

**2-CHANNEL 16-BIT D/A CONVERTER FOR AUDIO APPLICATION**

The  $\mu$ PD6379 and 6379A are 2-channel 16-bit D/A converters for digital audio signal demodulation. These D/A converters employ the resistor string conversion method which has been tested by existing model  $\mu$ PD6376 but they are more compact and require fewer external components than the  $\mu$ PD6376. In addition, low-voltage models, the  $\mu$ PD6379L and 6379AL (minimum operating supply voltage = +3.0 V) are also available for applications in portable systems.

**FEATURES**

- Resistor string conversion method
- 0-point digital shift circuit
- $\times 4$  oversampling  
Sampling frequency: 200 kHz MAX.
- Signal processing format for 2's complement, MSB first, and backward justification data accommodated
- Left and right in-phase output
- High performance (at  $V_{DD} = +5.0$  V)  
S/N ratio: 100 dB TYP.  
Dynamic range: 96 dB TYP.
- Low-voltage models available
- Bipolar LR clock (LRCK)
- Low power dissipation: 10 mW TYP.  
(with  $\mu$ PD6379L, 6379AL at  $V_{DD} = +3.3$  V)

Supply voltage \ LRCK	LRCK = L when L-ch data is input	LRCK = H when L-ch data is input
+3.3 V ( $V_{DD} = +3.0$ to 5.5 V)	$\mu$ PD6379L	$\mu$ PD6379AL
+5.0 V ( $V_{DD} = +4.5$ to 5.5 V)	$\mu$ PD6379	$\mu$ PD6379A

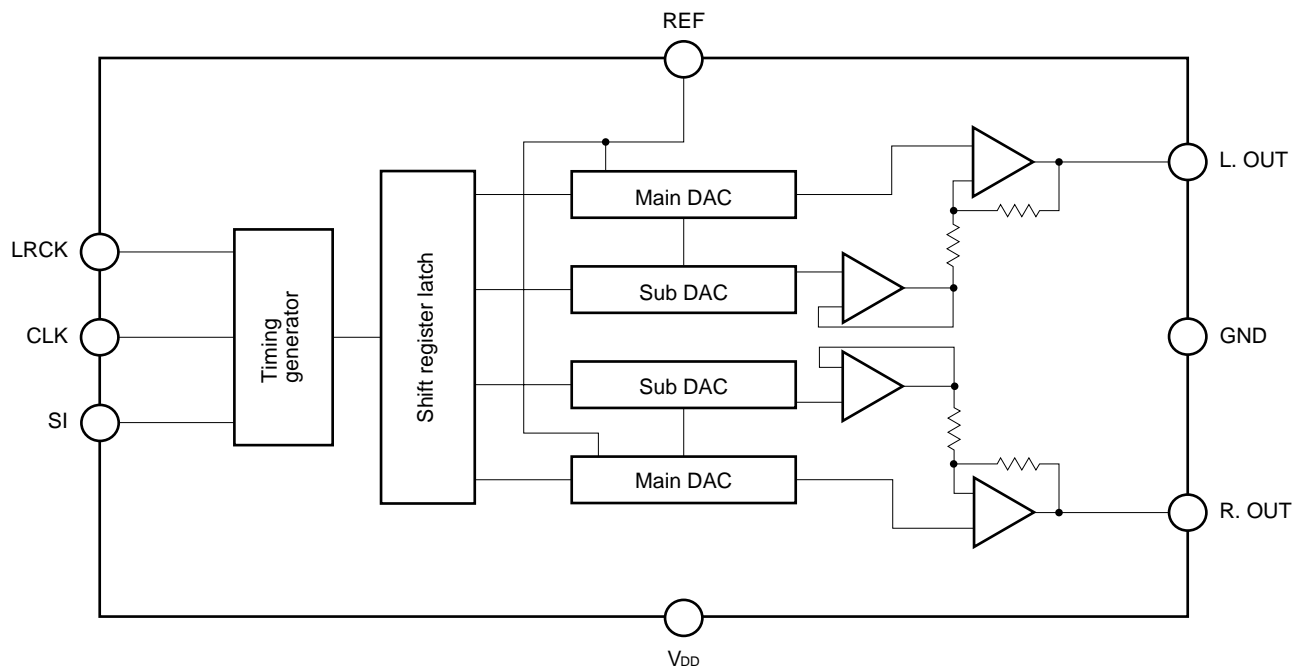
- Few external components  
Internal output operational amplifier  
Only one electrolytic capacitor required for smoothing reference voltage, instead of two capacitors required by existing D/A converters
- Small package: 8-pin plastic SOP (5.72 mm (225))

