

Technical Document

- [FAQs](#)
- [Application Note](#)

Features

- Operating voltage: 2.7V~5.2V
- Built-in 32kHz RC oscillator
- External 32.768kHz crystal oscillator or 32kHz frequency source input
- Standby current: <math><1\mu\text{A}</math> at 3V, <math><2\mu\text{A}</math> at 5V
- Internal resistor type: 1/6 bias or 1/5 bias, 1/32 duty, and 1/16 duty
- Three selectable LCD frame frequencies: 64Hz, 89Hz or 170Hz
- Max. 128×32 patterns, 128 segments and 32 commons
- 144 segments and 16 commons selectable by command method
- Built-in bit-map display RAM: 4096 bits (=128×32 bits)
- Built-in internal resistor type bias generator
- Six-wire interface (four data wires)
- Eight kinds of time base/WDT selection
- Time base or WDT overflow output
- R/W address auto increment
- Built-in buzzer driver (2kHz/4kHz)
- Power down command reduces power consumption
- Software configuration feature
- Data mode and Command mode instructions
- Three data accessing modes
- Provides VLCD pin to adjust LCD operating voltage and max. VLCD voltage up to 7V
- Provides three kinds of bias current programming
- Control of TN-type and STN-type LCDs
- 208-pin QFP package

Applications

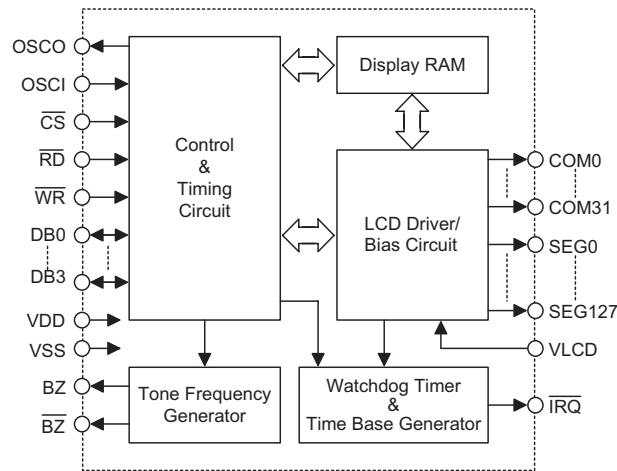
- Leisure products
- Games
- Personal digital assistant
- Cellular phone
- Global positioning system
- Consumer electronics

General Description

HT1670 is a peripheral device specially designed for I/O type MCU used to expand the display capability. The max. display segment of the device are 4096 patterns (128 segments and 32 commons). It also supports four data bits interface, buzzer sound, Watchdog Timer or time base timer functions. The HT1670 is a memory mapping and multi-function LCD controller. Since the

HT1670 can control TN-type (Twisted Nematic) or STN-type (Super Twisted Nematic) LCDs. The software configuration feature of the HT1670 make it suitable for multiple LCD applications including LCD modules and display subsystems. Only six lines (CS, WR, DB0~DB3) are required for the interface between the host controller and the HT1670.

Block Diagram

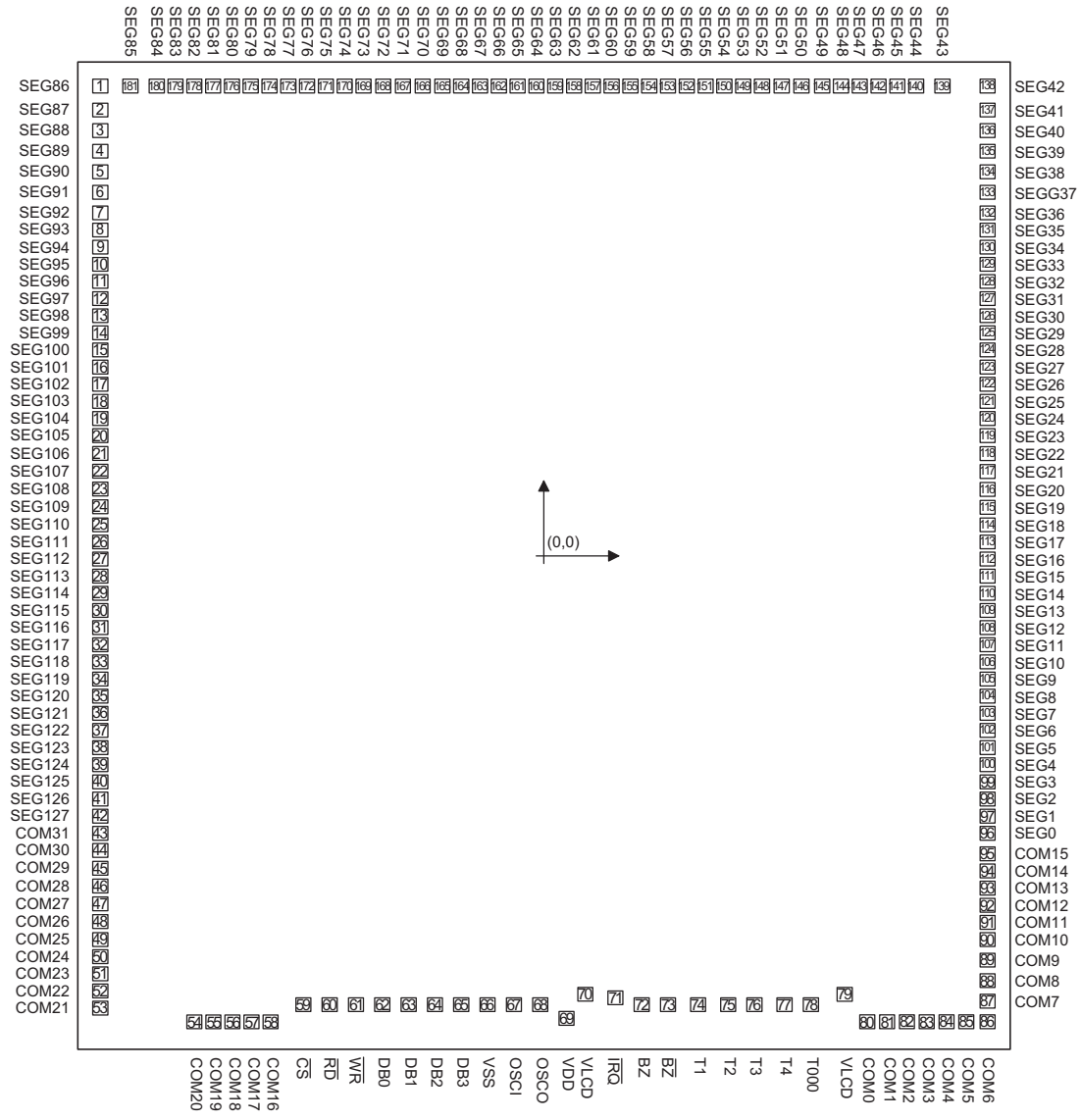


Note: \overline{CS} : Chip selection
 BZ, \overline{BZ} : Tone outputs
 WR, RD: WRITE clock, READ clock
 DB0-DB3: Data bus
 COM0-COM31, SEG0-SEG127: LCD outputs
 IRQ: Time base or WDT overflow output

