

To our customers,

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## Old Company Name in Catalogs and Other Documents

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April 1<sup>st</sup>, 2010  
Renesas Electronics Corporation

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### 300/309-OUTPUT TFT-LCD SOURCE DRIVER (COMPATIBLE WITH 64-GRAY SCALES)

The  $\mu$ PD16638A is a source driver for TFT-LCDs capable of supporting displays with 64-gray scales. Data input is based on digital input configured as 6 bits by 3 dots (1 pixel), which can realize a full-color display of 260,000 colors by the output of 64 values that have been  $\gamma$ -corrected by an internal D/A converter and 2 sets of 9 external power supplies. Because the output dynamic range is as large as 8.3 V<sub>p-p</sub>, level inversion operation of the LCD's common electrode is rendered unnecessary. Also, in order to deal with dot-line inversion, n-line inversion and column line inversion when mounted on a single side, this source driver is equipped with a non-chip 6-bit D/A converter circuit whose odd output pins and even output pins output gray scale voltages of differing polarity. Assuring a maximum clock frequency of 40 MHz when driving at 3.0 V, this driver is applicable to SVGA and XGA-standard TFT-LCD panels.

#### FEATURES

- CMOS level input
- Output number selectable (300/309)
- Input of 6 bits (gradation data) by 3 dots
- Capable of outputting 64 values by means of 2 sets of 9 external power supplies (18 units) and a D/A converter
- Output dynamic range 8.3 V<sub>p-p</sub> MIN. (@ V<sub>DD2</sub> = 8.5 V)
- High-speed data transfer: f<sub>MAX.</sub> = 40 MHz (internal data transfer speed when operating at 3.0 V)
- Applicable for dot-line inversion, n-line inversion and column line inversion
- Single bank arrangement is possible (loaded with slim or bending TCP)

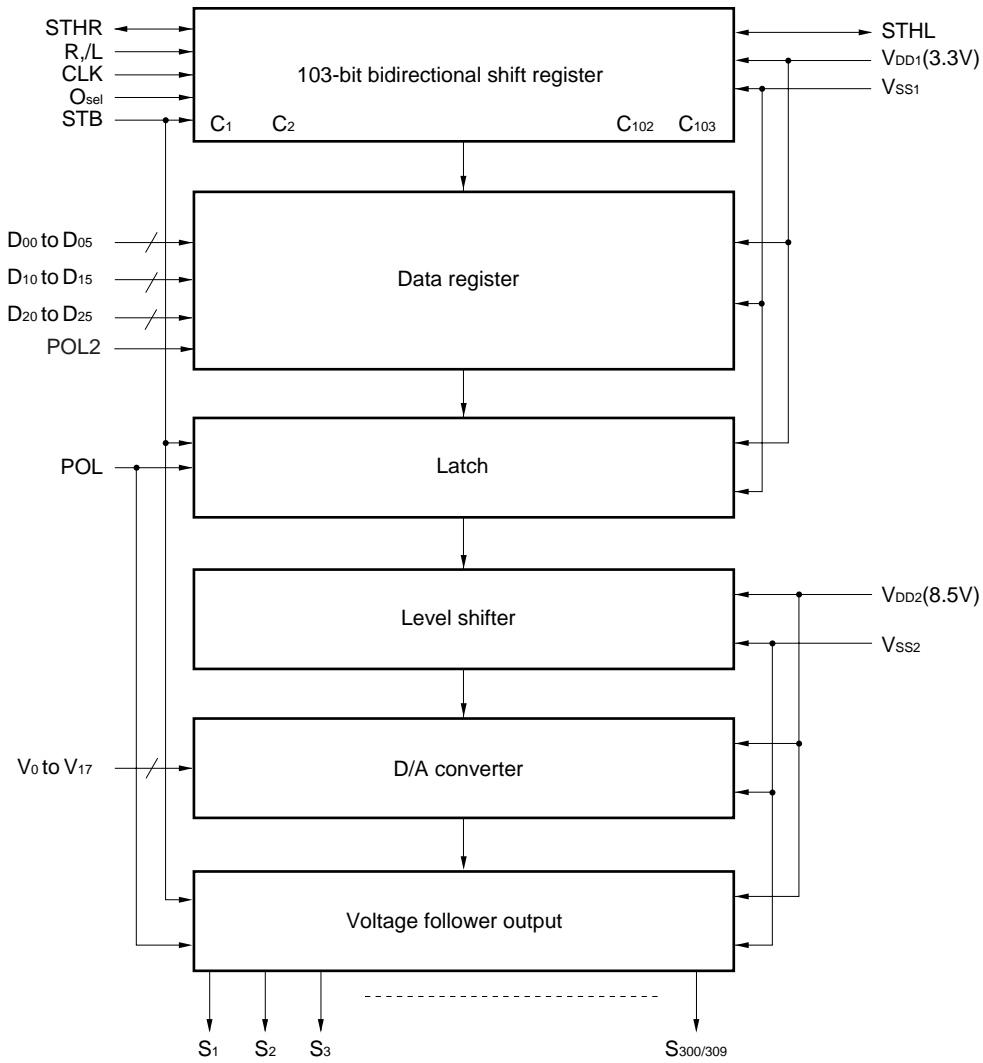
#### ORDERING INFORMATION

Part Number	Package
$\mu$ PD16638AN-xxx	TCP (TAB package)

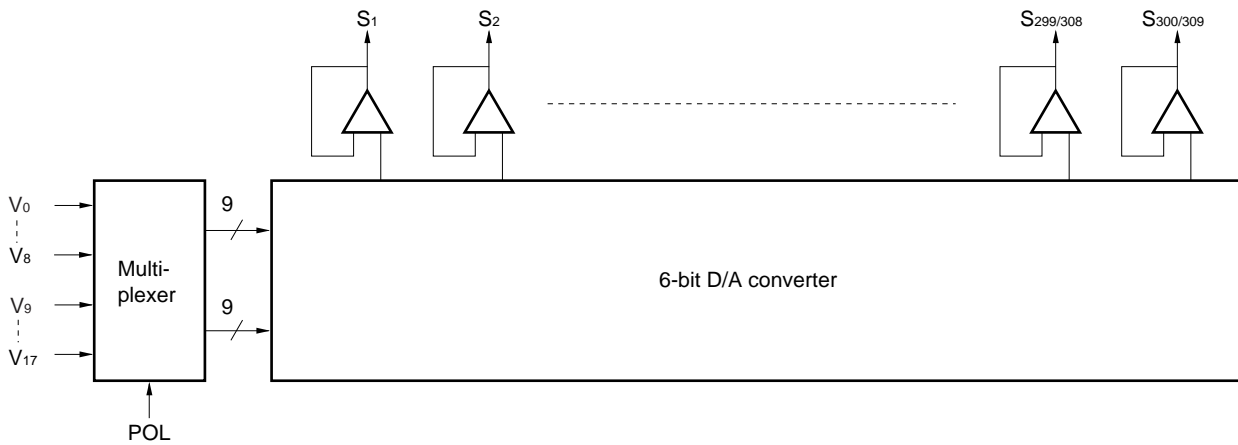
**Remark** The TCP's external shape is customized. To order your TCP's external shape, please contact a NEC salesperson.

The information in this document is subject to change without notice.