The information in this document is subject to change without notice. Before using this document, please confirm that this is the latest version.  
Not all devices/types available in every country. Please check with local NEC representative for availability and additional information.

## ORDERING INFORMATION

Part number	Package
$\mu$ PD6379GR	8-pin plastic SOP (5.72 mm (225))
$\mu$ PD6379LGR	8-pin plastic SOP (5.72 mm (225))
$\mu$ PD6379AGR	8-pin plastic SOP (5.72 mm (225))
$\mu$ PD6379ALGR	8-pin plastic SOP (5.72 mm (225))

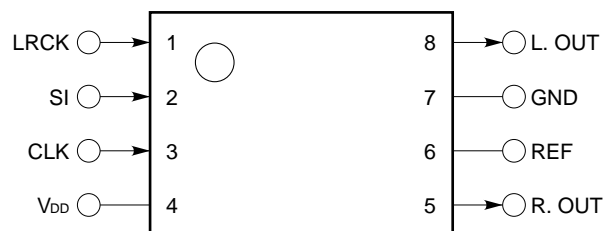
## BLOCK DIAGRAM



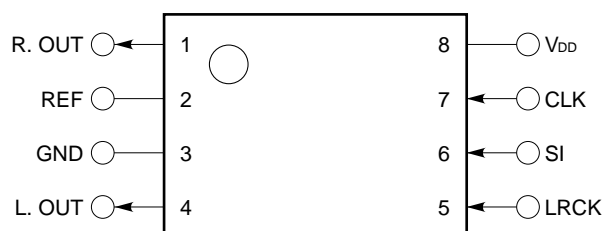
# PIN CONFIGURATIONS (Top View)

8-pin plastic SOP (5.72 mm (225))

- $\mu$ PD6379GR, 6379LGR



- $\mu$ PD6379AGR, 6379ALGR



**Remark** The pin configuration of the  $\mu$ PD6379 and 6379L is different from that of the  $\mu$ PD6379A and 6379AL.

## 1. PIN FUNCTIONS

Table 1-1 Pin Functions

Pin No.		Name	Symbol	I/O	Function
$\mu$ PD6379, 6379L	$\mu$ PD6379A, 6379AL				
1	5	Left/Right Clock	LRCK	Input	Input pin to identify left or right input data. $\mu$ PD6379, 6379L: Input "L" to this pin when inputting L-ch data to SI pin. $\mu$ PD6379A, 6379AL: Input "H" to this pin when inputting L-ch data to SI pin.
2	6	Serial Input	SI	Input	Serial data input pin. Input data on 2's complement, MSB first, and backward justification.
3	7	Clock	CLK	Input	Serial input data read clock (bit clock) input pin
4	8	Supply Voltage	V <sub>DD</sub>	—	Positive power supply pin
5	1	R-ch Output	R. OUT	Output	Right analog signal output pin
6	2	Reference Voltage	REF	—	Reference voltage pin. Connect this pin to GND through capacitor.
7	3	Ground	GND	—	GND pin
8	4	L-ch Output	L. OUT	Output	Left analog signal output pin

## 2. ELECTRICAL SPECIFICATIONS

### ABSOLUTE MAXIMUM RATINGS ( $T_A = 25\text{ }^{\circ}\text{C}$ )

Parameter	Symbol	Ratings	Unit
Supply voltage	$V_{DD}$	$-0.3$ to $+7.0$	V
Input voltage	$V_i$	$-0.3$ to $V_{DD} + 0.3$	V
Output voltage	$V_o$	$-0.3$ to $V_{DD} + 0.3$	V
Permissible package power dissipation	$P_D$	220 ( $T_A = 75\text{ }^{\circ}\text{C}$ )	mW
Operating ambient temperature	$T_A$	$-20$ to $+75$	$^{\circ}\text{C}$
Storage temperature	$T_{stg}$	$-40$ to $+125$	$^{\circ}\text{C}$

**Caution** Exposure to Absolute Maximum Ratings for extended periods may affect device reliability; exceeding the ratings could cause permanent damage. The parameters apply independently. The device should be operated within the limits specified under DC and AC Characteristics.

