

# HD74HC4051

## 8-Channel Analog Multiplexer Demultiplexer

REJ03D0648-0200  
(Previous ADE-205-535)  
Rev.2.00  
Mar 30, 2006

### Description

This device connects together the outputs of 8 switches, thus achieving an 8 Channel Multiplexer. The binary code placed on the A, B, and C select lines determine which one of the eight switches in “on”, and connects one of the eight inputs to the common output.

### Features

- High Speed Operation
- Wide Operating Voltage:  $V_{CC} = 2$  to  $6$  V
- Low Quiescent Supply Current:  $I_{CC}$  (static) =  $4 \mu A$  max ( $T_a = 25^\circ C$ )
- Ordering Information

| Part Name      | Package Type       | Package Code<br>(Previous Code) | Package<br>Abbreviation | Taping Abbreviation<br>(Quantity) |
|----------------|--------------------|---------------------------------|-------------------------|-----------------------------------|
| HD74HC4051P    | DILP-16 pin        | PRDP0016AE-B<br>(DP-16FV)       | P                       | —                                 |
| HD74HC4051FPEL | SOP-16 pin (JEITA) | PRSP0016DH-B<br>(FP-16DAV)      | FP                      | EL (2,000 pcs/reel)               |
| HD74HC4051RPEL | SOP-16 pin (JEDEC) | PRSP0016DG-A<br>(FP-16DNV)      | RP                      | EL (2,500 pcs/reel)               |

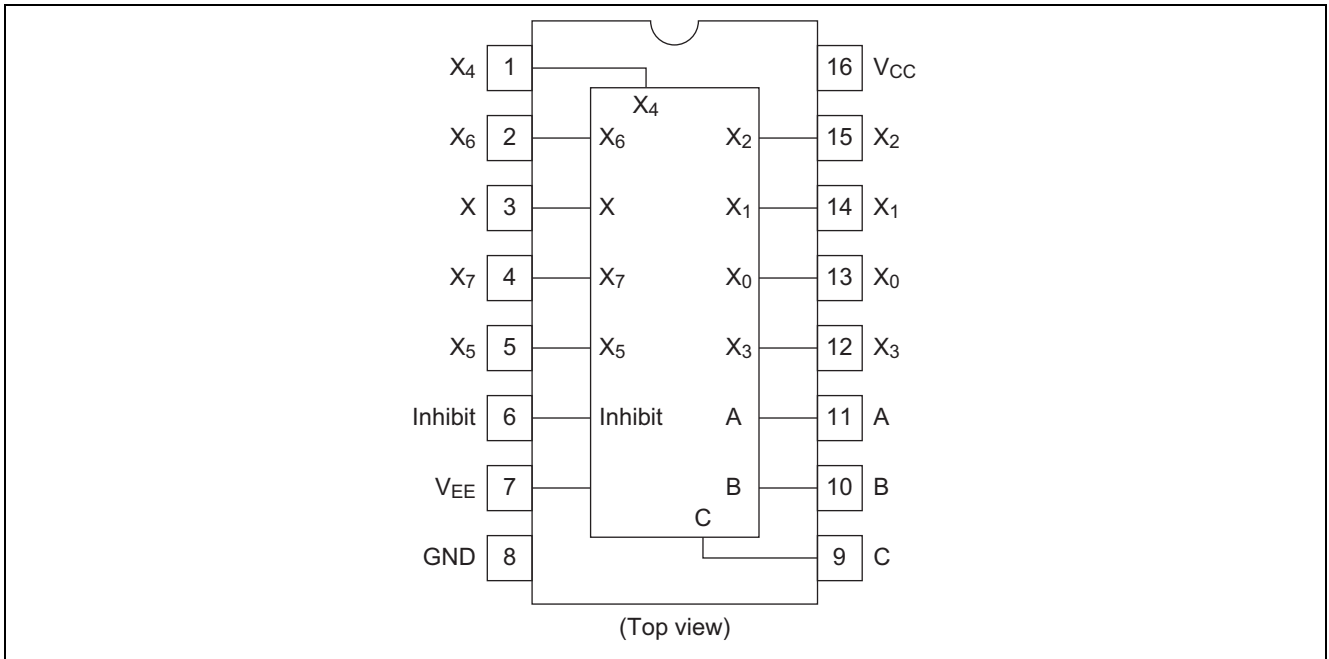
Note: Please consult the sales office for the above package availability.

### Function Table

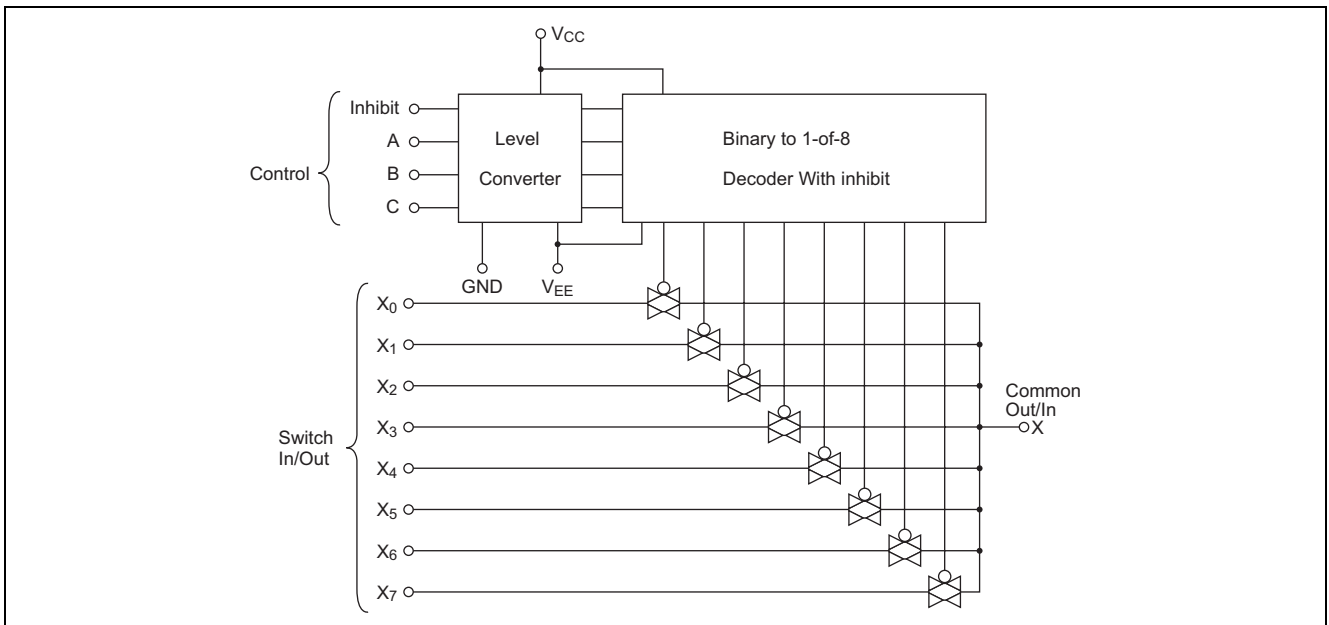
| Control Inputs |   |   |   | ON Switch |
|----------------|---|---|---|-----------|
| Inhibit        | C | B | A |           |
| L              | L | L | L | $X_0$     |
| L              | L | L | H | $X_1$     |
| L              | L | H | L | $X_2$     |
| L              | L | H | H | $X_3$     |
| L              | H | L | L | $X_4$     |
| L              | H | L | H | $X_5$     |
| L              | H | H | L | $X_6$     |
| L              | H | H | H | $X_7$     |
| H              | X | X | X | —         |