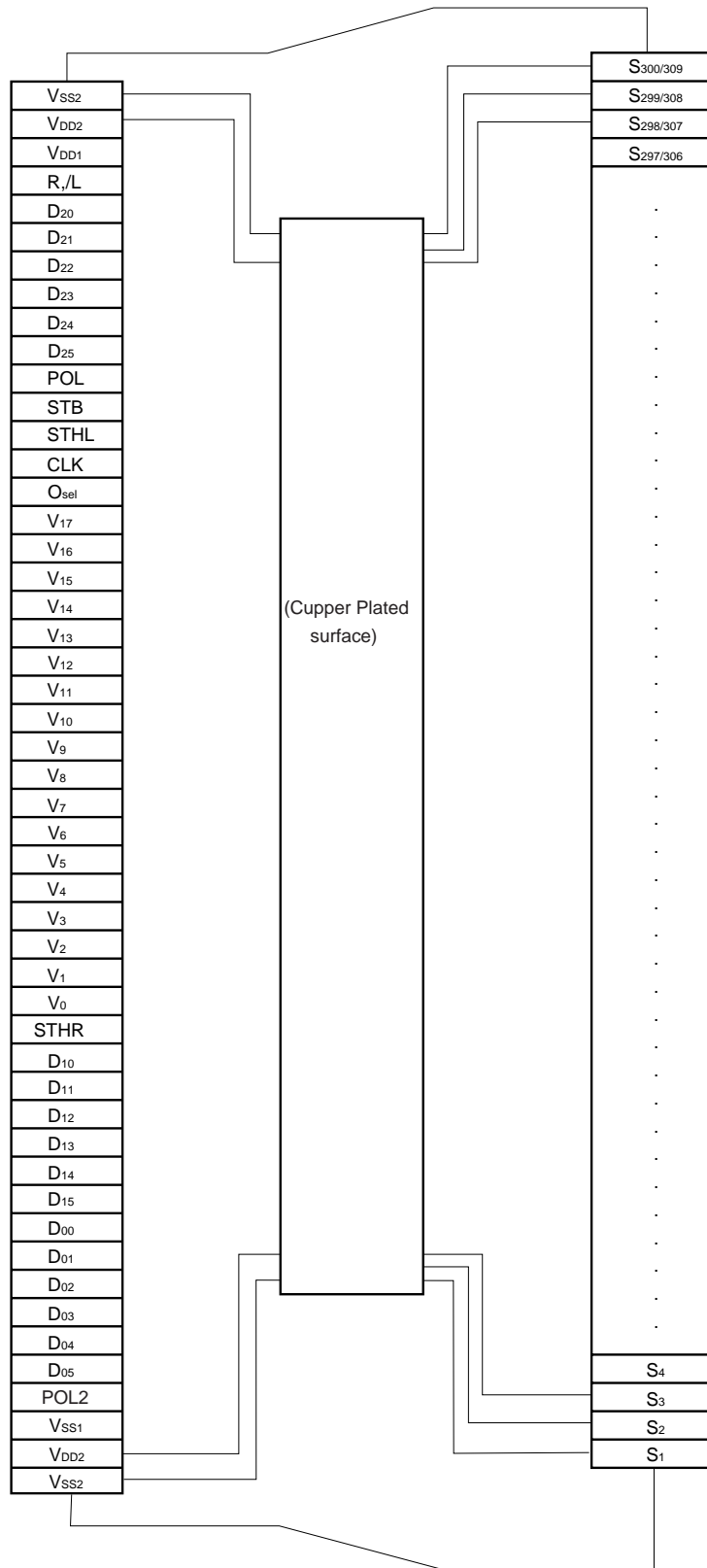
★ BLOCK DIAGRAM



★ RELATIONSHIP BETWEEN OUTPUT CIRCUIT AND D/A CONVERTER



PIN CONFIGURATION ( $\mu$ PD16638AN-xxx)



**Remark** This figure does not specify the TCP package. LPC terminal is pulled up to the VDD1 in the chip.

1. PIN FUNCTIONS

Pin Symbol	Pin Name	Description
S <sub>1</sub> to S <sub>300/309</sub>	Driver output	The D/A converted 64-gray-scale analog voltage is output.
D <sub>00</sub> to D <sub>05</sub>	Display data input	The display data is input with a width of 18 bits, viz., the gray scale data (6 bits) by 3 dots (1 pixels). D <sub>X0</sub> : LSB, D <sub>X5</sub> : MSB
D <sub>10</sub> to D <sub>15</sub>		
D <sub>20</sub> to D <sub>25</sub>		
R <sub>,</sub> /L	Shift direction control input	These refer to the start pulse input/output pins when driver ICs are connected in cascade. The shift directions of the shift registers are as follows. R <sub>,</sub> /L = H : STHR input, S <sub>1</sub> → S <sub>300/309</sub> , STHL output R <sub>,</sub> /L = L : STHL input, S <sub>300/309</sub> → S <sub>1</sub> , STHR output
STHR	Right shift start pulse input/output	R <sub>,</sub> /L = H : Becomes the start pulse input pin. R <sub>,</sub> /L = L : Becomes the start pulse output pin.
STHL	Left shift start pulse input/output	R <sub>,</sub> /L = H : Becomes the start pulse output pin. R <sub>,</sub> /L = L : Becomes the start pulse input pin.
O <sub>sel</sub>	Number of output pins select pin	This pin selects the number of output pins. O <sub>sel</sub> = H: 300-output mode O <sub>sel</sub> = L: 309-output mode
CLK	Shift clock input	Refers to the shift register's shift clock input. The display data is incorporated into the data register at the rising edge. O <sub>sel</sub> = H: At the rising edge of the 100th clock after the start pulse input, the start pulse output reaches the high level, thus becoming the start pulse of the next-level driver. O <sub>sel</sub> = L: At the rising edge of the 103rd clock after the start pulse input, the start pulse output reaches the high level, thus becoming the start pulse of the next-level driver.
STB	Latch input	The contents of the data register are transferred to the latch circuit at the rising edge, and at the falling edge, the gray scale voltage is supplied to the driver. It is necessary to ensure input of one pulse per horizontal period.
POL	Polarity input	POL = H: The S <sub>2n-1</sub> output uses V <sub>0</sub> to V <sub>8</sub> as the reference supply. The S <sub>2n</sub> output uses V <sub>9</sub> to V <sub>17</sub> as the reference supply. POL = L: The S <sub>2n-1</sub> output uses V <sub>0</sub> to V <sub>8</sub> as the reference supply. The S <sub>2n</sub> output uses V <sub>0</sub> to V <sub>8</sub> as the reference supply. S <sub>2n-1</sub> indicates the odd output: and S <sub>2n</sub> indicates the even output. Input of the POL signal is allowed the setup time(t <sub>POL-STB</sub> ) with respect to STB's rising edge.
POL2	Data inversion	POL2 = H : Display data is inverted. POL2 = L : Display data is not inverted.
V <sub>0</sub> to V <sub>17</sub>	γ-corrected power supplies	Input the γ-corrected power supplies from outside by using operational amplifier. Make sure to maintain the following relationships. During the gray scale voltage output, be sure to keep the gray scale level power supply at a constant level. V <sub>DD2</sub> > V <sub>0</sub> > V <sub>1</sub> > V <sub>2</sub> > V <sub>3</sub> > V <sub>4</sub> > V <sub>5</sub> > V <sub>6</sub> > V <sub>7</sub> > V <sub>8</sub> > V <sub>9</sub> > V <sub>10</sub> > V <sub>11</sub> > V <sub>12</sub> > V <sub>13</sub> > V <sub>14</sub> > V <sub>15</sub> > V <sub>16</sub> > V <sub>17</sub> > V <sub>SS2</sub>
V <sub>DD1</sub>	Test pin Logic power supply	3.3 V ±0.3 V
V <sub>DD2</sub>	Driver power supply	8.0 V to 9.0 V
V <sub>SS1</sub>	Logic ground	Grounding
V <sub>SS2</sub>	Driver ground	Grounding

- Cautions**
1. The power start sequence must be  $V_{DD1}$ , logic input, and  $V_{DD2}$  &  $V_0$  to  $V_{17}$  in that order. Reverse this sequence to shut down. (Simultaneous power application to  $V_{DD2}$  and  $V_0$  to  $V_{17}$  is possible.)
  2. To stabilize the supply voltage, be sure to insert a  $0.1 \mu\text{F}$  bypass capacitor between  $V_{DD1}-V_{SS1}$  and  $V_{DD2}-V_{SS2}$ . Furthermore, for increased precision of the D/A converter, insertion of a bypass capacitor of about  $0.01 \mu\text{F}$  is also advised between the  $\gamma$ -corrected power supply terminals ( $V_0, V_1, V_2, \dots, V_{17}$ ) and  $V_{SS2}$ .

★ 2. RELATIONSHIP BETWEEN INPUT DATA AND OUTPUT VOLTAGE VALUE

This product incorporates a 6-bit D/A converter whose odd output pins and even output pins output gray scale voltages of differing polarity with respect to the LCD's counter electrode (common electrode) voltage. The D/A converter consists of ladder resistors and switches.

Figure 2-1 shows the relationship between the driving voltages such as liquid-crystal driving voltages  $V_{DD2}$  and  $V_{SS2}$ , common electrode potential  $V_{COM}$ , and  $\gamma$ -corrected voltages  $V_0$  to  $V_{17}$ , and the input data. Be sure to maintain the voltage relationships of

$$V_{DD2} > V_0 > V_1 > V_2 > V_3 > V_4 > V_5 > V_6 > V_7 > V_8 > V_{COM} > V_9 > V_{10} > V_{11} > V_{12} > V_{13} > V_{14} > V_{15} > V_{16} > V_{17} > V_{SS2}.$$

Figures 2-2 and 2-3 show the relationship between the input data and the output data. This driver IC is designed for only single-sided mounting. Therefore, do not use it for  $\gamma$ -corrected power supply level inversion in double-sided mounting. Because the current flowing through ladder resistors  $r_0$  to  $r_{62}$  is small, its use for double-sided mounting impairs the IC's stable operation when the level of the  $\gamma$ -corrected power supply terminal is inverted thus causing display failures. Input  $\gamma$ -corrected power supply voltage by using an operational amplifier to maintain driver output accuracy.