$\mu$ PD6379, 6379A

## RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	Condition	MIN.	TYP.	MAX.	Unit
Supply voltage	$V_{DD}$		4.5	5.0	5.5	V
Logic input voltage (HIGH)	$V_{IH}$		0.7 $V_{DD}$		$V_{DD}$	V
Logic input voltage (LOW)	$V_{IL}$		0		0.3 $V_{DD}$	V
Operating ambient temperature	$T_A$		-20	+25	+75	°C
Output load resistance	$R_L$	R. OUT, L. OUT pins	5			k $\Omega$
Conversion frequency	$f_s$				200	kHz
Clock frequency	$f_{CLK}$				10	MHz
Clock pulse width	$t_{SCK}$		40			ns
SI, LRCK setup time	$t_{DC}$		12			ns
SI, LRCK hold time	$t_{CD}$		12			ns

ELECTRICAL CHARACTERISTICS ( $T_A = 25\text{ }^{\circ}\text{C}$ ,  $V_{DD} = +5\text{ V}$ ,  $f_s = 176.4\text{ kHz}$ )

Parameter	Symbol	Condition	MIN.	TYP.	MAX.	Unit
Resolution	RES			16		Bit
Total harmonic distortion	THD	$f_{IN} = 1\text{ kHz}$ , 0 dB		0.04	0.09	%
Full-scale output voltage	$V_{FS}$			2.0	2.3	$V_{P-P}$
S/N ratio	S/N	With A-weight filter	93	100		dB
Dynamic range	D.R	$f_{IN} = 1\text{ kHz}$ , -60 dB	89	96		dB
Crosstalk	C.T	One side channel = 0 dB, $f_{IN} = 1\text{ kHz}$	82	96		dB
Current dissipation	$I_{DD}$	$f_{IN} = 1\text{ kHz}$ , 0 dB		5	12	mA