Pin Assignment

| | | | |
|-----------------|-----|-----|-------|
| COM22 | 1 | 156 | SEG84 |
| COM21 | 2 | 155 | SEG83 |
| COM20 | 3 | 154 | SEG82 |
| COM19 | 4 | 153 | SEG81 |
| COM18 | 5 | 152 | SEG80 |
| COM17 | 6 | 151 | SEG79 |
| COM16 | 7 | 150 | SEG78 |
| NC | 8 | 149 | SEG77 |
| NC | 9 | 148 | SEG76 |
| NC | 10 | 147 | SEG75 |
| NC | 11 | 146 | SEG74 |
| NC | 12 | 145 | SEG73 |
| NC | 13 | 144 | SEG72 |
| NC | 14 | 143 | SEG71 |
| NC | 15 | 142 | SEG70 |
| NC | 16 | 141 | SEG69 |
| \overline{CS} | 17 | 140 | SEG68 |
| RD | 18 | 139 | SEG67 |
| WR | 19 | 138 | SEG66 |
| DB0 | 20 | 137 | SEG65 |
| DB1 | 21 | 136 | SEG64 |
| DB2 | 22 | 135 | NC |
| DB3 | 23 | 134 | NC |
| VSS | 24 | 133 | NC |
| OSCI | 25 | 132 | NC |
| OSCO | 26 | 131 | NC |
| VDD | 27 | 130 | NC |
| VLCD | 28 | 129 | NC |
| IRQ | 29 | 128 | NC |
| BZ | 30 | 127 | NC |
| \overline{BZ} | 31 | 126 | NC |
| T1 | 32 | 125 | SEG63 |
| T2 | 33 | 124 | SEG62 |
| T3 | 34 | 123 | SEG61 |
| T4 | 35 | 122 | SEG60 |
| T000 | 36 | 121 | SEG59 |
| VLCD | 37 | 120 | SEG58 |
| NC | 38 | 119 | SEG57 |
| NC | 39 | 118 | SEG56 |
| NC | 40 | 117 | SEG55 |
| NC | 41 | 116 | SEG54 |
| NC | 42 | 115 | SEG53 |
| NC | 43 | 114 | SEG52 |
| NC | 44 | 113 | SEG51 |
| NC | 45 | 112 | SEG50 |
| COM0 | 46 | 111 | SEG49 |
| COM1 | 47 | 110 | SEG48 |
| COM2 | 48 | 109 | SEG47 |
| COM3 | 49 | 108 | SEG46 |
| COM4 | 50 | 107 | SEG45 |
| COM5 | 51 | 106 | SEG44 |
| COM6 | 52 | 105 | SEG43 |
| COM7 | 53 | 104 | SEG42 |
| COM8 | 54 | 103 | SEG41 |
| COM9 | 55 | 102 | SEG40 |
| COM10 | 56 | 101 | SEG39 |
| COM11 | 57 | 100 | SEG38 |
| COM12 | 58 | 99 | SEG37 |
| COM13 | 59 | 98 | SEG36 |
| COM14 | 60 | 97 | SEG35 |
| COM15 | 61 | 96 | SEG34 |
| SEG1 | 62 | 95 | SEG33 |
| SEG2 | 63 | 94 | SEG32 |
| SEG3 | 64 | 93 | SEG31 |
| SEG4 | 65 | 92 | SEG30 |
| SEG5 | 66 | 91 | SEG29 |
| SEG6 | 67 | 90 | SEG28 |
| SEG7 | 68 | 89 | SEG27 |
| SEG8 | 69 | 88 | SEG26 |
| SEG9 | 70 | 87 | SEG25 |
| SEG10 | 71 | 86 | SEG24 |
| SEG11 | 72 | 85 | SEG23 |
| SEG12 | 73 | 84 | SEG22 |
| SEG13 | 74 | 83 | SEG21 |
| SEG14 | 75 | 82 | SEG20 |
| SEG15 | 76 | 81 | SEG19 |
| SEG16 | 77 | 80 | SEG18 |
| SEG17 | 78 | 79 | SEG17 |
| SEG18 | 79 | 78 | SEG16 |
| SEG19 | 80 | 77 | SEG15 |
| SEG20 | 81 | 76 | SEG14 |
| SEG21 | 82 | 75 | SEG13 |
| SEG22 | 83 | 74 | SEG12 |
| SEG23 | 84 | 73 | SEG11 |
| SEG24 | 85 | 72 | SEG10 |
| SEG25 | 86 | 71 | SEG9 |
| SEG26 | 87 | 70 | SEG8 |
| SEG27 | 88 | 69 | SEG7 |
| SEG28 | 89 | 68 | SEG6 |
| SEG29 | 90 | 67 | SEG5 |
| SEG30 | 91 | 66 | SEG4 |
| SEG31 | 92 | 65 | SEG3 |
| SEG32 | 93 | 64 | SEG2 |
| SEG33 | 94 | 63 | SEG1 |
| SEG34 | 95 | 62 | SEG0 |
| SEG35 | 96 | 61 | SEG0 |
| SEG36 | 97 | 60 | SEG0 |
| SEG37 | 98 | 59 | SEG0 |
| SEG38 | 99 | 58 | SEG0 |
| SEG39 | 100 | 57 | SEG0 |
| SEG40 | 101 | 56 | SEG0 |
| SEG41 | 102 | 55 | SEG0 |
| SEG42 | 103 | 54 | SEG0 |
| SEG43 | 104 | 53 | SEG0 |

HT1670
 - 208 QFP-A

Pad Assignment


* The IC substrate should be connected to VSS in the PCB layout artwork.

Pad Coordinates

Unit: μm

| Pad No. | X | Y | Pad No. | X | Y | Pad No. | X | Y |
|---------|----------|---------|---------|---------|----------|---------|---------|---------|
| 1 | -2343.20 | 2715.30 | 62 | -848.60 | -2594.80 | 123 | 2343.05 | 1090.25 |
| 2 | -2343.20 | 2581.20 | 63 | -713.20 | -2594.80 | 124 | 2343.05 | 1190.25 |
| 3 | -2343.20 | 2461.20 | 64 | -567.90 | -2594.80 | 125 | 2343.05 | 1290.25 |
| 4 | -2343.20 | 2341.20 | 65 | -432.30 | -2594.80 | 126 | 2343.05 | 1390.25 |
| 5 | -2343.20 | 2221.20 | 66 | -290.20 | -2594.90 | 127 | 2343.05 | 1490.25 |
| 6 | -2343.20 | 2101.20 | 67 | -156.70 | -2599.30 | 128 | 2343.05 | 1590.25 |
| 7 | -2343.20 | 1990.25 | 68 | -18.50 | -2599.30 | 129 | 2343.05 | 1690.25 |
| 8 | -2343.20 | 1890.25 | 69 | 119.80 | -2666.95 | 130 | 2343.05 | 1790.25 |
| 9 | -2343.20 | 1790.25 | 70 | 209.15 | -2531.95 | 131 | 2343.05 | 1890.25 |