Figure 2-1. Relationship between Input Data and Output Voltage

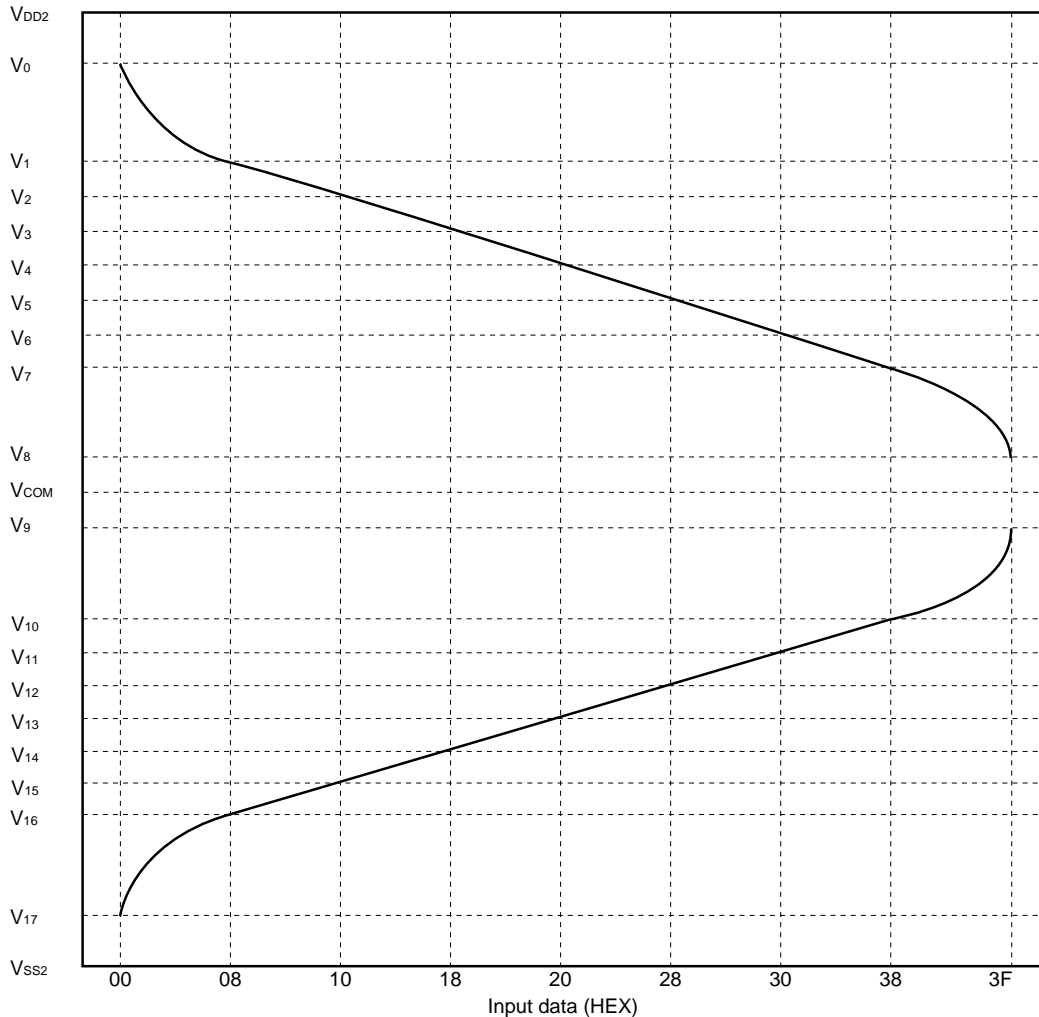
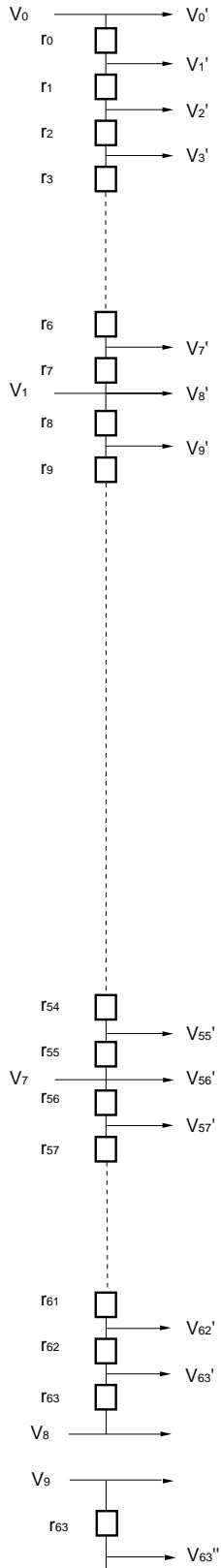




Figure 2-2. Relationship between Input Data and Output Voltage(1/2)