μPD6379L, 6379AL

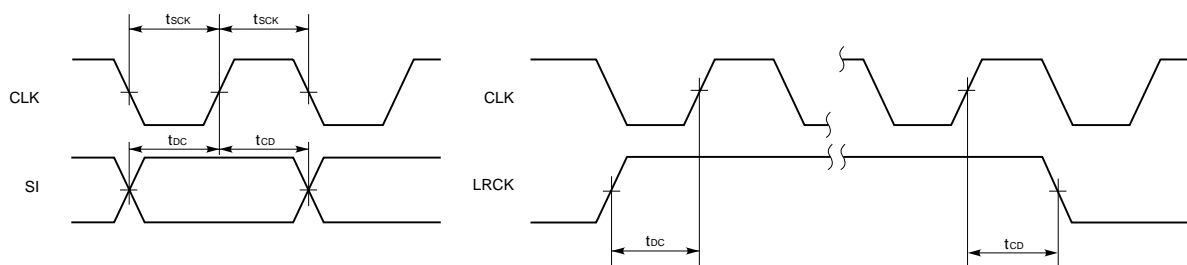
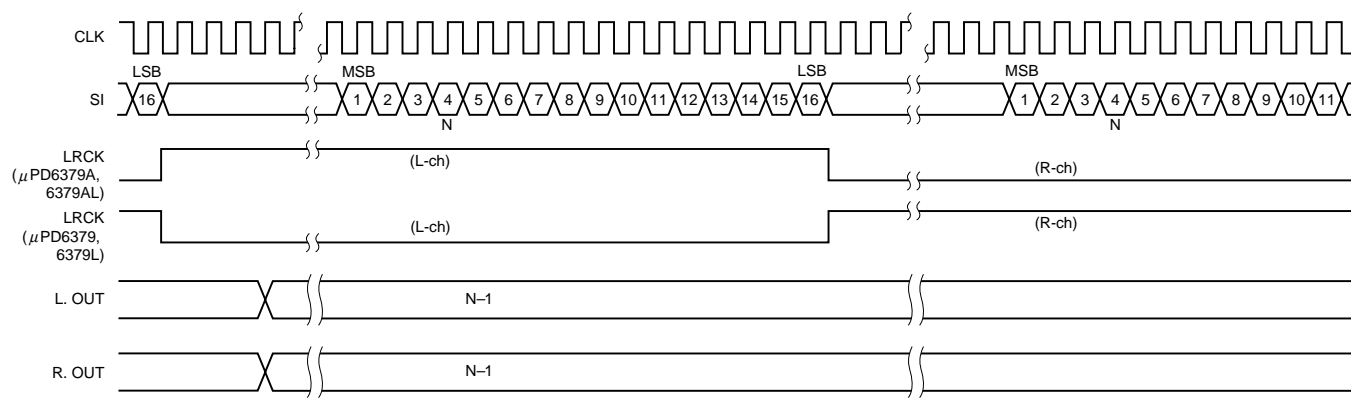
RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	Condition	MIN.	TYP.	MAX.	Unit
Supply voltage	V <sub>DD</sub>		3.0	3.3	5.5	V
Logic input voltage (HIGH)	V <sub>IH</sub>		0.7 V <sub>DD</sub>		V <sub>DD</sub>	V
Logic input voltage (LOW)	V <sub>IL</sub>		0		0.3 V <sub>DD</sub>	V
Operating ambient temperature	T <sub>A</sub>		−20	+25	+75	°C
Output load resistance	R <sub>L</sub>	R. OUT, L. OUT pins	10			kΩ
Conversion frequency	f <sub>s</sub>				200	kHz
Clock frequency	f <sub>CLK</sub>				10	MHz
Clock pulse width	t <sub>sck</sub>		40			ns
SI, LRCK setup time	t <sub>bc</sub>		12			ns
SI, LRCK hold time	t <sub>cd</sub>		12			ns

ELECTRICAL CHARACTERISTICS (T<sub>A</sub> = 25 °C, V<sub>DD</sub> = +3.3 V, f<sub>s</sub> = 176.4 kHz)

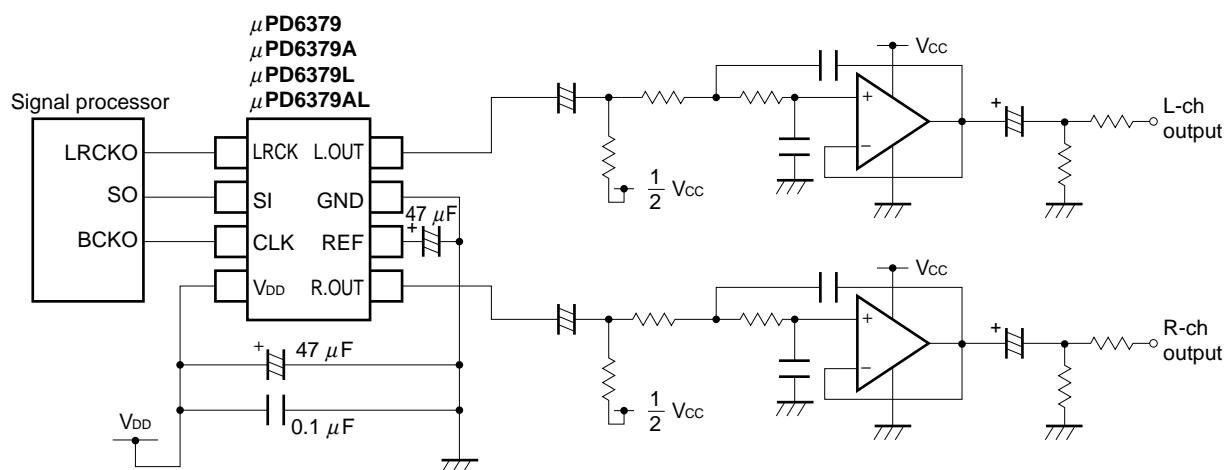
Parameter	Symbol	Condition	MIN.	TYP.	MAX.	Unit
Resolution	RES			16		Bit
Total harmonic distortion	THD	f <sub>IN</sub> = 1 kHz, 0 dB		0.04	0.09	%
Full-scale output voltage	V <sub>FS</sub>			1.32	1.52	V <sub>p-p</sub>
S/N ratio	S/N	With A-weight filter	93	98		dB
Dynamic range	D.R	f <sub>IN</sub> = 1 kHz, −60 dB	89	93		dB
Crosstalk	C.T	One side channel = 0 dB, f <sub>IN</sub> = 1 kHz	82	93		dB
Current dissipation	I <sub>DD</sub>	f <sub>IN</sub> = 1 kHz, 0 dB		3	6	mA

