.

S6C0671

8 BIT 384 CHANNEL TFT-LCD SOURCE DRIVER

February. 2000.

Ver. 0.0

Prepared by: Myoung-Sik, Suh

mail to: mssuh@samsung.co.kr

S6C0671 Specification Revision History		
Version	**Content**	**Date**
0.0	Original	Feb.2000
0.1	Ac timging	Mar. 2000

SAMSUNG
ELECTRONICS

<u>CONTENTS</u>

INTRODUCTION

The S6C0671 is a 384 channel output, TFT-LCD source driver for an 256 gray scale LCD panel. Data input is based on digital input consisting of 8 bits by 6 dots, which can realize a full-color display of 16,700,000 color by output of 256 values gamma-corrected.

This device has an internal D/A (Digital-to-Analog) converter for each output and 18 (9-by-2) reference voltages. Because the output dynamic range is as large as 7.8 - 14.8 Vp-p, it is unnecessary to operate level inversion of the LCD's common electrode. Besides, to be able to deal with dot-line inversion when mounted on a single-side, output gray scale voltages with different polarity can be output to the odd number output pins and the even output pins.

S6C0671 can be adopted to larger panel, and SHL (shift direction selection) pin makes the use of the LCD panel connection conveniently. Maximum operation clock frequency is 65 MHz at 2.7 V logic operation and it can be applied to the TFT-LCD panel of XGA/SXGA standard.

FEATURES

- TFT active matrix LCD source driver LSI

- 256G/S is possible through 18 (9 by 2) reference voltages and D/A converter

- Both dot inversion display and N-line inversion display are possible

- CMOS level input

- Compatible with gamma-correction

- Input data inversion function (DATPOL1,2)

- Logic supply voltage: 2.7 - 3.6 V

- LCD driver supply voltage: 8.0 - 15.0 V

- Output dynamic range: 7.8 - 14.8 Vp-p

- Maximum operating frequency: fMAX = 65 MHz (internal data transmission rate at 2.7 V operation)
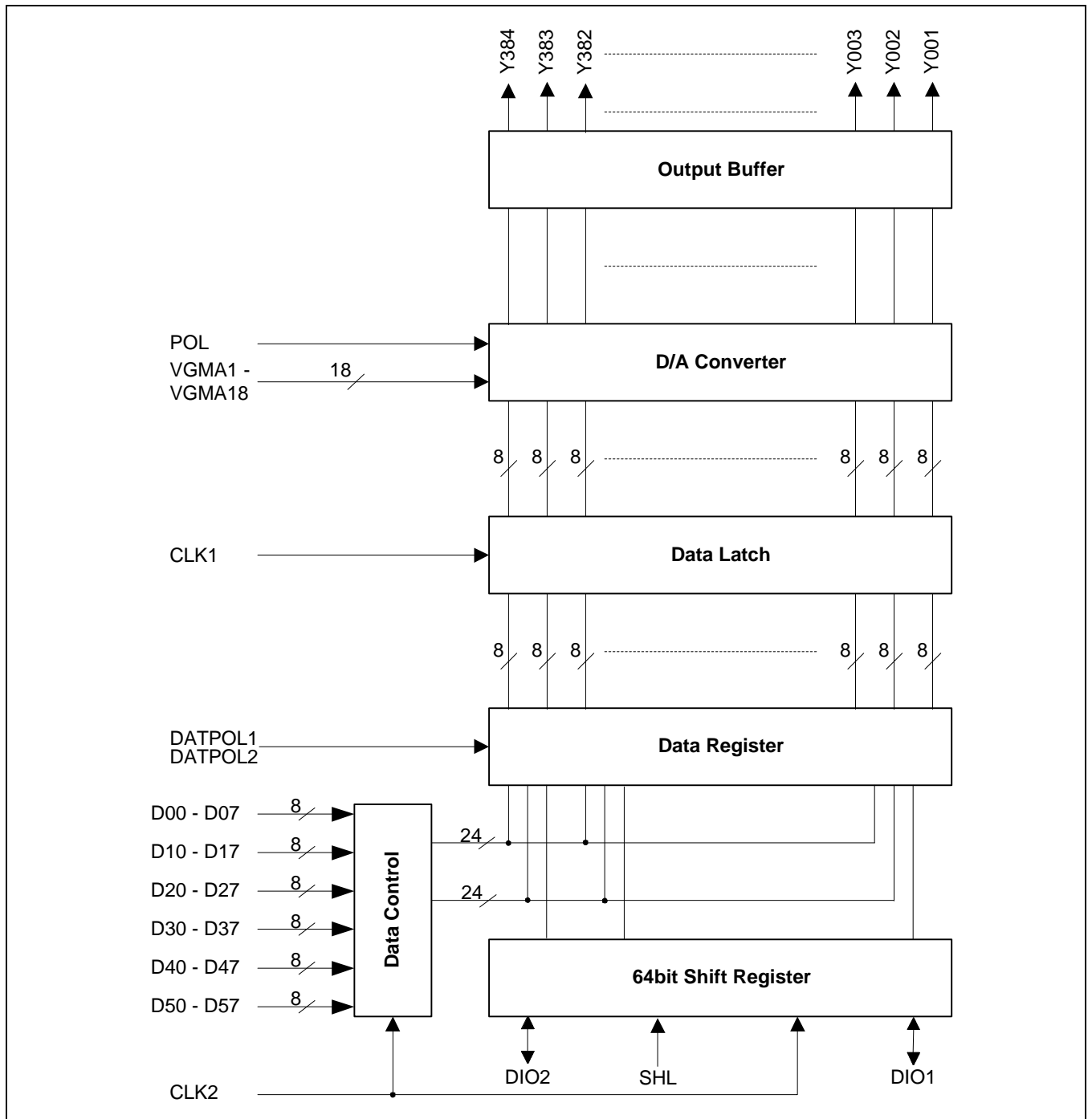
- Output: 384 outputs

- TCP

SAMSUNG
ELECTRONICS

BLOCK DIAGRAM

Figure 1. S6C0671 Block Diagram

PIN ASSIGNMENTS
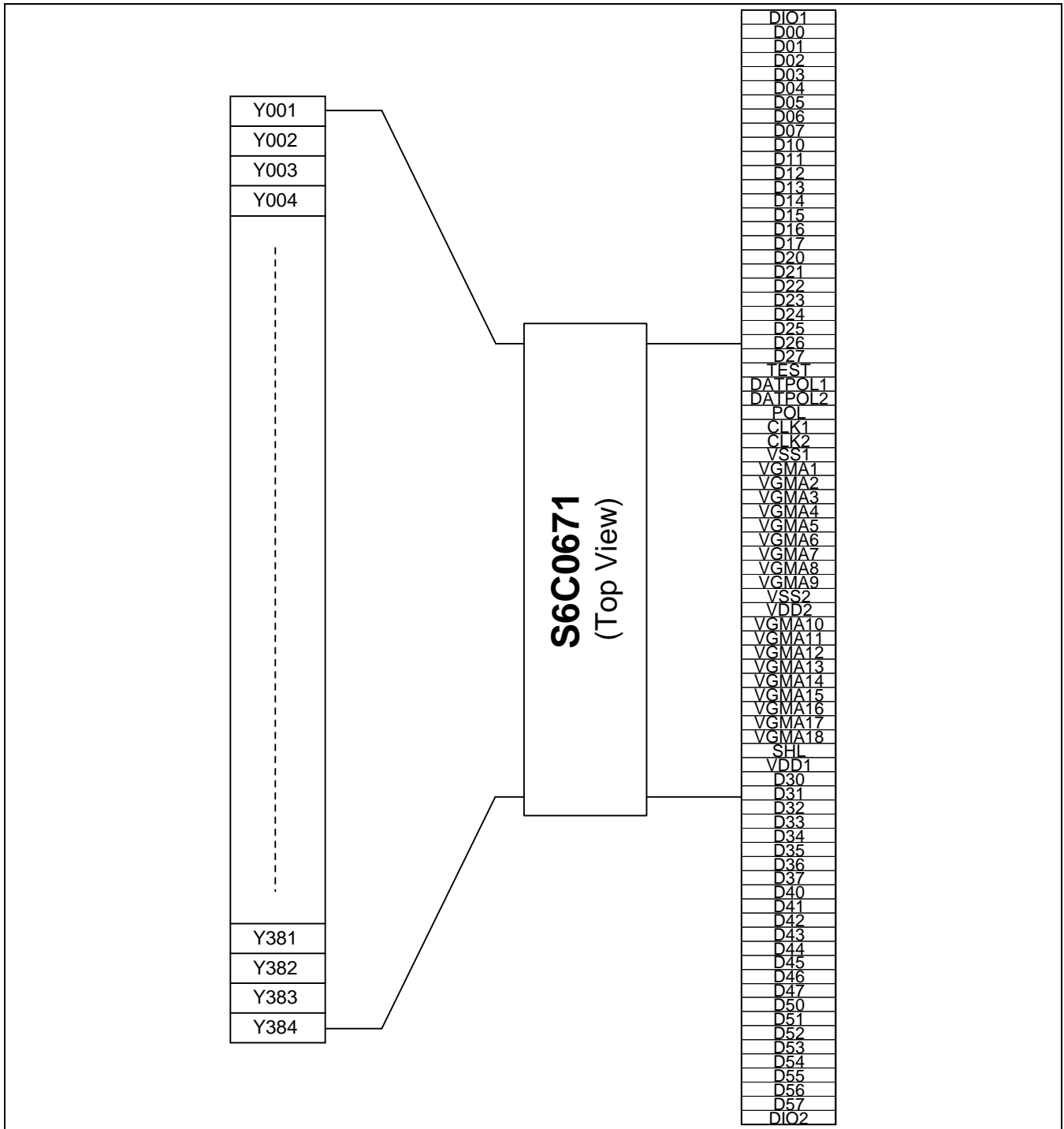
Figure 2. S6C0671 Pin Assignments

SAMSUNG
ELECTRONICS

PIN DESCRIPTIONS

Symbol	Pin Name	Description
VDD1	Logic power supply	2.7 - 3.6 V
VDD2	Driver power supply	8.0 - 15.0 V
VSS1	Logic ground	Ground (0 V)
VSS2	Driver ground	Ground (0 V)
Y1 – Y384	Driver outputs	The D/A converted 256 gray-scale analog voltage is output.
D0<0:7> - D5<0:7>	Display data input	The display data is input with a width of 48 bits, gray-scale data (8 bits) by 6 dots (R,G,B) DX0: LSB, DX7: MSB
SHL	Shift direction control input	This pin controls the direction of shift register in cascade connection. The shift direction of the shift registers is as follows. SHL = H: DIO1 input, Y1 $\rightarrow$ Y384, DIO2 output SHL = L: DIO2 input, Y384 $\rightarrow$ Y1, DIO1 output
DIO1	Start pulse input/output	SHL = H: Used as the start pulse input pin. SHL = L: Used as the start pulse output pin.
DIO2	Start pulse input/output	SHL = H: Used as the start pulse output pin. SHL = L: Used as the start pulse input pin.
DATPOL1 DATPOL2	Data inversion input	DATPOL1,2 = L: Display data is not inverted DATPOL1 = H: Display data of D0<0:7> - D2<0:7> is inverted DATPOL2 = H: Display data of D3<0:7> - D5<0:7> is inverted
POL	Polarity input	POL = H: The reference voltage for odd number outputs are VGMA10 – VGMA18 and those for even number outputs are VGMA1 – VGMA9. POL = L: The reference voltage for odd number outputs are VGMA1 – VGMA9 and those for even number outputs are VGMA10 – VGMA18.
CLK2	Shift clock input	Refer to the shift register's shift clock input. the display data is loaded to the data register at the rising edge of CLK2.
CLK1	Latch input	Latches the contents of the data register at rising edge and transfers them to the D/A converter. Also, after CLK1 input, clears the internal shift register contents. After 1 pulse input on start, operates normally. CLK1 input timing refers to the "Relationships between CLK1 start pulse (DIO1, DIO2) and blanking period" of the switching characteristic waveform. Outputs the G/S data at falling edge.
VGMA1 – VGMA18	Gamma corrected power supplies	Input the gamma corrected power supplies from external source. VDD2 > VGMA1 > VGMA2 > …… > VGMA17 > VGMA18 > VSS2 Keep gray-scale power supply unchanged during the gray-scale voltage output.
TEST	Test input	TEST = L: Normal operation mode TEST = H: Test mode (OP AMP CUT-OFF, Rpd = 10kΩ)

OPERATION DESCRIPTION

DISPLAY DATA TRANSFER

When DIO1 (or DIO2) pulse is loaded into internal latch on the rising edge of CLK2, DIO1 (or DIO2) pulse enables the operation of data transfer, so display data is valid on the next rising edge of CLK2. Once all the data of 384 channels are loaded into internal latch, it goes into stand-by state automatically, and any new data is not accepted even though CLK2 is provided until next DIO1 (or DIO2) input. When next DIO1 (or DIO2) is provided, new display data is valid on the 2nd rising edge of CLK2 after the rising edge of DIO1 (or DIO2).

EXTENSION OF OUTPUT

Output pin can be adjusted to an extended screen by cascade connection.

(1) SHL = "L"
Connect DIO1 pin of previous stage to the DIO2 pin of next stage and all the input pins
except DIO1 and DIO2 are connected together in each device.

(2) SHL = "H"
Connect DIO2 pin of previous stage to the DIO1 pin of next stage and all the input pins
except DIO2 and DIO1 are connected together in each device.