$$V_{DD2} > V_0 > V_1 > V_2 > V_3 > V_4 > V_5 > V_6 > V_7 > V_8$$



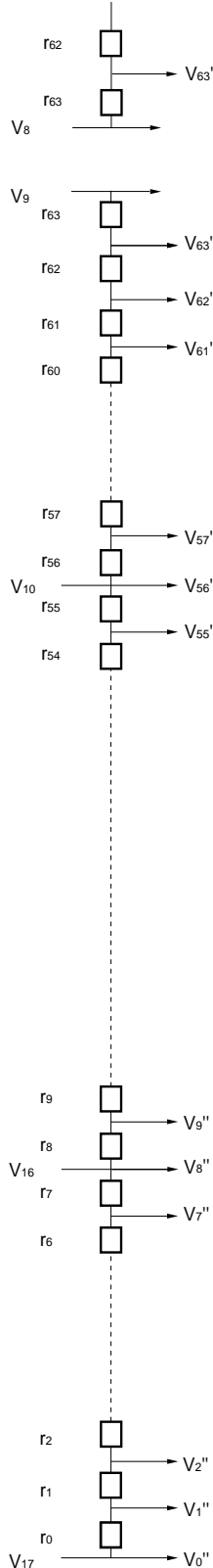
Data	D <sub>X5</sub>	D <sub>X4</sub>	D <sub>X3</sub>	D <sub>X2</sub>	D <sub>X1</sub>	D <sub>X0</sub>	Output Voltage	
00H	0	0	0	0	0	0	V <sub>0'</sub>	V <sub>0</sub>
01H	0	0	0	0	0	1	V <sub>1'</sub>	V <sub>1</sub> +(V <sub>0</sub> -V <sub>1</sub> )×3500/4000
02H	0	0	0	0	1	0	V <sub>2'</sub>	V <sub>1</sub> +(V <sub>0</sub> -V <sub>1</sub> )×3000/4000
03H	0	0	0	0	1	1	V <sub>3'</sub>	V <sub>1</sub> +(V <sub>0</sub> -V <sub>1</sub> )×2500/4000
04H	0	0	0	1	0	0	V <sub>4'</sub>	V <sub>1</sub> +(V <sub>0</sub> -V <sub>1</sub> )×2000/4000
05H	0	0	0	1	0	1	V <sub>5'</sub>	V <sub>1</sub> +(V <sub>0</sub> -V <sub>1</sub> )×1500/4000
06H	0	0	0	1	1	0	V <sub>6'</sub>	V <sub>1</sub> +(V <sub>0</sub> -V <sub>1</sub> )×1000/4000
07H	0	0	0	1	1	1	V <sub>7'</sub>	V <sub>1</sub> +(V <sub>0</sub> -V <sub>1</sub> )×500/4000
08H	0	0	1	0	0	0	V <sub>8'</sub>	V <sub>1</sub>
09H	0	0	1	0	0	1	V <sub>9'</sub>	V <sub>2</sub> +(V <sub>1</sub> -V <sub>2</sub> )×1750/2000
0AH	0	0	1	0	1	0	V <sub>10'</sub>	V <sub>2</sub> +(V <sub>1</sub> -V <sub>2</sub> )×1500/2000
0BH	0	0	1	0	1	1	V <sub>11'</sub>	V <sub>2</sub> +(V <sub>1</sub> -V <sub>2</sub> )×1250/2000
0CH	0	0	1	1	0	0	V <sub>12'</sub>	V <sub>2</sub> +(V <sub>1</sub> -V <sub>2</sub> )×1000/2000
0DH	0	0	1	1	0	1	V <sub>13'</sub>	V <sub>2</sub> +(V <sub>1</sub> -V <sub>2</sub> )×750/2000
0EH	0	0	1	1	1	0	V <sub>14'</sub>	V <sub>2</sub> +(V <sub>1</sub> -V <sub>2</sub> )×500/2000
0FH	0	0	1	1	1	1	V <sub>15'</sub>	V <sub>2</sub> +(V <sub>1</sub> -V <sub>2</sub> )×250/2000
10H	0	1	0	0	0	0	V <sub>16'</sub>	V <sub>2</sub>
11H	0	1	0	0	0	1	V <sub>17'</sub>	V <sub>3</sub> +(V <sub>2</sub> -V <sub>3</sub> )×1750/2000
12H	0	1	0	0	1	0	V <sub>18'</sub>	V <sub>3</sub> +(V <sub>2</sub> -V <sub>3</sub> )×1500/2000
13H	0	1	0	0	1	1	V <sub>19'</sub>	V <sub>3</sub> +(V <sub>2</sub> -V <sub>3</sub> )×1250/2000
14H	0	1	0	1	0	0	V <sub>20'</sub>	V <sub>3</sub> +(V <sub>2</sub> -V <sub>3</sub> )×1000/2000
15H	0	1	0	1	0	1	V <sub>21'</sub>	V <sub>3</sub> +(V <sub>2</sub> -V <sub>3</sub> )×750/2000
16H	0	1	0	1	1	0	V <sub>22'</sub>	V <sub>3</sub> +(V <sub>2</sub> -V <sub>3</sub> )×500/2000
17H	0	1	0	1	1	1	V <sub>23'</sub>	V <sub>3</sub> +(V <sub>2</sub> -V <sub>3</sub> )×250/2000
18H	0	1	1	0	0	0	V <sub>24'</sub>	V <sub>3</sub>
19H	0	1	1	0	0	1	V <sub>25'</sub>	V <sub>4</sub> +(V <sub>3</sub> -V <sub>4</sub> )×1750/2000
1AH	0	1	1	0	1	0	V <sub>26'</sub>	V <sub>4</sub> +(V <sub>3</sub> -V <sub>4</sub> )×1500/2000
1BH	0	1	1	0	1	1	V <sub>27'</sub>	V <sub>4</sub> +(V <sub>3</sub> -V <sub>4</sub> )×1250/2000
1CH	0	1	1	1	0	0	V <sub>28'</sub>	V <sub>4</sub> +(V <sub>3</sub> -V <sub>4</sub> )×1000/2000
1DH	0	1	1	1	0	1	V <sub>29'</sub>	V <sub>4</sub> +(V <sub>3</sub> -V <sub>4</sub> )×750/2000
1EH	0	1	1	1	1	0	V <sub>30'</sub>	V <sub>4</sub> +(V <sub>3</sub> -V <sub>4</sub> )×500/2000
1FH	0	1	1	1	1	1	V <sub>31'</sub>	V <sub>4</sub> +(V <sub>3</sub> -V <sub>4</sub> )×250/2000
20H	1	0	0	0	0	0	V <sub>32'</sub>	V <sub>4</sub>
21H	1	0	0	0	0	1	V <sub>33'</sub>	V <sub>5</sub> +(V <sub>4</sub> -V <sub>5</sub> )×1750/2000
22H	1	0	0	0	1	0	V <sub>34'</sub>	V <sub>5</sub> +(V <sub>4</sub> -V <sub>5</sub> )×1500/2000
23H	1	0	0	0	1	1	V <sub>35'</sub>	V <sub>5</sub> +(V <sub>4</sub> -V <sub>5</sub> )×1250/2000
24H	1	0	0	1	0	0	V <sub>36'</sub>	V <sub>5</sub> +(V <sub>4</sub> -V <sub>5</sub> )×1000/2000
25H	1	0	0	1	0	1	V <sub>37'</sub>	V <sub>5</sub> +(V <sub>4</sub> -V <sub>5</sub> )×750/2000
26H	1	0	0	1	1	0	V <sub>38'</sub>	V <sub>5</sub> +(V <sub>4</sub> -V <sub>5</sub> )×500/2000
27H	1	0	0	1	1	1	V <sub>39'</sub>	V <sub>5</sub> +(V <sub>4</sub> -V <sub>5</sub> )×250/2000
28H	1	0	1	0	0	0	V <sub>40'</sub>	V <sub>5</sub>
29H	1	0	1	0	0	1	V <sub>41'</sub>	V <sub>6</sub> +(V <sub>5</sub> -V <sub>6</sub> )×1750/2000
2AH	1	0	1	0	1	0	V <sub>42'</sub>	V <sub>6</sub> +(V <sub>5</sub> -V <sub>6</sub> )×1500/2000
2BH	1	0	1	0	1	1	V <sub>43'</sub>	V <sub>6</sub> +(V <sub>5</sub> -V <sub>6</sub> )×1250/2000
2CH	1	0	1	1	0	0	V <sub>44'</sub>	V <sub>6</sub> +(V <sub>5</sub> -V <sub>6</sub> )×1000/2000
2DH	1	0	1	1	0	1	V <sub>45'</sub>	V <sub>6</sub> +(V <sub>5</sub> -V <sub>6</sub> )×750/2000
2EH	1	0	1	1	1	0	V <sub>46'</sub>	V <sub>6</sub> +(V <sub>5</sub> -V <sub>6</sub> )×500/2000
2FH	1	0	1	1	1	1	V <sub>47'</sub>	V <sub>6</sub> +(V <sub>5</sub> -V <sub>6</sub> )×250/2000
30H	1	1	0	0	0	0	V <sub>48'</sub>	V <sub>6</sub>
31H	1	1	0	0	0	1	V <sub>49'</sub>	V <sub>7</sub> +(V <sub>6</sub> -V <sub>7</sub> )×1750/2000
32H	1	1	0	0	1	0	V <sub>50'</sub>	V <sub>7</sub> +(V <sub>6</sub> -V <sub>7</sub> )×1500/2000
33H	1	1	0	0	1	1	V <sub>51'</sub>	V <sub>7</sub> +(V <sub>6</sub> -V <sub>7</sub> )×1250/2000
34H	1	1	0	1	0	0	V <sub>52'</sub>	V <sub>7</sub> +(V <sub>6</sub> -V <sub>7</sub> )×1000/2000
35H	1	1	0	1	0	1	V <sub>53'</sub>	V <sub>7</sub> +(V <sub>6</sub> -V <sub>7</sub> )×750/2000
36H	1	1	0	1	1	0	V <sub>54'</sub>	V <sub>7</sub> +(V <sub>6</sub> -V <sub>7</sub> )×500/2000
37H	1	1	0	1	1	1	V <sub>55'</sub>	V <sub>7</sub> +(V <sub>6</sub> -V <sub>7</sub> )×250/2000
38H	1	1	1	0	0	0	V <sub>56'</sub>	V <sub>7</sub>
39H	1	1	1	0	0	1	V <sub>57'</sub>	V <sub>8</sub> +(V <sub>7</sub> -V <sub>8</sub> )×3500/4000
3AH	1	1	1	0	1	0	V <sub>58'</sub>	V <sub>8</sub> +(V <sub>7</sub> -V <sub>8</sub> )×3000/4000
3BH	1	1	1	0	1	1	V <sub>59'</sub>	V <sub>8</sub> +(V <sub>7</sub> -V <sub>8</sub> )×2500/4000
3CH	1	1	1	1	0	0	V <sub>60'</sub>	V <sub>8</sub> +(V <sub>7</sub> -V <sub>8</sub> )×2000/4000
3DH	1	1	1	1	0	1	V <sub>61'</sub>	V <sub>8</sub> +(V <sub>7</sub> -V <sub>8</sub> )×1500/4000
3EH	1	1	1	1	1	0	V <sub>62'</sub>	V <sub>8</sub> +(V <sub>7</sub> -V <sub>8</sub> )×1000/4000
3FH	1	1	1	1	1	1	V <sub>63'</sub>	V <sub>8</sub> +(V <sub>7</sub> -V <sub>8</sub> )×500/4000