# Timing Chart





### 3. APPLICATION CIRCUIT EXAMPLE



## 4. NOTES ON USE

## (1) Input signal format

- Input data must be input as 2's complement, MSB first, and backward justification.  
2's complement is a method of expressing both positive numbers and negative numbers as binary numbers.  
See the table below.

2's Complement				Decimal Number	L.OUT, R.OUT Pin Voltage TYP. (V) (Reference Values) <sup>Note 1</sup>	
(MSB)			(LSB)		V <sub>DD</sub> = 5.0 V	V <sub>DD</sub> = 3.3 V <sup>Note 2</sup>
0111	1111	1111	1111	+32767	3.0	1.98
0111	1111	1111	1110	+32766	⋮	⋮
		⋮		⋮	⋮	⋮
0000	0000	0000	0001	+1	⋮	⋮
0000	0000	0000	0000	0	2.0	1.32
1111	1111	1111	1111	-1	⋮	⋮
		⋮		⋮	⋮	⋮
1000	0000	0000	0001	-32767	⋮	⋮
1000	0000	0000	0000	-32768	1.0	0.66

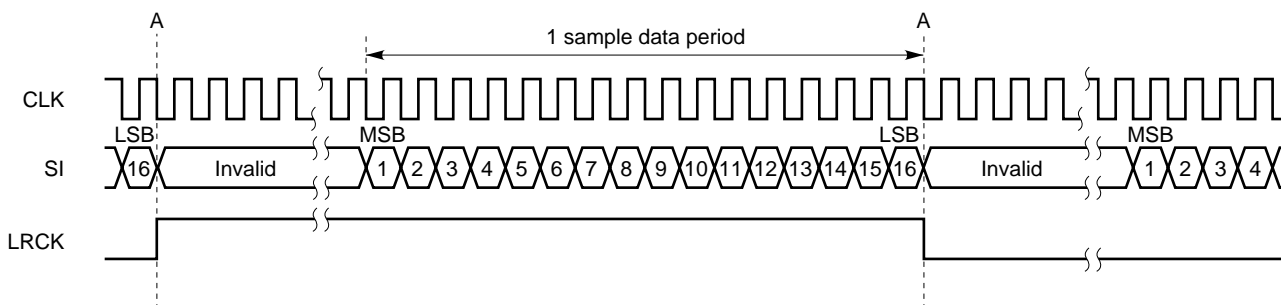
**Notes** 1. Values differ depending on IC fabrication variations, supply voltage fluctuations, and ambient temperature.

2.  $\mu$ PD6379L, 6379AL

- Make sure that the delimiter of each bit of the data (SI) and the changing timing of LRCK coincide with the falling edge of CLK.
- It is necessary that 16 clocks be input during 1 sample data period (16 bits). Make sure that the time width of 1 bit coincides with one cycle of the clock.
- ★ In the input data, the 16 bits preceding the change point of LRCK (shown in "1 sample data period" in Fig. 4-1, and Fig. 4-2) are considered to be valid data and are incorporated for use in D/A conversion.