RELATIONSHIP BETWEEN INPUT DATA VALUE AND OUTPUT VOLTAGE

The LCD drive output voltages are determined by the input data and 18 (9 by 2) gamma corrected power supplies (VGMA1 - VGMA18). Besides, to be able to deal with dot line inversion when mounted on a single-side, gradation voltages with different polarity can be output to the odd number output pins and the even number output pins. Among 9-by-2 gamma corrected voltages, input gray-scale voltages of the same polarity with respect to the common voltage, for the respective 9 gamma corrected voltages of VGMA1 – VGMA9 and VGMA10 - VGMA18.

SHL = H

OUTPUT	Y1	-	Y6	......	Y379	-	Y384
-		First		⟶		Last	
DATA	D00 - D07	-	D50 - D57	......	D00 - D07	-	D50 - D57

SHL = L

OUTPUT	Y1	-	Y6	......	Y379	-	Y384
-		Last		⟵		First	
DATA	D00 - D07	-	D50 - D57	......	D00 - D07	-	D50 - D57
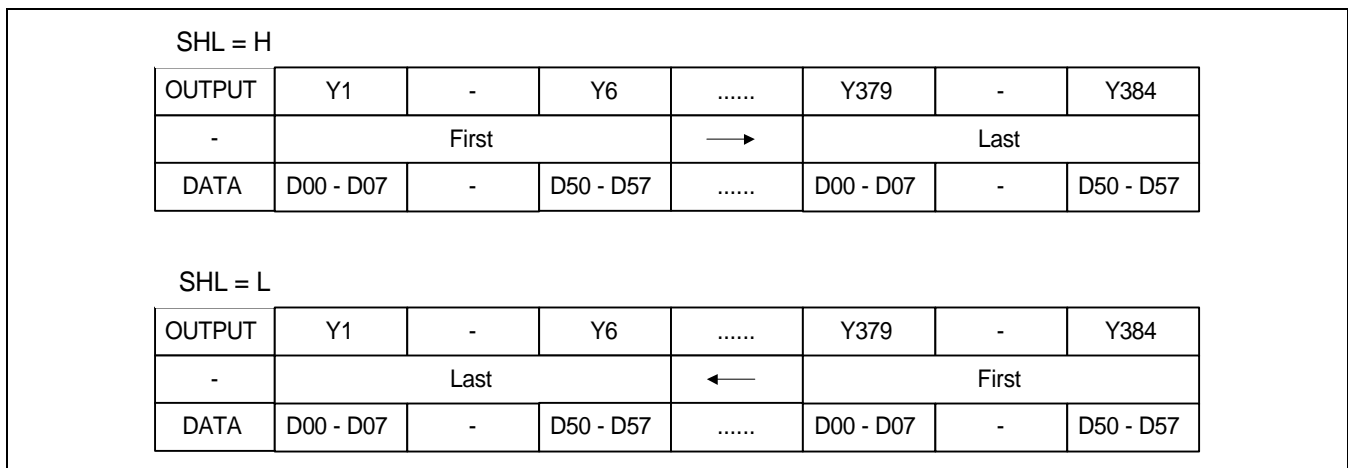
Figure 3. Relationship between Shift Direction and Output Data

SAMSUNG
ELECTRONICS
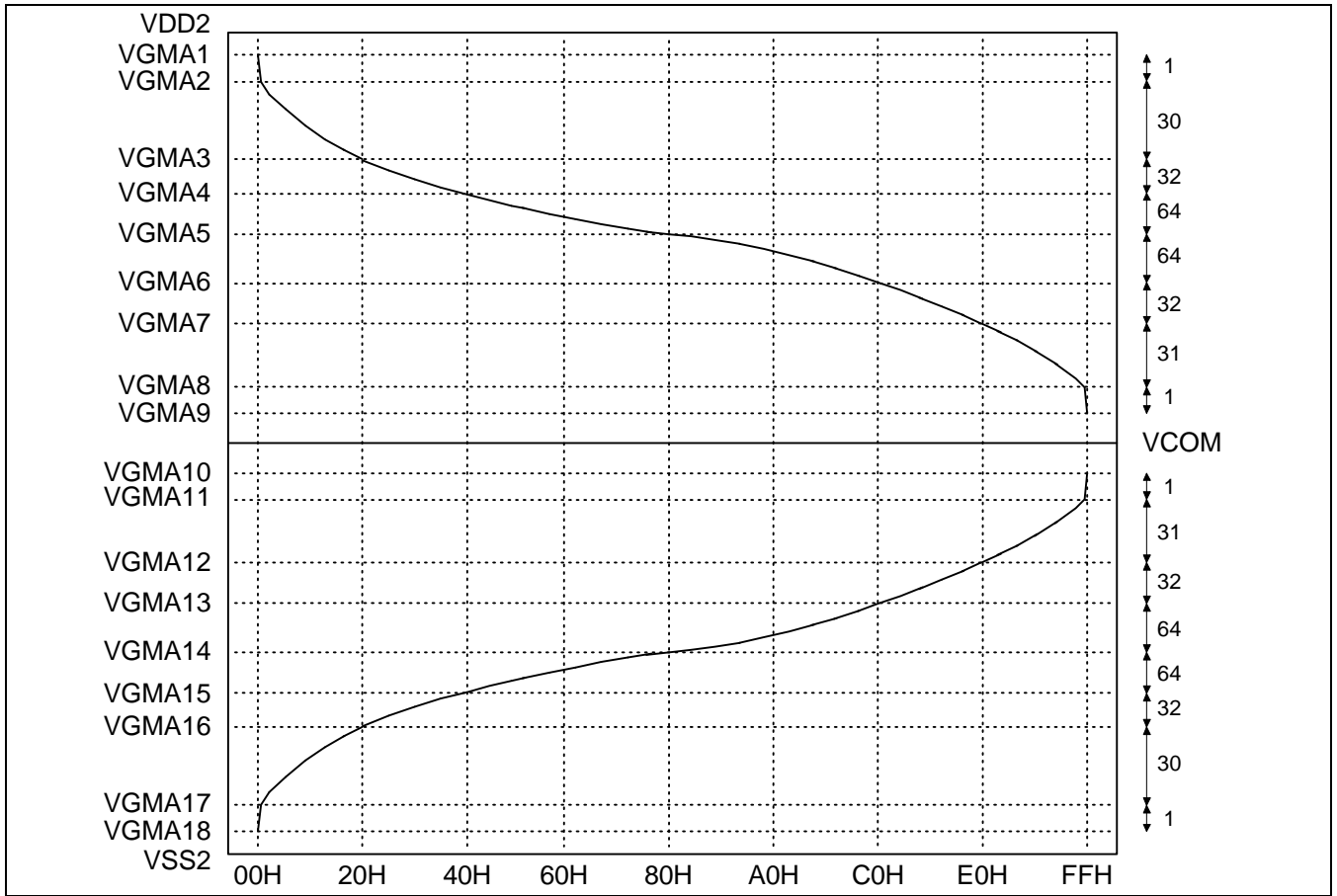
Figure 4. Gamma Correction Curve

Table 1. Resistor Strings (R0 - R254, unit: W)

Name	Value	Name	Value	Name	Value
R0	1500	R59 – R66	49	R221	82
R1	350	R67 – R70	46	R222 – R223	87
R2	300	R71 – R74	43	R224	89
R3	265	R75 – R78	40	R225	91
R4	240	R79 – R82	38	R226	92
R5	220	R83 – R86	37	R227	94
R6	202	R87 – R90	35	R228	95
R7	187	R91 – R94	34	R229	96
R8	174	R95 – R98	32	R230 – R231	97
R9	162	R99 – R102	31	R232	98
R10	150	R103 – R106	29	R233	99
R11	140	R107 – R114	28	R234	100
R12	130	R115 – R122	26	R235	102
R13	120	R123 – R130	25	R236 – R237	104
R14	110	R131 – R134	28	R238	106
R15	105	R135 – R138	31	R239	108
R16	100	R139 – R146	34	R240 – R241	110
R17	95	R147 – R150	37	R242	112
R18	92	R151 – R154	40	R243	114
R19	89	R155 – R162	43	R244	116
R20	86	R163 – R166	46	R245 – R246	118
R21	83	R167 – R170	49	R247 – R248	120
R22	82	R171 – R174	52	R249	122
R23 – R26	81	R175 – R178	55	R250	124
R27 – R30	79	R179 – R186	58	R251	127
R31 – R34	78	R187 – R194	61	R252	131
R35 – R38	71	R195 – R202	64	R253	135
R39 – R42	66	R203 – R210	67	R254	1500
R43 – R46	61	R211 – R214	70		
R47 – R50	58	R215 – R218	73		
R51 - R54	55	R219	74		
R55 - R58	52	R220	78		

SAMSUNG
ELECTRONICS

RELATIONSHIP BETWEEN INPUT DATA AND OUTPUT VOLTAGE VALUE

Table 2. Relationship between Input Data and Output Voltage Value (1)

Input data	DX7	DX6	DX5	DX4	DX3	DX2	DX1	DX0	G/S	Output voltage
00H	0	0	0	0	0	0	0	0	VH0	VGMA1
01H	0	0	0	0	0	0	0	1	VH1	VGMA2
02H	0	0	0	0	0	0	1	0	VH2	VGMA2 + (VGMA3 - VGMA2) $\times$ 350 / 4122
03H	0	0	0	0	0	0	1	1	VH3	VGMA2 + (VGMA3 - VGMA2) $\times$ 650 / 4122
04H	0	0	0	0	0	1	0	0	VH4	VGMA2 + (VGMA3 - VGMA2) $\times$ 915 / 4122
05H	0	0	0	0	0	1	0	1	VH5	VGMA2 + (VGMA3 - VGMA2) $\times$ 1155 / 4122
06H	0	0	0	0	0	1	1	0	VH6	VGMA2 + (VGMA3 - VGMA2) $\times$ 1375 / 4122
07H	0	0	0	0	0	1	1	1	VH7	VGMA2 + (VGMA3 - VGMA2) $\times$ 1577 / 4122
08H	0	0	0	0	1	0	0	0	VH8	VGMA2 + (VGMA3 - VGMA2) $\times$ 1764 / 4122
09H	0	0	0	0	1	0	0	1	VH9	VGMA2 + (VGMA3 - VGMA2) $\times$ 1938 / 4122
0AH	0	0	0	0	1	0	1	0	VH10	VGMA2 + (VGMA3 - VGMA2) $\times$ 2100 / 4122
0BH	0	0	0	0	1	0	1	1	VH11	VGMA2 + (VGMA3 - VGMA2) $\times$ 2250 / 4122
0CH	0	0	0	0	1	1	0	0	VH12	VGMA2 + (VGMA3 - VGMA2) $\times$ 2390 / 4122
0DH	0	0	0	0	1	1	0	1	VH13	VGMA2 + (VGMA3 - VGMA2) $\times$ 2520 / 4122
0EH	0	0	0	0	1	1	1	0	VH14	VGMA2 + (VGMA3 - VGMA2) $\times$ 2640 / 4122
0FH	0	0	0	0	1	1	1	1	VH15	VGMA2 + (VGMA3 - VGMA2) $\times$ 2750 / 4122
10H	0	0	0	1	0	0	0	0	VH16	VGMA2 + (VGMA3 - VGMA2) $\times$ 2855 / 4122
11H	0	0	0	1	0	0	0	1	VH17	VGMA2 + (VGMA3 - VGMA2) $\times$ 2955 / 4122
12H	0	0	0	1	0	0	1	0	VH18	VGMA2 + (VGMA3 - VGMA2) $\times$ 3040 / 4122
13H	0	0	0	1	0	0	1	1	VH19	VGMA2 + (VGMA3 - VGMA2) $\times$ 3132 / 4122
14H	0	0	0	1	0	1	0	0	VH20	VGMA2 + (VGMA3 - VGMA2) $\times$ 3221 / 4122
15H	0	0	0	1	0	1	0	1	VH21	VGMA2 + (VGMA3 - VGMA2) $\times$ 3307 / 4122
16H	0	0	0	1	0	1	1	0	VH22	VGMA2 + (VGMA3 - VGMA2) $\times$ 3390 / 4122
17H	0	0	0	1	0	1	1	1	VH23	VGMA2 + (VGMA3 - VGMA2) $\times$ 3472 / 4122
18H	0	0	0	1	1	0	0	0	VH24	VGMA2 + (VGMA3 - VGMA2) $\times$ 3553 / 4122
19H	0	0	0	1	1	0	0	1	VH25	VGMA2 + (VGMA3 - VGMA2) $\times$ 3634 / 4122
1AH	0	0	0	1	1	0	1	0	VH26	VGMA2 + (VGMA3 - VGMA2) $\times$ 3715 / 4122
1BH	0	0	0	1	1	0	1	1	VH27	VGMA2 + (VGMA3 - VGMA2) $\times$ 3796 / 4122
1CH	0	0	0	1	1	1	0	0	VH28	VGMA2 + (VGMA3 - VGMA2) $\times$ 3875 / 4122
1DH	0	0	0	1	1	1	0	1	VH29	VGMA2 + (VGMA3 - VGMA2) $\times$ 3944 / 4122
1EH	0	0	0	1	1	1	1	0	VH30	VGMA2 + (VGMA3 - VGMA2) $\times$ 4023 / 4122
1FH	0	0	0	1	1	1	1	1	VH31	VGMA3
20H	0	0	1	0	0	0	0	0	VH32	VGMA3 + (VGMA4 - VGMA3) $\times$ 78 / 1960
21H	0	0	1	0	0	0	0	1	VH33	VGMA3 + (VGMA4 - VGMA3) $\times$ 156 / 1960
22H	0	0	1	0	0	0	1	0	VH34	VGMA3 + (VGMA4 - VGMA3) $\times$ 234 / 1960
23H	0	0	1	0	0	0	1	1	VH35	VGMA3 + (VGMA4 - VGMA3) $\times$ 312 / 1960
24H	0	0	1	0	0	1	0	0	VH36	VGMA3 + (VGMA4 - VGMA3) $\times$ 383 / 1960
25H	0	0	1	0	0	1	0	1	VH37	VGMA3 + (VGMA4 - VGMA3) $\times$ 454 / 1960
26H	0	0	1	0	0	1	1	0	VH38	VGMA3 + (VGMA4 - VGMA3) $\times$ 525 / 1960
27H	0	0	1	0	0	1	1	1	VH39	VGMA3 + (VGMA4 - VGMA3) $\times$ 596 / 1960

