

# M62354P/FP/GP

R03DS0043EJ0400

Rev.4.00

Jun 03, 2011

## 8-bit 6ch D/A Converter with Buffer Amplifiers

### Description

The M62354 is an integrated circuit semiconductor of CMOS structured with 6 channels of built-in D/A converters with output buffer operational amplifiers.

The 3-wire serial interface method is used for the transfer format of digital data to allow connection with microcomputer with minimum wiring.

It is able to cascading serial use with DO terminal.

The output buffer operational amplifier operates in the whole voltage range from power supply to ground for both input/output.

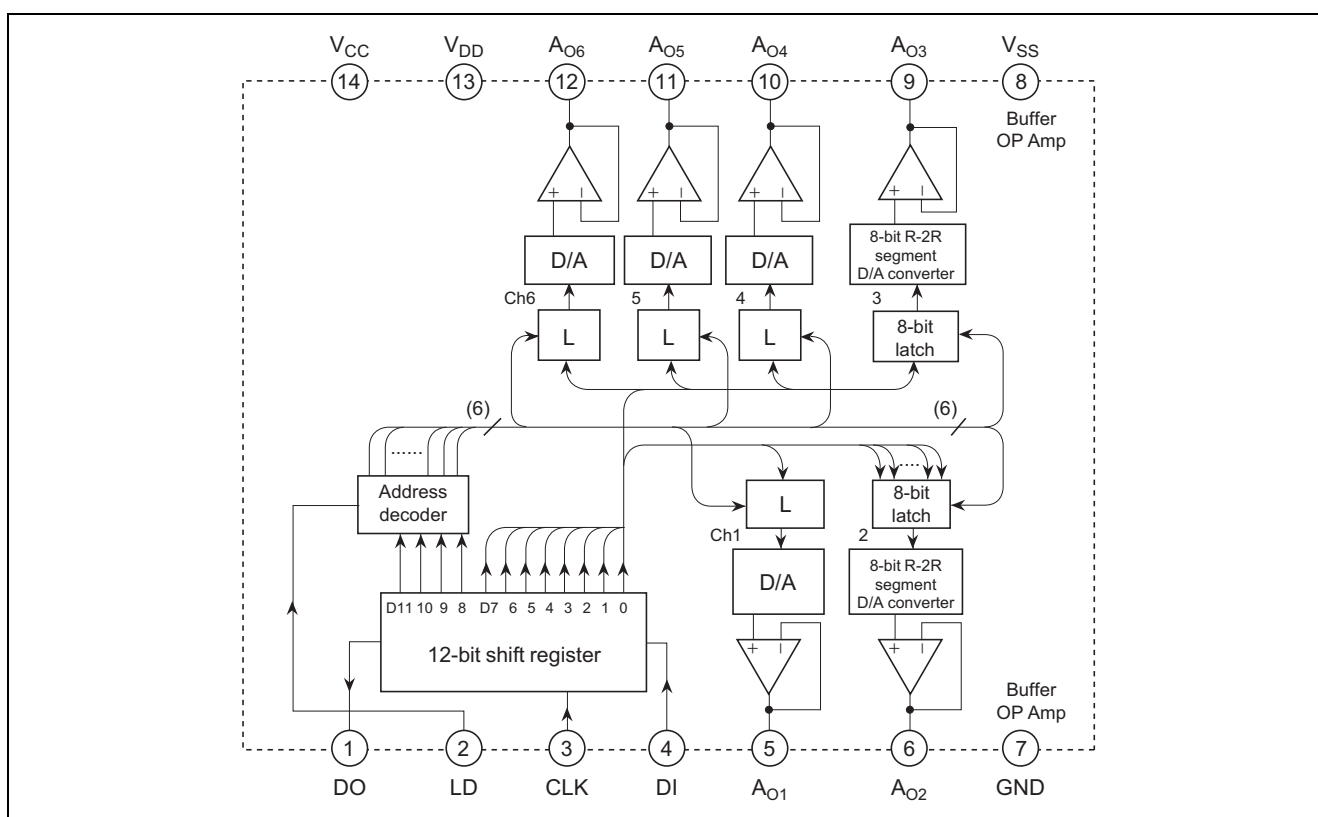
### Features

- 12-bit serial data input (3-wire serial data transfer method)
- Highly stable output buffer operational amplifier allow operation in the all voltage range from power supply to ground.

