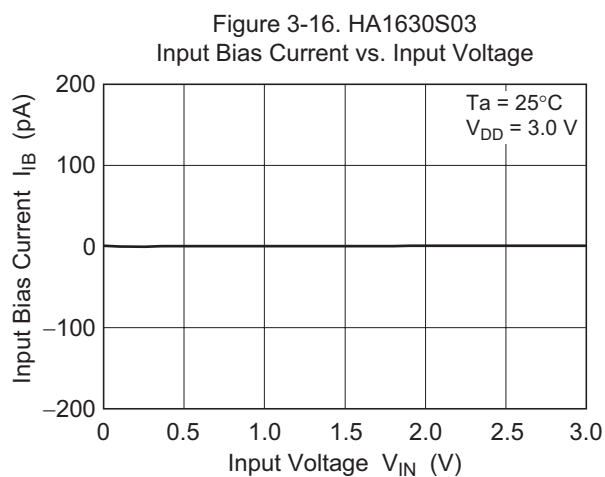
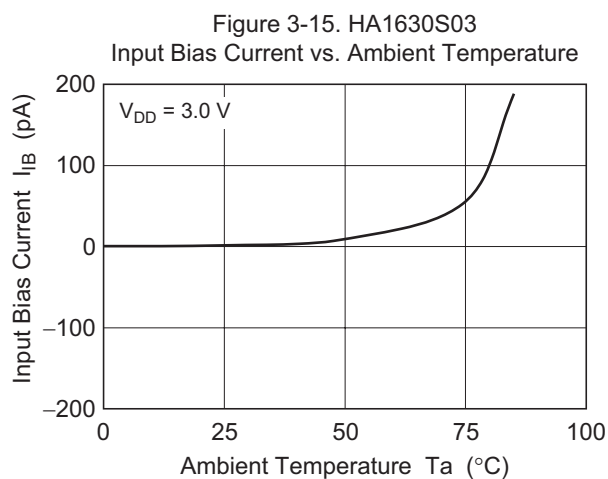