NOTE: VDD2>VGMA1>VGMA2>VGMA3>VGMA4>VGMA5>VGMA6>VGMA7>VGMA8>VGMA9

Table 2. Relationship between Input Data and Output Voltage Value (2)

Input data	DX7	DX6	DX5	DX4	DX3	DX2	DX1	DX0	G/S	Output voltage
28H	0	0	1	0	1	0	0	0	VH40	VGMA3 + (VGMA4 - VGMA3) × 662 / 1960
29H	0	0	1	0	1	0	0	1	VH41	VGMA3 + (VGMA4 - VGMA3) × 728 / 1960
2AH	0	0	1	0	1	0	1	0	VH42	VGMA3 + (VGMA4 - VGMA3) × 794 / 1960
2BH	0	0	1	0	1	0	1	1	VH43	VGMA3 + (VGMA4 - VGMA3) × 860 / 1960
2CH	0	0	1	0	1	1	0	0	VH44	VGMA3 + (VGMA4 - VGMA3) × 921 / 1960
2DH	0	0	1	0	1	1	0	1	VH45	VGMA3 + (VGMA4 - VGMA3) × 982 / 1960
2EH	0	0	1	0	1	1	1	0	VH46	VGMA3 + (VGMA4 - VGMA3) × 1043 / 1960
2FH	0	0	1	0	1	1	1	1	VH47	VGMA3 + (VGMA4 - VGMA3) × 1104 / 1960
30H	0	0	1	1	0	0	0	0	VH48	VGMA3 + (VGMA4 - VGMA3) × 1162 / 1960
31H	0	0	1	1	0	0	0	1	VH49	VGMA3 + (VGMA4 - VGMA3) × 1220 / 1960
32H	0	0	1	1	0	0	1	0	VH50	VGMA3 + (VGMA4 - VGMA3) × 1278 / 1960
33H	0	0	1	1	0	0	1	1	VH51	VGMA3 + (VGMA4 - VGMA3) × 1336 / 1960
34H	0	0	1	1	0	1	0	0	VH52	VGMA3 + (VGMA4 - VGMA3) × 1391 / 1960
35H	0	0	1	1	0	1	0	1	VH53	VGMA3 + (VGMA4 - VGMA3) × 1446 / 1960
36H	0	0	1	1	0	1	1	0	VH54	VGMA3 + (VGMA4 - VGMA3) × 1501 / 1960
37H	0	0	1	1	0	1	1	1	VH55	VGMA3 + (VGMA4 - VGMA3) × 1556 / 1960
38H	0	0	1	1	1	0	0	0	VH56	VGMA3 + (VGMA4 - VGMA3) × 1608 / 1960
39H	0	0	1	1	1	0	0	1	VH57	VGMA3 + (VGMA4 - VGMA3) × 1660 / 1960
3AH	0	0	1	1	1	0	1	0	VH58	VGMA3 + (VGMA4 - VGMA3) × 1712 / 1960
3BH	0	0	1	1	1	0	1	1	VH59	VGMA3 + (VGMA4 - VGMA3) × 1764 / 1960
3CH	0	0	1	1	1	1	0	0	VH60	VGMA3 + (VGMA4 - VGMA3) × 1813 / 1960
3DH	0	0	1	1	1	1	0	1	VH61	VGMA3 + (VGMA4 - VGMA3) × 1862 / 1960
3EH	0	0	1	1	1	1	1	0	VH62	VGMA3 + (VGMA4 - VGMA3) × 1911 / 1960
3FH	0	0	1	1	1	1	1	1	VH63	VGMA4
40H	0	1	0	0	0	0	0	0	VH64	VGMA4 + (VGMA5 - VGMA4) × 49 / 2188
41H	0	1	0	0	0	0	0	1	VH65	VGMA4 + (VGMA5 - VGMA4) × 98 / 2188
42H	0	1	0	0	0	0	1	0	VH66	VGMA4 + (VGMA5 - VGMA4) × 147 / 2188
43H	0	1	0	0	0	0	1	1	VH67	VGMA4 + (VGMA5 - VGMA4) × 196 / 2188
44H	0	1	0	0	0	1	0	0	VH68	VGMA4 + (VGMA5 - VGMA4) × 242 / 2188
45H	0	1	0	0	0	1	0	1	VH69	VGMA4 + (VGMA5 - VGMA4) × 288 / 2188
46H	0	1	0	0	0	1	1	0	VH70	VGMA4 + (VGMA5 - VGMA4) × 334 / 2188
47H	0	1	0	0	0	1	1	1	VH71	VGMA4 + (VGMA5 - VGMA4) × 380 / 2188
48H	0	1	0	0	1	0	0	0	VH72	VGMA4 + (VGMA5 - VGMA4) × 423 / 2188
49H	0	1	0	0	1	0	0	1	VH73	VGMA4 + (VGMA5 - VGMA4) × 466 / 2188
4AH	0	1	0	0	1	0	1	0	VH74	VGMA4 + (VGMA5 - VGMA4) × 509 / 2188
4BH	0	1	0	0	1	0	1	1	VH75	VGMA4 + (VGMA5 - VGMA4) × 552 / 2188
4CH	0	1	0	0	1	1	0	0	VH76	VGMA4 + (VGMA5 - VGMA4) × 592 / 2188
4DH	0	1	0	0	1	1	0	1	VH77	VGMA4 + (VGMA5 - VGMA4) × 632 / 2188
4EH	0	1	0	0	1	1	1	0	VH78	VGMA4 + (VGMA5 - VGMA4) × 672 / 2188
4FH	0	1	0	0	1	1	1	1	VH79	VGMA4 + (VGMA5 - VGMA4) × 712 / 2188

SAMSUNG
ELECTRONICS

Table 2. Relationship between Input Data and Output Voltage Value (3)

Input data	DX7	DX6	DX5	DX4	DX3	DX2	DX1	DX0	G/S	Output voltage
50H	0	1	0	1	0	0	0	0	VH80	VGMA4 + (VGMA5 - VGMA4) $\times$ 750 / 2188
51H	0	1	0	1	0	0	0	1	VH81	VGMA4 + (VGMA5 - VGMA4) $\times$ 788 / 2188
52H	0	1	0	1	0	0	1	0	VH82	VGMA4 + (VGMA5 - VGMA4) $\times$ 826 / 2188
53H	0	1	0	1	0	0	1	1	VH83	VGMA4 + (VGMA5 - VGMA4) $\times$ 864 / 2188
54H	0	1	0	1	0	1	0	0	VH84	VGMA4 + (VGMA5 - VGMA4) $\times$ 901 / 2188
55H	0	1	0	1	0	1	0	1	VH85	VGMA4 + (VGMA5 - VGMA4) $\times$ 938 / 2188
56H	0	1	0	1	0	1	1	0	VH86	VGMA4 + (VGMA5 - VGMA4) $\times$ 975 / 2188
57H	0	1	0	1	0	1	1	1	VH87	VGMA4 + (VGMA5 - VGMA4) $\times$ 1012 / 2188
58H	0	1	0	1	1	0	0	0	VH88	VGMA4 + (VGMA5 - VGMA4) $\times$ 1047 / 2188
59H	0	1	0	1	1	0	0	1	VH89	VGMA4 + (VGMA5 - VGMA4) $\times$ 1082 / 2188
5AH	0	1	0	1	1	0	1	0	VH90	VGMA4 + (VGMA5 - VGMA4) $\times$ 1117 / 2188
5BH	0	1	0	1	1	0	1	1	VH91	VGMA4 + (VGMA5 - VGMA4) $\times$ 1152 / 2188
5CH	0	1	0	1	1	1	0	0	VH92	VGMA4 + (VGMA5 - VGMA4) $\times$ 1186 / 2188
5DH	0	1	0	1	1	1	0	1	VH93	VGMA4 + (VGMA5 - VGMA4) $\times$ 1220 / 2188
5EH	0	1	0	1	1	1	1	0	VH94	VGMA4 + (VGMA5 - VGMA4) $\times$ 1254 / 2188
5FH	0	1	0	1	1	1	1	1	VH95	VGMA4 + (VGMA5 - VGMA4) $\times$ 1288 / 2188
60H	0	1	1	0	0	0	0	0	VH96	VGMA4 + (VGMA5 - VGMA4) $\times$ 1320 / 2188
61H	0	1	1	0	0	0	0	1	VH97	VGMA4 + (VGMA5 - VGMA4) $\times$ 1352 / 2188
62H	0	1	1	0	0	0	1	0	VH98	VGMA4 + (VGMA5 - VGMA4) $\times$ 1384 / 2188
63H	0	1	1	0	0	0	1	1	VH99	VGMA4 + (VGMA5 - VGMA4) $\times$ 1416 / 2188
64H	0	1	1	0	0	1	0	0	VH100	VGMA4 + (VGMA5 - VGMA4) $\times$ 1447 / 2188
65H	0	1	1	0	0	1	0	1	VH101	VGMA4 + (VGMA5 - VGMA4) $\times$ 1478 / 2188
66H	0	1	1	0	0	1	1	0	VH102	VGMA4 + (VGMA5 - VGMA4) $\times$ 1509 / 2188
67H	0	1	1	0	0	1	1	1	VH103	VGMA4 + (VGMA5 - VGMA4) $\times$ 1540 / 2188
68H	0	1	1	0	1	0	0	0	VH104	VGMA4 + (VGMA5 - VGMA4) $\times$ 1569 / 2188
69H	0	1	1	0	1	0	0	1	VH105	VGMA4 + (VGMA5 - VGMA4) $\times$ 1598 / 2188
6AH	0	1	1	0	1	0	1	0	VH106	VGMA4 + (VGMA5 - VGMA4) $\times$ 1627 / 2188
6BH	0	1	1	0	1	0	1	1	VH107	VGMA4 + (VGMA5 - VGMA4) $\times$ 1656 / 2188
6CH	0	1	1	0	1	1	0	0	VH108	VGMA4 + (VGMA5 - VGMA4) $\times$ 1684 / 2188
6DH	0	1	1	0	1	1	0	1	VH109	VGMA4 + (VGMA5 - VGMA4) $\times$ 1712 / 2188
6EH	0	1	1	0	1	1	1	0	VH110	VGMA4 + (VGMA5 - VGMA4) $\times$ 1740 / 2188
6FH	0	1	1	0	1	1	1	1	VH111	VGMA4 + (VGMA5 - VGMA4) $\times$ 1768 / 2188
70H	0	1	1	1	0	0	0	0	VH112	VGMA4 + (VGMA5 - VGMA4) $\times$ 1796 / 2188
71H	0	1	1	1	0	0	0	1	VH113	VGMA4 + (VGMA5 - VGMA4) $\times$ 1824 / 2188
72H	0	1	1	1	0	0	1	0	VH114	VGMA4 + (VGMA5 - VGMA4) $\times$ 1852 / 2188
73H	0	1	1	1	0	0	1	1	VH115	VGMA4 + (VGMA5 - VGMA4) $\times$ 1880 / 2188
74H	0	1	1	1	0	1	0	0	VH116	VGMA4 + (VGMA5 - VGMA4) $\times$ 1906 / 2188
75H	0	1	1	1	0	1	0	1	VH117	VGMA4 + (VGMA5 - VGMA4) $\times$ 1932 / 2188
76H	0	1	1	1	0	1	1	0	VH118	VGMA4 + (VGMA5 - VGMA4) $\times$ 1958 / 2188
77H	0	1	1	1	0	1	1	1	VH119	VGMA4 + (VGMA5 - VGMA4) $\times$ 1984 / 2188

SAMSUNG
ELECTRONICS

Table 2. Relationship between Input Data and Output Voltage Value (4)