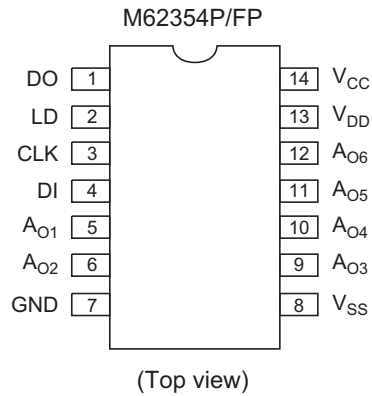
### Application

Adjustment/control of industrial or home-use electronic equipment, such as VTR camera, VTR set, TV, and CRT display.

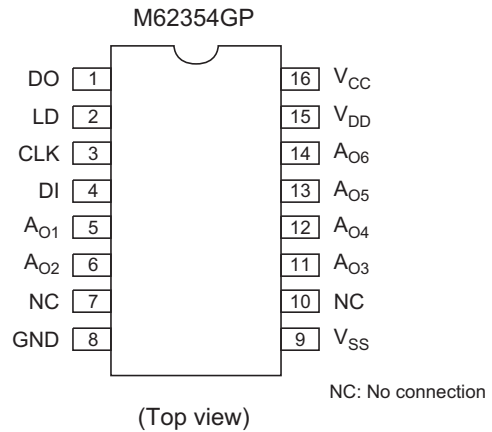
### Block Diagram



## Pin Arrangement



Outline: 14P4 [P] (not recommend for new design)  
PRSP0014DD-A (14P2N-A) [FP]



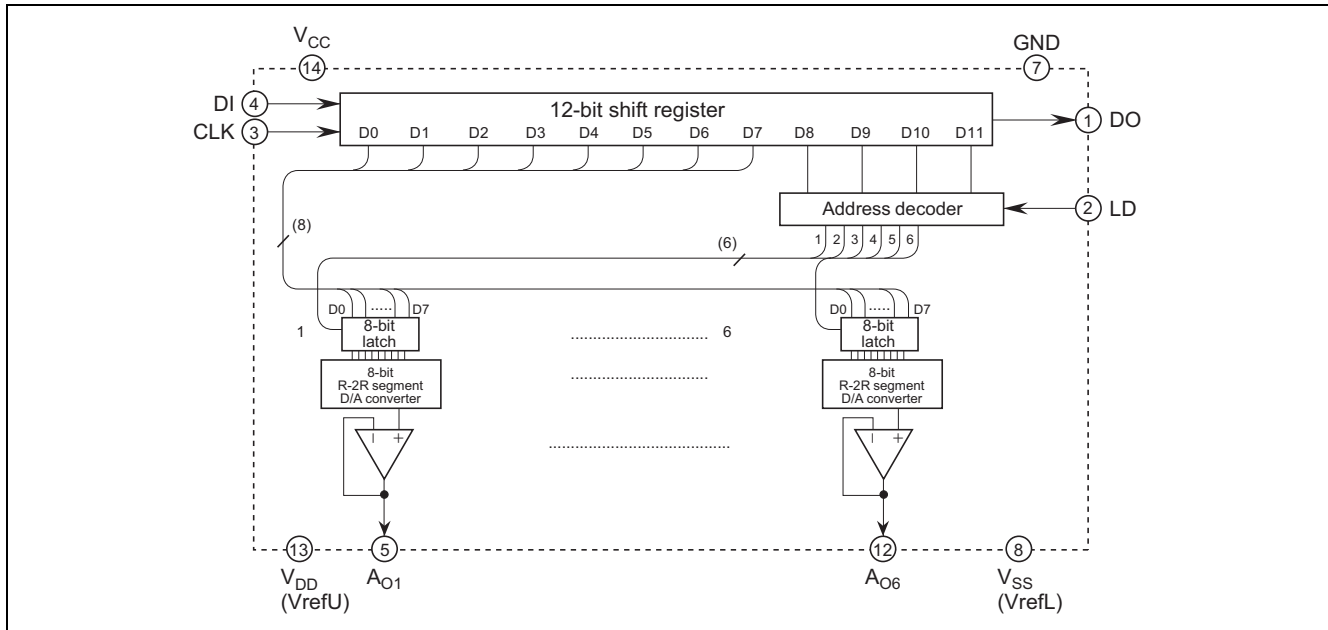
Outline: PLSP0016JA-A (16P2E-A) [GP]

