

To our customers,

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

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## 384-OUTPUT TFT-LCD SOURCE DRIVER (COMPATIBLE WITH 256-GRAY SCALES)

### DESCRIPTION

The  $\mu$  PD16753 is a source driver for TFT-LCDs capable of dealing with displays with 256-gray scales. Data input is based on digital input configured as 8 bits by 6 dots (2 pixels), which can realize a full-color display of 16,777,216 colors by output of 256 values  $\gamma$ -corrected by an internal D/A converter and 8-by-2 external power modules.

Because the output dynamic range is as large as  $V_{DD2} - 0.2$  V to  $V_{SS2} + 0.2$  V, level inversion operation of the LCD's common electrode is rendered unnecessary. Also, to be able 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 built-in 8-bit D/A converter circuit whose odd output pins and even output pins respectively output gray scale voltages of differing polarity. Assuring a clock frequency of 40 MHz when driving at 3.0 V, this driver is applicable to XGA-standard TFT-LCD panels and SXGA TFT-LCD panels.

### FEATURES

- CMOS level input
- 384 Outputs
- Input of 8 bits (gradation data) by 6 dots
- Capable of outputting 256 values by means of 8-by-2 external power modules (16 units) and a D/A converter
- Logic power supply voltage ( $V_{DD1}$ ):  $3.3 \pm 0.3$  V
- Driver power supply voltage ( $V_{DD2}$ ):  $9.0$  V  $\pm 0.5$  V
- High-speed data transfer:  $f_{CLK} = 40$  MHz (internal data transfer speed when operating at  $V_{DD1} = 3.0$  V)
- Output dynamic range  $V_{DD2} - 0.2$  V to  $V_{SS2} + 0.2$  V
- Apply for dot-line inversion, n-line inversion and column line inversion
- Output Voltage polarity inversion function (POL)
- Display data inversion function (POL21, POL22)
- Low power control function (LPC)

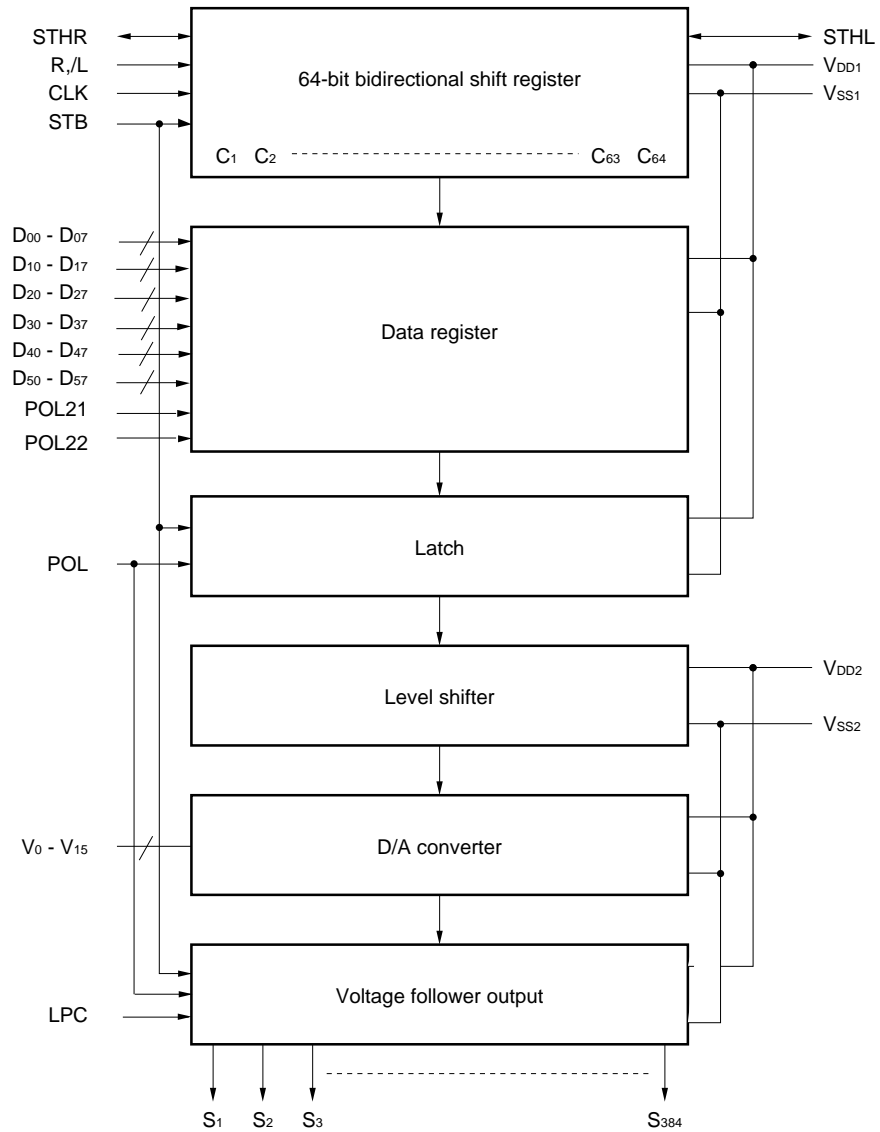
### ORDERING INFORMATION

Part Number	Package
$\mu$ PD16753N - xxx	TCP (TAB package)

**Remark** The TCP's external shape is customized. To order the required shape, please contact one of our sales representatives.

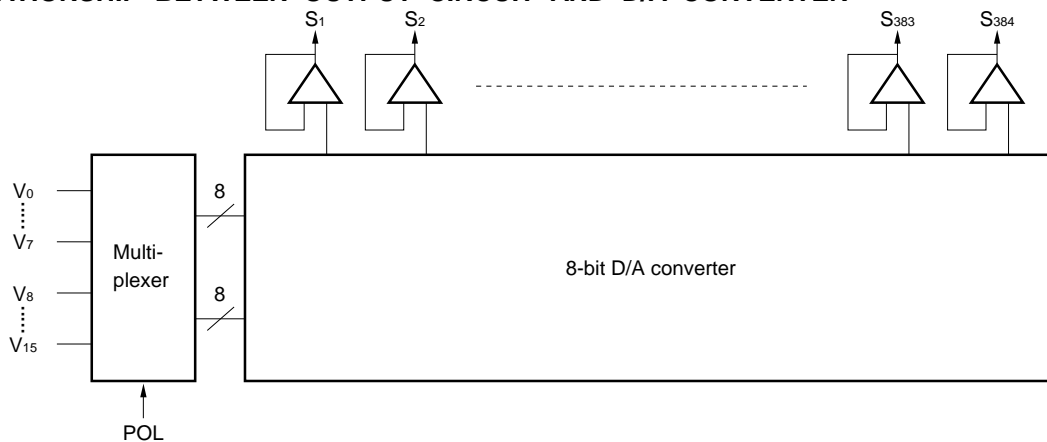
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1. BLOCK DIAGRAM



Remark /xxx indicates active low signal.

2. RELATIONSHIP BETWEEN OUTPUT CIRCUIT AND D/A CONVERTER





4. PIN FUNCTIONS

(1/2)

Pin Symbol	Pin Name	I/O	Description
S <sub>1</sub> to S <sub>384</sub>	Driver output	O	The D/A converted 256-gray-scale analog voltage is output.
D <sub>00</sub> to D <sub>07</sub>	Display data input	I	The display data is input with a width of 48 bits, viz., the gray scale data (8 bits) by 6 dots (2 pixels). D <sub>x0</sub> : LSB, D <sub>x7</sub> : MSB
D <sub>10</sub> to D <sub>17</sub>			
D <sub>20</sub> to D <sub>27</sub>			
D <sub>30</sub> to D <sub>37</sub>			
D <sub>40</sub> to D <sub>47</sub>			
D <sub>50</sub> to D <sub>57</sub>			
R <sub>,/L</sub>	Shift direction control input	I	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>,/L</sub> = H: STHR input, S <sub>1</sub> → S <sub>384</sub> , STHL output R <sub>,/L</sub> = L: STHL input, S <sub>384</sub> → S <sub>1</sub> , STHR output
STHR	Right shift start pulse input/output	I/O	These refer to the start pulse I/O pins when driver ICs are connected in cascade. Fetching of display data starts when H is read at the rising edge of CLK.
STHL	Left shift start pulse input/output	I/O	R <sub>,/L</sub> = H (right shift): STHR input, STHL output R <sub>,/L</sub> = L (left shift): STHL input, STHR output A high level should be input as the pulse of one cycle of the clock signal. If the start pulse input is more then 2CLK, the first 1CLK of the high-level input is valid
CLK	Shift clock input	I	Refers to the shift register's shift clock input. At the rising edge of the 64th after the start pulse input, the start pulse output reaches the high level, thus becoming the start pulse of the next-level driver. If 66th 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	I	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	I	POL = L: The S <sub>2n-1</sub> output uses V <sub>0</sub> to V <sub>7</sub> as the reference supply. The S <sub>2n</sub> output uses V <sub>8</sub> to V <sub>15</sub> as the reference supply. POL = H: The S <sub>2n-1</sub> output uses V <sub>8</sub> to V <sub>15</sub> as the reference supply. The S <sub>2n</sub> output uses V <sub>0</sub> to V <sub>7</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.
POL21 POL22	Data inversion input	I	Data inversion can invert when display data is loaded. POL21: Invert/not invert of display data D <sub>00</sub> to D <sub>07</sub> , D <sub>10</sub> to D <sub>17</sub> , D <sub>20</sub> to D <sub>27</sub> . POL22: Invert/not invert of display data D <sub>30</sub> to D <sub>37</sub> , D <sub>40</sub> to D <sub>47</sub> , D <sub>50</sub> to D <sub>57</sub> . POL21/22 = H: Data inversion loads display data after inverting it. POL21/22 = L: Data inversion does not invert input data.
LPC	Low power control input	I	The current consumption of V <sub>DD2</sub> is lowered by controlling the constant current source of the output amplifier. This pin is pulled up to the V <sub>DD1</sub> power supply inside the IC. LPC = L: Normal power mode LPC = H or Open: Low power mode (the static current consumption of V <sub>DD2</sub> reduced to about 2/3 of the normal current consumption.)