Input data	DX7	DX6	DX5	DX4	DX3	DX2	DX1	DX0	G/S	Output voltage
78H	0	1	1	1	1	0	0	0	VH120	VGMA4 + (VGMA5 - VGMA4) $\times$ 2010 / 2188
79H	0	1	1	1	1	0	0	1	VH121	VGMA4 + (VGMA5 - VGMA4) $\times$ 2036 / 2188
7AH	0	1	1	1	1	0	1	0	VH122	VGMA4 + (VGMA5 - VGMA4) $\times$ 2062 / 2188
7BH	0	1	1	1	1	0	1	1	VH123	VGMA4 + (VGMA5 - VGMA4) $\times$ 2088 / 2188
7CH	0	1	1	1	1	1	0	0	VH124	VGMA4 + (VGMA5 - VGMA4) $\times$ 2113 / 2188
7DH	0	1	1	1	1	1	0	1	VH125	VGMA4 + (VGMA5 - VGMA4) $\times$ 2138 / 2188
7EH	0	1	1	1	1	1	1	0	VH126	VGMA4 + (VGMA5 - VGMA4) $\times$ 2163 / 2188
7FH	0	1	1	1	1	1	1	1	VH127	VGMA5
80H	1	0	0	0	0	0	0	0	VH128	VGMA5 + (VGMA6 - VGMA5) $\times$ 25 / 2776
81H	1	0	0	0	0	0	0	1	VH129	VGMA5 + (VGMA6 - VGMA5) $\times$ 50 / 2776
82H	1	0	0	0	0	0	1	0	VH130	VGMA5 + (VGMA6 - VGMA5) $\times$ 75 / 2776
83H	1	0	0	0	0	0	1	1	VH131	VGMA5 + (VGMA6 - VGMA5) $\times$ 100 / 2776
84H	1	0	0	0	0	1	0	0	VH132	VGMA5 + (VGMA6 - VGMA5) $\times$ 128 / 2776
85H	1	0	0	0	0	1	0	1	VH133	VGMA5 + (VGMA6 - VGMA5) $\times$ 156 / 2776
86H	1	0	0	0	0	1	1	0	VH134	VGMA5 + (VGMA6 - VGMA5) $\times$ 184 / 2776
87H	1	0	0	0	0	1	1	1	VH135	VGMA5 + (VGMA6 - VGMA5) $\times$ 212 / 2776
88H	1	0	0	0	1	0	0	0	VH136	VGMA5 + (VGMA6 - VGMA5) $\times$ 243 / 2776
89H	1	0	0	0	1	0	0	1	VH137	VGMA5 + (VGMA6 - VGMA5) $\times$ 274 / 2776
8AH	1	0	0	0	1	0	1	0	VH138	VGMA5 + (VGMA6 - VGMA5) $\times$ 305 / 2776
8BH	1	0	0	0	1	0	1	1	VH139	VGMA5 + (VGMA6 - VGMA5) $\times$ 336 / 2776
8CH	1	0	0	0	1	1	0	0	VH140	VGMA5 + (VGMA6 - VGMA5) $\times$ 370 / 2776
8DH	1	0	0	0	1	1	0	1	VH141	VGMA5 + (VGMA6 - VGMA5) $\times$ 404 / 2776
8EH	1	0	0	0	1	1	1	0	VH142	VGMA5 + (VGMA6 - VGMA5) $\times$ 438 / 2776
8FH	1	0	0	0	1	1	1	1	VH143	VGMA5 + (VGMA6 - VGMA5) $\times$ 472 / 2776
90H	1	0	0	1	0	0	0	0	VH144	VGMA5 + (VGMA6 - VGMA5) $\times$ 506 / 2776
91H	1	0	0	1	0	0	0	1	VH145	VGMA5 + (VGMA6 - VGMA5) $\times$ 540 / 2776
92H	1	0	0	1	0	0	1	0	VH146	VGMA5 + (VGMA6 - VGMA5) $\times$ 574 / 2776
93H	1	0	0	1	0	0	1	1	VH147	VGMA5 + (VGMA6 - VGMA5) $\times$ 608 / 2776
94H	1	0	0	1	0	1	0	0	VH148	VGMA5 + (VGMA6 - VGMA5) $\times$ 645 / 2776
95H	1	0	0	1	0	1	0	1	VH149	VGMA5 + (VGMA6 - VGMA5) $\times$ 682 / 2776
96H	1	0	0	1	0	1	1	0	VH150	VGMA5 + (VGMA6 - VGMA5) $\times$ 719 / 2776
97H	1	0	0	1	0	1	1	1	VH151	VGMA5 + (VGMA6 - VGMA5) $\times$ 756 / 2776
98H	1	0	0	1	1	0	0	0	VH152	VGMA5 + (VGMA6 - VGMA5) $\times$ 796 / 2776
99H	1	0	0	1	1	0	0	1	VH153	VGMA5 + (VGMA6 - VGMA5) $\times$ 836 / 2776
9AH	1	0	0	1	1	0	1	0	VH154	VGMA5 + (VGMA6 - VGMA5) $\times$ 876 / 2776
9BH	1	0	0	1	1	0	1	1	VH155	VGMA5 + (VGMA6 - VGMA5) $\times$ 916 / 2776
9CH	1	0	0	1	1	1	0	0	VH156	VGMA5 + (VGMA6 - VGMA5) $\times$ 959 / 2776
9DH	1	0	0	1	1	1	0	1	VH157	VGMA5 + (VGMA6 - VGMA5) $\times$ 1002 / 2776
9EH	1	0	0	1	1	1	1	0	VH158	VGMA5 + (VGMA6 - VGMA5) $\times$ 1045 / 2776
9FH	1	0	0	1	1	1	1	1	VH159	VGMA5 + (VGMA6 - VGMA5) $\times$ 1088 / 2776

SAMSUNG ELECTRONICS

Table 2. Relationship between Input Data and Output Voltage Value (5)

Input data	DX7	DX6	DX5	DX4	DX3	DX2	DX1	DX0	G/S	Output voltage
A0H	1	0	1	0	0	0	0	0	VH160	$VGMA5 + (VGMA6 - VGMA5) \times 1131 / 2776$
A1H	1	0	1	0	0	0	0	1	VH161	$VGMA5 + (VGMA6 - VGMA5) \times 1174 / 2776$
A2H	1	0	1	0	0	0	1	0	VH162	$VGMA5 + (VGMA6 - VGMA5) \times 1217 / 2776$
A3H	1	0	1	0	0	0	1	1	VH163	$VGMA5 + (VGMA6 - VGMA5) \times 1260 / 2776$
A4H	1	0	1	0	0	1	0	0	VH164	$VGMA5 + (VGMA6 - VGMA5) \times 1306 / 2776$
A5H	1	0	1	0	0	1	0	1	VH165	$VGMA5 + (VGMA6 - VGMA5) \times 1352 / 2776$
A6H	1	0	1	0	0	1	1	0	VH166	$VGMA5 + (VGMA6 - VGMA5) \times 1398 / 2776$
A7H	1	0	1	0	0	1	1	1	VH167	$VGMA5 + (VGMA6 - VGMA5) \times 1444 / 2776$
A8H	1	0	1	0	1	0	0	0	VH168	$VGMA5 + (VGMA6 - VGMA5) \times 1493 / 2776$
A9H	1	0	1	0	1	0	0	1	VH169	$VGMA5 + (VGMA6 - VGMA5) \times 1542 / 2776$
AAH	1	0	1	0	1	0	1	0	VH170	$VGMA5 + (VGMA6 - VGMA5) \times 1591 / 2776$
ABH	1	0	1	0	1	0	1	1	VH171	$VGMA5 + (VGMA6 - VGMA5) \times 1640 / 2776$
ACH	1	0	1	0	1	1	0	0	VH172	$VGMA5 + (VGMA6 - VGMA5) \times 1692 / 2776$
ADH	1	0	1	0	1	1	0	1	VH173	$VGMA5 + (VGMA6 - VGMA5) \times 1744 / 2776$
AEH	1	0	1	0	1	1	1	0	VH174	$VGMA5 + (VGMA6 - VGMA5) \times 1796 / 2776$
AFH	1	0	1	0	1	1	1	1	VH175	$VGMA5 + (VGMA6 - VGMA5) \times 1848 / 2776$
B0H	1	0	1	1	0	0	0	0	VH176	$VGMA5 + (VGMA6 - VGMA5) \times 1903 / 2776$
B1H	1	0	1	1	0	0	0	1	VH177	$VGMA5 + (VGMA6 - VGMA5) \times 1958 / 2776$
B2H	1	0	1	1	0	0	1	0	VH178	$VGMA5 + (VGMA6 - VGMA5) \times 2013 / 2776$
B3H	1	0	1	1	0	0	1	1	VH179	$VGMA5 + (VGMA6 - VGMA5) \times 2068 / 2776$
B4H	1	0	1	1	0	1	0	0	VH180	$VGMA5 + (VGMA6 - VGMA5) \times 2126/ 2776$
B5H	1	0	1	1	0	1	0	1	VH181	$VGMA5 + (VGMA6 - VGMA5) \times 2184 / 2776$
B6H	1	0	1	1	0	1	1	0	VH182	$VGMA5 + (VGMA6 - VGMA5) \times 2242 / 2776$
B7H	1	0	1	1	0	1	1	1	VH183	$VGMA5 + (VGMA6 - VGMA5) \times 2300 / 2776$
B8H	1	0	1	1	1	0	0	0	VH184	$VGMA5 + (VGMA6 - VGMA5) \times 2358 / 2776$
B9H	1	0	1	1	1	0	0	1	VH185	$VGMA5 + (VGMA6 - VGMA5) \times 2416 / 2776$
BAH	1	0	1	1	1	0	1	0	VH186	$VGMA5 + (VGMA6 - VGMA5) \times 2474 / 2776$
BBH	1	0	1	1	1	0	1	1	VH187	$VGMA5 + (VGMA6 - VGMA5) \times 2532 / 2776$
BCH	1	0	1	1	1	1	0	0	VH188	$VGMA5 + (VGMA6 - VGMA5) \times 2593 / 2776$
BDH	1	0	1	1	1	1	0	1	VH189	$VGMA5 + (VGMA6 - VALUE5) \times 2654 / 2776$
BEH	1	0	1	1	1	1	1	0	VH190	$VGMA5 + (VGMA6 - VGMA5) \times 2715 / 2776$
BFH	1	0	1	1	1	1	1	1	VH191	VGMA6
C0H	1	1	0	0	0	0	0	0	VH192	$VGMA6 + (VGMA7 - VGMA6) \times 61 / 2185$
C1H	1	1	0	0	0	0	0	1	VH193	$VGMA6 + (VGMA7 - VGMA6) \times 122 / 2185$
C2H	1	1	0	0	0	0	1	0	VH194	$VGMA6 + (VGMA7 - VGMA6) \times 183 / 2185$
C3H	1	1	0	0	0	0	1	1	VH195	$VGMA6 + (VGMA7 - VGMA6) \times 244 / 2185$
C4H	1	1	0	0	0	1	0	0	VH196	$VGMA6 + (VGMA7 - VGMA6) \times 308 / 2185$
C5H	1	1	0	0	0	1	0	1	VH197	$VGMA6 + (VGMA7 - VGMA6) \times 372 / 2185$
C6H	1	1	0	0	0	1	1	0	VH198	$VGMA6 + (VGMA7 - VGMA6) \times 436 / 2185$
C7H	1	1	0	0	0	1	1	1	VH199	$VGMA6 + (VGMA7 - VGMA6) \times 500 / 2185$

Table 2. Relationship between Input Data and Output Voltage Value (6)

Input data	DX7	DX6	DX5	DX4	DX3	DX2	DX1	DX0	G/S	Output voltage
C8H	1	1	0	0	1	0	0	0	VH200	$VGMA6 + (VGMA7 - VGMA6) \times 564 / 2185$
C9H	1	1	0	0	1	0	0	1	VH201	$VGMA6 + (VGMA7 - VGMA6) \times 628 / 2185$
CAH	1	1	0	0	1	0	1	0	VH202	$VGMA6 + (VGMA7 - VGMA6) \times 692 / 2185$
CBH	1	1	0	0	1	0	1	1	VH203	$VGMA6 + (VGMA7 - VGMA6) \times 756 / 2185$
CCH	1	1	0	0	1	1	0	0	VH204	$VGMA6 + (VGMA7 - VGMA6) \times 823 / 2185$
CDH	1	1	0	0	1	1	0	1	VH205	$VGMA6 + (VGMA7 - VGMA6) \times 890 / 2185$
CEH	1	1	0	0	1	1	1	0	VH206	$VGMA6 + (VGMA7 - VGMA6) \times 957 / 2185$
CFH	1	1	0	0	1	1	1	1	VH207	$VGMA6 + (VGMA7 - VGMA6) \times 1024 / 2185$
D0H	1	1	0	1	0	0	0	0	VH208	$VGMA6 + (VGMA7 - VGMA6) \times 1091 / 2185$
D1H	1	1	0	1	0	0	0	1	VH209	$VGMA6 + (VGMA7 - VGMA6) \times 1158 / 2185$
D2H	1	1	0	1	0	0	1	0	VH210	$VGMA6 + (VGMA7 - VGMA6) \times 1225 / 2185$
D3H	1	1	0	1	0	0	1	1	VH211	$VGMA6 + (VGMA7 - VGMA6) \times 1292 / 2185$
D4H	1	1	0	1	0	1	0	0	VH212	$VGMA6 + (VGMA7 - VGMA6) \times 1362 / 2185$
D5H	1	1	0	1	0	1	0	1	VH213	$VGMA6 + (VGMA7 - VGMA6) \times 1432 / 2185$
D6H	1	1	0	1	0	1	1	0	VH214	$VGMA6 + (VGMA7 - VGMA6) \times 1502 / 2185$
D7H	1	1	0	1	0	1	1	1	VH215	$VGMA6 + (VGMA7 - VGMA6) \times 1572 / 2185$
D8H	1	1	0	1	1	0	0	0	VH216	$VGMA6 + (VGMA7 - VGMA6) \times 1645 / 2185$
D9H	1	1	0	1	1	0	0	1	VH217	$VGMA6 + (VGMA7 - VGMA6) \times 1718 / 2185$
DAH	1	1	0	1	1	0	1	0	VH218	$VGMA6 + (VGMA7 - VGMA6) \times 1791 / 2185$
DBH	1	1	0	1	1	0	1	1	VH219	$VGMA6 + (VGMA7 - VGMA6) \times 1864 / 2185$
DCH	1	1	0	1	1	1	0	0	VH220	$VGMA6 + (VGMA7 - VGMA6) \times 1938 / 2185$
DDH	1	1	0	1	1	1	0	1	VH221	$VGMA6 + (VGMA7 - VGMA6) \times 2016 / 2185$
DEH	1	1	0	1	1	1	1	0	VH222	$VGMA6 + (VGMA7 - VGMA6) \times 2098 / 2185$
DFH	1	1	0	1	1	1	1	1	VH223	VGMA7
E0H	1	1	1	0	0	0	0	0	VH224	$VGMA7 + (VGMA8 - VGMA7) \times 87 / 3336$
E1H	1	1	1	0	0	0	0	1	VH225	$VGMA7 + (VGMA8 - VGMA7) \times 176 / 3336$
E2H	1	1	1	0	0	0	1	0	VH226	$VGMA7 + (VGMA8 - VGMA7) \times 267 / 3336$
E3H	1	1	1	0	0	0	1	1	VH227	$VGMA7 + (VGMA8 - VGMA7) \times 359 / 3336$
E4H	1	1	1	0	0	1	0	0	VH228	$VGMA7 + (VGMA8 - VGMA7) \times 453 / 3336$
E5H	1	1	1	0	0	1	0	1	VH229	$VGMA7 + (VGMA8 - VGMA7) \times 548 / 3336$
E6H	1	1	1	0	0	1	1	0	VH230	$VGMA7 + (VGMA8 - VGMA7) \times 644 / 3336$
E7H	1	1	1	0	0	1	1	1	VH231	$VGMA7 + (VGMA8 - VGMA7) \times 741 / 3336$
E8H	1	1	1	0	1	0	0	0	VH232	$VGMA7 + (VGMA8 - VGMA7) \times 838 / 3336$
E9H	1	1	1	0	1	0	0	1	VH233	$VGMA7 + (VGMA8 - VGMA7) \times 936 / 3336$
EAH	1	1	1	0	1	0	1	0	VH234	$VGMA7 + (VGMA8 - VGMA7) \times 1035 / 3336$
EBH	1	1	1	0	1	0	1	1	VH235	$VGMA7 + (VGMA8 - VGMA7) \times 1135 / 3336$
ECH	1	1	1	0	1	1	0	0	VH236	$VGMA7 + (VGMA8 - VGMA7) \times 1237 / 3336$
EDH	1	1	1	0	1	1	0	1	VH237	$VGMA7 + (VGMA8 - VGMA7) \times 1341 / 3336$
EEH	1	1	1	0	1	1	1	0	VH238	$VGMA7 + (VGMA8 - VGMA7) \times 1445 / 3336$
EFH	1	1	1	0	1	1	1	1	VH239	$VGMA7 + (VGMA8 - VGMA7) \times 1551 / 3336$

