

R2A20152NS/SP

8-bit 2ch D/A Converter with Buffer Amplifiers for I²C BUS (Corresponds to Fast mode)

R03DS0013EJ0100

Rev.1.00

2011.09.05

Description

The R2A20152 is an integrated circuit semiconductor of CMOS structure with 2 channels of built in D/A converters with output buffer operational amplifiers. It is the characteristic improvement version of M62332.

The input interface is I²C Bus serial data method, and connects with a microcomputer with minimum wiring. It conforms FAST-MODE of I²C BUS Specifications.

The output circuit is composed of buffer operational amplifier with sync and source drive capacity of 1.0 mA or more, and it operates in the whole voltage range from VCC to ground.

Features

- Guarantee Differential nonlinearity error : +/-0.7LSB, Nonlinearity error : +/-1.0LSB
- Digital data transfer format: I²C BUS serial data method (Corresponds to Fast mode: 400kHz)
- Output buffer operational amplifier: It operates in the whole voltage range from VCC to ground.
- High output current drive capacity: +/-1.0 mA over
- Very small size SON-8 package

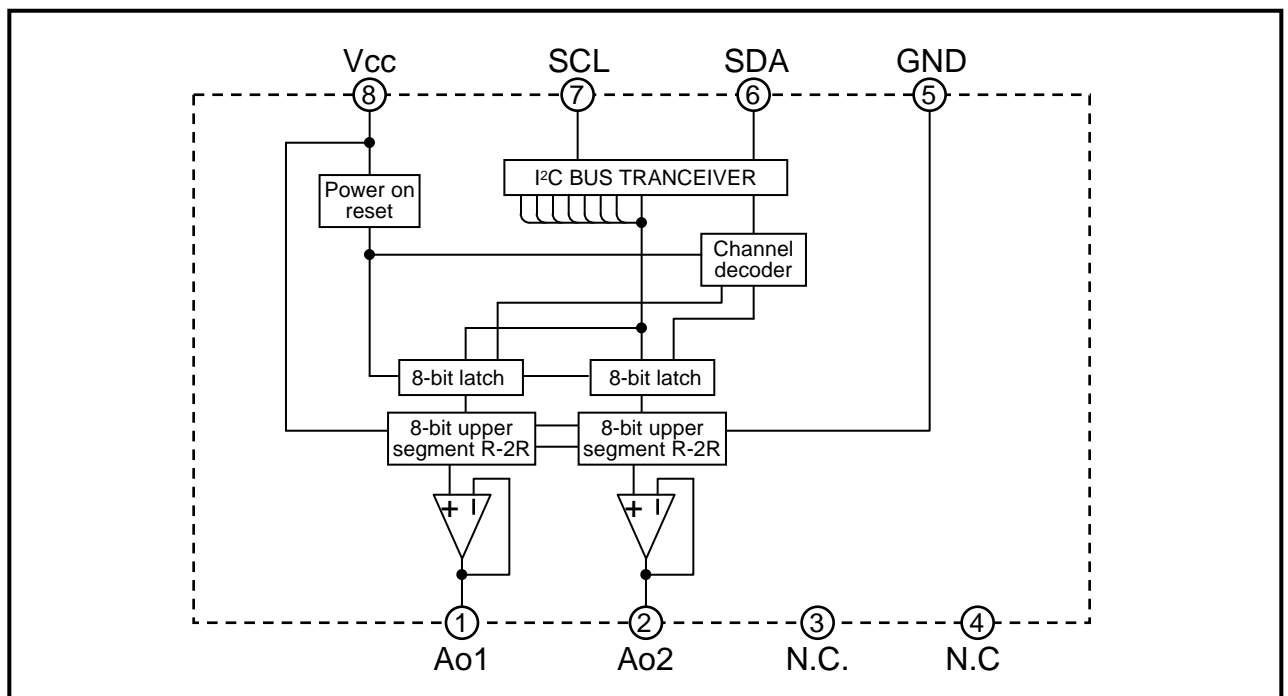
Application

Conversion from digital data to analog control data for home-use and industrial equipment.

