

300-OUTPUT TFT-LCD SOURCE DRIVER (COMPATIBLE WITH 64 GRAY SCALE)

DESCRIPTION

The μ PD16634A is a source driver for TFT-LCDs capable of dealing with displays 64 gray scales. Data input is based on digital input configured as 6 bits by 6 dots (2 pixels), which can realize a full-color display of 260,000 colors by output of 64 values γ -corrected by an internal D/A converter and 5-by-2 external power modules. Because the

★ output dynamic range is as large as $V_{SS2}+0.1$ V to $V_{DD2}-0.1$ V, level inversion operation of the LCD's common electrode is rendered unnecessary. Also to be able to deal with dot-line inversion when mounted on a single side, this source driver equipped with a built-in 6-bit D/A converter circuit whose odd output pins and even output pins respectively output gray scale voltages of differing polarity. Assuring a maximum clock frequent of 40 MHz when drivng at 3.0 V, this driver is applicable to XGA-standard TFT-LCD panels.

FEATURES

- 300 outputs
- CMOS level input
- Input of 6 bits (gradation data) by 6 dots
- Capable of outputting 64 values by means of 5-by-2 external power modules (10 units) and a D/A converter
- ★ • Output dynamic range : $V_{SS2}+0.1$ V to $V_{DD2}-0.1$ V
- ★ • Logic part supply voltage (V_{DD1}) : 3.3 V \pm 0.3 V
- ★ • Driver part supply voltage (V_{DD2}) : 8.0 V \pm 0.5 V
- High-speed data transfer: $f_{MAX}=40$ MHz MIN.(internal data transfer rate when operating at 3.0 V)
- Output voltage polarity inversion is possible (POL)
- Display data inversion function (POL2)
- Single bank arrangement is possible(loaded with slim TCP).

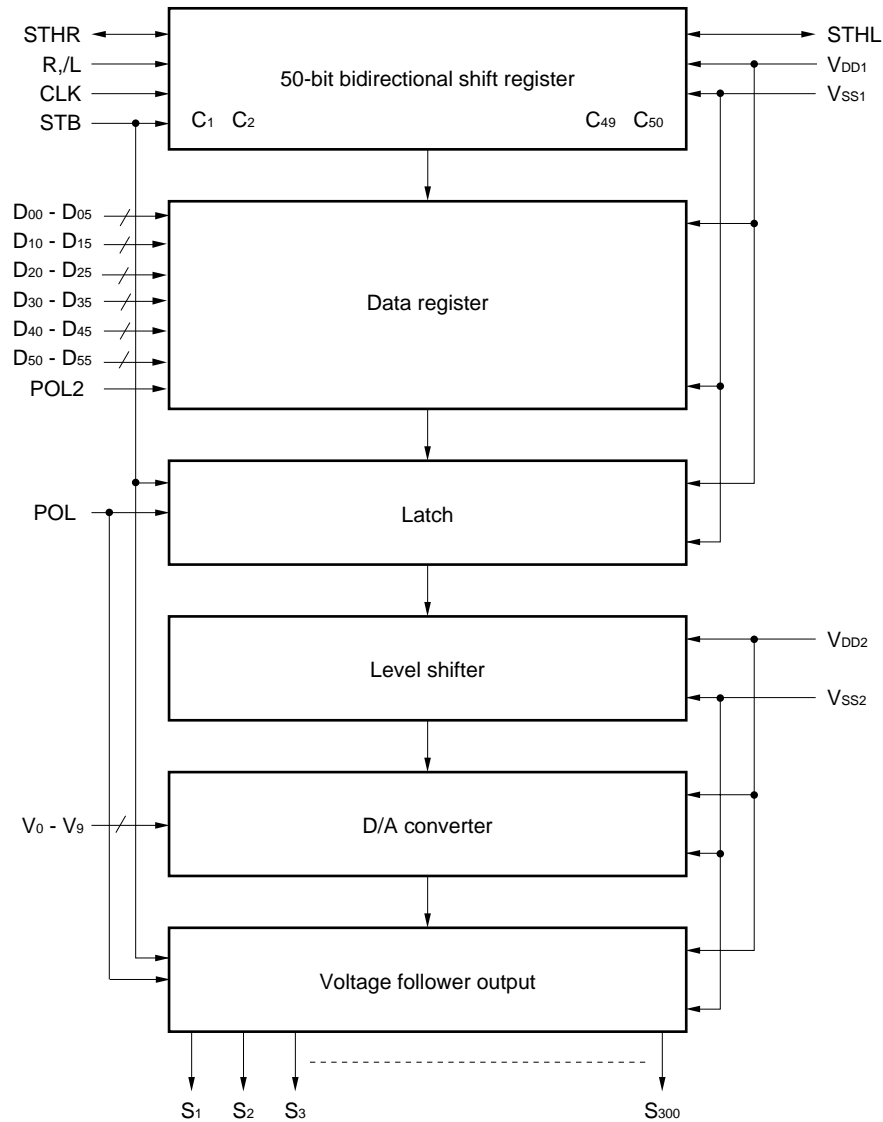
ORDERING INFORMATION

Part Number	Package
μ PD16634AN-xxx	TCP (TAB package)

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

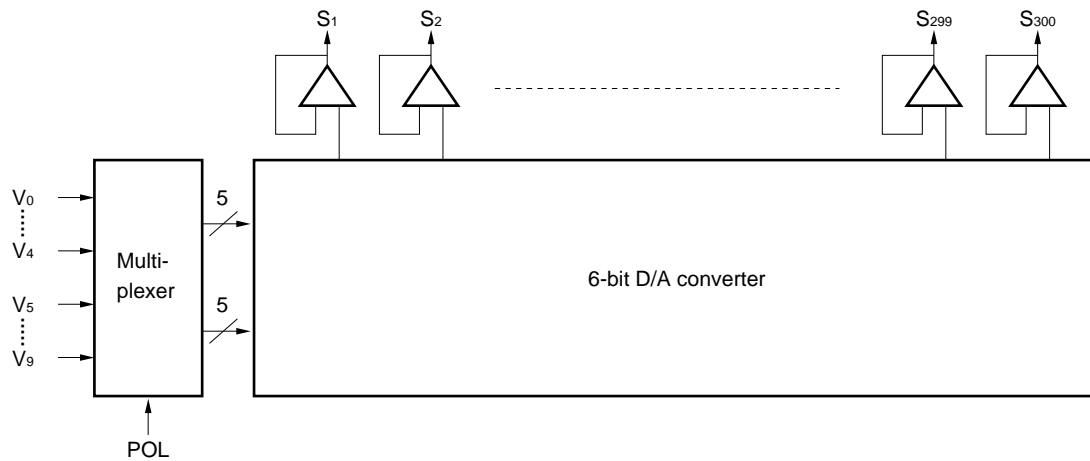
The information in this document is subject to change without notice. Before using this document, please confirm that this is the latest version.
Not all devices/types available in every country. Please check with local NEC representative for availability and additional information.