(2/2)

Pin Symbol	Pin Name	I/O	Description
V <sub>0</sub> to V <sub>15</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. $V_{DD2} - 0.2 V \geq V_0 > V_1 > V_2 > V_3 > V_4 > V_5 > V_6 > V_7 \geq 0.5 V_{DD2}$ $0.5 V_{DD2} - 0.3 \geq V_8 > V_9 > V_{10} > V_{11} > V_{12} > V_{13} > V_{14} > V_{15} \geq V_{SS2} + 0.2 V$
V <sub>DD1</sub>	Logic power supply	–	3.3 V ± 0.3 V
V <sub>DD2</sub>	Driver power supply	–	9.0 V ± 0.5 V
V <sub>SS1</sub>	Logic ground	–	Grounding
V <sub>SS2</sub>	Driver ground	–	Grounding

**Cautions** 1.The power start sequence must be V<sub>DD1</sub>, logic input, and V<sub>DD2</sub> & V<sub>0</sub> to V<sub>15</sub> in that order.

Reverse this sequence to shut down (Simultaneous power application to V<sub>DD2</sub> and V<sub>0</sub> to V<sub>15</sub> is possible.).

2.To stabilize the supply voltage, please be sure to insert a 0.1 μF bypass capacitor between V<sub>DD1</sub>-V<sub>SS1</sub> and V<sub>DD2</sub>-V<sub>SS2</sub>. Furthermore, for increased precision of the D/A converter, insertion of a bypass capacitor of about 0.01 μF is also advised between the γ-corrected power supply terminals (V<sub>0</sub>, V<sub>1</sub>, V<sub>2</sub>, ..., V<sub>15</sub>) and V<sub>SS2</sub>.

5. RELATIONSHIP BETWEEN INPUT DATA AND OUTPUT VOLTAGE VALUE

This product incorporates a 8-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.

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  $\gamma$ -corrected voltages  $V_0$  to  $V_{15}$  and the input data.

Be sure to maintain the voltage relationships as follows:

$$V_{DD2} - 0.2 V \geq V_0 > V_1 > V_2 > V_3 > V_4 > V_5 > V_6 > V_7 \geq 0.5 V_{DD2}$$

$$0.5 V_{DD2} - 0.3 \geq V_8 > V_9 > V_{10} > V_{11} > V_{12} > V_{13} > V_{14} > V_{15} \geq V_{SS2} + 0.2 V.$$

Figures 5-3 and 5-4 show the relationship between the input data and the output voltage. This driver IC is designed for only single-sided mounting.

Figure 5-1. Relationship between Input Data and  $\gamma$ -corrected Power Supplies

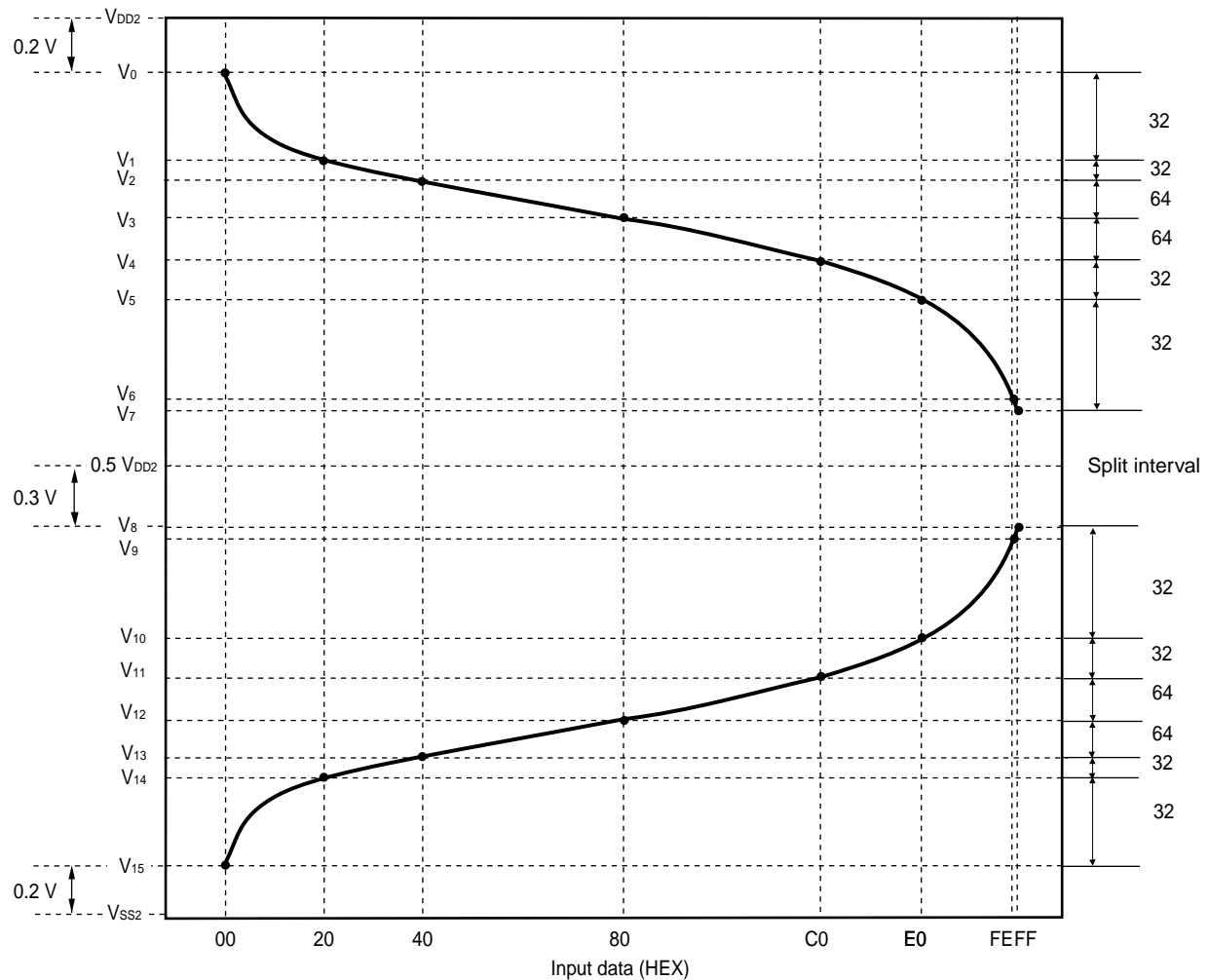
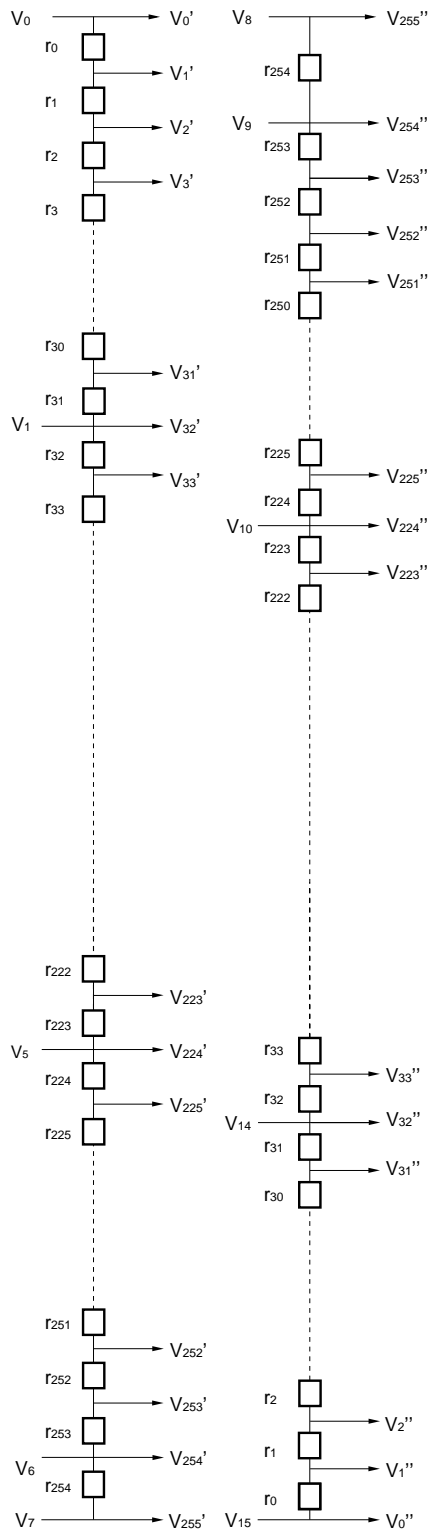




