

R2A20152NS/SP

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

R03DS0013EJ0100

Rev.1.00

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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

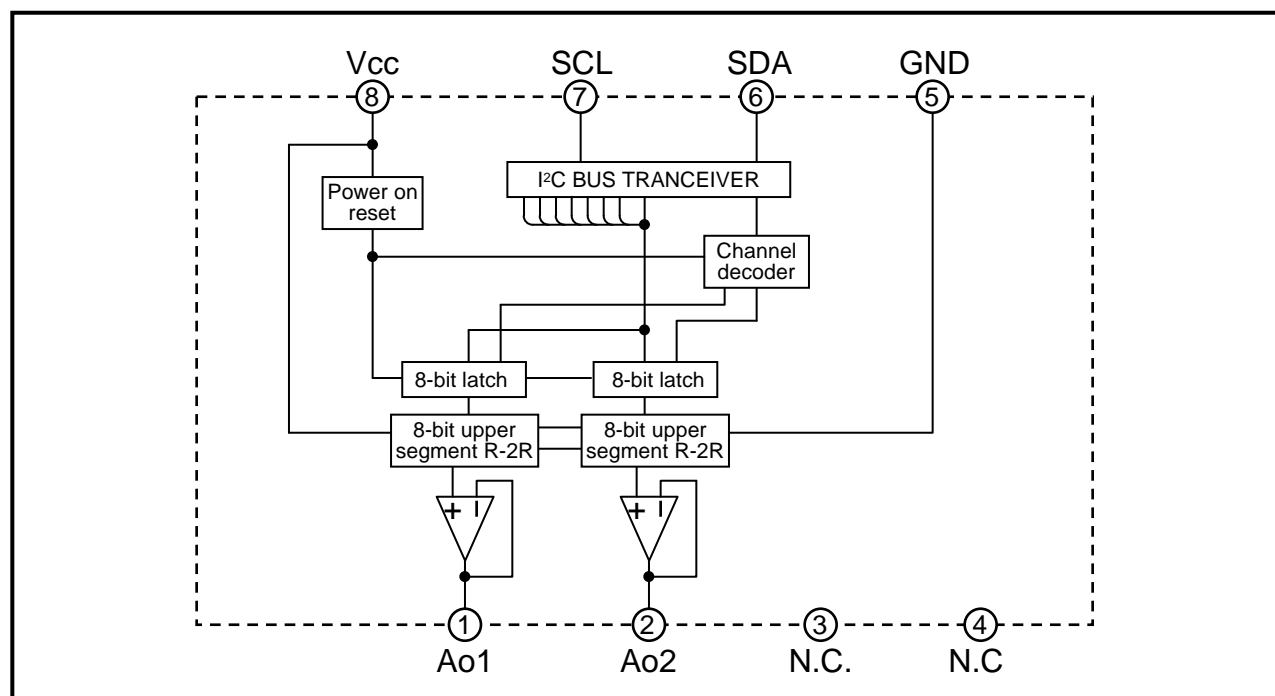
Application

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

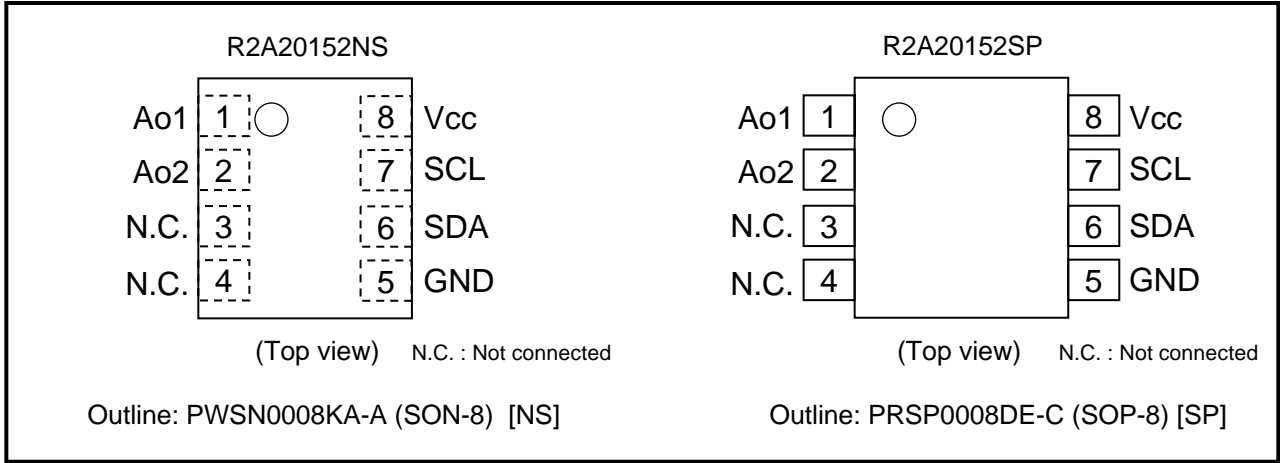
Signal gain control or automatic adjustment of LCD-TV, PDP-TV, LCD-monitor, or etc.