X: Irrelevant

## Pin Arrangement



## Block Diagram



## Absolute Maximum Ratings

| Item                         |              | Symbol            | Rating                           | Unit |
|------------------------------|--------------|-------------------|----------------------------------|------|
| Supply voltage               |              | $V_{CC}$          | -0.5 to +7.0                     | V    |
|                              |              | $V_{CC} - V_{EE}$ | -0.5 to +7.0                     | V    |
| Control input voltage        |              | $V_{IN}$          | GND – 0.5 to $V_{CC} + 0.5$      | V    |
| Switch I/O voltage           |              | $V_{I/O}$         | $V_{EE} - 0.5$ to $V_{CC} + 0.5$ | V    |
| Supply current               | ( $V_{CC}$ ) | $I_{CC}$          | +50                              | mA   |
|                              | (GND)        | $I_{GND}$         | -50                              | mA   |
| Switch I/O current (per pin) |              | $I_{I/O}$         | ±25                              | mA   |
| Control input diode current  |              | $I_{IK}$          | ±20                              | mA   |
| Switch I/O diode current     |              | $I_{IOK}$         | ±20                              | mA   |
| Power dissipation            |              | $P_T$             | 500                              | mW   |
| Storage temperature range    |              | $T_{stg}$         | -65 to +150                      | °C   |

## Recommended Operating Conditions

| Item                  |                         | Symbol            | Min      | Typ | Max      | Unit |
|-----------------------|-------------------------|-------------------|----------|-----|----------|------|
| Supply voltage        |                         | $V_{CC} - V_{EE}$ | 2        | —   | 6        | V    |
|                       |                         | GND – $V_{EE}$    | -4       | —   | 0        | V    |
| Control input voltage |                         | $V_{IN}$          | 0        | —   | $V_{CC}$ | V    |
| Switch I/O voltage    |                         | $V_{I/O}$         | $V_{EE}$ | —   | $V_{CC}$ | V    |
| Operating temperature |                         | $T_{opr}$         | -40      | —   | +85      | °C   |
| Input rise/fall time  | $V_{CC} = 2.0\text{ V}$ | $t_r, t_f$        | 0        | —   | 1000     | ns   |
|                       | $V_{CC} = 4.5\text{ V}$ |                   | 0        | —   | 500      | ns   |
|                       | $V_{CC} = 6.0\text{ V}$ |                   | 0        | —   | 400      | ns   |