Figure 5-2.  $\gamma$ -corrected Voltages and Ladder Resistors Ratio



rn	Ratio	rn	Ratio	rn	Ratio	rn	Ratio
r0	16.0	r64	1.0	r128	1.0	r192	1.7
r1	14.5	r65	1.0	r129	1.0	r193	1.7
r2	13.0	r66	1.0	r130	1.0	r194	1.7
r3	11.5	r67	1.0	r131	1.0	r195	1.7
r4	10.0	r68	1.0	r132	1.0	r196	1.7
r5	8.9	r69	1.0	r133	1.0	r197	1.7
r6	7.8	r70	1.0	r134	1.0	r198	1.7
r7	6.8	r71	1.0	r135	1.0	r199	1.7
r8	5.8	r72	1.0	r136	1.0	r200	1.9
r9	4.8	r73	1.0	r137	1.0	r201	1.9
r10	4.8	r74	1.0	r138	1.0	r202	1.9
r11	4.8	r75	1.0	r139	1.0	r203	1.9
r12	3.8	r76	1.0	r140	1.0	r204	1.9
r13	3.8	r77	1.0	r141	1.0	r205	1.9
r14	3.8	r78	1.0	r142	1.0	r206	1.9
r15	3.0	r79	1.0	r143	1.0	r207	1.9
r16	3.0	r80	1.0	r144	1.0	r208	2.1
r17	3.0	r81	1.0	r145	1.0	r209	2.1
r18	2.5	r82	1.0	r146	1.0	r210	2.1
r19	2.5	r83	1.0	r147	1.0	r211	2.1
r20	2.5	r84	1.0	r148	1.0	r212	2.1
r21	2.0	r85	1.0	r149	1.0	r213	2.1
r22	2.0	r86	1.0	r150	1.0	r214	2.1
r23	2.0	r87	1.0	r151	1.0	r215	2.1
r24	1.5	r88	1.0	r152	1.1	r216	2.3
r25	1.5	r89	1.0	r153	1.1	r217	2.3
r26	1.5	r90	1.0	r154	1.1	r218	2.3
r27	1.5	r91	1.0	r155	1.1	r219	2.3
r28	1.5	r92	1.0	r156	1.1	r220	2.3
r29	1.5	r93	1.0	r157	1.1	r221	2.3
r30	1.5	r94	1.0	r158	1.1	r222	2.3
r31	1.5	r95	1.0	r159	1.1	r223	2.3
r32	1.4	r96	1.0	r160	1.2	r224	2.3
r33	1.4	r97	1.0	r161	1.2	r225	2.8
r34	1.4	r98	1.0	r162	1.2	r226	2.8
r35	1.4	r99	1.0	r163	1.2	r227	2.8
r36	1.4	r100	1.0	r164	1.2	r228	3.3
r37	1.4	r101	1.0	r165	1.2	r229	3.3
r38	1.4	r102	1.0	r166	1.2	r230	3.3
r39	1.4	r103	1.0	r167	1.2	r231	3.8
r40	1.3	r104	1.0	r168	1.3	r232	3.8
r41	1.3	r105	1.0	r169	1.3	r233	3.8
r42	1.3	r106	1.0	r170	1.3	r234	4.5
r43	1.3	r107	1.0	r171	1.3	r235	4.5
r44	1.3	r108	1.0	r172	1.3	r236	4.5
r45	1.3	r109	1.0	r173	1.3	r237	5.2
r46	1.3	r110	1.0	r174	1.3	r238	5.2
r47	1.3	r111	1.0	r175	1.3	r239	5.9
r48	1.2	r112	1.0	r176	1.4	r240	5.9
r49	1.2	r113	1.0	r177	1.4	r241	6.6
r50	1.2	r114	1.0	r178	1.4	r242	6.6
r51	1.2	r115	1.0	r179	1.4	r243	7.3
r52	1.2	r116	1.0	r180	1.4	r244	7.3
r53	1.2	r117	1.0	r181	1.4	r245	8.0
r54	1.2	r118	1.0	r182	1.4	r246	8.0
r55	1.2	r119	1.0	r183	1.4	r247	9.0
r56	1.1	r120	1.0	r184	1.5	r248	9.0
r57	1.1	r121	1.0	r185	1.5	r249	10.0
r58	1.1	r122	1.0	r186	1.5	r250	10.0
r59	1.1	r123	1.0	r187	1.5	r251	12.0
r60	1.1	r124	1.0	r188	1.5	r252	12.0
r61	1.1	r125	1.0	r189	1.5	r253	14.0
r62	1.1	r126	1.0	r190	1.5	r254	14.0
r63	1.1	r127	1.0	r191	1.5		

Caution There is no connection between V7 and V8 in the chip.

Figure 5-3. Relationship between Input Data and Output Voltage (POL21/22 = L)  
 (Output Voltage 1)  $V_{DD2} - 0.2\text{ V} \geq V_0 > V_1 > V_2 > V_3 > V_4 > V_5 > V_6 > V_7 \geq 0.5\text{ V}_{DD2}$

Data	Output Voltage		Data	Output Voltage		Data	Output Voltage		Data	Output Voltage		
00H	V0	V0	40H	V64	V2	80H	V128	V3	C0H	V192	V4	
01H	V1	V1+(V0-V1) X	41H	V65	V3+(V2-V3) X	81H	V129	V4+(V3-V4) X	C1H	V193	V5+(V4-V5) X	
02H	V2	V1+(V0-V1) X	42H	V66	V3+(V2-V3) X	82H	V130	V4+(V3-V4) X	C2H	V194	V5+(V4-V5) X	
03H	V3	V1+(V0-V1) X	43H	V67	V3+(V2-V3) X	83H	V131	V4+(V3-V4) X	C3H	V195	V5+(V4-V5) X	
04H	V4	V1+(V0-V1) X	44H	V68	V3+(V2-V3) X	84H	V132	V4+(V3-V4) X	C4H	V196	V5+(V4-V5) X	
05H	V5	V1+(V0-V1) X	45H	V69	V3+(V2-V3) X	85H	V133	V4+(V3-V4) X	C5H	V197	V5+(V4-V5) X	
06H	V6	V1+(V0-V1) X	46H	V70	V3+(V2-V3) X	86H	V134	V4+(V3-V4) X	C6H	V198	V5+(V4-V5) X	
07H	V7	V1+(V0-V1) X	47H	V71	V3+(V2-V3) X	87H	V135	V4+(V3-V4) X	C7H	V199	V5+(V4-V5) X	
08H	V8	V1+(V0-V1) X	48H	V72	V3+(V2-V3) X	88H	V136	V4+(V3-V4) X	C8H	V200	V5+(V4-V5) X	
09H	V9	V1+(V0-V1) X	49H	V73	V3+(V2-V3) X	89H	V137	V4+(V3-V4) X	C9H	V201	V5+(V4-V5) X	
0AH	V10	V1+(V0-V1) X	4AH	V74	V3+(V2-V3) X	8AH	V138	V4+(V3-V4) X	CAH	V202	V5+(V4-V5) X	
0BH	V11	V1+(V0-V1) X	4BH	V75	V3+(V2-V3) X	8BH	V139	V4+(V3-V4) X	CBH	V203	V5+(V4-V5) X	
0CH	V12	V1+(V0-V1) X	4CH	V76	V3+(V2-V3) X	8CH	V140	V4+(V3-V4) X	COH	V204	V5+(V4-V5) X	
0DH	V13	V1+(V0-V1) X	4DH	V77	V3+(V2-V3) X	8DH	V141	V4+(V3-V4) X	CDH	V205	V5+(V4-V5) X	
0EH	V14	V1+(V0-V1) X	4EH	V78	V3+(V2-V3) X	8EH	V142	V4+(V3-V4) X	CEH	V206	V5+(V4-V5) X	
0FH	V15	V1+(V0-V1) X	4FH	V79	V3+(V2-V3) X	8FH	V143	V4+(V3-V4) X	CFH	V207	V5+(V4-V5) X	
10H	V16	V1+(V0-V1) X	50H	V80	V3+(V2-V3) X	48 / 64	90H	V144	V4+(V3-V4) X	DOH	V208	V5+(V4-V5) X
11H	V17	V1+(V0-V1) X	51H	V81	V3+(V2-V3) X	47 / 64	91H	V145	V4+(V3-V4) X	D1H	V209	V5+(V4-V5) X
12H	V18	V1+(V0-V1) X	52H	V82	V3+(V2-V3) X	46 / 64	92H	V146	V4+(V3-V4) X	D2H	V210	V5+(V4-V5) X
