

# NOVATEK



## NT3980

### TFT LCD Source Driver

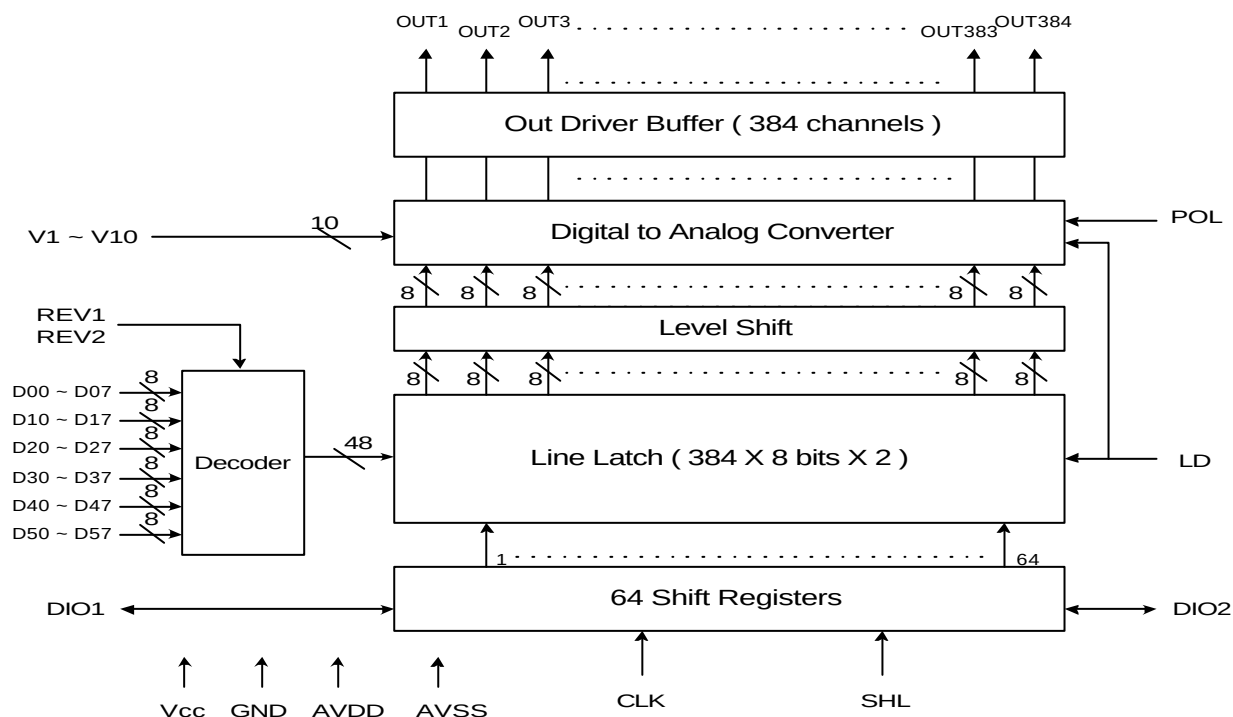
#### Features

- Output: 384 output channels
- 8-bit resolution /256 gray scales
- Dot inversion with polarity control
- V1 ~ V10 for adjusting Gamma correction
- Power for analog circuit: 7 ~ 10V
- Output dynamic range: 0.1V ~ AVDD-0.1
- Power consumption of analog circuit: 6mA
- Operating frequency: 70MHz(Vcc:3.0V~3.6V)  
45MHz(Vcc:2.5V~3.0V)
- Output deviation:  $\pm 2\text{mv}$
- Data inversion for reducing EMI
- Cascade function with bi-direction shift control
- CMOS silicon gate ( p-type substrate )
- TCP package

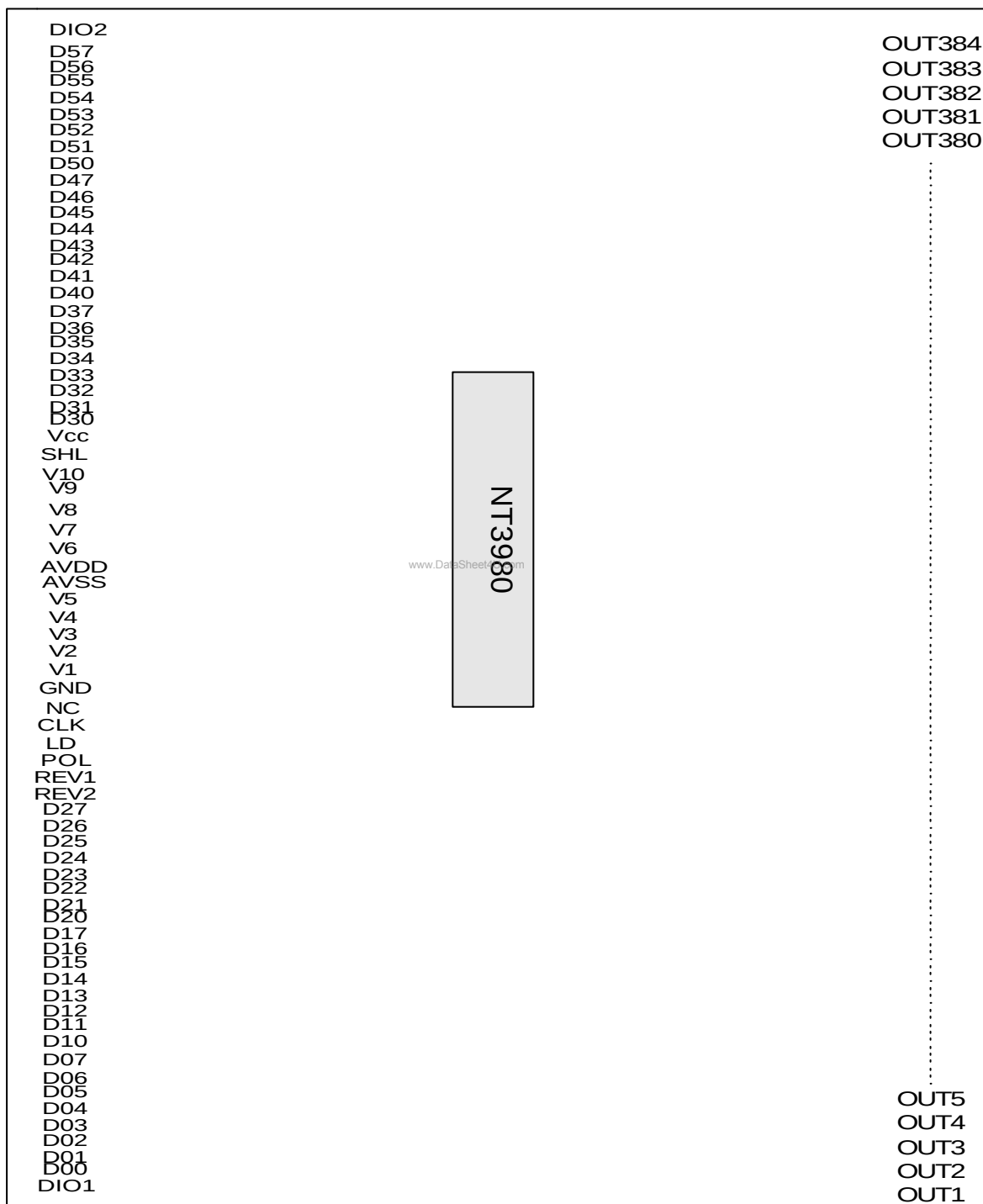
#### General Description

The NT3980 is a data driver IC for a color TFT LCD panel, XGA and SXGA applications. It receives 8 bit per-pixel digital display data, and generates output voltage for 256 grayscales, enabling a maximum of 16.77M display colors. For better performance, dot inversion and a wide range voltage output, 10V, are designed in this chip, and for reducing EMI, data inversion control is used. This chip supplies 10 sections of voltage-reference for Gamma correction.