## Electrical Characteristics

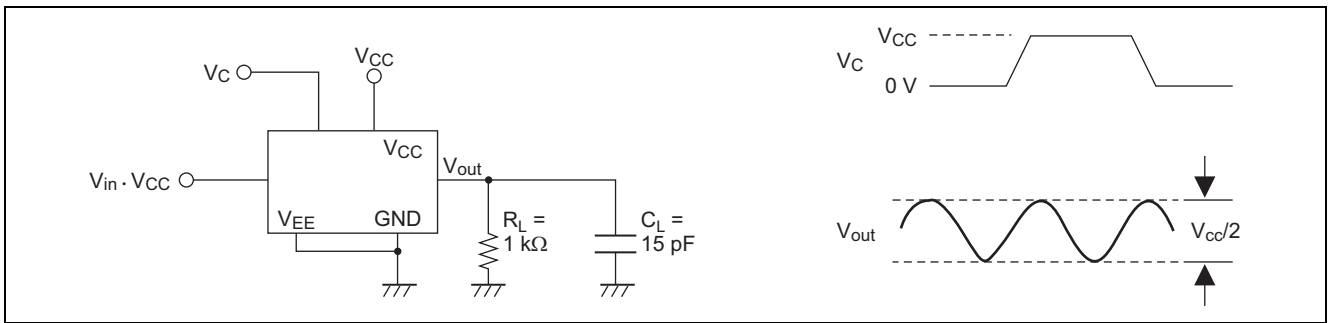
| Item                                     | Symbol               | V <sub>CC</sub> (V) | Ta = 25°C |      |      | Ta = -40 to +85°C |      | Unit | Test Conditions                                                                                                        |
|------------------------------------------|----------------------|---------------------|-----------|------|------|-------------------|------|------|------------------------------------------------------------------------------------------------------------------------|
|                                          |                      |                     | Min       | Typ  | Max  | Min               | Max  |      |                                                                                                                        |
| Control input voltage                    | V <sub>IH</sub>      | 2.0                 | 1.5       | —    | —    | 1.5               | —    | V    |                                                                                                                        |
|                                          |                      | 4.5                 | 3.15      | —    | —    | 3.15              | —    |      |                                                                                                                        |
|                                          |                      | 6.0                 | 4.2       | —    | —    | 4.2               | —    |      |                                                                                                                        |
|                                          | V <sub>IL</sub>      | 2.0                 | —         | —    | 0.5  | —                 | 0.5  | V    |                                                                                                                        |
|                                          |                      | 4.5                 | —         | —    | 1.35 | —                 | 1.35 |      |                                                                                                                        |
|                                          |                      | 6.0                 | —         | —    | 1.8  | —                 | 1.8  |      |                                                                                                                        |
| ON resistance                            | R <sub>ON</sub>      | 2.0                 | —         | 2000 | 5000 | —                 | 6250 | Ω    | V <sub>INH</sub> = V <sub>IL</sub><br>V <sub>I/O</sub> = V <sub>CC</sub> to V <sub>EE</sub><br>I <sub>I/O</sub> ≤ 2 mA |
|                                          |                      | 4.5                 | —         | 120  | 180  | —                 | 225  |      |                                                                                                                        |
|                                          |                      | 6.0                 | —         | 100  | 170  | —                 | 210  |      |                                                                                                                        |
|                                          |                      | 2.0                 | —         | 200  | 800  | —                 | 1000 | Ω    | V <sub>INH</sub> = V <sub>IL</sub><br>V <sub>I/O</sub> = V <sub>CC</sub> or V <sub>EE</sub><br>V <sub>I/O</sub> ≤ 2 mA |
|                                          |                      | 4.5                 | —         | 80   | 150  | —                 | 190  |      |                                                                                                                        |
|                                          |                      | 6.0                 | —         | 70   | 140  | —                 | 175  |      |                                                                                                                        |
| ΔON resistance between any two channels  | ΔR <sub>ON</sub>     | 2.0                 | —         | 50   | —    | —                 | —    | Ω    | V <sub>INH</sub> = V <sub>IL</sub><br>V <sub>I/O</sub> = V <sub>CC</sub> to V <sub>EE</sub><br>I <sub>I/O</sub> ≤ 2 mA |
|                                          |                      | 4.5                 | —         | 13   | 40   | —                 | 50   |      |                                                                                                                        |
|                                          |                      | 6.0                 | —         | 10   | 20   | —                 | 25   |      |                                                                                                                        |
| OFF channel leakage current (switch off) | I <sub>S (OFF)</sub> | 6.0                 | —         | —    | ±0.1 | —                 | ±1.0 | μA   | V <sub>INH</sub> = V <sub>IL</sub>                                                                                     |
| OFF channel leakage current (switch on)  | I <sub>S (ON)</sub>  | 6.0                 | —         | —    | ±0.1 | —                 | ±1.0 | μA   | V <sub>INH</sub> = V <sub>IL</sub>                                                                                     |
| Control input current                    | I <sub>in</sub>      | 6.0                 | —         | —    | ±0.1 | —                 | ±1.0 | μA   | V <sub>in</sub> = V <sub>CC</sub> or GND                                                                               |
| Quiescent supply current                 | I <sub>CC</sub>      | 6.0                 | —         | —    | 4.0  | —                 | 40   | μA   | V <sub>in</sub> = V <sub>CC</sub> or GND                                                                               |

Switching Characteristics ( $C_L = 50 \text{ pF}$ , Input  $t_r = t_f = 6 \text{ ns}$ ,  $V_{EE} = \text{GND}$ )