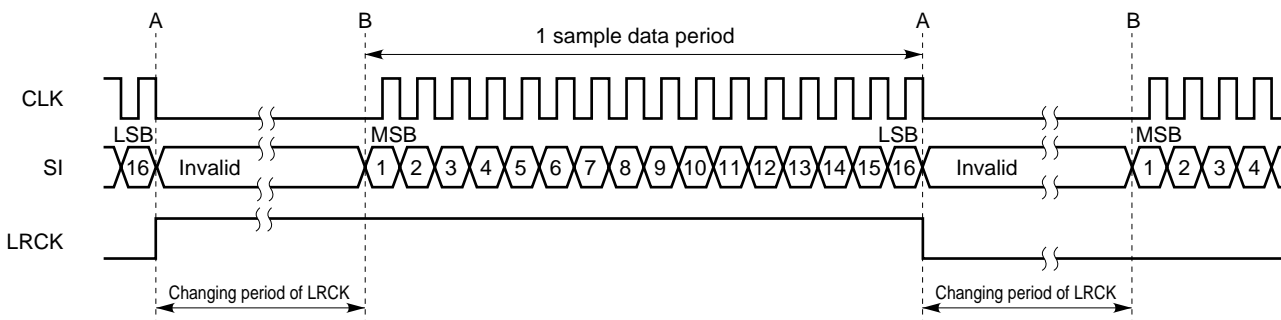
- If the clock is also supplied to CLK while data is not sampled (refer to Fig. 4-1), make sure that the changing timing of LRCK coincides with the falling edge (point A) of CLK after the LSB has been input.

Fig. 4-1 Input Timing Chart (1)



- If the clock is supplied to CLK only while data is sampled (refer to Fig. 4-2), set the changing timing of LRCK in between the falling edge (point A) of CLK after the LSB has been input and the start of inputting the next MSB (point B) (points A and B are included).

Fig. 4-2 Input Timing Chart (2)



★ (2) Output signal updating timing

The L.OUT and R.OUT signals are updated after the input of 3.5 clocks following the change point indicating the end of the LRCK pin R-ch data input period. Therefore, when the clock is supplied to CLK only during D/A conversion, the clock must be stopped after the L.OUT and R.OUT signals corresponding to the last input data are output. Be aware that the L.OUT and R.OUT signals corresponding to the last sample data are not output, especially when the clock is supplied to CLK only during a sample data period.

Fig. 4-3 Output Timing Chart (1) (for continuous clocks)