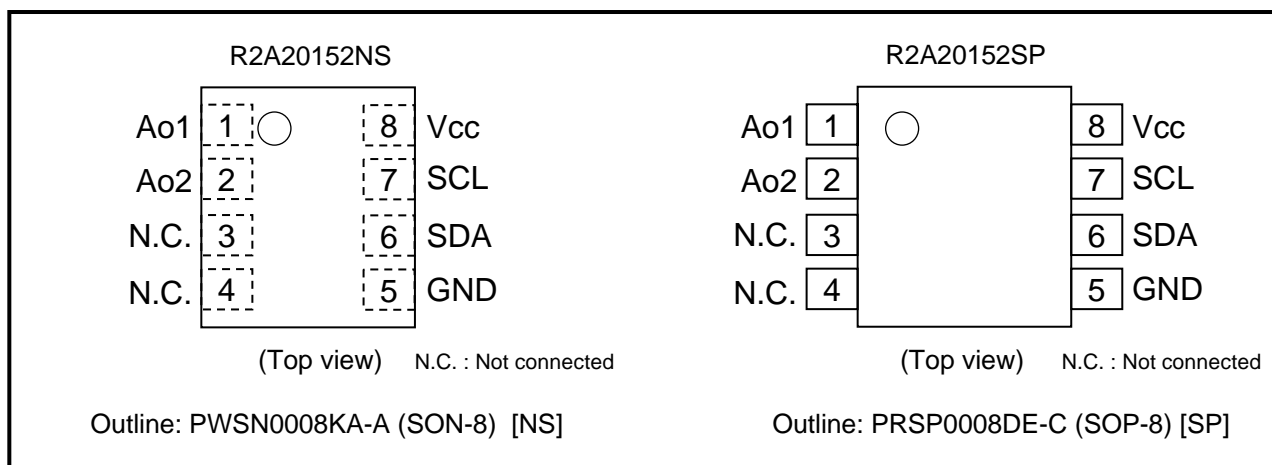
Signal gain control or automatic adjustment of LCD-TV, PDP-TV, LCD-monitor, or etc.

Blurring correction control or various control of the interchangeable lens of digital camera.

Block Diagram



Pin Arrangement



Pin Description

Pin No.	Pin Name	Function
1	Ao1	8-bit resolution D-A converter output terminal (After power on, analog output of every channel is set in DAC data "00h")
2	Ao2	
3	N.C.	Not connected
4	N.C.	
5	GND	GND terminal
6	SDA	Serial data input terminal
7	SCL	Serial clock input terminal
8	Vcc	Power supply terminal

Absolute Maximum Ratings

Ta= 25deg, unless otherwise noted)

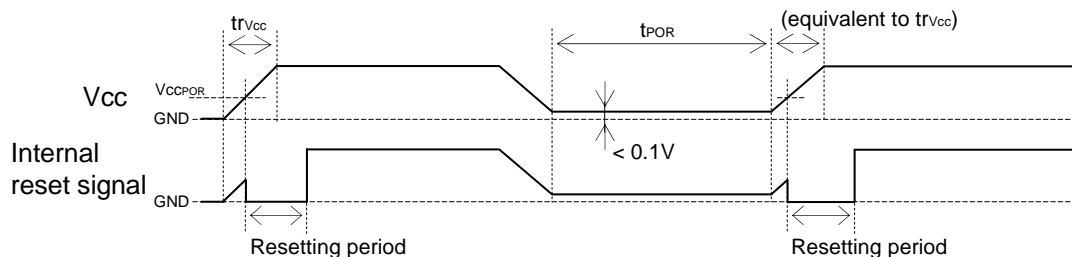
Item	Symbol	Condition	Ratings	Unit
Supply Voltage	V _{CC}		-0.3 to +6.5	V
Input Voltage	V _{IN}		-0.3 to V _{CC} +0.3 < +6.5	V
Output Voltage	V _O		-0.3 to V _{CC} +0.3 < +6.5	V
Buffer amp. Output current	I _{AO}	Continuous	-2.0 to +2.0	mA
Power dissipation	P _d	Ta = +85deg	270(NS) / 272(SP)	mW
Thermal derating factor	K theta	Ta > +25deg	6.75(NS) / 6.8(SP)	mW/deg
Operating temperature	T _{opr}		-30 to +85	deg
Storage temperature	T _{stg}		-40 to +125	deg