| Pad No. | X | Y | Pad No. | X | Y | Pad No. | X | Y |
|---------|----------|----------|---------|---------|----------|---------|----------|---------|
| 10 | -2343.20 | 1690.25 | 71 | 378.85 | -2553.20 | 132 | 2343.05 | 1990.25 |
| 11 | -2343.20 | 1590.25 | 72 | 525.35 | -2594.90 | 133 | 2343.05 | 2101.20 |
| 12 | -2343.20 | 1490.25 | 73 | 660.75 | -2594.90 | 134 | 2343.05 | 2221.20 |
| 13 | -2343.20 | 1390.25 | 74 | 820.45 | -2594.90 | 135 | 2343.05 | 2341.20 |
| 14 | -2343.20 | 1290.25 | 75 | 968.65 | -2594.90 | 136 | 2343.05 | 2461.20 |
| 15 | -2343.20 | 1190.25 | 76 | 1115.65 | -2594.90 | 137 | 2343.05 | 2581.20 |
| 16 | -2343.20 | 1090.25 | 77 | 1263.85 | -2594.90 | 138 | 2343.05 | 2715.30 |
| 17 | -2343.20 | 990.25 | 78 | 1410.85 | -2594.90 | 139 | 2095.70 | 2715.30 |
| 18 | -2343.20 | 890.25 | 79 | 1581.55 | -2531.90 | 140 | 1959.25 | 2715.30 |
| 19 | -2343.20 | 790.25 | 80 | 1707.05 | -2702.70 | 141 | 1859.25 | 2715.30 |
| 20 | -2343.20 | 690.25 | 81 | 1807.05 | -2702.70 | 142 | 1759.25 | 2715.30 |
| 21 | -2343.20 | 590.25 | 82 | 1907.05 | -2702.70 | 143 | 1659.25 | 2715.30 |
| 22 | -2343.20 | 490.25 | 83 | 2013.05 | -2702.70 | 144 | 1559.25 | 2715.30 |
| 23 | -2343.20 | 390.25 | 84 | 2123.05 | -2702.70 | 145 | 1459.25 | 2715.30 |
| 24 | -2343.20 | 290.25 | 85 | 2233.05 | -2702.70 | 146 | 1359.25 | 2715.30 |
| 25 | -2343.20 | 190.25 | 86 | 2343.05 | -2702.70 | 147 | 1259.25 | 2715.30 |
| 26 | -2343.20 | 90.25 | 87 | 2343.05 | -2571.70 | 148 | 1159.25 | 2715.30 |
| 27 | -2343.20 | -9.75 | 88 | 2343.05 | -2451.70 | 149 | 1059.25 | 2715.30 |
| 28 | -2343.20 | -109.75 | 89 | 2343.05 | -2331.70 | 150 | 959.25 | 2715.30 |
| 29 | -2343.20 | -209.75 | 90 | 2343.05 | -2215.05 | 151 | 859.25 | 2715.30 |
| 30 | -2343.20 | -309.75 | 91 | 2343.05 | -2115.05 | 152 | 759.25 | 2715.30 |
| 31 | -2343.20 | -409.75 | 92 | 2343.05 | -2015.05 | 153 | 659.25 | 2715.30 |
| 32 | -2343.20 | -509.75 | 93 | 2343.05 | -1915.05 | 154 | 559.25 | 2715.30 |
| 33 | -2343.20 | -609.75 | 94 | 2343.05 | -1815.05 | 155 | 459.25 | 2715.30 |
| 34 | -2343.20 | -709.75 | 95 | 2343.05 | -1715.05 | 156 | 359.25 | 2715.30 |
| 35 | -2343.20 | -809.75 | 96 | 2343.05 | -1609.75 | 157 | 259.25 | 2715.30 |
| 36 | -2343.20 | -909.75 | 97 | 2343.05 | -1509.75 | 158 | 159.25 | 2715.30 |
| 37 | -2343.20 | -1009.75 | 98 | 2343.05 | -1409.75 | 159 | 59.25 | 2715.30 |
| 38 | -2343.20 | -1109.75 | 99 | 2343.05 | -1309.75 | 160 | -40.75 | 2715.30 |
| 39 | -2343.20 | -1209.75 | 100 | 2343.05 | -1209.75 | 161 | -140.75 | 2715.30 |
| 40 | -2343.20 | -1309.75 | 101 | 2343.05 | -1109.75 | 162 | -240.75 | 2715.30 |
| 41 | -2343.20 | -1409.75 | 102 | 2343.05 | -1009.75 | 163 | -340.75 | 2715.30 |
| 42 | -2343.20 | -1509.75 | 103 | 2343.05 | -909.75 | 164 | -440.75 | 2715.30 |
| 43 | -2343.20 | -1609.75 | 104 | 2343.05 | -809.75 | 165 | -540.75 | 2715.30 |
| 44 | -2343.20 | -1709.75 | 105 | 2343.05 | -709.75 | 166 | -640.75 | 2715.30 |
| 45 | -2343.20 | -1809.75 | 106 | 2343.05 | -609.75 | 167 | -740.75 | 2715.30 |
| 46 | -2343.20 | -1909.75 | 107 | 2343.05 | -509.75 | 168 | -840.75 | 2715.30 |
| 47 | -2343.20 | -2009.75 | 108 | 2343.05 | -409.75 | 169 | -940.75 | 2715.30 |
| 48 | -2343.20 | -2109.75 | 109 | 2343.05 | -309.75 | 170 | -1040.75 | 2715.30 |
| 49 | -2343.20 | -2209.75 | 110 | 2343.05 | -209.75 | 171 | -1140.75 | 2715.30 |
| 50 | -2343.20 | -2309.75 | 111 | 2343.05 | -109.75 | 172 | -1240.75 | 2715.30 |
| 51 | -2343.20 | -2409.75 | 112 | 2343.05 | -9.75 | 173 | -1340.75 | 2715.30 |
| 52 | -2343.20 | -2509.75 | 113 | 2343.05 | 90.25 | 174 | -1440.75 | 2715.30 |
| 53 | -2343.20 | -2609.75 | 114 | 2343.05 | 190.25 | 175 | -1540.75 | 2715.30 |
| 54 | -1850.15 | -2702.70 | 115 | 2343.05 | 290.25 | 176 | -1640.75 | 2715.30 |
| 55 | -1750.15 | -2702.70 | 116 | 2343.05 | 390.25 | 177 | -1740.75 | 2715.30 |
| 56 | -1650.15 | -2702.70 | 117 | 2343.05 | 490.25 | 178 | -1840.75 | 2715.30 |
| 57 | -1550.15 | -2702.70 | 118 | 2343.05 | 590.25 | 179 | -1940.75 | 2715.30 |
| 58 | -1450.15 | -2702.70 | 119 | 2343.05 | 690.25 | 180 | -2040.75 | 2715.30 |
| 59 | -1273.50 | -2594.80 | 120 | 2343.05 | 790.25 | 181 | -2173.20 | 2715.30 |
| 60 | -1130.90 | -2594.80 | 121 | 2343.05 | 890.25 | | | |
| 61 | -995.50 | -2594.80 | 122 | 2343.05 | 990.25 | | | |

Pad Description

| Pad No. | Pad Name | I/O | Description |
|----------------|----------------------------|--------|---|
| 1~42 96~181 | SEG86~SEG127 SEG0~SEG85 | O | LCD segment outputs |
| 43~58 80~95 | COM31~COM16 COM0~COM15 | O | LCD common outputs, under 144×16 command mode, COM16~COM31 will share to SEG128~SEG143. COM31/SEG128, COM30/SEG129, COM29/SEG130....., COM18/SEG141, COM17/SEG142, COM16/SEG143 |
| 59 | \overline{CS} | I | Chip selection input with pull-high resistor. When the \overline{CS} is logic high, the data and command read from or write to the HT1670 are disabled. The serial interface circuit is also reset. But if the \overline{CS} is at a logic low level and is input to the \overline{CS} pad, the data and command transmission between the host controller and the HT1670 are all enabled. |
| 60 | \overline{RD} | I | READ clock input with pull-high resistor. Data in the RAM of the HT1670 are clocked out on the falling edge of the \overline{RD} signal. The clocked out data will appear on the data line. The host controller can use the next rising edge to latch the clocked out data. |
| 61 | \overline{WR} | I | WRITE clock input with pull-high resistor. Data on the DATA line are latched into the HT1670 on the rising edge of the \overline{WR} signal. |
| 62~65 | DB0~DB3 | I/O | Parallel data input/output with a pull-high resistor |
| 66 | VSS | — | Negative power supply for logic circuit, ground |
| 67 68 | OSCI OSCO | I O | The OSCI and OSCO pads are connected to a 32.768kHz crystal in order to generate a system clock. If the system clock comes from an external clock source, the external clock source should be connected to the OSCI pad. But if an on-chip RC oscillator is selected, the OSCI and OSCO pads can be left open. |
| 69 | VDD | — | Positive power supply for logic circuit |
| 70, 79 | VLCD | I | Power supply for LCD driver circuit |
| 71 | \overline{IRQ} | O | Time base or Watchdog Timer overflow flag, NMOS open drain output. |
| 72, 73 | BZ, \overline{BZ} | O | 2kHz or 4kHz frequency output pair (tristate output buffer) |
| 74~78 | T1~T4, T000 | I | Vary bias current pin It is usually not connected |