## Pin Description

| Pin No. | Pin Name        | Function                                                  |
|---------|-----------------|-----------------------------------------------------------|
| 4 (4)   | DI              | Serial data input terminal                                |
| 1 (1)   | DO              | Serial data output terminal                               |
| 3 (3)   | CLK             | Serial clock input terminal                               |
| 2 (2)   | LD              | LD terminal input high level then latch circuit data load |
| 5 (5)   | AO <sub>1</sub> | 8-bit D/A converter output terminal                       |
| 6 (6)   | AO <sub>2</sub> |                                                           |
| 9 (11)  | AO <sub>3</sub> |                                                           |
| 10 (12) | AO <sub>4</sub> |                                                           |
| 11 (13) | AO <sub>5</sub> |                                                           |
| 12 (14) | AO <sub>6</sub> |                                                           |
| 14 (16) | V <sub>CC</sub> | Power supply terminal                                     |
| 7 (8)   | GND             | Digital and analog common GND                             |
| 13 (15) | V <sub>DD</sub> | D/A converter upper reference voltage input terminal      |
| 8 (9)   | V <sub>SS</sub> | D/A converter lower reference voltage input terminal      |

Note: ( ) : M62354GP

## Block Diagram for Explanation of Terminals



## Absolute Maximum Ratings

| Item                                  | Symbol    | Ratings                       | Unit |
|---------------------------------------|-----------|-------------------------------|------|
| Supply voltage                        | $V_{CC}$  | -0.3 to +7.0                  | V    |
| D/A converter upper reference voltage | $V_{DD}$  | -0.3 to +7.0                  | V    |
| Input voltage                         | $V_{IN}$  | -0.3 to $V_{CC} + 0.3$        | V    |
| Output voltage                        | $V_O$     | -0.3 to $V_{CC} + 0.3$        | V    |
| Power dissipation                     | $P_d$     | 440 (P) / 250 (FP) / 150 (GP) | mW   |
| Operating temperature                 | $T_{opr}$ | -20 to +85                    | °C   |
| Storage temperature                   | $T_{stg}$ | -40 to +125                   | °C   |

## Electrical Characteristics

### <Digital Part>

( $V_{CC}$ ,  $V_{refU} = 5\text{ V} \pm 10\%$ ,  $V_{CC} \geq V_{refU}$ ,  $GND$ ,  $V_{refL} = 0\text{ V}$ ,  $T_a = -20$  to  $+85^\circ\text{C}$ , unless otherwise noted.)

| Item                | Symbol    | Limits         |     |              | Unit          | Conditions                                                                       |
|---------------------|-----------|----------------|-----|--------------|---------------|----------------------------------------------------------------------------------|
|                     |           | Min            | Typ | Max          |               |                                                                                  |
| Supply voltage      | $V_{CC}$  | 4.5            | 5.0 | 5.5          | V             |                                                                                  |
| Circuit current     | $I_{CC}$  | —              | 0.7 | 2.5          | mA            | CLK = 1 MHz operation<br>$V_{CC} = 5\text{ V}$ , $I_{AO} = 0\text{ }\mu\text{A}$ |
| Input leak current  | $I_{ILK}$ | -10            | —   | 10           | $\mu\text{A}$ | $V_{IN} = 0$ to $V_{CC}$                                                         |
| Input low voltage   | $V_{IL}$  | —              | —   | $0.2 V_{CC}$ | V             |                                                                                  |
| Input high voltage  | $V_{IH}$  | $0.8 V_{CC}$   | —   | —            | V             |                                                                                  |
| Output low voltage  | $V_{OL}$  | —              | —   | 0.4          | V             | $I_{OL} = 2.5\text{ mA}$                                                         |
| Output high voltage | $V_{OH}$  | $V_{CC} - 0.4$ | —   | —            | V             | $I_{OH} = -400\text{ }\mu\text{A}$                                               |

### <Analog Part>

( $V_{CC}$ ,  $V_{refU} = 5\text{ V} \pm 10\%$ ,  $V_{CC} \geq V_{refU}$ ,  $T_a = -20$  to  $+85^\circ\text{C}$ , unless otherwise noted.)