Electrical Characteristics

(V_{CC}= +5V +/-10%, GND=0V, Ta= -30 to +85deg, unless otherwise noted)

Item	Symbol	Test Condition	Ratings			Unit
			Min.	Typ.	Max.	
Supply voltage	V _{CC}		2.7	5.0	5.5	V
Supply current	I _{CC}	CLK = 500kHz, I _{AO} = 0μA, DATA: 6Ah (at maximum current)	0	0.5	1.5	mA
		SDA = SCL = GND, I _{AO} = 0μA	0	0.3	1.0	mA
Rise time of supply voltage *1	tr _{VCC}	V _{CC} = 0 to 2.7V	100	-	-	μs
Internal reset operating voltage *1	V _{CCPOR}	V _{CC} = 0 to 2.7V	-	1.5	1.9	V
Power supply restart interval (Power supply OFF → ON) *1	t _{POR}	V _{CC} < 0.1V	1	-	-	ms
Input leak current	I _{ILK}	V _{IN} = 0 to V _{CC}	-10	-	10	μA
Input low voltage	V _{IL}		0	-	0.2V _{CC}	V
Input high voltage	V _{IH}		0.8V _{CC}	-	V _{CC}	V
Hysteresis of Schmitt trigger input (SDA, SCL)	V _{hys}		0.5	0.8	-	V
Output low voltage (SDA)	V _{OL}	I _{sink} = 3mA	-	-	0.4	V
Pulse width of spike noise	t _{SP}		0	-	50	ns
Buffer amplifier output voltage range	V _{AO}	I _{AO} = 100μA	0.1	-	V _{CC} - 0.1	V
		I _{AO} = 500μA	0.2	-	V _{CC} - 0.2	
Buffer amplifier output Drive range	I _{AO}	Upper side saturation voltage = 0.3V, Lower side saturation voltage = 0.2V	-1.0	-	1.0	mA
Differential nonlinearity	SDL		-0.7	-	0.7	LSB
Nonlinearity	SL	V _{CC} = 5.12V (20mV/LSB), without load (I _{AO} = 0μA)	-1.0	-	1.0	LSB
Zero code error	S _{ZERO}		-2.0	-	2.0	LSB
Full scale error	S _{FULL}		-2.0	-	2.0	LSB
Output capacitate load	C _O		-	-	0.1	μF
Buffer amplifier output impedance	R _O		-	5.0	-	ohm

*1 : When power supply is turned on, internal circuit is initialized by power on reset circuit. But, if re-powered on quickly, initialize is not operate. So, keep the time period of re-powered on (t_{POR}).