Absolute Maximum Ratings

Supply Voltage $V_{SS}-0.3V$ to $V_{SS}+5.5V$ Storage Temperature $-50^{\circ}C$ to $125^{\circ}C$
 Input Voltage $V_{SS}-0.3V$ to $V_{DD}+0.3V$ Operating Temperature $-25^{\circ}C$ to $75^{\circ}C$

Note: These are stress ratings only. Stresses exceeding the range specified under "Absolute Maximum Ratings" may cause substantial damage to the device. Functional operation of this device at other conditions beyond those listed in the specification is not implied and prolonged exposure to extreme conditions may affect device reliability.

D.C. Characteristics

Ta=25°C

| Symbol | Parameter | Test Conditions | | Min. | Typ. | Max. | Unit |
|-------------------|---|-----------------|--|------|------|------|------|
| | | V _{DD} | Conditions | | | | |
| V _{DD} | Operating Voltage | — | — | 2.7 | — | 5.2 | V |
| I _{DD1} | Operating Current | 3V | No load/LCD ON | — | 150 | 250 | μA |
| | | 5V | On-chip RC oscillator | — | 250 | 370 | μA |
| I _{DD2} | Operating Current | 3V | No load/LCD ON | — | 135 | 200 | μA |
| | | 5V | Crystal oscillator | — | 200 | 300 | μA |
| I _{DD11} | Operating Current | 3V | No load/LCD OFF | — | 15 | 30 | μA |
| | | 5V | On-chip RC oscillator | — | 50 | 70 | μA |
| I _{DD22} | Operating Current | 3V | No load/LCD OFF | — | 2 | 10 | μA |
| | | 5V | Crystal oscillator | — | 3 | 10 | μA |
| I _{STB} | Standby Current | 3V | No load, Power down mode | — | — | 1 | μA |
| | | 5V | | — | — | 2 | μA |
| V _{IL} | Input Low Voltage | 3V | DB0~DB3, \overline{WR} , \overline{CS} , \overline{RD} | 0 | — | 0.6 | V |
| | | 5V | | 0 | — | 1.0 | V |
| V _{IH} | Input High Voltage | 3V | DB0~DB3, \overline{WR} , \overline{CS} , \overline{RD} | 2.4 | — | 3 | V |
| | | 5V | | 4.0 | — | 5 | V |
| I _{OL1} | BZ, \overline{BZ} , \overline{IRQ} Sink Current | 3V | V _{OL} =0.3V | 1.2 | 2.5 | — | mA |
| | | 5V | V _{OL} =0.5V | 3 | 6 | — | mA |
| I _{OH1} | BZ, \overline{BZ} Source Current | 3V | V _{OH} =2.7V | -0.9 | -1.8 | — | mA |
| | | 5V | V _{OH} =4.5V | -2 | -4 | — | mA |
| I _{OL2} | DB0~DB3 Sink Current | 3V | V _{OL} =0.3V | 1.2 | 2.5 | — | mA |
| | | 5V | V _{OL} =0.5V | 3 | 6 | — | mA |
| I _{OH2} | DB0~DB3 Source Current | 3V | V _{OH} =2.7V | -0.9 | -1.8 | — | mA |
| | | 5V | V _{OH} =4.5V | -2 | -4 | — | mA |
| I _{OL3} | LCD Common Sink Current | 3V | V _{OL} =0.3V | 80 | 160 | — | μA |
| | | 5V | V _{OL} =0.5V | 180 | 360 | — | μA |
| I _{OH3} | LCD Common Source Current | 3V | V _{OH} =2.7V | -40 | -80 | — | μA |
| | | 5V | V _{OH} =4.5V | -90 | -180 | — | μA |
| I _{OL4} | LCD Segment Sink Current | 3V | V _{OL} =0.3V | 50 | 100 | — | μA |
| | | 5V | V _{OL} =0.5V | 120 | 240 | — | μA |
| I _{OH4} | LCD Segment Source Current | 3V | V _{OH} =2.7V | -30 | -60 | — | μA |
| | | 5V | V _{OH} =4.5V | -70 | -140 | — | μA |
| R _{PH} | Pull-high Resistor | 3V | DB0~DB3, \overline{WR} , \overline{CS} , \overline{RD} | 150 | 250 | 410 | kΩ |
| | | 5V | | 60 | 125 | 210 | kΩ |

A.C. Characteristics

Ta=25°C

| Symbol | Parameter | Test Conditions | | Min. | Typ. | Max. | Unit |
|---------------------------------|--|-----------------|-----------------------|--------|--------------------|---------|------|
| | | V _{DD} | Conditions | | | | |
| f _{sys1} | System Clock | 3V | On-chip RC oscillator | 22 | 32 | 40 | kHz |
| | | 5V | | 24 | 32 | 40 | |
| f _{sys2} | System Clock | 3V | Crystal oscillator | — | 32.768 | — | kHz |
| | | 5V | | — | 32.768 | — | |
| f _{sys3} | System Clock | 3V | External clock source | — | 32 | — | kHz |
| | | 5V | | — | 32 | — | |
| f _{LCD1} | LCD Frame Frequency | 3V | On-chip RC oscillator | 61/117 | 89/170 | 111/213 | Hz |
| | | 5V | | 61/117 | 89/170 | 111/213 | |
| f _{LCD2} | LCD Frame Frequency | 3V | Crystal oscillator | — | 64 | — | Hz |
| | | 5V | | — | 64 | — | |
| f _{LCD3} | LCD Frame Frequency | 3V | External clock source | — | 64 | — | Hz |
| | | 5V | | — | 64 | — | |
| t _{COM} | LCD Common Period | — | n: Number of COM | — | n/f _{LCD} | — | sec |
| f _{CLK1} | 4-Bit Data Clock (\overline{WR} Pin) | 3V | Duty cycle 50% | — | — | 150 | kHz |
| | | 5V | | — | — | 300 | |
| f _{CLK2} | 4-Bit Data Clock (\overline{RD} Pin) | 3V | Duty cycle 50% | — | — | 75 | kHz |
| | | 5V | | — | — | 150 | |
| t _{CS} | 4-Bit Interface Reset Pulse Width (Figure 3) | — | \overline{CS} | — | 250 | — | ns |
| t _{CLK} | \overline{WR} , \overline{RD} Input Pulse Width (Figure 1) | 3V | Write mode | 3.34 | — | — | μs |
| | | | Read mode | 6.67 | | | |
| | | 5V | Write mode | 1.67 | — | — | μs |
| | | | Read mode | 3.34 | | | |
| t _r , t _f | Rise/Fall Time Serial Data Clock Width (Figure 1) | 3V | — | — | 120 | — | ns |
| | | 5V | | | | | |
| t _{su} | Setup Time for DB to \overline{WR} , \overline{RD} Clock Width (Figure 2) | 3V | — | — | 120 | — | ns |
| | | 5V | | | | | |
| t _h | Hold Time for DB to \overline{WR} , \overline{RD} Clock Width (Figure 2) | 3V | — | — | 120 | — | ns |
| | | 5V | | | | | |
| t _{su1} | Setup Time for \overline{CS} to \overline{WR} , \overline{RD} Clock Width (Figure 3) | 3V | — | — | 100 | — | ns |
| | | 5V | | | | | |
| t _{h1} | Hold Time for \overline{CS} to \overline{WR} , \overline{RD} Clock Width (Figure 3) | 3V | — | — | 100 | — | ns |
| | | 5V | | | | | |