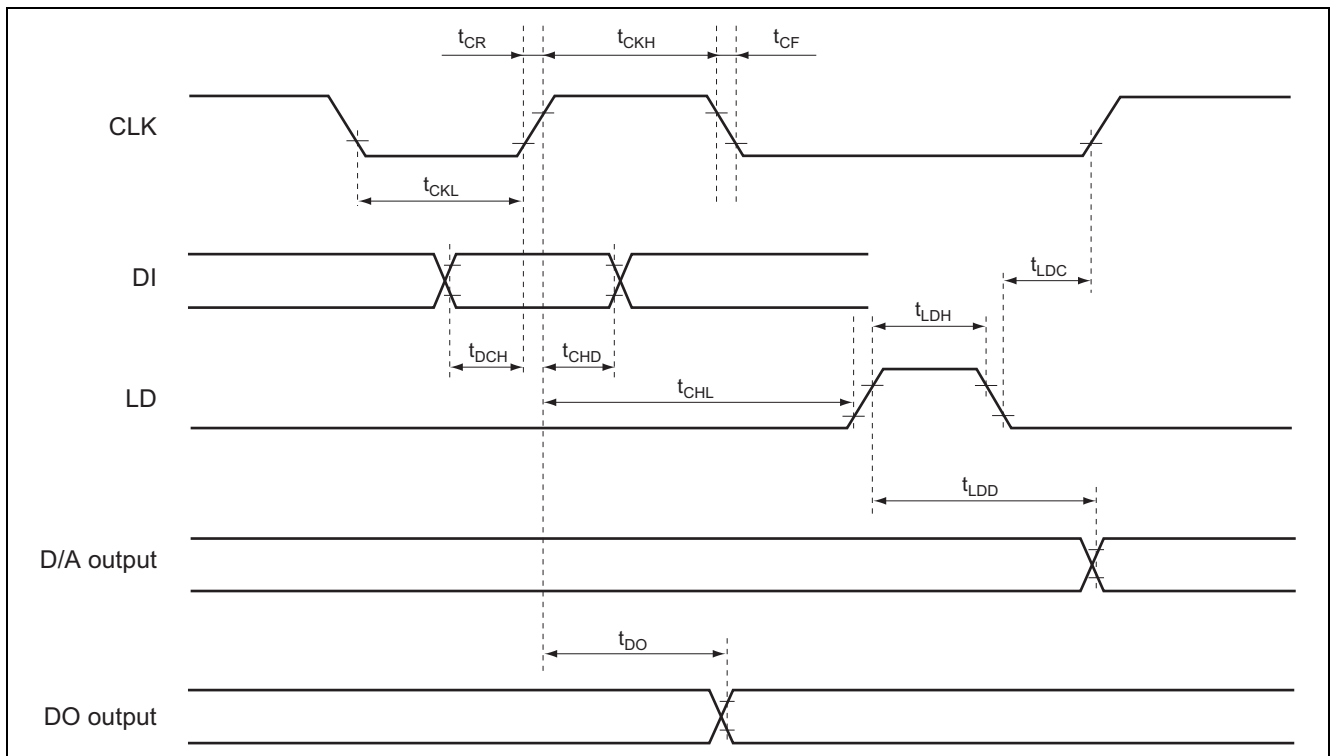
| Item                                        | Symbol     | Limits |     |                | Unit          | Conditions                                                                                                                                                                         |
|---------------------------------------------|------------|--------|-----|----------------|---------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                             |            | Min    | Typ | Max            |               |                                                                                                                                                                                    |
| Current dissipation                         | $I_{DD}$   | —      | 0.7 | 1.3            | mA            | $V_{refU} = 5\text{ V}$ , $V_{refL} = 0\text{ V}$<br>Data condition: at maximum current                                                                                            |
| D/A converter upper reference voltage range | $V_{DD}$   | 3.5    | —   | $V_{CC}$       | V             | The output does not necessarily be the value within the reference voltage setting range. The output value is determined by the buffer amplifier output voltage range ( $V_{AO}$ ). |
| D/A converter lower reference voltage range | $V_{SS}$   | GND    | —   | $V_{CC} - 3.5$ | V             |                                                                                                                                                                                    |
| Buffer amplifier output voltage range       | $V_{AO}$   | 0.1    | —   | $V_{CC} - 0.1$ | V             | $I_{AO} = \pm 100\text{ }\mu\text{A}$                                                                                                                                              |
|                                             |            | 0.2    | —   | $V_{CC} - 0.2$ |               | $I_{AO} = \pm 500\text{ }\mu\text{A}$                                                                                                                                              |
| Buffer amplifier output drive range         | $I_{AO}$   | -1     | —   | 1              | mA            | Upper side saturation voltage = 0.3 V<br>Lower side saturation voltage = 0.2 V                                                                                                     |
| Differential nonlinearity error             | $S_{DL}$   | -1.0   | —   | 1.0            | LSB           | $V_{refU} = 4.79\text{ V}$<br>$V_{refL} = 0.95\text{ V}$                                                                                                                           |
| Nonlinearity error                          | $S_L$      | -1.5   | —   | 1.5            | LSB           | $V_{CC} = 5.5\text{ V}$ (15 mV/LSB)<br>Without load ( $I_{AO} = \pm 0\text{ }\mu\text{A}$ )                                                                                        |
| Zero code error                             | $S_{ZERO}$ | -2     | —   | 2              | LSB           |                                                                                                                                                                                    |
| Full scale error                            | $S_{FULL}$ | -2     | —   | 2              | LSB           |                                                                                                                                                                                    |
| Output capacitive load                      | $C_O$      | —      | —   | 0.1            | $\mu\text{F}$ |                                                                                                                                                                                    |
| Buffer amplifier output impedance           | $R_O$      | —      | 5   | —              | $\Omega$      |                                                                                                                                                                                    |

