To our customers,

Old Company Name in Catalogs and Other Documents

On April 1st, 2010, NEC Electronics Corporation merged with Renesas Technology Corporation, and Renesas Electronics Corporation took over all the business of both companies. Therefore, although the old company name remains in this document, it is a valid Renesas Electronics document. We appreciate your understanding.

Renesas Electronics website: http://www.renesas.com

April 1st, 2010
Renesas Electronics Corporation

Issued by: Renesas Electronics Corporation (http://www.renesas.com)

Send any inquiries to http://www.renesas.com/inquiry.

RENESAS

Notice

1. All information included in this document is current as of the date this document is issued. Such information, however, is subject to change without any prior notice. Before purchasing or using any Renesas Electronics products listed herein, please confirm the latest product information with a Renesas Electronics sales office. Also, please pay regular and careful attention to additional and different information to be disclosed by Renesas Electronics such as that disclosed through our website.
2. Renesas Electronics does not assume any liability for infringement of patents, copyrights, or other intellectual property rights of third parties by or arising from the use of Renesas Electronics products or technical information described in this document. No license, express, implied or otherwise, is granted hereby under any patents, copyrights or other intellectual property rights of Renesas Electronics or others.
3. You should not alter, modify, copy, or otherwise misappropriate any Renesas Electronics product, whether in whole or in part.
4. Descriptions of circuits, software and other related information in this document are provided only to illustrate the operation of semiconductor products and application examples. You are fully responsible for the incorporation of these circuits, software, and information in the design of your equipment. Renesas Electronics assumes no responsibility for any losses incurred by you or third parties arising from the use of these circuits, software, or information.
5. When exporting the products or technology described in this document, you should comply with the applicable export control laws and regulations and follow the procedures required by such laws and regulations. You should not use Renesas Electronics products or the technology described in this document for any purpose relating to military applications or use by the military, including but not limited to the development of weapons of mass destruction. Renesas Electronics products and technology may not be used for or incorporated into any products or systems whose manufacture, use, or sale is prohibited under any applicable domestic or foreign laws or regulations.
6. Renesas Electronics has used reasonable care in preparing the information included in this document, but Renesas Electronics does not warrant that such information is error free. Renesas Electronics assumes no liability whatsoever for any damages incurred by you resulting from errors in or omissions from the information included herein.
7. Renesas Electronics products are classified according to the following three quality grades: “Standard”, “High Quality”, and “Specific”. The recommended applications for each Renesas Electronics product depends on the product’s quality grade, as indicated below. You must check the quality grade of each Renesas Electronics product before using it in a particular application. You may not use any Renesas Electronics product for any application categorized as “Specific” without the prior written consent of Renesas Electronics. Further, you may not use any Renesas Electronics product for any application for which it is not intended without the prior written consent of Renesas Electronics. Renesas Electronics shall not be in any way liable for any damages or losses incurred by you or third parties arising from the use of any Renesas Electronics product for an application categorized as “Specific” or for which the product is not intended where you have failed to obtain the prior written consent of Renesas Electronics. The quality grade of each Renesas Electronics product is “Standard” unless otherwise expressly specified in a Renesas Electronics data sheets or data books, etc.

   “Standard”: Computers; office equipment; communications equipment; test and measurement equipment; audio and visual equipment; home electronic appliances; machine tools; personal electronic equipment; and industrial robots.

   “High Quality”: Transportation equipment (automobiles, trains, ships, etc.); traffic control systems; anti-disaster systems; anti-crime systems; safety equipment; and medical equipment not specifically designed for life support.

   “Specific”: Aircraft; aerospace equipment; submersible repeaters; nuclear reactor control systems; medical equipment or systems for life support (e.g. artificial life support devices or systems), surgical implantations, or healthcare intervention (e.g. excision, etc.), and any other applications or purposes that pose a direct threat to human life.
8. You should use the Renesas Electronics products described in this document within the range specified by Renesas Electronics, especially with respect to the maximum rating, operating supply voltage range, movement power voltage range, heat radiation characteristics, installation and other product characteristics. Renesas Electronics shall have no liability for malfunctions or damages arising out of the use of Renesas Electronics products beyond such specified ranges.
9. Although Renesas Electronics endeavors to improve the quality and reliability of its products, semiconductor products have specific characteristics such as the occurrence of failure at a certain rate and malfunctions under certain use conditions. Further, Renesas Electronics products are not subject to radiation resistance design. Please be sure to implement safety measures to guard them against the possibility of physical injury, and injury or damage caused by fire in the event of the failure of a Renesas Electronics product, such as safety design for hardware and software including but not limited to redundancy, fire control and malfunction prevention, appropriate treatment for aging degradation or any other appropriate measures. Because the evaluation of microcomputer software alone is very difficult, please evaluate the safety of the final products or system manufactured by you.
10. Please contact a Renesas Electronics sales office for details as to environmental matters such as the environmental compatibility of each Renesas Electronics product. Please use Renesas Electronics products in compliance with all applicable laws and regulations that regulate the inclusion or use of controlled substances, including without limitation, the EU RoHS Directive. Renesas Electronics assumes no liability for damages or losses occurring as a result of your noncompliance with applicable laws and regulations.
11. This document may not be reproduced or duplicated, in any form, in whole or in part, without prior written consent of Renesas Electronics.
12. Please contact a Renesas Electronics sales office if you have any questions regarding the information contained in this document or Renesas Electronics products, or if you have any other inquiries.

(Note 1) “Renesas Electronics” as used in this document means Renesas Electronics Corporation and also includes its majority-owned subsidiaries.

(Note 2) “Renesas Electronics product(s)” means any product developed or manufactured by or for Renesas Electronics.

HA1630S08

Single CMOS High Drive Operational Amplifier

REJ03D0908-0100
Rev.1.00
Feb 22, 2008

Description

HA1630S08 is a low power single CMOS operational amplifier featuring high output current with typical current supply of 170 µA (2.7 - 5.5 V). This IC designed to operate from a single power supply and have full swing outputs. Available in CMPAK-5 and MPAK-5 package, the miniature size of this IC not only allows compact integration in portable devices but also minimizes distance of signal sources (sensors), thus reducing external noise pick up prior to amplification. This IC exhibit excellent current drive-power ratio capable of 600 Ω load driving and yet resistant to oscillation for capacitive loads up to 400 pF.

