

# R2A20178NP

8-bit 8ch Multiplying D/A Converter with Buffer Amplifiers

R03DS0021EJ0100

Rev.1.00

2011.09.05

## Description

The R2A20178 is a CMOS 8-bit 8ch D/A converter having a multiplying function and output buffer amplifiers. It has a serial data input and can easily communicate with a microcontroller by simple three-wiring method (DI, CLK, LD), and it is suitable for a use in automatic adjustment applications in conjunction with a MCU. The reference voltage terminals ( $V_{DAREF1}$ ,  $V_{DAREF2}$ ) are 4ch x 2 configuration, and the 4 quadrant operation is possible.

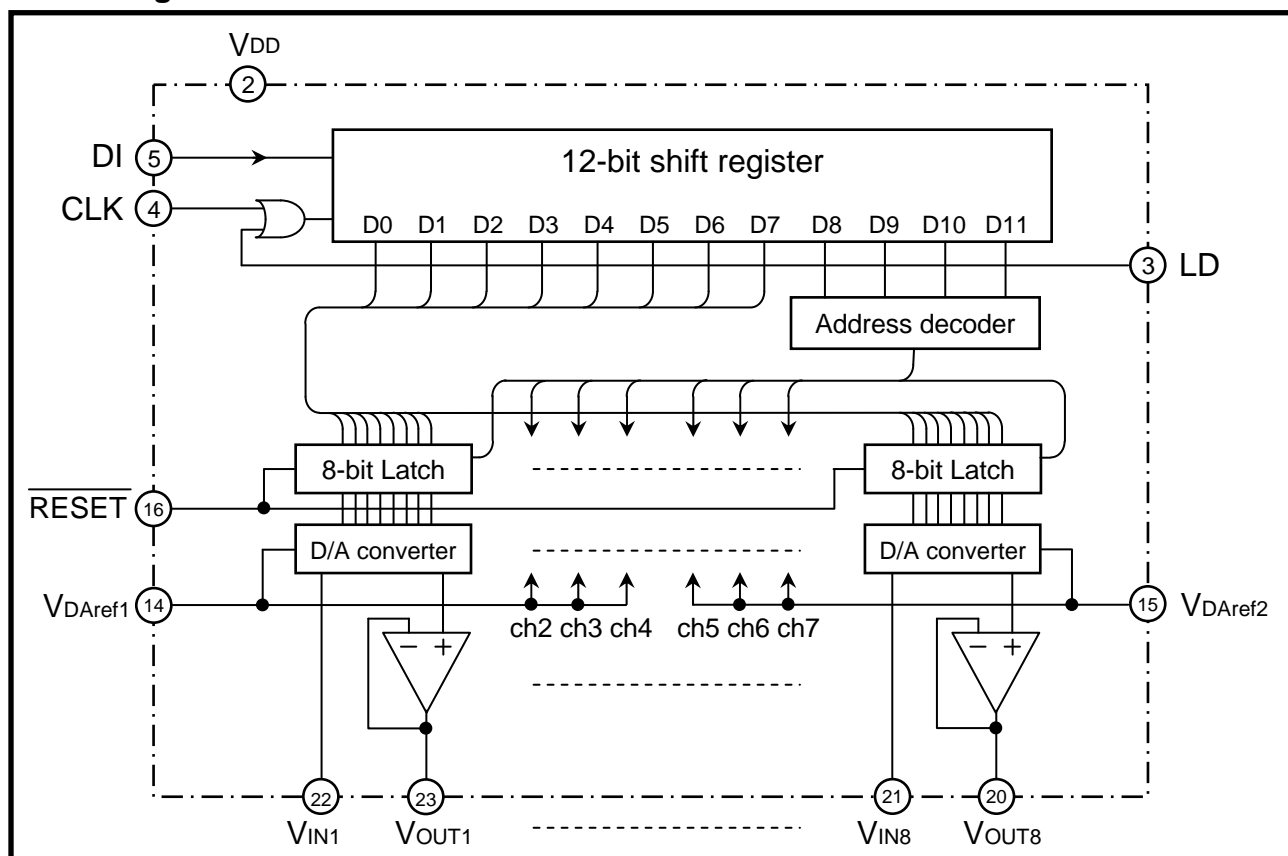
## Features

- Guarantee Nonlinearity error :  $\pm 1.0\text{LSB}$ , Differential nonlinearity error :  $\pm 0.7\text{LSB}$
- Three-wiring serial data transmission
- High performance 8ch D/A converter employing an R-2R with higher-order segment method
- 8 buffer amplifiers operating in a whole supply voltage range from  $V_{DD}$  to GND
- High anti-oscillation stability for capacitive loads
- 4 quadrant multiplication
- Very small package : QFN (pin pitch 0.5mm)