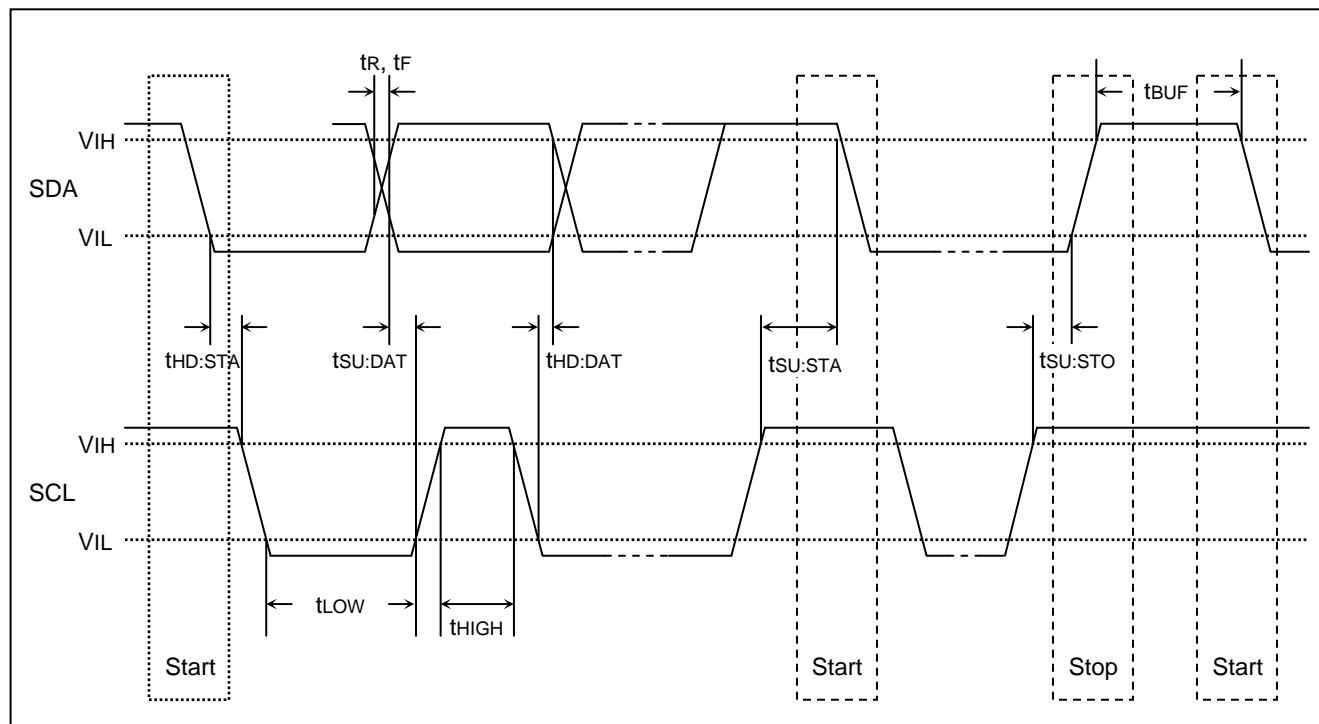


I²C BUS Line Characteristics

Item	Symbol	STANDARD MODE		FAST MODE		Unit
		Min.	Max.	Min.	Max.	
SCL clock frequency	f _{SCL}	0	100	0	400	kHz
Time the bus must be free before a new transmission can start	t _{BUF}	4.7	-	1.3	-	μs
Hold time (repeated) START condition After this period, the first clock pulse is generated.	t _{HD:STA}	4.0	-	0.6	-	μs
LOW period of the SCL clock	t _{LOW}	4.7	-	1.3	-	μs
HIGH period of the SCL clock	t _{HIGH}	4.0	-	0.6	-	μs
Set-up time for a repeated START condition	t _{SU:STA}	4.7	-	0.6	-	μs
Data hold time	t _{HD:DAT}	0	3.45	0	0.9	μs
Data set-up time	t _{SU:DAT}	250	-	100	-	ns
Rise time of both SDA and SCL signals	t _R	-	1000	-	300	ns
Fall time of both SDA and SCL signals	t _F	-	300	-	300	ns
Set-up time for STOP condition	t _{SU:STO}	4.0	-	0.6	-	μs
Capacitive load of bus line	C _b	-	400	-	400	pF

Above values correspond with input level (V_{IHmin} / V_{ILmax}).