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)

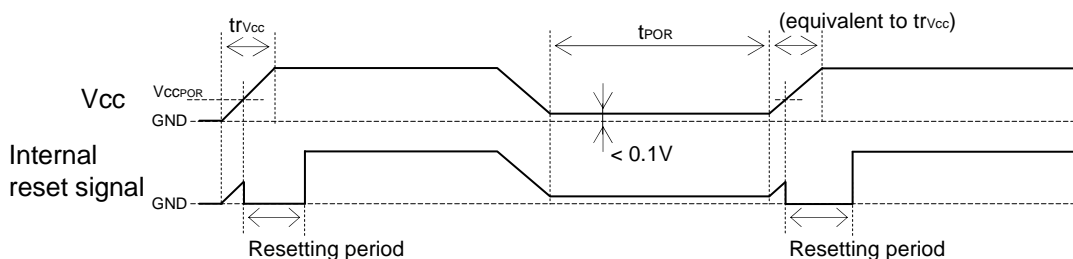
Item	Symbol	Condition	Ratings	Unit
Supply Voltage	Vcc		-0.3 to +6.5	V
Input Voltage	Vin		-0.3 to Vcc+0.3 < +6.5	V
Output Voltage	Vo		-0.3 to Vcc+0.3 < +6.5	V
Buffer amp. Output current	IAO	Continuous	-2.0 to +2.0	mA
Power dissipation	Pd	Ta = +85deg	270(NS) / 272(SP)	mW
Thermal derating factor	K theta	Ta > +25deg	6.75(NS) / 6.8(SP)	mW/deg
Operating temperature	Topr		-30 to +85	deg
Storage temperature	Tstg		-40 to +125	deg

Electrical Characteristics

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

Item	Symbol	Test Condition	Ratings			Unit
			Min.	Typ.	Max.	
Supply voltage	Vcc		2.7	5.0	5.5	V
Supply current	Icc	CLK = 500kHz, IAO = 0μA, DATA: 6Ah (at maximum current)	0	0.5	1.5	mA
		SDA = SCL = GND, IAO = 0μA	0	0.3	1.0	mA
Rise time of supply voltage *1	trVcc	Vcc = 0 to 2.7V	100	-	-	μs
Internal reset operating voltage *1	VCCPOR	Vcc = 0 to 2.7V	-	1.5	1.9	V
Power supply restart interval (Power supply OFF → ON) *1	tPOR	Vcc < 0.1V	1	-	-	ms
Input leak current	IILK	Vin = 0 to Vcc	-10	-	10	μA
Input low voltage	VIL		0	-	0.2Vcc	V
Input high voltage	VIH		0.8Vcc	-	Vcc	V
Hysteresis of Schmitt trigger input (SDA, SCL)	Vhys		0.5	0.8	-	V
Output low voltage (SDA)	VOL	Isink = 3mA	-	-	0.4	V
Pulse width of spike noise	tSP		0	-	50	ns
Buffer amplifier output voltage range	VAO	IAO = 100μA	0.1	-	Vcc - 0.1	V
		IAO = 500μA	0.2	-	Vcc - 0.2	
Buffer amplifier output Drive range	IAO	Upper side saturation voltage = 0.3V, Lower side saturation voltage = 0.2V	-1.0	-	1.0	mA
Differential nonlinearity	SDL	Vcc = 5.12V (20mV/LSB), without load (IAO = 0μA)	-0.7	-	0.7	LSB
Nonlinearity	SL		-1.0	-	1.0	LSB
Zero code error	SZERO		-2.0	-	2.0	LSB
Full scale error	SFULL		-2.0	-	2.0	LSB
Output capacitate load	Co		-	-	0.1	μF
Buffer amplifier output impedance	Ro		-	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 (tPOR).