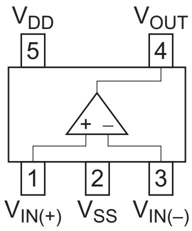
Features

- Low supply current — I_{DD} = 170 µA Typ (V_{DD} = 3 V, R_L = No load)
- Low voltage operation — V_{DD} = 2.7 V to 5.5 V
- Low input offset voltage — V_{IO} = 6 mV Max
- Low input bias current — I_{IB} = 1 pA Typ
- High output current — $I_{OSOURCE}$ = 30 mA Typ (V_{DD} = 3.0 V, V_{OH} = 2.5 V)
  I_{OSINK} = 30 mA Typ (V_{DD} = 3.0 V, V_{OL} = 0.5 V)
- Input common voltage range includes ground

Ordering Information

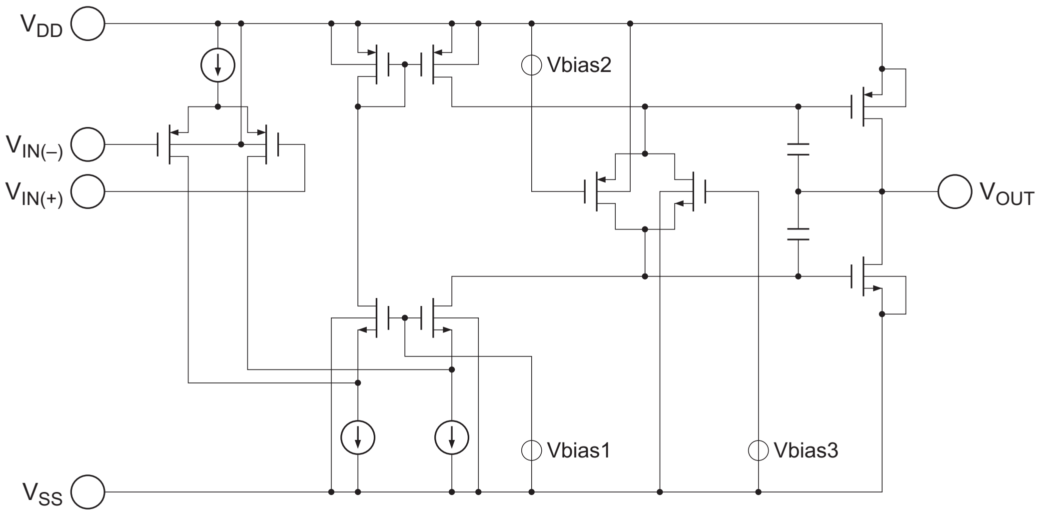
Part No.	Package Name	Package Code
HA1630S08CM	CMPAK-5	PTSP0005ZC-A
HA1630S08LP	MPAK-5	PLSP0005ZB-A

Pin Arrangement



(Top view)

Equivalent Circuit



Absolute Maximum Ratings

(Ta = 25°C)

Item	Symbol	Ratings	Unit	Note
Supply voltage	V_{DD}	7.0	V	
Differential input voltage	$V_{IN(diff)}$	$-V_{DD}$ to $+V_{DD}$	V	1
Input voltage	V_{IN}	–0.1 to $+V_{DD}$	V	
Output current	I_{OUT}	70	mA	
Power dissipation	P_T	80 (CMPAK-5)	mW	2
		120 (MPAK-5)		
Operating temperature	Topr	–40 to +85	°C	
Storage temperature	Tstg	–55 to +125	°C	

Note: 1. Do not apply input voltage exceeding V_{DD} or 7 V.
2. If Ta > 25°C,
CMPAK-5: –0.8 mW/°C
MPAK-5: –1.2 mW/°C

Electrical Characteristics

DC Characteristics

(Ta = 25°C, V_{DD} = 3.0 V, V_{SS} = 0 V)

Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Input offset voltage	V_{IO}	—	—	6	mV	V_{IN} = 1.5 V, R_L = 1 MΩ
Input bias current	I_{IB}	—	(1)	—	pA	V_{IN} = 1.5 V
Input offset current	I_{IO}	—	(1)	—	pA	V_{IN} = 1.5 V
Common mode input voltage range	V_{CM}	–0.1	—	1.8	V	
Supply current	I_{DD}	—	170	500	µA	$V_{IN(+)}$ = 1.0 V, $R_L = \infty$
Output source current	$I_{OSOURCE}$	15	30	—	mA	Vout = 2.5 V
Output sink current	I_{OSINK}	15	30	—	mA	Vout = 0.5 V
Open loop voltage gain	A_V	55	80	—	dB	R_L = 100 kΩ
Common mode rejection ratio	CMRR	50	80	—	dB	V_{IN1} = 0 V, V_{IN2} = 1.8 V
Power supply rejection ratio	PSRR	55	80	—	dB	V_{DD1} = 2.7 V, V_{DD2} = 5.5 V
Output high voltage	V_{OH}	2.9	—	—	V	R_L = 600 Ω to V_{SS}
Output low voltage	V_{OL}	—	—	0.1	V	R_L = 600 Ω to V_{DD}

Note: ( ) : Design specification

AC Characteristics

(Ta = 25°C, V_{DD} = 3.0 V, V_{SS} = 0 V)

Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Slew rate	SRr	—	(1.5)	—	V/µs	V_{IN} = 1.5 V, C_L = 15 pF
	SRf	—	(1.5)	—		(V_{INL} = 0.2 V, V_{INH} = 1.7 V)
Gain bandwidth product	GBW	—	(2.0)	—	MHz	V_{IN} = 1.5 V, C_L = 15 pF

Note: ( ) : Design specification

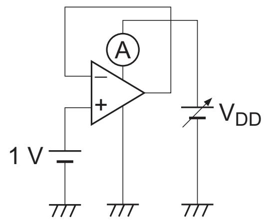
Table of Graphs

Electrical Characteristics			Characteristic Curves	Test Circuit No.
Supply current	I_{DD}	vs. Supply voltage	1	1
		vs. Temperature	2	1
Output high voltage	V_{OH}	vs. Rload	3	2
Output low voltage	V_{OL}	vs. Rload	4	3
Output source current	$I_{OSOURCE}$	vs. Output high voltage	5	4
		vs. Temperature	6	4
Output sink current	I_{OSINK}	vs. Output low voltage	7	5
		vs. Temperature	8	5
Input offset voltage	V_{IO}	vs. Supply voltage	9	6
		vs. Input voltage	10	6
		vs. Temperature	11	7
Common mode input voltage range	V_{CM}	vs. Supply voltage	12	8
		vs. Temperature	13	8
Common mode rejection ratio	CMRR	vs. Input voltage	14	9
Power supply rejection ratio	PSRR	vs. Supply voltage	15	10
Input bias current	I_{IB}	vs. Input voltage	16	11, 12
		vs. Temperature	17	11, 12
Slew rate (rising)	SRr	vs. Cload	18	13
		vs. Temperature	19	13
		Time waveform	20	13
Slew rate (falling)	SRf	vs. Cload	21	13
		vs. Temperature	22	13
		Time waveform	23	13
Open loop gain	A_V	vs. Rload	24	14
		vs. Frequency	25, 26	14
Phase margin	PM	vs. Cload	27	14
Noise input voltage	VNI	vs. Frequency	28	15

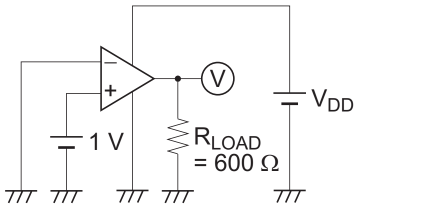
Test Circuits

(Unless otherwise noted, V_{DD} = 3 V, V_{SS} = 0 V, Ta = 25°C)