	(Ω)
r <sub>0</sub>	500
r <sub>1</sub>	500
r <sub>2</sub>	500
r <sub>3</sub>	500
r <sub>4</sub>	500
r <sub>5</sub>	500
r <sub>6</sub>	500
r <sub>7</sub>	500
r <sub>8</sub>	250
r <sub>9</sub>	250
r <sub>10</sub>	250
r <sub>11</sub>	250
r <sub>12</sub>	250
r <sub>13</sub>	250
r <sub>14</sub>	250
r <sub>15</sub>	250
r <sub>16</sub>	250
r <sub>17</sub>	250
r <sub>18</sub>	250
r <sub>19</sub>	250
r <sub>20</sub>	250
r <sub>21</sub>	250
r <sub>22</sub>	250
r <sub>23</sub>	250
r <sub>24</sub>	250
r <sub>25</sub>	250
r <sub>26</sub>	250
r <sub>27</sub>	250
r <sub>28</sub>	250
r <sub>29</sub>	250
r <sub>30</sub>	250
r <sub>31</sub>	250
r <sub>32</sub>	250
r <sub>33</sub>	250
r <sub>34</sub>	250
r <sub>35</sub>	250
r <sub>36</sub>	250
r <sub>37</sub>	250
r <sub>38</sub>	250
r <sub>39</sub>	250
r <sub>40</sub>	250
r <sub>41</sub>	250
r <sub>42</sub>	250
r <sub>43</sub>	250
r <sub>44</sub>	250
r <sub>45</sub>	250
r <sub>46</sub>	250
r <sub>47</sub>	250
r <sub>48</sub>	250
r <sub>49</sub>	250
r <sub>50</sub>	250
r <sub>51</sub>	250
r <sub>52</sub>	250
r <sub>53</sub>	250
r <sub>54</sub>	250
r <sub>55</sub>	250
r <sub>56</sub>	500
r <sub>57</sub>	500
r <sub>58</sub>	500
r <sub>59</sub>	500
r <sub>60</sub>	500
r <sub>61</sub>	500
r <sub>62</sub>	500
r <sub>63</sub>	500
r <sub>total</sub>	20000

**Caution** There is no connection V<sub>8</sub> and V<sub>9</sub> in the chip.

Figure 2-3. Relationship between Input Data and Output Voltage(2/2)

$$V_9 > V_{10} > V_{11} > V_{12} > V_{13} > V_{14} > V_{15} > V_{16} > V_{17} > V_{SS2}$$



Data	D <sub>X5</sub>	D <sub>X4</sub>	D <sub>X3</sub>	D <sub>X2</sub>	D <sub>X1</sub>	D <sub>X0</sub>	Output Voltage	
3F <sub>H</sub>	1	1	1	1	1	1	V <sub>63</sub> ''	V <sub>10</sub> +(V <sub>9</sub> -V <sub>10</sub> )×3500/4000
3E <sub>H</sub>	1	1	1	1	1	0	V <sub>62</sub> ''	V <sub>10</sub> +(V <sub>9</sub> -V <sub>10</sub> )×3000/4000
3D <sub>H</sub>	1	1	1	1	0	1	V <sub>61</sub> ''	V <sub>10</sub> +(V <sub>9</sub> -V <sub>10</sub> )×2500/4000
3C <sub>H</sub>	1	1	1	1	0	0	V <sub>60</sub> ''	V <sub>10</sub> +(V <sub>9</sub> -V <sub>10</sub> )×2000/4000
3B <sub>H</sub>	1	1	1	0	1	1	V <sub>59</sub> ''	V <sub>10</sub> +(V <sub>9</sub> -V <sub>10</sub> )×1500/4000
3A <sub>H</sub>	1	1	1	0	1	0	V <sub>58</sub> ''	V <sub>10</sub> +(V <sub>9</sub> -V <sub>10</sub> )×1000/4000
39 <sub>H</sub>	1	1	1	0	0	1	V <sub>57</sub> ''	V <sub>10</sub> +(V <sub>9</sub> -V <sub>10</sub> )×500/4000
38 <sub>H</sub>	1	1	1	0	0	0	V <sub>56</sub> ''	V <sub>10</sub>
37 <sub>H</sub>	1	1	0	1	1	1	V <sub>55</sub> ''	V <sub>11</sub> +(V <sub>10</sub> -V <sub>11</sub> )×1750/2000
36 <sub>H</sub>	1	1	0	1	1	0	V <sub>54</sub> ''	V <sub>11</sub> +(V <sub>10</sub> -V <sub>11</sub> )×1500/2000
35 <sub>H</sub>	1	1	0	1	0	1	V <sub>53</sub> ''	V <sub>11</sub> +(V <sub>10</sub> -V <sub>11</sub> )×1250/2000
34 <sub>H</sub>	1	1	0	1	0	0	V <sub>52</sub> ''	V <sub>11</sub> +(V <sub>10</sub> -V <sub>11</sub> )×1000/2000
33 <sub>H</sub>	1	1	0	0	1	1	V <sub>51</sub> ''	V <sub>11</sub> +(V <sub>10</sub> -V <sub>11</sub> )×750/2000
32 <sub>H</sub>	1	1	0	0	1	0	V <sub>50</sub> ''	V <sub>11</sub> +(V <sub>10</sub> -V <sub>11</sub> )×500/2000
31 <sub>H</sub>	1	1	0	0	0	1	V <sub>49</sub> ''	V <sub>11</sub> +(V <sub>10</sub> -V <sub>11</sub> )×250/2000
30 <sub>H</sub>	1	1	0	0	0	0	V <sub>48</sub> ''	V <sub>11</sub>
2F <sub>H</sub>	1	0	1	1	1	1	V <sub>47</sub> ''	V <sub>12</sub> +(V <sub>11</sub> -V <sub>12</sub> )×1750/2000
2E <sub>H</sub>	1	0	1	1	1	0	V <sub>46</sub> ''	V <sub>12</sub> +(V <sub>11</sub> -V <sub>12</sub> )×1500/2000
2D <sub>H</sub>	1	0	1	1	0	1	V <sub>45</sub> ''	V <sub>12</sub> +(V <sub>11</sub> -V <sub>12</sub> )×1250/2000
2C <sub>H</sub>	1	0	1	1	0	0	V <sub>44</sub> ''	V <sub>12</sub> +(V <sub>11</sub> -V <sub>12</sub> )×1000/2000
2B <sub>H</sub>	1	0	1	0	1	1	V <sub>43</sub> ''	V <sub>12</sub> +(V <sub>11</sub> -V <sub>12</sub> )×750/2000
2A <sub>H</sub>	1	0	1	0	1	0	V <sub>42</sub> ''	V <sub>12</sub> +(V <sub>11</sub> -V <sub>12</sub> )×500/2000
29 <sub>H</sub>	1	0	1	0	0	1	V <sub>41</sub> ''	V <sub>12</sub> +(V <sub>11</sub> -V <sub>12</sub> )×250/2000
28 <sub>H</sub>	1	0	1	0	0	0	V <sub>40</sub> ''	V <sub>12</sub>
27 <sub>H</sub>	1	0	0	1	1	1	V <sub>39</sub> ''	V <sub>13</sub> +(V <sub>12</sub> -V <sub>13</sub> )×1750/2000
26 <sub>H</sub>	1	0	0	1	1	0	V <sub>38</sub> ''	V <sub>13</sub> +(V <sub>12</sub> -V <sub>13</sub> )×1500/2000
25 <sub>H</sub>	1	0	0	1	0	1	V <sub>37</sub> ''	V <sub>13</sub> +(V <sub>12</sub> -V <sub>13</sub> )×1250/2000
24 <sub>H</sub>	1	0	0	1	0	0	V <sub>36</sub> ''	V <sub>13</sub> +(V <sub>12</sub> -V <sub>13</sub> )×1000/2000
23 <sub>H</sub>	1	0	0	0	1	1	V <sub>35</sub> ''	V <sub>13</sub> +(V <sub>12</sub> -V <sub>13</sub> )×750/2000
22 <sub>H</sub>	1	0	0	0	1	0	V <sub>34</sub> ''	V <sub>13</sub> +(V <sub>12</sub> -V <sub>13</sub> )×500/2000
21 <sub>H</sub>	1	0	0	0	0	1	V <sub>33</sub> ''	V <sub>13</sub> +(V <sub>12</sub> -V <sub>13</sub> )×250/2000
20 <sub>H</sub>	1	0	0	0	0	0	V <sub>32</sub> ''	V <sub>13</sub>
1F <sub>H</sub>	0	1	1	1	1	1	V <sub>31</sub> ''	V <sub>14</sub> +(V <sub>13</sub> -V <sub>14</sub> )×1750/2000
1E <sub>H</sub>	0	1	1	1	1	0	V <sub>30</sub> ''	V <sub>14</sub> +(V <sub>13</sub> -V <sub>14</sub> )×1500/2000
1D <sub>H</sub>	0	1	1	1	0	1	V <sub>29</sub> ''	V <sub>14</sub> +(V <sub>13</sub> -V <sub>14</sub> )×1250/2000
1C <sub>H</sub>	0	1	1	1	0	0	V <sub>28</sub> ''	V <sub>14</sub> +(V <sub>13</sub> -V <sub>14</sub> )×1000/2000
1B <sub>H</sub>	0	1	1	0	1	1	V <sub>27</sub> ''	V <sub>14</sub> +(V <sub>13</sub> -V <sub>14</sub> )×750/2000
1A <sub>H</sub>	0	1	1	0	1	0	V <sub>26</sub> ''	V <sub>14</sub> +(V <sub>13</sub> -V <sub>14</sub> )×500/2000
19 <sub>H</sub>	0	1	1	0	0	1	V <sub>25</sub> ''	V <sub>14</sub> +(V <sub>13</sub> -V <sub>14</sub> )×250/2000
18 <sub>H</sub>	0	1	1	0	0	0	V <sub>24</sub> ''	V <sub>14</sub>
17 <sub>H</sub>	0	1	0	1	1	1	V <sub>23</sub> ''	V <sub>15</sub> +(V <sub>14</sub> -V <sub>15</sub> )×1750/2000
16 <sub>H</sub>	0	1	0	1	1	0	V <sub>22</sub> ''	V <sub>15</sub> +(V <sub>14</sub> -V <sub>15</sub> )×1500/2000
15 <sub>H</sub>	0	1	0	1	0	1	V <sub>21</sub> ''	V <sub>15</sub> +(V <sub>14</sub> -V <sub>15</sub> )×1250/2000
14 <sub>H</sub>	0	1	0	1	0	0	V <sub>20</sub> ''	V <sub>15</sub> +(V <sub>14</sub> -V <sub>15</sub> )×1000/2000
13 <sub>H</sub>	0	1	0	0	1	1	V <sub>19</sub> ''	V <sub>15</sub> +(V <sub>14</sub> -V <sub>15</sub> )×750/2000
12 <sub>H</sub>	0	1	0	0	1	0	V <sub>18</sub> ''	V <sub>15</sub> +(V <sub>14</sub> -V <sub>15</sub> )×500/2000
11 <sub>H</sub>	0	1	0	0	0	1	V <sub>17</sub> ''	V <sub>15</sub> +(V <sub>14</sub> -V <sub>15</sub> )×250/2000
10 <sub>H</sub>	0	1	0	0	0	0	V <sub>16</sub> ''	V <sub>15</sub>
0F <sub>H</sub>	0	0	1	1	1	1	V <sub>15</sub> ''	V <sub>16</sub> +(V <sub>15</sub> -V <sub>16</sub> )×1750/2000
0E <sub>H</sub>	0	0	1	1	1	0	V <sub>14</sub> ''	V <sub>16</sub> +(V <sub>15</sub> -V <sub>16</sub> )×1500/2000
0D <sub>H</sub>	0	0	1	1	0	1	V <sub>13</sub> ''	V <sub>16</sub> +(V <sub>15</sub> -V <sub>16</sub> )×1250/2000
0C <sub>H</sub>	0	0	1	1	0	0	V <sub>12</sub> ''	V <sub>16</sub> +(V <sub>15</sub> -V <sub>16</sub> )×1000/2000
0B <sub>H</sub>	0	0	1	0	1	1	V <sub>11</sub> ''	V <sub>16</sub> +(V <sub>15</sub> -V <sub>16</sub> )×750/2000
0A <sub>H</sub>	0	0	1	0	1	0	V <sub>10</sub> ''	V <sub>16</sub> +(V <sub>15</sub> -V <sub>16</sub> )×500/2000
09 <sub>H</sub>	0	0	1	0	0	1	V <sub>9</sub> ''	V <sub>16</sub> +(V <sub>15</sub> -V <sub>16</sub> )×250/2000
08 <sub>H</sub>	0	0	1	0	0	0	V <sub>8</sub> ''	V <sub>16</sub>
07 <sub>H</sub>	0	0	0	1	1	1	V <sub>7</sub> ''	V <sub>17</sub> +(V <sub>16</sub> -V <sub>17</sub> )×3500/4000
06 <sub>H</sub>	0	0	0	1	1	0	V <sub>6</sub> ''	V <sub>17</sub> +(V <sub>16</sub> -V <sub>17</sub> )×3000/4000
05 <sub>H</sub>	0	0	0	1	0	1	V <sub>5</sub> ''	V <sub>17</sub> +(V <sub>16</sub> -V <sub>17</sub> )×2500/4000
04 <sub>H</sub>	0	0	0	1	0	0	V <sub>4</sub> ''	V <sub>17</sub> +(V <sub>16</sub> -V <sub>17</sub> )×2000/4000
03 <sub>H</sub>	0	0	0	0	1	1	V <sub>3</sub> ''	V <sub>17</sub> +(V <sub>16</sub> -V <sub>17</sub> )×1500/4000
02 <sub>H</sub>	0	0	0	0	1	0	V <sub>2</sub> ''	V <sub>17</sub> +(V <sub>16</sub> -V <sub>17</sub> )×1000/4000
01 <sub>H</sub>	0	0	0	0	0	1	V <sub>1</sub> ''	V <sub>17</sub> +(V <sub>16</sub> -V <sub>17</sub> )×500/4000
00 <sub>H</sub>	0	0	0	0	0	0	V <sub>0</sub> ''	V <sub>17</sub>