Timing Chart

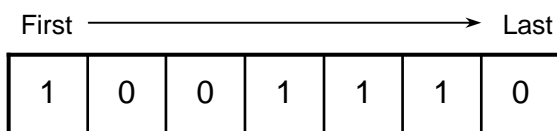


I²C BUS Format

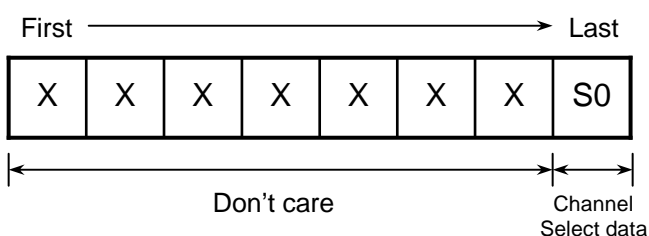
STA	Slave address	W	A	Sub address	A	DAC data	A	STP
-----	---------------	---	---	-------------	---	----------	---	-----

Note: STA: START condition, W: write (SDA = Low), A: acknowledge bit, STP: STOP condition

- Slave address



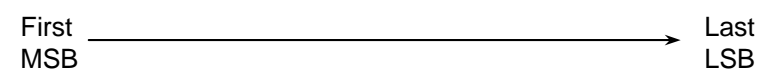
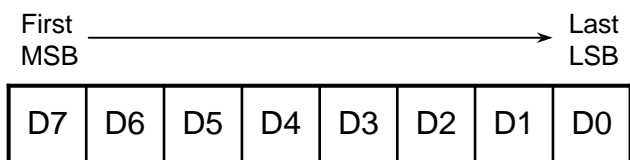
- Sub address



Channel select data

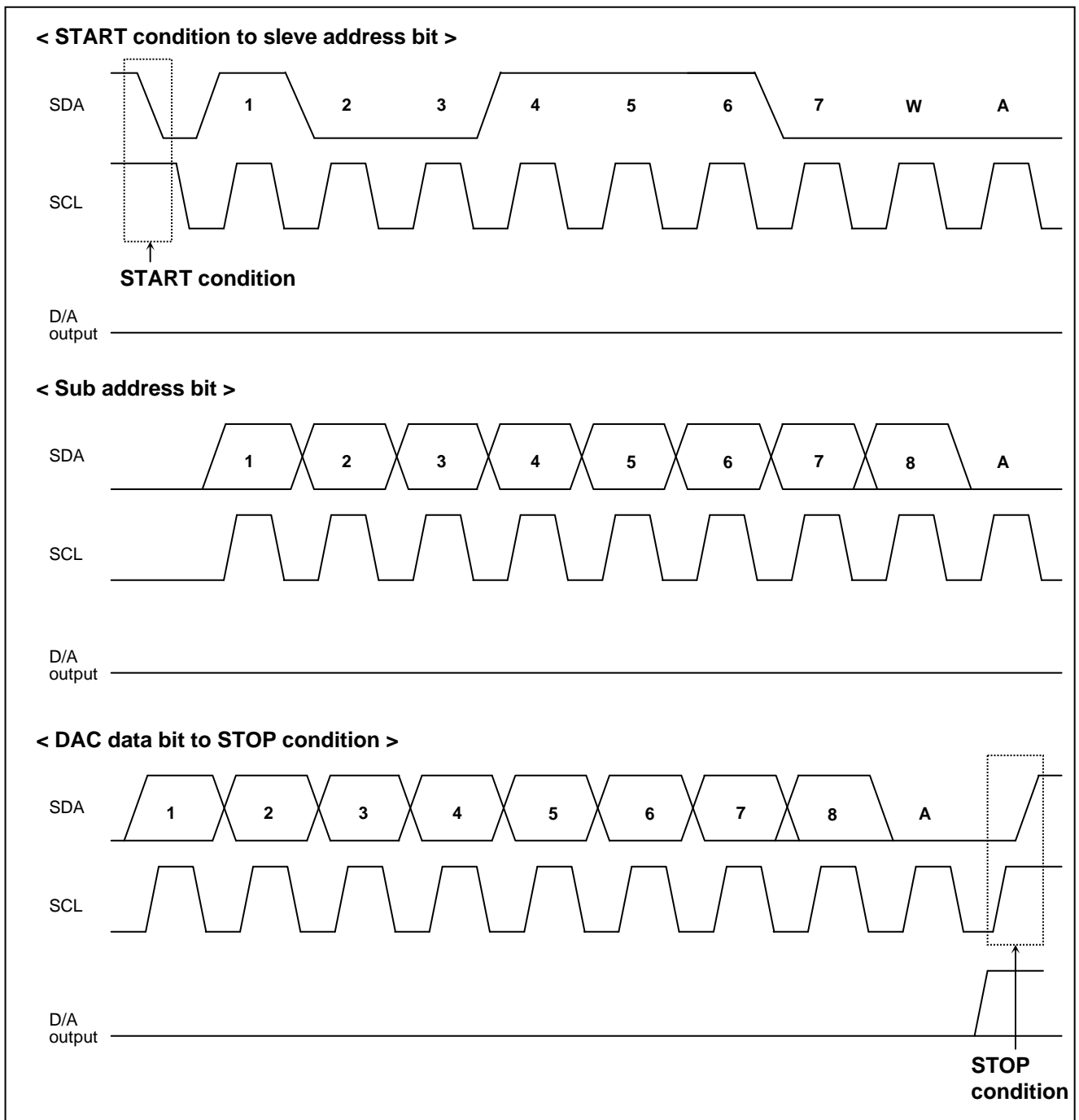
S0	Channel Selection
0	ch1 selection
1	ch2 selection