Figure 3-21. HA1630S03
Total Harmonic Distortion + Noise vs.
Output Voltage p-p

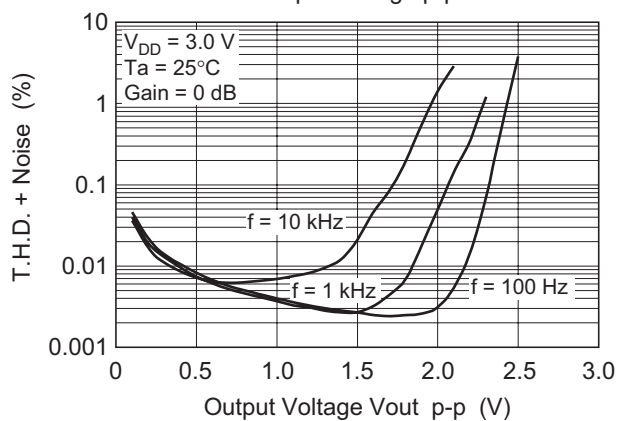


Figure 3-22. HA1630S03
Total Harmonic Distortion + Noise vs.
Output Voltage p-p

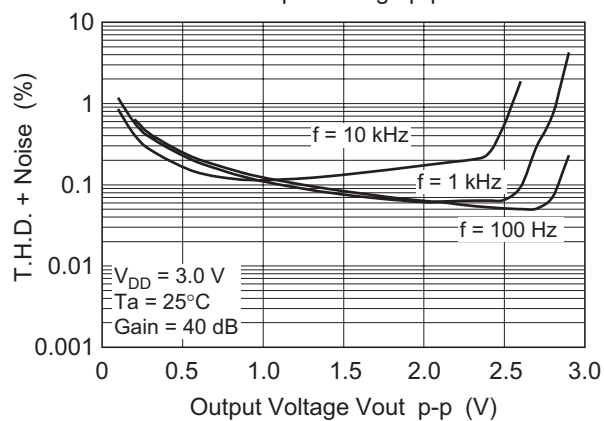


Figure 3-23. HA1630S03
Voltage Output p-p vs. Frequency

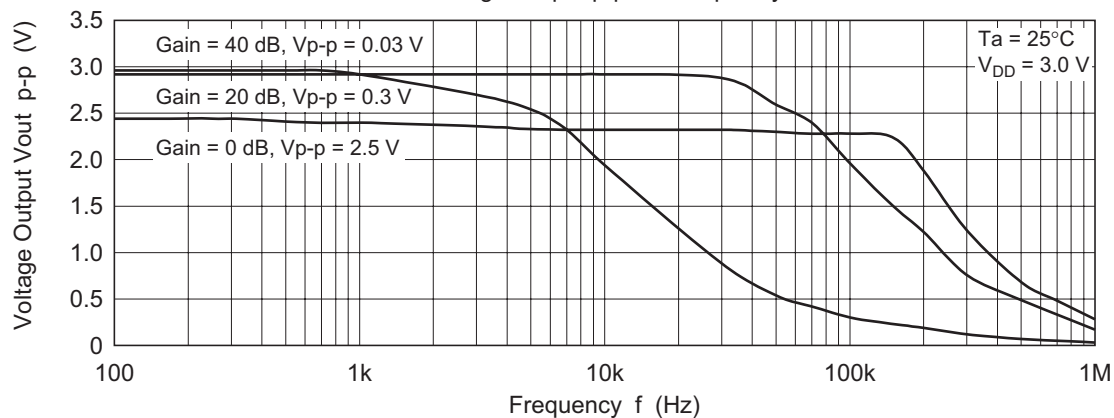
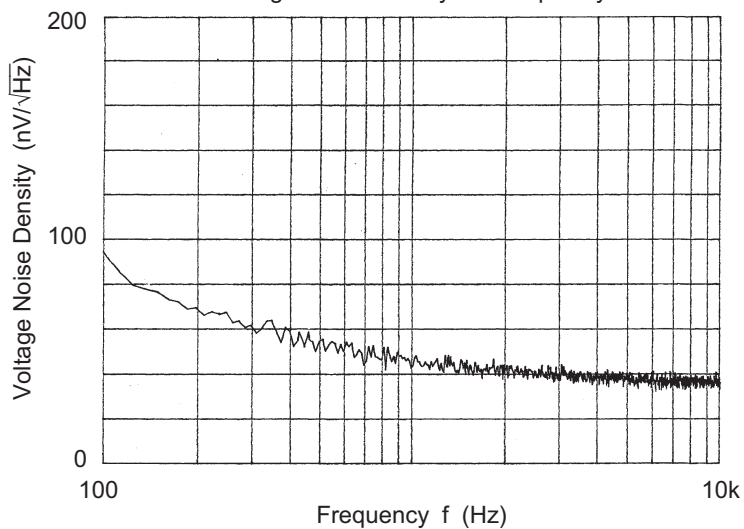
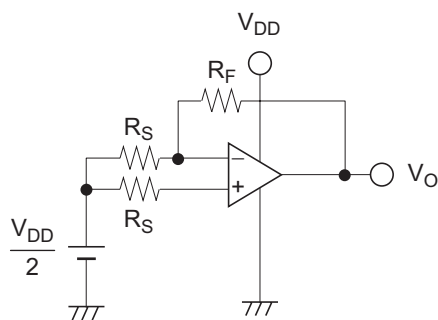


