



IT7020C / IT7020H

**Durable High-Voltage 240-Channel
Common Driver for Dot-Matrix STN LCD**

Preliminary Specification V0.4



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Additional copies of this manual or other ITE literature may be obtained from:

ITE, Inc.
Marketing Department
7F, No. 435, Nei Hu District, Jui Kuang Rd.,
Taipei 114, Taiwan, R.O.C.

Phone: (02) 2657-9896
Fax: (02) 2657-8561, 2657-8576

ITE (USA) Inc.
Marketing Department
1235 Midas Way
Sunnyvale, CA 94086
U.S.A.

Phone: (408) 530-8860
Fax: (408) 530-8861

ITE (USA) Inc.
Eastern U.S.A. Sales Office
896 Summit St., #105
Round Rock, TX 78664
U.S.A.

Phone: (512) 388-7880
Fax: (512) 388-3108

If you have any marketing or sales questions, please contact:

Lawrence Liu, at ITE Taiwan: E-mail: lawrence.liu@ite.com.tw, Tel: 886-2-26579896 X6071,
Fax: 886-2-26578561

David Lin, at ITE U.S.A.: E-mail: david.lin@iteusa.com, Tel: (408) 530-8860 X238,
Fax: (408) 530-8861

Don Gardenhire, at ITE Eastern USA Office: E-mail: don.gardenhire@iteusa.com
Tel: (512) 388-7880, Fax: (512) 388-3108

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<http://www.ite.com.tw>
<http://www.iteusa.com>

Or e-mail itesupport@ite.com.tw for more product information/services.



Revision History

| Section | Revision | Page No. |
|----------------|--------------------------------------|-----------------|
| 4 | • Add Section 4.2 Bare Chip Package. | 7-11 |

CONTENTS

| | |
|--|-----------|
| 1. Features | 1 |
| 2. General Description | 3 |
| 3. Block Diagram | 5 |
| 4. Pin Configuration | 7 |
| 4.1 273-pin TCP | 7 |
| 4.2 Bare-chip Package | 7 |
| 5. IT7020C/H Pin Descriptions | 13 |
| 6. System Configuration | 17 |
| 6.1 Overview | 17 |
| 6.2 LCD Drive Circuit | 17 |
| 6.3 Shift Register Circuit | 17 |
| 6.4 Alternating Signal (M) Generation Circuit | 17 |
| 7. Terminal Configuration | 19 |
| 8. DC Electrical Characteristics | 21 |
| 8.1 Activation and Inactivation Sequence | 21 |
| 8.1.1 Power On Sequence | 22 |
| 8.1.2 Power Down Sequence | 22 |
| 8.1 DC | 24 |
| 8.2 Electrical Characteristics ($V_{cc} = 3$ to $5.5V$, $GND = 0V$, $VLCD - VEE = 15$ to $43V$, $T_a = -30$ to $+75\text{ }^\circ\text{C}$) | 24 |
| 9. AC Characteristics | 27 |
| 9.1 AC Characteristics 1 ($V_{cc} = 3$ to $5.5V$, $GND = 0V$, $VLCD - VEE = 15$ to $43V$, $T_a = -30$ to $+75\text{ }^\circ\text{C}$) | 27 |
| 9.2 AC Characteristics 2 ($V_{cc} = 3$ to $4.5V$, $GND = 0V$, $VLCD - VEE = 43V$, $T_a = -30$ to $+75\text{ }^\circ\text{C}$) | 27 |
| 9.3 AC Characteristics 3 ($V_{cc} = 4.5$ to $5.5V$, $GND = 0V$, $VLCD - VEE = 43V$, $T_a = -30$ to $+75\text{ }^\circ\text{C}$) | 27 |
| 10. Package Information | 29 |
| 11. Ordering Information | 31 |

FIGURES

| | |
|---|----|
| Figure 5-1. DOC Waveform | 16 |
| Figure 5-2. LCD Driver Terminal Output Voltage Level | 16 |
| Figure 7-1. IT7020 Power and Input Terminal Configuration | 19 |
| Figure 7-2. IT7020 I/O, Input and Output Terminal Configuration | 20 |
| Figure 8-1. IT7020 Power On/Down Scenario | 23 |
| Figure 8-2. LCD Common Drive Output Waveform & Voltage Level | 25 |
| Figure 9-1. AC Characteristics Testing Configuration | 28 |
| Figure 9-2. IT7020 Timing Diagram | 28 |



TABLES

| | |
|--|----|
| Table 4-1. IT7020H Bump Name and Bump Size | 8 |
| Table 4-2. IT7020H Align Mark Locations..... | 8 |
| Table 4-3. Bump Center Coordinates (Unit: μm)..... | 9 |
| Table 5-1. Pin Descriptions of Power Signals..... | 13 |
| Table 5-2. Pin Descriptions of Control Signals..... | 13 |
| Table 5-3. Pin Descriptions of LCD Drive Output Signals | 15 |
| Table 8-1. DC Characteristics ($V_{cc} = 3$ to 5.5V , $GND = 0\text{V}$, $V_{LCD} - V_{EE} = 15$ to 43V , $T_a = -30$ to $+75\text{ }^\circ\text{C}$) . | 24 |
| Table 9-1. AC Characteristics 1($V_{cc} = 3$ to 5.5V , $GND = 0\text{V}$, $V_{LCD} - V_{EE} = 15$ to 43V , $T_a = -30$ to $+75\text{ }^\circ\text{C}$) | 27 |
| Table 9-2. AC Characteristics 2 ($V_{cc} = 3$ to 4.5V , $GND = 0\text{V}$, $V_{LCD} - V_{EE} = 43\text{V}$, $T_a = -30$ to $+75\text{ }^\circ\text{C}$)..... | 27 |
| Table 9-3. AC Characteristics 3 ($V_{cc} = 4.5$ to 5.5V , $GND = 0\text{V}$, $V_{LCD} - V_{EE} = 43\text{V}$, $T_a = -30$ to $+75\text{ }^\circ\text{C}$)..... | 27 |



1. Features

- Supports up to 1/240 display duty
- Supports 43V LCD drive voltage at maximum
- Supports 3.0 to 5.5V operating voltage
- Provides 240 LCD drive circuit
- Provides built-in power circuit for generating -21.5 V
- Provides the intermediate voltage interface
- Provides 3 selections of output modes:
 - 240-output mode
 - 200-output mode
 - 160-output mode
- Built-in alternating signal generation circuit (programmable through the MWS0 – MWS4 pins) is provided to restrain crosstalk
- Supports the display-off function
- Package
 - Flex TCP
 - can also be shipped in bare chip



2. General Description

The IT7020 features a high-voltage common driver, which consists of 240 channels. The IT7020 can drive a dot matrix STN LCD panel, and has been designed specifically to meet the LCD requirement in PDA devices. It can be used in conjunction with the segment drivers: IT7010 or IT7012C.

In terms of power consumption, the device is able to reduce the required voltage level and power consumption considerably. Additionally, the built-in screen display off function supported in the device can also help to reduce the overall power consumption while the LCD panel is not actively in use. In logic portion, the IT7020 operates with a low 3V logic drive voltage to help reducing power consumption.

The device can generate a high voltage drive of +21.5V and -21.5V through a 43V high voltage CMOS process technology. By the built-in power circuit and external capacity, the generation of -21.5V will occur from +21.5V.

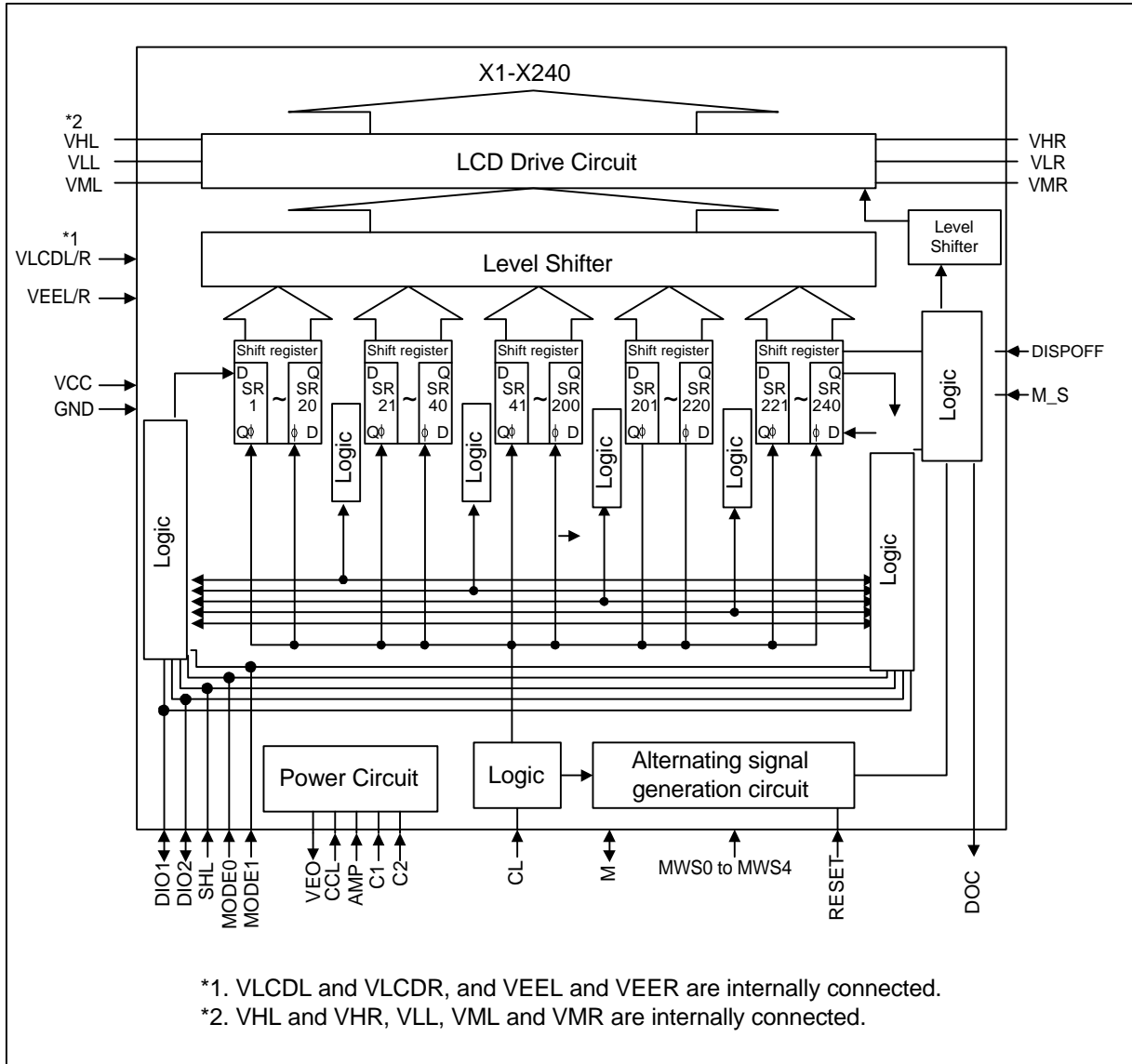
In addition, users are allowed the selection of 240-, 200- and 160-channel output mode by conveniently changing the mode according to what panel resolution they have.