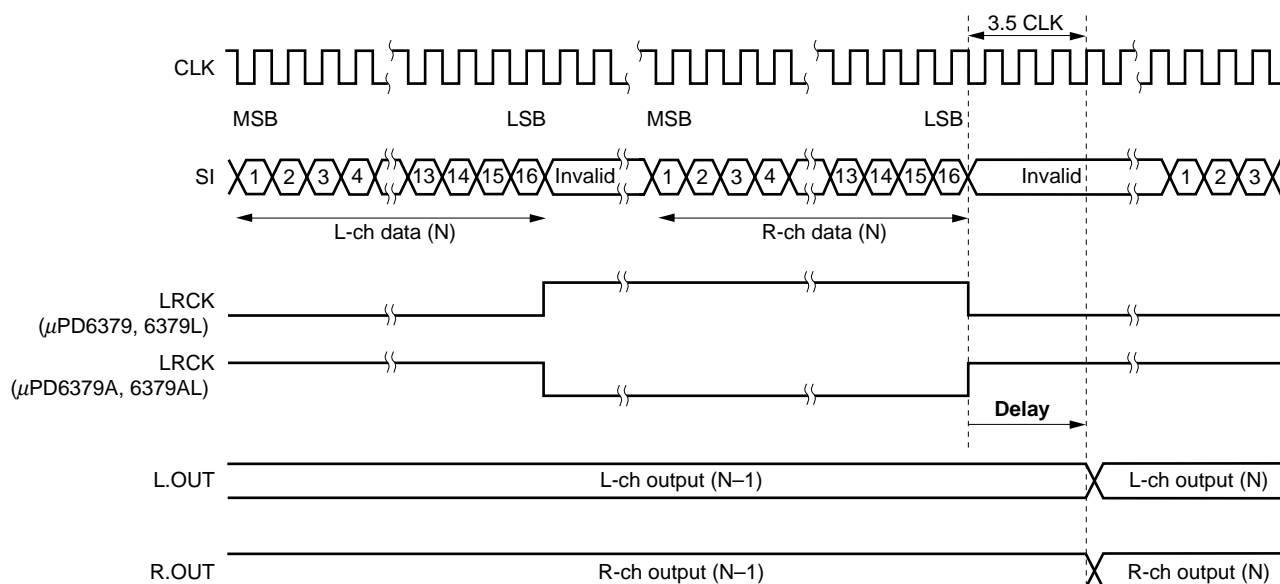
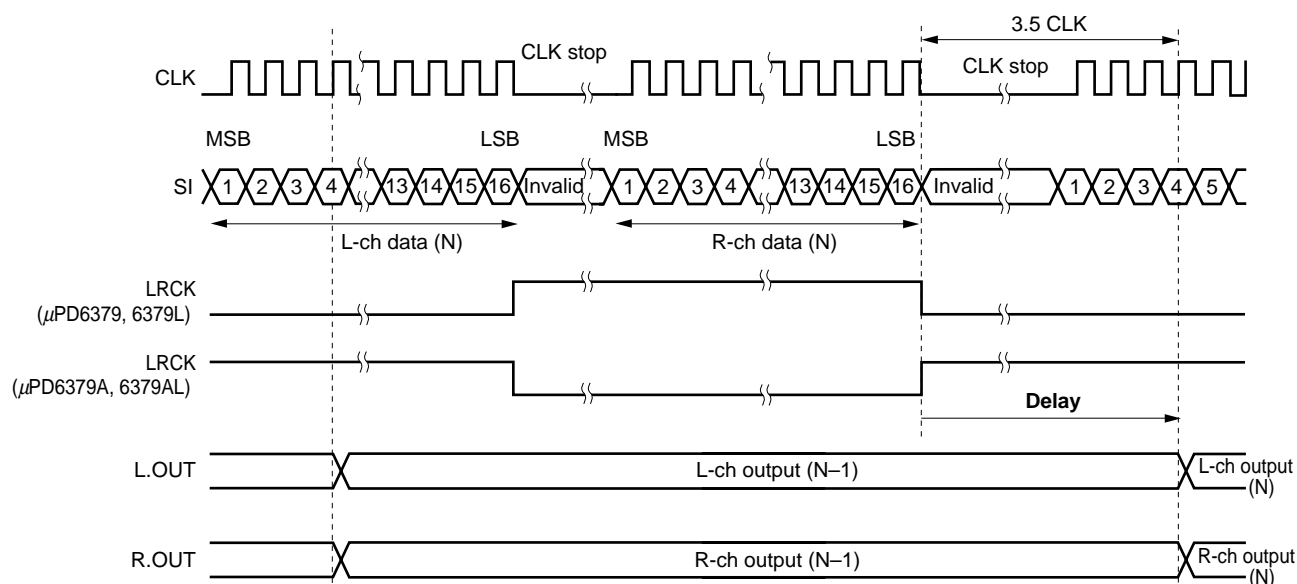


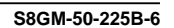
Fig. 4-4 Output Timing Chart (2) (when there is an interval which the clock is stopped)



(3) Countermeasures against shock noise

It is recommended that a mute circuit be connected to the next stage of the D/A converter. If a mute circuit is not provided, shock noise may occur when power is applied.

### 8-PIN PLASTIC SOP (5.72 mm (225))



## 6. RECOMMENDED SOLDERING CONDITIONS

The following conditions must be met for soldering conditions of the product.

For more details, refer to our document “**SEMICONDUCTOR DEVICE MOUNTING TECHNOLOGY MANUAL**” (C10535E).

Please consult with our sales offices in case other soldering process is used, or in case the soldering is done under different conditions.