Figure 3-24. HA1630S03
Voltage Noise Density vs. Frequency



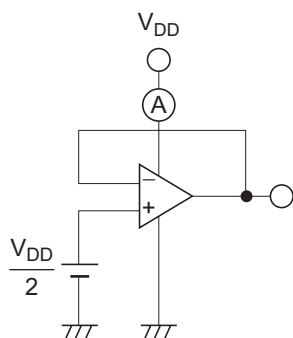
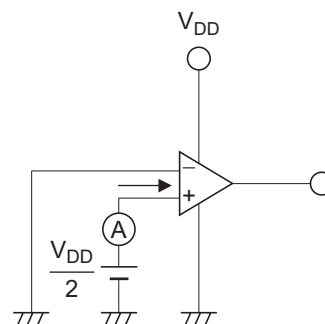
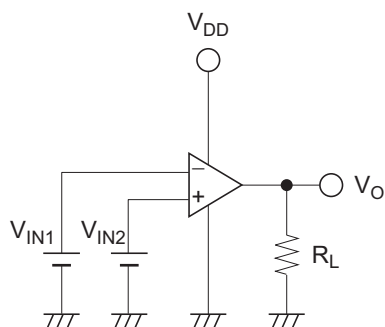
Test Circuits

1. Power Supply Rejection Ratio, PSRR & Voltage Offset, V_{IO}  V_{IO}

$$V_{IO} = \left(V_O - \frac{V_{DD}}{2} \right) \times \frac{R_S}{R_S + R_F}$$

 $PSRR$

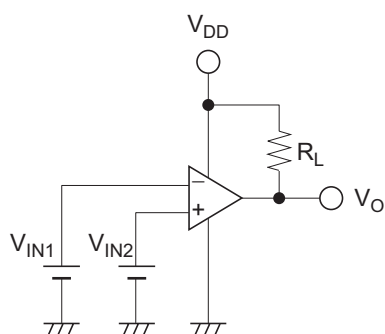
$$PSRR = -20 \log \left(\left| \frac{V_{O1} - V_{O2}}{V_{DD1} - V_{DD2}} \right| \times \frac{R_S}{R_S + R_F} \right)$$

Measure V_O corresponding to $V_{DD1} = 1.8 \text{ V}$ and $V_{DD2} = 5.5 \text{ V}$ 2. Supply Current, I_{DD} 3. Input Bias Current, I_{IB} 4. Output High Voltage, V_{OH}  V_{OH}

$$R_L = 1 \text{ M}\Omega$$

$$V_{IN1} = V_{DD} / 2 - 0.05 \text{ V}$$

$$V_{IN2} = V_{DD} / 2 + 0.05 \text{ V}$$

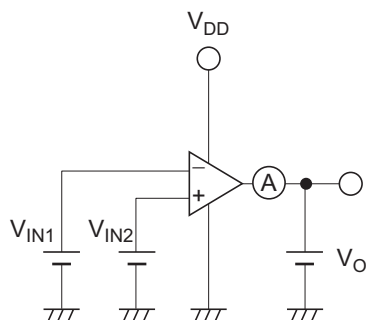
5. Output Low Voltage, V_{OL}  V_{OL}

$$R_L = 1 \text{ M}\Omega$$

$$V_{IN1} = V_{DD} / 2 + 0.05 \text{ V}$$

$$V_{IN2} = V_{DD} / 2 - 0.05 \text{ V}$$

6. Output Source Current, $I_{OSOURCE}$ & Output Sink Current, I_{OSINK}



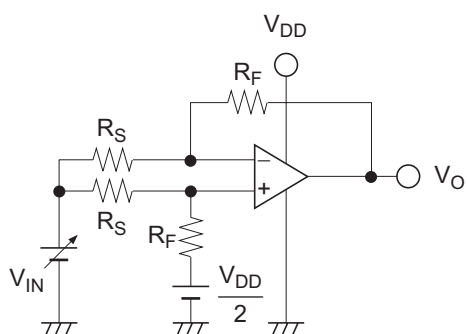
$I_{OSOURCE}$

$$\begin{aligned} V_O &= V_{DD} - 0.5 \text{ V} \\ V_{IN1} &= V_{DD} / 2 - 0.05 \text{ V} \\ V_{IN2} &= V_{DD} / 2 + 0.05 \text{ V} \end{aligned}$$