SAMSUNG
ELECTRONICS

Table 2. Relationship between Input Data and Output Voltage Value (7)

Input data	DX7	DX6	DX5	DX4	DX3	DX2	DX1	DX0	G/S	Output voltage
F0H	1	1	1	1	0	0	0	0	VH240	VGMA7 + (VGMA8 - VGMA7) $\times$ 1659 / 3336
F1H	1	1	1	1	0	0	0	1	VH241	VGMA7 + (VGMA8 - VGMA7) $\times$ 1769 / 3336
F2H	1	1	1	1	0	0	1	0	VH242	VGMA7 + (VGMA8 - VGMA7) $\times$ 1879 / 3336
F3H	1	1	1	1	0	0	1	1	VH243	VGMA7 + (VGMA8 - VGMA7) $\times$ 1991 / 3336
F4H	1	1	1	1	0	1	0	0	VH244	VGMA7 + (VGMA8 - VGMA7) $\times$ 2105 / 3336
F5H	1	1	1	1	0	1	0	1	VH245	VGMA7 + (VGMA8 - VGMA7) $\times$ 2221 / 3336
F6H	1	1	1	1	0	1	1	0	VH246	VGMA7 + (VGMA8 - VGMA7) $\times$ 2339 / 3336
F7H	1	1	1	1	0	1	1	1	VH247	VGMA7 + (VGMA8 - VGMA7) $\times$ 2457 / 3336
F8H	1	1	1	1	1	0	0	0	VH248	VGMA7 + (VGMA8 - VGMA7) $\times$ 2577 / 3336
F9H	1	1	1	1	1	0	0	1	VH249	VGMA7 + (VGMA8 - VGMA7) $\times$ 2697 / 3336
FAH	1	1	1	1	1	0	1	0	VH250	VGMA7 + (VGMA8 - VGMA7) $\times$ 2819 / 3336
FBH	1	1	1	1	1	0	1	1	VH251	VGMA7 + (VGMA8 - VGMA7) $\times$ 2943 / 3336
FCH	1	1	1	1	1	1	0	0	VH252	VGMA7 + (VGMA8 - VGMA7) $\times$ 3070 / 3336
FDH	1	1	1	1	1	1	0	1	VH253	VGMA7 + (VGMA8 - VGMA7) $\times$ 3201 / 3336
FEH	1	1	1	1	1	1	1	0	VH254	VGMA8
FFH	1	1	1	1	1	1	1	1	VH255	VGMA9

SAMSUNG
ELECTRONICS

Table 2. Relationship between Input Data and Output Voltage Value (8)

Input data	DX7	DX6	DX5	DX4	DX3	DX2	DX1	DX0	G/S	Output voltage
00H	0	0	0	0	0	0	0	0	VL0	VGMA18
01H	0	0	0	0	0	0	0	1	VL1	VGMA17
02H	0	0	0	0	0	0	1	0	VL2	VGMA17 + (VGMA16 - VGMA17) $\times$ 350 / 4122
03H	0	0	0	0	0	0	1	1	VL3	VGMA17 + (VGMA16 - VGMA17) $\times$ 650 / 4122
04H	0	0	0	0	0	1	0	0	VL4	VGMA17 + (VGMA16 - VGMA17) $\times$ 915 / 4122
05H	0	0	0	0	0	1	0	1	VL5	VGMA17 + (VGMA16 - VGMA17) $\times$ 1155 / 4122
06H	0	0	0	0	0	1	1	0	VL6	VGMA17 + (VGMA16 - VGMA17) $\times$ 1375 / 4122
07H	0	0	0	0	0	1	1	1	VL7	VGMA17 + (VGMA16 - VGMA17) $\times$ 1577 / 4122
08H	0	0	0	0	1	0	0	0	VL8	VGMA17 + (VGMA16 - VGMA17) $\times$ 1764 / 4122
09H	0	0	0	0	1	0	0	1	VL9	VGMA17 + (VGMA16 - VGMA17) $\times$ 1938 / 4122
0AH	0	0	0	0	1	0	1	0	VL10	VGMA17 + (VGMA16 - VGMA17) $\times$ 2100 / 4122
0BH	0	0	0	0	1	0	1	1	VL11	VGMA17 + (VGMA16 - VGMA17) $\times$ 2250 / 4122
0CH	0	0	0	0	1	1	0	0	VL12	VGMA17 + (VGMA16 - VGMA17) $\times$ 2390 / 4122
0DH	0	0	0	0	1	1	0	1	VL13	VGMA17 + (VGMA16 - VGMA17) $\times$ 2520 / 4122
0EH	0	0	0	0	1	1	1	0	VL14	VGMA17 + (VGMA16 - VGMA17) $\times$ 2640 / 4122
0FH	0	0	0	0	1	1	1	1	VL15	VGMA17 + (VGMA16 - VGMA17) $\times$ 2750 / 4122
10H	0	0	0	1	0	0	0	0	VL16	VGMA17 + (VGMA16 - VGMA17) $\times$ 2855 / 4122
11H	0	0	0	1	0	0	0	1	VL17	VGMA17 + (VGMA16 - VGMA17) $\times$ 2955 / 4122
12H	0	0	0	1	0	0	1	0	VL18	VGMA17 + (VGMA16 - VGMA17) $\times$ 3040 / 4122
13H	0	0	0	1	0	0	1	1	VL19	VGMA17 + (VGMA16 - VGMA17) $\times$ 3132 / 4122
14H	0	0	0	1	0	1	0	0	VL20	VGMA17 + (VGMA16 - VGMA17) $\times$ 3221 / 4122
15H	0	0	0	1	0	1	0	1	VL21	VGMA17 + (VGMA16 - VGMA17) $\times$ 3307 / 4122
16H	0	0	0	1	0	1	1	0	VL22	VGMA17 + (VGMA16 - VGMA17) $\times$ 3390 / 4122
17H	0	0	0	1	0	1	1	1	VL23	VGMA17 + (VGMA16 - VGMA17) $\times$ 3472 / 4122
18H	0	0	0	1	1	0	0	0	VL24	VGMA17 + (VGMA16 - VGMA17) $\times$ 3553 / 4122
19H	0	0	0	1	1	0	0	1	VL25	VGMA17 + (VGMA16 - VGMA17) $\times$ 3634 / 4122
1AH	0	0	0	1	1	0	1	0	VL26	VGMA17 + (VGMA16 - VGMA17) $\times$ 3715 / 4122
1BH	0	0	0	1	1	0	1	1	VL27	VGMA17 + (VGMA16 - VGMA17) $\times$ 3796 / 4122
1CH	0	0	0	1	1	1	0	0	VL28	VGMA17 + (VGMA16 - VGMA17) $\times$ 3875 / 4122
1DH	0	0	0	1	1	1	0	1	VL29	VGMA17 + (VGMA16 - VGMA17) $\times$ 3944 / 4122
1EH	0	0	0	1	1	1	1	0	VL30	VGMA17 + (VGMA16 - VGMA17) $\times$ 4023 / 4122
1FH	0	0	0	1	1	1	1	1	VL31	VGMA16
20H	0	0	1	0	0	0	0	0	VL32	VGMA16 + (VGMA15 - VGMA16) $\times$ 78 / 1960
21H	0	0	1	0	0	0	0	1	VL33	VGMA16 + (VGMA15 - VGMA16) $\times$ 156 / 1960
22H	0	0	1	0	0	0	1	0	VL34	VGMA16 + (VGMA15 - VGMA16) $\times$ 234 / 1960
23H	0	0	1	0	0	0	1	1	VL35	VGMA16 + (VGMA15 - VGMA16) $\times$ 312 / 1960
24H	0	0	1	0	0	1	0	0	VL36	VGMA16 + (VGMA15 - VGMA16) $\times$ 383 / 1960
25H	0	0	1	0	0	1	0	1	VL37	VGMA16 + (VGMA15 - VGMA16) $\times$ 454 / 1960
26H	0	0	1	0	0	1	1	0	VL38	VGMA16 + (VGMA15 - VGMA16) $\times$ 525 / 1960
27H	0	0	1	0	0	1	1	1	VL39	VGMA16 + (VGMA15 - VGMA16) $\times$ 596 / 1960

NOTE: VSS2<VGMA18<VGMA17<VGMA16<VGMA15<VGMA14<VGMA13<VGMA12<VGMA11<VGMA10

Table 2. Relationship between Input Data and Output Voltage Value (9)