In addition to the bare-chip package, the IT7020 is also available in 273-pin fine-pitch flex Tape-Carrier Package (TCP).

Moreover, ITE also provides users with complete local technical support. The company is dedicated to assisting customers in procuring multiple competitive edges, such as reducing development time, cost effectiveness and low power consumption for expanding the STN-LCD market share in a fast move.

ITE is committed to launching the LCD driver and controller series products, and will offer the most competitive solution through high integration and solid R&D expertise.

3. Block Diagram



1. Chip size: 16565 μ m * 1520 μ m (excluding scribe line).
2. Coordinate: Bump center.
3. Origin: Chip center.
4. Chip window: (-8282.5, -760), (8282.5, 760).
5. Minimum bump pitch: 66 μ m
6. Chip thickness: 675 μ m (typical)

Table 4-1. IT7020H Bump Name and Bump Size

| Bump No. | Bump Name | Bump Size (Typical) | | |
|--------------------|-------------|---------------------|--------|--------|
| | | X (mm) | Y (mm) | h (mm) |
| 1, 242, 257, 335 | NC | 58 | 65 | 18 |
| 2-241 | X1 - X240 | 46 | 65 | 18 |
| 243, 256, 336, 349 | NC | 65 | 58 | 18 |
| 244, 245 | NC | 65 | 46 | 18 |
| 246 - 248 | VLCDR | 65 | 46 | 18 |
| 249 - 251 | VHR | 65 | 46 | 18 |
| 252, 253 | VMR | 65 | 46 | 18 |
| 254, 255 | VLR | 65 | 46 | 18 |
| 337 - 339 | VML | 65 | 46 | 18 |
| 340 - 342 | VHL | 65 | 46 | 18 |
| 343, 344 | VLCDL | 65 | 46 | 18 |
| 345 - 348 | NC | 65 | 46 | 18 |
| ***** | Other bumps | 58 | 65 | 18 |

Table 4-2. IT7020H Align Mark Locations

| Align Mark Type | Align Mark Center Coordinate | | Align Mark Size or Diameter (mm) |
|-----------------|------------------------------|--------|----------------------------------|
| | X (mm) | Y (mm) | |
| Cross | 8192.2 | 673.7 | 90 |
| Circle | -8191.45 | 673.7 | 90 |

Notes:

1. Dont connect any wires to NC bumps.



Pin Configuration

Table 4-3. Bump Center Coordinates (Unit: mm)

| Bump No. | Bump Name | Coordinate | | Bump No. | Bump Name | Coordinate | | Bump No. | Bump Name | Coordinate | |
|----------|-----------|------------|--------|----------|-----------|------------|--------|----------|-----------|------------|--------|
| | | X-axis | Y-axis | | | X-axis | Y-axis | | | X-axis | Y-axis |
| 1 | NC | -7963 | 691.75 | 51 | X50 | -4653 | 691.75 | 101 | X100 | -1353 | 691.75 |
| 2 | X1 | -7887 | 691.75 | 52 | X51 | -4587 | 691.75 | 102 | X101 | -1287 | 691.75 |
| 3 | X2 | -7821 | 691.75 | 53 | X52 | -4521 | 691.75 | 103 | X102 | -1221 | 691.75 |
| 4 | X3 | -7755 | 691.75 | 54 | X53 | -4455 | 691.75 | 104 | X103 | -1155 | 691.75 |
| 5 | X4 | -7689 | 691.75 | 55 | X54 | -4389 | 691.75 | 105 | X104 | -1089 | 691.75 |
| 6 | X5 | -7623 | 691.75 | 56 | X55 | -4323 | 691.75 | 106 | X105 | -1023 | 691.75 |
| 7 | X6 | -7557 | 691.75 | 57 | X56 | -4257 | 691.75 | 107 | X106 | -957 | 691.75 |
| 8 | X7 | -7491 | 691.75 | 58 | X57 | -4191 | 691.75 | 108 | X107 | -891 | 691.75 |
| 9 | X8 | -7425 | 691.75 | 59 | X58 | -4125 | 691.75 | 109 | X108 | -825 | 691.75 |
| 10 | X9 | -7359 | 691.75 | 60 | X59 | -4059 | 691.75 | 110 | X109 | -759 | 691.75 |
| 11 | X10 | -7293 | 691.75 | 61 | X60 | -3993 | 691.75 | 111 | X110 | -693 | 691.75 |
| 12 | X11 | -7227 | 691.75 | 62 | X61 | -3927 | 691.75 | 112 | X111 | -627 | 691.75 |
| 13 | X12 | -7161 | 691.75 | 63 | X62 | -3861 | 691.75 | 113 | X112 | -561 | 691.75 |
| 14 | X13 | -7095 | 691.75 | 64 | X63 | -3795 | 691.75 | 114 | X113 | -495 | 691.75 |
| 15 | X14 | -7029 | 691.75 | 65 | X64 | -3729 | 691.75 | 115 | X114 | -429 | 691.75 |
| 16 | X15 | -6963 | 691.75 | 66 | X65 | -3663 | 691.75 | 116 | X115 | -363 | 691.75 |
| 17 | X16 | -6897 | 691.75 | 67 | X66 | -3597 | 691.75 | 117 | X116 | -297 | 691.75 |
| 18 | X17 | -6831 | 691.75 | 68 | X67 | -3531 | 691.75 | 118 | X117 | -231 | 691.75 |
| 19 | X18 | -6765 | 691.75 | 69 | X68 | -3465 | 691.75 | 119 | X118 | -165 | 691.75 |
| 20 | X19 | -6699 | 691.75 | 70 | X69 | -3399 | 691.75 | 120 | X119 | -99 | 691.75 |
| 21 | X20 | -6633 | 691.75 | 71 | X70 | -3333 | 691.75 | 121 | X120 | -33 | 691.75 |
| 22 | X21 | -6567 | 691.75 | 72 | X71 | -3267 | 691.75 | 122 | X121 | 33 | 691.75 |
| 23 | X22 | -6501 | 691.75 | 73 | X72 | -3201 | 691.75 | 123 | X122 | 99 | 691.75 |
| 24 | X23 | -6435 | 691.75 | 74 | X73 | -3135 | 691.75 | 124 | X123 | 165 | 691.75 |
| 25 | X24 | -6369 | 691.75 | 75 | X74 | -3069 | 691.75 | 125 | X124 | 231 | 691.75 |
| 26 | X25 | -6303 | 691.75 | 76 | X75 | -3003 | 691.75 | 126 | X125 | 297 | 691.75 |
| 27 | X26 | -6237 | 691.75 | 77 | X76 | -2937 | 691.75 | 127 | X126 | 363 | 691.75 |
| 28 | X27 | -6171 | 691.75 | 78 | X77 | -2871 | 691.75 | 128 | X127 | 429 | 691.75 |
| 29 | X28 | -6105 | 691.75 | 79 | X78 | -2805 | 691.75 | 129 | X128 | 495 | 691.75 |
| 30 | X29 | -6039 | 691.75 | 80 | X79 | -2739 | 691.75 | 130 | X129 | 561 | 691.75 |
| 31 | X30 | -5973 | 691.75 | 81 | X80 | -2673 | 691.75 | 131 | X130 | 627 | 691.75 |
| 32 | X31 | -5907 | 691.75 | 82 | X81 | -2607 | 691.75 | 132 | X131 | 693 | 691.75 |
| 33 | X32 | -5841 | 691.75 | 83 | X82 | -2541 | 691.75 | 133 | X132 | 759 | 691.75 |
| 34 | X33 | -5775 | 691.75 | 84 | X83 | -2475 | 691.75 | 134 | X133 | 825 | 691.75 |
| 35 | X34 | -5709 | 691.75 | 85 | X84 | -2409 | 691.75 | 135 | X134 | 891 | 691.75 |
| 36 | X35 | -5643 | 691.75 | 86 | X85 | -2343 | 691.75 | 136 | X135 | 957 | 691.75 |
| 37 | X36 | -5577 | 691.75 | 87 | X86 | -2277 | 691.75 | 137 | X136 | 1023 | 691.75 |
| 38 | X37 | -5511 | 691.75 | 88 | X87 | -2211 | 691.75 | 138 | X137 | 1089 | 691.75 |
| 39 | X38 | -5445 | 691.75 | 89 | X88 | -2145 | 691.75 | 139 | X138 | 1155 | 691.75 |
| 40 | X39 | -5379 | 691.75 | 90 | X89 | -2079 | 691.75 | 140 | X139 | 1221 | 691.75 |
| 41 | X40 | -5313 | 691.75 | 91 | X90 | -2013 | 691.75 | 141 | X140 | 1287 | 691.75 |
| 42 | X41 | -5247 | 691.75 | 92 | X91 | -1947 | 691.75 | 142 | X141 | 1353 | 691.75 |
| 43 | X42 | -5181 | 691.75 | 93 | X92 | -1881 | 691.75 | 143 | X142 | 1419 | 691.75 |
| 44 | X43 | -5115 | 691.75 | 94 | X93 | -1815 | 691.75 | 144 | X143 | 1485 | 691.75 |
| 45 | X44 | -5049 | 691.75 | 95 | X94 | -1749 | 691.75 | 145 | X144 | 1551 | 691.75 |
| 46 | X45 | -4983 | 691.75 | 96 | X95 | -1683 | 691.75 | 146 | X145 | 1617 | 691.75 |
| 47 | X46 | -4917 | 691.75 | 97 | X96 | -1617 | 691.75 | 147 | X146 | 1683 | 691.75 |
| 48 | X47 | -4851 | 691.75 | 98 | X97 | -1551 | 691.75 | 148 | X147 | 1749 | 691.75 |
| 49 | X48 | -4785 | 691.75 | 99 | X98 | -1485 | 691.75 | 149 | X148 | 1815 | 691.75 |
| 50 | X49 | -4719 | 691.75 | 100 | X99 | -1419 | 691.75 | 150 | X149 | 1881 | 691.75 |