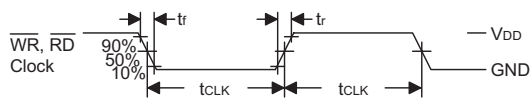


Figure 1

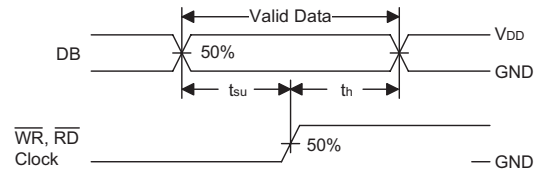


Figure 2

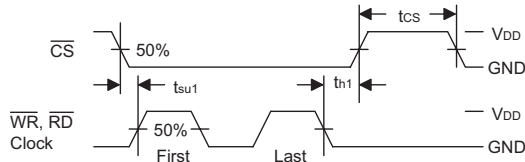


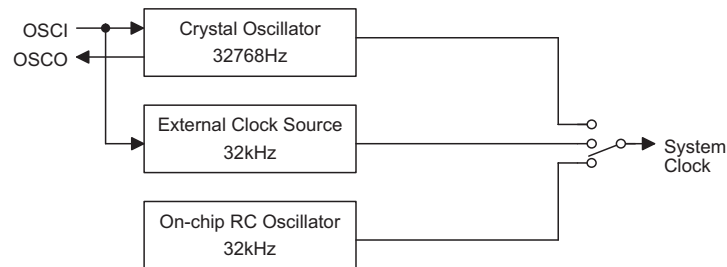
Figure 3

Functional Description

System Oscillator

The HT1670 system clock is used to generate the time base/Watchdog Timer (WDT) clock frequency, LCD driving clock, and tone frequency. The clock source may be from an on-chip RC oscillator (32kHz), a crystal oscillator (32.768kHz), or an external 32kHz clock by the S/W setting. The configuration of the system oscillator is as shown. After the SYS DIS command is executed, the system clock will stop and the LCD bias generator will turn off. That command is available only for the on-chip RC oscillator or for the crystal oscillator. Once the system clock stops, the LCD display will become blank, and the time base/WDT loses its function as well.

The LCD OFF command is used to turn the LCD bias generator off. After the LCD bias generator switches off by issuing the LCD OFF command, using the SYS DIS command reduces power consumption, thus serving as a system power down command. But if the external clock source is chosen as the system clock, using the SYS DIS command can neither turn the oscillator off nor carry out the power down mode. The crystal oscillator option can be applied to connect an external frequency source of 32kHz to the OSC1 pin. In this case, the system fails to enter the power down mode, similar to the case in the external 32kHz clock source operation. At the initial system power on, the HT1670 is at the SYS DIS state.



System Oscillator Configuration

Display Memory – RAM Structure

The static display RAM is organized into 1024×4 bits and stores the display data. The contents of the RAM are directly mapped to the contents of the LCD driver. Data in the RAM can be accessed by the READ, WRITE and READ-MODIFY-WRITE commands. The following is a mapping from the RAM to the LCD patterns.

| | | | | | | | | | |
|--------------|-------------|-------------|-------------|-------------|---------------------------|---------------|---------------|---------------|---------------|
| | 00H | 08H | 10H | 18H | 20H - - - - - 3D8H | 3E0H | 3E8H | 3F0H | 3F8H |
| COM0 | Bit0 | Bit0 | Bit0 | | | | Bit0 | Bit0 | Bit0 |
| COM1 | Bit1 | Bit1 | Bit1 | | | | Bit1 | Bit1 | Bit1 |
| COM2 | Bit2 | Bit2 | Bit2 | | | | Bit2 | Bit2 | Bit2 |
| COM3 | Bit3 | Bit3 | Bit3 | | | | Bit3 | Bit3 | Bit3 |
| | 01H | 09H | 11H | 19H | 21H - - - - - 3D9H | 3E1H | 3E9H | 3F1H | 3F9H |
| COM4 | Bit0 | Bit0 | Bit0 | | | | Bit0 | Bit0 | Bit0 |
| COM5 | Bit1 | Bit1 | Bit1 | | | | Bit1 | Bit1 | Bit1 |
| COM6 | Bit2 | Bit2 | Bit2 | | | | Bit2 | Bit2 | Bit2 |
| COM7 | Bit3 | Bit3 | Bit3 | | | | Bit3 | Bit3 | Bit3 |
| | 02H | 0AH | 12H | 1AH | 22H - - - - - 3DAH | 3E2H | 3EAH | 3F2H | 3FAH |
| COM8 | Bit0 | Bit0 | Bit0 | | | | Bit0 | Bit0 | Bit0 |
| COM9 | Bit1 | Bit1 | Bit1 | | | | Bit1 | Bit1 | Bit1 |
| COM10 | Bit2 | Bit2 | Bit2 | | | | Bit2 | Bit2 | Bit2 |
| COM11 | Bit3 | Bit3 | Bit3 | | | | Bit3 | Bit3 | Bit3 |
| | 03H | 0BH | 13H | 1BH | 23H - - - - - 3DBH | 3E3H | 3EBH | 3F3H | 3FBH |
| COM12 | Bit0 | Bit0 | Bit0 | | | | Bit0 | Bit0 | Bit0 |
| COM13 | Bit1 | Bit1 | Bit1 | | | | Bit1 | Bit1 | Bit1 |
| COM14 | Bit2 | Bit2 | Bit2 | | | | Bit2 | Bit2 | Bit2 |
| COM15 | Bit3 | Bit3 | Bit3 | | | | Bit3 | Bit3 | Bit3 |
| | 04H | 0CH | 14H | 1CH | 24H - - - - - 3DCH | 3E4H | 3ECH | 3F4H | 3FCH |
| COM16 | Bit0 | Bit0 | Bit0 | | | | Bit0 | Bit0 | Bit0 |
| COM17 | Bit1 | Bit1 | Bit1 | | | | Bit1 | Bit1 | Bit1 |
| COM18 | Bit2 | Bit2 | Bit2 | | | | Bit2 | Bit2 | Bit2 |
| COM19 | Bit3 | Bit3 | Bit3 | | | | Bit3 | Bit3 | Bit3 |
| | 05H | 0DH | 15H | 1DH | 25H - - - - - 3DDH | 3E5H | 3EDH | 3F5H | 3FDH |
| COM20 | Bit0 | Bit0 | Bit0 | | | | Bit0 | Bit0 | Bit0 |
| COM21 | Bit1 | Bit1 | Bit1 | | | | Bit1 | Bit1 | Bit1 |
| COM22 | Bit2 | Bit2 | Bit2 | | | | Bit2 | Bit2 | Bit2 |
| COM23 | Bit3 | Bit3 | Bit3 | | | | Bit3 | Bit3 | Bit3 |
| | 06H | 0EH | 16H | 1EH | 26H - - - - - 3DEH | 3E6H | 3EEH | 3F6H | 3FEH |
| COM24 | Bit0 | Bit0 | Bit0 | | | | Bit0 | Bit0 | Bit0 |
| COM25 | Bit1 | Bit1 | Bit1 | | | | Bit1 | Bit1 | Bit1 |
| COM26 | Bit2 | Bit2 | Bit2 | | | | Bit2 | Bit2 | Bit2 |
| COM27 | Bit3 | Bit3 | Bit3 | | | | Bit3 | Bit3 | Bit3 |
| | 07H | 0FH | 17H | 1FH | 27H - - - - - 3DFH | 3E7H | 3EFH | 3F7H | 3FFH |
| COM28 | Bit0 | Bit0 | Bit0 | | | | Bit0 | Bit0 | Bit0 |
| COM29 | Bit1 | Bit1 | Bit1 | | | | Bit1 | Bit1 | Bit1 |
| COM30 | Bit2 | Bit2 | Bit2 | | | | Bit2 | Bit2 | Bit2 |
| COM31 | Bit3 | Bit3 | Bit3 | | | | Bit3 | Bit3 | Bit3 |
| | SEG0 | SEG1 | SEG2 | SEG3 | | SEG124 | SEG125 | SEG126 | SEG127 |