1. BLOCK DIAGRAM

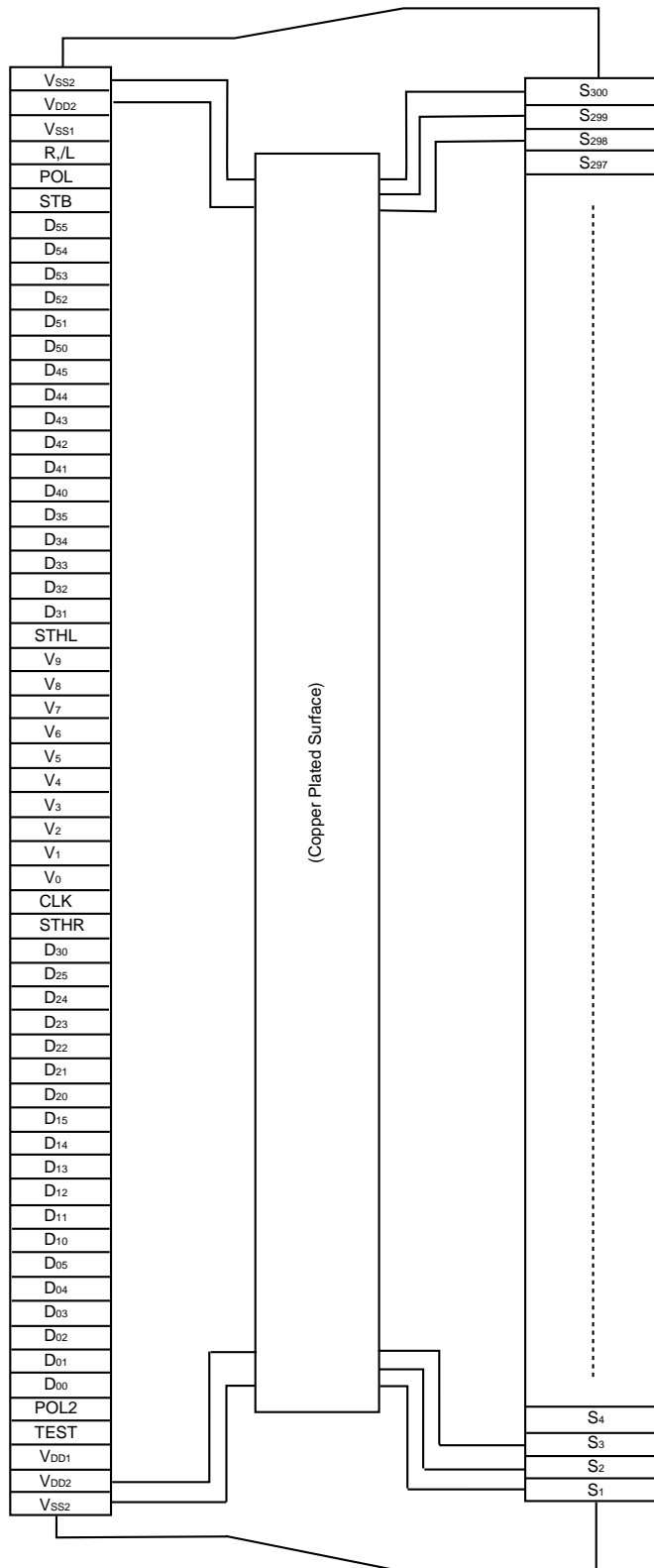


Remark /xxx indicates active low signal.

★ 2. RELATIONSHIP BETWEEN OUTPUT CIRCUIT AND D/A CONVERTER



3. PIN CONFIGURATION (μPD16634AN-xxx)



Caution This figure does not specify the TCP package. Therefore POL2 pins can be reduced by opening or short-circuiting to Vss2 by TCP wiring. POL2 pin can short to Vss1 on TCP. So when you not use “data inversion function”, can reduce input pins.

4. PIN FUNCTIONS

Pin Symbol	Pin Name	Description
S ₁ to S ₃₀₀	Driver output	The D/A converted 64-gray-scale analog voltage is output
D ₀₀ to D ₀₅	Display data input	The display data is input with a width of 36 bits, viz., the gray scale data (6 bits) by 6 dots (2 pixels). D _{x0} : LSB, D _{x5} : MSB
D ₁₀ to D ₁₅		
D ₂₀ to D ₂₅		
D ₃₀ to D ₃₅		
D ₄₀ to D ₄₅		
D ₅₀ to D ₅₅		
R _/ L	Shift direction switching input	These refer to the start pulse input/output pins when cascades are connected. The shift directions of the shift registers are as follows. R _/ L = H : STHR input, S ₁ →S ₃₀₀ , STHL output R _/ L = L : STHL input, S ₃₀₀ →S ₁ , STHR output
STHR	Right shift start pulse input/output	R _/ L = H : Becomes the start pulse input pin. R _/ L = L : Becomes the start pulse output pin.
STHL	Left shift start pulse input/output	R _/ L = H : Becomes the start pulse input pin. R _/ L = L : Becomes the start pulse output pin.
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. At the rising edge of the 50th clock after the start pulse input, the start pulse output reaches the high level, thus becoming the start pulse of the next-level driver. The initial-level driver's 50th clock becomes valid as the next-level driver's start pulse is input. If 52 clock pulses are input after input of the start pulse, input of display data is halted automatically. The contents of the shift register are cleared at the STB's rising edge.
STB	Latch input	The contents of the data register are transferred to the latch 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 = L ; The S _{2n-1} output uses V ₀ to V ₄ as the reference supply; and the S _{2n} output uses V ₅ to V ₉ as the reference supply. POL = H ; The S _{2n-1} output uses V ₅ to V ₉ as the reference supply; and the S _{2n} output uses V ₀ to V ₄ as the reference supply. S _{2n-1} indicates the odd output; and S _{2n} indicates the even output. Input of the POL signal is allowed the setup time (t _{POL-STB}) with respect to STB's rising edge.
POL2	Data inversion input	POL2 = H : Display data is inverted. POL2 = L : Display data is not inverted.
V ₀ to V ₉	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 _{DD2} > V ₀ > V ₁ > V ₂ > V ₃ > V ₄ > V ₅ > V ₆ > V ₇ > V ₈ > V ₉ > V _{SS2}
TEST	Test pin	Set it to open.
V _{DD1}	Logic circuit power supply	3.3 V \pm 0.3 V
V _{DD2}	Driver circuit power supply	8.0 V \pm 0.5 V
V _{SS1}	Logic ground	Grounding
V _{SS2}	Driver ground	Grounding

- Cautions**
1. The power start sequence must be V_{DD1}, logic input, and V_{DD2} & V₀ to V₉ in that order. Reverse this sequence to shut down.(Simultaneous power application to V_{DD2} and V₀ to V₉ is possible.)
 2. To stabilize the supply voltage, please be sure to insert 0.1 μ F bypass capacitor between V_{DD1}-V_{SS1} and V_{DD2}-V_{SS2}. Furthermore, for increase precision of the D/A converter, insertion of a bypass capacitor of about 0.01 μ F is also advised between the γ -corrected power supply terminals(V₀,V₁,V₂...,V₉) and V_{SS2}.
 3. We recommend to use Operational Amplifier to lower input impedance of γ -corrected voltage.