Table 4-3. Bump Center Coordinates (Unit: mm) [continued]

| Bump No. | Bump Name | Coordinate | | Bump No. | Bump Name | Coordinate | | Bump No. | Bump Name | Coordinate | |
|----------|-----------|------------|--------|----------|-----------|------------|--------|----------|-----------|------------|---------|
| | | X-axis | Y-axis | | | X-axis | Y-axis | | | X-axis | Y-axis |
| 151 | X150 | 1947 | 691.75 | 201 | X200 | 5247 | 691.75 | 251 | VHR | 8111 | -25.45 |
| 152 | X151 | 2013 | 691.75 | 202 | X201 | 5313 | 691.75 | 252 | VMR | 8111 | -91.45 |
| 153 | X152 | 2079 | 691.75 | 203 | X202 | 5379 | 691.75 | 253 | VMR | 8111 | -157.45 |
| 154 | X153 | 2145 | 691.75 | 204 | X203 | 5445 | 691.75 | 254 | VLR | 8111 | -223.45 |
| 155 | X154 | 2211 | 691.75 | 205 | X204 | 5511 | 691.75 | 255 | VLR | 8111 | -289.45 |
| 156 | X155 | 2277 | 691.75 | 206 | X205 | 5577 | 691.75 | 256 | NC | 8111 | -365.45 |
| 157 | X156 | 2343 | 691.75 | 207 | X206 | 5643 | 691.75 | 257 | NC | 7963 | -616.65 |
| 158 | X157 | 2409 | 691.75 | 208 | X207 | 5709 | 691.75 | 258 | VEER | 7800 | -616.65 |
| 159 | X158 | 2475 | 691.75 | 209 | X208 | 5775 | 691.75 | 259 | VEER | 7667.2 | -616.65 |
| 160 | X159 | 2541 | 691.75 | 210 | X209 | 5841 | 691.75 | 260 | VEER | 7554.9 | -616.65 |
| 161 | X160 | 2607 | 691.75 | 211 | X210 | 5907 | 691.75 | 261 | DIO1 | 7176 | -616.65 |
| 162 | X161 | 2673 | 691.75 | 212 | X211 | 5973 | 691.75 | 262 | DIO1 | 7055.5 | -616.65 |
| 163 | X162 | 2739 | 691.75 | 213 | X212 | 6039 | 691.75 | 263 | M_S | 6642.8 | -616.65 |
| 164 | X163 | 2805 | 691.75 | 214 | X213 | 6105 | 691.75 | 264 | M_S | 6552 | -616.65 |
| 165 | X164 | 2871 | 691.75 | 215 | X214 | 6171 | 691.75 | 265 | M_S | 6244.9 | -616.65 |
| 166 | X165 | 2937 | 691.75 | 216 | X215 | 6237 | 691.75 | 266 | CCL | 6018.8 | -616.65 |
| 167 | X166 | 3003 | 691.75 | 217 | X216 | 6303 | 691.75 | 267 | CCL | 5928 | -616.65 |
| 168 | X167 | 3069 | 691.75 | 218 | X217 | 6369 | 691.75 | 268 | CCL | 5620.9 | -616.65 |
| 169 | X168 | 3135 | 691.75 | 219 | X218 | 6435 | 691.75 | 269 | CL | 5394.8 | -616.65 |
| 170 | X169 | 3201 | 691.75 | 220 | X219 | 6501 | 691.75 | 270 | CL | 5304 | -616.65 |
| 171 | X170 | 3267 | 691.75 | 221 | X220 | 6567 | 691.75 | 271 | CL | 4996.9 | -616.65 |
| 172 | X171 | 3333 | 691.75 | 222 | X221 | 6633 | 691.75 | 272 | GND | 4789 | -616.65 |
| 173 | X172 | 3399 | 691.75 | 223 | X222 | 6699 | 691.75 | 273 | GND | 4680 | -616.65 |
| 174 | X173 | 3465 | 691.75 | 224 | X223 | 6765 | 691.75 | 274 | GND | 4550.4 | -616.65 |
| 175 | X174 | 3531 | 691.75 | 225 | X224 | 6831 | 691.75 | 275 | GND | 4417.6 | -616.65 |
| 176 | X175 | 3597 | 691.75 | 226 | X225 | 6897 | 691.75 | 276 | GND | 4305.3 | -616.65 |
| 177 | X176 | 3663 | 691.75 | 227 | X226 | 6963 | 691.75 | 277 | GND | 4193 | -616.65 |
| 178 | X177 | 3729 | 691.75 | 228 | X227 | 7029 | 691.75 | 278 | SHL | 4008.3 | -616.65 |
| 179 | X178 | 3795 | 691.75 | 229 | X228 | 7095 | 691.75 | 279 | SHL | 3898.4 | -616.65 |
| 180 | X179 | 3861 | 691.75 | 230 | X229 | 7161 | 691.75 | 280 | SHL | 3807.6 | -616.65 |
| 181 | X180 | 3927 | 691.75 | 231 | X230 | 7227 | 691.75 | 281 | SHL | 3500.5 | -616.65 |
| 182 | X181 | 3993 | 691.75 | 232 | X231 | 7293 | 691.75 | 282 | AMP | 3384 | -616.65 |
| 183 | X182 | 4059 | 691.75 | 233 | X232 | 7359 | 691.75 | 283 | AMP | 3293.2 | -616.65 |
| 184 | X183 | 4125 | 691.75 | 234 | X233 | 7425 | 691.75 | 284 | AMP | 2986.1 | -616.65 |
| 185 | X184 | 4191 | 691.75 | 235 | X234 | 7491 | 691.75 | 285 | DISPOFF | 2869.6 | -616.65 |
| 186 | X185 | 4257 | 691.75 | 236 | X235 | 7557 | 691.75 | 286 | DISPOFF | 2778.8 | -616.65 |
| 187 | X186 | 4323 | 691.75 | 237 | X236 | 7623 | 691.75 | 287 | DISPOFF | 2471.7 | -616.65 |
| 188 | X187 | 4389 | 691.75 | 238 | X237 | 7689 | 691.75 | 288 | DOC | 2304.5 | -616.65 |
| 189 | X188 | 4455 | 691.75 | 239 | X238 | 7755 | 691.75 | 289 | DOC | 2184 | -616.65 |
| 190 | X189 | 4521 | 691.75 | 240 | X239 | 7821 | 691.75 | 290 | MODE0 | 1770.2 | -616.65 |
| 191 | X190 | 4587 | 691.75 | 241 | X240 | 7887 | 691.75 | 291 | MODE0 | 1679.4 | -616.65 |
| 192 | X191 | 4653 | 691.75 | 242 | NC | 7963 | 691.75 | 292 | MODE0 | 1372.3 | -616.65 |
| 193 | X192 | 4719 | 691.75 | 243 | NC | 8111 | 512.55 | 293 | MODE1 | 1146.2 | -616.65 |
| 194 | X193 | 4785 | 691.75 | 244 | NC | 8111 | 436.55 | 294 | MODE1 | 1055.4 | -616.65 |
| 195 | X194 | 4851 | 691.75 | 245 | NC | 8111 | 370.55 | 295 | MODE1 | 748.3 | -616.65 |
| 196 | X195 | 4917 | 691.75 | 246 | VLCDR | 8111 | 304.55 | 296 | Vcc | 552.1 | -616.65 |
| 197 | X196 | 4983 | 691.75 | 247 | VLCDR | 8111 | 238.55 | 297 | Vcc | 443.1 | -616.65 |
| 198 | X197 | 5049 | 691.75 | 248 | VLCDR | 8111 | 172.55 | 298 | Vcc | 313.5 | -616.65 |
| 199 | X198 | 5115 | 691.75 | 249 | VHR | 8111 | 106.55 | 299 | Vcc | 180.7 | -616.65 |
| 200 | X199 | 5181 | 691.75 | 250 | VHR | 8111 | 40.55 | 300 | Vcc | 68.4 | -616.65 |



Pin Configuration

Table 4-3. Bump Center Coordinates (Unit: mm) [continued]

| Bump No. | Bump Name | Coordinate | |
|----------|-----------------|------------|---------|
| | | X-axis | Y-axis |
| 301 | V _{CC} | -43.9 | -616.65 |
| 302 | MWS0 | -221.2 | -616.65 |
| 303 | MWS0 | -312 | -616.65 |
| 304 | MWS0 | -619.1 | -616.65 |
| 305 | MWS1 | -784.8 | -616.65 |
| 306 | MWS1 | -875.6 | -616.65 |
| 307 | MWS1 | -1182.7 | -616.65 |
| 308 | MWS2 | -1408.8 | -616.65 |
| 309 | MWS2 | -1499.6 | -616.65 |
| 310 | MWS2 | -1806.7 | -616.65 |
| 311 | MWS3 | -2032.8 | -616.65 |
| 312 | MWS3 | -2123.6 | -616.65 |
| 313 | MWS3 | -2430.7 | -616.65 |
| 314 | MWS4 | -2597.8 | -616.65 |
| 315 | MWS4 | -2688.6 | -616.65 |
| 316 | MWS4 | -2995.7 | -616.65 |
| 317 | RESET | -3177.1 | -616.65 |
| 318 | RESET | -3267.9 | -616.65 |
| 319 | RESET | -3575 | -616.65 |
| 320 | M | -3941.5 | -616.65 |
| 321 | M | -4062 | -616.65 |
| 322 | DIO2 | -4680 | -616.65 |
| 323 | DIO2 | -4800.5 | -616.65 |
| 324 | C2 | -5291 | -616.65 |
| 325 | C2 | -5518.4 | -616.65 |
| 326 | C1 | -5805.7 | -616.65 |
| 327 | C1 | -6033.1 | -616.65 |
| 328 | VEO | -6296.8 | -616.65 |
| 329 | VEO | -6524.2 | -616.65 |
| 330 | VEEL | -6791.1 | -616.65 |
| 331 | VEEL | -7018.5 | -616.65 |
| 332 | VEEL | -7233.6 | -616.65 |
| 333 | VLL | -7520.1 | -616.65 |
| 334 | VLL | -7747.5 | -616.65 |
| 335 | NC | -7963 | -616.65 |
| 336 | NC | -8111 | -365.45 |
| 337 | VML | -8111 | -289.45 |
| 338 | VML | -8111 | -223.45 |
| 339 | VML | -8111 | -157.45 |
| 340 | VHL | -8111 | -91.45 |
| 341 | VHL | -8111 | -25.45 |
| 342 | VHL | -8111 | 40.55 |
| 343 | VLCDL | -8111 | 106.55 |
| 344 | VLCDL | -8111 | 172.55 |
| 345 | NC | -8111 | 238.55 |
| 346 | NC | -8111 | 304.55 |
| 347 | NC | -8111 | 370.55 |
| 348 | NC | -8111 | 436.55 |
| 349 | NC | -8111 | 512.55 |