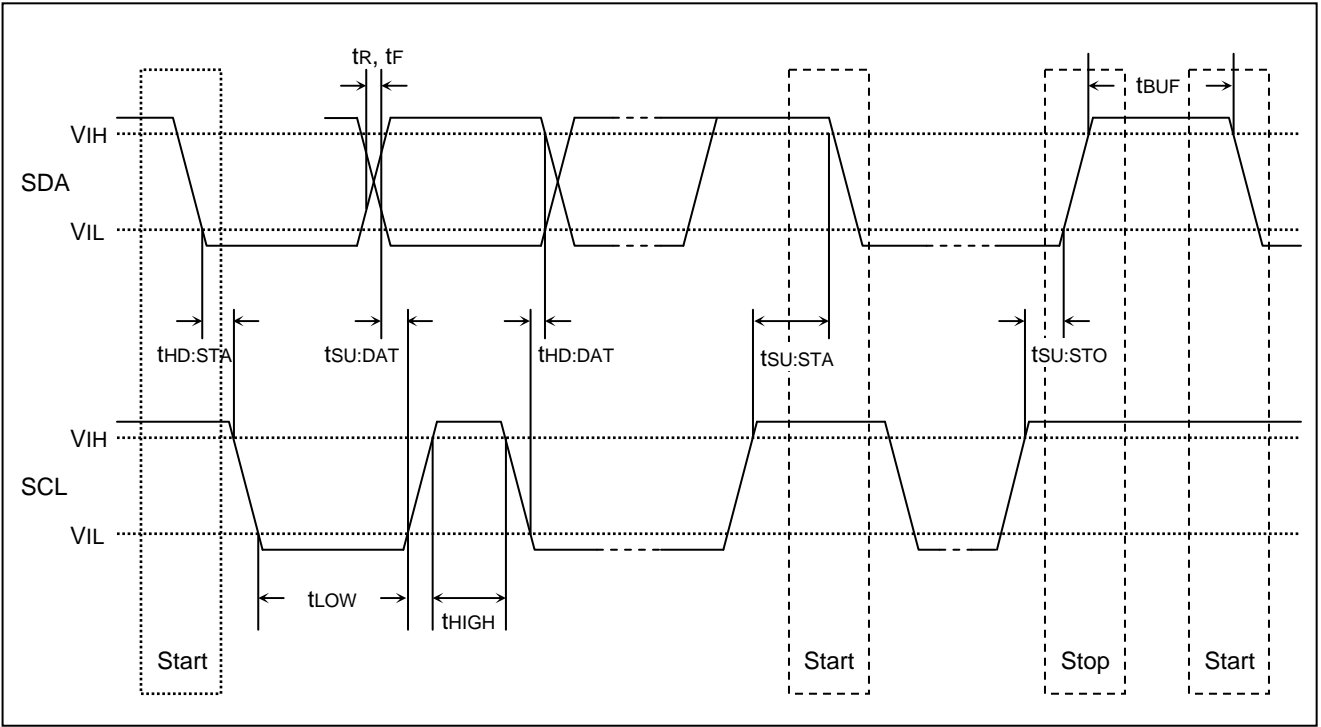


I²C BUS Line Characteristics

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

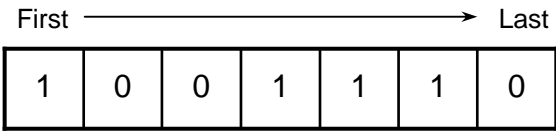


I²C BUS Format

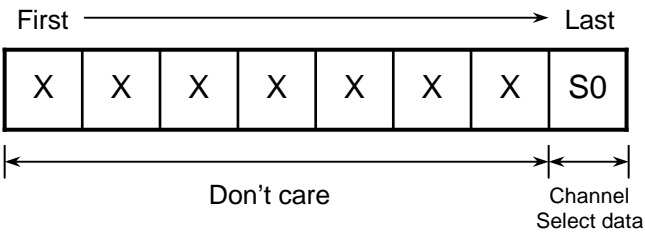
STA	Slave address	W	A	Sub address	A	DAC data	A	STP
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Note: STA: START condition, W: write (SDA = Low), A: acknowledge bit, STP: STOP condition