**Table 6-1 Soldering Conditions**

$\mu$ PD6379GR, 6379AGR, 6379LGR, 6379ALGR : 8-pin plastic SOP (5.72 mm (225))

Soldering Process	Soldering Conditions	Symbol
Infrared ray reflow	Peak temperature of package surface: 235 °C or below, Reflow time: 30 seconds or less (at 210 °C or higher), Number of reflow processes: MAX. 2.	IR35-00-2
VPS	Peak temperature of package surface: 215 °C or below, Reflow time: 40 seconds or less (at 200 °C or higher), Number of reflow processes: MAX. 2.	VP15-00-2
Wave soldering	Solder temperature: 260 °C or below, Flow time: 10 seconds or less, Pre-heating temperature: 120 °C or below (Package surface), Number of flow processes: MAX. 1.	WS60-00-1
Partial heating method	Terminal temperature: 300 °C or below, Time: 3 seconds or less (Per one side of the device).	—

**Caution** Do not apply more than one soldering method at any one time, except for “Partial heating method”.

## NOTES FOR CMOS DEVICES

### ① PRECAUTION AGAINST ESD FOR SEMICONDUCTORS

**Note:** Strong electric field, when exposed to a MOS device, can cause destruction of the gate oxide and ultimately degrade the device operation. Steps must be taken to stop generation of static electricity as much as possible, and quickly dissipate it once, when it has occurred. Environmental control must be adequate. When it is dry, humidifier should be used. It is recommended to avoid using insulators that easily build static electricity. Semiconductor devices must be stored and transported in an anti-static container, static shielding bag or conductive material. All test and measurement tools including work bench and floor should be grounded. The operator should be grounded using wrist strap. Semiconductor devices must not be touched with bare hands. Similar precautions need to be taken for PW boards with semiconductor devices on it.

### ② HANDLING OF UNUSED INPUT PINS FOR CMOS

**Note:** No connection for CMOS device inputs can be cause of malfunction. If no connection is provided to the input pins, it is possible that an internal input level may be generated due to noise, etc., hence causing malfunction. CMOS devices behave differently than Bipolar or NMOS devices. Input levels of CMOS devices must be fixed high or low by using a pull-up or pull-down circuitry. Each unused pin should be connected to  $V_{DD}$  or GND with a resistor, if it is considered to have a possibility of being an output pin. All handling related to the unused pins must be judged device by device and related specifications governing the devices.

### ③ STATUS BEFORE INITIALIZATION OF MOS DEVICES

**Note:** Power-on does not necessarily define initial status of MOS device. Production process of MOS does not define the initial operation status of the device. Immediately after the power source is turned ON, the devices with reset function have not yet been initialized. Hence, power-on does not guarantee out-pin levels, I/O settings or contents of registers. Device is not initialized until the reset signal is received. Reset operation must be executed immediately after power-on for devices having reset function.

[MEMO]

- **The information in this document is subject to change without notice. Before using this document, please confirm that this is the latest version.**
  - No part of this document may be copied or reproduced in any form or by any means without the prior written consent of NEC Corporation. NEC Corporation assumes no responsibility for any errors which may appear in this document.
  - NEC Corporation does not assume any liability for infringement of patents, copyrights or other intellectual property rights of third parties by or arising from use of a device described herein or any other liability arising from use of such device. No license, either express, implied or otherwise, is granted under any patents, copyrights or other intellectual property rights of NEC Corporation or others.
  - Descriptions of circuits, software, and other related information in this document are provided for illustrative purposes in semiconductor product operation and application examples. The incorporation of these circuits, software, and information in the design of the customer's equipment shall be done under the full responsibility of the customer. NEC Corporation assumes no responsibility for any losses incurred by the customer or third parties arising from the use of these circuits, software, and information.
  - While NEC Corporation has been making continuous effort to enhance the reliability of its semiconductor devices, the possibility of defects cannot be eliminated entirely. To minimize risks of damage or injury to persons or property arising from a defect in an NEC semiconductor device, customers must incorporate sufficient safety measures in its design, such as redundancy, fire-containment, and anti-failure features.
  - NEC devices are classified into the following three quality grades:  
 "Standard", "Special", and "Specific". The Specific quality grade applies only to devices developed based on a customer designated "quality assurance program" for a specific application. The recommended applications of a device depend on its quality grade, as indicated below. Customers must check the quality grade of each device before using it in a particular application.
    - 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
    - Special: 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, life support systems or medical equipment for life support, etc.
- The quality grade of NEC devices is "Standard" unless otherwise specified in NEC's Data Sheets or Data Books. If customers intend to use NEC devices for applications other than those specified for Standard quality grade, they should contact an NEC sales representative in advance.