Input data	DX7	DX6	DX5	DX4	DX3	DX2	DX1	DX0	G/S	Output voltage
28H	0	0	1	0	1	0	0	0	VL40	$VGMA16 + (VGMA15 - VGMA16) \times 662 / 1960$
29H	0	0	1	0	1	0	0	1	VL41	$VGMA16 + (VGMA15 - VGMA16) \times 728 / 1960$
2AH	0	0	1	0	1	0	1	0	VL42	$VGMA16 + (VGMA15 - VGMA16) \times 794 / 1960$
2BH	0	0	1	0	1	0	1	1	VL43	$VGMA16 + (VGMA15 - VGMA16) \times 860 / 1960$
2CH	0	0	1	0	1	1	0	0	VL44	$VGMA16 + (VGMA15 - VGMA16) \times 921 / 1960$
2DH	0	0	1	0	1	1	0	1	VL45	$VGMA16 + (VGMA15 - VGMA16) \times 982 / 1960$
2EH	0	0	1	0	1	1	1	0	VL46	$VGMA16 + (VGMA15 - VGMA16) \times 1043 / 1960$
2FH	0	0	1	0	1	1	1	1	VL47	$VGMA16 + (VGMA15 - VGMA16) \times 1104 / 1960$
30H	0	0	1	1	0	0	0	0	VL48	$VGMA16 + (VGMA15 - VGMA16) \times 1162 / 1960$
31H	0	0	1	1	0	0	0	1	VL49	$VGMA16 + (VGMA15 - VGMA16) \times 1220 / 1960$
32H	0	0	1	1	0	0	1	0	VL50	$VGMA16 + (VGMA15 - VGMA16) \times 1278 / 1960$
33H	0	0	1	1	0	0	1	1	VL51	$VGMA16 + (VGMA15 - VGMA16) \times 1336 / 1960$
34H	0	0	1	1	0	1	0	0	VL52	$VGMA16 + (VGMA15 - VGMA16) \times 1391 / 1960$
35H	0	0	1	1	0	1	0	1	VL53	$VGMA16 + (VGMA15 - VGMA16) \times 1446 / 1960$
36H	0	0	1	1	0	1	1	0	VL54	$VGMA16 + (VGMA15 - VGMA16) \times 1501 / 1960$
37H	0	0	1	1	0	1	1	1	VL55	$VGMA16 + (VGMA15 - VGMA16) \times 1556 / 1960$
38H	0	0	1	1	1	0	0	0	VL56	$VGMA16 + (VGMA15 - VGMA16) \times 1608 / 1960$
39H	0	0	1	1	1	0	0	1	VL57	$VGMA16 + (VGMA15 - VGMA16) \times 1660 / 1960$
3AH	0	0	1	1	1	0	1	0	VL58	$VGMA16 + (VGMA15 - VGMA16) \times 1712 / 1960$
3BH	0	0	1	1	1	0	1	1	VL59	$VGMA16 + (VGMA15 - VGMA16) \times 1764 / 1960$
3CH	0	0	1	1	1	1	0	0	VL60	$VGMA16 + (VGMA15 - VGMA16) \times 1813 / 1960$
3DH	0	0	1	1	1	1	0	1	VL61	$VGMA16 + (VGMA15 - VGMA16) \times 1862 / 1960$
3EH	0	0	1	1	1	1	1	0	VL62	$VGMA16 + (VGMA15 - VGMA16) \times 1911 / 1960$
3FH	0	0	1	1	1	1	1	1	VL63	$VGMA15$
40H	0	1	0	0	0	0	0	0	VL64	$VGMA15 + (VGMA14 - VGMA15) \times 49 / 2188$
41H	0	1	0	0	0	0	0	1	VL65	$VGMA15 + (VGMA14 - VGMA15) \times 98 / 2188$
42H	0	1	0	0	0	0	1	0	VL66	$VGMA15 + (VGMA14 - VGMA15) \times 147 / 2188$
43H	0	1	0	0	0	0	1	1	VL67	$VGMA15 + (VGMA14 - VGMA15) \times 196 / 2188$
44H	0	1	0	0	0	1	0	0	VL68	$VGMA15 + (VGMA14 - VGMA15) \times 242 / 2188$
45H	0	1	0	0	0	1	0	1	VL69	$VGMA15 + (VGMA14 - VGMA15) \times 288 / 2188$
46H	0	1	0	0	0	1	1	0	VL70	$VGMA15 + (VGMA14 - VGMA15) \times 334 / 2188$
47H	0	1	0	0	0	1	1	1	VL71	$VGMA15 + (VGMA14 - VGMA15) \times 380 / 2188$
48H	0	1	0	0	1	0	0	0	VL72	$VGMA15 + (VGMA14 - VGMA15) \times 423 / 2188$
49H	0	1	0	0	1	0	0	1	VL73	$VGMA15 + (VGMA14 - VGMA15) \times 466 / 2188$
4AH	0	1	0	0	1	0	1	0	VL74	$VGMA15 + (VGMA14 - VGMA15) \times 509 / 2188$
4BH	0	1	0	0	1	0	1	1	VL75	$VGMA15 + (VGMA14 - VGMA15) \times 552 / 2188$
4CH	0	1	0	0	1	1	0	0	VL76	$VGMA15 + (VGMA14 - VGMA15) \times 592 / 2188$
4DH	0	1	0	0	1	1	0	1	VL77	$VGMA15 + (VGMA14 - VGMA15) \times 632 / 2188$
4EH	0	1	0	0	1	1	1	0	VL78	$VGMA15 + (VGMA14 - VGMA15) \times 672 / 2188$
4FH	0	1	0	0	1	1	1	1	VL79	$VGMA15 + (VGMA14 - VGMA15) \times 712 / 2188$

SAMSUNG
ELECTRONICS

Table 2. Relationship between Input Data and Output Voltage Value (10)

Input data	DX7	DX6	DX5	DX4	DX3	DX2	DX1	DX0	G/S	Output voltage
50H	0	1	0	1	0	0	0	0	VL80	$VGMA15 + (VGMA14 - VGMA15) \times 750 / 2188$
51H	0	1	0	1	0	0	0	1	VL81	$VGMA15 + (VGMA14 - VGMA15) \times 788 / 2188$
52H	0	1	0	1	0	0	1	0	VL82	$VGMA15 + (VGMA14 - VGMA15) \times 826 / 2188$
53H	0	1	0	1	0	0	1	1	VL83	$VGMA15 + (VGMA14 - VGMA15) \times 864 / 2188$
54H	0	1	0	1	0	1	0	0	VL84	$VGMA15 + (VGMA14 - VGMA15) \times 901 / 2188$
55H	0	1	0	1	0	1	0	1	VL85	$VGMA15 + (VGMA14 - VGMA15) \times 938 / 2188$
56H	0	1	0	1	0	1	1	0	VL86	$VGMA15 + (VGMA14 - VGMA15) \times 975 / 2188$
57H	0	1	0	1	0	1	1	1	VL87	$VGMA15 + (VGMA14 - VGMA15) \times 1012 / 2188$
58H	0	1	0	1	1	0	0	0	VL88	$VGMA15 + (VGMA14 - VGMA15) \times 1047 / 2188$
59H	0	1	0	1	1	0	0	1	VL89	$VGMA15 + (VGMA14 - VGMA15) \times 1082 / 2188$
5AH	0	1	0	1	1	0	1	0	VL90	$VGMA15 + (VGMA14 - VGMA15) \times 1117 / 2188$
5BH	0	1	0	1	1	0	1	1	VL91	$VGMA15 + (VGMA14 - VGMA15) \times 1152 / 2188$
5CH	0	1	0	1	1	1	0	0	VL92	$VGMA15 + (VGMA14 - VGMA15) \times 1186 / 2188$
5DH	0	1	0	1	1	1	0	1	VL93	$VGMA15 + (VGMA14 - VGMA15) \times 1220 / 2188$
5EH	0	1	0	1	1	1	1	0	VL94	$VGMA15 + (VGMA14 - VGMA15) \times 1254 / 2188$
5FH	0	1	0	1	1	1	1	1	VL95	$VGMA15 + (VGMA14 - VGMA15) \times 1288 / 2188$
60H	0	1	1	0	0	0	0	0	VL96	$VGMA15 + (VGMA14 - VGMA15) \times 1320 / 2188$
61H	0	1	1	0	0	0	0	1	VL97	$VGMA15 + (VGMA14 - VGMA15) \times 1352 / 2188$
62H	0	1	1	0	0	0	1	0	VL98	$VGMA15 + (VGMA14 - VGMA15) \times 1384 / 2188$
63H	0	1	1	0	0	0	1	1	VL99	$VGMA15 + (VGMA14 - VGMA15) \times 1416 / 2188$
64H	0	1	1	0	0	1	0	0	VL100	$VGMA15 + (VGMA14 - VGMA15) \times 1447 / 2188$
65H	0	1	1	0	0	1	0	1	VL101	$VGMA15 + (VGMA14 - VGMA15) \times 1478 / 2188$
66H	0	1	1	0	0	1	1	0	VL102	$VGMA15 + (VGMA14 - VGMA15) \times 1509 / 2188$
67H	0	1	1	0	0	1	1	1	VL103	$VGMA15 + (VGMA14 - VGMA15) \times 1540 / 2188$
68H	0	1	1	0	1	0	0	0	VL104	$VGMA15 + (VGMA14 - VGMA15) \times 1569 / 2188$
69H	0	1	1	0	1	0	0	1	VL105	$VGMA15 + (VGMA14 - VGMA15) \times 1598 / 2188$
6AH	0	1	1	0	1	0	1	0	VL106	$VGMA15 + (VGMA14 - VGMA15) \times 1627 / 2188$
6BH	0	1	1	0	1	0	1	1	VL107	$VGMA15 + (VGMA14 - VGMA15) \times 1656 / 2188$
6CH	0	1	1	0	1	1	0	0	VL108	$VGMA15 + (VGMA14 - VGMA15) \times 1684 / 2188$
6DH	0	1	1	0	1	1	0	1	VL109	$VGMA15 + (VGMA14 - VGMA15) \times 1712 / 2188$
6EH	0	1	1	0	1	1	1	0	VL110	$VGMA15 + (VGMA14 - VGMA15) \times 1740 / 2188$
6FH	0	1	1	0	1	1	1	1	VL111	$VGMA15 + (VGMA14 - VGMA15) \times 1768 / 2188$
70H	0	1	1	1	0	0	0	0	VL112	$VGMA15 + (VGMA14 - VGMA15) \times 1796 / 2188$
71H	0	1	1	1	0	0	0	1	VL113	$VGMA15 + (VGMA14 - VGMA15) \times 1824 / 2188$
72H	0	1	1	1	0	0	1	0	VL114	$VGMA15 + (VGMA14 - VGMA15) \times 1852 / 2188$
73H	0	1	1	1	0	0	1	1	VL115	$VGMA15 + (VGMA14 - VGMA15) \times 1880 / 2188$
74H	0	1	1	1	0	1	0	0	VL116	$VGMA15 + (VGMA14 - VGMA15) \times 1906 / 2188$
75H	0	1	1	1	0	1	0	1	VL117	$VGMA15 + (VGMA14 - VGMA15) \times 1932 / 2188$
76H	0	1	1	1	0	1	1	0	VL118	$VGMA15 + (VGMA14 - VGMA15) \times 1958 / 2188$
77H	0	1	1	1	0	1	1	1	VL119	$VGMA15 + (VGMA14 - VGMA15) \times 1984 / 2188$

SAMSUNG
ELECTRONICS

Table 2. Relationship between Input Data and Output Voltage Value (11)

Input data	DX7	DX6	DX5	DX4	DX3	DX2	DX1	DX0	G/S	Output voltage
78H	0	1	1	1	1	0	0	0	VL120	VGMA15 + (VGMA14 - VGMA15) $\times$ 2010 / 2188
79H	0	1	1	1	1	0	0	1	VL121	VGMA15 + (VGMA14 - VGMA15) $\times$ 2036 / 2188
7AH	0	1	1	1	1	0	1	0	VL122	VGMA15 + (VGMA14 - VGMA15) $\times$ 2062 / 2188
7BH	0	1	1	1	1	0	1	1	VL123	VGMA15 + (VGMA14 - VGMA15) $\times$ 2088 / 2188
7CH	0	1	1	1	1	1	0	0	VL124	VGMA15 + (VGMA14 - VGMA15) $\times$ 2113 / 2188
7DH	0	1	1	1	1	1	0	1	VL125	VGMA15 + (VGMA14 - VGMA15) $\times$ 2138 / 2188
7EH	0	1	1	1	1	1	1	0	VL126	VGMA15 + (VGMA14 - VGMA15) $\times$ 2163 / 2188
7FH	0	1	1	1	1	1	1	1	VL127	VGMA14
80H	1	0	0	0	0	0	0	0	VL128	VGMA14 + (VGMA13 - VGMA14) $\times$ 25 / 2776
81H	1	0	0	0	0	0	0	1	VL129	VGMA14 + (VGMA13 - VGMA14) $\times$ 50 / 2776
82H	1	0	0	0	0	0	1	0	VL130	VGMA14 + (VGMA13 - VGMA14) $\times$ 75 / 2776
83H	1	0	0	0	0	0	1	1	VL131	VGMA14 + (VGMA13 - VGMA14) $\times$ 100 / 2776
84H	1	0	0	0	0	1	0	0	VL132	VGMA14 + (VGMA13 - VGMA14) $\times$ 128 / 2776
85H	1	0	0	0	0	1	0	1	VL133	VGMA14 + (VGMA13 - VGMA14) $\times$ 156 / 2776
86H	1	0	0	0	0	1	1	0	VL134	VGMA14 + (VGMA13 - VGMA14) $\times$ 184 / 2776
87H	1	0	0	0	0	1	1	1	VL135	VGMA14 + (VGMA13 - VGMA14) $\times$ 212 / 2776
88H	1	0	0	0	1	0	0	0	VL136	VGMA14 + (VGMA13 - VGMA14) $\times$ 243 / 2776
89H	1	0	0	0	1	0	0	1	VL137	VGMA14 + (VGMA13 - VGMA14) $\times$ 274 / 2776
8AH	1	0	0	0	1	0	1	0	VL138	VGMA14 + (VGMA13 - VGMA14) $\times$ 305 / 2776
8BH	1	0	0	0	1	0	1	1	VL139	VGMA14 + (VGMA13 - VGMA14) $\times$ 336 / 2776
8CH	1	0	0	0	1	1	0	0	VL140	VGMA14 + (VGMA13 - VGMA14) $\times$ 370 / 2776
8DH	1	0	0	0	1	1	0	1	VL141	VGMA14 + (VGMA13 - VGMA14) $\times$ 404 / 2776
8EH	1	0	0	0	1	1	1	0	VL142	VGMA14 + (VGMA13 - VGMA14) $\times$ 438 / 2776
8FH	1	0	0	0	1	1	1	1	VL143	VGMA14 + (VGMA13 - VGMA14) $\times$ 472 / 2776
90H	1	0	0	1	0	0	0	0	VL144	VGMA14 + (VGMA13 - VGMA14) $\times$ 506 / 2776
91H	1	0	0	1	0	0	0	1	VL145	VGMA14 + (VGMA13 - VGMA14) $\times$ 540 / 2776
92H	1	0	0	1	0	0	1	0	VL146	VGMA14 + (VGMA13 - VGMA14) $\times$ 574 / 2776
93H	1	0	0	1	0	0	1	1	VL147	VGMA14 + (VGMA13 - VGMA14) $\times$ 608 / 2776
94H	1	0	0	1	0	1	0	0	VL148	VGMA14 + (VGMA13 - VGMA14) $\times$ 645 / 2776
95H	1	0	0	1	0	1	0	1	VL149	VGMA14 + (VGMA13 - Value14) $\times$ 682 / 2776
96H	1	0	0	1	0	1	1	0	VL150	VGMA14 + (VGMA13 - VGMA14) $\times$ 719 / 2776
97H	1	0	0	1	0	1	1	1	VL151	VGMA14 + (VGMA13 - VGMA14) $\times$ 756 / 2776
98H	1	0	0	1	1	0	0	0	VL152	VGMA14 + (VGMA13 - VGMA14) $\times$ 796 / 2776
99H	1	0	0	1	1	0	0	1	VL153	VGMA14 + (VGMA13 - VGMA14) $\times$ 836 / 2776
9AH	1	0	0	1	1	0	1	0	VL154	VGMA14 + (VGMA13 - VGMA14) $\times$ 876 / 2776
9BH	1	0	0	1	1	0	1	1	VL155	VGMA14 + (VGMA13 - VGMA14) $\times$ 916 / 2776
9CH	1	0	0	1	1	1	0	0	VL156	VGMA14 + (VGMA13 - VGMA14) $\times$ 959 / 2776
9DH	1	0	0	1	1	1	0	1	VL157	VGMA14 + (VGMA13 - VGMA14) $\times$ 1002 / 2776
9EH	1	0	0	1	1	1	1	0	VL158	VGMA14 + (VGMA13 - VGMA14) $\times$ 1045 / 2776
9FH	1	0	0	1	1	1	1	1	VL159	VGMA14 + (VGMA13 - VGMA14) $\times$ 1088 / 2776