5. RELATIONSHIP BETWEEN INPUT DATA AND OUTPUT VOLTAGE VALUE

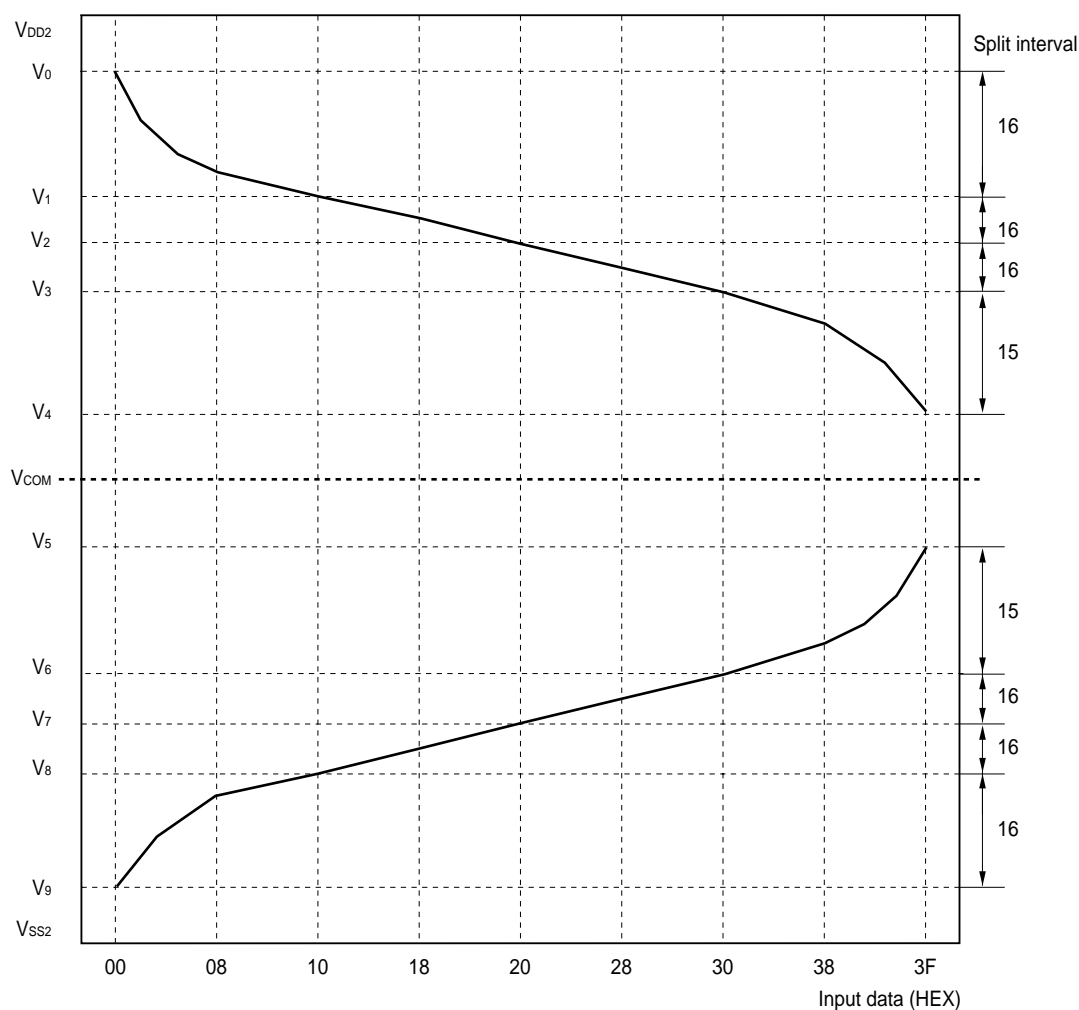
This product incorporates a 6-bit D/A converter whose odd output pins and even output pins output respectively gray scale voltages of differing polarity with respect to the LCD's counter electrode (common electrode) voltage. The D/A converter consists of ladder resistors and switches. The ladder resistors r_0 to r_{62} are so designed that the ratios between the LCD panel's γ -corrected voltages and V_0' to V_{63}' , V_0'' to V_{63}'' are roughly equal; and their respective resistance values are as shown in Table 6-1. Among the 5-by 2 γ -corrected voltages, input gray scale voltages of the same polarity with respect to the common voltage, for the respective five γ -corrected voltages of V_0 to V_4 and V_5 to V_9 . If fine gray scale voltage precision is not necessary, the voltage follower circuit supplied to the γ -corrected power supplies V_1 to V_3 and V_6 to V_8 can be deleted.

Figure 5-1 shows the relationship between the driving voltages such as liquid-crystal driving voltages V_{DD2} and V_{SS2} , common electrode potential V_{COM} , and γ -corrected voltages V_0 to V_9 and the input data. Be sure to maintain the voltage relationships of $V_{DD2} > V_0 > V_1 > V_2 > V_3 > V_4 > V_5 > V_6 > V_7 > V_8 > V_9 > V_{SS2}$. Figure 6-1 and 6-2 show the relationship between the input data and the output data.

This driver IC is designed for single-sided mounting. Therefore, please do not use it for γ -corrected power supply level inversion in double-sided mounting.

★

Figure 5-1. Relationship between Input Data and Output Voltage

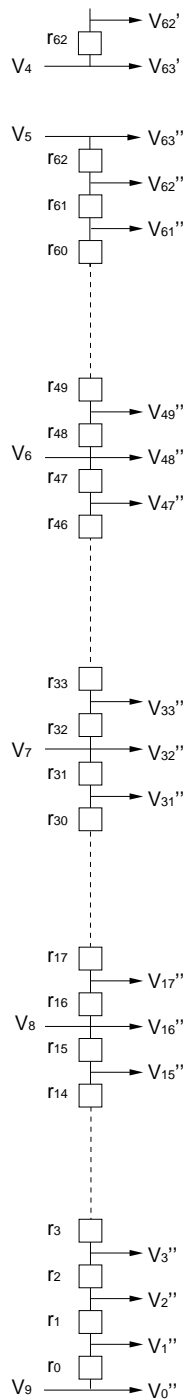


6. RESISTOR STRINGS

Figure 6-1. Relationship Between Input Data and Output Voltage : $V_{DD2} > V_0 > V_1 > V_2 > V_3 > V_4 > V_5$, POL2 = L