	(Ω)
r <sub>63</sub>	500
r <sub>62</sub>	500
r <sub>61</sub>	500
r <sub>60</sub>	500
r <sub>59</sub>	500
r <sub>58</sub>	500
r <sub>57</sub>	500
r <sub>56</sub>	500
r <sub>55</sub>	250
r <sub>54</sub>	250
r <sub>53</sub>	250
r <sub>52</sub>	250
r <sub>51</sub>	250
r <sub>50</sub>	250
r <sub>49</sub>	250
r <sub>48</sub>	250
r <sub>47</sub>	250
r <sub>46</sub>	250
r <sub>45</sub>	250
r <sub>44</sub>	250
r <sub>43</sub>	250
r <sub>42</sub>	250
r <sub>41</sub>	250
r <sub>40</sub>	250
r <sub>39</sub>	250
r <sub>38</sub>	250
r <sub>37</sub>	250
r <sub>36</sub>	250
r <sub>35</sub>	250
r <sub>34</sub>	250
r <sub>33</sub>	250
r <sub>32</sub>	250
r <sub>31</sub>	250
r <sub>30</sub>	250
r <sub>29</sub>	250
r <sub>28</sub>	250
r <sub>27</sub>	250
r <sub>26</sub>	250
r <sub>25</sub>	250
r <sub>24</sub>	250
r <sub>23</sub>	250
r <sub>22</sub>	250
r <sub>21</sub>	250
r <sub>20</sub>	250
r <sub>19</sub>	250
r <sub>18</sub>	250
r <sub>17</sub>	250
r <sub>16</sub>	250
r <sub>15</sub>	250
r <sub>14</sub>	250
r <sub>13</sub>	250
r <sub>12</sub>	250
r <sub>11</sub>	250
r <sub>10</sub>	250
r <sub>9</sub>	250
r <sub>8</sub>	250
r <sub>7</sub>	500
r <sub>6</sub>	500
r <sub>5</sub>	500
r <sub>4</sub>	500
r <sub>3</sub>	500
r <sub>2</sub>	500
r <sub>1</sub>	500
r <sub>0</sub>	500
r <sub>total</sub>	20000

**Caution** There is no connection V<sub>8</sub> and V<sub>9</sub> in the chip.

**3. RELATIONSHIP BETWEEN INPUT DATA AND OUTPUT PIN**

Data format: 6 bits × 1 RGBs (3 dots)

Input width : 18 bits (1-pixel data)