13H	V19	V1+(V0-V1) X	53H	V83	V3+(V2-V3) X	45 / 64	93H	V147	V4+(V3-V4) X	D3H	V211	V5+(V4-V5) X
14H	V20	V1+(V0-V1) X	54H	V84	V3+(V2-V3) X	44 / 64	94H	V148	V4+(V3-V4) X	D4H	V212	V5+(V4-V5) X
15H	V21	V1+(V0-V1) X	55H	V85	V3+(V2-V3) X	43 / 64	95H	V149	V4+(V3-V4) X	D5H	V213	V5+(V4-V5) X
16H	V22	V1+(V0-V1) X	56H	V86	V3+(V2-V3) X	42 / 64	96H	V150	V4+(V3-V4) X	D6H	V214	V5+(V4-V5) X
17H	V23	V1+(V0-V1) X	57H	V87	V3+(V2-V3) X	41 / 64	97H	V151	V4+(V3-V4) X	D7H	V215	V5+(V4-V5) X
18H	V24	V1+(V0-V1) X	58H	V88	V3+(V2-V3) X	40 / 64	98H	V152	V4+(V3-V4) X	D8H	V216	V5+(V4-V5) X
19H	V25	V1+(V0-V1) X	59H	V89	V3+(V2-V3) X	39 / 64	99H	V153	V4+(V3-V4) X	D9H	V217	V5+(V4-V5) X
1AH	V26	V1+(V0-V1) X	5AH	V90	V3+(V2-V3) X	38 / 64	9AH	V154	V4+(V3-V4) X	DAH	V218	V5+(V4-V5) X
1BH	V27	V1+(V0-V1) X	5BH	V91	V3+(V2-V3) X	37 / 64	9BH	V155	V4+(V3-V4) X	DBH	V219	V5+(V4-V5) X
1CH	V28	V1+(V0-V1) X	5CH	V92	V3+(V2-V3) X	36 / 64	9CH	V156	V4+(V3-V4) X	DCH	V220	V5+(V4-V5) X
1DH	V29	V1+(V0-V1) X	5DH	V93	V3+(V2-V3) X	35 / 64	9DH	V157	V4+(V3-V4) X	DDH	V221	V5+(V4-V5) X
1EH	V30	V1+(V0-V1) X	5EH	V94	V3+(V2-V3) X	34 / 64	9EH	V158	V4+(V3-V4) X	DEH	V222	V5+(V4-V5) X
1FH	V31	V1+(V0-V1) X	5FH	V95	V3+(V2-V3) X	33 / 64	9FH	V159	V4+(V3-V4) X	DFH	V223	V5+(V4-V5) X
20H	V32	V1	60H	V96	V3+(V2-V3) X	32 / 64	A0H	V160	V4+(V3-V4) X	E0H	V224	V5
21H	V33	V2+(V1-V2) X	61H	V97	V3+(V2-V3) X	31 / 64	A1H	V161	V4+(V3-V4) X	E1H	V225	V6+(V5-V6) X
22H	V34	V2+(V1-V2) X	62H	V98	V3+(V2-V3) X	30 / 64	A2H	V162	V4+(V3-V4) X	E2H	V226	V6+(V5-V6) X
23H	V35	V2+(V1-V2) X	63H	V99	V3+(V2-V3) X	29 / 64	A3H	V163	V4+(V3-V4) X	E3H	V227	V6+(V5-V6) X
24H	V36	V2+(V1-V2) X	64H	V100	V3+(V2-V3) X	28 / 64	A4H	V164	V4+(V3-V4) X	E4H	V228	V6+(V5-V6) X
25H	V37	V2+(V1-V2) X	65H	V101	V3+(V2-V3) X	27 / 64	A5H	V165	V4+(V3-V4) X	E5H	V229	V6+(V5-V6) X
26H	V38	V2+(V1-V2) X	66H	V102	V3+(V2-V3) X	26 / 64	A6H	V166	V4+(V3-V4) X	E6H	V230	V6+(V5-V6) X
27H	V39	V2+(V1-V2) X	67H	V103	V3+(V2-V3) X	25 / 64	A7H	V167	V4+(V3-V4) X	E7H	V231	V6+(V5-V6) X
28H	V40	V2+(V1-V2) X	68H	V104	V3+(V2-V3) X	24 / 64	A8H	V168	V4+(V3-V4) X	E8H	V232	V6+(V5-V6) X
29H	V41	V2+(V1-V2) X	69H	V105	V3+(V2-V3) X	23 / 64	A9H	V169	V4+(V3-V4) X	E9H	V233	V6+(V5-V6) X
2AH	V42	V2+(V1-V2) X	6AH	V106	V3+(V2-V3) X	22 / 64	AAH	V170	V4+(V3-V4) X	EAH	V234	V6+(V5-V6) X
2BH	V43	V2+(V1-V2) X	6BH	V107	V3+(V2-V3) X	21 / 64	ABH	V171	V4+(V3-V4) X	EBH	V235	V6+(V5-V6) X
2CH	V44	V2+(V1-V2) X	6CH	V108	V3+(V2-V3) X	20 / 64	ACH	V172	V4+(V3-V4) X	ECH	V236	V6+(V5-V6) X
2DH	V45	V2+(V1-V2) X	6DH	V109	V3+(V2-V3) X	19 / 64	ADH	V173	V4+(V3-V4) X	EDH	V237	V6+(V5-V6) X
2EH	V46	V2+(V1-V2) X	6EH	V110	V3+(V2-V3) X	18 / 64	AEH	V174	V4+(V3-V4) X	EEH	V238	V6+(V5-V6) X
2FH	V47	V2+(V1-V2) X	6FH	V111	V3+(V2-V3) X	17 / 64	AFH	V175	V4+(V3-V4) X	EFH	V239	V6+(V5-V6) X
30H	V48	V2+(V1-V2) X	70H	V112	V3+(V2-V3) X	16 / 64	BOH	V176	V4+(V3-V4) X	FOH	V240	V6+(V5-V6) X
31H	V49	V2+(V1-V2) X	71H	V113	V3+(V2-V3) X	15 / 64	B1H	V177	V4+(V3-V4) X	F1H	V241	V6+(V5-V6) X
32H	V50	V2+(V1-V2) X	72H	V114	V3+(V2-V3) X	14 / 64	B2H	V178	V4+(V3-V4) X	F2H	V242	V6+(V5-V6) X
33H	V51	V2+(V1-V2) X	73H	V115	V3+(V2-V3) X	13 / 64	B3H	V179	V4+(V3-V4) X	F3H	V243	V6+(V5-V6) X
34H	V52	V2+(V1-V2) X	74H	V116	V3+(V2-V3) X	12 / 64	B4H	V180	V4+(V3-V4) X	F4H	V244	V6+(V5-V6) X
35H	V53	V2+(V1-V2) X	75H	V117	V3+(V2-V3) X	11 / 64	B5H	V181	V4+(V3-V4) X	F5H	V245	V6+(V5-V6) X
36H	V54	V2+(V1-V2) X	76H	V118	V3+(V2-V3) X	10 / 64	B6H	V182	V4+(V3-V4) X	F6H	V246	V6+(V5-V6) X
37H	V55	V2+(V1-V2) X	77H	V119	V3+(V2-V3) X	9 / 64	B7H	V183	V4+(V3-V4) X	F7H	V247	V6+(V5-V6) X
38H	V56	V2+(V1-V2) X	78H	V120	V3+(V2-V3) X	8 / 64	B8H	V184	V4+(V3-V4) X	F8H	V248	V6+(V5-V6) X
39H	V57	V2+(V1-V2) X	79H	V121	V3+(V2-V3) X	7 / 64	B9H	V185	V4+(V3-V4) X	F9H	V249	V6+(V5-V6) X
3AH	V58	V2+(V1-V2) X	7AH	V122	V3+(V2-V3) X	6 / 64	BAH	V186	V4+(V3-V4) X	FAH	V250	V6+(V5-V6) X
3BH	V59	V2+(V1-V2) X	7BH	V123	V3+(V2-V3) X	5 / 64	BBH	V187	V4+(V3-V4) X	FBH	V251	V6+(V5-V6) X
3CH	V60	V2+(V1-V2) X	7CH	V124	V3+(V2-V3) X	4 / 64	BOH	V188	V4+(V3-V4) X	FOH	V252	V6+(V5-V6) X
3DH	V61	V2+(V1-V2) X	7DH	V125	V3+(V2-V3) X	3 / 64	BCH	V189	V4+(V3-V4) X	FDH	V253	V6+(V5-V6) X
3EH	V62	V2+(V1-V2) X	7EH	V126	V3+(V2-V3) X	2 / 64	BEH	V190	V4+(V3-V4) X	FEH	V254	V6
3FH	V63	V2+(V1-V2) X	7FH	V127	V3+(V2-V3) X	1 / 64	BFH	V191	V4+(V3-V4) X	FFH	V255	V7