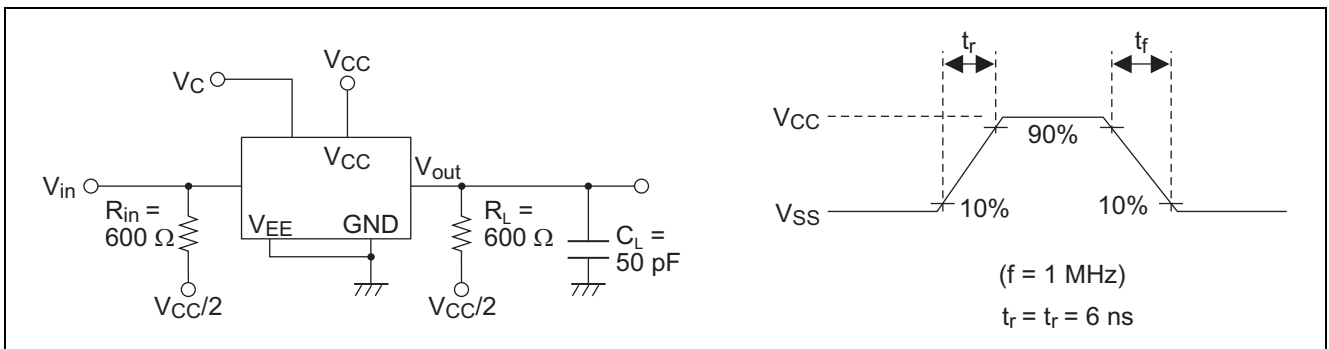
| Item                                              | Symbol              | V <sub>CC</sub> (V) | Ta = 25°C |      |     | Ta = -40 to +85°C |     | Unit | Test Conditions                                                                                                                            |
|---------------------------------------------------|---------------------|---------------------|-----------|------|-----|-------------------|-----|------|--------------------------------------------------------------------------------------------------------------------------------------------|
|                                                   |                     |                     | Min       | Typ  | Max | Min               | Max |      |                                                                                                                                            |
| Propagation delay time                            | t <sub>PLH</sub>    | 2.0                 | —         | 25   | 60  | —                 | 75  | ns   | R <sub>L</sub> = 10 kΩ<br>Switch input to switch output                                                                                    |
|                                                   |                     | 4.5                 | —         | 6    | 12  | —                 | 15  |      |                                                                                                                                            |
|                                                   |                     | 6.0                 | —         | 5    | 10  | —                 | 13  |      |                                                                                                                                            |
|                                                   | t <sub>PHL</sub>    | 2.0                 | —         | 25   | 60  | —                 | 75  | ns   |                                                                                                                                            |
|                                                   |                     | 4.5                 | —         | 6    | 12  | —                 | 15  |      |                                                                                                                                            |
|                                                   |                     | 6.0                 | —         | 5    | 10  | —                 | 13  |      |                                                                                                                                            |
| Propagation delay time                            | t <sub>PLH</sub>    | 2.0                 | —         | 50   | 153 | —                 | 191 | ns   | R <sub>L</sub> = 10 kΩ<br>Control input to switch output                                                                                   |
|                                                   |                     | 4.5                 | —         | 16   | 30  | —                 | 38  |      |                                                                                                                                            |
|                                                   |                     | 6.0                 | —         | 14   | 26  | —                 | 33  |      |                                                                                                                                            |
|                                                   | t <sub>PHL</sub>    | 2.0                 | —         | 50   | 153 | —                 | 191 | ns   |                                                                                                                                            |
|                                                   |                     | 4.5                 | —         | 16   | 30  | —                 | 38  |      |                                                                                                                                            |
|                                                   |                     | 6.0                 | —         | 14   | 26  | —                 | 33  |      |                                                                                                                                            |
| Output enable time                                | t <sub>ZH</sub>     | 2.0                 | —         | 50   | 153 | —                 | 191 | ns   | R <sub>L</sub> = 1 kΩ                                                                                                                      |
|                                                   |                     | 4.5                 | —         | 14   | 30  | —                 | 38  |      |                                                                                                                                            |
|                                                   |                     | 6.0                 | —         | 12   | 26  | —                 | 33  |      |                                                                                                                                            |
|                                                   | t <sub>ZL</sub>     | 2.0                 | —         | 50   | 153 | —                 | 191 | ns   |                                                                                                                                            |
|                                                   |                     | 4.5                 | —         | 14   | 30  | —                 | 38  |      |                                                                                                                                            |
|                                                   |                     | 6.0                 | —         | 12   | 26  | —                 | 33  |      |                                                                                                                                            |
| Output disable time                               | t <sub>HZ</sub>     | 2.0                 | —         | 40   | 153 | —                 | 191 | ns   | R <sub>L</sub> = 1 kΩ                                                                                                                      |
|                                                   |                     | 4.5                 | —         | 17   | 30  | —                 | 38  |      |                                                                                                                                            |
|                                                   |                     | 6.0                 | —         | 14   | 26  | —                 | 33  |      |                                                                                                                                            |
|                                                   | t <sub>LZ</sub>     | 2.0                 | —         | 40   | 153 | —                 | 191 | ns   |                                                                                                                                            |
|                                                   |                     | 4.5                 | —         | 17   | 30  | —                 | 38  |      |                                                                                                                                            |
|                                                   |                     | 6.0                 | —         | 14   | 26  | —                 | 33  |      |                                                                                                                                            |
| Control input capacitance                         | C <sub>in</sub>     | —                   | —         | 5    | 10  | —                 | 10  | pF   |                                                                                                                                            |
| Switch input capacitance                          | C <sub>in</sub>     | 5.0                 | —         | 5    | —   | —                 | —   | pF   |                                                                                                                                            |
| Output capacitance (Common pin)                   | C <sub>out</sub>    | 5.0                 | —         | 22   | —   | —                 | —   | pF   |                                                                                                                                            |
| Feed through capacitance                          | C <sub>in-out</sub> | 5.0                 | —         | 0.7  | —   | —                 | —   | pF   |                                                                                                                                            |
| Power dissipation capacitance                     | C <sub>PD</sub>     | 5.0                 | —         | 22.0 | —   | —                 | —   | pF   |                                                                                                                                            |
| Sine wave distortion                              |                     | 4.5                 | —         | 0.1  | —   | —                 | —   | %    | f <sub>in</sub> = 1 kHz, V <sub>in</sub> = 4 V <sub>P-P</sub><br>R <sub>L</sub> = 10 kΩ, C <sub>L</sub> = 50 pF                            |
| Frequency response channel “ON” (Sine wave input) |                     | 4.5                 | —         | 95   | —   | —                 | —   | MHz  | f <sub>in</sub> = 1 MHz,<br>20 log <sub>10</sub> V <sub>OS</sub> /V <sub>IS</sub> = -3 dB<br>R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 10 pF |
| Feed through attenuation                          |                     | 4.5                 | —         | -50  | —   | —                 | —   | dB   | R <sub>L</sub> = 600 Ω, C <sub>L</sub> = 50 pF,<br>f <sub>in</sub> = 1 MHz                                                                 |
| Cross talk between any two switches               |                     | 2.0                 | —         | 25   | —   | —                 | —   | mV   | R <sub>L</sub> = 600 Ω, C <sub>L</sub> = 15 pF,<br>f <sub>in</sub> = 1 MHz                                                                 |
|                                                   |                     | 4.5                 | —         | 60   | —   | —                 | —   |      |                                                                                                                                            |
|                                                   |                     | 6.0                 | —         | 75   | —   | —                 | —   |      |                                                                                                                                            |
| Maximum control frequency                         |                     | 2.0                 | —         | 20   | —   | —                 | —   | MHz  | R <sub>L</sub> = 1 kΩ, C <sub>L</sub> = 15 pF<br>V <sub>out</sub> = 1/2 (V <sub>CC</sub> )                                                 |
|                                                   |                     | 4.5                 | —         | 30   | —   | —                 | —   |      |                                                                                                                                            |
|                                                   |                     | 6.0                 | —         | 30   | —   | —                 | —   |      |                                                                                                                                            |