## AC Characteristics

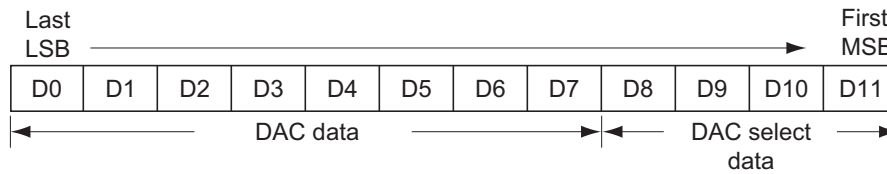
( $V_{CC}$ ,  $V_{refU} = 5\text{ V} \pm 10\%$ ,  $V_{CC} \geq V_{refU}$ ,  $GND$ ,  $V_{refL} = 0\text{ V}$ ,  $T_a = -20$  to  $+85^\circ\text{C}$ , unless otherwise noted.)

| Item                    | Symbol    | Limits |     |     | Unit          | Conditions                                                                                                                            |
|-------------------------|-----------|--------|-----|-----|---------------|---------------------------------------------------------------------------------------------------------------------------------------|
|                         |           | Min    | Typ | Max |               |                                                                                                                                       |
| Clock "L" pulse width   | $t_{CKL}$ | 200    | —   | —   | ns            |                                                                                                                                       |
| Clock "H" pulse width   | $t_{CKH}$ | 200    | —   | —   | ns            |                                                                                                                                       |
| Clock rise time         | $t_{CR}$  | —      | —   | 200 | ns            |                                                                                                                                       |
| Clock fall time         | $t_{CF}$  | —      | —   | 200 | ns            |                                                                                                                                       |
| Data setup time         | $t_{DCH}$ | 30     | —   | —   | ns            |                                                                                                                                       |
| Data hold time          | $t_{CHD}$ | 60     | —   | —   | ns            |                                                                                                                                       |
| LD setup time           | $t_{CHL}$ | 200    | —   | —   | ns            |                                                                                                                                       |
| LD hold time            | $t_{LDC}$ | 100    | —   | —   | ns            |                                                                                                                                       |
| LD "H" pulse width      | $t_{LDH}$ | 100    | —   | —   | ns            |                                                                                                                                       |
| Data output delay time  | $t_{DO}$  | 70     | —   | 350 | ns            | $C_L \leq 100\text{ pF}$                                                                                                              |
| D/A output setting time | $t_{LDD}$ | —      | —   | 300 | $\mu\text{s}$ | $C_L \leq 100\text{ pF}$ , $V_{AO}: 0.5 \leftrightarrow 4.5\text{ V}$<br>The time until the output becomes the final value of 1/2 LSB |

## Timing Chart



## Digital Data Format



### DAC Data

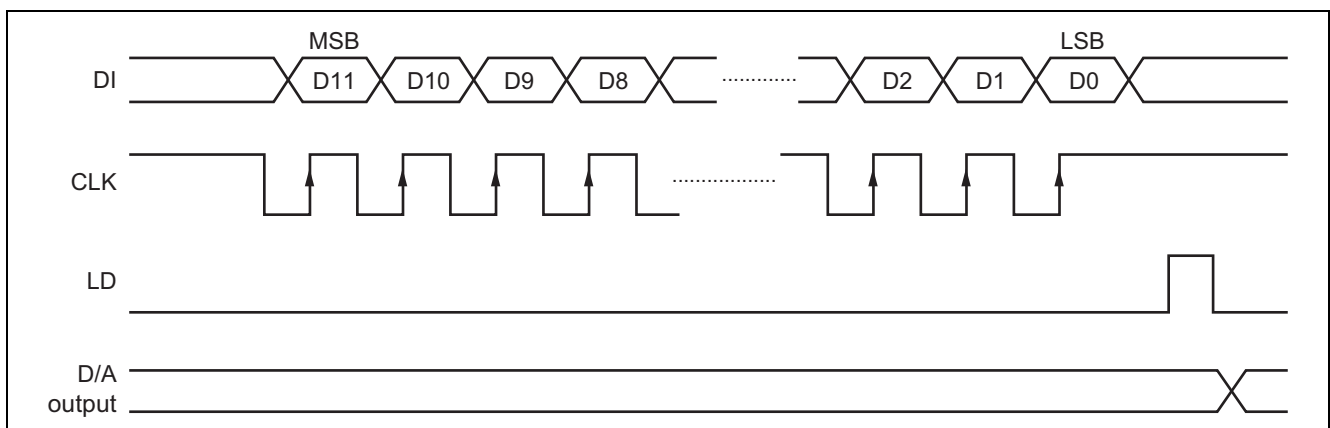
| D0 | D1 | D2 | D3 | D4 | D5 | D6 | D7 | D/A Output                                          |
|----|----|----|----|----|----|----|----|-----------------------------------------------------|
| 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | $(V_{refU} - V_{refL}) / 256 \times 1 + V_{refL}$   |
| 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | $(V_{refU} - V_{refL}) / 256 \times 2 + V_{refL}$   |
| 0  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | $(V_{refU} - V_{refL}) / 256 \times 3 + V_{refL}$   |
| 1  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | $(V_{refU} - V_{refL}) / 256 \times 4 + V_{refL}$   |
| :  | :  | :  | :  | :  | :  | :  | :  | :                                                   |
| 0  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | $(V_{refU} - V_{refL}) / 256 \times 255 + V_{refL}$ |
| 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | $V_{refU}$                                          |