Figure 5-4. Relationship between Input Data and Output Voltage (POL21/22 = L)  
 (Output Voltage 2)  $0.5 V_{DD2} - 0.3 V \geq V_8 > V_9 > V_{10} > V_{11} > V_{12} > V_{13} > V_{14} > V_{15} \geq V_{DD2} + 0.2 V$

Data	Output Voltage	Data	Output Voltage	Data	Output Voltage	Data	Output Voltage
00H	V0 <sup>†</sup> V15	40H	V64 <sup>†</sup> V13	80H	V128 <sup>†</sup> V12	C0H	V192 <sup>†</sup> V11
01H	V1 <sup>†</sup> V15+(V14-V15) X 16 / 154.6	41H	V65 <sup>†</sup> V13+(V12-V13) X 1 / 64	81H	V129 <sup>†</sup> V12+(V11-V12) X 1 / 76	C1H	V193 <sup>†</sup> V11+(V10-V11) X 1.7 / 64
02H	V2 <sup>†</sup> V15+(V14-V15) X 30.5 / 154.6	42H	V66 <sup>†</sup> V13+(V12-V13) X 2 / 64	82H	V130 <sup>†</sup> V12+(V11-V12) X 2 / 76	C2H	V194 <sup>†</sup> V11+(V10-V11) X 3.4 / 64
03H	V3 <sup>†</sup> V15+(V14-V15) X 43.5 / 154.6	43H	V67 <sup>†</sup> V13+(V12-V13) X 3 / 64	83H	V131 <sup>†</sup> V12+(V11-V12) X 3 / 76	C3H	V195 <sup>†</sup> V11+(V10-V11) X 5.1 / 64
04H	V4 <sup>†</sup> V15+(V14-V15) X 55 / 154.6	44H	V68 <sup>†</sup> V13+(V12-V13) X 4 / 64	84H	V132 <sup>†</sup> V12+(V11-V12) X 4 / 76	C4H	V196 <sup>†</sup> V11+(V10-V11) X 6.8 / 64
05H	V5 <sup>†</sup> V15+(V14-V15) X 65 / 154.6	45H	V69 <sup>†</sup> V13+(V12-V13) X 5 / 64	85H	V133 <sup>†</sup> V12+(V11-V12) X 5 / 76	C5H	V197 <sup>†</sup> V11+(V10-V11) X 8.5 / 64
06H	V6 <sup>†</sup> V15+(V14-V15) X 73.9 / 154.6	46H	V70 <sup>†</sup> V13+(V12-V13) X 6 / 64	86H	V134 <sup>†</sup> V12+(V11-V12) X 6 / 76	C6H	V198 <sup>†</sup> V11+(V10-V11) X 10.2 / 64
07H	V7 <sup>†</sup> V15+(V14-V15) X 81.7 / 154.6	47H	V71 <sup>†</sup> V13+(V12-V13) X 7 / 64	87H	V135 <sup>†</sup> V12+(V11-V12) X 7 / 76	C7H	V199 <sup>†</sup> V11+(V10-V11) X 11.9 / 64
08H	V8 <sup>†</sup> V15+(V14-V15) X 88.5 / 154.6	48H	V72 <sup>†</sup> V13+(V12-V13) X 8 / 64	88H	V136 <sup>†</sup> V12+(V11-V12) X 8 / 76	C8H	V200 <sup>†</sup> V11+(V10-V11) X 13.6 / 64
09H	V9 <sup>†</sup> V15+(V14-V15) X 94.3 / 154.6	49H	V73 <sup>†</sup> V13+(V12-V13) X 9 / 64	89H	V137 <sup>†</sup> V12+(V11-V12) X 9 / 76	C9H	V201 <sup>†</sup> V11+(V10-V11) X 15.5 / 64
0AH	V10 <sup>†</sup> V15+(V14-V15) X 99.1 / 154.6	4AH	V74 <sup>†</sup> V13+(V12-V13) X 10 / 64	8AH	V138 <sup>†</sup> V12+(V11-V12) X 10 / 76	CAH	V202 <sup>†</sup> V11+(V10-V11) X 17.4 / 64
0BH	V11 <sup>†</sup> V15+(V14-V15) X 103.9 / 154.6	4BH	V75 <sup>†</sup> V13+(V12-V13) X 11 / 64	8BH	V139 <sup>†</sup> V12+(V11-V12) X 11 / 76	CBH	V203 <sup>†</sup> V11+(V10-V11) X 19.3 / 64
0CH	V12 <sup>†</sup> V15+(V14-V15) X 108.7 / 154.6	4CH	V76 <sup>†</sup> V13+(V12-V13) X 12 / 64	8CH	V140 <sup>†</sup> V12+(V11-V12) X 12 / 76	COH	V204 <sup>†</sup> V11+(V10-V11) X 21.2 / 64
0DH	V13 <sup>†</sup> V15+(V14-V15) X 112.5 / 154.6	4DH	V77 <sup>†</sup> V13+(V12-V13) X 13 / 64	8DH	V141 <sup>†</sup> V12+(V11-V12) X 13 / 76	COH	V205 <sup>†</sup> V11+(V10-V11) X 23.1 / 64
0EH	V14 <sup>†</sup> V15+(V14-V15) X 116.3 / 154.6	4EH	V78 <sup>†</sup> V13+(V12-V13) X 14 / 64	8EH	V142 <sup>†</sup> V12+(V11-V12) X 14 / 76	CEH	V206 <sup>†</sup> V11+(V10-V11) X 25 / 64
0FH	V15 <sup>†</sup> V15+(V14-V15) X 120.1 / 154.6	4FH	V79 <sup>†</sup> V13+(V12-V13) X 15 / 64	8FH	V143 <sup>†</sup> V12+(V11-V12) X 15 / 76	CFH	V207 <sup>†</sup> V11+(V10-V11) X 26.9 / 64
10H	V16 <sup>†</sup> V15+(V14-V15) X 123.1 / 154.6	50H	V80 <sup>†</sup> V13+(V12-V13) X 16 / 64	90H	V144 <sup>†</sup> V12+(V11-V12) X 16 / 76	DOH	V208 <sup>†</sup> V11+(V10-V11) X 28.8 / 64
11H	V17 <sup>†</sup> V15+(V14-V15) X 126.1 / 154.6	51H	V81 <sup>†</sup> V13+(V12-V13) X 17 / 64	91H	V145 <sup>†</sup> V12+(V11-V12) X 17 / 76	D1H	V209 <sup>†</sup> V11+(V10-V11) X 30.9 / 64
12H	V18 <sup>†</sup> V15+(V14-V15) X 129.1 / 154.6	52H	V82 <sup>†</sup> V13+(V12-V13) X 18 / 64	92H	V146 <sup>†</sup> V12+(V11-V12) X 18 / 76	D2H	V210 <sup>†</sup> V11+(V10-V11) X 33 / 64
13H	V19 <sup>†</sup> V15+(V14-V15) X 131.6 / 154.6	53H	V83 <sup>†</sup> V13+(V12-V13) X 19 / 64	93H	V147 <sup>†</sup> V12+(V11-V12) X 19 / 76	D3H	V211 <sup>†</sup> V11+(V10-V11) X 35.1 / 64
14H	V20 <sup>†</sup> V15+(V14-V15) X 134.1 / 154.6	54H	V84 <sup>†</sup> V13+(V12-V13) X 20 / 64	94H	V148 <sup>†</sup> V12+(V11-V12) X 20 / 76	D4H	V212 <sup>†</sup> V11+(V10-V11) X 37.2 / 64
15H	V21 <sup>†</sup> V15+(V14-V15) X 136.6 / 154.6	55H	V85 <sup>†</sup> V13+(V12-V13) X 21 / 64	95H	V149 <sup>†</sup> V12+(V11-V12) X 21 / 76	D5H	V213 <sup>†</sup> V11+(V10-V11) X 39.3 / 64
16H	V22 <sup>†</sup> V15+(V14-V15) X 138.6 / 154.6	56H	V86 <sup>†</sup> V13+(V12-V13) X 22 / 64	96H	V150 <sup>†</sup> V12+(V11-V12) X 22 / 76	D6H	V214 <sup>†</sup> V11+(V10-V11) X 41.4 / 64
17H	V23 <sup>†</sup> V15+(V14-V15) X 140.6 / 154.6	57H	V87 <sup>†</sup> V13+(V12-V13) X 23 / 64	97H	V151 <sup>†</sup> V12+(V11-V12) X 23 / 76	D7H	V215 <sup>†</sup> V11+(V10-V11) X 43.5 / 64
18H	V24 <sup>†</sup> V15+(V14-V15) X 142.6 / 154.6	58H	V88 <sup>†</sup> V13+(V12-V13) X 24 / 64	98H	V152 <sup>†</sup> V12+(V11-V12) X 24 / 76	D8H	V216 <sup>†</sup> V11+(V10-V11) X 45.6 / 64
19H	V25 <sup>†</sup> V15+(V14-V15) X 144.1 / 154.6	59H	V89 <sup>†</sup> V13+(V12-V13) X 25 / 64	99H	V153 <sup>†</sup> V12+(V11-V12) X 25.1 / 76	D9H	V217 <sup>†</sup> V11+(V10-V11) X 47.9 / 64
1AH	V26 <sup>†</sup> V15+(V14-V15) X 145.6 / 154.6	5AH	V90 <sup>†</sup> V13+(V12-V13) X 26 / 64	9AH	V154 <sup>†</sup> V12+(V11-V12) X 26.2 / 76	DAH	V218 <sup>†</sup> V11+(V10-V11) X 50.2 / 64
1BH	V27 <sup>†</sup> V15+(V14-V15) X 147.1 / 154.6	5BH	V91 <sup>†</sup> V13+(V12-V13) X 27 / 64	9BH	V155 <sup>†</sup> V12+(V11-V12) X 27.3 / 76	DBH	V219 <sup>†</sup> V11+(V10-V11) X 52.5 / 64
1CH	V28 <sup>†</sup> V15+(V14-V15) X 148.6 / 154.6	5CH	V92 <sup>†</sup> V13+(V12-V13) X 28 / 64	9CH	V156 <sup>†</sup> V12+(V11-V12) X 28.4 / 76	DCH	V220 <sup>†</sup> V11+(V10-V11) X 54.8 / 64
1DH	V29 <sup>†</sup> V15+(V14-V15) X 150.1 / 154.6	5DH	V93 <sup>†</sup> V13+(V12-V13) X 29 / 64	9DH	V157 <sup>†</sup> V12+(V11-V12) X 29.5 / 76	DOH	V221 <sup>†</sup> V11+(V10-V11) X 57.1 / 64
1EH	V30 <sup>†</sup> V15+(V14-V15) X 151.6 / 154.6	5EH	V94 <sup>†</sup> V13+(V12-V13) X 30 / 64	9EH	V158 <sup>†</sup> V12+(V11-V12) X 30.6 / 76	DEH	V222 <sup>†</sup> V11+(V10-V11) X 59.4 / 64