IT7020C/H Pin Descriptions

5. IT7020C/H Pin Descriptions

Table 5-1. Pin Descriptions of Power Signals

| Pin(s) No. | Symbol | Attribute | Description |
|----------------------------------|-------------------------------|-----------|--|
| 267, 266 | C1, C2 | - | Connect the external capacitance here when the power circuit is enabled for VEE generation. It is advisable that users should not connect any traces to these pins if the built-in power circuit is not used. |
| 273, 241 269, 245 257, 250 | VLCDL/R VEEL/R Vcc, GND | - | VLCDL/R and VEEL/R are used to provide the power supply for the usage of LCD drive. VEEL/R are used to provide the power supply for the usage of power circuits. Vcc, GND are used to provide the power supply for the usage of logic circuits. |
| 272, 242 270, 244 271, 243 | VHL/R VLL/R VML/R | Input | These pins are used to provide the power supply for LCD drive level. VHL/R and VLL/R indicate the selected level of LCD drive. Note that VHL/R is set to the same voltage as VLCDL/R while VLL/R is set to the same voltage as VEEL/R. VML/R indicates the non-selected LCD drive level. It provides the power supply for the built-in power circuits as well. |
| 268 | VEO | Output | Connect VEO pin to the VEEL/R pins when the built-in power circuit is enabled to generate VEE voltage. In this case, the VM voltage is used as the point of reference and the output voltage of VEO is equal to $(2*VM - VLCD)$. Users are advised not to connect any lines to this pin if the built-in power circuit is not used. |

Table 5-2. Pin Descriptions of Control Signals

| Pin(s) No. | Symbol | Attribute | Description |
|------------|--------------|------------------|---|
| 252 | AMP | Input | This signal is used to control the on and off states the built-in power circuit. When the circuit is used, this pin must be tied to Vcc. When the built-in power circuit is not used, this pin must be tied to GND. |
| 248 | CCL | Input | Indicates the built-in power circuit clock input. When the built-in power circuit is enabled and VEE is generated, this pin is connected to the CL pin. When the built-in power circuit is not used, CCL must be tied to GND. |
| 249 | CL | Input | Shift Clock Input. Data is shifted and latched at the falling edge of CL in the shift register. |
| 246 265 | DIO1 DIO2 | Input/ Output | Serial Data Input/Output Pin. When the SHL is high, the DIO1 is the serial output pin and DIO2 is the serial input pin. When the SHL is low, the DIO1 is the serial input pin and DIO2 is the serial output pin. |

Table 5-2. Pin Descriptions of Control Signals (continued)

| Pin(s) No. | Symbol | Attribute | Description | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---------------------------------|--------------------------------------|---|---|-----------------|-------|--|--------------|-------|---|------------------------|--------------|---|-----|-----|----------------------------------|---|---|---|-------|---|---|---|---|---|---|------------|--------|---|---|---|---|---|---|--------------------|--|---|---|---|---|---|---|--------------------|--|---|---|---|---|---|---|---|--|----|---|---|---|---|---|---------------------|--|
| 253 | DISPOFF | Input | Set LCD drive outputs of X1 to X240 to the VM level by connecting this pin to GND. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 254 | DOC | Output | When the M_S pin is set to high level, the output level of DOC pin is the same as the DISPOFF pin. When the M_S pin is set to low level, DOC pin outputs low level until serial data input 16 times. See Figure 5-1 for more details. Note that when M_S is set to low level, the DOC pin should be connected to IT7010C DOF_N control pin. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 264 | M | Input/Output | Input or output the toggling waveform for LCD drive output level. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 247 | M_S | Input | Control the LCD display-off function and determine the LCD display-off signal to output from DOC pin. When the M_S is set to high level and the DISPOFF is low level, X1-X240 pins will set to the VM level. When the M_S is set to low level, the X1-X240 pins will stay on the VM level until serial data input 16 times (See Figure 5-1). | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 255 256 | MODE0 MODE1 | Input | Input terminals for specifying the effective number of LCD drive output pins. MODE0 MODE1 Shift Direction <table border="1"> <tr> <td>"H"</td> <td>"H"</td> <td>240-output (X1, X2, X3...X238, X239, X240)</td> </tr> <tr> <td>"H"</td> <td>"L"</td> <td>200-output (X21, X22, X23...X218, X219, X220)</td> </tr> <tr> <td>"L"</td> <td>"H"</td> <td>160-output (X41, X42, X43...X198, X199, X200)</td> </tr> <tr> <td>"L"</td> <td>"L"</td> <td>Undefined. Use at your own risk!</td> </tr> </table> | "H" | "H" | 240-output (X1, X2, X3...X238, X239, X240) | "H" | "L" | 200-output (X21, X22, X23...X218, X219, X220) | "L" | "H" | 160-output (X41, X42, X43...X198, X199, X200) | "L" | "L" | Undefined. Use at your own risk! | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| "H" | "H" | 240-output (X1, X2, X3...X238, X239, X240) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| "H" | "L" | 200-output (X21, X22, X23...X218, X219, X220) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| "L" | "H" | 160-output (X41, X42, X43...X198, X199, X200) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| "L" | "L" | Undefined. Use at your own risk! | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 258 259 260 261 262 | MWS0 MWS1 MWS2 MWS3 MWS4 | Input | These pins are used to specify the frequency of the toggling signal (M signal) in the unit of number of display lines. The number of display lines is an integer ranging from 2 to 31 and is specified in the table below. Typically, the number of display lines ranges from 10 to 31. If IT7020 is configured in the slave mode, i.e., driven by an external M signal, MWS0 – MWS4 should be tied to low level. <table border="1"> <thead> <tr> <th>Number of lines</th> <th>MWS 4</th> <th>MWS 3</th> <th>MWS 2</th> <th>MWS 1</th> <th>MWS 0</th> <th>Line toggling waveform</th> <th>M-pin status</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>-</td> <td>Input</td> </tr> <tr> <td>1</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>1</td> <td>Prohibited</td> <td>Output</td> </tr> <tr> <td>2</td> <td>0</td> <td>0</td> <td>0</td> <td>1</td> <td>0</td> <td>2 lines alternated</td> <td></td> </tr> <tr> <td>3</td> <td>0</td> <td>0</td> <td>0</td> <td>1</td> <td>1</td> <td>3 lines alternated</td> <td></td> </tr> <tr> <td>:</td> <td>:</td> <td>:</td> <td>:</td> <td>:</td> <td>:</td> <td>:</td> <td></td> </tr> <tr> <td>31</td> <td>1</td> <td>1</td> <td>1</td> <td>1</td> <td>1</td> <td>31 lines alternated</td> <td></td> </tr> </tbody> </table> | Number of lines | MWS 4 | MWS 3 | MWS 2 | MWS 1 | MWS 0 | Line toggling waveform | M-pin status | 0 | 0 | 0 | 0 | 0 | 0 | - | Input | 1 | 0 | 0 | 0 | 0 | 1 | Prohibited | Output | 2 | 0 | 0 | 0 | 1 | 0 | 2 lines alternated | | 3 | 0 | 0 | 0 | 1 | 1 | 3 lines alternated | | : | : | : | : | : | : | : | | 31 | 1 | 1 | 1 | 1 | 1 | 31 lines alternated | |
| Number of lines | MWS 4 | MWS 3 | MWS 2 | MWS 1 | MWS 0 | Line toggling waveform | M-pin status | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0 | 0 | 0 | 0 | 0 | 0 | - | Input | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | 0 | 0 | 0 | 0 | 1 | Prohibited | Output | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2 | 0 | 0 | 0 | 1 | 0 | 2 lines alternated | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3 | 0 | 0 | 0 | 1 | 1 | 3 lines alternated | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| : | : | : | : | : | : | : | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 31 | 1 | 1 | 1 | 1 | 1 | 31 lines alternated | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 263 | RESET | Input | Initialize the toggling signal (M signal) circuit by connecting this pin to GND. Tied to Vcc for normal operation. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |



IT7020C/H Pin Descriptions

Table 5-2. Pin Descriptions of Control Signals (continued)

| Pin(s) No. | Symbol | Attribute | Description |
|------------|--------|-----------|--|
| 251 | SHL | Input | <i>This pin is used to switch the shift directions.</i> |
| | | | SHL MODE0 MODE1 Shift Direction |
| | | | Right shift |
| | | | "H" "H" "H" DIO2→SR1...SR240→DIO1 |
| | | | level "H" "L" DIO2→SR21...SR220→DIO1 |
| | | | "H" "H" DIO2→SR41...SR200→DIO1 |
| | | | Left shift |
| | | | "L" "H" "H" DIO1→SR240...SR1→DIO2 |
| | | | level "H" "L" DIO1→SR220...SR21→DIO2 |
| | | | "L" "H" DIO1→SR200...SR41→DIO2 |
| | | | SR1, SR2...SR240 are the outputs of the shift registers and correspond to X1, X2...X240. Note: The 40 or 80 pins, which are invalidated at the 200 or 160-output mode, will output the non-selected level (VM). |

Table 5-3. Pin Descriptions of LCD Drive Output Signals

| Pin(s) No. | Symbol | Attribute | Description |
|------------|------------|-----------|---|
| 1 to 240 | X1 to X240 | Output | <i>LCD Drive Output.</i> When DISPOFF is set to Vcc, the output level of X1 – X240 are determined by the combination of the display data and the M signal. Either one of VH, VL, or VM is selected and then transmitted to the output circuit. See Figure 5-2 for more details. |