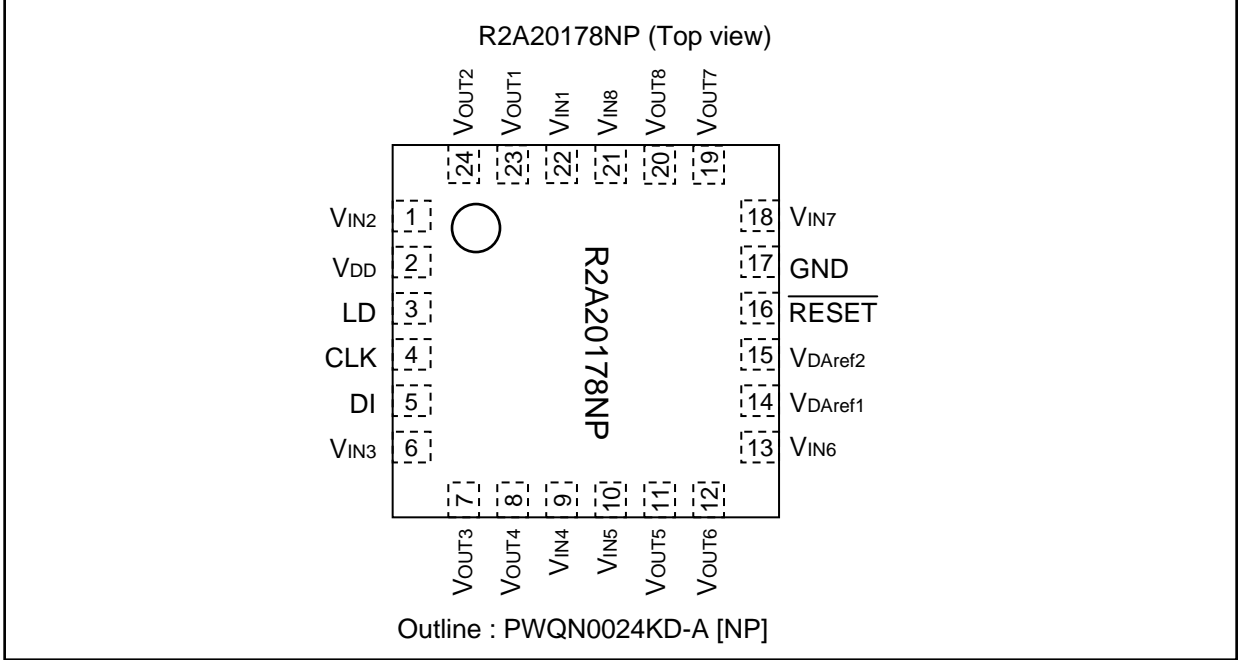
## Application

- Digital to analog conversion for consumer and industrial equipment.
- Self adjustment by combination with microcomputer and EEPROM (substitution of half fixed resistance)
- Signal gain control or automatic adjustment of LCD-TV, PDP-TV or LCD display-monitor.
- Voltage control of transmission power amplifier of transceiver