Data	D _{x5}	D _{x4}	D _{x3}	D _{x2}	D _{x1}	D _{x0}	Output Voltage	
							V _{0'}	V ₀
00H	0	0	0	0	0	0	V _{0'}	V ₀
01H	0	0	0	0	0	1	V _{1'}	$V_1 + (V_0 - V_1) \times 7250/8050$
02H	0	0	0	0	1	0	V _{2'}	$V_1 + (V_0 - V_1) \times 6500/8050$
03H	0	0	0	0	1	1	V _{3'}	$V_1 + (V_0 - V_1) \times 5800/8050$
04H	0	0	0	1	0	0	V _{4'}	$V_1 + (V_0 - V_1) \times 5150/8050$
05H	0	0	0	1	0	1	V _{5'}	$V_1 + (V_0 - V_1) \times 4550/8050$
06H	0	0	0	1	1	0	V _{6'}	$V_1 + (V_0 - V_1) \times 4000/8050$
07H	0	0	0	1	1	1	V _{7'}	$V_1 + (V_0 - V_1) \times 3450/8050$
08H	0	0	1	0	0	0	V _{8'}	$V_1 + (V_0 - V_1) \times 2950/8050$
09H	0	0	1	0	0	1	V _{9'}	$V_1 + (V_0 - V_1) \times 2450/8050$
0AH	0	0	1	0	1	0	V _{10'}	$V_1 + (V_0 - V_1) \times 2050/8050$
0BH	0	0	1	0	1	1	V _{11'}	$V_1 + (V_0 - V_1) \times 1650/8050$
0CH	0	0	1	1	0	0	V _{12'}	$V_1 + (V_0 - V_1) \times 1300/8050$
0DH	0	0	1	1	0	1	V _{13'}	$V_1 + (V_0 - V_1) \times 950/8050$
0EH	0	0	1	1	1	0	V _{14'}	$V_1 + (V_0 - V_1) \times 600/8050$
0FH	0	0	1	1	1	1	V _{15'}	$V_1 + (V_0 - V_1) \times 300/8050$
10H	0	1	0	0	0	0	V _{16'}	V ₁
11H	0	1	0	0	0	1	V _{17'}	$V_2 + (V_1 - V_2) \times 2450/2750$
12H	0	1	0	0	1	0	V _{18'}	$V_2 + (V_1 - V_2) \times 2200/2750$
13H	0	1	0	0	1	1	V _{19'}	$V_2 + (V_1 - V_2) \times 1950/2750$
14H	0	1	0	1	0	0	V _{20'}	$V_2 + (V_1 - V_2) \times 1700/2750$
15H	0	1	0	1	0	1	V _{21'}	$V_2 + (V_1 - V_2) \times 1500/2750$
16H	0	1	0	1	1	0	V _{22'}	$V_2 + (V_1 - V_2) \times 1300/2750$
17H	0	1	0	1	1	1	V _{23'}	$V_2 + (V_1 - V_2) \times 1100/2750$
18H	0	1	1	0	0	0	V _{24'}	$V_2 + (V_1 - V_2) \times 950/2750$
19H	0	1	1	0	0	1	V _{25'}	$V_2 + (V_1 - V_2) \times 800/2750$
1AH	0	1	1	0	1	0	V _{26'}	$V_2 + (V_1 - V_2) \times 650/2750$
1BH	0	1	1	0	1	1	V _{27'}	$V_2 + (V_1 - V_2) \times 500/2750$
1CH	0	1	1	1	0	0	V _{28'}	$V_2 + (V_1 - V_2) \times 400/2750$
1DH	0	1	1	1	0	1	V _{29'}	$V_2 + (V_1 - V_2) \times 300/2750$
1EH	0	1	1	1	1	0	V _{30'}	$V_2 + (V_1 - V_2) \times 200/2750$
1FH	0	1	1	1	1	1	V _{31'}	$V_2 + (V_1 - V_2) \times 100/2750$
20H	1	0	0	0	0	0	V _{32'}	V ₂
21H	1	0	0	0	0	1	V _{33'}	$V_3 + (V_2 - V_3) \times 1500/1600$
22H	1	0	0	0	1	0	V _{34'}	$V_3 + (V_2 - V_3) \times 1400/1600$
23H	1	0	0	0	1	1	V _{35'}	$V_3 + (V_2 - V_3) \times 1300/1600$
24H	1	0	0	1	0	0	V _{36'}	$V_3 + (V_2 - V_3) \times 1200/1600$
25H	1	0	0	1	0	1	V _{37'}	$V_3 + (V_2 - V_3) \times 1100/1600$
26H	1	0	0	1	1	0	V _{38'}	$V_3 + (V_2 - V_3) \times 1000/1600$
27H	1	0	0	1	1	1	V _{39'}	$V_3 + (V_2 - V_3) \times 900/1600$
28H	1	0	1	0	0	0	V _{40'}	$V_3 + (V_2 - V_3) \times 800/1600$
29H	1	0	1	0	0	1	V _{41'}	$V_3 + (V_2 - V_3) \times 700/1600$
2AH	1	0	1	0	1	0	V _{42'}	$V_3 + (V_2 - V_3) \times 600/1600$
2BH	1	0	1	0	1	1	V _{43'}	$V_3 + (V_2 - V_3) \times 500/1600$
2CH	1	0	1	1	0	0	V _{44'}	$V_3 + (V_2 - V_3) \times 400/1600$
2DH	1	0	1	1	0	1	V _{45'}	$V_3 + (V_2 - V_3) \times 300/1600$
2EH	1	0	1	1	1	0	V _{46'}	$V_3 + (V_2 - V_3) \times 200/1600$
2FH	1	0	1	1	1	1	V _{47'}	$V_3 + (V_2 - V_3) \times 100/1600$
30H	1	1	0	0	0	0	V _{48'}	V ₃
31H	1	1	0	0	0	1	V _{49'}	$V_4 + (V_3 - V_4) \times 3350/3450$
32H	1	1	0	0	1	0	V _{50'}	$V_4 + (V_3 - V_4) \times 3250/3450$
33H	1	1	0	0	1	1	V _{51'}	$V_4 + (V_3 - V_4) \times 3150/3450$
34H	1	1	0	1	0	0	V _{52'}	$V_4 + (V_3 - V_4) \times 3050/3450$
35H	1	1	0	1	0	1	V _{53'}	$V_4 + (V_3 - V_4) \times 2950/3450$
36H	1	1	0	1	1	0	V _{54'}	$V_4 + (V_3 - V_4) \times 2800/3450$
37H	1	1	0	1	1	1	V _{55'}	$V_4 + (V_3 - V_4) \times 2650/3450$
38H	1	1	1	0	0	0	V _{56'}	$V_4 + (V_3 - V_4) \times 2500/3450$
39H	1	1	1	0	0	1	V _{57'}	$V_4 + (V_3 - V_4) \times 2300/3450$
3AH	1	1	1	0	1	0	V _{58'}	$V_4 + (V_3 - V_4) \times 2100/3450$
3BH	1	1	1	0	1	1	V _{59'}	$V_4 + (V_3 - V_4) \times 1850/3450$
3CH	1	1	1	1	0	0	V _{60'}	$V_4 + (V_3 - V_4) \times 1600/3450$
3DH	1	1	1	1	0	1	V _{61'}	$V_4 + (V_3 - V_4) \times 1300/3450$
3EH	1	1	1	1	1	0	V _{62'}	$V_4 + (V_3 - V_4) \times 800/3450$
3FH	1	1	1	1	1	1	V _{63'}	V ₄