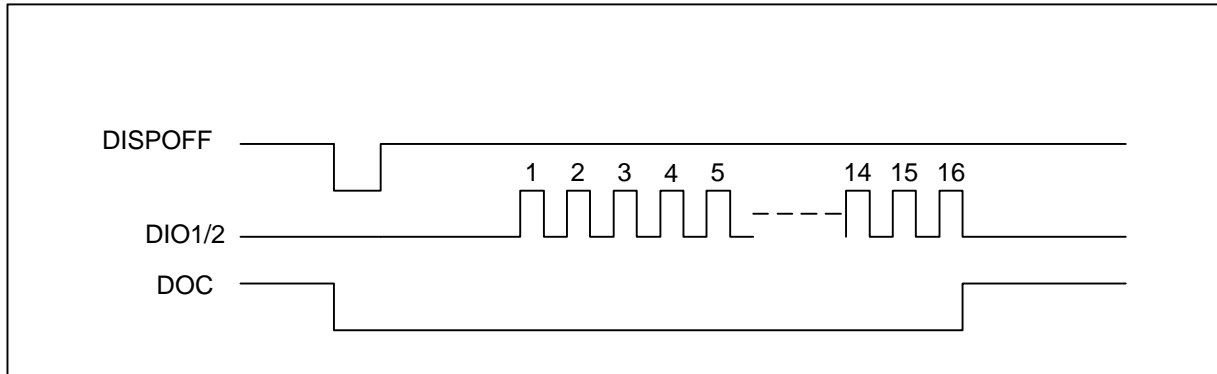


Figure 5-1. DOC Waveform

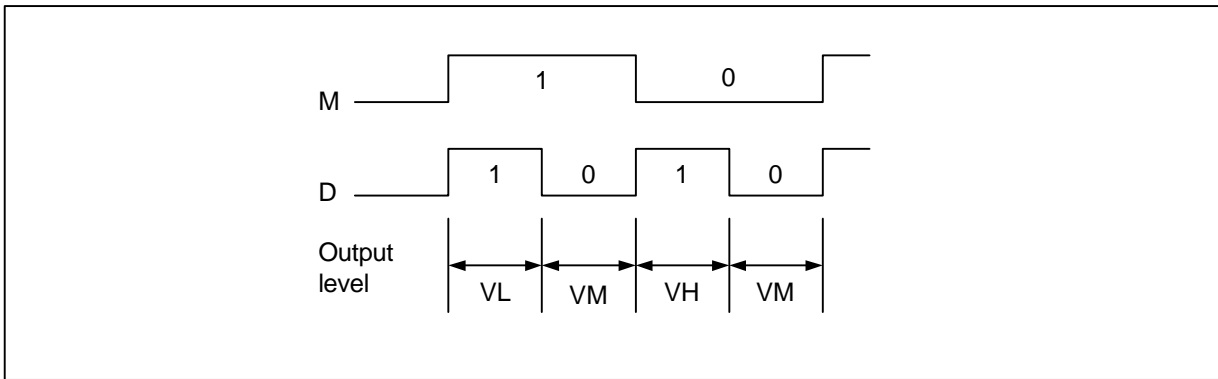


Figure 5-2. LCD Driver Terminal Output Voltage Level



6. System Configuration

6.1 Overview

The IT7020 is composed of 4 main elements to work properly: LCD Drive Circuits, Level Shifter, Shift Register Circuit, and Alternating Signal Generation Circuits. The functional descriptions for each of the 4 elements are described below:

6.2 LCD Drive Circuit

The device consists of 240 LCD drive circuits, and each of the LCD drive circuit is responsible to select and output the three level signals for the LCD drive. Either one of VH, VL and VM will be selected and transmitted to the output circuit by combining the data in the shift register and M signal together. The level shifter is responsible for boosting a 5V signal to the high voltage for LCD drive.

6.3 Shift Register Circuit

The shift register circuit is made up of 240 bits and is bi-directional. Through the shift register circuit, the first line marker signal can be generated from the DIO1 pin and DIO2 pin. The first line marker signal can be then sequentially shifted via the shift clock CL. The shifting direction is determined by SHL pin.

6.4 Alternating Signal (M) Generation Circuit

The alternating Signal Generation circuit is used to generate an alternating signal (M signal) for proper LCD display. To restrain the crosstalk function, the signal is alternated from several lines to a host of lines. If pins MWS0 to MWS4 are connected to Vcc or GND, the intended number of signals can be alternated. Note that the connection of pins MWS0 to MWS4 with GND can be done when the alternating signals are input externally.