## Block Diagram



Pin Arrangement



Pin Description

Pin No.	Pin Name	Function
3	LD	A low state of LD enables data of DI loading to the 12-bit resister. During a rising edge of LD, the data in the 12-bit shift register on a rising edge of register.
4	CLK	Shift clock input. Input data of DI are taken into the 12-bit shift register on a rising edge Of the clock.
5	DI	Serial data input. The serial data length is 12-bit.
16	$\overline{\text{RESET}}$	Reset 8-bit latches. A low state of $\overline{\text{RESET}}$ clear the all 8-bit latches.
23	V <sub>OUT1</sub>	D/A converter output with 8-bit resolution
24	V <sub>OUT2</sub>	
7	V <sub>OUT3</sub>	
8	V <sub>OUT4</sub>	
11	V <sub>OUT5</sub>	
12	V <sub>OUT6</sub>	
19	V <sub>OUT7</sub>	
20	V <sub>OUT8</sub>	
2	V <sub>DD</sub>	Power supply
17	GND	Ground
22	V <sub>IN1</sub>	D/A converter input
1	V <sub>IN2</sub>	
6	V <sub>IN3</sub>	
9	V <sub>IN4</sub>	
10	V <sub>IN5</sub>	
13	V <sub>IN6</sub>	
18	V <sub>IN7</sub>	
21	V <sub>IN8</sub>	
14	V <sub>DAref1</sub>	D/A converter reference voltage input (ch1 to ch4). $V_{\text{OUT}} = (V_{\text{IN}} - V_{\text{DAref}}) \times n/256 + V_{\text{DAref1}}$
15	V <sub>DAref2</sub>	D/A converter reference voltage input (ch5 to ch8). $V_{\text{OUT}} = (V_{\text{IN}} - V_{\text{DAref}}) \times n/256 + V_{\text{DAref2}}$

**Absolute Maximum Ratings**

(Ta = +25deg unless otherwise noted)

Item	Symbol	Conditions	Ratings	Unit
Supply voltage (for digital)	V <sub>DD</sub>		-0.3 to +6.5	V
Digital input voltage	V <sub>IND</sub>		-0.3 to +6.5	V
Analog input voltage	V <sub>IN</sub>		-0.3 to V <sub>DD</sub> +0.3 <+6.5	V
Analog output voltage	V <sub>OUT</sub>		-0.3 to V <sub>DD</sub> +0.3 <+6.5	V
D/A reference voltage	V <sub>DAref</sub>		-0.3 to V <sub>DD</sub> +0.3 <+6.5	V
Power dissipation	P <sub>d</sub>	Ta = +85deg	300	mW
Thermal derating	K theta	Ta > +25deg	7.5	mW/deg
Operating temperature	T <sub>opr</sub>		-30 to +85	deg
Storage temperature	T <sub>stg</sub>		-40 to +125	deg

**Electrical Characteristics**

&lt; Analog/Digital Common Part &gt;

(V<sub>DD</sub>, V<sub>IN</sub> = +5V +/-10%, V<sub>DD</sub>>V<sub>IN</sub>, GND=V<sub>DAref1</sub>=V<sub>DAref2</sub> = 0V, Ta = -30 to +85deg, unless otherwise noted.)

Item	Symbol	Conditions	Limits			Unit
			Min	Typ	Max	
Supply voltage	V <sub>DD</sub>		2.7	5.0	5.5	V
Supply current	I <sub>DD</sub>	CLK =1MHz, V <sub>DD</sub> =5V, I <sub>AO</sub> =0μA	-	-	2.0	mA

&lt; Digital Part &gt;

(V<sub>DD</sub>, V<sub>IN</sub> = +5V +/-10%, V<sub>DD</sub>>V<sub>IN</sub>, GND=V<sub>DAref1</sub>=V<sub>DAref2</sub> = 0V, Ta = -30 to +85deg, unless otherwise noted.)

Item	Symbol	Conditions	Limits			Unit
			Min	Typ	Max	
Input leak current	I <sub>ILK</sub>	V <sub>IN</sub> = 0 to V <sub>DD</sub>	-10	-	10	μA
Digital input "Low" voltage	V <sub>IL</sub>		-	-	0.2 V <sub>DD</sub>	V
Digital input "High" voltage	V <sub>IH</sub>		0.8 V <sub>DD</sub>	-	-	V

&lt; Analog Part &gt;

(V<sub>DD</sub>, V<sub>IN</sub> = +5V +/-10%, V<sub>DD</sub>>V<sub>IN</sub>, GND=V<sub>DAref1</sub>=V<sub>DAref2</sub> = 0V, Ta = -30 to +85deg, unless otherwise noted.)