Note:  $V_{refU} = V_{DD}$ ,  $V_{refL} = V_{SS}$

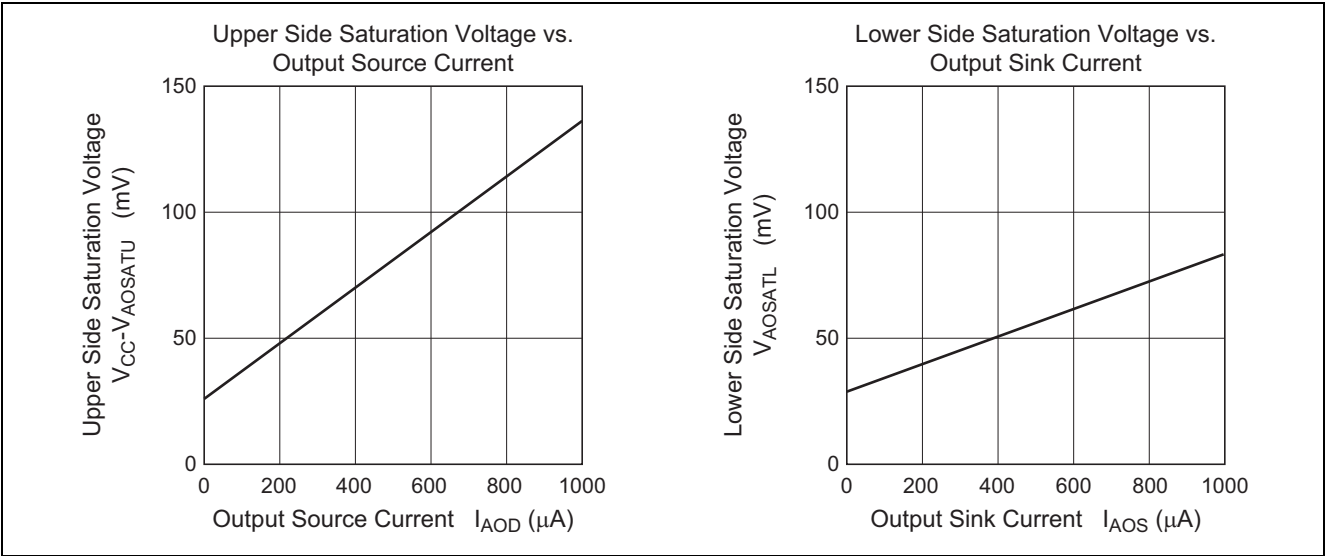
### DAC Select Data

| D8 | D9 | D10 | D11 | DAC Selection             |
|----|----|-----|-----|---------------------------|
| 0  | 0  | 0   | 0   | Don't care                |
| 0  | 0  | 0   | 1   | A <sub>O1</sub> selection |
| 0  | 0  | 1   | 0   | A <sub>O2</sub> selection |
| 0  | 0  | 1   | 1   | A <sub>O3</sub> selection |
| 0  | 1  | 0   | 0   | A <sub>O4</sub> selection |
| 0  | 1  | 0   | 1   | A <sub>O5</sub> selection |
| 0  | 1  | 1   | 0   | A <sub>O6</sub> selection |
| 0  | 1  | 1   | 1   | Don't care                |
| 1  | 0  | 0   | 0   | Don't care                |
| 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                |