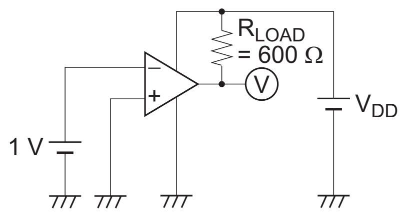
1. Supply Current, I_{DD}



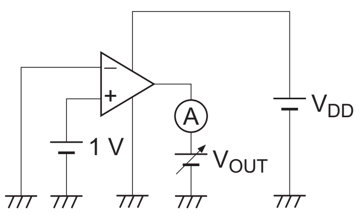
2. Output High Voltage, V_{OH} (Output High)



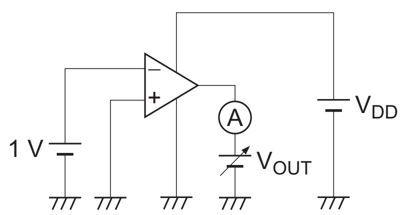
3. Output Low Voltage, V_{OL} (Output Low)



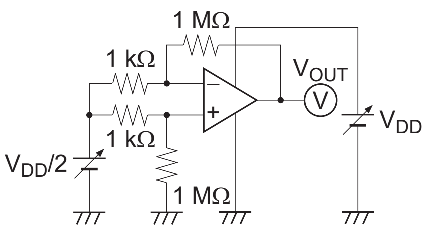
4. Output Source Current, $I_{OSOURCE}$



5. Output Sink Current, I_{OSINK}

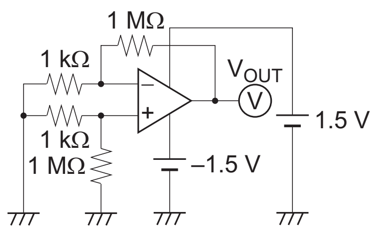


6. Input Offset Voltage vs. Operating Voltage



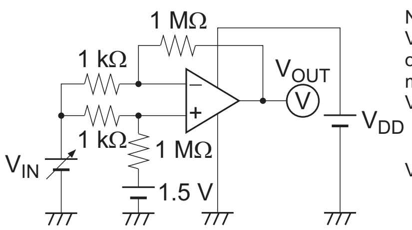
$V_{IO} = V_{OUT} / 1001$

7. Input Offset Voltage, V_{IO}

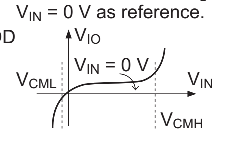


$V_{IO} = V_{OUT} / 1001$

8. Common Mode Input Voltage Range, V_{CM}



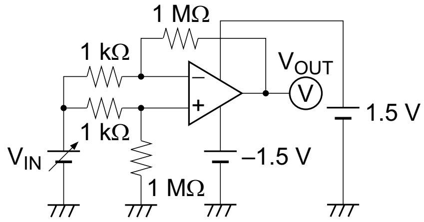
Note:
V_{CML} and V_{CMH} are values of V_{IN} when V_{IO} changes more than 50 dB taking V_{IN} = 0 V as reference.



Test Circuits (cont.)

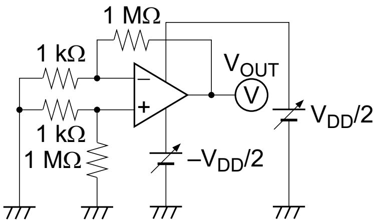
(Unless otherwise noted, V_{DD} = 3 V, V_{SS} = 0 V, Ta = 25°C)

9. Common Mode Rejection Ratio, CMRR



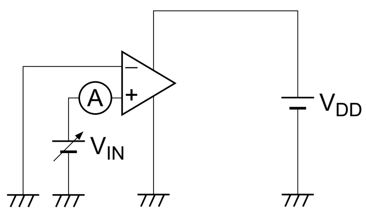
V_{IN}	Measure Point	Calculate V_{IO}	CMRR Calculation
–1.5 V	V_{OUT1}	$V_{IO1} = V_{OUT1} / 1001$	$CMRR = \left\| 20\log_{10} \frac{\|[V_{IO2} - V_{IO1}]\|}{0.3 - (-1.5\ V)} \right\|$
0.3 V	V_{OUT2}	$V_{IO2} = V_{OUT2} / 1001$	

10. Power Supply Rejection Ratio, PSRR

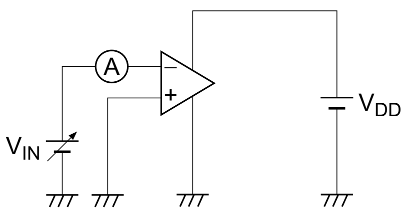


V_{DD}	Measure Point	Calculate V_{IO}	CMRR Calculation
2.7 V	V_{OUT1}	$V_{IO1} = V_{OUT1} / 1001$	$PSRR = \left\| 20\log_{10} \frac{\|[V_{IO2} - V_{IO1}]\|}{5.5\ V - 2.7\ V} \right\|$
5.5 V	V_{OUT2}	$V_{IO2} = V_{OUT2} / 1001$	

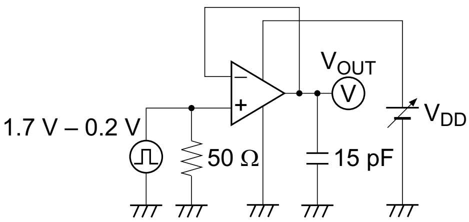
11. Input Bias Current, I_{IB+}

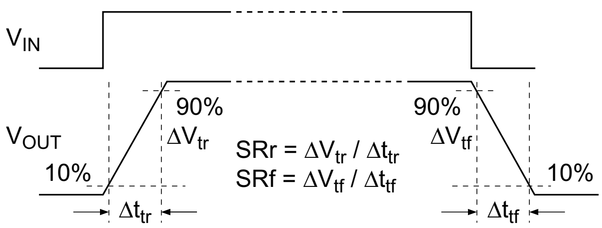


12. Input Bias Current, I_{IB-}



13. Slew Rate (Large Signal Input)

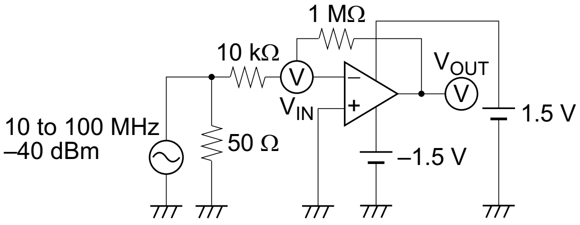




Test Circuits (cont.)