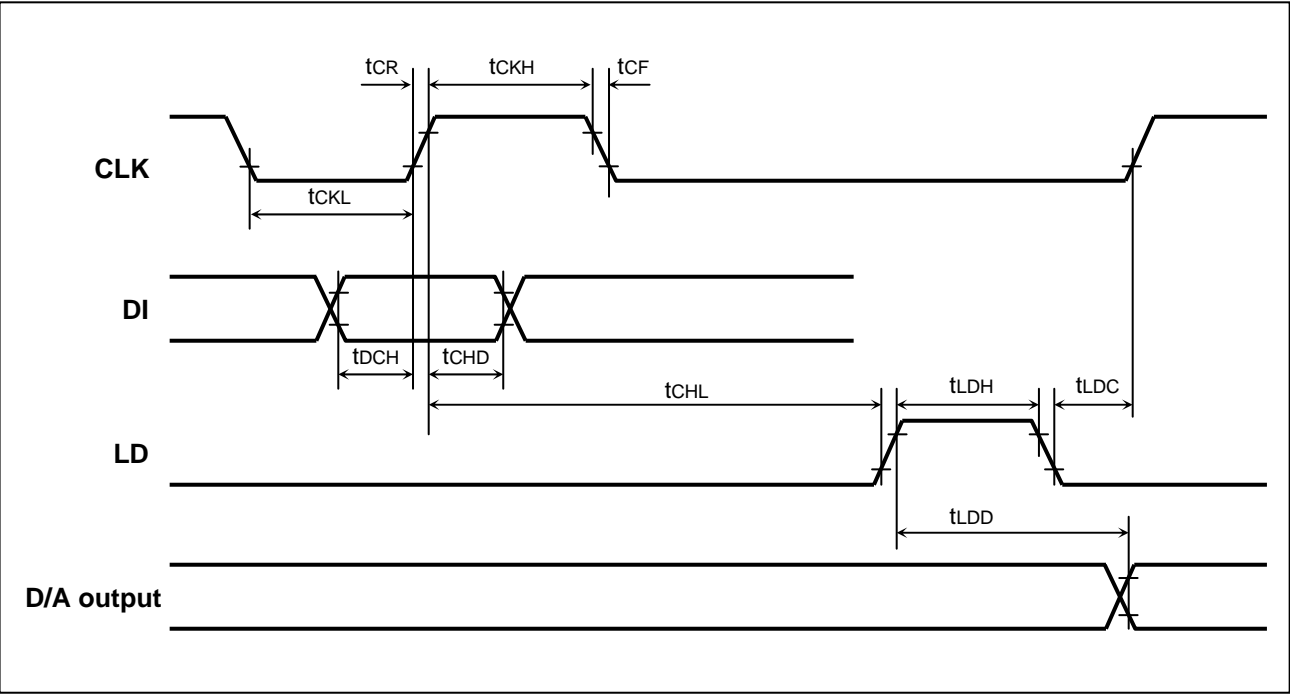
Item	Symbol	Conditions	Limits			Unit
			Min	Typ	Max	
Input current	I <sub>IN</sub>	V <sub>IN</sub> =5V, V <sub>DAref</sub> =0 V, Proportional to Max. input current condition (V <sub>IN</sub> -V <sub>DAref</sub> ) and digital data of each channels	-	-	0.3	mA
D/A reference input current	I <sub>DAref</sub>	V <sub>IN1</sub> to V <sub>IN8</sub> =5V, V <sub>DAref</sub> =0 V, Proportional to Max. input current condition (V <sub>IN</sub> -V <sub>DAref</sub> ) and digital data of each channels	-2.4	-	-	mA
Resolution	RES		-	8	-	bit
Differential nonlinearity	DNL	V <sub>DAref1</sub> =V <sub>DAref2</sub> =0.05V,	-0.7	-	0.7	LSB
nonlinearity	NL	Without load ( I <sub>VOUT</sub> = 0μA )	-1	-	1	LSB
Buffer amplifier output voltage range	V <sub>AO</sub>	I <sub>AO</sub> = +/-100 μA	0.1	-	V <sub>CC</sub> - 0.1	V
		I <sub>AO</sub> = +/-500 μA	0.2	-	V <sub>CC</sub> - 0.2	
Buffer amplifier output current range	I <sub>AO</sub>	Upper saturation voltage =0.4V, Lower saturation voltage =0.4V	-1	-	1	mA
Output capacitive load	C <sub>O</sub>		-	-	0.1	μF
Buffer amplifier output impedance	R <sub>O</sub>		-	5	-	ohm