## Timing Chart (Model)



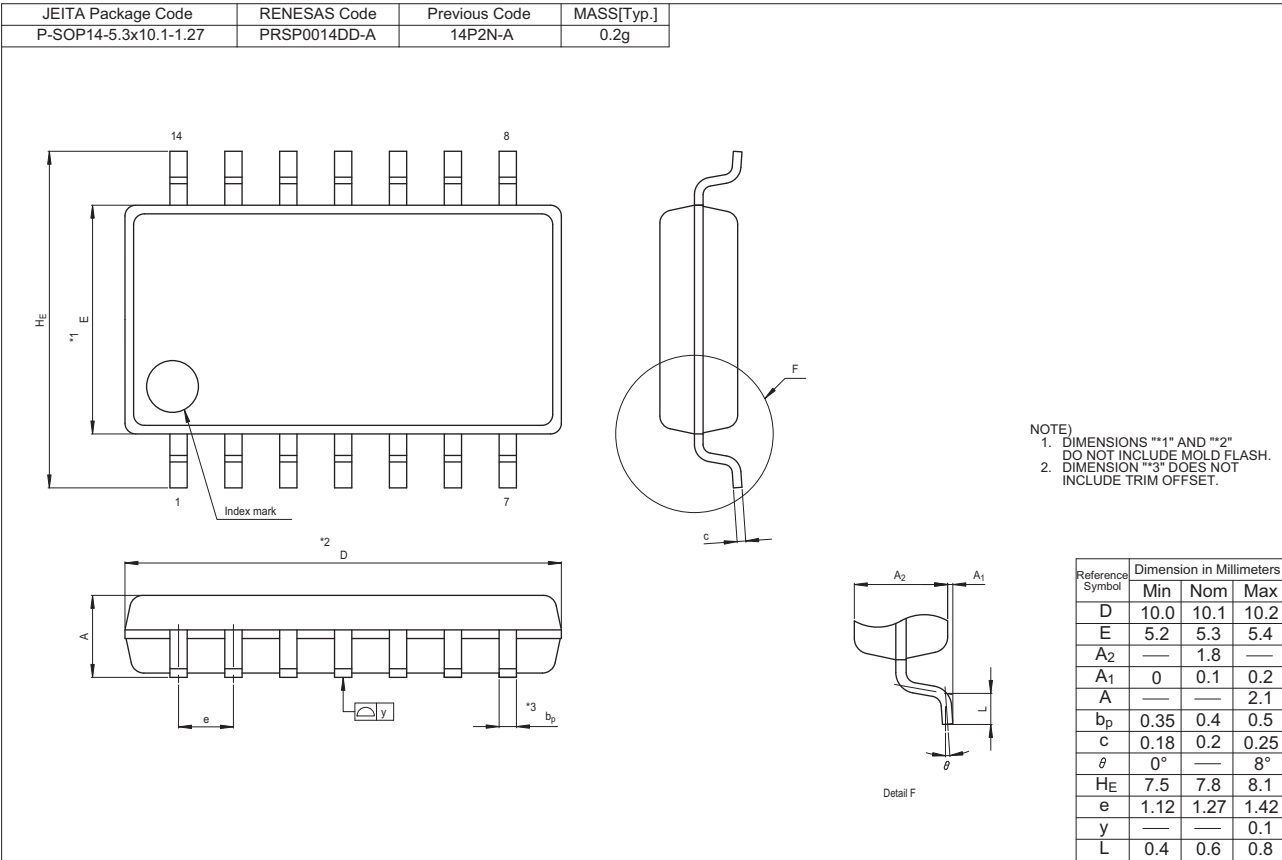
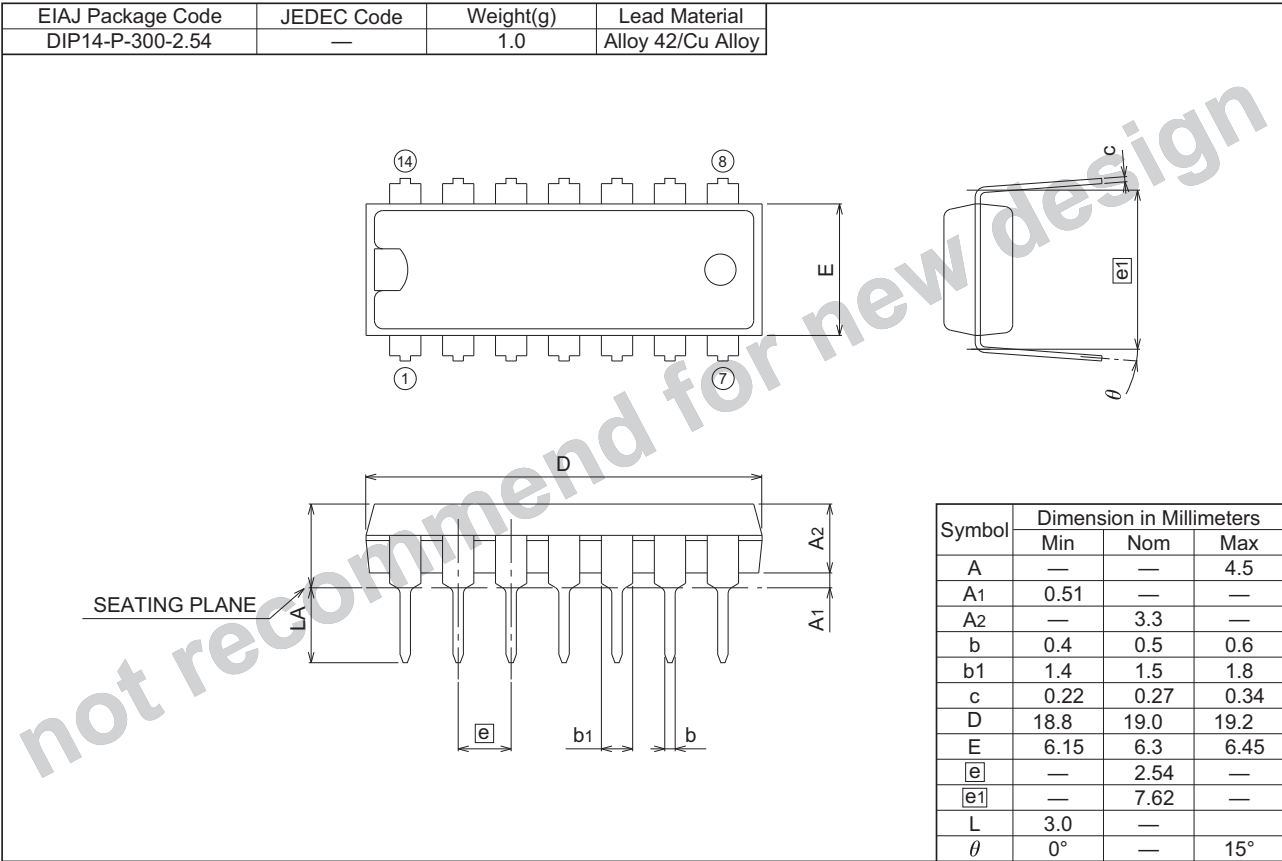
Typical Characteristics