## Test Circuit

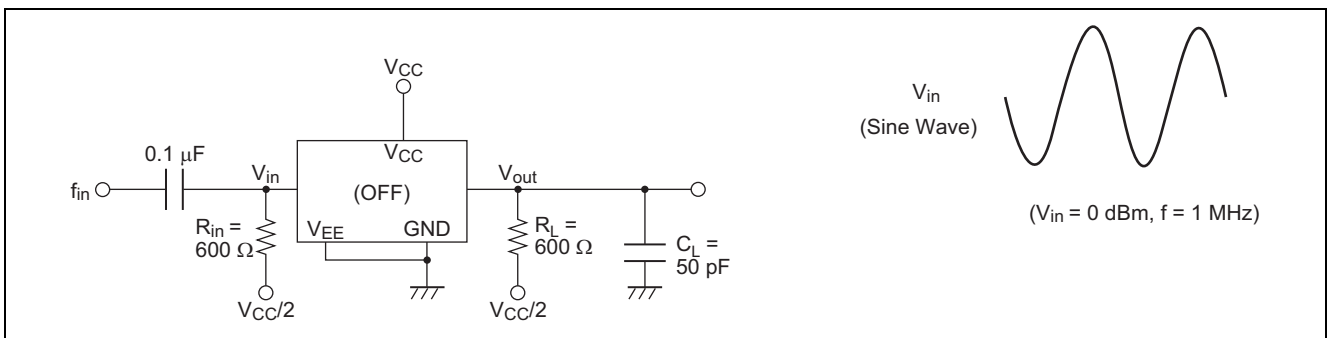
### Maximum Control Frequency



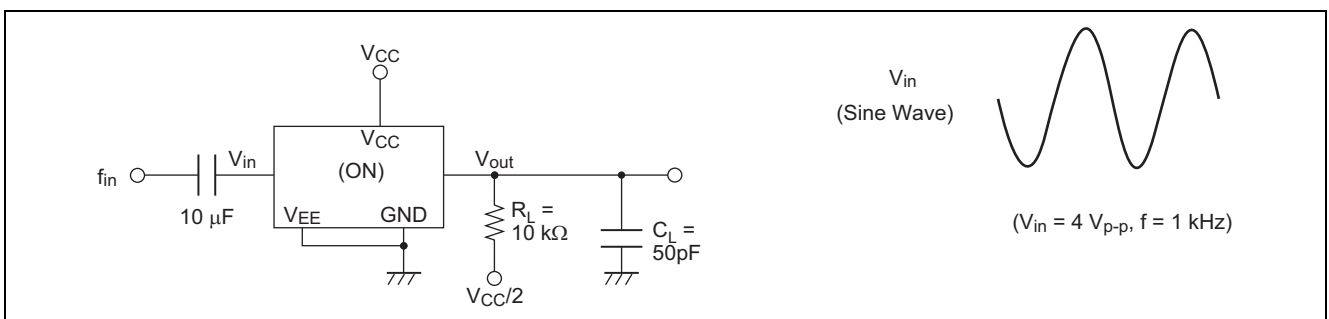
### Cross talk (Control Input to Switch Output)



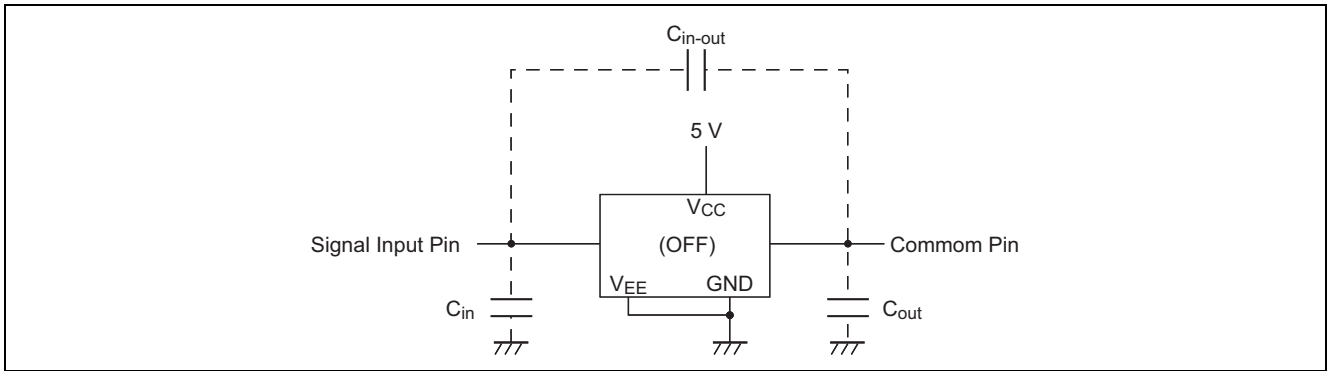
### Feed through Attenuation



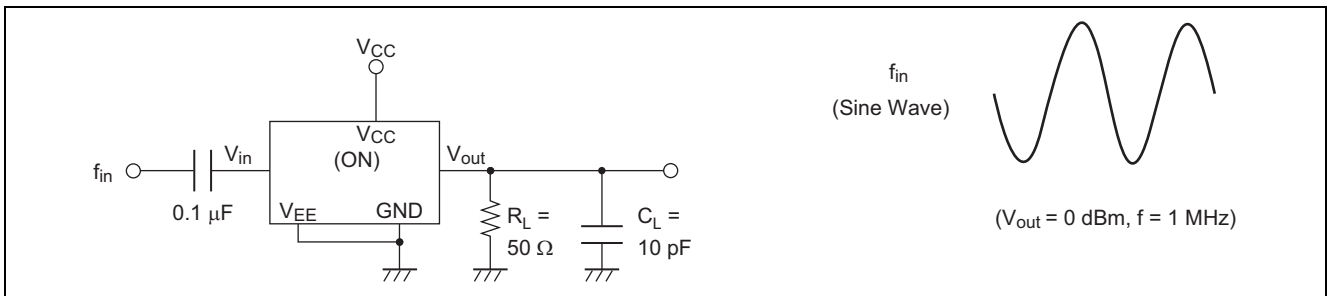
### Sine Wave Distortion



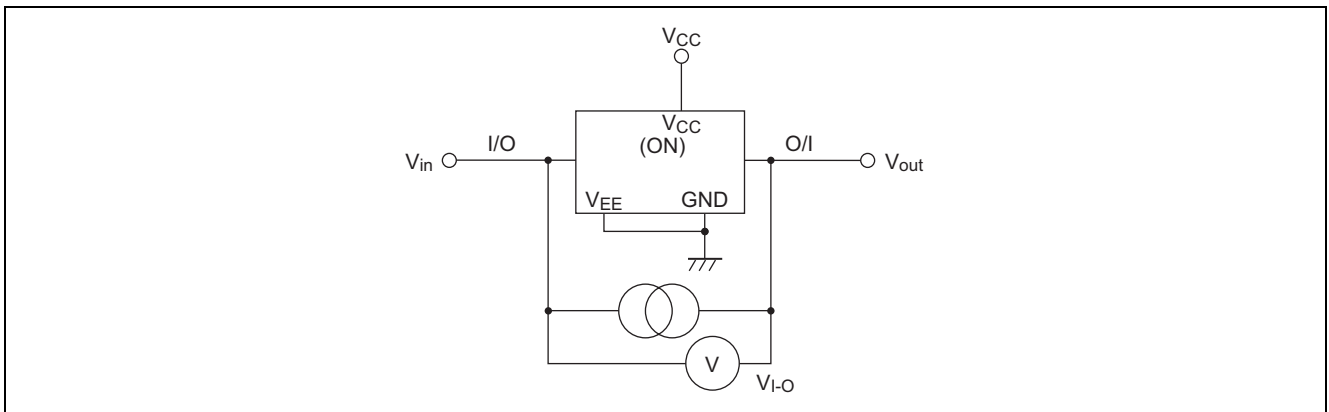
**C<sub>in</sub>, C<sub>out</sub>, C<sub>in-out</sub> (Input, Output, and Feed through Capacitance)**