SAMSUNG ELECTRONICS

Table 2. Relationship between Input Data and Output Voltage Value (12)

Input data	DX7	DX6	DX5	DX4	DX3	DX2	DX1	DX0	G/S	Output voltage
A0H	1	0	1	0	0	0	0	0	VL160	$VGMA14 + (VGMA13 - VGMA14) \times 1131 / 2776$
A1H	1	0	1	0	0	0	0	1	VL161	$VGMA14 + (VGMA13 - VGMA14) \times 1174 / 2776$
A2H	1	0	1	0	0	0	1	0	VL162	$VGMA14 + (VGMA13 - VGMA14) \times 1217 / 2776$
A3H	1	0	1	0	0	0	1	1	VL163	$VGMA14 + (VGMA13 - VGMA14) \times 1260 / 2776$
A4H	1	0	1	0	0	1	0	0	VL164	$VGMA14 + (VGMA13 - VGMA14) \times 1306 / 2776$
A5H	1	0	1	0	0	1	0	1	VL165	$VGMA14 + (VGMA13 - VGMA14) \times 1352 / 2776$
A6H	1	0	1	0	0	1	1	0	VL166	$VGMA14 + (VGMA13 - VGMA14) \times 1398 / 2776$
A7H	1	0	1	0	0	1	1	1	VL167	$VGMA14 + (VGMA13 - VGMA14) \times 1444 / 2776$
A8H	1	0	1	0	1	0	0	0	VL168	$VGMA14 + (VGMA13 - VGMA14) \times 1493 / 2776$
A9H	1	0	1	0	1	0	0	1	VL169	$VGMA14 + (VGMA13 - VGMA14) \times 1542 / 2776$
AAH	1	0	1	0	1	0	1	0	VL170	$VGMA14 + (VGMA13 - VGMA14) \times 1591 / 2776$
ABH	1	0	1	0	1	0	1	1	VL171	$VGMA14 + (VGMA13 - VGMA14) \times 1640 / 2776$
ACH	1	0	1	0	1	1	0	0	VL172	$VGMA14 + (VGMA13 - VGMA14) \times 1692 / 2776$
ADH	1	0	1	0	1	1	0	1	VL173	$VGMA14 + (VGMA13 - VGMA14) \times 1744 / 2776$
AEH	1	0	1	0	1	1	1	0	VL174	$VGMA14 + (VGMA13 - VGMA14) \times 1796 / 2776$
AFH	1	0	1	0	1	1	1	1	VL175	$VGMA14 + (VGMA13 - VGMA14) \times 1848 / 2776$
B0H	1	0	1	1	0	0	0	0	VL176	$VGMA14 + (VGMA13 - VGMA14) \times 1903 / 2776$
B1H	1	0	1	1	0	0	0	1	VL177	$VGMA14 + (VGMA13 - VGMA14) \times 1958 / 2776$
B2H	1	0	1	1	0	0	1	0	VL178	$VGMA14 + (VGMA13 - VGMA14) \times 2013 / 2776$
B3H	1	0	1	1	0	0	1	1	VL179	$VGMA14 + (VGMA13 - VGMA14) \times 2068 / 2776$
B4H	1	0	1	1	0	1	0	0	VL180	$VGMA14 + (VGMA13 - VGMA14) \times 2126 / 2776$
B5H	1	0	1	1	0	1	0	1	VL181	$VGMA14 + (VGMA13 - VGMA14) \times 2184 / 2776$
B6H	1	0	1	1	0	1	1	0	VL182	$VGMA14 + (VGMA13 - VGMA14) \times 2242 / 2776$
B7H	1	0	1	1	0	1	1	1	VL183	$VGMA14 + (VGMA13 - VGMA14) \times 2300 / 2776$
B8H	1	0	1	1	1	0	0	0	VL184	$VGMA14 + (VGMA13 - VGMA14) \times 2358 / 2776$
B9H	1	0	1	1	1	0	0	1	VL185	$VGMA14 + (VGMA13 - VGMA14) \times 2416 / 2776$
BAH	1	0	1	1	1	0	1	0	VL186	$VGMA14 + (VGMA13 - VGMA14) \times 2474 / 2776$
BBH	1	0	1	1	1	0	1	1	VL187	$VGMA14 + (VGMA13 - VGMA14) \times 2532 / 2776$
BCH	1	0	1	1	1	1	0	0	VL188	$VGMA14 + (VGMA13 - VGMA14) \times 2593 / 2776$
BDH	1	0	1	1	1	1	0	1	VL189	$VGMA14 + (VGMA13 - VGMA14) \times 2654 / 2776$
BEH	1	0	1	1	1	1	1	0	VL190	$VGMA14 + (VGMA13 - VGMA14) \times 2715 / 2776$
BFH	1	0	1	1	1	1	1	1	VL191	VGMA13
C0H	1	1	0	0	0	0	0	0	VL192	$VGMA13 + (VGMA12 - VGMA13) \times 61 / 2185$
C1H	1	1	0	0	0	0	0	1	VL193	$VGMA13 + (VGMA12 - VGMA13) \times 122 / 2185$
C2H	1	1	0	0	0	0	1	0	VL194	$VGMA13 + (VGMA12 - VGMA13) \times 183 / 2185$
C3H	1	1	0	0	0	0	1	1	VL195	$VGMA13 + (VGMA12 - VGMA13) \times 244 / 2185$
C4H	1	1	0	0	0	1	0	0	VL196	$VGMA13 + (VGMA12 - VGMA13) \times 308 / 2185$
C5H	1	1	0	0	0	1	0	1	VL197	$VGMA13 + (VGMA12 - VGMA13) \times 372 / 2185$
C6H	1	1	0	0	0	1	1	0	VL198	$VGMA13 + (VGMA12 - VGMA13) \times 436 / 2185$
C7H	1	1	0	0	0	1	1	1	VL199	$VGMA13 + (VGMA12 - VGMA13) \times 500 / 2185$

SAMSUNG
ELECTRONICS

Table 2. Relationship between Input Data and Output Voltage Value (13)

Input data	DX7	DX6	DX5	DX4	DX3	DX2	DX1	DX0	G/S	Output voltage
C8H	1	1	0	0	1	0	0	0	VL200	$VGMA13 + (VGMA12 - VGMA13) \times 564 / 2185$
C9H	1	1	0	0	1	0	0	1	VL201	$VGMA13 + (VGMA12 - VGMA13) \times 628 / 2185$
CAH	1	1	0	0	1	0	1	0	VL202	$VGMA13 + (VGMA12 - VGMA13) \times 692 / 2185$
CBH	1	1	0	0	1	0	1	1	VL203	$VGMA13 + (VGMA12 - VGMA13) \times 756 / 2185$
CCH	1	1	0	0	1	1	0	0	VL204	$VGMA13 + (VGMA12 - VGMA13) \times 823 / 2185$
CDH	1	1	0	0	1	1	0	1	VL205	$VGMA13 + (VGMA12 - VGMA13) \times 890 / 2185$
CEH	1	1	0	0	1	1	1	0	VL206	$VGMA13 + (VGMA12 - VGMA13) \times 957 / 2185$
CFH	1	1	0	0	1	1	1	1	VL207	$VGMA13 + (VGMA12 - VGMA13) \times 1024 / 2185$
D0H	1	1	0	1	0	0	0	0	VL208	$VGMA13 + (VGMA12 - VGMA13) \times 1091 / 2185$
D1H	1	1	0	1	0	0	0	1	VL209	$VGMA13 + (VGMA12 - VGMA13) \times 1158 / 2185$
D2H	1	1	0	1	0	0	1	0	VL210	$VGMA13 + (VGMA12 - VGMA13) \times 1225 / 2185$
D3H	1	1	0	1	0	0	1	1	VL211	$VGMA13 + (VGMA12 - VGMA13) \times 1292 / 2185$
D4H	1	1	0	1	0	1	0	0	VL212	$VGMA13 + (VGMA12 - VGMA13) \times 1362 / 2185$
D5H	1	1	0	1	0	1	0	1	VL213	$VGMA13 + (VGMA12 - VGMA13) \times 1432 / 2185$
D6H	1	1	0	1	0	1	1	0	VL214	$VGMA13 + (VGMA12 - VGMA13) \times 1502 / 2185$
D7H	1	1	0	1	0	1	1	1	VL215	$VGMA13 + (VGMA12 - VGMA13) \times 1572 / 2185$
D8H	1	1	0	1	1	0	0	0	VL216	$VGMA13 + (VGMA12 - VGMA13) \times 1645 / 2185$
D9H	1	1	0	1	1	0	0	1	VL217	$VGMA13 + (VGMA12 - VGMA13) \times 1718 / 2185$
DAH	1	1	0	1	1	0	1	0	VL218	$VGMA13 + (VGMA12 - VGMA13) \times 1791 / 2185$
DBH	1	1	0	1	1	0	1	1	VL219	$VGMA13 + (VGMA12 - VGMA13) \times 1864 / 2185$
DCH	1	1	0	1	1	1	0	0	VL220	$VGMA13 + (VGMA12 - VGMA13) \times 1938 / 2185$
DDH	1	1	0	1	1	1	0	1	VL221	$VGMA13 + (VGMA12 - VGMA13) \times 2016 / 2185$
DEH	1	1	0	1	1	1	1	0	VL222	$VGMA13 + (VGMA12 - VGMA13) \times 2098 / 2185$
DFH	1	1	0	1	1	1	1	1	VL223	VGMA12
E0H	1	1	1	0	0	0	0	0	VL224	$VGMA12 + (VGMA11 - VGMA12) \times 87 / 3336$
E1H	1	1	1	0	0	0	0	1	VL225	$VGMA12 + (VGMA11 - VGMA12) \times 176 / 3336$
E2H	1	1	1	0	0	0	1	0	VL226	$VGMA12 + (VGMA11 - VGMA12) \times 267 / 3336$
E3H	1	1	1	0	0	0	1	1	VL227	$VGMA12 + (VGMA11 - VGMA12) \times 359 / 3336$
E4H	1	1	1	0	0	1	0	0	VL228	$VGMA12 + (VGMA11 - VGMA12) \times 453 / 3336$
E5H	1	1	1	0	0	1	0	1	VL229	$VGMA12 + (VGMA11 - VGMA12) \times 548 / 3336$
E6H	1	1	1	0	0	1	1	0	VL230	$VGMA12 + (VGMA11 - VGMA12) \times 644 / 3336$
E7H	1	1	1	0	0	1	1	1	VL231	$VGMA12 + (VGMA11 - VGMA12) \times 741 / 3336$
E8H	1	1	1	0	1	0	0	0	VL232	$VGMA12 + (VGMA11 - VGMA12) \times 838 / 3336$
E9H	1	1	1	0	1	0	0	1	VL233	$VGMA12 + (VGMA11 - VGMA12) \times 936 / 3336$
EAH	1	1	1	0	1	0	1	0	VL234	$VGMA12 + (VGMA11 - VGMA12) \times 1035 / 3336$
EBH	1	1	1	0	1	0	1	1	VL235	$VGMA12 + (VGMA11 - VGMA12) \times 1135 / 3336$
ECH	1	1	1	0	1	1	0	0	VL236	$VGMA12 + (VGMA11 - VGMA12) \times 1237 / 3336$
EDH	1	1	1	0	1	1	0	1	VL237	$VGMA12 + (VGMA11 - VGMA12) \times 1341 / 3336$
EEH	1	1	1	0	1	1	1	0	VL238	$VGMA12 + (VGMA11 - VGMA12) \times 1445 / 3336$
EFH	1	1	1	0	1	1	1	1	VL239	$VGMA12 + (VGMA11 - VGMA12) \times 1551 / 3336$

Table 2. Relationship between Input Data and Output Voltage Value (14)