128×32 Selection Mode RAM Mapping Table

| | | | | | | | | | |
|--------------|-------------|-------------|-------------|-------------|---------------------------|---------------|---------------|---------------|---------------|
| | 00H | 04H | 08H | 0CH | 10H - - - - - 22CH | 230H | 234H | 238H | 23CH |
| COM0 | Bit0 | Bit0 | Bit0 | | | | Bit0 | Bit0 | Bit0 |
| COM1 | Bit1 | Bit1 | Bit1 | | | | Bit1 | Bit1 | Bit1 |
| COM2 | Bit2 | Bit2 | Bit2 | | | | Bit2 | Bit2 | Bit2 |
| COM3 | Bit3 | Bit3 | Bit3 | | | | Bit3 | Bit3 | Bit3 |
| | 01H | 05H | 09H | 0DH | 11H - - - - - 22DH | 231H | 235H | 239H | 23DH |
| COM4 | Bit0 | Bit0 | Bit0 | | | | Bit0 | Bit0 | Bit0 |
| COM5 | Bit1 | Bit1 | Bit1 | | | | Bit1 | Bit1 | Bit1 |
| COM6 | Bit2 | Bit2 | Bit2 | | | | Bit2 | Bit2 | Bit2 |
| COM7 | Bit3 | Bit3 | Bit3 | | | | Bit3 | Bit3 | Bit3 |
| | 02H | 06H | 0AH | 0EH | 12H - - - - - 22EH | 232H | 236H | 23AH | 23EH |
| COM8 | Bit0 | Bit0 | Bit0 | | | | Bit0 | Bit0 | Bit0 |
| COM9 | Bit1 | Bit1 | Bit1 | | | | Bit1 | Bit1 | Bit1 |
| COM10 | Bit2 | Bit2 | Bit2 | | | | Bit2 | Bit2 | Bit2 |
| COM11 | Bit3 | Bit3 | Bit3 | | | | Bit3 | Bit3 | Bit3 |
| | 03H | 07H | 0BH | 0FH | 13H - - - - - 22FH | 233H | 237H | 23BH | 23FH |
| COM12 | Bit0 | Bit0 | Bit0 | | | | Bit0 | Bit0 | Bit0 |
| COM13 | Bit1 | Bit1 | Bit1 | | | | Bit1 | Bit1 | Bit1 |
| COM14 | Bit2 | Bit2 | Bit2 | | | | Bit2 | Bit2 | Bit2 |
| COM15 | Bit3 | Bit3 | Bit3 | | | | Bit3 | Bit3 | Bit3 |
| | SEG0 | SEG1 | SEG2 | SEG3 | | SEG140 | SEG141 | SEG142 | SEG143 |

144×16 Selection Mode RAM Mapping Table

| Name | Command Code | Function |
|---|---------------------|--|
| 144×16 Mode | X100-0001-1111-XXXX | Change segment from 144 to 96 and common from 32 to 16 |
| The default value after power ON reset is 128×32 mode, set "Normal" command will change 144×16 mode to 128×32 mode. | | |

Frame Frequency

HT1670 provides three kinds of frame frequency option by command code; 64Hz, 89Hz and 170Hz respectively. FRAME 64Hz provides 64Hz frame frequency. FRAME 89Hz provides 89Hz frame frequency. FRAME 170Hz provides 170Hz frame frequency.

| Name | Command Code | Function |
|-------------|---------------------|------------------------------|
| FRAME 170Hz | X100-0001-1000-XXXX | Select 170Hz frame frequency |
| FRAME 89Hz | X100-0001-1101-XXXX | Select 89Hz frame frequency |
| FRAME 64Hz | X100-0001-1110-XXXX | Select 64Hz frame frequency |

Frame Frequency Selection Command Code
Time Base and Watchdog Timer – WDT

The time base generator and WDT share the same counter which is divided by 256. The \overline{IRQ} clock can be programmed as 1Hz, 2Hz, ..., 128Hz output. TIMER DIS/EN/CLR, WDT DIS/EN/CLR and \overline{IRQ} EN/DIS are independent from each other. Once the WDT time-out occurs, the \overline{IRQ} pin will remain at a logic low level until the CLR WDT or the \overline{IRQ} DIS command is issued.

If an external clock is selected as the system frequency source, the SYS DIS command turns out invalid and the power down mode fails to be carried out until the external clock source is removed.

Buzzer Tone Output

A simple tone generator is implemented in the HT1670. The tone generator can output a pair of differential driving signals on the BZ and \overline{BZ} which are used to generate a single tone.

By executing the TONE 4K and TONE 2K commands there are two tone frequency outputs selectable that can turn on the tone output. The TONE 4K and TONE 2K commands set the tone frequency to 4kHz and 2kHz, respectively. The tone output can be turned off by invoking the TONE OFF command. The tone outputs, namely BZ and \overline{BZ} , are a pair of differential driving outputs used to drive a piezo buzzer. Once the system is disabled or the tone output is inhibited, the BZ and the \overline{BZ} outputs will remain at low level.

Command Format

The HT1670 can be configured by software setting. There are two mode commands to configure the HT1670 resource and to transfer the LCD display data.

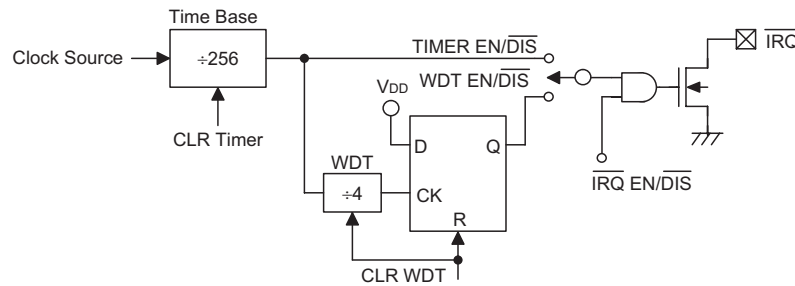
The configuration mode of the HT1670 is called command mode, and its command mode ID is 100. The command mode consists of a system configuration

command, a system frequency selection command, an LCD configuration command, a tone frequency selection command, a bias current selection command, a timer/WDT setting command, and an operating command. The data mode, on the other hand, includes READ, WRITE, and READ-MODIFY-WRITE operations.