I_{OSINK}

$$\begin{aligned} V_O &= +0.5 \text{ V} \\ V_{IN1} &= V_{DD} / 2 + 0.05 \text{ V} \\ V_{IN2} &= V_{DD} / 2 - 0.05 \text{ V} \end{aligned}$$

7. Common Mode Input Voltage, V_{CM} & Common Mode Rejection Ratio, CMRR

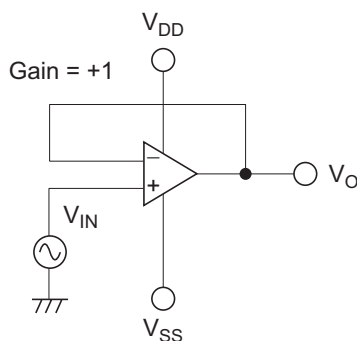
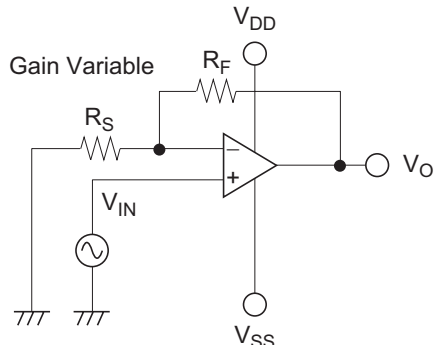


CMRR

$$CMRR = -20 \log \left(\left| \frac{V_{O1} - V_{O2}}{V_{IN1} - V_{IN2}} \right| \times \frac{R_S}{R_S + R_F} \right)$$

Measure V_O corresponding to $V_{IN1} = 0 \text{ V}$ and $V_{IN2} = 2.1 \text{ V}$