7. Terminal Configuration

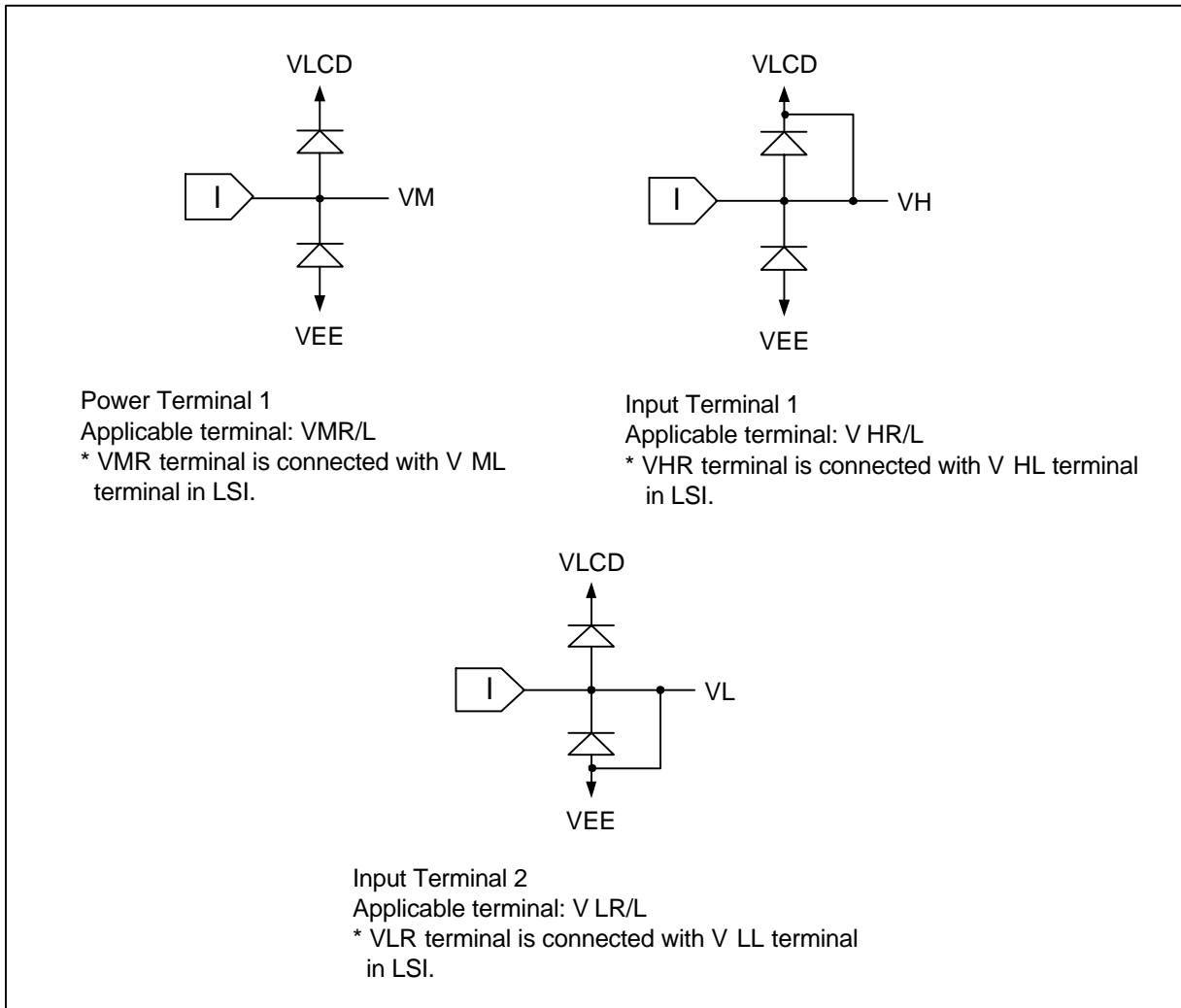


Figure 7-1. IT7020 Power and Input Terminal Configuration

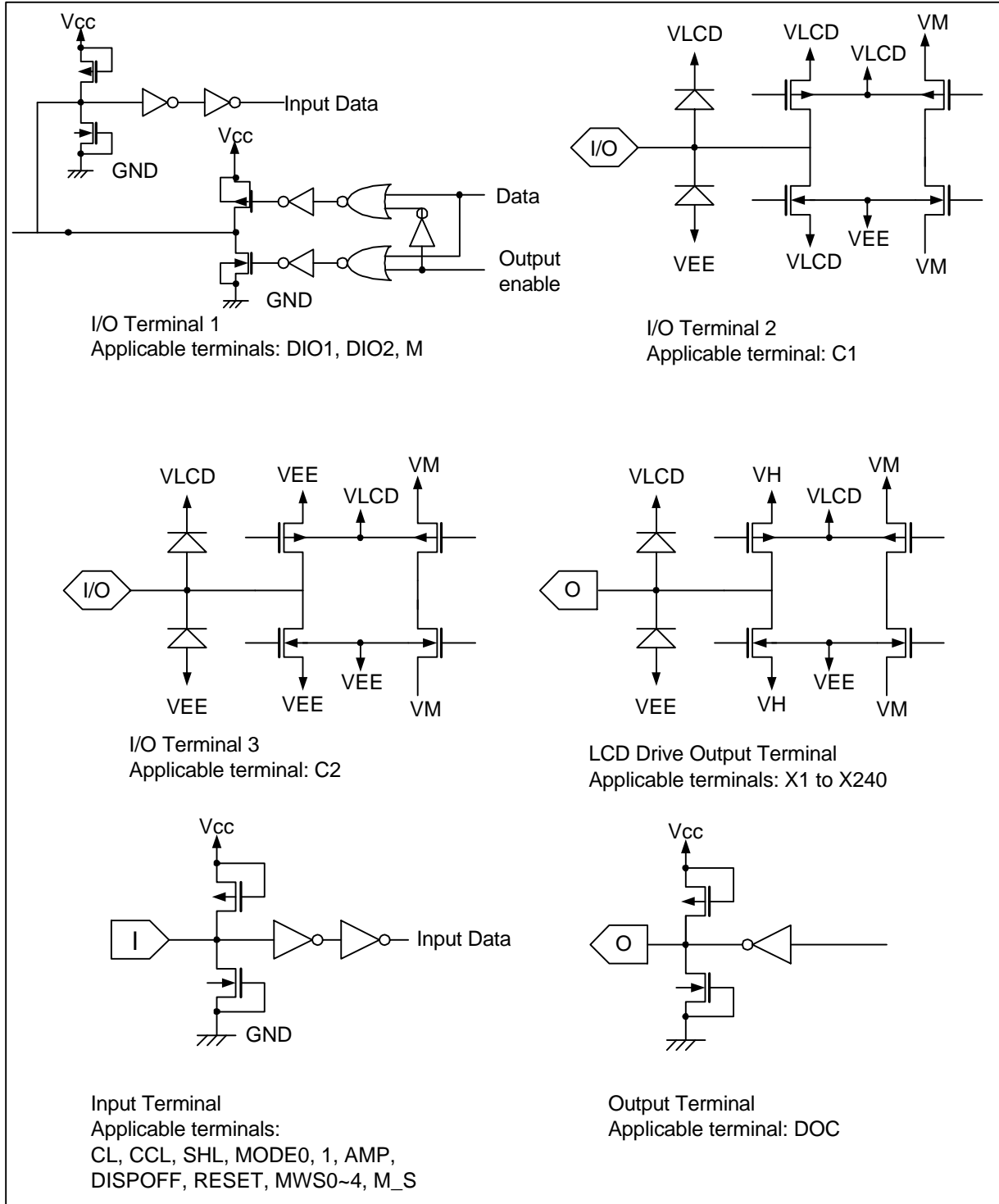


Figure 7-2. IT7020 I/O, Input and Output Terminal Configuration



DC Electrical Characteristics

8. DC Electrical Characteristics

Absolute Maximum Ratings

| | |
|------------------------------------|-------------------|
| Power Supply (Vcc) | -0.3 to +7.0V |
| Power Supply (VLCD) | -0.3 to +25.0V |
| Power Supply (VEE) | -23.0 to +0.3V |
| Input Voltage (1) (VT1) | -0.3 to Vcc + 0.3 |
| Input Voltage (2) (VH) | -0.3 to VLCD |
| Input Voltage (3) (VL) | -0.3 to VEE |
| Input Voltage (4) (VM) | -0.3 to +5.0V |
| Operating temperature (Topr) | -30 to +75V |
| Storage temperature (Tetg) | - 55 + 110V |

*Comments:

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

| Parameter | Symbol | Ratings | Unit | Notes | |
|-----------------------|-------------------|-------------------|----------------|---------|---------|
| Power supply voltage | Logic circuit | Vcc | -0.3 to + 7.0 | V | 1, 8 |
| | LCD drive circuit | VLCD | -0.3 to + 25.0 | V | 1, 3, 8 |
| | | VEE | -23.0 to + 0.3 | V | 1, 4, 8 |
| Input voltage (1) | VT1 | -0.3 to Vcc + 0.3 | V | 1, 2 | |
| Input voltage (2) | VH | -0.3 to VLCD | V | 1, 5, 8 | |
| Input voltage (3) | VL | -0.3 to VEE | V | 1, 6, 8 | |
| Input voltage (4) | VM | -0.3 to + 5.0 | V | 1, 7, 8 | |
| Operating temperature | Topr | -30 to + 75 | °C | - | |
| Storage temperature | Tetg | -55 to + 110 | °C | - | |

- Notes: 1. Indicates the voltage from GND.
 2. The input voltage (1) is applicable to DIO1, DISPOFF, SHL, M, MWS0-MWS4, RESET, MODE0, MODE1, CL, M_S, AMP, CCL, and DIO2.
 3. The power supply voltage for LCD drive circuits can be applied to VLCDL/R pins.
 4. The power supply voltage for LCD drive circuits can be applied to VEE/R pins.
 5. The input voltage (2) is applied to VHL/R pins.
 6. The input voltage (3) is applied to VLL/R pins.
 7. The input voltage (4) is applied to VML/R pins.
 8. See section 8.1 for details.

8.1 Activation and Inactivation Sequence

Make sure to follow activation and inactivation sequence for power supplies and signals as illustrated in the Figure 8-1. This sequence is applied to the built-in power circuit. It is recommended that users must follow the sequence correctly; otherwise, the device malfunction, permanent damage, or undesired effects may occur.

8.1.1 Power On Sequence

1. Power on the power supply in the order listed below:
Power On order: GND-Vcc, GND-VLCD (VH), and VM.
VM-VEE is generated automatically. Input GND power to the DISPOFF pin.
2. The LCD level is forced to output the VM level through the DISPOFF function.
3. The DISPOFF function has a higher priority even if the input signal distortion occurs instantly after Vcc input.
4. Then input the preset signals to get the driver registers initialized. In this case, make sure a period that lasts more than one frame is reserved.
5. The preceding work for normal display is completed here. At this point, users should cancel the DISPOFF function by setting the DISPOFF pin to Vcc. The voltage levels of VEE (VL), VLCD (VH) and VM must have reached the preset voltage respectively.

8.1.2 Power Down Sequence

Shut down the power in an opposite order described for power on sequence on the last page.

1. Firstly, the DISPOFF pin should be set to GND.
2. Secondly, the LCD power supply of GND-VLCD (VH) should be turned off. At the same time, GND-VEE (VL) gets to VM. Shut off the VM next.
3. Vcc should be set, and the input signal should be set to GND.
4. At this moment, the inputs of pins VEE (VL), VLCD (VH) and VM must go down to 0 V completely.
In addition, an incorrect display may occur at power down or power on. This is because the function of DISPOFF is inactivated when the Vcc level goes down to GND, which may cause the LCD to output a level other than VM.

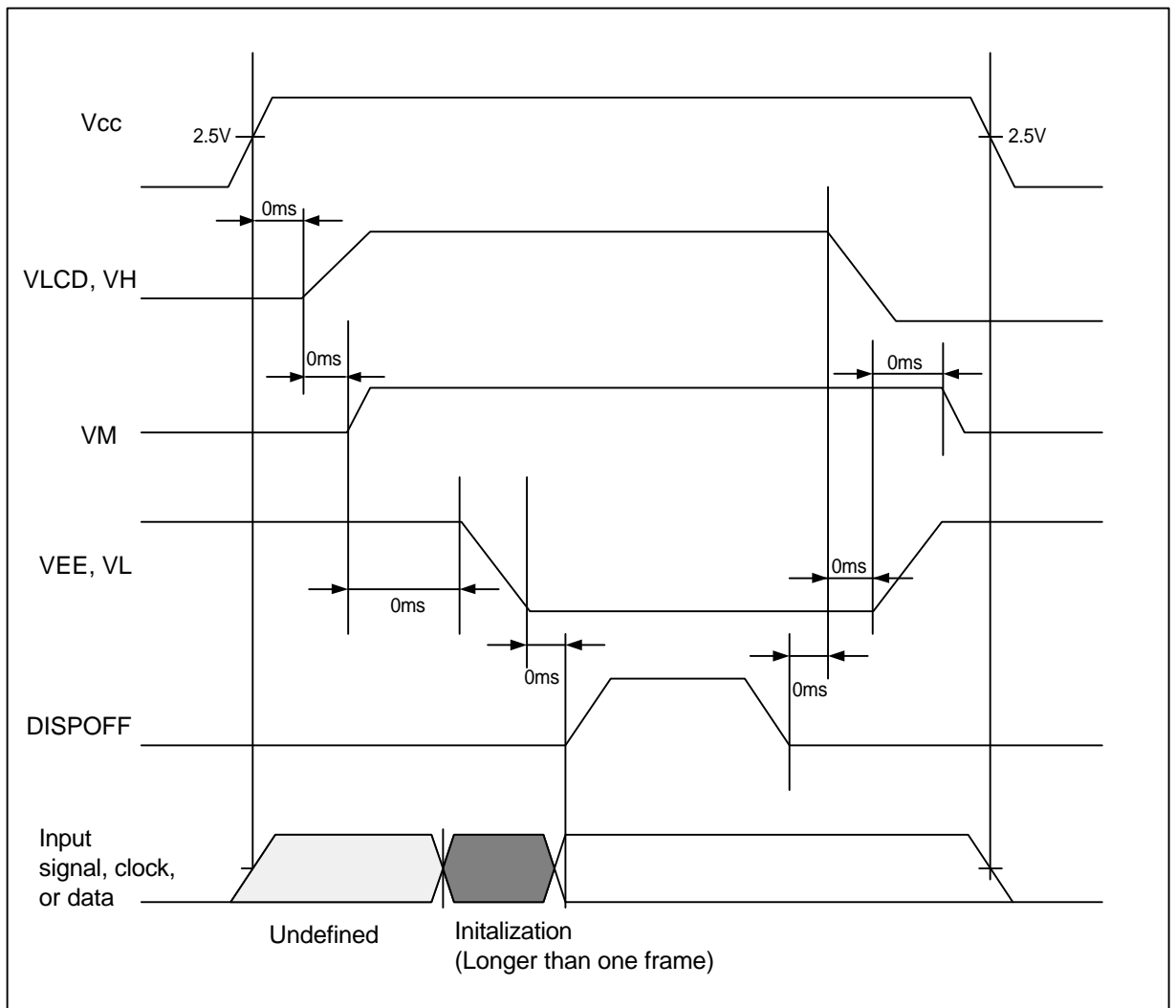


Figure 8-1. IT7020 Power On/Down Scenario

8.2 DC Electrical Characteristics (V_{CC} = 3 to 5.5V, GND = 0V, VLCD - VEE = 15 to 43V, Ta = - 30 to +75 °C)

- The parameter "ON resistance between Vi—Xj" in the table below indicates a resistance value between of the X and one of the V pins (either one of VH, VL, or VM) when a load current is applied to one of X1 to X240 pins. These resistance values are specified under the conditions listed below:
VLCD = VH = 21.75V, VEE = VL = -18.5V, VM = 1.75V, GND = 0V.
Use VH, VL, and VM in the range of VLCD - VM ≥ VH - VM = 21.5 to 7.5V, VEE - VM ≤ VL - VM = -21.5 to -7.5V in the relation of VH > VM > VL.
- The current applied between the input and output is removed. The power supply current will increase through the current flows between the power supplies under the condition that an input to a CMOS gate is at an intermediate level. Therefore, use V_{IH} = V_{CC} and V_{IL} = GND.
- The voltage relationship of each signal is illustrated in Figure 8-2:

Table 8-1. DC Characteristics (V_{CC} = 3 to 5.5V, GND = 0V, VLCD - VEE = 15 to 43V, Ta = - 30 to +75 °C)

| Symbol | Parameter | Min. | Typ. | Max. | Unit | Conditions | Applicable Pin(s) |
|------------------|-----------------------------|----------------------|------|---------------------|------|---------------------------|--|
| V _{IH} | Input high-level voltage | 0.7×V _{CC} | — | V _{CC} | V | | DIO1, DISPOFF, SHL, M, M_S, MWS0-4, RESET |
| V _{IL} | Input low-level voltage | 0 | — | 0.3×V _{CC} | V | | CL, MODE0, MODE1, DOC, AMP, CCL, DIO2 |
| V _{OH} | Output high-level voltage | V _{CC} -0.4 | — | — | V | I _{OH} = -0.4 mA | M, DOC, DIO1, DIO2 |
| V _{OL} | Output low-level voltage | — | — | 0.4 | V | I _{OL} = 0.4 mA | M, DOC, DIO1, DIO2 |
| RON | ON resistance between Vi—Xj | — | 0.7 | 2.0 | kΩ | I _{ON} = 150 μA | X1-X240, V pin |
| I _{IL1} | Input leak current (1) | TBD | TBD | TBD | μA | | DIO1, DISPOFF, SHL, M, M_S, MWS0-4, RESET, CL, MODE0, MODE1, DOC, AMP, CCL, DIO2 |
| I _{IL2} | Input leak current (2) | TBD | TBD | TBD | μA | | VH, VL, VM, C1, C2 |
| I _{CC1} | Current consumption (1) | TBD | TBD | TBD | μA | | V _{CC} |
| I _{CC2} | Current consumption (2) | TBD | TBD | TBD | μA | | V _{CC} |
| I _{LCD} | Current consumption (3) | TBD | TBD | TBD | μA | | VLCD |

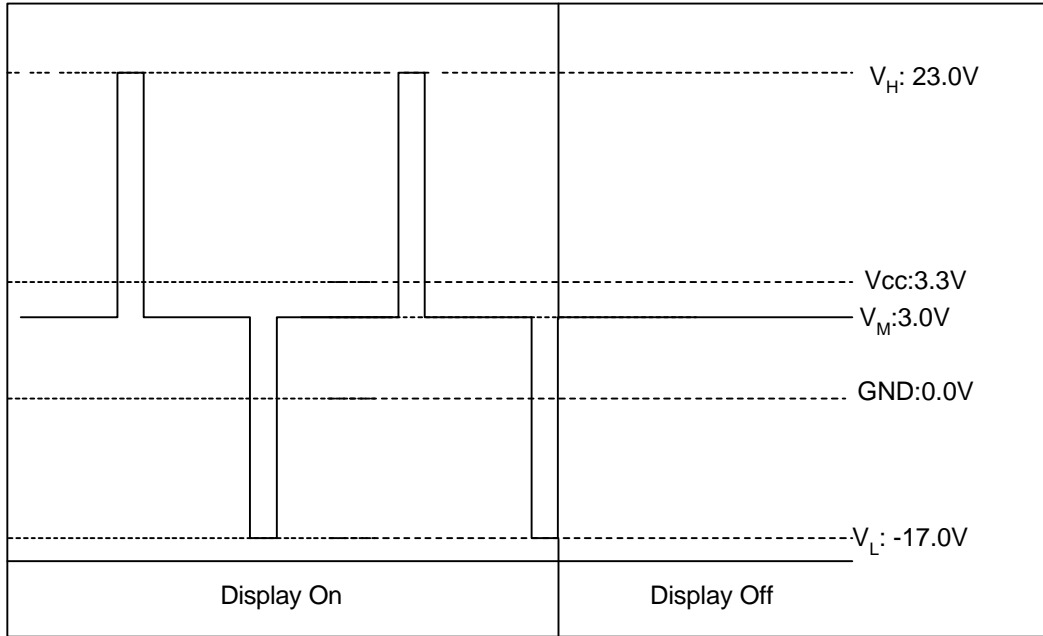


Figure 8-2. LCD Common Drive Output Waveform & Voltage Level

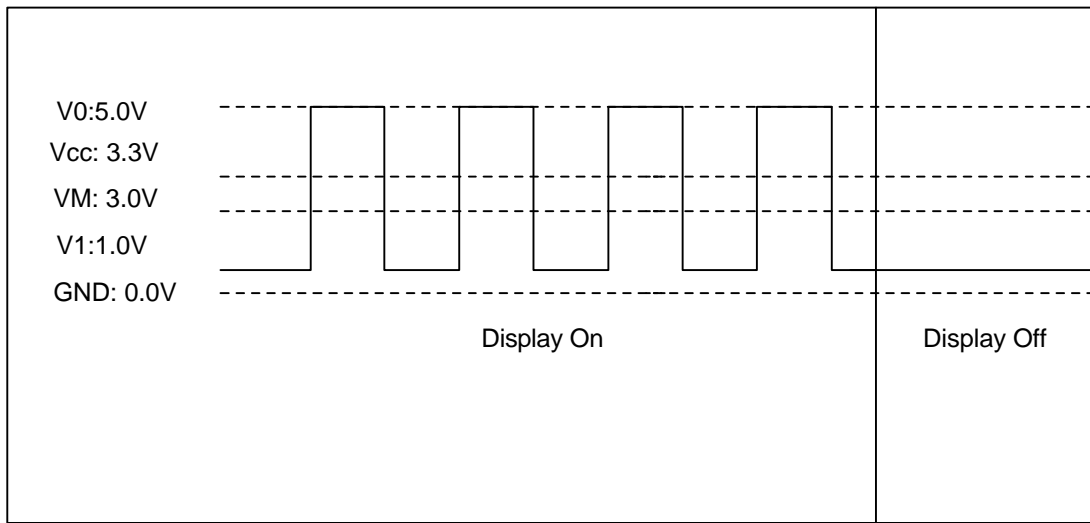


Figure 8-3. LCD Segment Drive Output Waveform & Voltage Level

9. AC Characteristics

9.1 AC Characteristics 1 ($V_{CC} = 3$ to $5.5V$, $GND = 0V$, VLCD - $VEE = 15$ to $43V$, $T_a = -30$ to $+75^\circ C$)

Table 9-1. AC Characteristics 1 ($V_{CC} = 3$ to $5.5V$, $GND = 0V$, VLCD - $VEE = 15$ to $43V$, $T_a = -30$ to $+75^\circ C$)

| Symbol | Parameter | Applicable Pins | Typ. | Min. | Max. | Unit |
|------------|------------------------|-----------------|------|------|------|------|
| t_{CYC} | Clock cycle time | CL | | 400 | — | ns |
| t_{CWH} | CL high-level width | CL | | 25 | — | ns |
| t_{CWL} | CL low-level width | CL | | 370 | — | ns |
| t_r | CL rising time | CL | | — | 30 | ns |
| t_f | CL falling time | CL | | — | 30 | ns |
| t_{DS} | Data set-up time | DIO1, DIO2, CL | | 100 | — | ns |
| t_{DH} | Data hold time | DIO1, DIO2, CL | | 10 | — | ns |
| t_{DD} | Data output delay time | DIO1, DIO2, CL | 615 | — | 200 | ns |
| t_{MD} | M output delay time | M, CL | 585 | — | 200 | ns |
| t_{MS} | M setup time | M, CL | | 20 | — | ns |
| t_{MH} | M hold time | M, CL | | 20 | — | ns |
| t_{DOC1} | DOC delay time 1 | DISPOFF, DOC | | — | 300 | ns |
| t_{DOC2} | DOC delay time 2 | DIO1, DIO2, DOC | | — | 300 | ns |

9.2 AC Characteristics 2 ($V_{CC} = 3$ to $4.5V$, $GND = 0V$, VLCD - $VEE = 43V$, $T_a = -30$ to $+75^\circ C$)

Table 9-2. AC Characteristics 2 ($V_{CC} = 3$ to $4.5V$, $GND = 0V$, VLCD - $VEE = 43V$, $T_a = -30$ to $+75^\circ C$)

| Symbol | Parameter | Applicable Pins | Typ. | Min. | Max. | Unit |
|-----------|---------------------|-----------------|------|------|------|---------|
| t_{pd1} | Output delay time 1 | X (n), M | 1.44 | — | 1.2 | μs |

9.3 AC Characteristics 3 ($V_{CC} = 4.5$ to $5.5V$, $GND = 0V$, VLCD - $VEE = 43V$, $T_a = -30$ to $+75^\circ C$)

Table 9-3. AC Characteristics 3 ($V_{CC} = 4.5$ to $5.5V$, $GND = 0V$, VLCD - $VEE = 43V$, $T_a = -30$ to $+75^\circ C$)

| Symbol | Parameter | Applicable Pins | Typ. | Min. | Max. | Unit |
|-----------|---------------------|-----------------|------|------|------|---------|
| t_{pd1} | Output delay time 1 | X (n), M | | — | 0.7 | μs |