#### Block diagram



NT3980 TCP ( Top view )



**Pin Description**

| Designation                                                                | I/O    | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |       |      |      |       |   |       |        |       |   |        |       |      |
|----------------------------------------------------------------------------|--------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|------|------|-------|---|-------|--------|-------|---|--------|-------|------|
| D07 ~ D00<br>D17 ~ D10<br>D27 ~ D20<br>D37 ~ D30<br>D47 ~ D40<br>D57 ~ D50 | I      | Data input. For six 8-bit data,2 pixels, of color data (R, G, B)<br>DX7 : MSB; DX0 : LSB                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |       |      |      |       |   |       |        |       |   |        |       |      |
| REV1<br>REV2                                                               | I      | Controls whether data are inverted or not.<br>When “REVx”=1 the data will be inverted. EX. “00” → “ FF”, “07” → “ F8”, “15” → “ EA”, and so on.<br>REV1: control D0x to D2x ,REV2: control D3x to D5x .<br>(These two pins can be connected together on TCP.)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |       |      |      |       |   |       |        |       |   |        |       |      |
| V1 ~ V10                                                                   | I      | Gamma correction reference voltage. The voltage of these pins must be AVSS< V10< V9< V8<V7<V6; V5<V4<V3<V2<V1< AVDD                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |       |      |      |       |   |       |        |       |   |        |       |      |
| OUT1 ~<br>OUT384                                                           | O      | Output drive signals;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |       |      |      |       |   |       |        |       |   |        |       |      |
| SHL                                                                        | I      | Selects left or right shift;<br>SHL=“ 1” : DIO1→OUT1,2,3,4,5,6→OUT7,8,9,10,11,12--→OUT379,380,381,382,383,384= DIO2<br>SHL=“ 0” : DIO1=OUT1,2,3,4,5,6←OUT7,8,9,10,11,12←-- OUT379,380,381,382,383,384←DIO2<br><table><tr><td>SHL</td><td>DIO1</td><td>DIO2</td><td>SHIFT</td></tr><tr><td>1</td><td>Input</td><td>Output</td><td>Right</td></tr><tr><td>0</td><td>Output</td><td>Input</td><td>Left</td></tr></table>                                                                                                                                                                                                                                                                                                                                                                                                                 | SHL   | DIO1 | DIO2 | SHIFT | 1 | Input | Output | Right | 0 | Output | Input | Left |
| SHL                                                                        | DIO1   | DIO2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | SHIFT |      |      |       |   |       |        |       |   |        |       |      |
| 1                                                                          | Input  | Output                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Right |      |      |       |   |       |        |       |   |        |       |      |
| 0                                                                          | Output | Input                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Left  |      |      |       |   |       |        |       |   |        |       |      |
| DIO1<br>DIO2                                                               | I/O    | Start pulse signal input/output<br>When SHL is applied high (SHL=“ 1” ), a start high-pulse on DIO1 is latched at the rising edge of the CLK. Then the data are latched serially onto internal latches at the rising edge of the CLK. After all line latches are filled with data, 64 clocks , a pulse is shifted out through the DIO2 pin at the rising edge of the CLK. This function can cascade two or more devices for dot expansion. In normal applications, the DIO2 signal of the first device is connected to the DIO1 of the second stage, the DIO2 of the second one is connected to the DIO1 of the third, and so on, like a daisy chain.<br>In contrast, when SHL is applied low, a start pulse inputs on DIO2, and a pulse outputs through DIO1.<br>*Remark : The input pulse-width of DIO1/2 may exceed 1 clock-cycle. |       |      |      |       |   |       |        |       |   |        |       |      |
| LD                                                                         | I      | Latches the polarity of outputs and switches the new data to outputs.<br>1.At the rising edge, the pin latches the “ POL” signal to control the polarity of the outputs.<br>2.This pin also controls the switch of the line registers that switches the new incoming data to outputs.<br>*Remark: The LD may switch the new data to outputs at anytime even if the line data are not completely full.                                                                                                                                                                                                                                                                                                                                                                                                                                 |       |      |      |       |   |       |        |       |   |        |       |      |
| CLK                                                                        | I      | Clock input; latching data onto the line latches at the rising edge .<br>After a start pulse input, display data latching is halted automatically after 64 clock cycles.<br>*Remark: At least one CLK cycle is necessary during the high-level period of LD.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |       |      |      |       |   |       |        |       |   |        |       |      |
| POL                                                                        | I      | Polarity selector for the dot-inversion control. Available at the rising edge of LD.<br>“ POL” value is latched at the rising edge of “ LD” to control the polarity of the even or odd outputs.<br>“ POL=1” indicates that even outputs are of positive polarity with a voltage range from V1~V5, and odd outputs are of negative polarity with a voltage range from V6 to V10. On the other hand, if LD receives low level “ POL” , even outputs are of negative polarity and odd outputs are of positive polarity.<br>POL=1: Even outputs range from V1 ~ V5<br>Odd outputs range from V6 ~ V10<br>POL=0: Even outputs range from V6 ~ V10<br>Odd outputs range from V1 ~ V5                                                                                                                                                        |       |      |      |       |   |       |        |       |   |        |       |      |
| AVDD                                                                       | I      | Power supply for analog circuit;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |       |      |      |       |   |       |        |       |   |        |       |      |
| AVSS                                                                       | I      | Ground pin for analog circuit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |       |      |      |       |   |       |        |       |   |        |       |      |
| Vcc                                                                        | I      | Power supply for digital circuit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |       |      |      |       |   |       |        |       |   |        |       |      |
| GND                                                                        | I      | Ground pin for digital circuit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |       |      |      |       |   |       |        |       |   |        |       |      |

**Power on/off sequence:**

This IC is a high-voltage LCD driver, so it may be damaged by a large current flow when an incorrect power sequence is used. The recommended connection sequence is to first connect the logical power, Vcc & GND and then connect the drive power, AVDD&AVSS with V1~V10. When shutting off the power, first shut off the drive power and then the logic system, or turn off all power simultaneously.

**Relationship between the order of input data and output channels**

(1) SHL="1", shift right, a start pulse from DIO1

| Output | OUT1       | OUT2    | OUT3    | OUT4    | OUT5    | OUT6    | --- | --- | OUT384    |
|--------|------------|---------|---------|---------|---------|---------|-----|-----|-----------|
| Order  | First data |         |         |         |         |         | --> |     | Last data |
| Data   | D07~D00    | D17~D10 | D27~D20 | D37~D30 | D47~D40 | D57~D50 | --- | --- | D57~D50   |

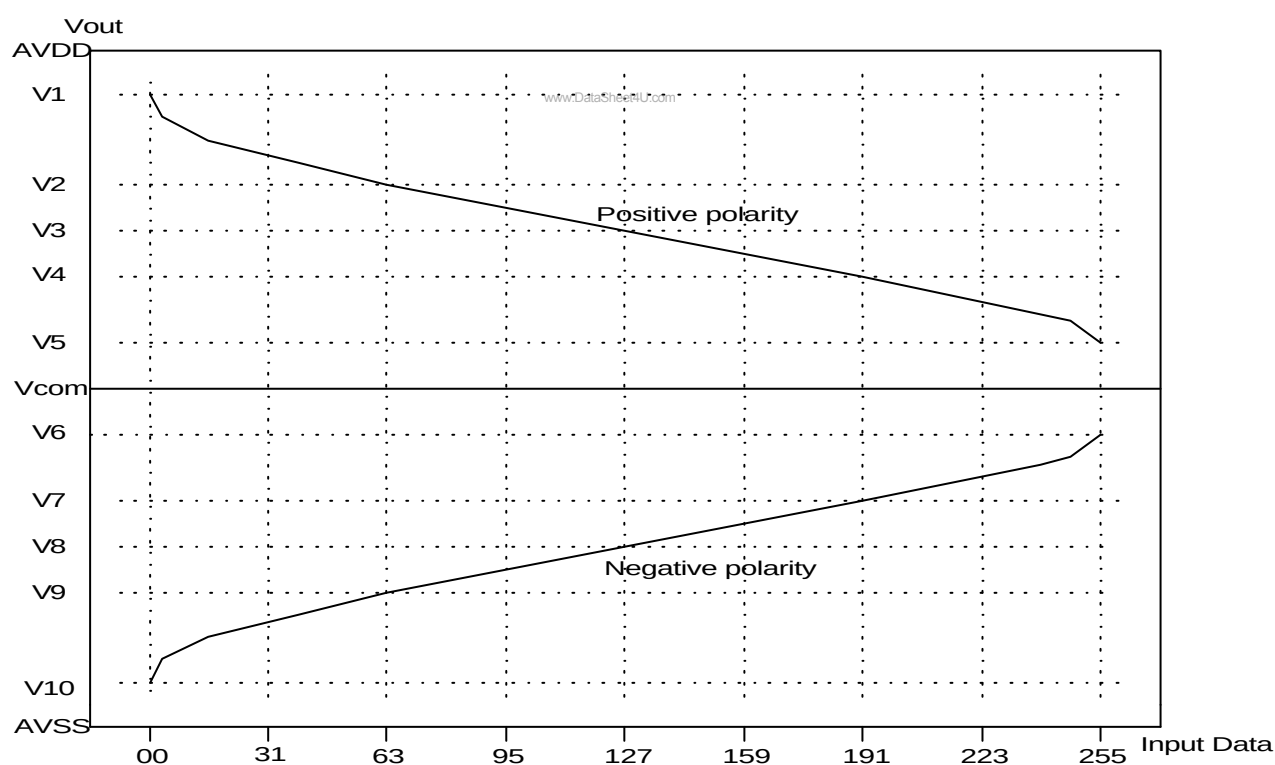
(2) SHL="0", shift left, a start pulse from DIO2