1FH	V31 <sup>†</sup> V15+(V14-V15) X 153.1 / 154.6	5FH	V95 <sup>†</sup> V13+(V12-V13) X 31 / 64	9FH	V159 <sup>†</sup> V12+(V11-V12) X 31.7 / 76	DFH	V223 <sup>†</sup> V11+(V10-V11) X 61.7 / 64
20H	V32 <sup>†</sup> V14	60H	V96 <sup>†</sup> V13+(V12-V13) X 32 / 64	A0H	V160 <sup>†</sup> V12+(V11-V12) X 32.8 / 76	E0H	V224 <sup>†</sup> V10
21H	V33 <sup>†</sup> V14+(V13-V14) X 1.4 / 40	61H	V97 <sup>†</sup> V13+(V12-V13) X 33 / 64	A1H	V161 <sup>†</sup> V12+(V11-V12) X 34 / 76	E1H	V225 <sup>†</sup> V10+(V9-V10) X 2.3 / 187.5
22H	V34 <sup>†</sup> V14+(V13-V14) X 2.8 / 40	62H	V98 <sup>†</sup> V13+(V12-V13) X 34 / 64	A2H	V162 <sup>†</sup> V12+(V11-V12) X 35.2 / 76	E2H	V226 <sup>†</sup> V10+(V9-V10) X 5.1 / 187.5
23H	V35 <sup>†</sup> V14+(V13-V14) X 4.2 / 40	63H	V99 <sup>†</sup> V13+(V12-V13) X 35 / 64	A3H	V163 <sup>†</sup> V12+(V11-V12) X 36.4 / 76	E3H	V227 <sup>†</sup> V10+(V9-V10) X 7.9 / 187.5
24H	V36 <sup>†</sup> V14+(V13-V14) X 5.6 / 40	64H	V100 <sup>†</sup> V13+(V12-V13) X 36 / 64	A4H	V164 <sup>†</sup> V12+(V11-V12) X 37.6 / 76	E4H	V228 <sup>†</sup> V10+(V9-V10) X 10.7 / 187.5
25H	V37 <sup>†</sup> V14+(V13-V14) X 7 / 40	65H	V101 <sup>†</sup> V13+(V12-V13) X 37 / 64	A5H	V165 <sup>†</sup> V12+(V11-V12) X 38.8 / 76	E5H	V229 <sup>†</sup> V10+(V9-V10) X 14 / 187.5
26H	V38 <sup>†</sup> V14+(V13-V14) X 8.4 / 40	66H	V102 <sup>†</sup> V13+(V12-V13) X 38 / 64	A6H	V166 <sup>†</sup> V12+(V11-V12) X 40 / 76	E6H	V230 <sup>†</sup> V10+(V9-V10) X 17.3 / 187.5
27H	V39 <sup>†</sup> V14+(V13-V14) X 9.8 / 40	67H	V103 <sup>†</sup> V13+(V12-V13) X 39 / 64	A7H	V167 <sup>†</sup> V12+(V11-V12) X 41.2 / 76	E7H	V231 <sup>†</sup> V10+(V9-V10) X 20.6 / 187.5
28H	V40 <sup>†</sup> V14+(V13-V14) X 11.2 / 40	68H	V104 <sup>†</sup> V13+(V12-V13) X 40 / 64	A8H	V168 <sup>†</sup> V12+(V11-V12) X 42.4 / 76	E8H	V232 <sup>†</sup> V10+(V9-V10) X 24.4 / 187.5
29H	V41 <sup>†</sup> V14+(V13-V14) X 12.5 / 40	69H	V105 <sup>†</sup> V13+(V12-V13) X 41 / 64	A9H	V169 <sup>†</sup> V12+(V11-V12) X 43.7 / 76	E9H	V233 <sup>†</sup> V10+(V9-V10) X 28.2 / 187.5
2AH	V42 <sup>†</sup> V14+(V13-V14) X 13.8 / 40	6AH	V106 <sup>†</sup> V13+(V12-V13) X 42 / 64	AAH	V170 <sup>†</sup> V12+(V11-V12) X 45 / 76	EAH	V234 <sup>†</sup> V10+(V9-V10) X 32 / 187.5
2BH	V43 <sup>†</sup> V14+(V13-V14) X 15.1 / 40	6BH	V107 <sup>†</sup> V13+(V12-V13) X 43 / 64	ABH	V171 <sup>†</sup> V12+(V11-V12) X 46.3 / 76	EBH	V235 <sup>†</sup> V10+(V9-V10) X 36.5 / 187.5
2CH	V44 <sup>†</sup> V14+(V13-V14) X 16.4 / 40	6CH	V108 <sup>†</sup> V13+(V12-V13) X 44 / 64	ACH	V172 <sup>†</sup> V12+(V11-V12) X 47.6 / 76	ECH	V236 <sup>†</sup> V10+(V9-V10) X 41 / 187.5
2DH	V45 <sup>†</sup> V14+(V13-V14) X 17.7 / 40	6DH	V109 <sup>†</sup> V13+(V12-V13) X 45 / 64	ADH	V173 <sup>†</sup> V12+(V11-V12) X 48.9 / 76	EDH	V237 <sup>†</sup> V10+(V9-V10) X 45.5 / 187.5
2EH	V46 <sup>†</sup> V14+(V13-V14) X 19 / 40	6EH	V110 <sup>†</sup> V13+(V12-V13) X 46 / 64	AEH	V174 <sup>†</sup> V12+(V11-V12) X 50.2 / 76	EEH	V238 <sup>†</sup> V10+(V9-V10) X 50.7 / 187.5
2FH	V47 <sup>†</sup> V14+(V13-V14) X 20.3 / 40	6FH	V111 <sup>†</sup> V13+(V12-V13) X 47 / 64	AFH	V175 <sup>†</sup> V12+(V11-V12) X 51.5 / 76	EFH	V239 <sup>†</sup> V10+(V9-V10) X 55.9 / 187.5
30H	V48 <sup>†</sup> V14+(V13-V14) X 21.6 / 40	70H	V112 <sup>†</sup> V13+(V12-V13) X 48 / 64	BOH	V176 <sup>†</sup> V12+(V11-V12) X 52.8 / 76	FOH	V240 <sup>†</sup> V10+(V9-V10) X 61.8 / 187.5
31H	V49 <sup>†</sup> V14+(V13-V14) X 22.8 / 40	71H	V113 <sup>†</sup> V13+(V12-V13) X 49 / 64	B1H	V177 <sup>†</sup> V12+(V11-V12) X 54.2 / 76	F1H	V241 <sup>†</sup> V10+(V9-V10) X 67.7 / 187.5
32H	V50 <sup>†</sup> V14+(V13-V14) X 24 / 40	72H	V114 <sup>†</sup> V13+(V12-V13) X 50 / 64	B2H	V178 <sup>†</sup> V12+(V11-V12) X 55.6 / 76	F2H	V242 <sup>†</sup> V10+(V9-V10) X 74.3 / 187.5
33H	V51 <sup>†</sup> V14+(V13-V14) X 25.2 / 40	73H	V115 <sup>†</sup> V13+(V12-V13) X 51 / 64	B3H	V179 <sup>†</sup> V12+(V11-V12) X 57 / 76	F3H	V243 <sup>†</sup> V10+(V9-V10) X 80.9 / 187.5
34H	V52 <sup>†</sup> V14+(V13-V14) X 26.4 / 40	74H	V116 <sup>†</sup> V13+(V12-V13) X 52 / 64	B4H	V180 <sup>†</sup> V12+(V11-V12) X 58.4 / 76	F4H	V244 <sup>†</sup> V10+(V9-V10) X 88.2 / 187.5
35H	V53 <sup>†</sup> V14+(V13-V14) X 27.6 / 40	75H	V117 <sup>†</sup> V13+(V12-V13) X 53 / 64	B5H	V181 <sup>†</sup> V12+(V11-V12) X 59.8 / 76	F5H	V245 <sup>†</sup> V10+(V9-V10) X 95.5 / 187.5
36H	V54 <sup>†</sup> V14+(V13-V14) X 28.8 / 40	76H	V118 <sup>†</sup> V13+(V12-V13) X 54 / 64	B6H	V182 <sup>†</sup> V12+(V11-V12) X 61.2 / 76	F6H	V246 <sup>†</sup> V10+(V9-V10) X 103.5 / 187.5
37H	V55 <sup>†</sup> V14+(V13-V14) X 30 / 40	77H	V119 <sup>†</sup> V13+(V12-V13) X 55 / 64	B7H	V183 <sup>†</sup> V12+(V11-V12) X 62.6 / 76	F7H	V247 <sup>†</sup> V10+(V9-V10) X 111.5 / 187.5
38H	V56 <sup>†</sup> V14+(V13-V14) X 31.2 / 40	78H	V120 <sup>†</sup> V13+(V12-V13) X 56 / 64	B8H	V184 <sup>†</sup> V12+(V11-V12) X 64 / 76	F8H	V248 <sup>†</sup> V10+(V9-V10) X 120.5 / 187.5
39H	V57 <sup>†</sup> V14+(V13-V14) X 32.3 / 40	79H	V121 <sup>†</sup> V13+(V12-V13) X 57 / 64	B9H	V185 <sup>†</sup> V12+(V11-V12) X 65.5 / 76	F9H	V249 <sup>†</sup> V10+(V9-V10) X 129.5 / 187.5
3AH	V58 <sup>†</sup> V14+(V13-V14) X 33.4 / 40	7AH	V122 <sup>†</sup> V13+(V12-V13) X 58 / 64	BAH	V186 <sup>†</sup> V12+(V11-V12) X 67 / 76	FAH	V250 <sup>†</sup> V10+(V9-V10) X 139.5 / 187.5
3BH	V59 <sup>†</sup> V14+(V13-V14) X 34.5 / 40	7BH	V123 <sup>†</sup> V13+(V12-V13) X 59 / 64	BBH	V187 <sup>†</sup> V12+(V11-V12) X 68.5 / 76	FBH	V251 <sup>†</sup> V10+(V9-V10) X 149.5 / 187.5
3CH	V60 <sup>†</sup> V14+(V13-V14) X 35.6 / 40	7CH	V124 <sup>†</sup> V13+(V12-V13) X 60 / 64	BCH	V188 <sup>†</sup> V12+(V11-V12) X 70 / 76	FCH	V252 <sup>†</sup> V10+(V9-V10) X 161.5 / 187.5
3DH	V61 <sup>†</sup> V14+(V13-V14) X 36.7 / 40	7DH	V125 <sup>†</sup> V13+(V12-V13) X 61 / 64	BDH	V189 <sup>†</sup> V12+(V11-V12) X 71.5 / 76	FDH	V253 <sup>†</sup> V10+(V9-V10) X 173.5 / 187.5
3EH	V62 <sup>†</sup> V14+(V13-V14) X 37.8 / 40	7EH	V126 <sup>†</sup> V13+(V12-V13) X 62 / 64	BEH	V190 <sup>†</sup> V12+(V11-V12) X 73 / 76	FEH	V254 <sup>†</sup> V9
3FH	V63 <sup>†</sup> V14+(V13-V14) X 38.9 / 40	7FH	V127 <sup>†</sup> V13+(V12-V13) X 63 / 64	BFH	V191 <sup>†</sup> V12+(V11-V12) X 74.5 / 76	FFH	V255 <sup>†</sup> V8