The following are the data mode ID and the command mode ID:

| Operation | Mode | ID |
|-------------------|---------|-----|
| READ | Data | 110 |
| WRITE | Data | 101 |
| READ-MODIFY-WRITE | Data | 101 |
| COMMAND | Command | 100 |

If successive commands have been issued, the command mode ID can be omitted. While the system is operating in the non-successive command or the non-successive address data mode, the \overline{CS} pin should be set to "1" and the previous operation mode will also be reset. The \overline{CS} pin returns to "0", so a new operation mode ID should be issued first.



Time Base and WDT Configurations

| Name | Command Code | Function |
|----------|---------------------|---|
| TONE OFF | X100-0000-1000-XXXX | Turn-off tone output |
| TONE 4K | X100-0001-0000-XXXX | Turn-on tone output, tone frequency is 4kHz |
| TONE 2K | X100-0001-0001-XXXX | Turn-on tone output, tone frequency is 2kHz |

Buzzer Tone Output Command Code

The following are the data mode ID and the command ID:

| Operation | Mode | ID |
|-------------------|---------|-----|
| READ | Data | 110 |
| WRITE | Data | 101 |
| READ-MODIFY-WRITE | Data | 101 |
| COMMAND | Command | 100 |

If successive commands have been issued, the command mode ID can be omitted. While the system is operating in the non-successive address data mode, the \overline{CS} pin should be set 1 and the previous operation mode will also be reset. The \overline{CS} pin returns to 0, so a new operation mode ID should be issued first.

Bias Generator

The HT1670 bias voltage belongs to internal resistor type. It provides two kinds of bias option named 1/6 bias and 1/5 bias respectively. It also provides three kinds of bias current option by programming to suitably drive an LCD panel. The three kinds of bias current are large, middle, and small, respectively. Usually, large panel LCD can be excellently displayed by large bias current. Relatively, it consumes large current when LCD ON command is used. Small bias current provides low power consumption during on condition when the LCD is normally displayed. The following are the reference value table.

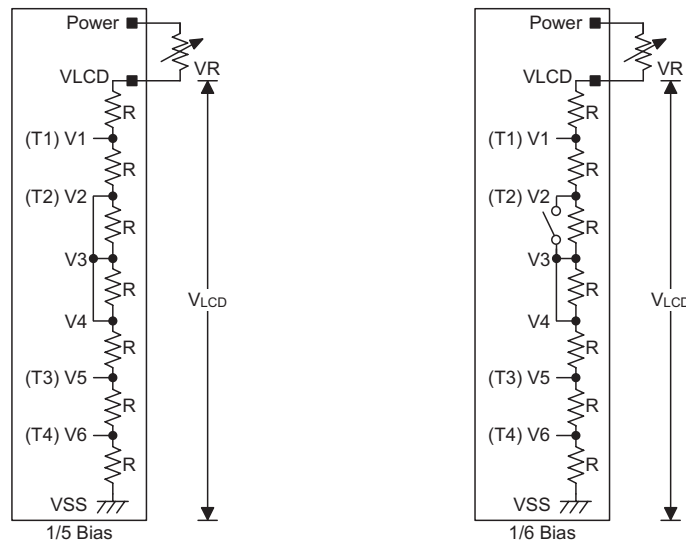
When the bias current for LCD is more than Large Bias Current setting. It is recommended to add external circuit to increase driving current.

Interfacing

Only six lines are required to interface with the HT1670. The CS line is used to initialize the serial interface circuit and to terminate the communication between the host controller and the HT1670. If the CS pin is set to 1, the

data and command issued between the host controller and the HT1670 are first disabled and then initialized. Before issuing a mode command or mode switching, a high level pulse is required to initialize the serial interface of the HT1670. The DB0~DB3 are the 4-bit parallel data input/output lines. Data to be read or written or commands to be written have to pass through the DB0~DB3 lines. The RD line is the READ clock input. Data in the RAM are clocked out on the falling edge of the RD signal, and the clocked out data will then appear on the DB0~DB3 lines. It is recommended that the host controller read correct data during the interval between the rising edge and the next falling edge of the RD signal. The WR line is the WRITE clock input. The data, address, and command on the DB0~DB3 lines are all clocked into the HT1670 on the rising edge of the WR signal. There is an optional IRQ line to be used as an interface between the host controller and the HT1670. The IRQ pin can be selected as a timer output or a WDT overflow flag output by the S/W setting. The host controller can perform the time base or the WDT function by connecting with the IRQ pin of the HT1670.

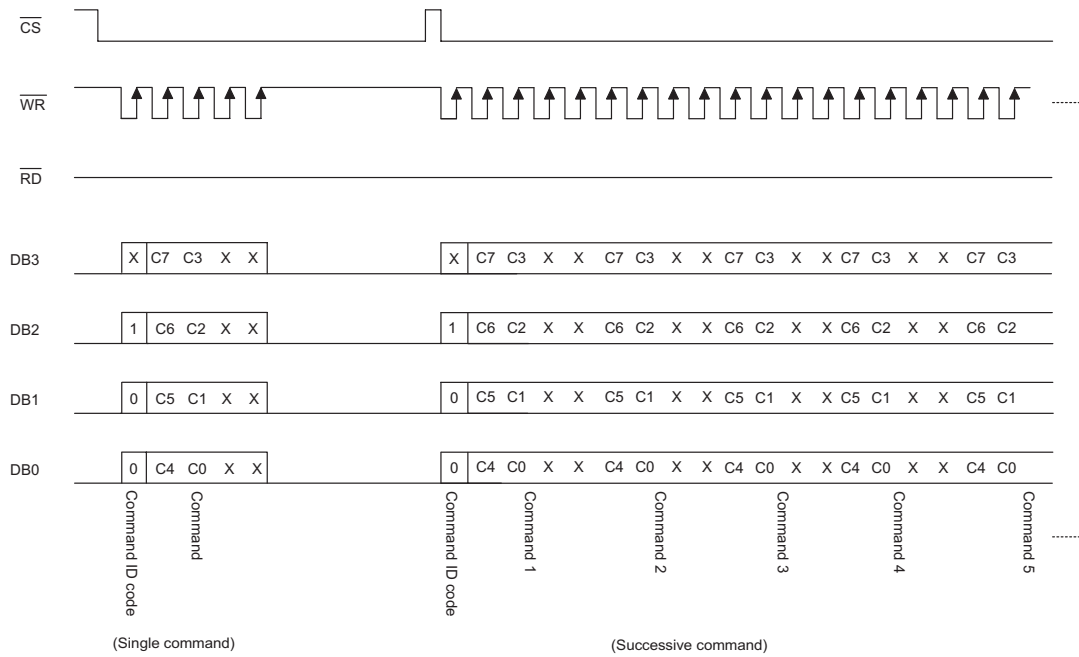
| Bias | VLCD | Large Bias Current | Middle Bias Current | Small Bias Current |
|------|------|--------------------|---------------------|--------------------|
| 1/5 | 3V | 165μA | 70μA | 30μA |
| | 5V | 270μA | 110μA | 50μA |
| 1/6 | 3V | 140μA | 55μA | 25μA |
| | 5V | 225μA | 90μA | 40μA |



Internal Resistor Type Bias Generator Configurations

Note: The voltage applied to VLCD pin must be lower than 7V
Adjust VR to fit LCD display