| Output | OUT379     | OUT380  | OUT381  | OUT382  | OUT383  | OUT384  | --- | --- | OUT6      |
|--------|------------|---------|---------|---------|---------|---------|-----|-----|-----------|
| Order  | First data |         |         |         |         |         | --> |     | Last data |
| Data   | D07~D00    | D17~D10 | D27~D20 | D37~D30 | D47~D40 | D57~D50 | --- | --- | D57~D50   |

**Relationship between input data and output voltage**

The figure below shows the relationship among the input data and the output voltage and the polarity. The range of V1~V5 is for positive polarity, and V6 ~ V10 for negative polarity. Please refer to the following page to get the relative resistors value and voltage calculation method.

**Gamma correction diagram**



Remark :  $AVDD - 0.1 > V1 > V2 > V3 > V4 > V5 > AVDD/2$ ;  $AVDD/2 > V6 > V7 > V8 > V9 > V10 > 0.1$

**Gamma correction resistor**

| V1,V10 | NAME | Resistor | V2,V9 | NAME | Resistor | V3,V8 | NAME | Resistor | V4,V7 | NAME | Resistor |
|--------|------|----------|-------|------|----------|-------|------|----------|-------|------|----------|
|        | R0   | 210      |       | R64  | 10       |       | R128 | 10       |       | R192 | 10       |
|        | R1   | 210      |       | R65  | 10       |       | R129 | 10       |       | R193 | 10       |
|        | R2   | 150      |       | R66  | 10       |       | R130 | 10       |       | R194 | 10       |
|        | R3   | 150      |       | R67  | 10       |       | R131 | 10       |       | R195 | 10       |
|        | R4   | 110      |       | R68  | 10       |       | R132 | 10       |       | R196 | 10       |
|        | R5   | 110      |       | R69  | 10       |       | R133 | 10       |       | R197 | 10       |
|        | R6   | 80       |       | R70  | 10       |       | R134 | 10       |       | R198 | 10       |
|        | R7   | 80       |       | R71  | 10       |       | R135 | 10       |       | R199 | 10       |
|        | R8   | 80       |       | R72  | 10       |       | R136 | 10       |       | R200 | 10       |
|        | R9   | 80       |       | R73  | 10       |       | R137 | 10       |       | R201 | 10       |
|        | R10  | 80       |       | R74  | 10       |       | R138 | 10       |       | R202 | 10       |
|        | R11  | 80       |       | R75  | 10       |       | R139 | 10       |       | R203 | 10       |
|        | R12  | 50       |       | R76  | 10       |       | R140 | 10       |       | R204 | 10       |
|        | R13  | 50       |       | R77  | 10       |       | R141 | 10       |       | R205 | 10       |
|        | R14  | 50       |       | R78  | 10       |       | R142 | 10       |       | R206 | 10       |
|        | R15  | 50       |       | R79  | 10       |       | R143 | 10       |       | R207 | 10       |
|        | R16  | 40       |       | R80  | 10       |       | R144 | 10       |       | R208 | 10       |
|        | R17  | 40       |       | R81  | 10       |       | R145 | 10       |       | R209 | 10       |
|        | R18  | 40       |       | R82  | 10       |       | R146 | 10       |       | R210 | 10       |
|        | R19  | 40       |       | R83  | 10       |       | R147 | 10       |       | R211 | 10       |
|        | R20  | 40       |       | R84  | 10       |       | R148 | 10       |       | R212 | 10       |
|        | R21  | 40       |       | R85  | 10       |       | R149 | 10       |       | R213 | 10       |
|        | R22  | 40       |       | R86  | 10       |       | R150 | 10       |       | R214 | 10       |
|        | R23  | 40       |       | R87  | 10       |       | R151 | 10       |       | R215 | 10       |
|        | R24  | 30       |       | R88  | 10       |       | R152 | 10       |       | R216 | 20       |
|        | R25  | 30       |       | R89  | 10       |       | R153 | 10       |       | R217 | 20       |
|        | R26  | 30       |       | R90  | 10       |       | R154 | 10       |       | R218 | 20       |
|        | R27  | 30       |       | R91  | 10       |       | R155 | 10       |       | R219 | 20       |
|        | R28  | 30       |       | R92  | 10       |       | R156 | 10       |       | R220 | 20       |
|        | R29  | 30       |       | R93  | 10       |       | R157 | 10       |       | R221 | 20       |
|        | R30  | 30       |       | R94  | 10       |       | R158 | 10       |       | R222 | 20       |
|        | R31  | 30       |       | R95  | 10       |       | R159 | 10       |       | R223 | 20       |
|        | R32  | 30       |       | R96  | 10       |       | R160 | 10       |       | R224 | 20       |
|        | R33  | 30       |       | R97  | 10       |       | R161 | 10       |       | R225 | 20       |
|        | R34  | 30       |       | R98  | 10       |       | R162 | 10       |       | R226 | 20       |
|        | R35  | 30       |       | R99  | 10       |       | R163 | 10       |       | R227 | 20       |
|        | R36  | 30       |       | R100 | 10       |       | R164 | 10       |       | R228 | 20       |
|        | R37  | 30       |       | R101 | 10       |       | R165 | 10       |       | R229 | 20       |
|        | R38  | 20       |       | R102 | 10       |       | R166 | 10       |       | R230 | 20       |
|        | R39  | 20       |       | R103 | 10       |       | R167 | 10       |       | R231 | 20       |
|        | R40  | 20       |       | R104 | 10       |       | R168 | 10       |       | R232 | 20       |
|        | R41  | 20       |       | R105 | 10       |       | R169 | 10       |       | R233 | 20       |
|        | R42  | 20       |       | R106 | 10       |       | R170 | 10       |       | R234 | 20       |
|        | R43  | 20       |       | R107 | 10       |       | R171 | 10       |       | R235 | 20       |
|        | R44  | 20       |       | R108 | 10       |       | R172 | 10       |       | R236 | 20       |
|        | R45  | 20       |       | R109 | 10       |       | R173 | 10       |       | R237 | 30       |
|        | R46  | 20       |       | R110 | 10       |       | R174 | 10       |       | R238 | 30       |
|        | R47  | 20       |       | R111 | 10       |       | R175 | 10       |       | R239 | 30       |
|        | R48  | 20       |       | R112 | 10       |       | R176 | 10       |       | R240 | 30       |
|        | R49  | 20       |       | R113 | 10       |       | R177 | 10       |       | R241 | 30       |
|        | R50  | 20       |       | R114 | 10       |       | R178 | 10       |       | R242 | 30       |
|        | R51  | 20       |       | R115 | 10       |       | R179 | 10       |       | R243 | 30       |
|        | R52  | 20       |       | R116 | 10       |       | R180 | 10       |       | R244 | 30       |
|        | R53  | 20       |       | R117 | 10       |       | R181 | 10       |       | R245 | 40       |
|        | R54  | 20       |       | R118 | 10       |       | R182 | 10       |       | R246 | 40       |
|        | R55  | 20       |       | R119 | 10       |       | R183 | 10       |       | R247 | 40       |
|        | R56  | 20       |       | R120 | 10       |       | R184 | 10       |       | R248 | 50       |
|        | R57  | 20       |       | R121 | 10       |       | R185 | 10       |       | R249 | 50       |
|        | R58  | 20       |       | R122 | 10       |       | R186 | 10       |       | R250 | 80       |
|        | R59  | 20       |       | R123 | 10       |       | R187 | 10       |       | R251 | 100      |
|        | R60  | 20       |       | R124 | 10       |       | R188 | 10       |       | R252 | 130      |
|        | R61  | 20       |       | R125 | 10       |       | R189 | 10       |       | R253 | 190      |
|        | R62  | 20       |       | R126 | 10       |       | R190 | 10       |       | R254 | 290      |
|        | R63  | 20       |       | R127 | 10       |       | R191 | 10       |       |      |          |