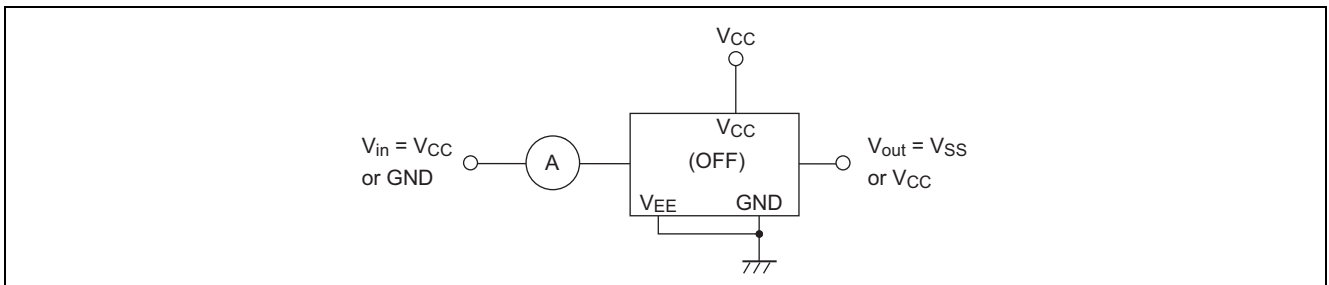
**Frequency Response Channel ON**



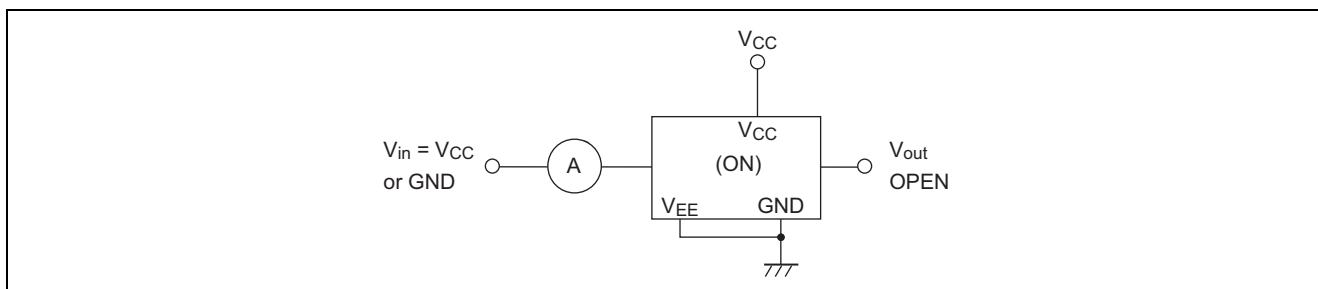
**R<sub>ON</sub>: ON Resistance**



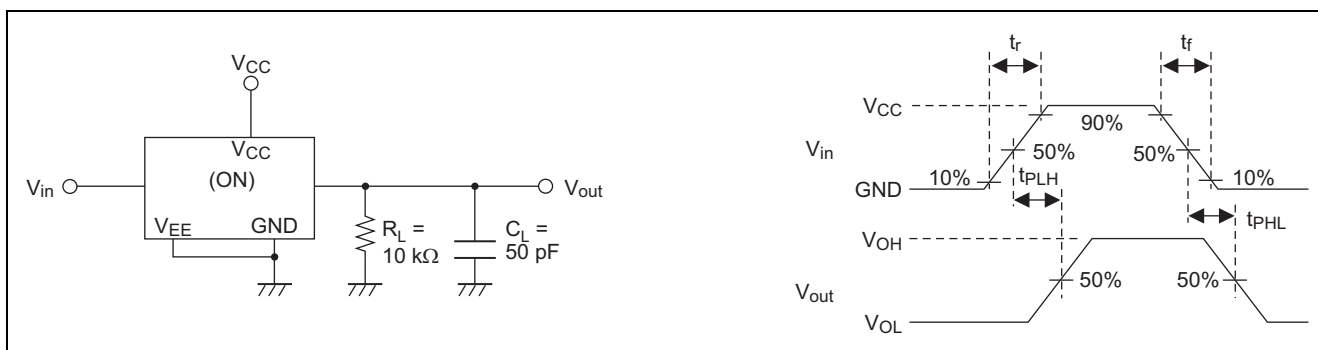
**I<sub>s</sub> (OFF): OFF Channel Leakage Current (Switch OFF)**



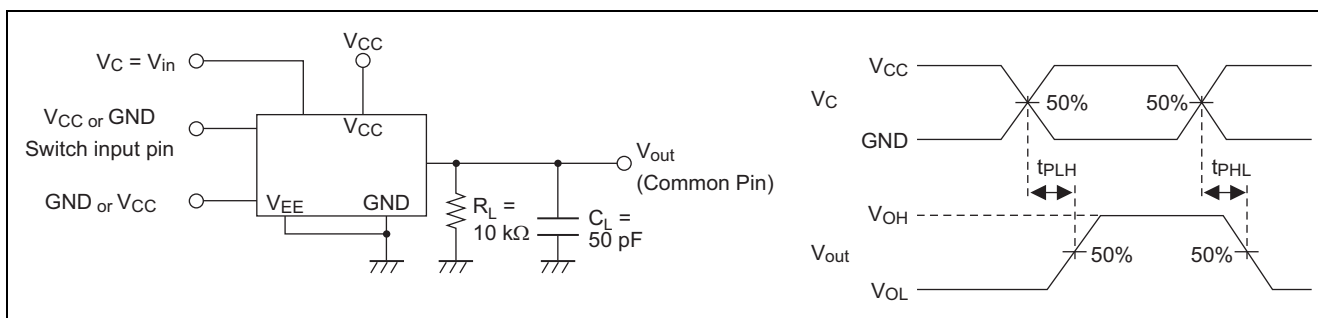
**$I_S$  (ON): OFF Channel Leakage Current (Switch ON)**