• Slave address

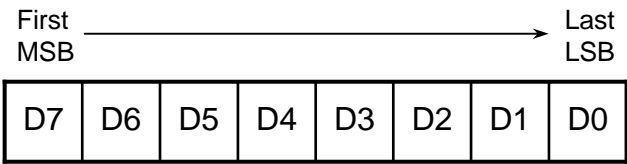



• Sub address



S0	Channel Selection
0	ch1 selection
1	ch2 selection

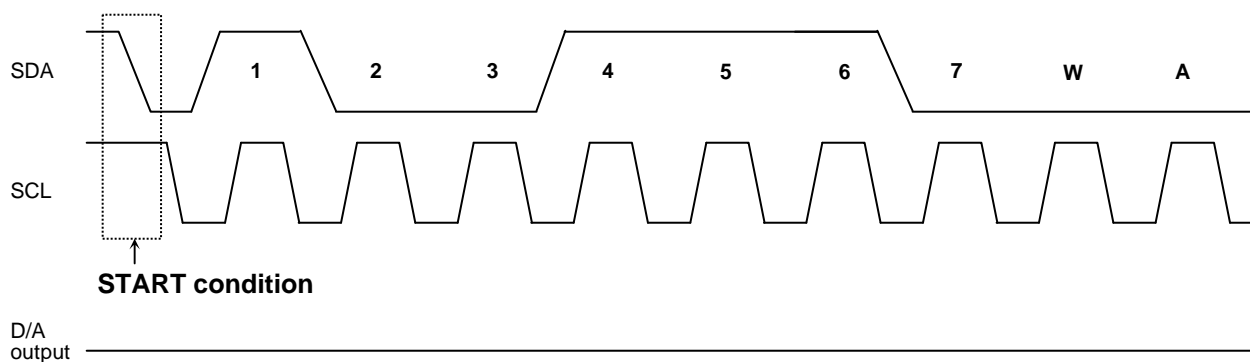
• DAC data



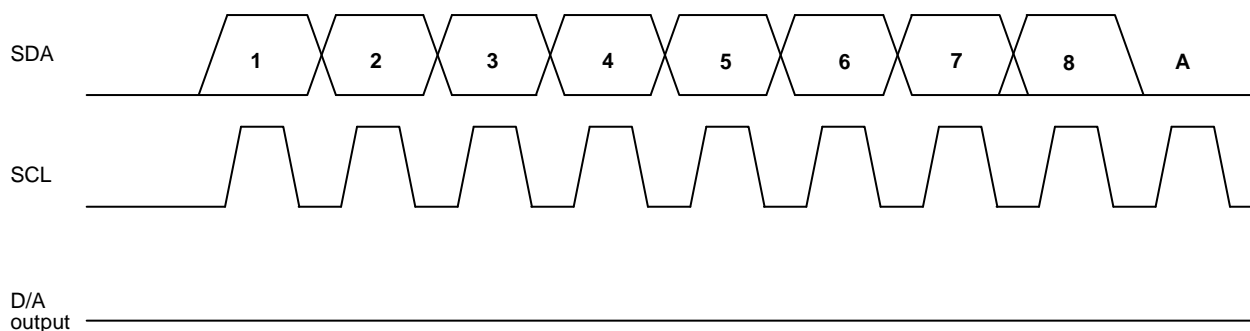
First MSB								Last LSB
D7	D6	D5	D4	D3	D2	D1	D0	DAC output
0	0	0	0	0	0	0	0	$V_{cc} / 256 \times 1$
0	0	0	0	0	0	0	1	$V_{cc} / 256 \times 2$
0	0	0	0	0	0	1	0	$V_{cc} / 256 \times 3$
0	0	0	0	0	0	1	1	$V_{cc} / 256 \times 4$
:	:	:	:	:	:	:	:	:
1	1	1	1	1	1	1	0	$V_{cc} / 256 \times 255$
1	1	1	1	1	1	1	1	V_{cc}

Data Timing Chart SCL and SDA (Model)

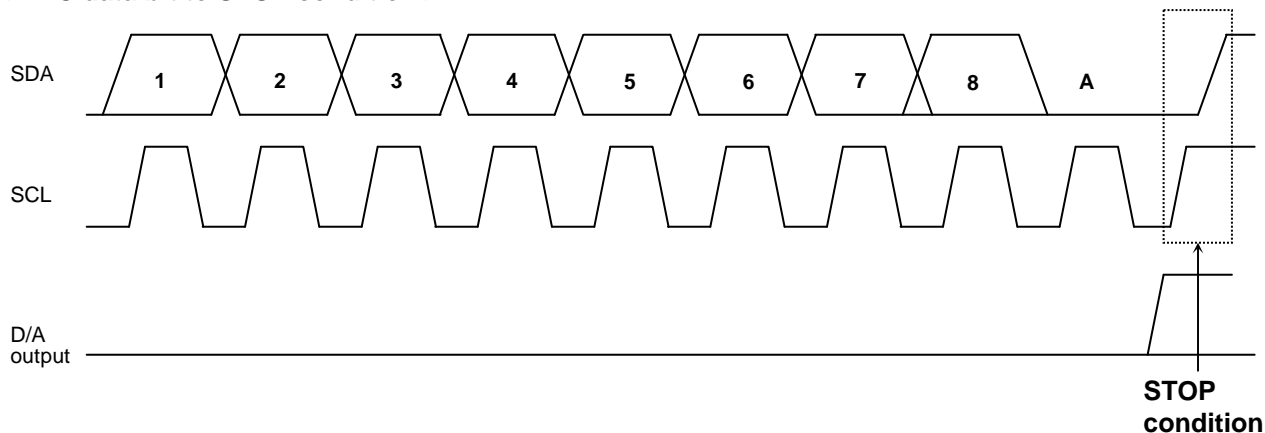
< START condition to slave address bit >