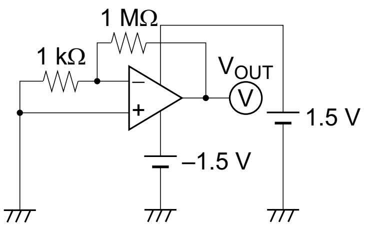
(Unless otherwise noted, V_{DD} = 3 V, V_{SS} = 0 V, Ta = 25°C)

14. Open Loop Voltage Gain, A_V



$$A_V = \left| 20\log_{10} \frac{101 \times |V_{OUT}|}{|V_{IN}|} \right|$$

15. Noise Input Voltage, VNI



$$VNI = \frac{V_{OUT}}{1001}$$

Characteristic Curves

Figure 1 HA1630S08
Supply Current vs. Supply Voltage

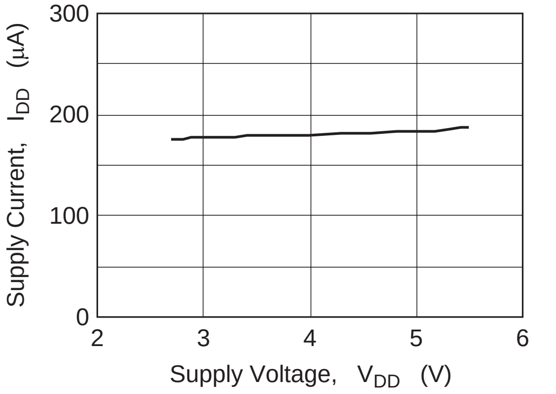


Figure 2 HA1630S08
Supply Current vs. Ambient Temperature

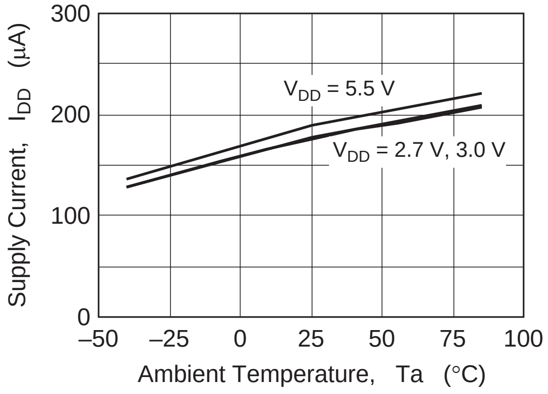


Figure 3 HA1630S08
Output High Voltage vs. Resistor Load

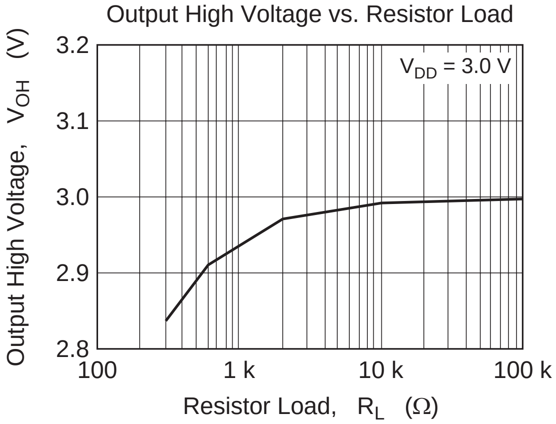


Figure 4 HA1630S08
Output Low Voltage vs. Resistor Load

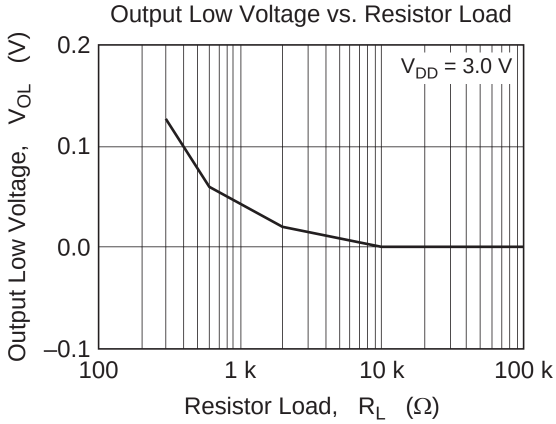


Figure 5 HA1630S08
Output High Voltage vs. Output Source Current

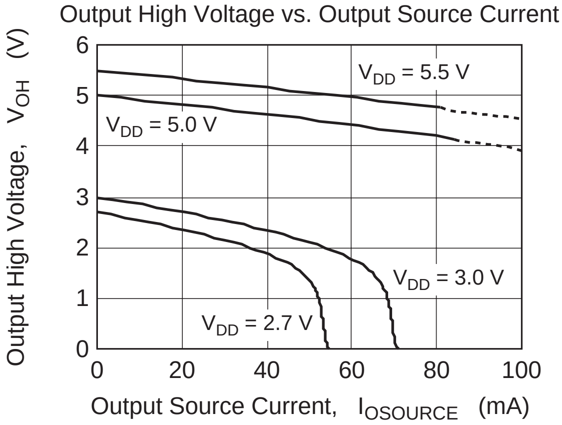
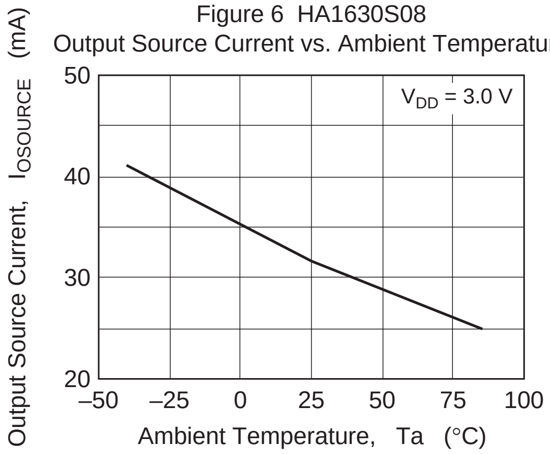


Figure 6 HA1630S08
Output Source Current vs. Ambient Temperature



Characteristic Curves (cont.)