# Package Dimensions

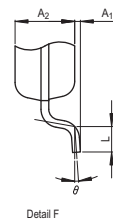
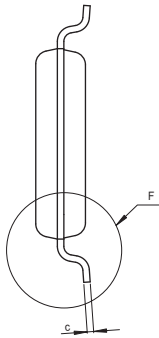
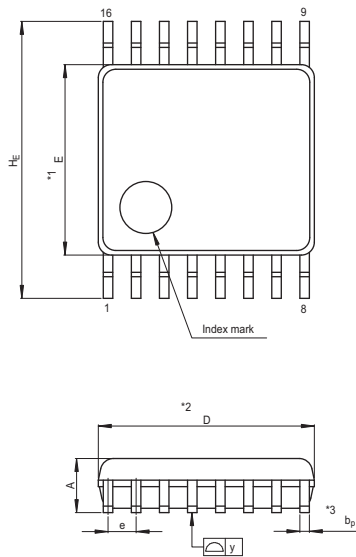
## 14P4

Plastic 14pin 300mil DIP





| JEITA Package Code   | RENESAS Code | Previous Code | MASS[Typ.] |
|----------------------|--------------|---------------|------------|
| P-LSSOP16-4.4x5-0.65 | PLSP0016JA-A | 16P2E-A       | 0.06g      |



NOTE)  
1. DIMENSIONS \*\*1\* AND \*\*2\*  
DO NOT INCLUDE MOLD FLASH.  
2. DIMENSION \*\*3\* DOES NOT  
INCLUDE TRIM OFFSET.

| Reference<br>Symbol | Dimension in Millimeters |      |      |
|---------------------|--------------------------|------|------|
|                     | Min                      | Nom  | Max  |
| D                   | 4.9                      | 5.0  | 5.1  |
| E                   | 4.3                      | 4.4  | 4.5  |
| A <sub>2</sub>      | —                        | 1.15 | —    |
| A                   | —                        | —    | 1.45 |
| A <sub>1</sub>      | 0                        | 0.1  | 0.2  |
| b <sub>p</sub>      | 0.17                     | 0.22 | 0.32 |
| c                   | 0.13                     | 0.15 | 0.2  |
| θ                   | 0°                       | —    | 10°  |
| H <sub>E</sub>      | 6.2                      | 6.4  | 6.6  |
| e                   | 0.53                     | 0.65 | 0.77 |
| y                   | —                        | —    | 0.10 |
| L                   | 0.3                      | 0.5  | 0.7  |

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