Input data	DX7	DX6	DX5	DX4	DX3	DX2	DX1	DX0	G/S	Output voltage
F0H	1	1	1	1	0	0	0	0	VL240	$VGMA12 + (VGMA11 - VGMA12) \times 1659 / 3336$
F1H	1	1	1	1	0	0	0	1	VL241	$VGMA12 + (VGMA11 - VGMA12) \times 1769 / 3336$
F2H	1	1	1	1	0	0	1	0	VL242	$VGMA12 + (VGMA11 - VGMA12) \times 1879 / 3336$
F3H	1	1	1	1	0	0	1	1	VL243	$VGMA12 + (VGMA11 - VGMA12) \times 1991 / 3336$
F4H	1	1	1	1	0	1	0	0	VL244	$VGMA12 + (VGMA11 - VGMA12) \times 2105 / 3336$
F5H	1	1	1	1	0	1	0	1	VL245	$VGMA12 + (VGMA11 - VGMA12) \times 2221 / 3336$
F6H	1	1	1	1	0	1	1	0	VL246	$VGMA12 + (VGMA11 - VGMA12) \times 2339 / 3336$
F7H	1	1	1	1	0	1	1	1	VL247	$VGMA12 + (VGMA11 - VGMA12) \times 2457 / 3336$
F8H	1	1	1	1	1	0	0	0	VL248	$VGMA12 + (VGMA11 - VGMA12) \times 2577 / 3336$
F9H	1	1	1	1	1	0	0	1	VL249	$VGMA12 + (VGMA11 - VGMA12) \times 2697 / 3336$
FAH	1	1	1	1	1	0	1	0	VL250	$VGMA12 + (VGMA11 - VGMA12) \times 2819 / 3336$
FBH	1	1	1	1	1	0	1	1	VL251	$VGMA12 + (VGMA11 - VGMA12) \times 2943 / 3336$
FCH	1	1	1	1	1	1	0	0	VL252	$VGMA12 + (VGMA11 - VGMA12) \times 3070 / 3336$
FDH	1	1	1	1	1	1	0	1	VL253	$VGMA12 + (VGMA11 - VGMA12) \times 3201 / 3336$
FEH	1	1	1	1	1	1	1	0	VL254	VGMA11
FFH	1	1	1	1	1	1	1	1	VL255	VGMA10

SAMSUNG
ELECTRONICS

ABSOLUTE MAXIMUM RATINGS

Table 3. Absolute Maximum Ratings (VSS1 = VSS2 = 0 V)

Parameter	Symbol	Ratings	Unit
Logic supply voltage	VDD1	-0.3 to 5.0	V
Driver supply voltage	VDD2	-0.3 to 16.0	V
Input voltage	VGMA1 - 18	-0.3 to VDD2+0.3	V
	Others	-0.3 to VDD1+0.3	
Output voltage	DIO1, 2	-0.3 to VDD1+0.3	V
	Y1 – Y384	-0.3 to VDD2+0.3	
Operating power dissipation	Pd	300 [1]	mW
Operation temperature	Top	-20 to 75	°C
Storage temperature	Tstg	-55 to 125	°C

CAUTIONS:

If LSIs are stressed beyond those listed above "absolute maximum ratings". they may be permanently destroyed. These are stress ratings only, and functional operation of the device at these or any other condition beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute maximum rated conditions for extended periods may affect device reliability.
Turn on power order: VDD1 → control signal input → VDD2 → VGMA1 to VGMA18
Turn off power order: VGMA1 to VGMA18 → VDD2 → control signal input → VDD1

RECOMMENDED OPERATION CONDITIONS

Table 4. Recommended Operation Conditions (Ta = -20 to 75 °C, VSS1 = VSS2 = 0 V)

Parameter	Symbol	Min.	Typ.	Max.	Unit
Logic supply voltage	VDD1	2.7	3.3	3.6	V
Driver supply voltage	VDD2 [1]	8.0	12.0	15.0	V
Gamma corrected voltage	VGMA1 – VGMA9	0.5 VDD2	-	VDD2 - 0.1	V
	VGMA10 – VGMA18	VSS2 + 0.1	-	0.5 VDD2	V
Driver part output voltage	Vyo	VSS2 + 0.1	-	VDD2 - 0.1	V
Maximum clock frequency	fmax	VDD1 = 2.7 V		65	MHz
Output load capacitance	CL[1]	-	-	200	pF / PIN

NOTE: 1. Relationship between TFT-LCD panel and Pd ($Pd \propto CL * (VDD2)^2 * fCLK1$)

TFT-LCD panel standard	CL = 140pF	CL = 200pF
SXGA	max. VDD2 = 15 V	max. VDD2 = 13 V

DC CHARACTERISTICS

Table 5. DC Characteristics (Ta = -20 to 75 °C, VDD1 = 2.7 to 3.6 V, VDD2 = 8 to 15 V, VSS1 = VSS2 = 0 V)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
High level input voltage	VIH	SHL, CLK2, D00 - D57, CLK1, DATPOL1, DATPOL2, POL, DIO1 (DIO2)	0.8 VDD1	-	VDD1	V
Low level input voltage	VIL		0	-	0.2 VDD1	
Input leakage current	IL		-1	-	1	μA
High level output voltage	VOH	DIO1 (DIO2), IO = -1.0 mA	VDD1 - 0.5	-	-	V
Low level output voltage	VOL	DIO1 (DIO2), IO = +1.0 mA	-	-	0.5	
Resistor	R0 - R254	Refer to Table 1. Resistor Strings	Rn × 0.7		Rn × 1.3	Ω
Driver output current	IVOH	VDD2 = 10.0 V, Vx = 3.5 V, Vyo = 9.5 V[1]	-	-2.0	-1.0	mA
	IVOL	VDD2 = 10.0 V, Vx = 6.5 V, Vyo = 0.5 V[1]	1.0	2.0	-	mA
Output voltage deviation	ΔVO	VSS2 + 0.1 V to VDD2 - 1.5 V	-	±7	±15	mV
		VDD2 - 1.5 V to VDD2 - 0.1 V	-	±10	±20	
Output RMS voltage deviation	dVrms[2]	Input data: 00H to FFH	-	±3	±10	
Output voltage range	Vyo	Input data: 00H to FFH	VSS2 + 0.1	-	VDD2 – 0.1	V
Logic part dynamic current	IDD1	VDD1 = 3.0 V [3]	-	4.0	7.0	mA
Driver part dynamic current	IDD2	VDD2 = 10 V [4]	-	10.0	15.0	

NOTES:

1. Vyo is the output voltage of analog output pins Y1 to Y384.
   Vx is the voltage applied to analog output pins Y1 to Y384.
2. dVrms is a maximum deviation value from ideal difference between high output and low output at the same gray scale.
3. CLK1 period is defined to be 15.6 μs at fCLK2 = 54 MHz, data pattern = 10101010
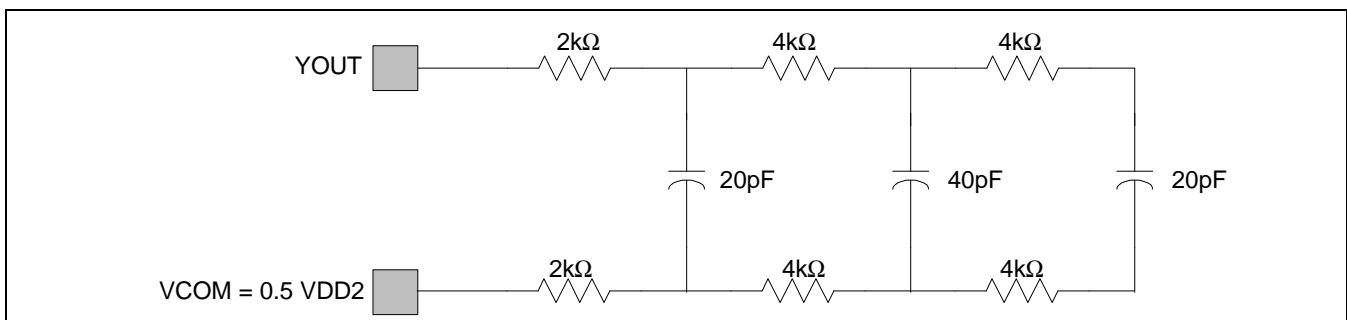   (checkerboard pattern), Ta = 25 °C.
4, Yout Load Condition

Figure 5. Yout Load Condition

SAMSUNG
ELECTRONICS

AC CHARACTERISTICS

Table 6. AC Characteristics (Ta = -20 to 75 °C, VDD1 = 2.7 to 3.6 V ,VDD2 = 8 to 15 V, VSS1 = VSS2 = 0 V)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Clock pulse width	PWCLK	-	15	-	-	ns
Clock pulse low period	PWCLK(L)	-	3	-	-	
Clock pulse high period	PWCLK(H)	-	3	-	-	
Data setup time	tSETUP1	-	0	-	-	
Data hold time	tHOLD1	-	2	-	-	
Start pulse setup time	tSETUP2	-	0	-	-	
Start pulse hold time	tHOLD2	-	2	-	-	
DATPOL-CLK2 setup time	tSETUP4	-	0	-	-	
DATPOL-CLK2 hold time	tHOLD4	-	2	-	-	
Start pulse delay time	tPLH1	CL = 20 pF	-	-	12	
CLK1 setup time	tSETUP3	-	2	-	-	CLK2 period
Driver output delay time1	tPHL1	PWCLK1 = 1 μs, Refer Figure 5. Yout Load Condition	-	-	4	μs
Driver output delay time2	tPHL2		-	-	8	
CLK1 pulse high period	PWCLK1	-	(3CLK2)	-	2	
Data invalid period	tINV	-	1	-	-	CLK2 period
Last data timing	tLDT	-	1	-	-	
CLK1-CLK2 time	tCLK1-CLK2	CLK1↑ or ↓ → CLK2↑	7	-	-	ns
POL-CLK1 time	tPOL-CLK1	POL↑ or ↓ → CLK1↑	7	-	-	ns

WAVEFORMS (VIH = 0.8 VDD1, VIL = 0.2 VDD1)

Figure 6. Waveforms, DEC = L

SAMSUNG
ELECTRONICS
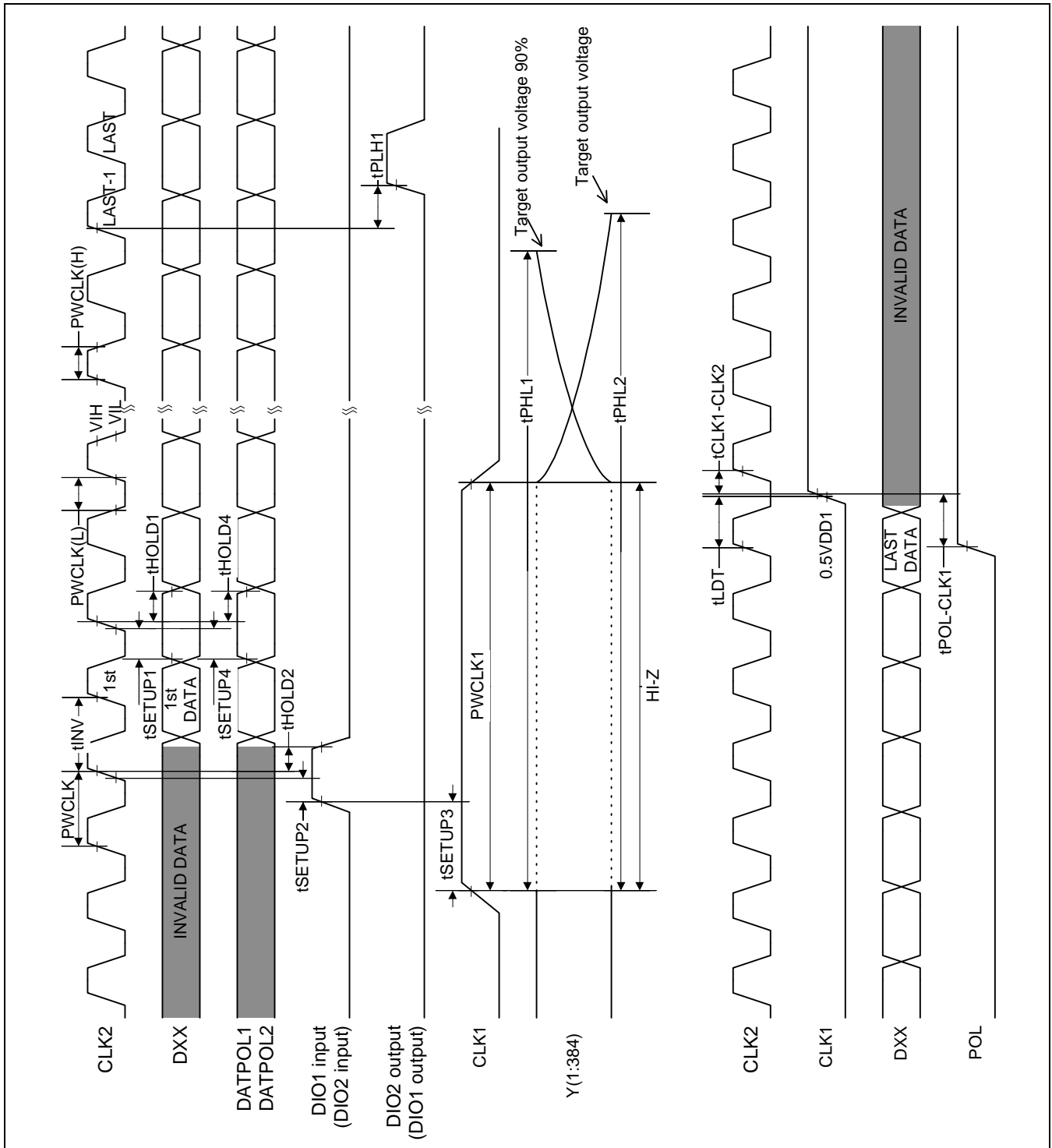
RELATIONSHIPS BETWEEN CLK1, START PULSE (DIO1, DIO2) AND BLANKING PERIOD

Figure 7. Waveforms