Figure 7 HA1630S08
Output Low Voltage vs. Output Sink Current

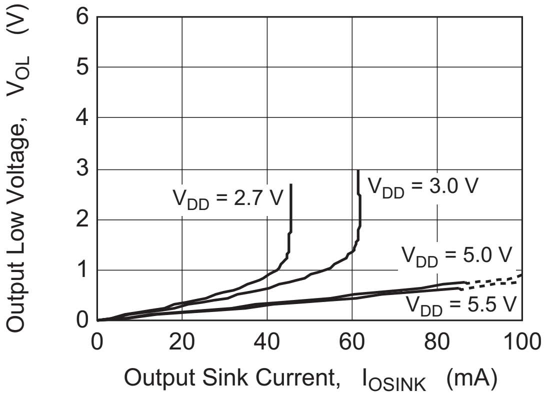


Figure 8 HA1630S08
Output Sink Current vs. Ambient Temperature

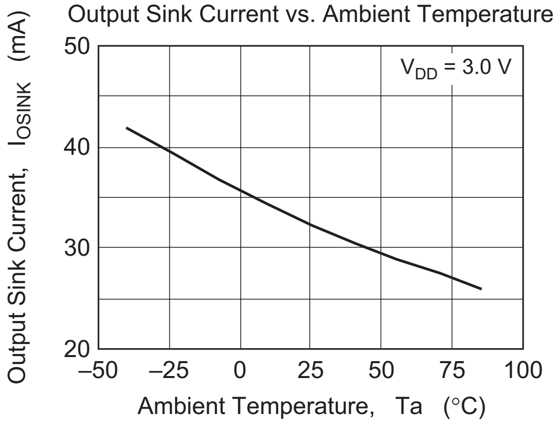


Figure 9 HA1630S08
Input Offset Voltage vs. Supply Voltage

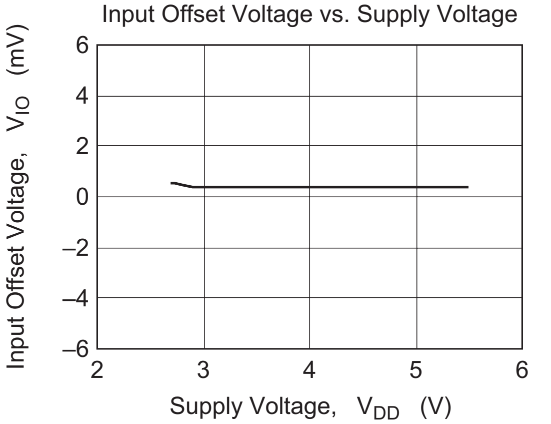


Figure 10 HA1630S08
Input Offset Voltage vs. Input Voltage

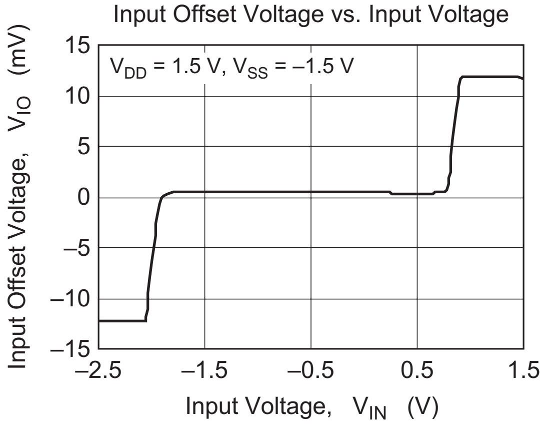


Figure 11 HA1630S08
Input Offset Voltage vs. Ambient Temperature

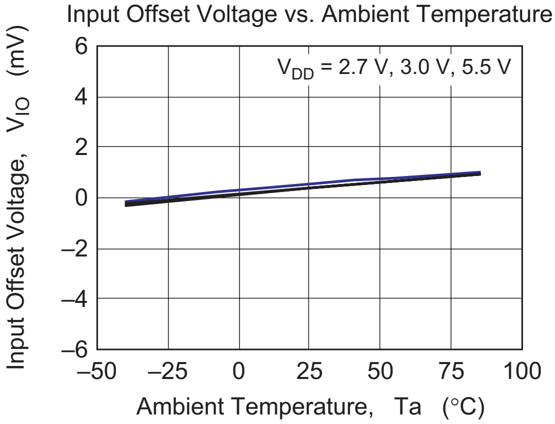
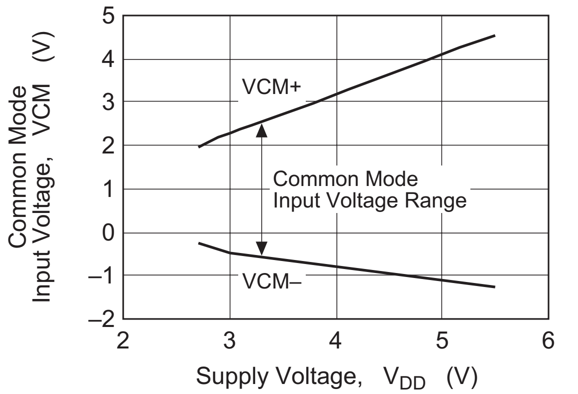


Figure 12 HA1630S08
Common Mode Input Voltage vs. Supply Voltage



Characteristic Curves (cont.)