**Output Voltage VS Input Data**

| Data(h) | Positive polarity Output Voltage | Negative polarity Output Voltage  |
|---------|----------------------------------|-----------------------------------|
| 0       | V1                               | V10                               |
| 1       | $V2 + (V1 - V2) \times 267/288$  | $V10 + (V9 - V10) \times 217/288$ |
| 2       | $V2 + (V1 - V2) \times 246/288$  | $V10 + (V9 - V10) \times 42/288$  |
| 3       | $V2 + (V1 - V2) \times 231/288$  | $V10 + (V9 - V10) \times 57/288$  |
| 4       | $V2 + (V1 - V2) \times 216/288$  | $V10 + (V9 - V10) \times 72/288$  |
| 5       | $V2 + (V1 - V2) \times 205/288$  | $V10 + (V9 - V10) \times 83/288$  |
| 6       | $V2 + (V1 - V2) \times 194/288$  | $V10 + (V9 - V10) \times 94/288$  |
| 7       | $V2 + (V1 - V2) \times 186/288$  | $V10 + (V9 - V10) \times 102/288$ |
| 8       | $V2 + (V1 - V2) \times 178/288$  | $V10 + (V9 - V10) \times 110/288$ |
| 9       | $V2 + (V1 - V2) \times 170/288$  | $V10 + (V9 - V10) \times 118/288$ |
| 10      | $V2 + (V1 - V2) \times 162/288$  | $V10 + (V9 - V10) \times 126/288$ |
| 11      | $V2 + (V1 - V2) \times 154/288$  | $V10 + (V9 - V10) \times 134/288$ |
| 12      | $V2 + (V1 - V2) \times 146/288$  | $V10 + (V9 - V10) \times 142/288$ |
| 13      | $V2 + (V1 - V2) \times 141/288$  | $V10 + (V9 - V10) \times 147/288$ |
| 14      | $V2 + (V1 - V2) \times 136/288$  | $V10 + (V9 - V10) \times 152/288$ |
| 15      | $V2 + (V1 - V2) \times 131/288$  | $V10 + (V9 - V10) \times 157/288$ |
| 16      | $V2 + (V1 - V2) \times 126/288$  | $V10 + (V9 - V10) \times 162/288$ |
| 17      | $V2 + (V1 - V2) \times 122/288$  | $V10 + (V9 - V10) \times 166/288$ |
| 18      | $V2 + (V1 - V2) \times 118/288$  | $V10 + (V9 - V10) \times 170/288$ |
| 19      | $V2 + (V1 - V2) \times 114/288$  | $V10 + (V9 - V10) \times 174/288$ |
| 20      | $V2 + (V1 - V2) \times 110/288$  | $V10 + (V9 - V10) \times 178/288$ |
| 21      | $V2 + (V1 - V2) \times 106/288$  | $V10 + (V9 - V10) \times 182/288$ |
| 22      | $V2 + (V1 - V2) \times 102/288$  | $V10 + (V9 - V10) \times 186/288$ |
| 23      | $V2 + (V1 - V2) \times 98/288$   | $V10 + (V9 - V10) \times 190/288$ |
| 24      | $V2 + (V1 - V2) \times 94/288$   | $V10 + (V9 - V10) \times 194/288$ |
| 25      | $V2 + (V1 - V2) \times 91/288$   | $V10 + (V9 - V10) \times 197/288$ |
| 26      | $V2 + (V1 - V2) \times 88/288$   | $V10 + (V9 - V10) \times 200/288$ |
| 27      | $V2 + (V1 - V2) \times 85/288$   | $V10 + (V9 - V10) \times 203/288$ |
| 28      | $V2 + (V1 - V2) \times 82/288$   | $V10 + (V9 - V10) \times 206/288$ |
| 29      | $V2 + (V1 - V2) \times 79/288$   | $V10 + (V9 - V10) \times 209/288$ |
| 30      | $V2 + (V1 - V2) \times 76/288$   | $V10 + (V9 - V10) \times 212/288$ |
| 31      | $V2 + (V1 - V2) \times 73/288$   | $V10 + (V9 - V10) \times 215/288$ |
| 32      | $V2 + (V1 - V2) \times 70/288$   | $V10 + (V9 - V10) \times 218/288$ |
| 33      | $V2 + (V1 - V2) \times 67/288$   | $V10 + (V9 - V10) \times 221/288$ |
| 34      | $V2 + (V1 - V2) \times 64/288$   | $V10 + (V9 - V10) \times 224/288$ |
| 35      | $V2 + (V1 - V2) \times 61/288$   | $V10 + (V9 - V10) \times 227/288$ |
| 36      | $V2 + (V1 - V2) \times 58/288$   | $V10 + (V9 - V10) \times 230/288$ |
| 37      | $V2 + (V1 - V2) \times 55/288$   | $V10 + (V9 - V10) \times 233/288$ |
| 38      | $V2 + (V1 - V2) \times 52/288$   | $V10 + (V9 - V10) \times 236/288$ |
| 39      | $V2 + (V1 - V2) \times 50/288$   | $V10 + (V9 - V10) \times 238/288$ |
| 40      | $V2 + (V1 - V2) \times 48/288$   | $V10 + (V9 - V10) \times 240/288$ |
| 41      | $V2 + (V1 - V2) \times 46/288$   | $V10 + (V9 - V10) \times 242/288$ |
| 42      | $V2 + (V1 - V2) \times 44/288$   | $V10 + (V9 - V10) \times 244/288$ |
| 43      | $V2 + (V1 - V2) \times 42/288$   | $V10 + (V9 - V10) \times 246/288$ |
| 44      | $V2 + (V1 - V2) \times 40/288$   | $V10 + (V9 - V10) \times 248/288$ |
| 45      | $V2 + (V1 - V2) \times 38/288$   | $V10 + (V9 - V10) \times 250/288$ |
| 46      | $V2 + (V1 - V2) \times 36/288$   | $V10 + (V9 - V10) \times 252/288$ |
| 47      | $V2 + (V1 - V2) \times 34/288$   | $V10 + (V9 - V10) \times 254/288$ |
| 48      | $V2 + (V1 - V2) \times 32/288$   | $V10 + (V9 - V10) \times 256/288$ |
| 49      | $V2 + (V1 - V2) \times 30/288$   | $V10 + (V9 - V10) \times 258/288$ |
| 50      | $V2 + (V1 - V2) \times 28/288$   | $V10 + (V9 - V10) \times 260/288$ |
| 51      | $V2 + (V1 - V2) \times 26/288$   | $V10 + (V9 - V10) \times 262/288$ |
| 52      | $V2 + (V1 - V2) \times 24/288$   | $V10 + (V9 - V10) \times 264/288$ |
| 53      | $V2 + (V1 - V2) \times 22/288$   | $V10 + (V9 - V10) \times 266/288$ |
| 54      | $V2 + (V1 - V2) \times 20/288$   | $V10 + (V9 - V10) \times 268/288$ |
| 55      | $V2 + (V1 - V2) \times 18/288$   | $V10 + (V9 - V10) \times 270/288$ |
| 56      | $V2 + (V1 - V2) \times 16/288$   | $V10 + (V9 - V10) \times 272/288$ |
| 57      | $V2 + (V1 - V2) \times 14/288$   | $V10 + (V9 - V10) \times 274/288$ |
| 58      | $V2 + (V1 - V2) \times 12/288$   | $V10 + (V9 - V10) \times 276/288$ |
| 59      | $V2 + (V1 - V2) \times 10/288$   | $V10 + (V9 - V10) \times 278/288$ |
| 60      | $V2 + (V1 - V2) \times 8/288$    | $V10 + (V9 - V10) \times 280/288$ |
| 61      | $V2 + (V1 - V2) \times 6/288$    | $V10 + (V9 - V10) \times 282/288$ |
| 62      | $V2 + (V1 - V2) \times 4/288$    | $V10 + (V9 - V10) \times 284/288$ |
| 63      | $V2 + (V1 - V2) \times 2/288$    | $V10 + (V9 - V10) \times 286/288$ |