< Sub address bit >

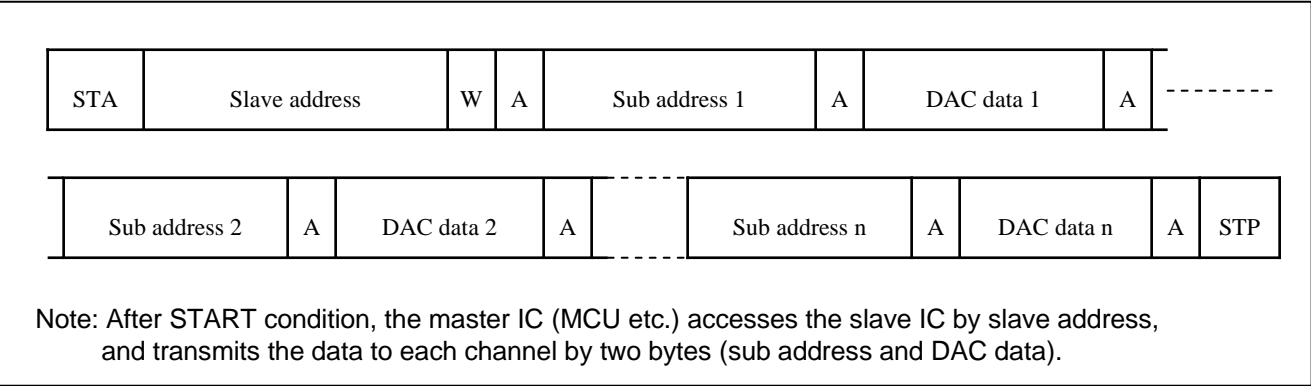


< DAC data bit to STOP condition >



- 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.)

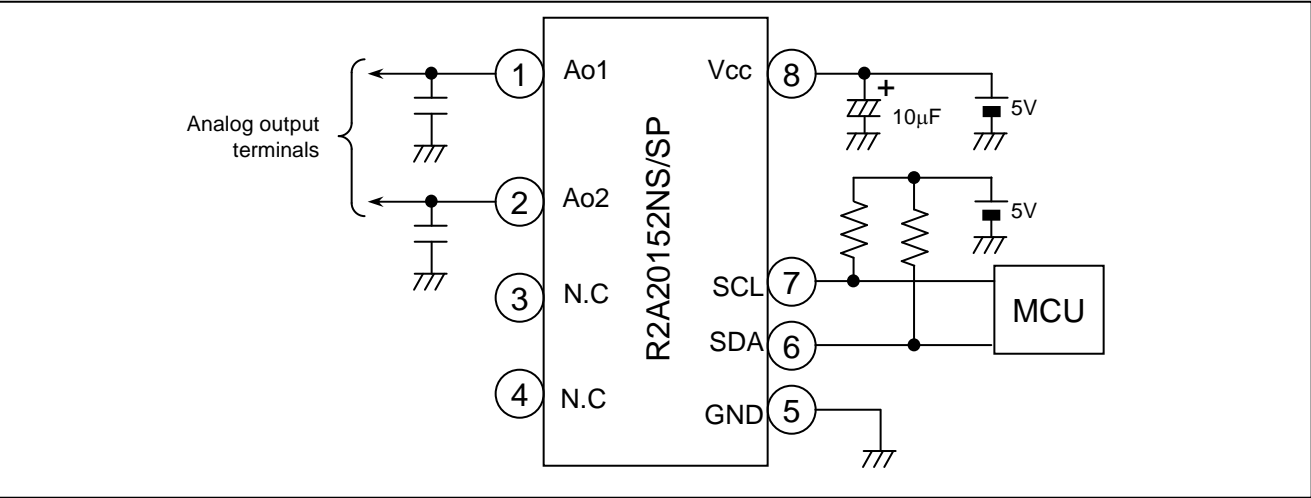
Digital Data Formats



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 (0.1μF 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.

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