Figure 13 HA1630S08
Common Mode Input Voltage vs. Ambient Temperature

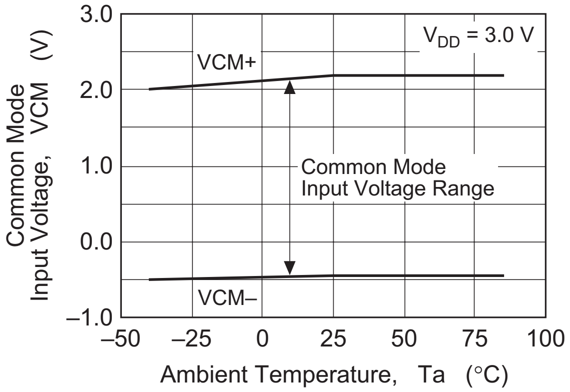


Figure 14 HA1630S08
Common Mode Rejection Ratio vs. Input Voltage

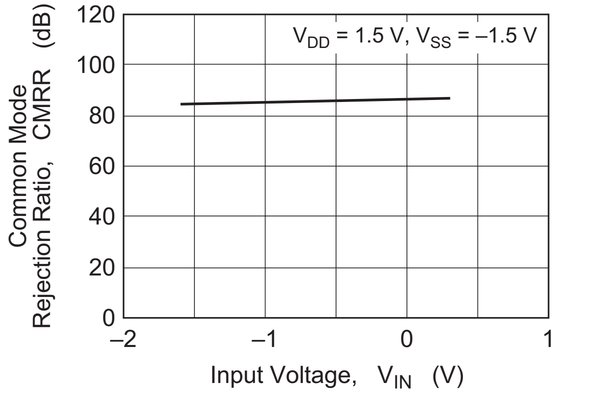


Figure 15 HA1630S08
Power Supply Rejection Ratio vs. Supply Voltage

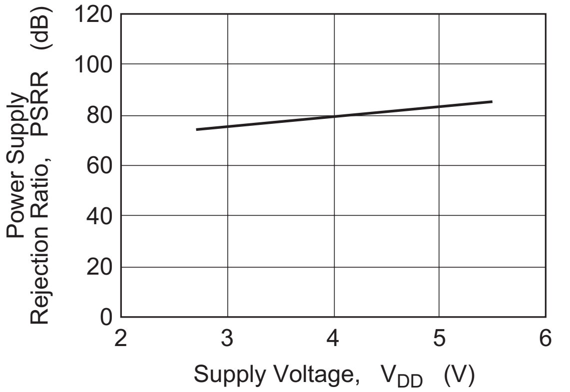


Figure 16 HA1630S08
Input Bias Current vs. Input Voltage

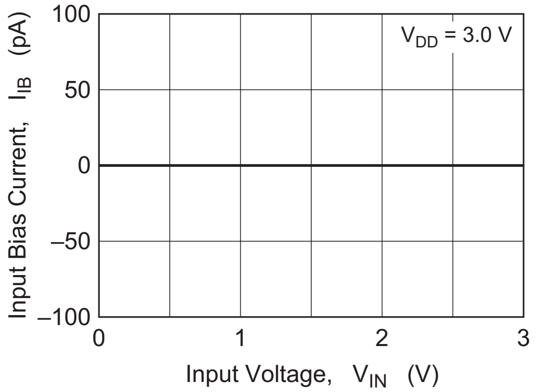


Figure 17 HA1630S08
Input Bias Current vs. Ambient Temperature

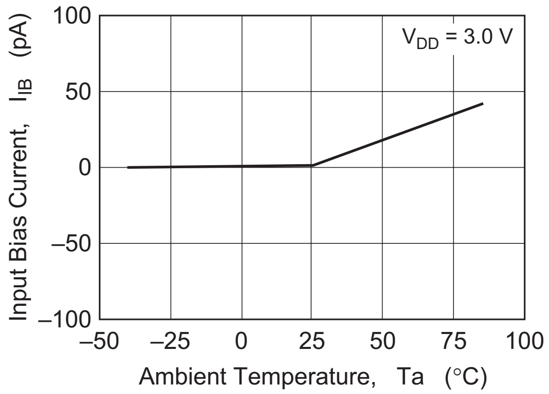
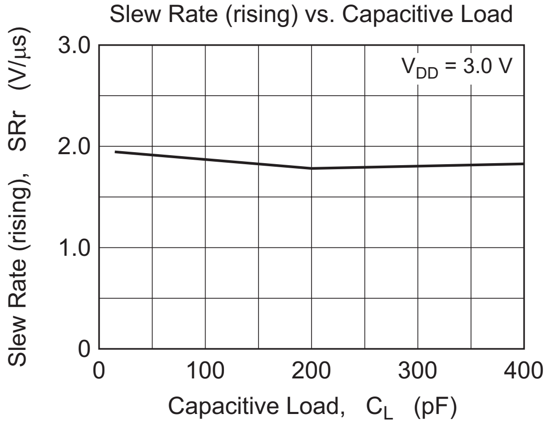


Figure 18 HA1630S08
Slew Rate (rising) vs. Capacitive Load



Characteristic Curves (cont.)

Figure 19 HA1630S08
Slew Rate (rising) vs. Ambient Temperature

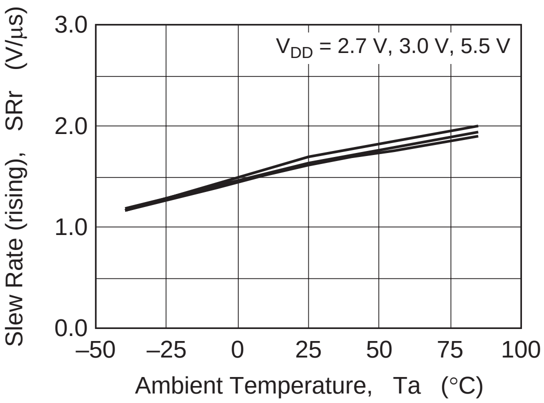


Figure 20 HA1630S08
Slew Rate (rising)

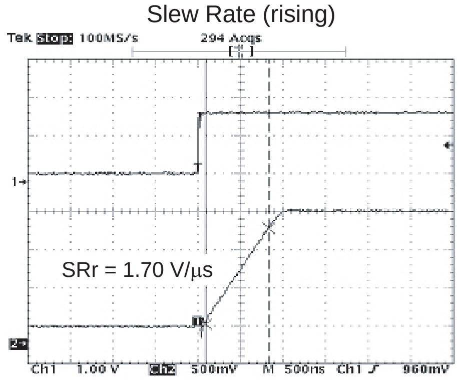


Figure 21 HA1630S08
Slew Rate (falling) vs. Capacitive Load

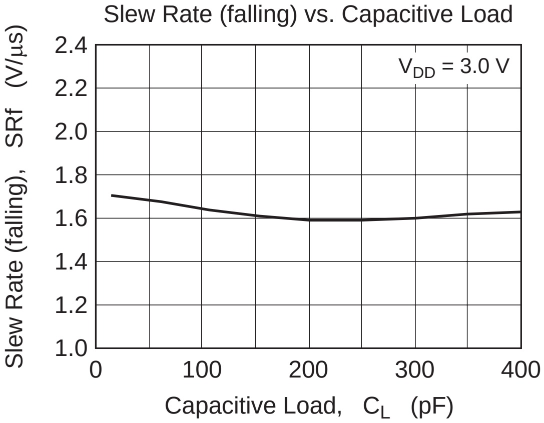


Figure 22 HA1630S08
Slew Rate (falling) vs. Ambient Temperature

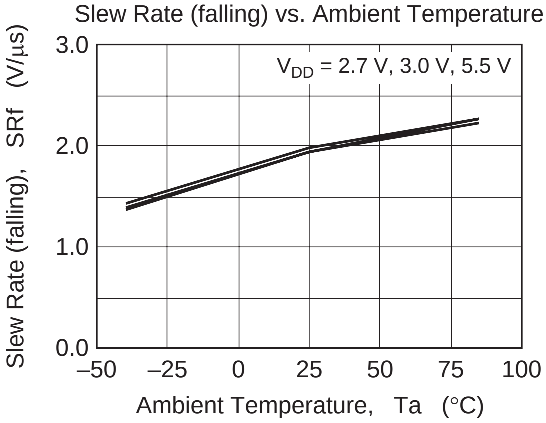


Figure 23 HA1630S08
Slew Rate (falling)