- DAC data



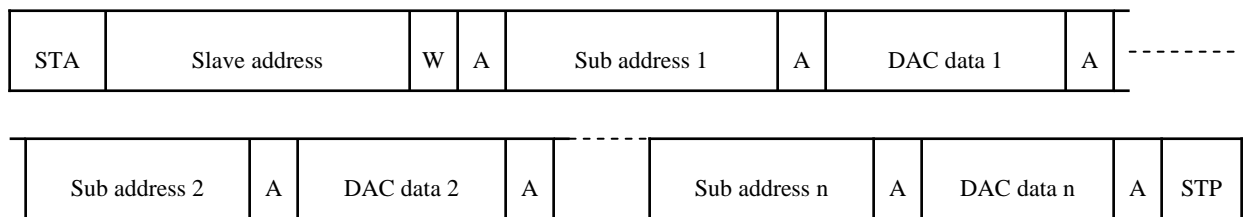
D7	D6	D5	D4	D3	D2	D1	D0	DAC output
0	0	0	0	0	0	0	0	$V_{cc} / 256 \times 1$
0	0	0	0	0	0	0	1	$V_{cc} / 256 \times 2$
0	0	0	0	0	0	1	0	$V_{cc} / 256 \times 3$
0	0	0	0	0	0	1	1	$V_{cc} / 256 \times 4$
:	:	:	:	:	:	:	:	:
1	1	1	1	1	1	1	0	$V_{cc} / 256 \times 255$
1	1	1	1	1	1	1	1	V_{cc}

Data Timing Chart SCL and SDA (Model)



- **START condition** With SCL at High, SDA goes from High to Low.
- **STOP condition** With SCL at High, SDA goes from Low to High.
(Under normal condition, SDA must be changed, when SCL is Low.)
- **Acknowledge bit** The receiving IC has to pull down SDA line whenever receive slave data
(Transmitting IC releases the SDA line just then transmit 8-bit data.)