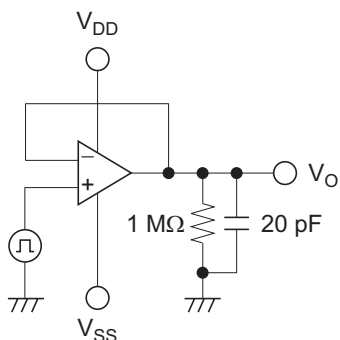
8. Total Harmonic Distortion, THD



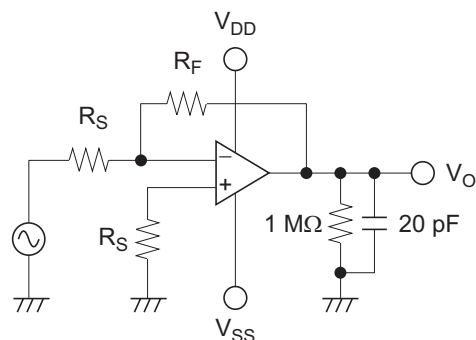
THD

Gain Variable
 $1 + R_F / R_S = 100$
 freq = 100 Hz, 1 kHz, 10 kHz

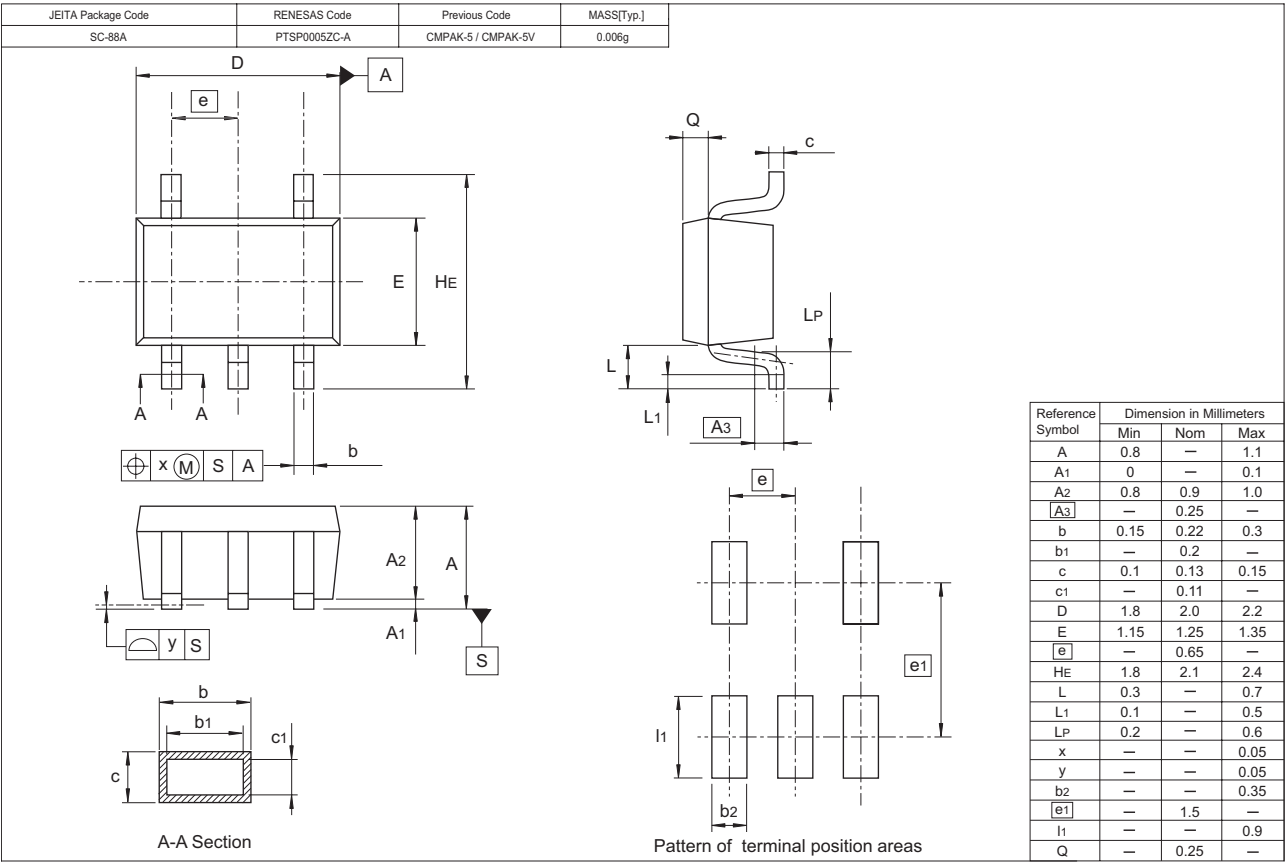
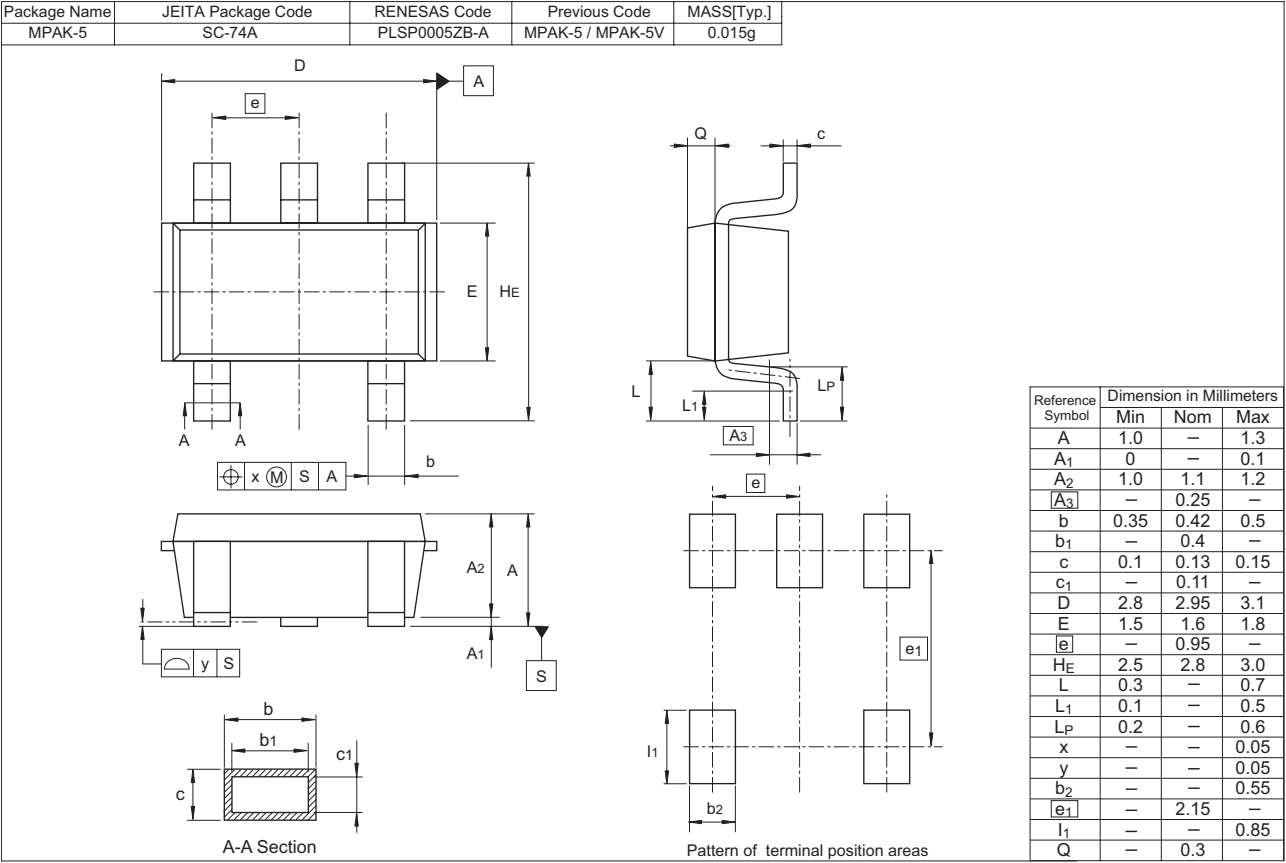
9. Slew Rate, SR