**R,/L = H (Right shift)**

Output	S <sub>1</sub>	S <sub>2</sub>	S <sub>3</sub>	S <sub>4</sub>	...	S <sub>299/308</sub>	S <sub>300/309</sub>
Data	D <sub>00</sub> to D <sub>05</sub>	D <sub>10</sub> to D <sub>15</sub>	D <sub>20</sub> to D <sub>25</sub>	D <sub>00</sub> to D <sub>05</sub>	...	D <sub>10</sub> to D <sub>15</sub>	D <sub>20</sub> to D <sub>25</sub>

**R,/L = L (Left shift)**

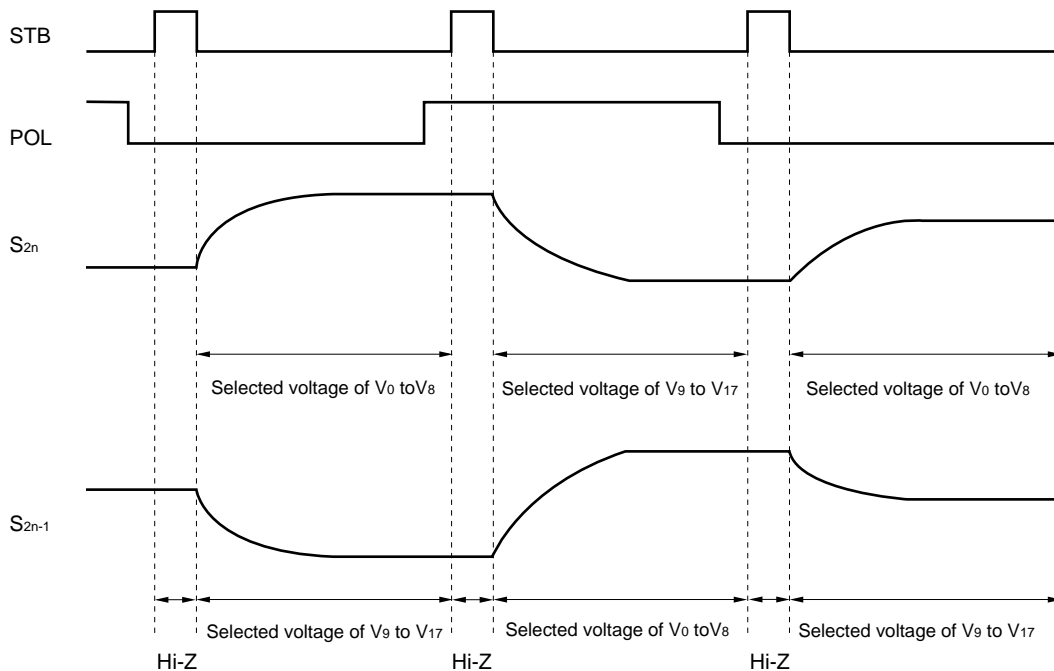
Output	S <sub>1</sub>	S <sub>2</sub>	S <sub>3</sub>	S <sub>4</sub>	...	S <sub>299/308</sub>	S <sub>300/309</sub>
Data	D <sub>00</sub> to D <sub>05</sub>	D <sub>10</sub> to D <sub>15</sub>	D <sub>20</sub> to D <sub>25</sub>	D <sub>00</sub> to D <sub>05</sub>	...	D <sub>10</sub> to D <sub>15</sub>	D <sub>20</sub> to D <sub>25</sub>

POL	S <sub>2n-1</sub> <sup>Note</sup>	S <sub>2n</sub> <sup>Note</sup>
H	V <sub>0</sub> to V <sub>8</sub>	V <sub>9</sub> to V <sub>17</sub>
L	V <sub>9</sub> to V <sub>17</sub>	V <sub>0</sub> to V <sub>8</sub>

**Note** S<sub>2n-1</sub> (Odd output), S<sub>2n</sub> (Even output) n = 1, 2, ..., 155(Except S310)

**4. RELATIONSHIP BETWEEN STB, POL, AND OUTPUT WAVEFORM**

The output voltage is written to the LCD panel synchronized with the STB falling edge.



5. ELECTRICAL SPECIFICATIONS

★ Absolute Maximum Ratings ( $T_A = 25\text{ °C}$ ,  $V_{SS1} = V_{SS2} = 0\text{ V}$ )

Parameter	Symbol	Rating	Unit
Logic Part Supply Voltage	$V_{DD1}$	-0.5 to +5.0	V
Driver Part Supply Voltage	$V_{DD2}$	-0.5 to +10.0	V
Logic Part Input Voltage	$V_{I1}$	-0.5 to $V_{DD1} + 0.5$	V
Driver Part Input Voltage	$V_{I2}$	-0.5 to $V_{DD2} + 0.5$	V
Logic Part Output Voltage	$V_{O1}$	-0.5 to $V_{DD1} + 0.5$	V
Driver Part Output Voltage	$V_{O2}$	-0.5 to $V_{DD2} + 0.5$	V
Operating Ambient Temperature Range	$T_A$	-10 to +75	°C
Storage Temperature Range	$T_{stg}$	-55 to +125	°C

**Caution** If the absolute maximum rating of even one of the above parameters is exceeded even momentarily, the quality of the product may be degraded. Absolute maximum ratings, therefore, specify the values exceeding which the product may be physically damaged. Be sure to use the product within the range of the absolute maximum ratings.

Recommended Operating Range ( $T_A = -10\text{ to }+75\text{ °C}$ ,  $V_{SS1} = V_{SS2} = 0\text{ V}$ )

Parameter	Symbol	MIN.	TYP.	MAX.	Unit
Logic Part Supply Voltage	$V_{DD1}$	3.0	3.3	3.6	V
Driver Part Supply Voltage	$V_{DD2}$	8.0	8.5	9.0	V
High-Level Input Voltage	$V_{IH}$	$0.7 V_{DD1}$		$V_{DD1}$	V
Low-Level Input Voltage	$V_{IL}$	0		$0.3 V_{DD1}$	V
γ-Corrected Voltage	$V_0$ to $V_{17}$	$V_{SS2}$		$V_{DD2}$	V
Driver System Output Voltage	$V_O$	$V_{SS2} + 0.1$		$V_{DD2} - 0.1$	V
Maximum Clock Frequency	$f_{MAX.}$	40			MHz

★ **Electrical Specifications** ( $T_A = -10$  to  $+75$  °C,  $V_{DD1} = 3.3$  V  $\pm 0.3$  V,  $V_{DD2} = 8.5$  V  $\pm 0.5$  V,  $V_{SS1} = V_{SS2} = 0$  V)

Parameter	Symbol	Condition	MIN.	TYP.	MAX.	Unit	
Input Leak Current	$I_L$				$\pm 1.0$	$\mu A$	
High-Level Output Voltage	$V_{OH}$	STHR (STHL), $I_{OH} = 0$ mA	$V_{DD1} - 0.1$			V	
Low-Level Output Voltage	$V_{OL}$	STHR (STHL), $I_{OL} = 0$ mA			0.1	V	
$\gamma$ -Corrected Supply Current	$I_\gamma$	$V_0$ to $V_8 = V_9$ to $V_{17} = 4.0$ V	$V_0$ pin, $V_9$ pin	100	200	400	$\mu A$
			$V_8$ pin, $V_{17}$ pin	-400	-200	-100	$\mu A$
Driver Output Current	$V_{VOH}$	$V_X = 7.0$ V, $V_{OUT} = 6.5$ V <sup>Note</sup>			-30	$\mu A$	
	$V_{VOL}$	$V_X = 1.0$ V, $V_{OUT} = 1.5$ V <sup>Note</sup>	30			$\mu A$	
Output Voltage Deviation	$\Delta V_O$	$V_{OUT} = 2.0$ V, 4.25 V, 6.5 V		$\pm 10$	$\pm 20$	mV	
Output swing difference deviation	$\Delta V_{P-P}$			$\pm 5$		mV	
Output Voltage Range	$V_O$		0.1		$V_{DD2} - 0.1$	V	
Logic System Dynamic Current Consumption	$I_{DD1}$	$V_{DD1}$ , with no load		2.0	3.5	mA	
Driver System Dynamic Current Consumption	$I_{DD2}$	$V_{DD2}$ , with no load		2.5	6.0	mA	

**Note**  $V_X$  refers to the output voltage of analog output pins  $S_1$  to  $S_{300/309}$ .  
 $V_{OUT}$  refers to the voltage applied to analog output pins  $S_1$  to  $S_{300/309}$ .

- Cautions**
1. The STB cycle is defined to be 20  $\mu s$  at  $f_{CLK} = 40$  MHz.
  2. The TYP. values refer to an all-black or all-white input pattern. The MAX. value refers to the measured values in the dot checkerboard input pattern.
  3. Refers to the current consumption per driver when cascades are connected assuming XGA single-sided mounting (10 units).