AC Characteristics

(V<sub>DD</sub>, V<sub>IN</sub> = +5V +/-10%, V<sub>DD</sub>>V<sub>IN</sub>, GND=V<sub>DAref1</sub>=V<sub>DAref2</sub> = 0V, Ta = -30 to +85deg, unless otherwise noted.)

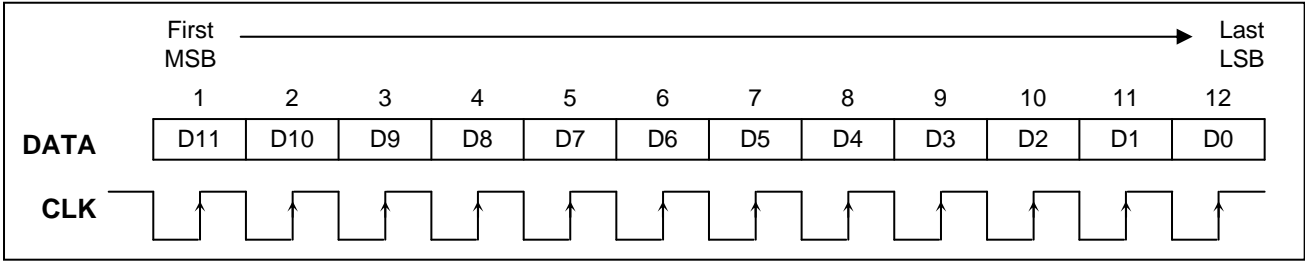
Item	Symbol	Conditions	Limits			Unit
			Min	Typ	Max	
Clock “L” pulse width	t <sub>CKL</sub>		200	-	-	ns
Clock “H” pulse width	t <sub>CKH</sub>		200	-	-	ns
Clock rise time	t <sub>CR</sub>		-	-	200	ns
Clock fall time	t <sub>CF</sub>		-	-	200	ns
Data setup time	t <sub>DCH</sub>		60	-	-	ns
Data hold time	t <sub>CHD</sub>		100	-	-	ns
LD setup time	t <sub>CHL</sub>		200	-	-	ns
LD hold time	t <sub>LDC</sub>		100	-	-	ns
LD “H” pulse duration time	t <sub>LDH</sub>		100	-	-	ns
D/A output settling time	t <sub>LDD</sub>	C <sub>L</sub> <100pF, V <sub>OUT</sub> : 0.5↔4.5V, Time until the output becomes the final value of 1/2 LSB	-	-	300	μs
RESET “Low” level minimum pulse width	t <sub>RL</sub>		200	-	-	ns