Figure 6-2. Relationship Between Input Data and Output Voltage : $V_4 > V_5 > V_6 > V_7 > V_8 > V_9 > V_{SS2}$, POL2 = L



Data	D _{X5}	D _{X4}	D _{X3}	D _{X2}	D _{X1}	D _{X0}	Output Voltage	
00H	0	0	0	0	0	0	V_0''	V_9
01H	0	0	0	0	0	1	V_1''	$V_9 + (V_8 - V_9) \times 800/8050$
02H	0	0	0	0	1	0	V_2''	$V_9 + (V_8 - V_9) \times 1550/8050$
03H	0	0	0	0	1	1	V_3''	$V_9 + (V_8 - V_9) \times 2250/8050$
04H	0	0	0	1	0	0	V_4''	$V_9 + (V_8 - V_9) \times 2900/8050$
05H	0	0	0	1	0	1	V_5''	$V_9 + (V_8 - V_9) \times 3500/8050$
06H	0	0	0	1	1	0	V_6''	$V_9 + (V_8 - V_9) \times 4050/8050$
07H	0	0	0	1	1	1	V_7''	$V_9 + (V_8 - V_9) \times 4600/8050$
08H	0	0	1	0	0	0	V_8''	$V_9 + (V_8 - V_9) \times 5100/8050$
09H	0	0	1	0	0	1	V_9''	$V_9 + (V_8 - V_9) \times 5600/8050$
0AH	0	0	1	0	1	0	V_{10}''	$V_9 + (V_8 - V_9) \times 6000/8050$
0BH	0	0	1	0	1	1	V_{11}''	$V_9 + (V_8 - V_9) \times 6400/8050$
0CH	0	0	1	1	0	0	V_{12}''	$V_9 + (V_8 - V_9) \times 6750/8050$
0DH	0	0	1	1	0	1	V_{13}''	$V_9 + (V_8 - V_9) \times 7100/8050$
0EH	0	0	1	1	1	0	V_{14}''	$V_9 + (V_8 - V_9) \times 7450/8050$
0FH	0	0	1	1	1	1	V_{15}''	$V_9 + (V_8 - V_9) \times 7750/8050$
10H	0	1	0	0	0	0	V_{16}''	V_8
11H	0	1	0	0	0	1	V_{17}''	$V_8 + (V_7 - V_8) \times 300/2750$
12H	0	1	0	0	1	0	V_{18}''	$V_8 + (V_7 - V_8) \times 550/2750$
13H	0	1	0	0	1	1	V_{19}''	$V_8 + (V_7 - V_8) \times 800/2750$
14H	0	1	0	1	0	0	V_{20}''	$V_8 + (V_7 - V_8) \times 1050/2750$
15H	0	1	0	1	0	1	V_{21}''	$V_8 + (V_7 - V_8) \times 1250/2750$
16H	0	1	0	1	1	0	V_{22}''	$V_8 + (V_7 - V_8) \times 1450/2750$
17H	0	1	0	1	1	1	V_{23}''	$V_8 + (V_7 - V_8) \times 1650/2750$
18H	0	1	1	0	0	0	V_{24}''	$V_8 + (V_7 - V_8) \times 1800/2750$
19H	0	1	1	0	0	1	V_{25}''	$V_8 + (V_7 - V_8) \times 1950/2750$
1AH	0	1	1	0	1	0	V_{26}''	$V_8 + (V_7 - V_8) \times 2100/2750$
1BH	0	1	1	0	1	1	V_{27}''	$V_8 + (V_7 - V_8) \times 2250/2750$
1CH	0	1	1	1	0	0	V_{28}''	$V_8 + (V_7 - V_8) \times 2350/2750$
1DH	0	1	1	1	0	1	V_{29}''	$V_8 + (V_7 - V_8) \times 2450/2750$
1EH	0	1	1	1	1	0	V_{30}''	$V_8 + (V_7 - V_8) \times 2550/2750$
1FH	0	1	1	1	1	1	V_{31}''	$V_8 + (V_7 - V_8) \times 2650/2750$
20H	1	0	0	0	0	0	V_{32}''	V_7
21H	1	0	0	0	0	1	V_{33}''	$V_7 + (V_6 - V_7) \times 100/1600$
22H	1	0	0	0	1	0	V_{34}''	$V_7 + (V_6 - V_7) \times 200/1600$
23H	1	0	0	0	1	1	V_{35}''	$V_7 + (V_6 - V_7) \times 300/1600$
24H	1	0	0	1	0	0	V_{36}''	$V_7 + (V_6 - V_7) \times 400/1600$
25H	1	0	0	1	0	1	V_{37}''	$V_7 + (V_6 - V_7) \times 500/1600$
26H	1	0	0	1	1	0	V_{38}''	$V_7 + (V_6 - V_7) \times 600/1600$
27H	1	0	0	1	1	1	V_{39}''	$V_7 + (V_6 - V_7) \times 700/1600$
28H	1	0	1	0	0	0	V_{40}''	$V_7 + (V_6 - V_7) \times 800/1600$
29H	1	0	1	0	0	1	V_{41}''	$V_7 + (V_6 - V_7) \times 900/1600$
2AH	1	0	1	0	1	0	V_{42}''	$V_7 + (V_6 - V_7) \times 1000/1600$
2BH	1	0	1	0	1	1	V_{43}''	$V_7 + (V_6 - V_7) \times 1100/1600$
2CH	1	0	1	1	0	0	V_{44}''	$V_7 + (V_6 - V_7) \times 1200/1600$
2DH	1	0	1	1	0	1	V_{45}''	$V_7 + (V_6 - V_7) \times 1300/1600$
2EH	1	0	1	1	1	0	V_{46}''	$V_7 + (V_6 - V_7) \times 1400/1600$
2FH	1	0	1	1	1	1	V_{47}''	$V_7 + (V_6 - V_7) \times 1500/1600$
30H	1	1	0	0	0	0	V_{48}''	V_6
31H	1	1	0	0	0	1	V_{49}''	$V_6 + (V_5 - V_6) \times 100/3450$
32H	1	1	0	0	1	0	V_{50}''	$V_6 + (V_5 - V_6) \times 200/3450$
33H	1	1	0	0	1	1	V_{51}''	$V_6 + (V_5 - V_6) \times 300/3450$
34H	1	1	0	1	0	0	V_{52}''	$V_6 + (V_5 - V_6) \times 400/3450$
35H	1	1	0	1	0	1	V_{53}''	$V_6 + (V_5 - V_6) \times 500/3450$
36H	1	1	0	1	1	0	V_{54}''	$V_6 + (V_5 - V_6) \times 650/3450$
37H	1	1	0	1	1	1	V_{55}''	$V_6 + (V_5 - V_6) \times 800/3450$
38H	1	1	1	0	0	0	V_{56}''	$V_6 + (V_5 - V_6) \times 950/3450$
39H	1	1	1	0	0	1	V_{57}''	$V_6 + (V_5 - V_6) \times 1150/3450$
3AH	1	1	1	0	1	0	V_{58}''	$V_6 + (V_5 - V_6) \times 1350/3450$
3BH	1	1	1	0	1	1	V_{59}''	$V_6 + (V_5 - V_6) \times 1600/3450$
3CH	1	1	1	1	0	0	V_{60}''	$V_6 + (V_5 - V_6) \times 1850/3450$
3DH	1	1	1	1	0	1	V_{61}''	$V_6 + (V_5 - V_6) \times 2150/3450$
3EH	1	1	1	1	1	0	V_{62}''	$V_6 + (V_5 - V_6) \times 2650/3450$
3FH	1	1	1	1	1	1	V_{63}''	V_5