10. Gain, A_V & Phase, GBW



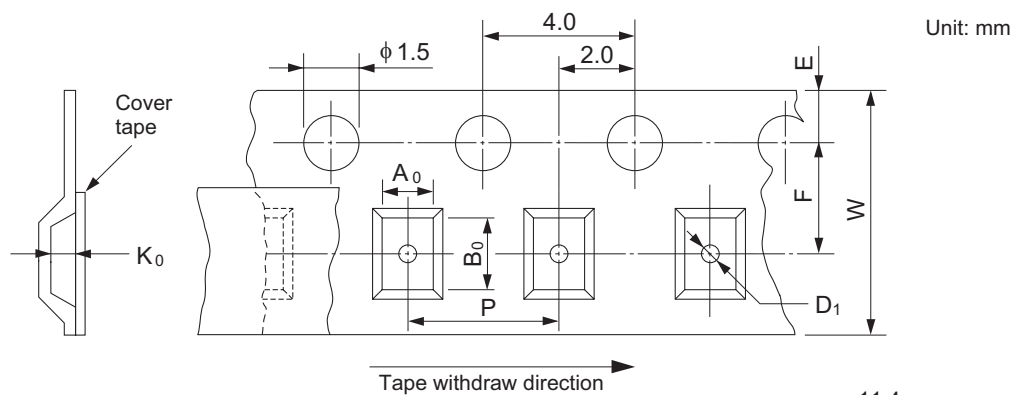
Package Dimensions



Taping & Reel Specification

[Taping]

Package Code	W	P	Ao	Bo	Ko	E	F	D1	Maximum Storage No.
MPAK-5	8	4	3.3	3.3	1.5	1.75	3.5	1.05	3,000 pcs/reel
CMPAK-5	8	4	2.25	2.45	1.1	1.75	3.5	1.05	3,000 pcs/reel