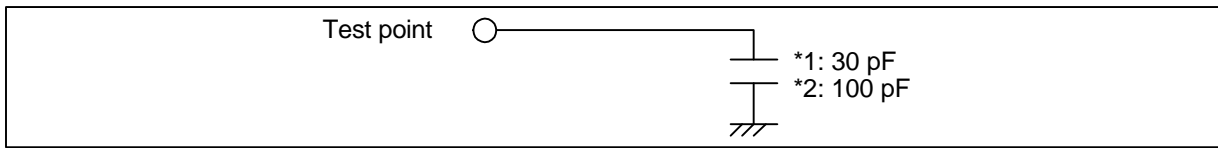


Figure 9-1. AC Characteristics Testing Configuration

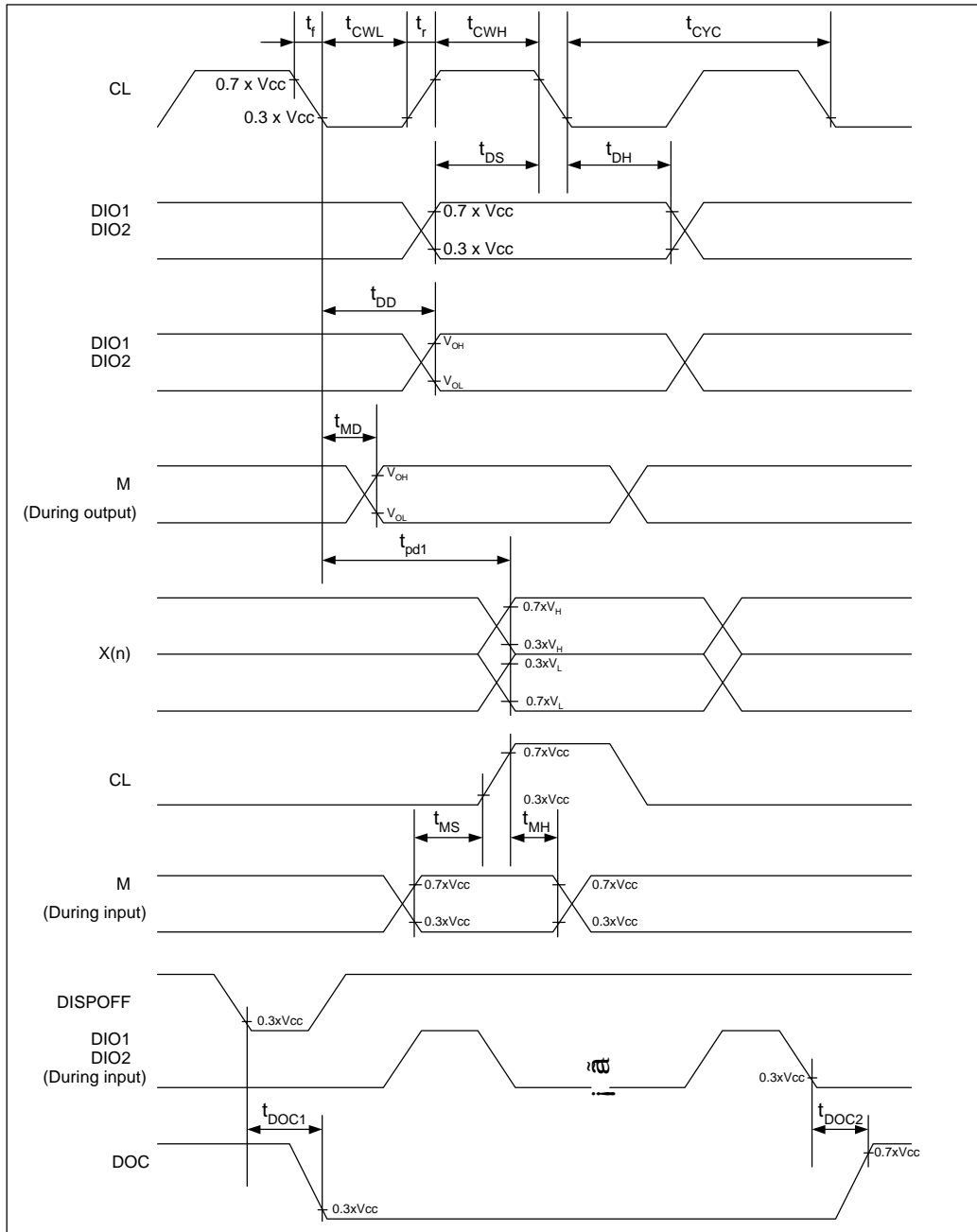


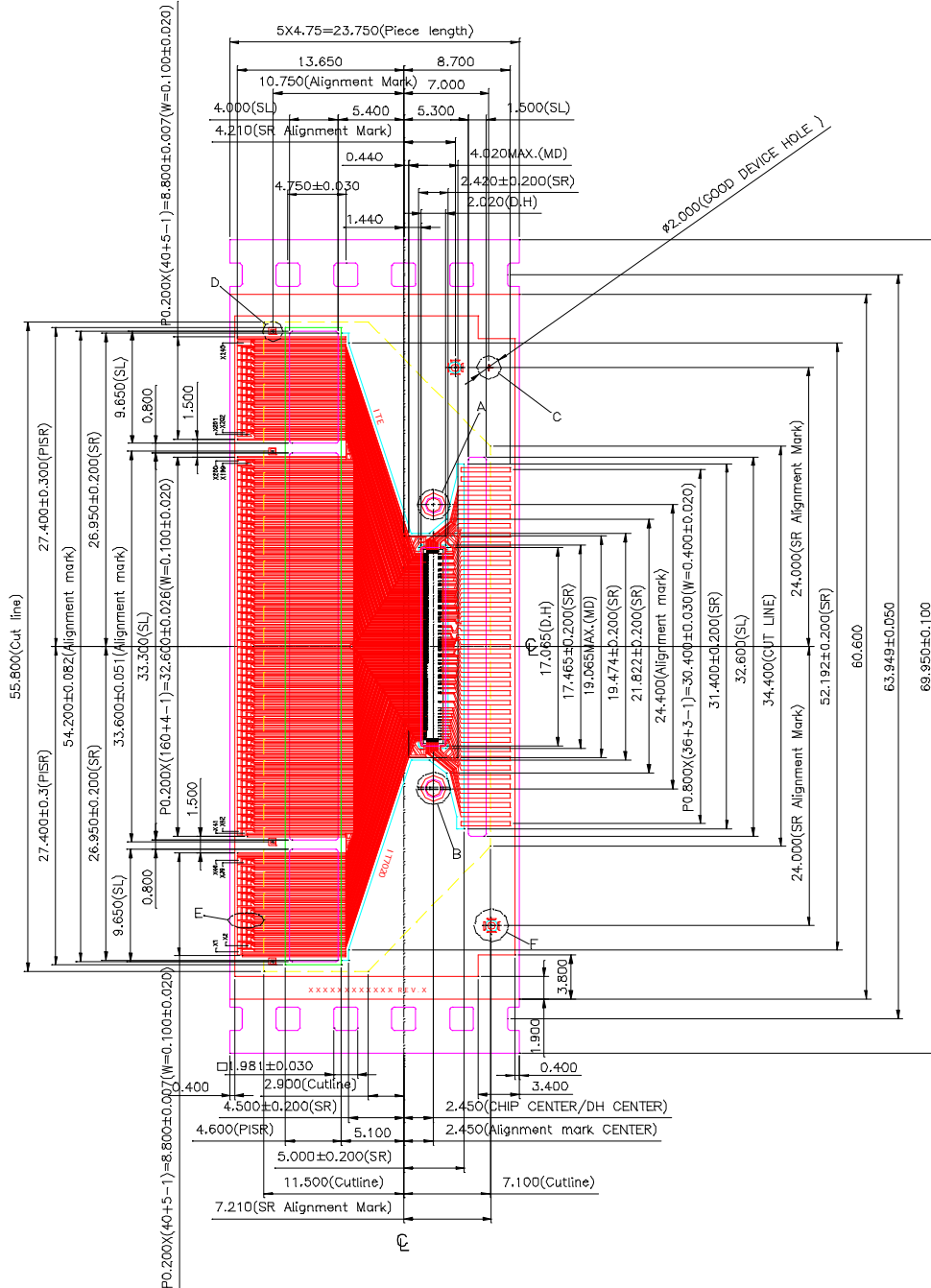
Figure 9-2. IT7020 Timing Diagram

10. Package Information

TCP Outline Dimensions

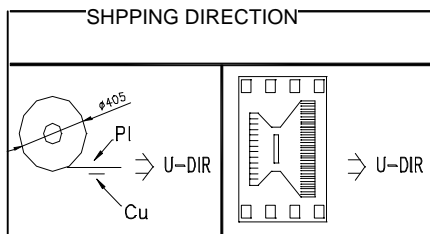
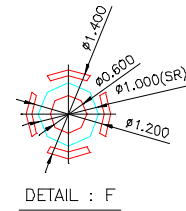
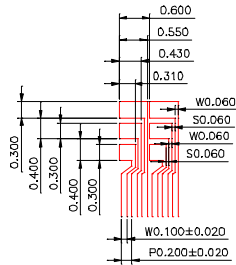
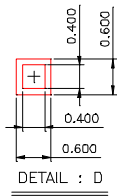
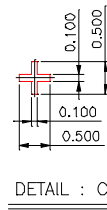
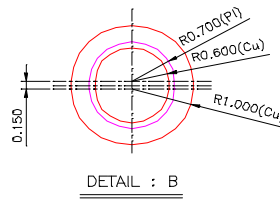
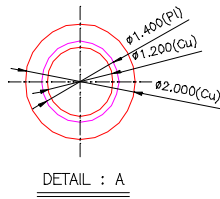
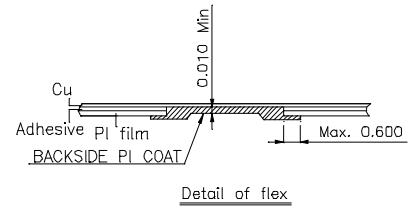
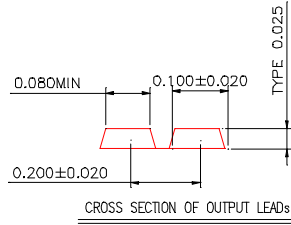
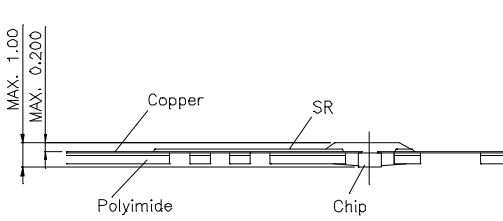
unit: mm

INPUT LEAD NAME



| |
|---------|
| NC |
| NC |
| NC |
| VLCDR |
| VHR |
| VMR |
| VLR |
| VEER |
| DIO1 |
| M_S |
| CCL |
| CL |
| GND |
| SHL |
| AMP |
| DISPOFF |
| DOC |
| MODE0 |
| MODE1 |
| Vcc |
| MWS0 |
| MWS1 |
| MWS2 |
| MWS3 |
| MWS4 |
| RESET |
| M |
| DIO2 |
| C2 |
| C1 |
| VEO |
| VEEL |
| VLL |
| VML |
| VHL |
| VLCDL |
| NC |
| NC |
| NC |

IT7020C/IT7020H



NOTE:

- Film: UPILEX-S 75±5um thickness
Copper: FQ-VLP 25±5um thickness
Adhesive: Toray #7100 12±2um thickness
Solder resist: AE-70-M11 26±14um thickness
Flex Coating: FS-100L Min. 10um
- Plating: Pure Sn thickness : 0.21±0.05um unless otherwise noted
- All corner radius of Base Film are less than 0.2mm
- Other specs than displayed in this drawing are based on the standard spec lists
- All dimensional tolerances of "SR" are ±0.2mm unless otherwise noted
- All dimensional tolerances of "base film" are ±0.05mm unless otherwise noted
- Inner lead accumulative pitch :
Output side : 15.926±0.0096 mm
Input side : 15.926±0.0096 mm



11. Ordering Information

| Part No. | Package |
|-----------------|-----------------------|
| IT7020C | 273-TCP |
| IT7020H | Bare-chip (349 bumps) |