Table 6-1. Ladder Resistance Values (r_0 to r_{62}) : Reference Value

Resistor Name	Resistance Value (Ω)	Resistor Name	Resistance Value (Ω)
r_0	800	r_{32}	100
r_1	750	r_{33}	100
r_2	700	r_{34}	100
r_3	650	r_{35}	100
r_4	600	r_{36}	100
r_5	550	r_{37}	100
r_6	550	r_{38}	100
r_7	500	r_{39}	100
r_8	500	r_{40}	100
r_9	400	r_{41}	100
r_{10}	400	r_{42}	100
r_{11}	350	r_{43}	100
r_{12}	350	r_{44}	100
r_{13}	350	r_{45}	100
r_{14}	300	r_{46}	100
r_{15}	300	r_{47}	100
r_{16}	300	r_{48}	100
r_{17}	250	r_{49}	100
r_{18}	250	r_{50}	100
r_{19}	250	r_{51}	100
r_{20}	200	r_{52}	100
r_{21}	200	r_{53}	150
r_{22}	200	r_{54}	150
r_{23}	150	r_{55}	150
r_{24}	150	r_{56}	200
r_{25}	150	r_{57}	200
r_{26}	150	r_{58}	250
r_{27}	100	r_{59}	250
r_{28}	100	r_{60}	300
r_{29}	100	r_{61}	500
r_{30}	100	r_{62}	800
r_{31}	100	Total	15850

7. RELATIONSHIP BETWEEN INPUT DATA AND OUTPUT PIN

Data format : 6 bits x 2 RGBs (6 dots)

Input width : 36 bits (2-pixel data)

(1) R,/L = H (right shift)

Output	S ₁	S ₂	S ₃	S ₄	S ₅	...	S ₂₉₉	S ₃₀₀
Data	D ₀₀ to D ₀₅	D ₁₀ to D ₁₅	D ₂₀ to D ₂₅	D ₃₀ to D ₃₅	D ₄₀ to D ₄₅	...	D ₄₀ to D ₄₅	D ₅₀ to D ₅₅

(2) R,/L = L (left shift)

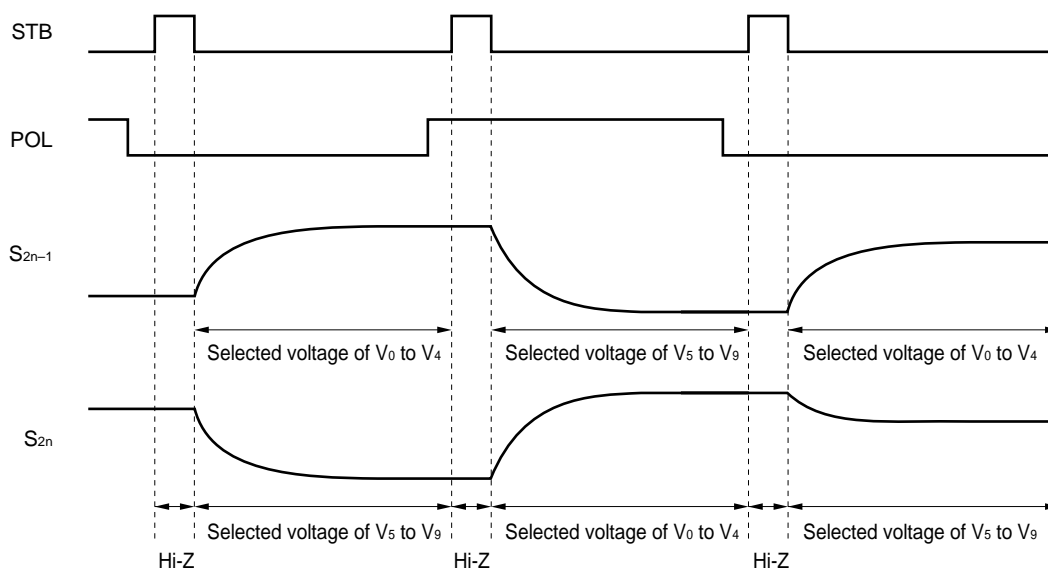
Output	S ₁	S ₂	S ₃	S ₄	S ₅	...	S ₂₉₉	S ₃₀₀
Data	D ₀₀ to D ₀₅	D ₁₀ to D ₁₅	D ₂₀ to D ₂₅	D ₃₀ to D ₃₅	D ₄₀ to D ₄₅	...	D ₄₀ to D ₄₅	D ₅₀ to D ₅₅