Digital Data Formats

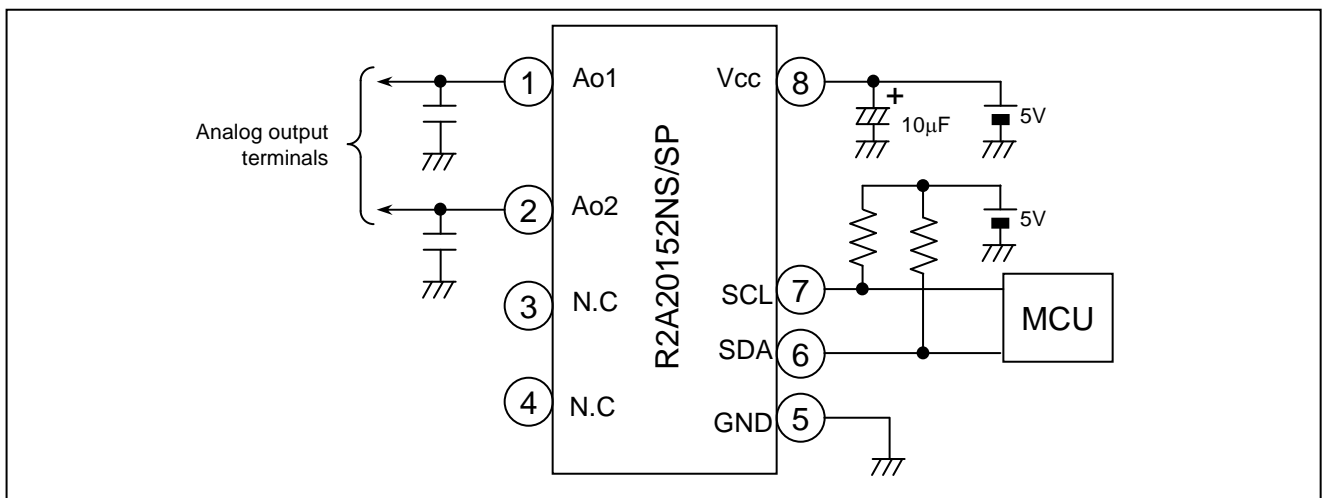


Note: After START condition, the master IC (MCU etc.) accesses the slave IC by slave address, and transmits the data to each channel by two bytes (sub address and DAC data).

Precaution for Use

1. Supply voltage terminal (VCC) is also used for D/A converter upper reference voltage setting. If ripple or spike is input this terminal, accuracy of D/A conversion is down. So, when use this device, please connect capacitor among VCC to GND for stable D/A conversion.
2. This IC's output amplifier has an advantage to capacitive load. So it's no problem at device action when the capacitor (0.1 μ F Max) is connected among output to GND for every noise elimination.

Standard Application Circuit



Ordering Information

Order part No.	Package Name	Package Code	Package type No.	Packing/Quantity
R2A20152SP	SOP-8	PRSP0008DE-C	SP	Embossed Taping/2,500 pcs.
R2A20152NS	SON-8	PWSN0008KA-A	NS	Embossed Taping/5,000 pcs.

Package Dimensions

PRSP0008DE-C [SP]

JEITA Package Code	RENESAS Code	Previous Code	MASS[Typ.]
P-SOP8-4.4x4.85-1.27	PRSP0008DE-C	—	0.1g

NOTE

- DIMENSIONS "1" (Nom) "AND" "2" DO NOT INCLUDE MOLD FLASH.
- DIMENSION "3" DOES NOT INCLUDE TRIM OFFSET.

Reference Symbol	Dimension in Millimeters		
	Min	Nom	Max
D	4.65	4.85	5.05
E	4.2	4.4	4.6
A ₂	—	1.85	—
A ₁	0.00	0.1	0.20
A	—	—	2.03
b _p	0.34	0.4	0.46
b ₁	—	—	—
c	0.15	0.20	0.25
C ₁	—	—	—
θ	0°	—	8°
H _E	5.7	6.2	6.5
Ⓢ	1.12	1.27	1.42
x	—	—	0.12
y	—	—	0.10
z	—	—	0.75
L	0.25	0.45	0.65
L ₁	—	0.90	—