6. RELATIONSHIP BETWEEN INPUT DATA AND OUTPUT PIN

Data format : 8 bits × 2 RGBs (6 dots)

Input width : 48 bits (2-pixel data)

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

Output	S <sub>1</sub>	S <sub>2</sub>	S <sub>3</sub>	S <sub>4</sub>	...	S <sub>383</sub>	S <sub>384</sub>
Data	D <sub>00</sub> to D <sub>07</sub>	D <sub>10</sub> to D <sub>17</sub>	D <sub>20</sub> to D <sub>27</sub>	D <sub>30</sub> to D <sub>37</sub>	...	D <sub>40</sub> to D <sub>47</sub>	D <sub>50</sub> to D <sub>57</sub>

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

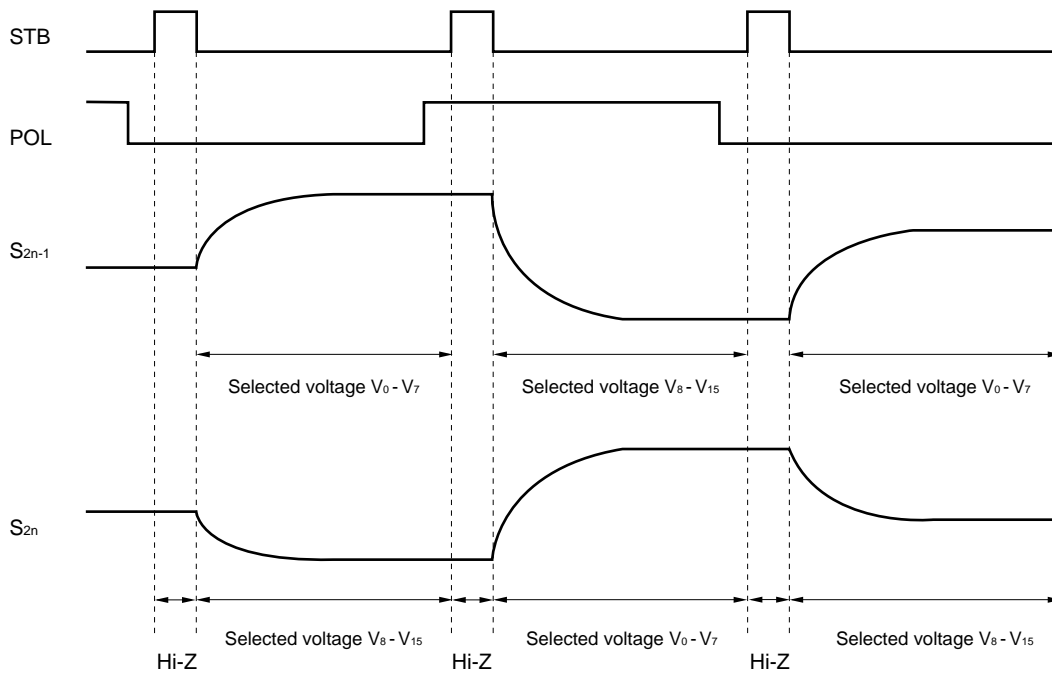
Output	S <sub>1</sub>	S <sub>2</sub>	S <sub>3</sub>	S <sub>4</sub>	...	S <sub>383</sub>	S <sub>384</sub>
Data	D <sub>00</sub> to D <sub>07</sub>	D <sub>10</sub> to D <sub>17</sub>	D <sub>20</sub> to D <sub>27</sub>	D <sub>30</sub> to D <sub>37</sub>	...	D <sub>40</sub> to D <sub>47</sub>	D <sub>50</sub> to D <sub>57</sub>

POL	S <sub>2n-1</sub> <small>Note</small>	S <sub>2n</sub> <small>Note</small>
L	V <sub>0</sub> to V <sub>7</sub>	V <sub>8</sub> to V <sub>15</sub>
H	V <sub>8</sub> to V <sub>15</sub>	V <sub>0</sub> to V <sub>7</sub>

**Note** S<sub>2n-1</sub> (Odd output), S<sub>2n</sub> (Even output)

7. RELATIONSHIP BETWEEN STB, POL AND OUTPUT WAVEFORM

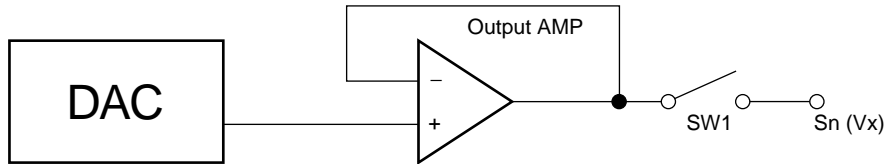
The output voltage is written to the LCD panel synchronized with the STB falling edge.



8. RELATIONSHIP BETWEEN STB, CLK, AND OUTPUT WAVEFORM

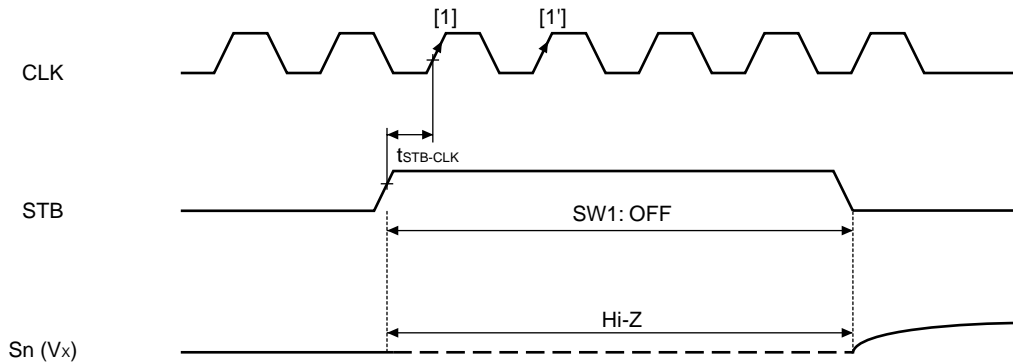
The output voltage is written to the LCD panel synchronized with the STB falling edge.

Figure 8–1. Output Circuit Block Diagram



SW1 switches according to the level of STB signal.  
 STB = L: SW = ON  
 STB = H: SW = OFF

Figure 8–2. Output Circuit Timing Chart



STB = H is loaded with the rising edge of CLK [1]. However, when not satisfying the specification of  $t_{STB-CLK}$ , STB = H is loaded with the rising edge of the next CLK [1']. Latch operation of display data is completed with the falling edge of the next CLK which loaded STB = H. Therefore, in order to complete latch operation of display data, it is necessary to input at least 2 CLK in STB = H period.

## 9. CURRENT CONSUMPTION REDUCTION FUNCTION

The  $\mu$ PD16753 has a low power control function (LPC) which can switch the bias current of the output amplifier between two levels.

### <Low Power control function (LPC) >

The bias current of the output amplifier can be switched between two levels using this pin.

LPC = H or open: low power mode

LPC = L: normal power mode

The  $V_{DD2}$  of static current consumption can be reduced to two thirds of that in normal mode, input a stable DC current ( $V_{DD1}/V_{SS1}$ ) to this pin.

**Caution** Because the power and bias-current control functions control the bias current in the output amplifier and regulate the overall current consumption of the driver IC, when this occurs, the characteristics of the output amplifier will simultaneously change. Therefore, when using these functions, be sure to sufficiently evaluate the picture quality.

10. ELECTRICAL SPECIFICATIONS

**Absolute Maximum Ratings (T<sub>A</sub> = 25°C, V<sub>SS1</sub> = V<sub>SS2</sub> = 0 V)**

Parameter	Symbol	Rating	Unit
Logic Part Supply Voltage	V <sub>DD1</sub>	-0.5 to +4.0	V
Driver Part Supply Voltage	V <sub>DD2</sub>	-0.5 to +10.0	V
Logic Part Input Voltage	V <sub>I1</sub>	-0.5 to V <sub>DD1</sub> +0.5	V
Driver Part Input Voltage	V <sub>I2</sub>	-0.5 to V <sub>DD2</sub> +0.5	V
Logic Part Output Voltage	V <sub>O1</sub>	-0.5 to V <sub>DD1</sub> +0.5	V
Driver Part Output Voltage	V <sub>O2</sub>	-0.5 to V <sub>DD2</sub> +0.5	V
Operating Ambient Temperature	T <sub>A</sub>	-10 to +75	°C
Storage Temperature	T <sub>stg</sub>	-55 to +125	°C

**Caution** Product quality may suffer if the absolute maximum rating is exceeded even momentarily for any parameter. That is, the absolute maximum ratings are rated values at which the product is on the verge of suffering physical damage, and therefore the product must be used under conditions that ensure that the absolute maximum ratings are not exceeded.

**Recommended Operating Range (T<sub>A</sub> = -10 to +75°C, V<sub>SS1</sub> = V<sub>SS2</sub> = 0 V)**

Parameter	Symbol	MIN.	TYP.	MAX.	Unit
Logic Part Supply Voltage	V <sub>DD1</sub>	3.0	3.3	3.6	V
Driver Part Supply Voltage	V <sub>DD2</sub>	8.5	9.0	9.5	V
High-Level Input Voltage	V <sub>IH</sub>	0.7 V <sub>DD1</sub>		V <sub>DD1</sub>	V
Low-Level Input Voltage	V <sub>IL</sub>	0		0.3 V <sub>DD1</sub>	V
γ-Corrected Voltage	V <sub>0</sub> to V <sub>7</sub>	0.5 V <sub>DD2</sub>		V <sub>DD2</sub> -0.2	V
	V <sub>8</sub> to V <sub>15</sub>	V <sub>SS2</sub> +0.2		0.5 V <sub>DD2</sub> -0.3	
Driver Part Output Voltage	V <sub>O</sub>	V <sub>SS2</sub> +0.2		V <sub>DD2</sub> -0.2	V
Clock Frequency	f <sub>CLK</sub>			40	MHz

**Electrical Characteristics (T<sub>A</sub> = -10 to +75°C, V<sub>DD1</sub> = 3.3 V ± 0.3 V, V<sub>DD2</sub> = 9.0 V ± 0.5 V, V<sub>SS1</sub> = V<sub>SS2</sub> = 0 V,  
Unless otherwise specified, LPC = H or Open)**

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input Leak Current	I <sub>IL</sub>	Except LPC		±0.1	±1.0	μA
		LPC		60		μA
High-Level Output Voltage	V <sub>OH</sub>	STHR (STHL), I <sub>OH</sub> = 0 mA	V <sub>DD1</sub> - 0.1			V
Low-Level Output Voltage	V <sub>OL</sub>	STHR (STHL), I <sub>OL</sub> = 0 mA			0.1	V
γ-Corrected Supply Resistance	R <sub>γ</sub>	V <sub>0</sub> to V <sub>7</sub> = V <sub>8</sub> to V <sub>15</sub> = 4.0 V	4.4	8.9	17.8	k
Driver Output Current	I <sub>VOH</sub>	V <sub>X</sub> = 7.0 V, V <sub>OUT</sub> = 6.5 V <sup>Note</sup>		-0.185	-0.09	mA
	I <sub>VOL</sub>	V <sub>X</sub> = 1.0 V, V <sub>OUT</sub> = 1.5 V <sup>Note</sup>	0.12	0.238		mA
Output Voltage Deviation	ΔV <sub>O</sub>	V <sub>O</sub> = 0.2 V to 1.2 V V <sub>O</sub> = V <sub>DD2</sub> - 1.2 V to V <sub>DD2</sub> - 0.2 V		±30	±50	mV
		V <sub>O</sub> = 1.2 V to 0.5 V <sub>DD2</sub> - 0.3 V V <sub>O</sub> = 0.5 V <sub>DD2</sub> to V <sub>DD2</sub> - 1.2 V		±10	±20	mV
Output Swing Difference Deviation	ΔV <sub>P-P</sub>	V <sub>O</sub> = 0.2 V to 0.8 V V <sub>O</sub> = V <sub>DD2</sub> - 0.8 V to V <sub>DD2</sub> - 0.2 V		±20	±40	mV
		V <sub>O</sub> = 0.8 V to 1.2 V V <sub>O</sub> = V <sub>DD2</sub> - 1.2 V to V <sub>DD2</sub> - 0.8 V		±10	±20	mV
		V <sub>O</sub> = 1.2 V to 0.5 V <sub>DD2</sub> - 0.3 V V <sub>O</sub> = 0.5 V <sub>DD2</sub> to V <sub>DD2</sub> - 1.2 V		±3	±10	mV
Output Swing Average Difference Deviation	AV <sub>O</sub>	V <sub>DD2</sub> = 8.5 V, V <sub>O</sub> = 7.9 V, V <sub>3</sub> = 6.22 V, V <sub>7</sub> = 4.0 V, V <sub>8</sub> = 4.0 V, V <sub>12</sub> = 1.78 V, V <sub>12</sub> = 0.1 V, V <sub>1</sub> , V <sub>2</sub> , V <sub>4</sub> , V <sub>5</sub> , V <sub>6</sub> , V <sub>9</sub> , V <sub>10</sub> , V <sub>11</sub> , V <sub>13</sub> , V <sub>14</sub> : Open, T <sub>A</sub> = 25°C, Input data: 80H	4.433		4.447	V
Logic Part Dynamic Current Consumption	I <sub>DD1</sub>	V <sub>DD1</sub> , with no load		0.8	6.0	mA
Driver Part Dynamic Current Consumption	I <sub>DD2</sub>	V <sub>DD2</sub> , with no load		4.5	11.0	mA