POL	S _{2n-1}	S _{2n}
L	V ₀ to V ₄	V ₅ to V ₉
H	V ₅ to V ₉	V ₀ to V ₄

Remark S_{2n-1} (Odd output), S_{2n} (Even output)n = 1,2,.....,150

8. RELATIONSHIP BETWEEN STB, POL, AND OUTPUT WAVEFORM

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

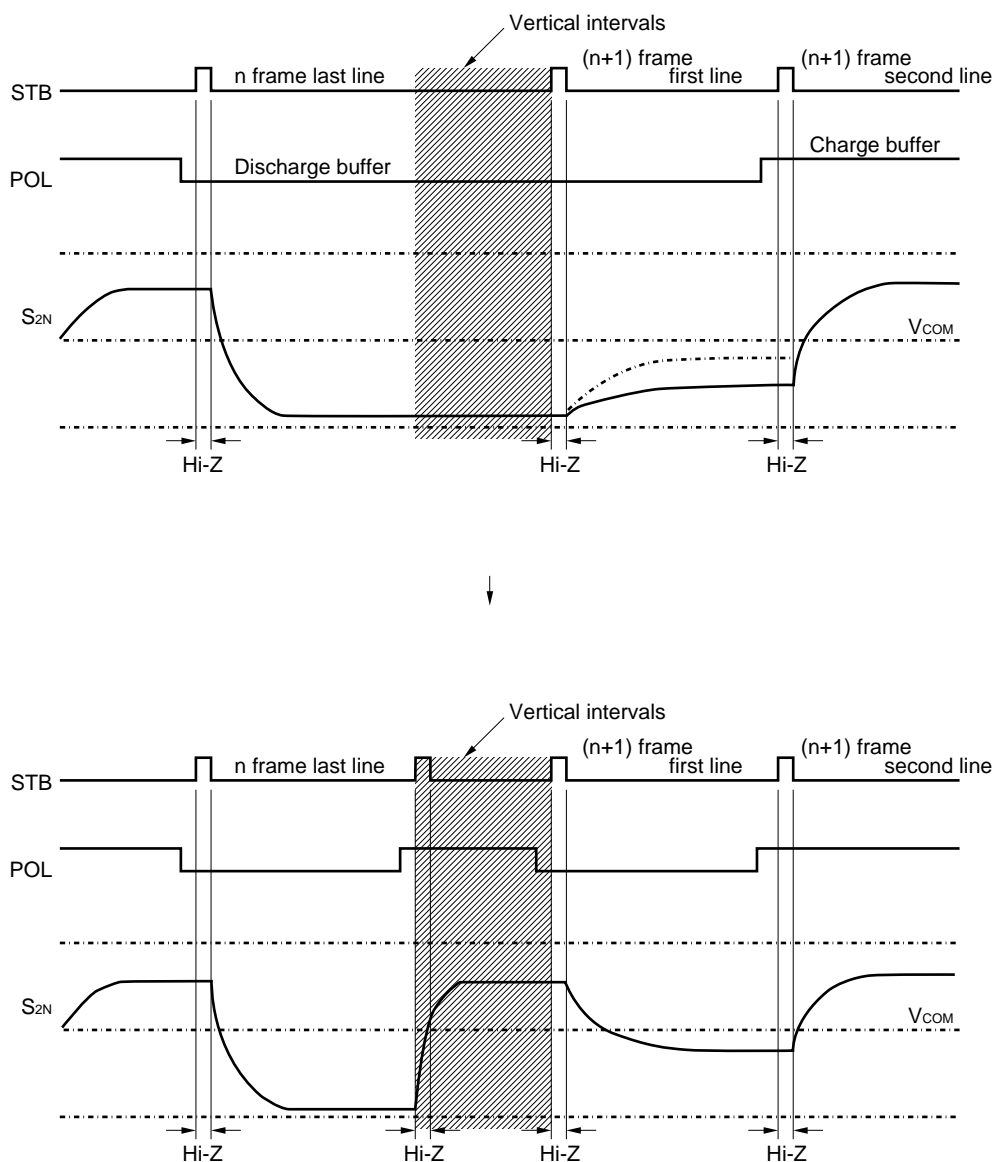


9. CAUTIONS ABOUT FRAME INVERSION

In the case of dot inversion, n frame last line and (n+1) frame first line is the same polarity. When write the same polarity twice; there are two cases as follows.

- (1) Last line output in n frame > First line output in (n+1) frame \rightarrow Positive to write
- (2) Last line output in n frame < First line output in (n+1) frame \rightarrow Not possible to write

μ PD16634A has charge buffer and discharge buffer, so need to inversion polarity and write in the case of both ways.



10. ELECTRICAL SPECIFICATIONS

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

Parameter	Symbol	Ratings	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	T_A	-10 to +75	$^{\circ}\text{C}$
Storage temperature	T_{stg}	-55 to +125	$^{\circ}\text{C}$

- ★ **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 ($T_A = -10\text{ to }+75\text{ }^{\circ}\text{C}$, $V_{SS1} = V_{SS2} = 0\text{ V}$)

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}	7.5	8.0	8.5	V
High-level input voltage	V_{IH}	$0.7V_{DD1}$		V_{DD1}	V
Low-level input voltage	V_{IL}	0		$0.3V_{DD1}$	V
γ -corrected supply voltage	$V_0\text{ to }V_9$	V_{SS2}		V_{DD2}	V
Driver part output voltage	V_O	$V_{SS2} + 0.1$		$V_{DD2} - 0.1$	V
Maximum clock frequency	$f_{MAX.}$	40			MHz

Electrical Characteristics ($T_A = -10$ to $+75$ °C, $V_{DD1} = 3.3$ V \pm 0.3 V, $V_{DD2} = 8.0$ V \pm 0.5 V, $V_{SS1} = V_{SS2} = 0$ V)

Parameter	Symbol	Condition	MIN.	TYP.	MAX.	Unit
Input leakage current	I_{IL}				± 1.0	μ A
High-level output voltage	V_{OH}	STHR(STHL), $I_O = 0$ mA	$V_{DD1} - 0.1$			V
Low-level output voltage	V_{OL}	STHR(STHL), $I_O = 0$ mA			0.1	V
γ -corrected supply current	I_γ	$V_0 - V_9 = 8$ V V_0, V_9		0.3	0.6	mA
Driver output current	I_{VOH}	$V_X = 7$ V, $V_{OUT} = 1$ V ^{Note1}			-0.5	mA
	I_{VOL}	$V_X = 1$ V, $V_{OUT} = 7$ V ^{Note1}	0.5			mA
Output voltage deviation ^{Note2}	ΔV_O	Input data : 00H to 3FH		± 5	± 20	mV
Average output voltage variation ^{Note3}	ΔV_{AV}	Input data : 00H to 3FH		± 10		mV
Output voltage range	V_O	Input data : 00H to 3FH	0.1		$V_{DD2} - 0.1$	V
Logic part dynamic current consumption ^{Notes4,5}	I_{DD1}	V_{DD1} , when with no load		0.5	3.5	mA
★ Driver part dynamic current consumption ^{Notes4,5}	I_{DD2}	V_{DD2} , when with no load		2.2	8.0	mA

Notes 1. V_X refers to the output voltage of analog output pins S1 to S300.

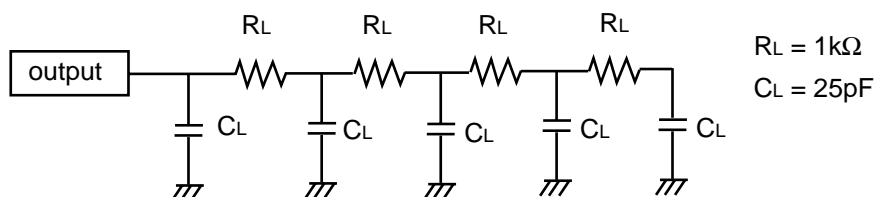
V_{OUT} refers to the voltage applied to analog output pins S1 to S300.

- The output voltage deviation refers to the voltage difference between adjoining output pins when the display data is the same (within the chip).
- The average output voltage variation refers to the average output voltage difference between chips. The average output voltage refers to the average voltage between chips when the display data is the same.
- The STB cycle is defined to be 20 μ s at $f_{CLK} = 40$ MHz. 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.
- Refers to the current consumption per driver when cascades are connected under the assumption of SVGA single-sided mounting (10 units).