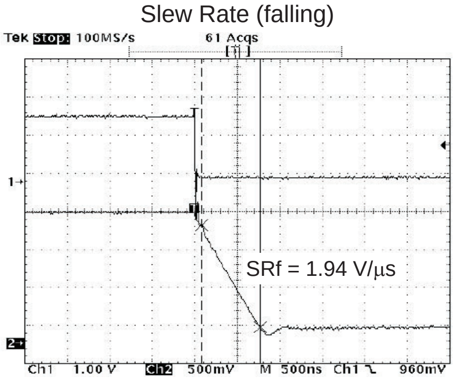
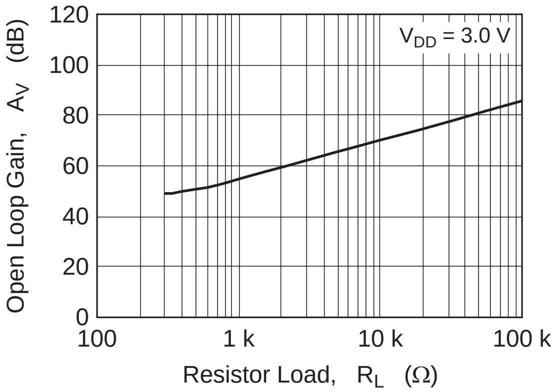
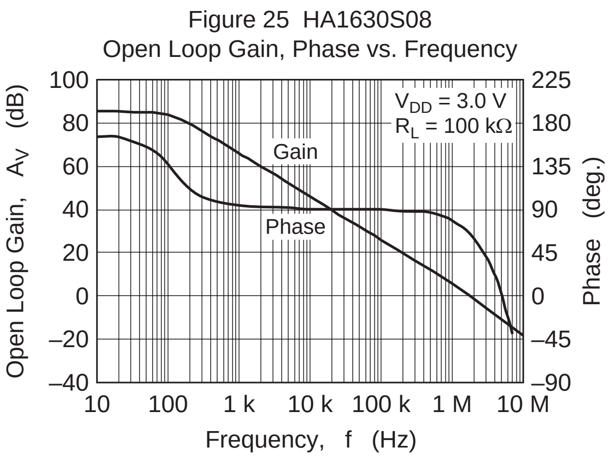
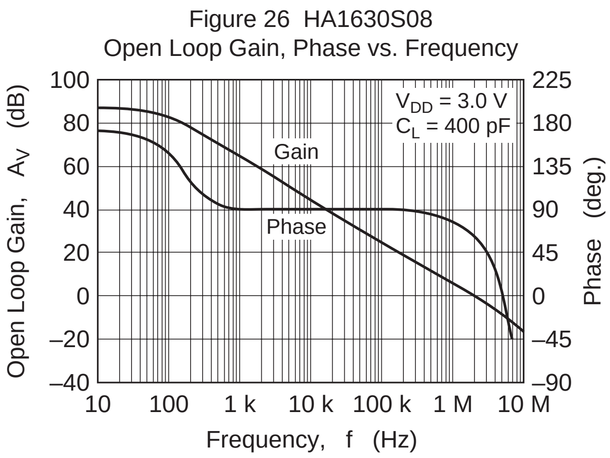


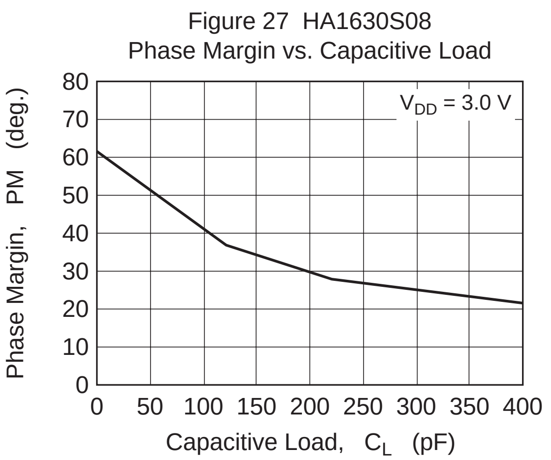
Figure 24 HA1630S08
Open Loop Gain vs. Resistor Load

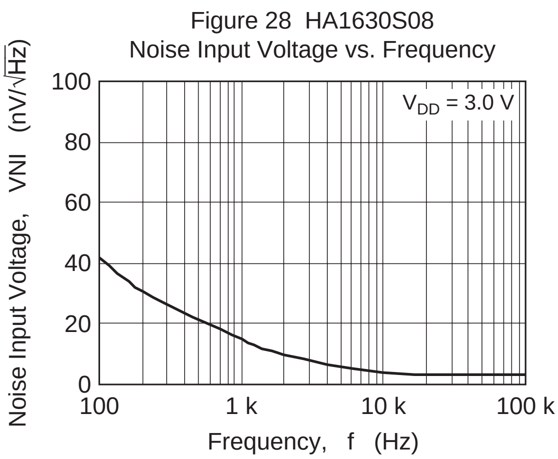


Characteristic Curves (cont.)



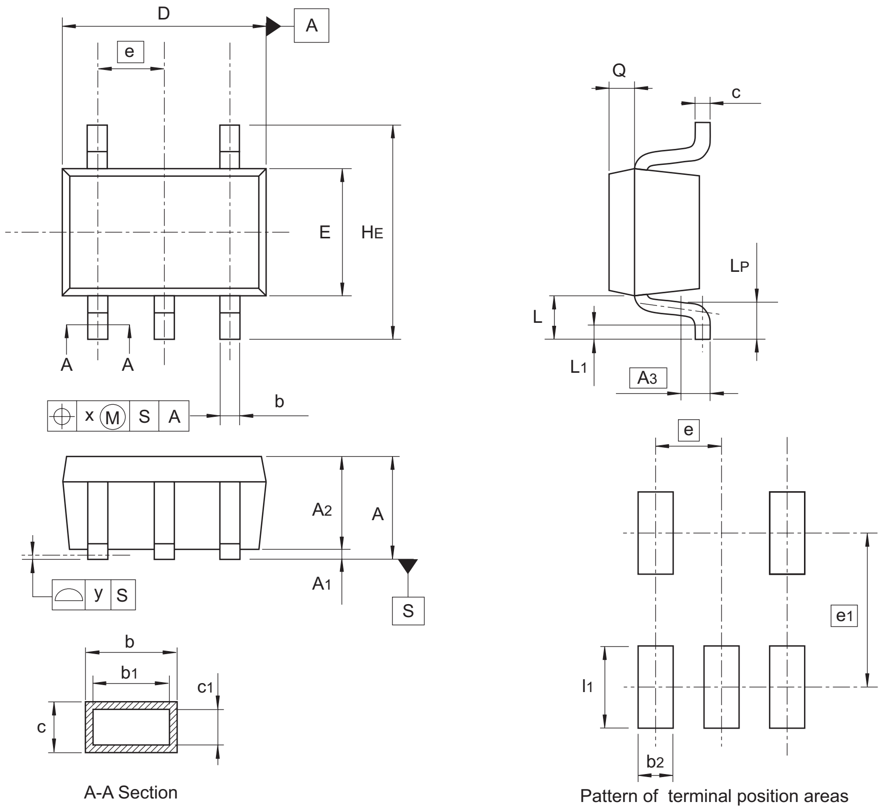






Package Dimensions

JEITA Package Code	RENESAS Code	Previous Code	MASS[Typ.]
SC-88A	PTSP0005ZC-A	CMPAK-5 / CMPAK-5V	0.006g