**Output Voltage VS Input Data**

| Data(h) | Positive polarity Output Voltage | Negative polarity Output Voltage |
|---------|----------------------------------|----------------------------------|
| 64      | V2                               | V9                               |
| 65      | V3+(V2-V3) X 63/64               | V9+(V8-V9) X 1/64                |
| 66      | V3+(V2-V3) X 62/64               | V9+(V8-V9) X 2/64                |
| 67      | V3+(V2-V3) X 61/64               | V9+(V8-V9) X 3/64                |
| 68      | V3+(V2-V3) X 60/64               | V9+(V8-V9) X 4/64                |
| 69      | V3+(V2-V3) X 59/64               | V9+(V8-V9) X 5/64                |
| 70      | V3+(V2-V3) X 58/64               | V9+(V8-V9) X 6/64                |
| 71      | V3+(V2-V3) X 57/64               | V9+(V8-V9) X 7/64                |
| 72      | V3+(V2-V3) X 56/64               | V9+(V8-V9) X 8/64                |
| 73      | V3+(V2-V3) X 55/64               | V9+(V8-V9) X 9/64                |
| 74      | V3+(V2-V3) X 54/64               | V9+(V8-V9) X 10/64               |
| 75      | V3+(V2-V3) X 53/64               | V9+(V8-V9) X 11/64               |
| 76      | V3+(V2-V3) X 52/64               | V9+(V8-V9) X 12/64               |
| 77      | V3+(V2-V3) X 51/64               | V9+(V8-V9) X 13/64               |
| 78      | V3+(V2-V3) X 50/64               | V9+(V8-V9) X 14/64               |
| 79      | V3+(V2-V3) X 49/64               | V9+(V8-V9) X 15/64               |
| 80      | V3+(V2-V3) X 48/64               | V9+(V8-V9) X 16/64               |
| 81      | V3+(V2-V3) X 47/64               | V9+(V8-V9) X 17/64               |
| 82      | V3+(V2-V3) X 46/64               | V9+(V8-V9) X 18/64               |
| 83      | V3+(V2-V3) X 45/64               | V9+(V8-V9) X 19/64               |
| 84      | V3+(V2-V3) X 44/64               | V9+(V8-V9) X 20/64               |
| 85      | V3+(V2-V3) X 43/64               | V9+(V8-V9) X 21/64               |
| 86      | V3+(V2-V3) X 42/64               | V9+(V8-V9) X 22/64               |
| 87      | V3+(V2-V3) X 41/64               | V9+(V8-V9) X 23/64               |
| 88      | V3+(V2-V3) X 40/64               | V9+(V8-V9) X 24/64               |
| 89      | V3+(V2-V3) X 39/64               | V9+(V8-V9) X 25/64               |
| 90      | V3+(V2-V3) X 38/64               | V9+(V8-V9) X 26/64               |
| 91      | V3+(V2-V3) X 37/64               | V9+(V8-V9) X 27/64               |
| 92      | V3+(V2-V3) X 36/64               | V9+(V8-V9) X 28/64               |
| 93      | V3+(V2-V3) X 35/64               | V9+(V8-V9) X 29/64               |
| 94      | V3+(V2-V3) X 34/64               | V9+(V8-V9) X 30/64               |
| 95      | V3+(V2-V3) X 33/64               | V9+(V8-V9) X 31/64               |
| 96      | V3+(V2-V3) X 32/64               | V9+(V8-V9) X 32/64               |
| 97      | V3+(V2-V3) X 31/64               | V9+(V8-V9) X 33/64               |
| 98      | V3+(V2-V3) X 30/64               | V9+(V8-V9) X 34/64               |
| 99      | V3+(V2-V3) X 29/64               | V9+(V8-V9) X 35/64               |
| 100     | V3+(V2-V3) X 28/64               | V9+(V8-V9) X 36/64               |
| 101     | V3+(V2-V3) X 27/64               | V9+(V8-V9) X 37/64               |
| 102     | V3+(V2-V3) X 26/64               | V9+(V8-V9) X 38/64               |
| 103     | V3+(V2-V3) X 25/64               | V9+(V8-V9) X 39/64               |
| 104     | V3+(V2-V3) X 24/64               | V9+(V8-V9) X 40/64               |
| 105     | V3+(V2-V3) X 23/64               | V9+(V8-V9) X 41/64               |
| 106     | V3+(V2-V3) X 22/64               | V9+(V8-V9) X 42/64               |
| 107     | V3+(V2-V3) X 21/64               | V9+(V8-V9) X 43/64               |
| 108     | V3+(V2-V3) X 20/64               | V9+(V8-V9) X 44/64               |
| 109     | V3+(V2-V3) X 19/64               | V9+(V8-V9) X 45/64               |
| 110     | V3+(V2-V3) X 18/64               | V9+(V8-V9) X 46/64               |
| 111     | V3+(V2-V3) X 17/64               | V9+(V8-V9) X 47/64               |
| 112     | V3+(V2-V3) X 16/64               | V9+(V8-V9) X 48/64               |
| 113     | V3+(V2-V3) X 15/64               | V9+(V8-V9) X 49/64               |
| 114     | V3+(V2-V3) X 14/64               | V9+(V8-V9) X 50/64               |
| 115     | V3+(V2-V3) X 13/64               | V9+(V8-V9) X 51/64               |
| 116     | V3+(V2-V3) X 12/64               | V9+(V8-V9) X 52/64               |
| 117     | V3+(V2-V3) X 11/64               | V9+(V8-V9) X 53/64               |
| 118     | V3+(V2-V3) X 10/64               | V9+(V8-V9) X 54/64               |
| 119     | V3+(V2-V3) X 9/64                | V9+(V8-V9) X 55/64               |
| 120     | V3+(V2-V3) X 8/64                | V9+(V8-V9) X 56/64               |
| 121     | V3+(V2-V3) X 7/64                | V9+(V8-V9) X 57/64               |
| 122     | V3+(V2-V3) X 6/64                | V9+(V8-V9) X 58/64               |
| 123     | V3+(V2-V3) X 5/64                | V9+(V8-V9) X 59/64               |
| 124     | V3+(V2-V3) X 4/64                | V9+(V8-V9) X 60/64               |
| 125     | V3+(V2-V3) X 3/64                | V9+(V8-V9) X 61/64               |
| 126     | V3+(V2-V3) X 2/64                | V9+(V8-V9) X 62/64               |
| 127     | V3+(V2-V3) X 1/64                | V9+(V8-V9) X 63/64               |