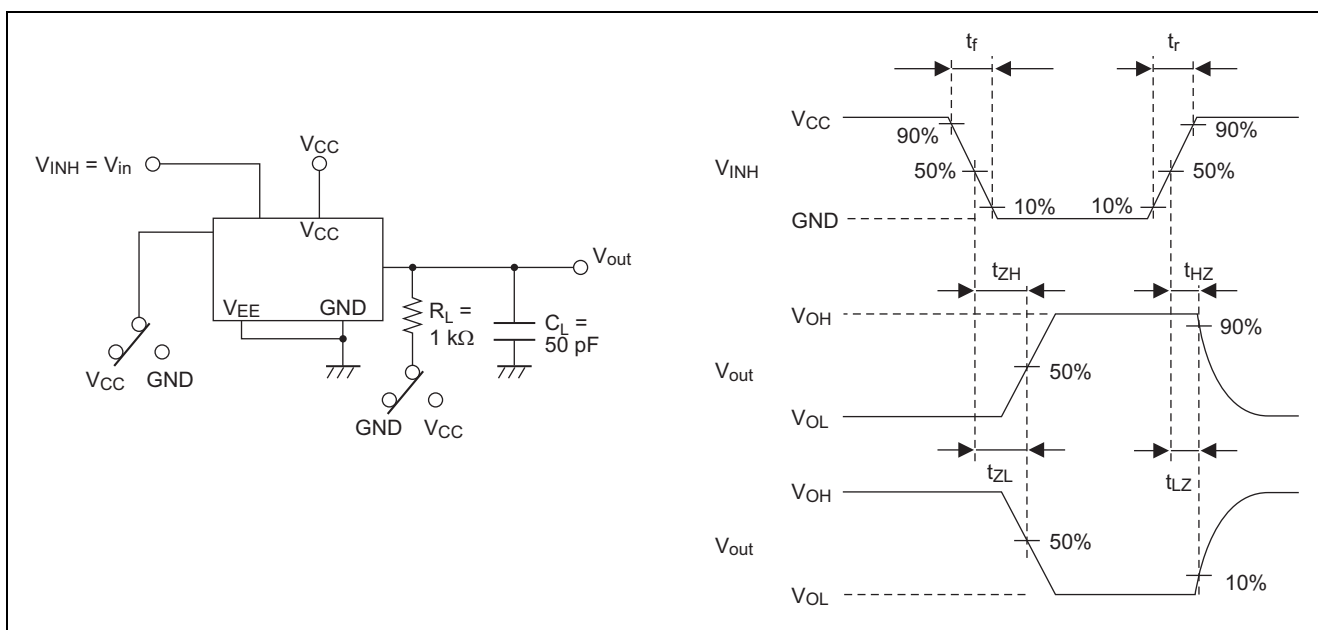
**$t_{PLH}$ ,  $t_{PHL}$ : Propagation Delay Time (Switch Input to Switch Output)**



**$t_{PLH}$ ,  $t_{PHL}$ : Propagation Delay Time (Control Input to Switch Output)**

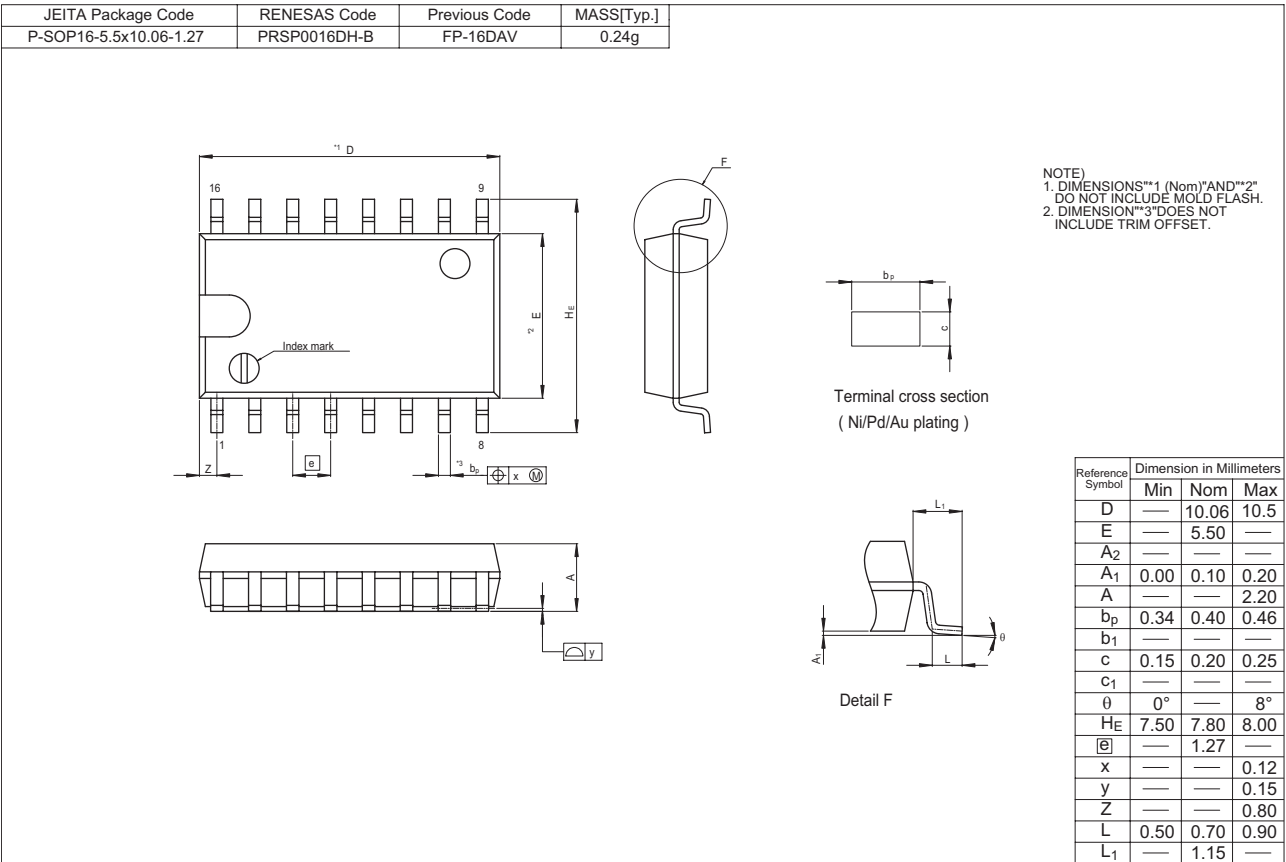
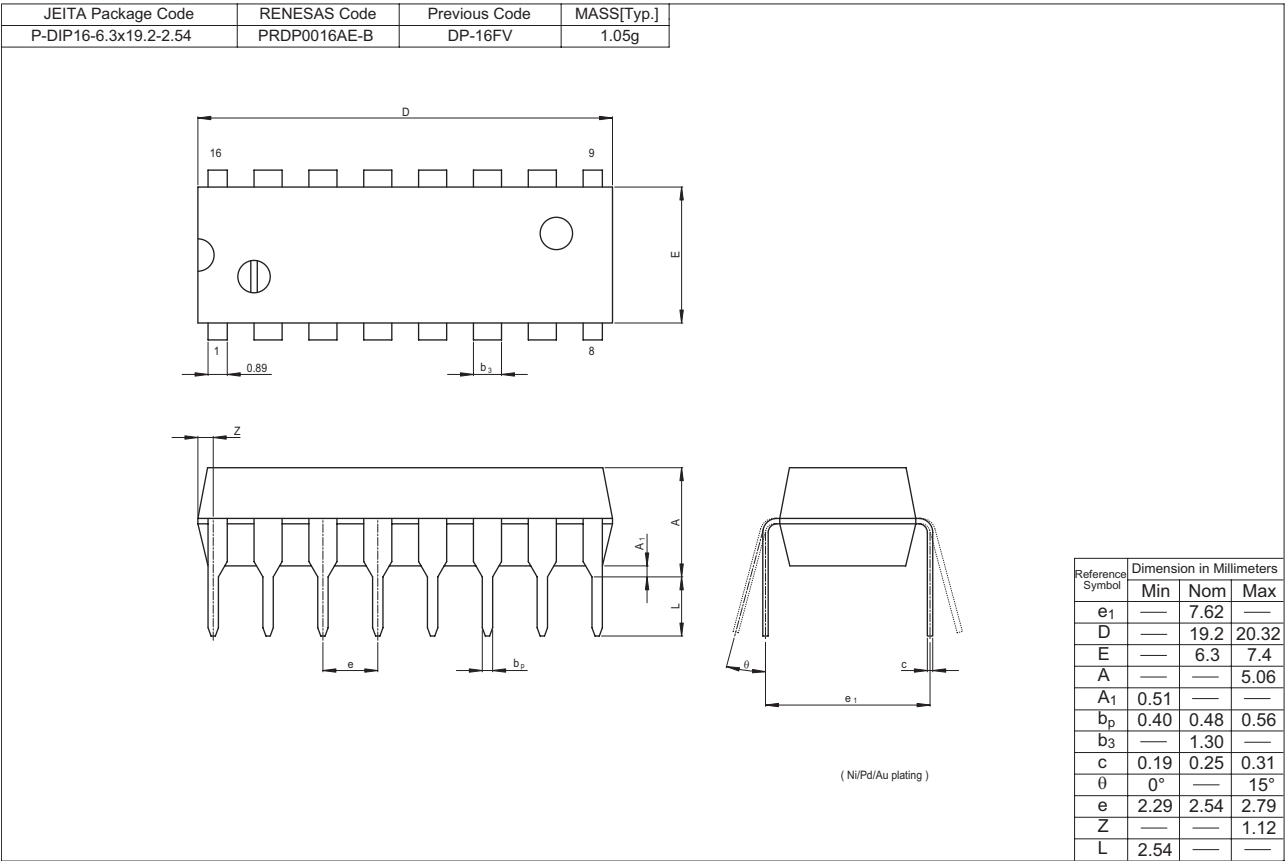