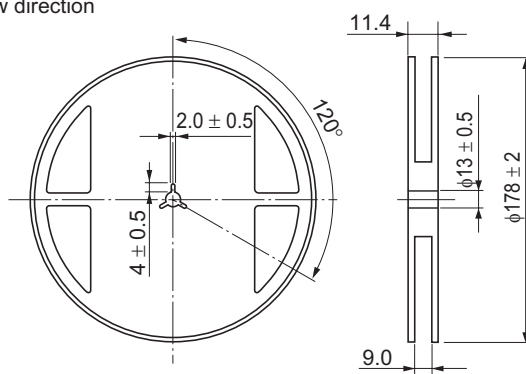


[Reel]

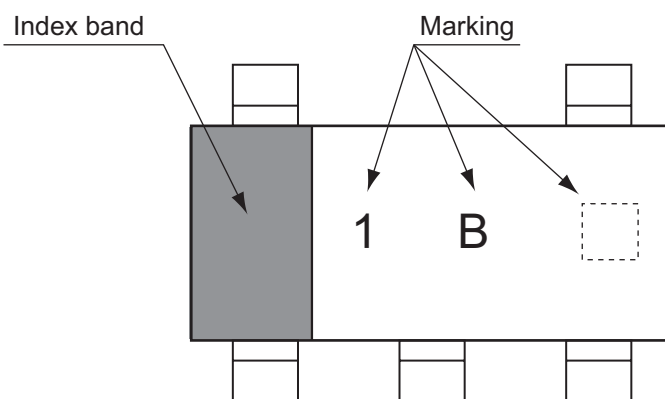
Package	Tape width	W1	W2
MPAK-5	8	11.4	9
CMPAK-5	8	11.4	9

[Ordering Information]

Ordering Unit
3,000 pcs



Mark Indication



1 A □ : HA1630S01

1 B □ : HA1630S02

1 C □ : HA1630S03

□ = Control code
(— or blank)

Renesas Technology Corp. Sales Strategic Planning Div. Nippon Bldg., 2-6-2, Ohte-machi, Chiyoda-ku, Tokyo 100-0004, Japan

Keep safety first in your circuit designs!

1. Renesas Technology Corp. puts the maximum effort into making semiconductor products better and more reliable, but there is always the possibility that trouble may occur with them. Trouble with semiconductors may lead to personal injury, fire or property damage.
Remember to give due consideration to safety when making your circuit designs, with appropriate measures such as (i) placement of substitutive, auxiliary circuits, (ii) use of nonflammable material or (iii) prevention against any malfunction or mishap.

Notes regarding these materials

1. These materials are intended as a reference to assist our customers in the selection of the Renesas Technology Corp. product best suited to the customer's application; they do not convey any license under any intellectual property rights, or any other rights, belonging to Renesas Technology Corp. or a third party.
2. Renesas Technology Corp. assumes no responsibility for any damage, or infringement of any third-party's rights, originating in the use of any product data, diagrams, charts, programs, algorithms, or circuit application examples contained in these materials.
3. All information contained in these materials, including product data, diagrams, charts, programs and algorithms represents information on products at the time of publication of these materials, and are subject to change by Renesas Technology Corp. without notice due to product improvements or other reasons. It is therefore recommended that customers contact Renesas Technology Corp. or an authorized Renesas Technology Corp. product distributor for the latest product information before purchasing a product listed herein.
The information described here may contain technical inaccuracies or typographical errors.
Renesas Technology Corp. assumes no responsibility for any damage, liability, or other loss rising from these inaccuracies or errors.
Please also pay attention to information published by Renesas Technology Corp. by various means, including the Renesas Technology Corp. Semiconductor home page (<http://www.renesas.com>).
4. When using any or all of the information contained in these materials, including product data, diagrams, charts, programs, and algorithms, please be sure to evaluate all information as a total system before making a final decision on the applicability of the information and products. Renesas Technology Corp. assumes no responsibility for any damage, liability or other loss resulting from the information contained herein.
5. Renesas Technology Corp. semiconductors are not designed or manufactured for use in a device or system that is used under circumstances in which human life is potentially at stake. Please contact Renesas Technology Corp. or an authorized Renesas Technology Corp. product distributor when considering the use of a product contained herein for any specific purposes, such as apparatus or systems for transportation, vehicular, medical, aerospace, nuclear, or undersea repeater use.
6. The prior written approval of Renesas Technology Corp. is necessary to reprint or reproduce in whole or in part these materials.
7. If these products or technologies are subject to the Japanese export control restrictions, they must be exported under a license from the Japanese government and cannot be imported into a country other than the approved destination.
Any diversion or reexport contrary to the export control laws and regulations of Japan and/or the country of destination is prohibited.
8. Please contact Renesas Technology Corp. for further details on these materials or the products contained therein.