**Output Voltage VS Input Data**

| Data(h) | Positive polarity Output Voltage | Negative polarity Output Voltage |
|---------|----------------------------------|----------------------------------|
| 128     | V3                               | V8                               |
| 129     | V4+(V3-V4) X 63/64               | V8+(V7-V8) X 1/64                |
| 130     | V4+(V3-V4) X 62/64               | V8+(V7-V8) X 2/64                |
| 131     | V4+(V3-V4) X 61/64               | V8+(V7-V8) X 3/64                |
| 132     | V4+(V3-V4) X 60/64               | V8+(V7-V8) X 4/64                |
| 133     | V4+(V3-V4) X 59/64               | V8+(V7-V8) X 5/64                |
| 134     | V4+(V3-V4) X 58/64               | V8+(V7-V8) X 6/64                |
| 135     | V4+(V3-V4) X 57/64               | V8+(V7-V8) X 7/64                |
| 136     | V4+(V3-V4) X 56/64               | V8+(V7-V8) X 8/64                |
| 137     | V4+(V3-V4) X 55/64               | V8+(V7-V8) X 9/64                |
| 138     | V4+(V3-V4) X 54/64               | V8+(V7-V8) X 10/64               |
| 139     | V4+(V3-V4) X 53/64               | V8+(V7-V8) X 11/64               |
| 140     | V4+(V3-V4) X 52/64               | V8+(V7-V8) X 12/64               |
| 141     | V4+(V3-V4) X 51/64               | V8+(V7-V8) X 13/64               |
| 142     | V4+(V3-V4) X 50/64               | V8+(V7-V8) X 14/64               |
| 143     | V4+(V3-V4) X 49/64               | V8+(V7-V8) X 15/64               |
| 144     | V4+(V3-V4) X 48/64               | V8+(V7-V8) X 16/64               |
| 145     | V4+(V3-V4) X 47/64               | V8+(V7-V8) X 17/64               |
| 146     | V4+(V3-V4) X 46/64               | V8+(V7-V8) X 18/64               |
| 147     | V4+(V3-V4) X 45/64               | V8+(V7-V8) X 19/64               |
| 148     | V4+(V3-V4) X 44/64               | V8+(V7-V8) X 20/64               |
| 149     | V4+(V3-V4) X 43/64               | V8+(V7-V8) X 21/64               |
| 150     | V4+(V3-V4) X 42/64               | V8+(V7-V8) X 22/64               |
| 151     | V4+(V3-V4) X 41/64               | V8+(V7-V8) X 23/64               |
| 152     | V4+(V3-V4) X 40/64               | V8+(V7-V8) X 24/64               |
| 153     | V4+(V3-V4) X 39/64               | V8+(V7-V8) X 25/64               |
| 154     | V4+(V3-V4) X 38/64               | V8+(V7-V8) X 26/64               |
| 155     | V4+(V3-V4) X 37/64               | V8+(V7-V8) X 27/64               |
| 156     | V4+(V3-V4) X 36/64               | V8+(V7-V8) X 28/64               |
| 157     | V4+(V3-V4) X 35/64               | V8+(V7-V8) X 29/64               |
| 158     | V4+(V3-V4) X 34/64               | V8+(V7-V8) X 30/64               |
| 159     | V4+(V3-V4) X 33/64               | V8+(V7-V8) X 31/64               |
| 160     | V4+(V3-V4) X 32/64               | V8+(V7-V8) X 32/64               |
| 161     | V4+(V3-V4) X 31/64               | V8+(V7-V8) X 33/64               |
| 162     | V4+(V3-V4) X 30/64               | V8+(V7-V8) X 34/64               |
| 163     | V4+(V3-V4) X 29/64               | V8+(V7-V8) X 35/64               |
| 164     | V4+(V3-V4) X 28/64               | V8+(V7-V8) X 36/64               |
| 165     | V4+(V3-V4) X 27/64               | V8+(V7-V8) X 37/64               |
| 166     | V4+(V3-V4) X 26/64               | V8+(V7-V8) X 38/64               |
| 167     | V4+(V3-V4) X 25/64               | V8+(V7-V8) X 39/64               |
| 168     | V4+(V3-V4) X 24/64               | V8+(V7-V8) X 40/64               |
| 169     | V4+(V3-V4) X 23/64               | V8+(V7-V8) X 41/64               |
| 170     | V4+(V3-V4) X 22/64               | V8+(V7-V8) X 42/64               |
| 171     | V4+(V3-V4) X 21/64               | V8+(V7-V8) X 43/64               |
| 172     | V4+(V3-V4) X 20/64               | V8+(V7-V8) X 44/64               |
| 173     | V4+(V3-V4) X 19/64               | V8+(V7-V8) X 45/64               |
| 174     | V4+(V3-V4) X 18/64               | V8+(V7-V8) X 46/64               |
| 175     | V4+(V3-V4) X 17/64               | V8+(V7-V8) X 47/64               |
| 176     | V4+(V3-V4) X 16/64               | V8+(V7-V8) X 48/64               |
| 177     | V4+(V3-V4) X 15/64               | V8+(V7-V8) X 49/64               |
| 178     | V4+(V3-V4) X 14/64               | V8+(V7-V8) X 50/64               |
| 179     | V4+(V3-V4) X 13/64               | V8+(V7-V8) X 51/64               |
| 180     | V4+(V3-V4) X 12/64               | V8+(V7-V8) X 52/64               |
| 181     | V4+(V3-V4) X 11/64               | V8+(V7-V8) X 53/64               |
| 182     | V4+(V3-V4) X 10/64               | V8+(V7-V8) X 54/64               |
| 183     | V4+(V3-V4) X 9/64                | V8+(V7-V8) X 55/64               |
| 184     | V4+(V3-V4) X 8/64                | V8+(V7-V8) X 56/64               |
| 185     | V4+(V3-V4) X 7/64                | V8+(V7-V8) X 57/64               |
| 186     | V4+(V3-V4) X 6/64                | V8+(V7-V8) X 58/64               |
| 187     | V4+(V3-V4) X 5/64                | V8+(V7-V8) X 59/64               |
| 188     | V4+(V3-V4) X 4/64                | V8+(V7-V8) X 60/64               |
| 189     | V4+(V3-V4) X 3/64                | V8+(V7-V8) X 61/64               |
| 190     | V4+(V3-V4) X 2/64                | V8+(V7-V8) X 62/64               |
| 191     | V4+(V3-V4) X 1/64                | V8+(V7-V8) X 63/64               |



**Output Voltage VS Input Data**

| Data(h) | Positive polarity Output Voltage | Negative polarity Output Voltage |
|---------|----------------------------------|----------------------------------|
| 192     | V4                               | V7                               |
| 193     | V5+(V4V5) X 190/191              | V7+(V6V7) X 1/191                |
| 194     | V5+(V4V5) X 189/191              | V7+(V6V7) X 2/191                |
| 195     | V5+(V4V5) X 188/191              | V7+(V6V7) X 3/191                |
| 196     | V5+(V4V5) X 187/191              | V7+(V6V7) X 4/191                |
| 197     | V5+(V4V5) X 186/191              | V7+(V6V7) X 5/191                |
| 198     | V5+(V4V5) X 185/191              | V7+(V6V7) X 6/191                |
| 199     | V5+(V4V5) X 184/191              | V7+(V6V7) X 7/191                |
| 200     | V5+(V4V5) X 183/191              | V7+(V6V7) X 8/191                |
| 201     | V5+(V4V5) X 182/191              | V7+(V6V7) X 9/191                |
| 202     | V5+(V4V5) X 181/191              | V7+(V6V7) X 10/191               |
| 203     | V5+(V4V5) X 180/191              | V7+(V6V7) X 11/191               |
| 204     | V5+(V4V5) X 179/191              | V7+(V6V7) X 12/191               |
| 205     | V5+(V4V5) X 178/191              | V7+(V6V7) X 13/191               |
| 206     | V5+(V4V5) X 177/191              | V7+(V6V7) X 14/191               |
| 207     | V5+(V4V5) X 176/191              | V7+(V6V7) X 15/191               |
| 208     | V5+(V4V5) X 175/191              | V7+(V6V7) X 16/191               |
| 209     | V5+(V4V5) X 174/191              | V7+(V6V7) X 17/191               |
| 210     | V5+(V4V5) X 173/191              | V7+(V6V7) X 18/191               |
| 211     | V5+(V4V5) X 172/191              | V7+(V6V7) X 19/191               |
| 212     | V5+(V4V5) X 171/191              | V7+(V6V7) X 20/191               |
| 213     | V5+(V4V5) X 170/191              | V7+(V6V7) X 21/191               |
| 214     | V5+(V4V5) X 169/191              | V7+(V6V7) X 22/191               |
| 215     | V5+(V4V5) X 168/191              | V7+(V6V7) X 23/191               |
| 216     | V5+(V4V5) X 167/191              | V7+(V6V7) X 24/191               |
| 217     | V5+(V4V5) X 165/191              | V7+(V6V7) X 26/191               |
| 218     | V5+(V4V5) X 163/191              | V7+(V6V7) X 28/191               |
| 219     | V5+(V4V5) X 161/191              | V7+(V6V7) X 30/191               |
| 220     | V5+(V4V5) X 159/191              | V7+(V6V7) X 32/191               |
| 221     | V5+(V4V5) X 157/191              | V7+(V6V7) X 34/191               |
| 222     | V5+(V4V5) X 155/191              | V7+(V6V7) X 36/191               |
| 223     | V5+(V4V5) X 153/191              | V7+(V6V7) X 38/191               |
| 224     | V5+(V4V5) X 151/191              | V7+(V6V7) X 40/191               |
| 225     | V5+(V4V5) X 149/191              | V7+(V6V7) X 42/191               |
| 226     | V5+(V4V5) X 147/191              | V7+(V6V7) X 44/191               |
| 227     | V5+(V4V5) X 145/191              | V7+(V6V7) X 46/191               |
| 228     | V5+(V4V5) X 143/191              | V7+(V6V7) X 48/191               |
| 229     | V5+(V4V5) X 141/191              | V7+(V6V7) X 50/191               |
| 230     | V5+(V4V5) X 139/191              | V7+(V6V7) X 52/191               |
| 231     | V5+(V4V5) X 137/191              | V7+(V6V7) X 54/191               |
| 232     | V5+(V4V5) X 135/191              | V7+(V6V7) X 56/191               |
| 233     | V5+(V4V5) X 133/191              | V7+(V6V7) X 58/191               |
| 234     | V5+(V4V5) X 131/191              | V7+(V6V7) X 60/191               |
| 235     | V5+(V4V5) X 129/191              | V7+(V6V7) X 62/191               |
| 236     | V5+(V4V5) X 127/191              | V7+(V6V7) X 64/191               |
| 237     | V5+(V4V5) X 125/191              | V7+(V6V7) X 66/191               |
| 238     | V5+(V4V5) X 122/191              | V7+(V6V7) X 69/191               |
| 239     | V5+(V4V5) X 119/191              | V7+(V6V7) X 72/191               |
| 240     | V5+(V4V5) X 116/191              | V7+(V6V7) X 75/191               |
| 241     | V5+(V4V5) X 113/191              | V7+(V6V7) X 78/191               |
| 242     | V5+(V4V5) X 110/191              | V7+(V6V7) X 81/191               |
| 243     | V5+(V4V5) X 107/191              | V7+(V6V7) X 84/191               |
| 244     | V5+(V4V5) X 104/191              | V7+(V6V7) X 87/191               |
| 245     | V5+(V4V5) X 101/191              | V7+(V6V7) X 90/191               |
| 246     | V5+(V4V5) X 97/191               | V7+(V6V7) X 94/191               |
| 247     | V5+(V4V5) X 93/191               | V7+(V6V7) X 98/191               |
| 248     | V5+(V4V5) X 89/191               | V7+(V6V7) X 102/191              |
| 249     | V5+(V4V5) X 84/191               | V7+(V6V7) X 107/191              |
| 250     | V5+(V4V5) X 79/191               | V7+(V6V7) X 112/191              |
| 251     | V5+(V4V5) X 71/191               | V7+(V6V7) X 120/191              |
| 252     | V5+(V4V5) X 61/191               | V7+(V6V7) X 130/191              |
| 253     | V5+(V4V5) X 48/191               | V7+(V6V7) X 143/191              |
| 254     | V5+(V4V5) X 29/191               | V7+(V6V7) X 162/191              |
| 255     | V5                               | V6                               |