**$t_{ZH}$ ,  $t_{ZL}/t_{HZ}$ ,  $t_{LZ}$ : Output Enable and Disable Time**

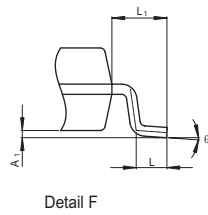
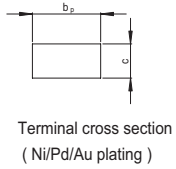
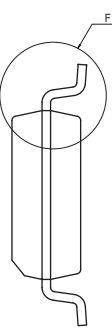
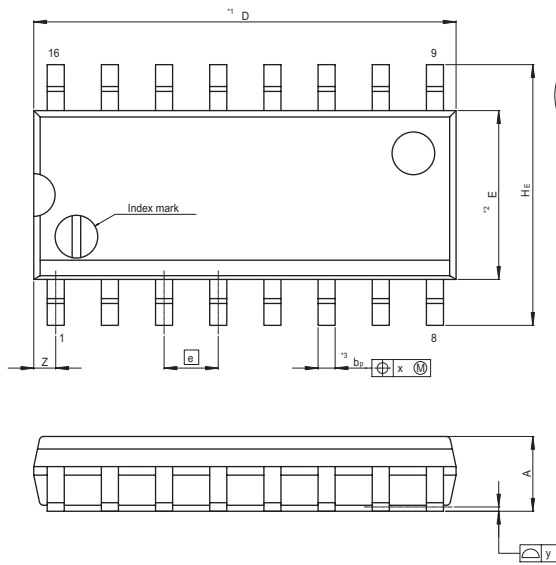




Package Dimensions



|                       |              |               |            |
|-----------------------|--------------|---------------|------------|
| JEITA Package Code    | RENESAS Code | Previous Code | MASS[Typ.] |
| P-SOP16-3.95x9.9-1.27 | PRSP0016DG-A | FP-16DNV      | 0.15g      |



NOTE)  
1. DIMENSIONS\*\*1 (Nom)\*\*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                   | —                        | 9.90 | 10.30 |
| E                   | —                        | 3.95 | —     |
| A <sub>2</sub>      | —                        | —    | —     |
| A <sub>1</sub>      | 0.10                     | 0.14 | 0.25  |
| A                   | —                        | —    | 1.75  |
| b <sub>p</sub>      | 0.34                     | 0.40 | 0.46  |
| b <sub>1</sub>      | —                        | —    | —     |
| c                   | 0.15                     | 0.20 | 0.25  |
| c <sub>1</sub>      | —                        | —    | —     |
| θ                   | 0°                       | —    | 8°    |
| HE                  | 5.80                     | 6.10 | 6.20  |
| e                   | —                        | 1.27 | —     |
| x                   | —                        | —    | 0.25  |
| y                   | —                        | —    | 0.15  |
| Z                   | —                        | —    | 0.635 |
| L                   | 0.40                     | 0.60 | 1.27  |
| L <sub>1</sub>      | —                        | 1.08 | —     |

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