**Note** V<sub>X</sub> refers to the output voltage of analog output pins S<sub>1</sub> to S<sub>384</sub>. V<sub>OUT</sub> refers to the voltage applied to analog output pins S<sub>1</sub> to S<sub>384</sub>.

- Cautions**
- 1.The STB cycle is defined to be 20 μs at f<sub>CLK</sub> = 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 under the assumption of XGA single-sided mounting (8 units).



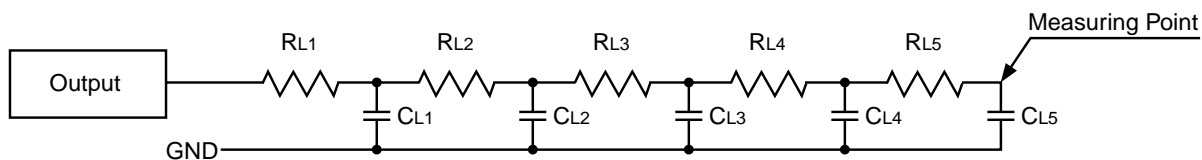
Switching Characteristics ( $T_A = -10$  to  $+75^\circ\text{C}$ ,  $V_{DD1} = 3.3\text{ V} \pm 0.3\text{ V}$ ,  $V_{DD2} = 9.0\text{ V} \pm 0.5\text{ V}$ ,  $V_{SS1} = V_{SS2} = 0\text{ V}$ ,  
 Unless otherwise specified, LPC = H or Open)

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Start Pulse Delay Time	$t_{PLH1}$	$C_L = 15\text{ pF}$		8	20	ns
Driver Output Delay Time	$t_{PLH2}$	$C_L = 75\text{ pF}$ , $R_L = 5\text{ k}\Omega$		3	6	$\mu\text{s}$
	$t_{PLH3}$			4	8	$\mu\text{s}$
	$t_{PHL2}$			3	6	$\mu\text{s}$
	$t_{PHL3}$			4	8	$\mu\text{s}$
Input Capacitance	$C_{i1}$	STHR (STHL) excluded, $T_A = 25^\circ\text{C}$		4.8	10	pF
	$C_{i2}$	STHR (STHL), $T_A = 25^\circ\text{C}$		8.6	15	pF

<Measure Condition>

$R_{Ln} = 1\text{ k}\Omega$

$C_{Ln} = 15\text{ pF}$



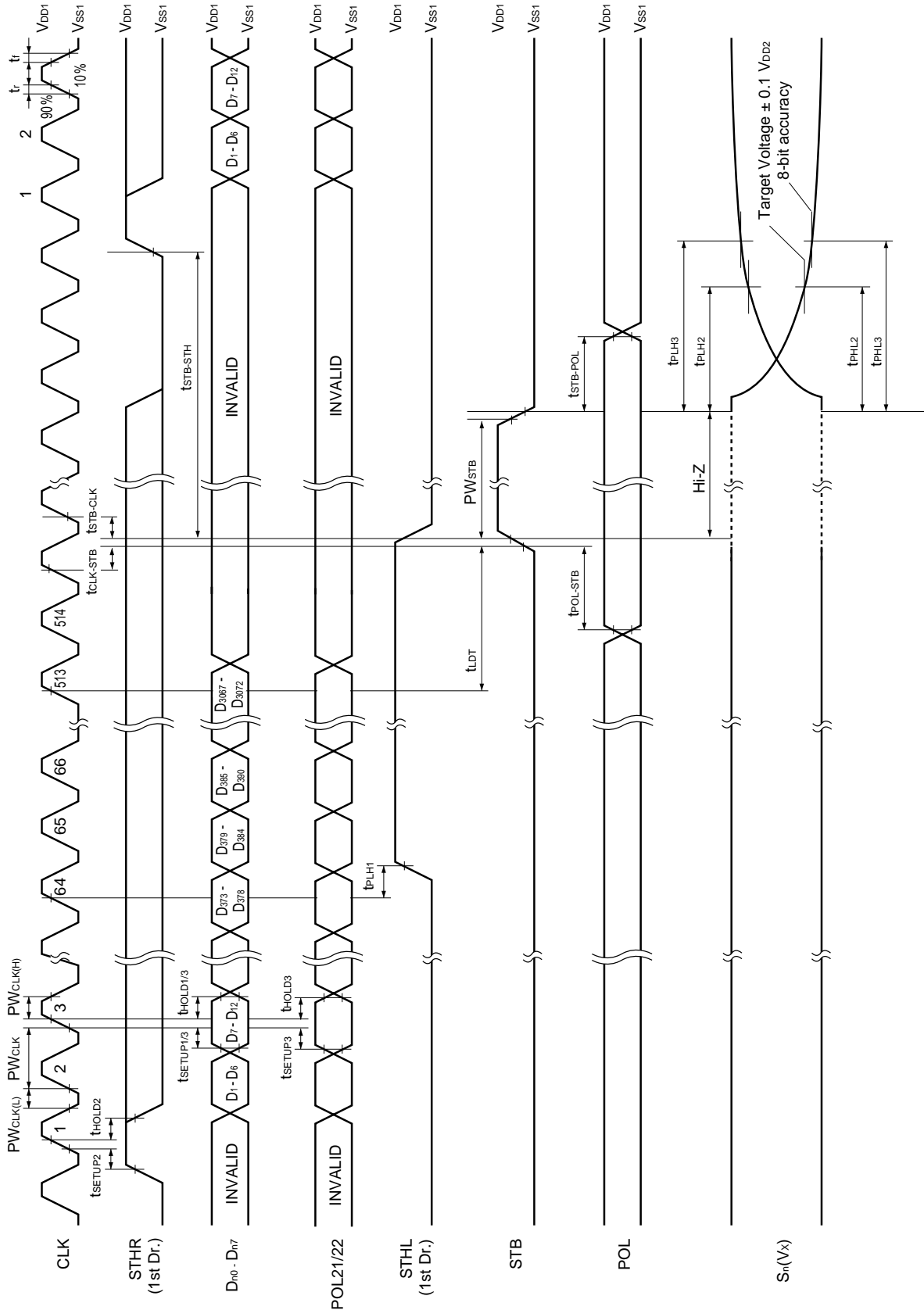
**Timing Requirement ( $T_A = -10$  to  $+75^\circ\text{C}$ ,  $V_{DD1} = 3.3 \text{ V} \pm 0.3 \text{ V}$ ,  $V_{SS1} = 0 \text{ V}$ ,  $t_r = t_f = 8.0 \text{ ns}$ )**

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Clock Pulse Width	$PW_{CLK}$		25			ns
Clock Pulse High Period	$PW_{CLK(H)}$		4			ns
Clock Pulse Low Period	$PW_{CLK(L)}$		4			ns
Data Setup Time	$t_{SETUP1}$		2			ns
Data Hold Time	$t_{HOLD1}$		2			ns
Start Pulse Setup Time	$t_{SETUP2}$		2			ns
Start Pulse Hold Time	$t_{HOLD2}$		2			ns
POL21/22 Setup Time	$t_{SETUP3}$		2			ns
POL21/22 Hold Time	$t_{HOLD3}$		2			ns
STB Pulse Width	$PW_{STB}$		2			μs
Last Data Timing	$t_{LDT}$		2			CLK
CLK-STB Time	$t_{CLK-STB}$	CLK $\uparrow \rightarrow$ STB $\uparrow$	6			ns
STB-CLK Time	$t_{STB-CLK}$	STB $\uparrow \rightarrow$ CLK $\uparrow$	6			ns
Time Between STB and Start Pulse	$t_{STB-STH}$	STB $\uparrow \rightarrow$ STHR(STHL) $\uparrow$	2			CLK
POL-STB Time	$t_{POL-STB}$	POL $\uparrow$ or $\downarrow \rightarrow$ STB $\uparrow$	-5			ns
STB-POL Time	$t_{STB-POL}$	STB $\downarrow \rightarrow$ POL $\downarrow$ or $\uparrow$	6			ns

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

**Switching Characteristics Waveform (R,/L = H)**

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



### 11. RECOMMENDED SOLDERING CONDITIONS

The following conditions must be met for soldering conditions of the μ PD16753.

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

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

#### μ PD16753N - xxx: TCP (TAB package)

Mounting Condition	Mounting Method	Condition
Thermocompression	Soldering	Heating tool 300 to 350°C, heating for 2 to 3 seconds, pressure 100g (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 seconds. Real bonding 165 to 180°C, pressure 25 to 45 kg/cm <sup>2</sup> , time 30 to 40 seconds. (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.

**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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