**Absolute Maximum Ratings\***
**\*Comments**

|                             |                  |
|-----------------------------|------------------|
| Supply voltage, Vcc         | -0.3V to 5V      |
| Supply voltage, AVDD        | -0.3V to +12V    |
| Input voltage, V1~ V10      | -0.3 to AVDD+0.3 |
| Input range(digital inputs) | -0.3 to Vcc+0.3  |
| Storage temperature         | -55°C to 110°C   |
| Operating temperature       | -30°C to 75°C    |

Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only. Functional operation of this device at these or under any other conditions above those indicated in the operational sections of this specification are not implied and exposure to absolute maximum rating conditions for extended periods may affect device reliability.

**DC Electrical Characteristics** (Vcc=3.3V , AVDD=10V, AVSS=GND=0V, TA= -30°C~ 75 °C)

(For the digital circuit)

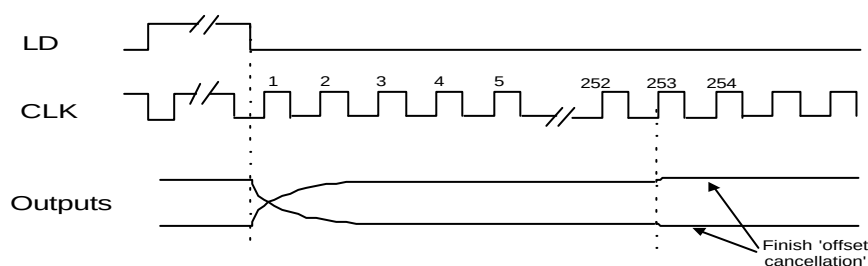
| Parameter                 | Symbol | Min.    | Typ. | Max.    | Unit | Conditions                                            |
|---------------------------|--------|---------|------|---------|------|-------------------------------------------------------|
| Supply Voltage            | Vcc    | 2.5     | --   | 3.6     | V    | Digital power                                         |
| Low Level Input Voltage   | Vil    | 0       | -    | 0.3xVcc | V    | For the digital circuit                               |
| High Level Input Voltage  | Vih    | 0.7xVcc | -    | Vcc     | V    | For the digital circuit                               |
| High Level Output Voltage | Voh    | 0.7xVcc | -    | --      | V    | DIO1(O), DIO2(O), loh=-0.4mA                          |
| Low Level Output Voltage  | Vol    | --      | -    | 0.3Vcc  | V    | DIO1(O), DIO2(O), lol=0.4mA                           |
| Input Leakage Current     | Ii     | -1      | -    | 1       | μA   | For LD,CLK,SHL,Dxx,POL,REV1/2,DIO1/2                  |
| Gamma correction Current  | Iref   | --      | 800  | 1000    | μA   | For V1~V5=4.75V or V6~V10=4.75V                       |
| Digital Operating Current | Icc    | -       | 3    | 6       | mA   | Vcc=3.6V, AVDD=9.5V, fld=50kHz, fclk=45MHz<br>No load |

(For the analog circuit)

[www.DataSheet4U.com](http://www.DataSheet4U.com)

| Parameter                         | Symbol | Min.   | Typ. | Max.     | Unit | Conditions                                            |
|-----------------------------------|--------|--------|------|----------|------|-------------------------------------------------------|
| Supply Voltage                    | AVDD   | 7.0    | --   | 10       | V    | For the analog circuit power                          |
| Input level of V1 ~ V5            | Vref   | AVDD/2 | -    | AVDD-0.1 | V    | Gamma correction voltage                              |
| Input level of V6 ~ V10           | Vref   | 0.1    | -    | AVDD/2   | V    | Gamma correction voltage                              |
| Output Voltage Deviation          | Vvd    | --     | ±6   | ±12      | mV   | Input data ' without ' offset cancellation            |
|                                   |        | --     | ±2   | ±5       | mV   | Input data ' with ' offset cancellation (Note1)       |
| Average output voltage dispersion | Vod    | --     | ±5   | ±10      | mV   | OUT1 ~ OUT384, input data 00 to FF.                   |
| Dynamic Range of Output           | Vdr    | 0.1    | -    | AVDD-0.1 | V    | OUT1 ~ OUT384                                         |
| Low-Level Output Current          | IOL    | -150   | -300 | -        | μA   | OUT1 ~ OUT384; Vo=0.1V V.S 1.0V                       |
| High-Level Output Current         | IOH    | 150    | 300  | -        | μA   | OUT1 ~ OUT384; Vo=9.9V V.S 9V                         |
| Analog Operating Current          | IDD    | -      | 6    | 12       | mA   | Vcc=3.6V, AVDD=9.5V, fld=50kHz, fclk=45MHz<br>No load |
| Input capacitance1                | C1     | --     | 5    | 10       | pF   | For Input pins ,except DIO1,DIO2                      |
| Input capacitance2                | C2     | --     | 10   | 15       | pF   | For DIO1,DIO2                                         |

(Note 1) This chip needs 253 CLK cycles to use its 'offset cancellation' function to get a precision output voltage.  
Please refer to the timing chart below :