Timing Chart



Digital Data Format

12-bit serial data



Data Assignment

D8	D9	D10	D11	: DAC select data				
D0	D1	D2	D3	D4	D5	D6	D7	: DAC data

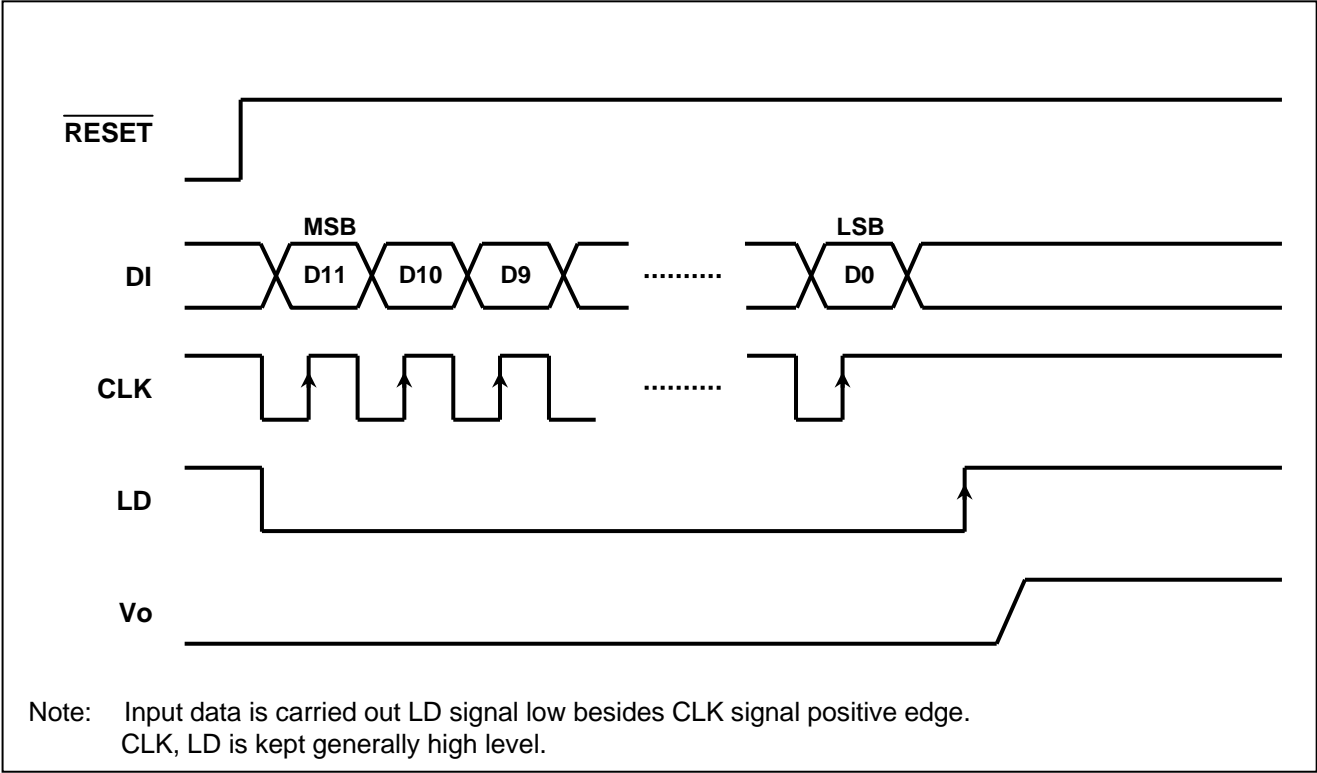
DAC select data

D8	D9	D10	D11	DAC Selection
0	0	0	0	Don't care
0	0	0	1	V <sub>OUT1</sub> selection
0	0	1	0	V <sub>OUT2</sub> selection
0	0	1	1	V <sub>OUT3</sub> selection
0	1	0	0	V <sub>OUT4</sub> selection
0	1	0	1	V <sub>OUT5</sub> selection
0	1	1	0	V <sub>OUT6</sub> selection
0	1	1	1	V <sub>OUT7</sub> selection
1	0	0	0	V <sub>OUT8</sub> selection
1	0	0	1	Don't care
1	0	1	0	Don't care
1	0	1	1	Don't care
1	1	0	0	Don't care
1	1	0	1	Don't care
1	1	1	0	Don't care
1	1	1	1	Don't care

DAC data

D0	D1	D2	D3	D4	D5	D6	D7	DAC Output
0	0	0	0	0	0	0	0	V <sub>DAref</sub>
1	0	0	0	0	0	0	0	( V <sub>IN</sub> – V <sub>DAref</sub> ) / 256 x 1+ V <sub>DAref</sub>
0	1	0	0	0	0	0	0	( V <sub>IN</sub> – V <sub>DAref</sub> ) / 256 x 2 + V <sub>DAref</sub>
1	1	0	0	0	0	0	0	( V <sub>IN</sub> – V <sub>DAref</sub> ) / 256 x 3 + V <sub>DAref</sub>
:	:	:	:	:	:	:	:	:
1	1	1	1	1	1	1	1	( V <sub>IN</sub> – V <sub>DAref</sub> ) / 256 x 255 + V <sub>DAref</sub>