PWSN0008KA-A [NS]

JEITA Package Code	RENESAS Code	Previous Code	MASS[Typ.]
P-HWSON8-2.2x2.2-0.50	PWSN0008KA-A	—	0.011g

Reference Symbol	Dimension in Millimeters		
	Min	Nom	Max
D	2.10	2.20	2.30
E	2.10	2.20	2.30
A ₂	—	—	—
A	—	—	0.80
A ₁	0	—	0.05
b	0.18	0.23	0.28
b ₁	—	—	—
Ⓢ	—	0.5	—
L _p	0.20	0.30	0.40
x	—	—	0.1
y	—	—	0.08
y ₁	—	—	0.1
t	—	—	—
H _D	—	—	—
H _E	—	—	—
Z _D	—	—	—
Z _E	—	—	—
c	—	0.20	—
C ₁	—	—	—

Notice

- 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.
- 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.
- You should not alter, modify, copy, or otherwise misappropriate any Renesas Electronics product, whether in whole or in part.
- 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.
- 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.
- 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.
- 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.
- 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.
- 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.
- 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.
- This document may not be reproduced or duplicated, in any form, in whole or in part, without prior written consent of Renesas Electronics.
- 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.



SALES OFFICES

Renesas Electronics Corporation

<http://www.renesas.com>

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

Renesas Electronics America Inc.
2880 Scott Boulevard Santa Clara, CA 95050-2554, U.S.A.
Tel: +1-408-586-6000, Fax: +1-408-586-6130

Renesas Electronics Canada Limited
1101 Nicholson Road, Newmarket, Ontario L3Y 9C3, Canada
Tel: +1-905-898-5441, Fax: +1-905-898-3220

Renesas Electronics Europe Limited
Dukes Meadow, Millboard Road, Bourne End, Buckinghamshire, SL8 5FH, U.K
Tel: +44-1628-585-100, Fax: +44-1628-585-900

Renesas Electronics Europe GmbH
Arcadiastrasse 10, 40472 Düsseldorf, Germany
Tel: +49-211-65030, Fax: +49-211-6503-1327

Renesas Electronics (China) Co., Ltd.
7th Floor, Quantum Plaza, No.27 ZhiChunLu Haidian District, Beijing 100083, P.R.China
Tel: +86-10-8235-1155, Fax: +86-10-8235-7679

Renesas Electronics (Shanghai) Co., Ltd.
Unit 204, 205, AZIA Center, No.1233 Lujiazui Ring Rd., Pudong District, Shanghai 200120, China
Tel: +86-21-5877-1818, Fax: +86-21-6887-7858 / -7898

Renesas Electronics Hong Kong Limited
Unit 1601-1613, 16/F., Tower 2, Grand Century Place, 193 Prince Edward Road West, Mongkok, Kowloon, Hong Kong
Tel: +852-2886-9318, Fax: +852 2886-9022/9044

Renesas Electronics Taiwan Co., Ltd.
13F, No. 363, Fu Shing North Road, Taipei, Taiwan
Tel: +886-2-8175-9600, Fax: +886 2-8175-9670

Renesas Electronics Singapore Pte. Ltd.
1 HarbourFront Avenue, #06-10, Keppel Bay Tower, Singapore 098632
Tel: +65-6213-0200, Fax: +65-6276-8001

Renesas Electronics Malaysia Sdn.Bhd.
Unit 906, Block B, Menara Amcorp, Amcorp Trade Centre, No. 18, Jin Persiaran Barat, 46050 Petaling Jaya, Selangor Darul Ehsan, Malaysia
Tel: +60-3-7955-9390, Fax: +60-3-7955-9510

Renesas Electronics Korea Co., Ltd.
11F., Samik Lavied' or Bldg., 720-2 Yeoksam-Dong, Kangnam-Ku, Seoul 135-080, Korea
Tel: +82-2-558-3737, Fax: +82-2-558-5141