RENESAS SALES OFFICES

<http://www.renesas.com>

Refer to "<http://www.renesas.com/en/network>" for the latest and detailed information.

Renesas Technology America, Inc.

450 Holger Way, San Jose, CA 95134-1368, U.S.A
Tel: <1> (408) 382-7500, Fax: <1> (408) 382-7501

Renesas Technology Europe Limited

Dukes Meadow, Millboard Road, Bourne End, Buckinghamshire, SL8 5FH, U.K.
Tel: <44> (1628) 585-100, Fax: <44> (1628) 585-900

Renesas Technology (Shanghai) Co., Ltd.

Unit 204, 205, AZIA Center, No.1233 Lujiazui Ring Rd, Pudong District, Shanghai, China 200120
Tel: <86> (21) 5877-1818, Fax: <86> (21) 6887-7898

Renesas Technology Hong Kong Ltd.

7th Floor, North Tower, World Finance Centre, Harbour City, 1 Canton Road, Tsimshatsui, Kowloon, Hong Kong
Tel: <852> 2265-6688, Fax: <852> 2730-6071

Renesas Technology Taiwan Co., Ltd.

10th Floor, No.99, Fushing North Road, Taipei, Taiwan
Tel: <886> (2) 2715-2888, Fax: <886> (2) 2713-2999

Renesas Technology Singapore Pte. Ltd.

1 Harbour Front Avenue, #06-10, Keppel Bay Tower, Singapore 098632
Tel: <65> 6213-0200, Fax: <65> 6278-8001

Renesas Technology Korea Co., Ltd.

Kukje Center Bldg. 18th Fl., 191, 2-ka, Hangang-ro, Yongsan-ku, Seoul 140-702, Korea
Tel: <82> (2) 796-3115, Fax: <82> (2) 796-2145

Renesas Technology Malaysia Sdn. Bhd

Unit 906, Block B, Menara Amcorp, Amcorp Trade Centre, No.18, Jalan Persiaran Barat, 46050 Petaling Jaya, Selangor Darul Ehsan, Malaysia
Tel: <603> 7955-9390, Fax: <603> 7955-9510



ООО «НИОКРсистемс» - это оперативные поставки широкого спектра электронных компонентов отечественного и импортного производства напрямую от производителей и с крупнейших мировых складов. Реализуемая нашей компанией продукция насчитывает более полумиллиона наименований.

Благодаря этому наша компания предлагает к поставке практически не ограниченный ассортимент компонентов как оптовыми, мелкооптовыми партиями, так и в розницу.

Благодаря развитой сети поставщиков, помогаем в поиске и приобретении экзотичных или снятых с производства компонентов.

Наша компания это:

- Гарантия качества поставляемой продукции
- Широкий ассортимент
- Минимальные сроки поставок
- Техническая поддержка
- Подбор комплектации
- Индивидуальный подход
- Гибкое ценообразование
- Работаем по 275 ФЗ