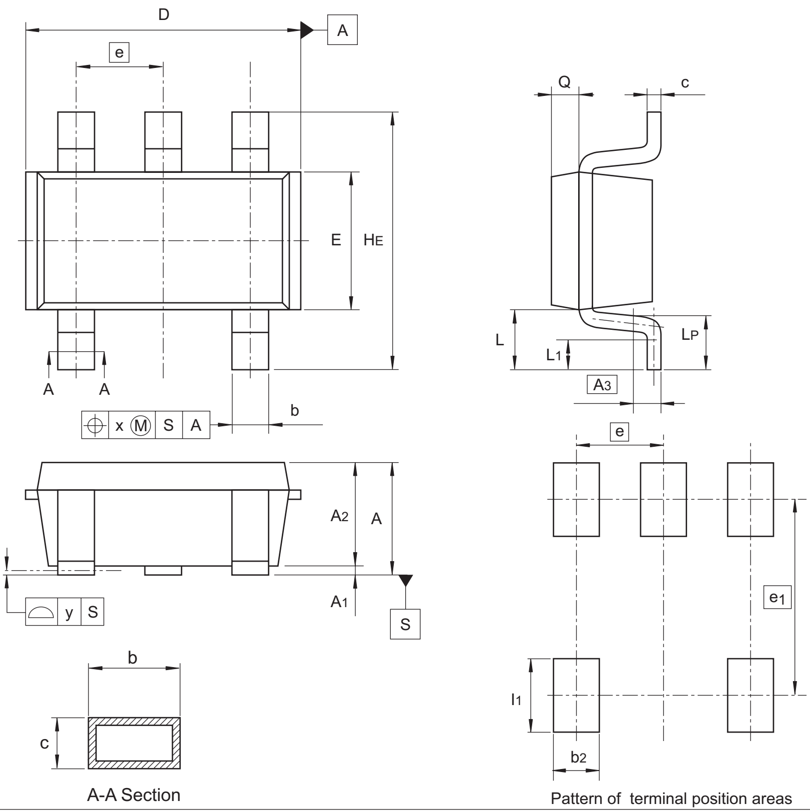


A-A Section

Pattern of terminal position areas

Reference Symbol	Dimension in Millimeters		
	Min	Nom	Max
A	0.8	—	1.1
A_1	0	—	0.1
A_2	0.8	0.9	1.0
A_3	—	0.25	—
b	0.15	0.22	0.3
b_1	—	0.2	—
c	0.1	0.13	0.15
c_1	—	0.11	—
D	1.8	2.0	2.2
E	1.15	1.25	1.35
e	—	0.65	—
H_E	1.8	2.1	2.4
L	0.3	—	0.7
L_1	0.1	—	0.5
L_P	0.2	—	0.6
x	—	—	0.05
y	—	—	0.05
b_2	—	—	0.35
e_1	—	1.5	—
l_1	—	—	0.9
Q	—	0.25	—

Package Name	JEITA Package Code	RENESAS Code	Previous Code	MASS[Typ.]
MPAK-5	SC-74A	PLSP0005ZB-A	MPAK-5 / MPAK-5V	0.015g



A-A Section

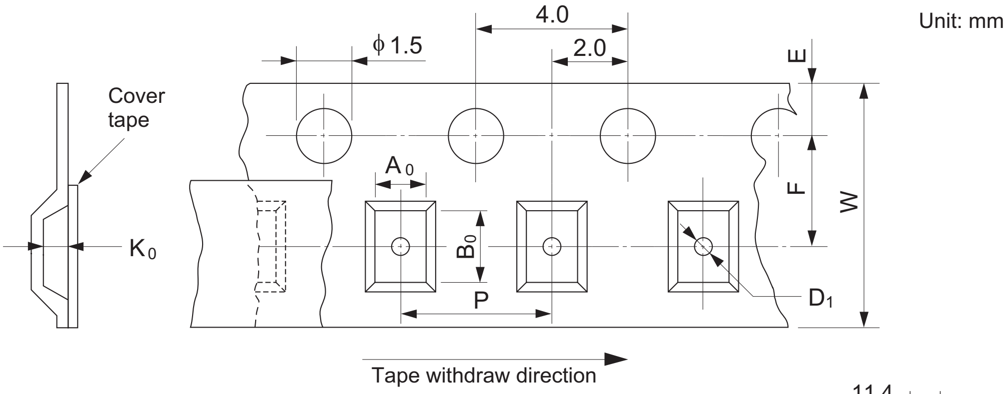
Pattern of terminal position areas

Reference Symbol	Dimension in Millimeters		
	Min	Nom	Max
A	1.0	—	1.4
A_1	0	—	0.1
A_2	1.0	1.1	1.3
A_3	—	0.25	—
b	0.35	0.4	0.5
c	0.11	0.16	0.26
D	2.8	2.95	3.1
E	1.5	1.6	1.8
e	—	0.95	—
H_E	2.5	2.8	3.0
L	0.3	—	0.7
L_1	0.1	—	0.5
L_P	0.2	—	0.6
x	—	—	0.05
y	—	—	0.05
b_2	—	—	0.55
e_1	—	2.15	—
l_1	—	—	0.85
Q	—	0.3	—

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

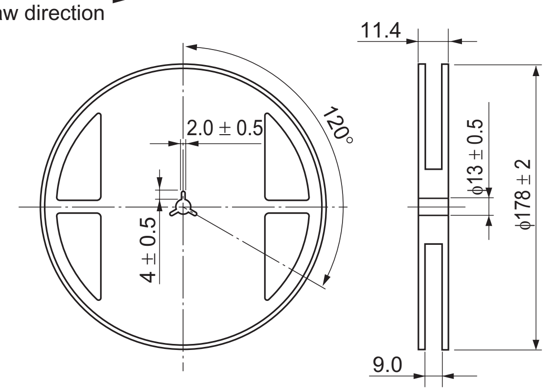


[Reel]

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

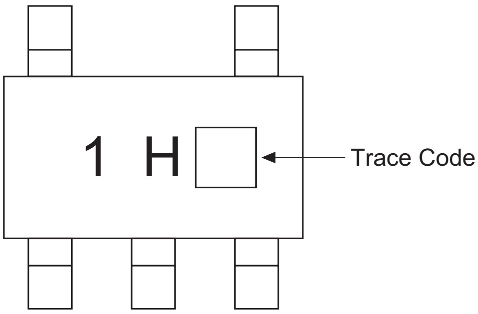
[Ordering Information]

Ordering Unit
3,000 pcs

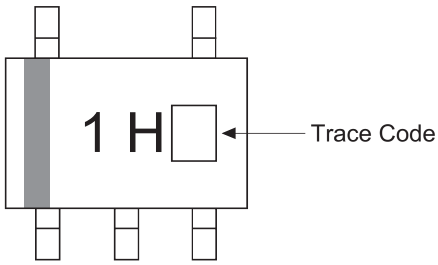


Mark Indication

• MPAK-5



• CMPAK-5



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

RENESAS

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, AZIACenter, No.1233 Lujiazui Ring Rd, Pudong District, Shanghai, China 200120
Tel: <86> (21) 5877-1818, Fax: <86> (21) 6887-7858/7898

Renesas Technology Hong Kong Ltd.
7th Floor, North Tower, World Finance Centre, Harbour City, Canton Road, Tsimshatsui, Kowloon, Hong Kong
Tel: <852> 2265-6688, Fax: <852> 2377-3473

Renesas Technology Taiwan Co., Ltd.
10th Floor, No.99, Fushing North Road, Taipei, Taiwan
Tel: <886> (2) 2715-2888, Fax: <886> (2) 3518-3399

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, Jln Persiaran Barat, 46050 Petaling Jaya, Selangor Darul Ehsan, Malaysia
Tel: <603> 7955-9390, Fax: <603> 7955-9510