Timing Chart ( Model )

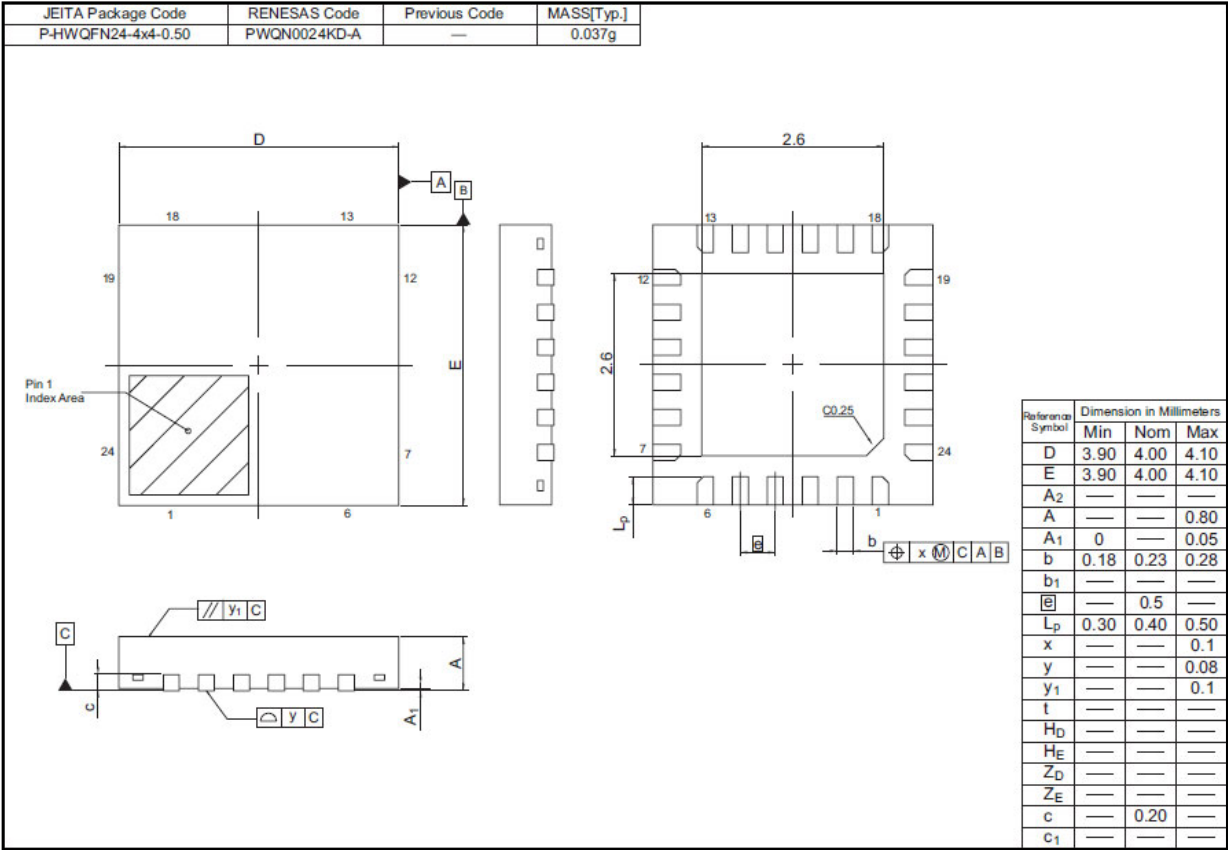


Ordering Information

Order part No.	Package Name	Package Code	Package type No.	Packing/Quantity
R2A20178NP	QFN-24	PWQN0024KD-A	NP	Embossed Taping/2,500 pcs.

Package Dimensions

PWQN0024KD-A



## 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.



### 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: +1-408-588-6000, Fax: +1-408-588-6130

**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: +65-6278-8001

**Renesas Electronics 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: +60-3-7955-9390, Fax: +60-3-7955-9510

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



# Mouser Electronics

Authorized Distributor

Click to View Pricing, Inventory, Delivery & Lifecycle Information:

[Renesas Electronics:](#)

[R2A20113ASP#W5](#)