★ **Switching Characteristics** ( $T_A = -10$  to  $+75$  °C,  $V_{DD1} = 3.3$  V  $\pm 0.3$  V,  $V_{DD2} = 8.5$  V  $\pm 0.5$  V,  $V_{SS1} = V_{SS2} = 0$  V)

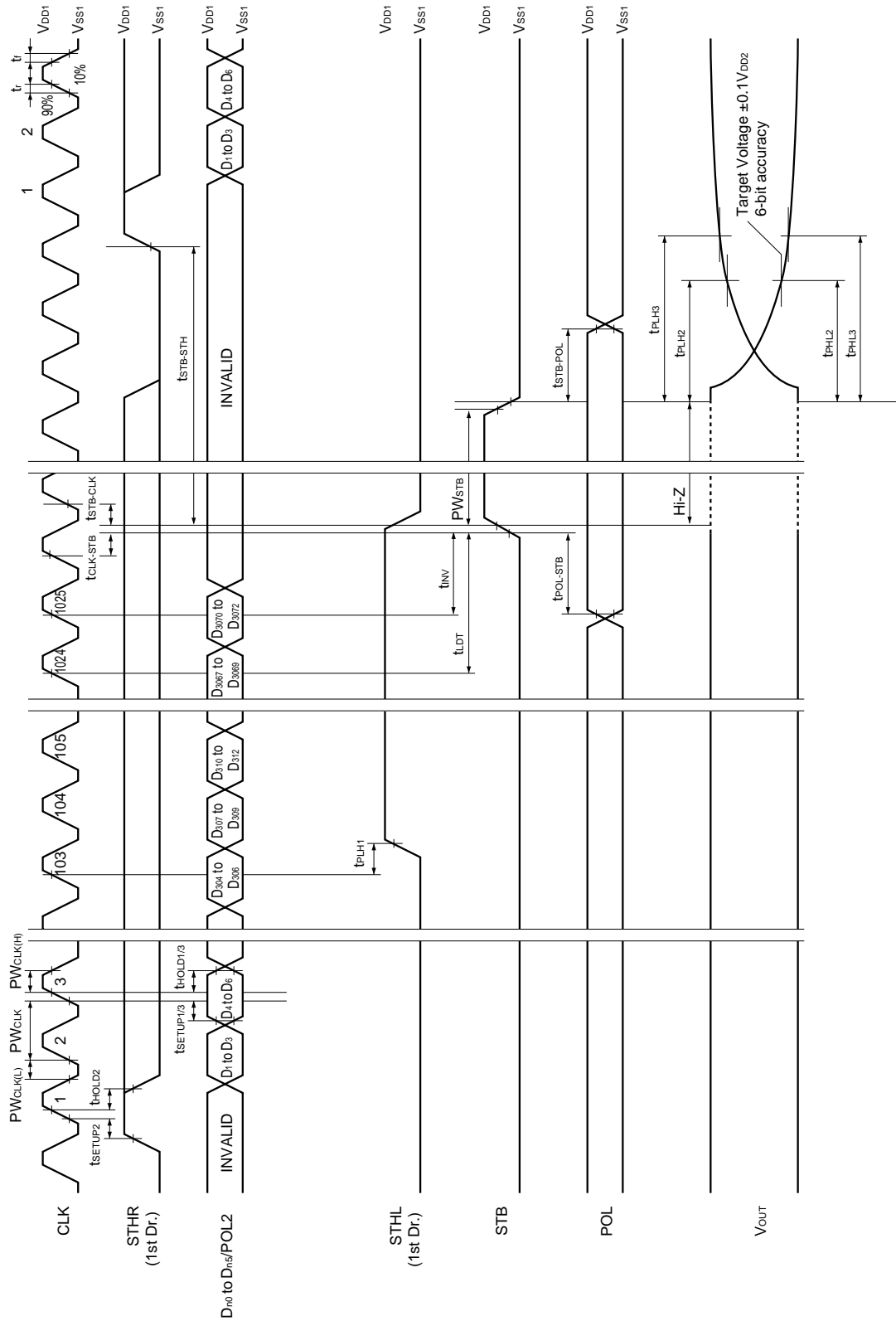
Parameter	Symbol	Condition	MIN.	TYP.	MAX.	Unit
Start Pulse Delay Time	$t_{PLH1}$	$C_L = 10$ pF		10	20	ns
Driver Output Delay Time 1	$t_{PLH2}$	$C_L = 31.5$ pF $\times 2$ , $R_L = 4.5$ k $\Omega$		4	7	$\mu s$
	$t_{PLH3}$			7	10	$\mu s$
	$t_{PHL2}$			4	7	$\mu s$
	$t_{PHL3}$			7	10	$\mu s$
Input Capacitance	$C_{I1}$	STHR (STHL) excluded, $T_A = 25$ °C		5	10	pF
	$C_{I2}$	STHR (STHL), $T_A = 25$ °C		5	10	pF

★ Timing Requirements ( $T_A = -10$  to  $+75$  °C,  $V_{DD1} = 3.3$  V  $\pm 0.3$  V,  $V_{SS1} = V_{SS2} = 0$  V,  $t_r = t_f = 8.0$  ns)

Parameter	Symbol	Condition	MIN.	TYP.	MAX.	Unit
Clock Pulse Width	PW <sub>CLK</sub>		25			ns
Clock Pulse High Period	PW <sub>CLK(H)</sub>		6			ns
Clock Pulse Low Period	PW <sub>CLK(L)</sub>		6			ns
Data Setup Time	t <sub>SETUP1</sub>		3			ns
Data Hold Time	t <sub>HOLD1</sub>		3			ns
Start Pulse Setup Time	t <sub>SETUP2</sub>		5			ns
Start Pulse Hold Time	t <sub>HOLD2</sub>		1			ns
POL2 Setup Time	t <sub>SETUP3</sub>		3			ns
POL2 Hold Time	t <sub>HOLD3</sub>		3			ns
Start Pulse Low Period	t <sub>SPL</sub>		6			ns
STB Pulse Width	PW <sub>STB</sub>		2			CLK
					4	μs
Data Invalid Period	t <sub>INV</sub>		1			CLK
Last Data Timing	t <sub>LDT</sub>		2			CLK
CLK-STB Time	t <sub>CLK-STB</sub>	CLK ↑ → STB ↑	6			ns
STB-CLK Time	t <sub>STB-CLK</sub>	STB ↑ → CLK ↑	6			ns
Time Between STB and Start Pulse	t <sub>STB-STH</sub>	STB ↓ → STHR(STHL) ↑	1			CLK
POL-STB Time	t <sub>POL-STB</sub>	POL ↑ or ↓ → STB ↑	-5			ns
STB-POL Time	t <sub>STB-POL</sub>	STB ↓ → POL ↓ or ↑	6			ns

★ 6. SWITCHING CHARACTERISTICS WAVEFORM (R,/L = H)

(Unless otherwise specified, the input level is defined to be  $V_{IH} = 0.7 V_{DD1}$ ,  $V_{IL} = 0.3 V_{DD1}$ .)



**7. RECOMMENDED SOLDERING CONDITIONS**

The following conditions must be met when soldering the μ PD16638A.

For more details, refer to the **Semiconductor Device Mounting Technology Manual (C10535E)**.

Please consult with our sales offices when other soldering processes are used, or when the soldering is done under different conditions.

**μ PD16638AN-xxx : TCP (TAB package)**

Mounting Condition	Mounting Method	Condition
Thermocompression	Soldering	Heating tool 300 to 350 °C: heating for 2 to 3 seconds: pressure 100 g (per solder)
	ACF (Adhesive Conductive Film)	Temporary bonding 70 to 100 °C: pressure 3 to 8 kg/cm <sup>2</sup> : time 3 to 5 secs. Real bonding 165 to 180 °C: pressure 25 to 45 kg/cm <sup>2</sup> : time 30 to 40 secs. (When using the anisotropy conductive film SUMIZAC-1003 of Sumitomo Bakelite, Ltd.)

**Caution** For detailed conditions for mounting the ACF part, please contact the ACF manufacturing company. Be sure to avoid using two or more mounting methods at a time.



## 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.

**Reference Documents****NEC Semiconductor Device Reliability / Quality Control System (C10983E)****Quality Grades to NEC's Semiconductor Devices (C11531E)**

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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:** Aircrafts, 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.

Anti-radioactive design is not implemented in this product.