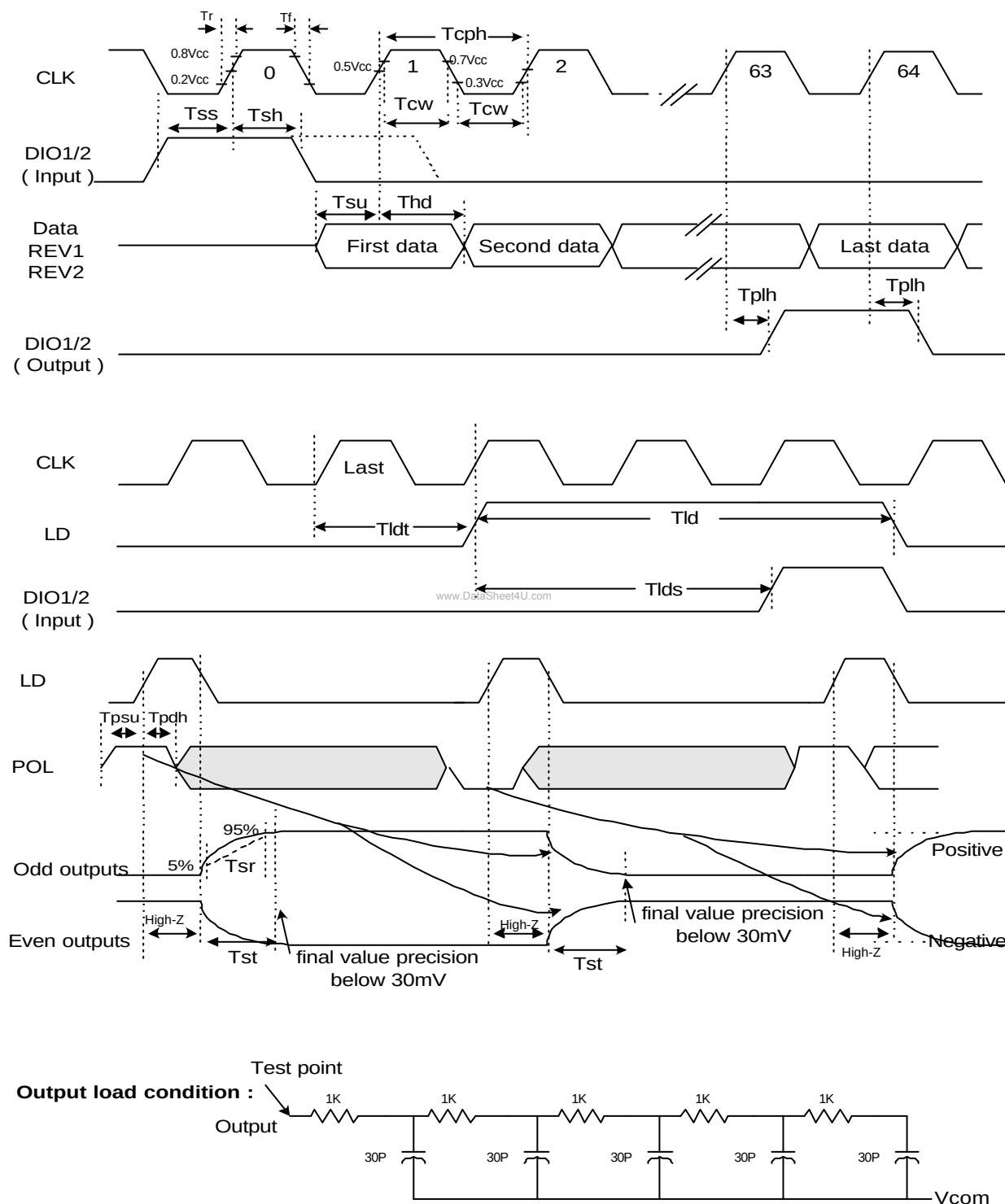
**AC Electrical Characteristics 1** ( $V_{CC}=3.0V$ ,  $AV_{DD}=10V$ ,  $AV_{SS}=GND=0V$ ,  $T_A=-30 \sim 75^{\circ}C$ ,  $T_r=T_f=2ns$ )

| Parameter                     | Symbol | Min. | Typ. | Max. | Unit | Conditions                                                       |
|-------------------------------|--------|------|------|------|------|------------------------------------------------------------------|
| CLK frequency                 | Fclk   | -    | 45   | 70   | MHz  | $V_{CC}=3.0\sim 3.6V$                                            |
| CLK period cycle              | Tcph   | 14   | -    | -    | ns   |                                                                  |
| CLK pulse width               | Tcw    | 4    | -    | -    | ns   |                                                                  |
| Data set-up time              | Tsu    | 2    | -    | -    | ns   | D00 ~ D57, REV to CLK                                            |
| Data hold time                | Thd    | 2    | -    | -    | ns   | D00 ~ D57, REV to CLK                                            |
| Start pulse setup time        | Tss    | 2    | --   | --   | ns   | DIO1,DIO2 to CLK                                                 |
| Start pulse hold time         | Tsh    | 2    | --   | --   | ns   | DIO1,DIO2 to CLK                                                 |
| LD high-level width           | Tld    | 1    | --   | --   | us   |                                                                  |
| Propagation delay of DIO2/1   | Tplh   | 6    | --   | 12   | ns   | CL=25pF ( Output )                                               |
| Time that the last data to LD | Tldt   | 1    | -    | -    | Tcph |                                                                  |
| Time that LD to DIO1/2(In)    | Tlds   | 2    | -    | -    | Tcph |                                                                  |
| POL set-up time               | Tpsu   | 5    | -    | -    | ns   | POL to LD                                                        |
| POL hold time                 | Tphd   | 5    | -    | -    | ns   | POL to LD                                                        |
| Output stable time            | Tst    | -    | 4    | 6    | us   | Final value precision below 30mV,<br>CL=150pF,R=5k ohm ,AVDD=10V |
| Slew rate of outputs          | Tsr    | 3    | 5    | -    | V/us | 5% to 95% at 10V swing,<br>CL=150pF,R=5k ohm                     |
| Output loading                | CL     | -    | -    | 150  | pF   |                                                                  |

**AC Electrical Characteristics 2** ( $V_{CC}=2.5V$ ,  $AV_{DD}=10V$ ,  $AV_{SS}=GND=0V$ ,  $T_A=-30\sim 75^{\circ}C$ ,  $T_r=T_f=3ns$ )

| Parameter                     | Symbol | Min. | Typ. | Max. | Unit | Conditions                                                       |
|-------------------------------|--------|------|------|------|------|------------------------------------------------------------------|
| CLK frequency                 | Fclk   | -    | 35   | 45   | MHz  | $V_{CC}=2.5\sim 3.0V$                                            |
| CLK period cycle              | Tcph   | 22   | -    | -    | ns   |                                                                  |
| CLK pulse width               | Tcw    | 7    | -    | -    | ns   |                                                                  |
| Data set-up time              | Tsu    | 4    | -    | -    | ns   | D00 ~ D57, REV to CLK                                            |
| Data hold time                | Thd    | 4    | -    | -    | ns   | D00 ~ D57, REV to CLK                                            |
| Start pulse setup time        | Tss    | 4    | --   | --   | ns   | DIO1,DIO2 to CLK                                                 |
| Start pulse hold time         | Tsh    | 4    | --   | --   | ns   | DIO1,DIO2 to CLK                                                 |
| LD high-level width           | Tld    | 1    | --   | --   | us   |                                                                  |
| Propagation delay of DIO2/1   | Tplh   | 6    | --   | 18   | ns   | CL=25pF ( Output )                                               |
| Time that the last data to LD | Tldt   | 1    | -    | -    | Tcph |                                                                  |
| Time that LD to DIO1/2(In)    | Tlds   | 2    | -    | -    | Tcph |                                                                  |
| POL set-up time               | Tpsu   | 5    | -    | -    | ns   | POL to LD                                                        |
| POL hold time                 | Tphd   | 5    | -    | -    | ns   | POL to LD                                                        |
| Output stable time            | Tst    | -    | 4    | 6    | us   | Final value precision below 30mV,<br>CL=150pF,R=5k ohm ,AVDD=10V |
| Slew rate of outputs          | Tsr    | 3    | 5    | -    | V/us | 5% to 95% at 10V swing,<br>CL=150pF,R=5k ohm                     |
| Output loading                | CL     | -    | -    | 150  | pF   |                                                                  |

### Timing Diagram



### Function operation