Switching Characteristics ($T_A = -10$ to $+75$ °C, $V_{DD1} = 3.3$ V \pm 0.3 V, $V_{DD2} = 8.0$ V \pm 0.5 V, $V_{SS1} = V_{SS2} = 0$ V)

Parameter	Symbol	Condition	MIN.	TYP.	MAX.	Unit
Start pulse delay time	t_{PLH1}	$C_L = 25$ pF		13	20	ns
Driver output delay time	t_{PHL2}	$C_L = 125$ pF, $R_L = 4$ k Ω ^{Note}		3.7	8	μ s
	t_{PHL3}			5.3	14	μ s
	t_{PLH2}			3.0	8	μ s
	t_{PLH3}			5.3	14	μ s
Input capacitance	C_1	STHR,STHL excluded, $T_A = 25$ °C		5.4	15	pF
	C_2			7.6	15	pF

Note Load condition

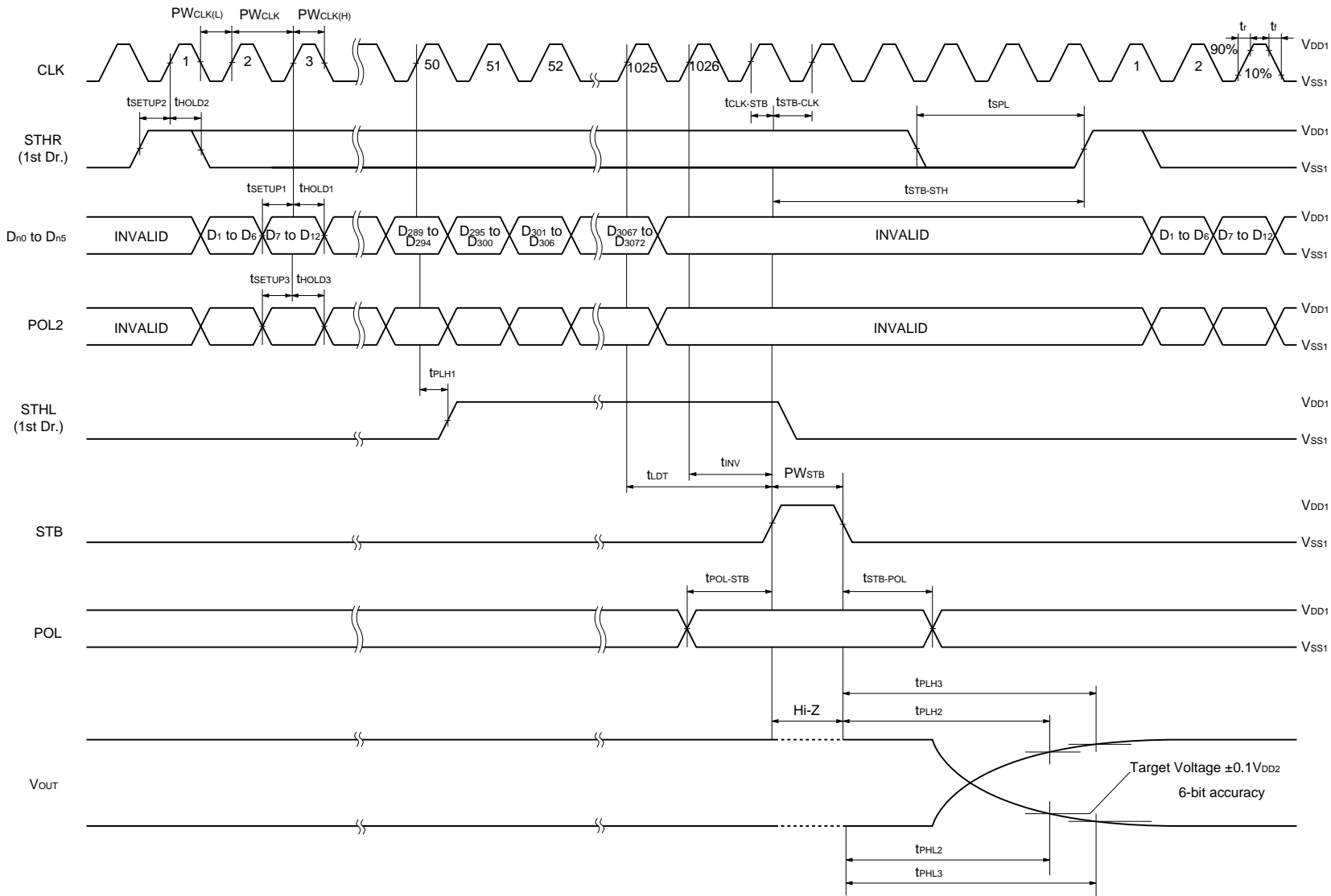


Timing Requirements ($T_A = -10$ to $+75$ °C, $V_{DD1} = 3.3\text{ V} \pm 0.3\text{ V}$, $V_{SS1} = V_{SS2} = 0\text{ V}$, $t_r = t_f = 8.0\text{ ns}$)

Parameter	Symbol	Condition	MIN.	TYP.	MAX.	Unit
Clock pulse width	PW_{CLK}		25			ns
Clock pulse low period	$PW_{CLK(L)}$		6			ns
Clock pulse high period	$PW_{CLK(H)}$		6			ns
Data setup time	t_{SETUP1}		6			ns
Data hold time	t_{HOLD1}		6			ns
Start pulse setup time	t_{SETUP2}		5			ns
Start pulse hold time	t_{HOLD2}		5			ns
Start pulse low period	t_{SPL}		6			ns
POL2 setup time	t_{SETUP3}		6			ns
POL2 hold time	t_{HOLD3}		6			ns
STB pulse width	PW_{STB}		1			μs
Data invalid period	t_{INV}		1			CLK
Final data timing	t_{LDT}		2			CLK
★ CLK-STB time	$t_{CLK-STB}$	CLK↑→STB↑	6			ns
★ STB-CLK time	$t_{STB-CLK}$	STB↑→CLK↑	6			ns
Time between STB and start pulse	$t_{STB-STH}$	STB↓→CLK↑	60			ns
POL-STB time	$t_{POL-STB}$	POL↑or↓→STB↑	-5			ns
STB-POL time	$t_{STB-POL}$	STB↓→POL↑or↓	6			ns

★ 11. SWITCHING CHARACTERISTIC WAVEFORM(R,/L= H)

Unless otherwise specified, the input level is defined to be 0.5 V_{DD1}.



12. RECOMMENDED MOUNTING CONDITIONS

The following conditions must be met for mounting conditions of the μPD16634A.

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

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

μPD16634AN-xxx : TCP(TAB Package)

Mounting Condition	Mounting Method	Condition
Thermocompression	Soldering	Heating tool 300 to 350 °C, heating for 2 to 3 sec ; pressure 100g(per solder)
	ACF (Adhesive Conductive Film)	Temporary bonding 70 to 100 °C ; pressure 3 to 8 kg/cm ² ; time 3 to 5 sec. Real bonding 165 to 180 °C pressure 25 to 45 kg/cm ² time 30 to 40secs(When using the anisotropy conductive film SUMIZAC1003 of Sumitomo Bakelite,Ltd).

Caution To find out the 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.

[MEMO]

[MEMO]

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)**

- **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.