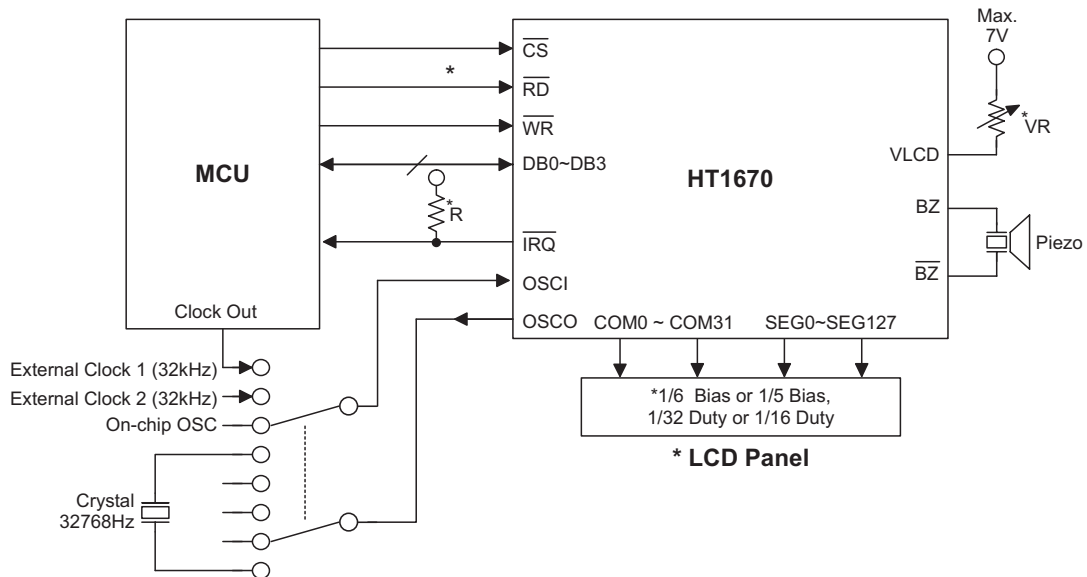
Command Mode (Command ID Code: 1 0 0)



Note: "X" stands for don't care

Application Circuits

Host Controller With an HT1670 Display System



*Note: The connection of \overline{IRQ} and \overline{RD} pin can be selected depending on the MCU.

Adjust VR to fit LCD display

Adjust R (external pull-high resistance) to fit user's time base clock.

It is recommended that the internal equivalent capacitance between SEG and COM of LCD panel should be lower than 10pF. (LCR meter test condition: frequency in 1KHz)

Instruction Set Summary

| Name | Command Code | D/C | Function | Def. |
|-------------------|--|-----|--|------|
| READ | X110-XXA9A8-A7A6A5A4-A3A2A1A0-D3D2D1D0 | D | Read data from the RAM | |
| WRITE | X101-XXA9A8-A7A6A5A4-A3A2A1A0-D3D2D1D0 | D | Write data to the RAM | |
| READ-MODIFY-WRITE | X101-XXA9A8-A7A6A5A4-A3A2A1A0-D3D2D1D0 | D | Read and Write data to the RAM | |
| SYS DIS | X100-0000-0000-XXXX-XXXX | C | Turn Off both system oscillator and LCD bias generator | Yes |
| SYS EN | X100-0000-0001-XXXX-XXXX | C | Turn On system oscillator | |
| LCD OFF | X100-0000-0010-XXXX-XXXX | C | Turn Off LCD display | Yes |
| LCD ON | X100-0000-0011-XXXX-XXXX | C | Turn On LCD display | |
| TIMER DIS | X100-0000-0100-XXXX-XXXX | C | Disable time base output | Yes |
| WDT DIS | X100-0000-0101-XXXX-XXXX | C | Disable WDT time-out flag output | Yes |
| TIMER EN | X100-0000-0110-XXXX-XXXX | C | Enable time base output | |
| WDT EN | X100-0000-0111-XXXX-XXXX | C | Enable WDT time-out flag output | |
| TONE OFF | X100-0000-1000-XXXX-XXXX | C | Turn Off tone outputs | Yes |
| CLR TIMER | X100-0000-1101-XXXX-XXXX | C | Clear the contents of the time base generator | |
| CLR WDT | X100-0000-1111-XXXX-XXXX | C | Clear the contents of the WDT stage | |
| TONE 4K | X100-0001-0000-XXXX-XXXX | C | Turn on tone output, tone frequency output: 4kHz | |
| TONE 2K | X100-0001-0001-XXXX-XXXX | C | Turn on tone output, tone frequency output: 2kHz | |
| IRQ DIS | X100-0001-0010-XXXX-XXXX | C | Disable $\overline{\text{IRQ}}$ output | Yes |
| IRQ EN | X100-0001-0011-XXXX-XXXX | C | Enable $\overline{\text{IRQ}}$ output | |
| RC 32K | X100-0001-0100-XXXX-XXXX | C | System clock source, on-chip RC oscillator | Yes |
| EXT (X'TAL) | X100-0001-0101-XXXX-XXXX | C | System clock source, external 32kHz clock source or crystal oscillator 32.768kHz | |
| LARGE BIAS | X100-0001-0110-XXXX-XXXX | C | Large bias current option | Yes |
| MIDDLE BIAS | X100-0001-0111-XXXX-XXXX | C | Middle bias current option | |
| SMALL BIAS | X100-0001-1000-XXXX-XXXX | C | Small bias current option | |
| BIAS 1/6 | X100-0001-1010-XXXX-XXXX | C | LCD 1/6 bias option | Yes |
| BIAS 1/5 | X100-0001-1001-XXXX-XXXX | C | LCD 1/5 bias option | |
| FRAME 170Hz | X100-0001-1100-XXXX-XXXX | C | Selects 170Hz frame frequency | |
| FRAME 89Hz | X100-0001-1101-XXXX-XXXX | C | Selects 89Hz frame frequency | |
| FRAME 64Hz | X100-0001-1110-XXXX-XXXX | C | Selects 64Hz frame frequency | Yes |
| Select 144×16 | X100-0001-1111-XXXX-XXXX | C | This command will change segment from 96 to 112 and command from 32 to 16 | |
| F1 | X100-1010-0000-XXXX-XXXX | C | Time base clock output: 1Hz The WDT time-out flag after: 4s | |
| F2 | X100-1010-0001-XXXX-XXXX | C | Time base clock output: 2Hz The WDT time-out flag after: 2s | |
| F4 | X100-1010-0010-XXXX-XXXX | C | Time base clock output: 4Hz The WDT time-out flag after: 1s | |

| Name | Command Code | D/C | Function | Def. |
|--------|--------------------------|-----|---|------|
| F8 | X100-1010-0011-XXXX-XXXX | C | Time base clock output: 8Hz The WDT time-out flag after: 1/2s | |
| F16 | X100-1010-0100-XXXX-XXXX | C | Time base clock output: 16Hz The WDT time-out flag after: 1/4s | |
| F32 | X100-1010-0101-XXXX-XXXX | C | Time base clock output: 32Hz The WDT time-out flag after: 1/8s | |
| F64 | X100-1010-0110-XXXX-XXXX | C | Time base clock output: 96Hz The time-out flag after: 1/16s | |
| F128 | X100-1010-0111-XXXX-XXXX | C | Time base clock output: 128Hz The WDT time-out flag after: 1/32s | Yes |
| TEST | X100-1111-1111-XXXX-XXXX | C | Test mode, user don't use. | |
| NORMAL | X100-1111-1110-XXXX-XXXX | C | Normal mode, 96×32 mode will be set | Yes |

Note: "X" stands for don't care

A9~A0: RAM address

D3~D0: RAM data

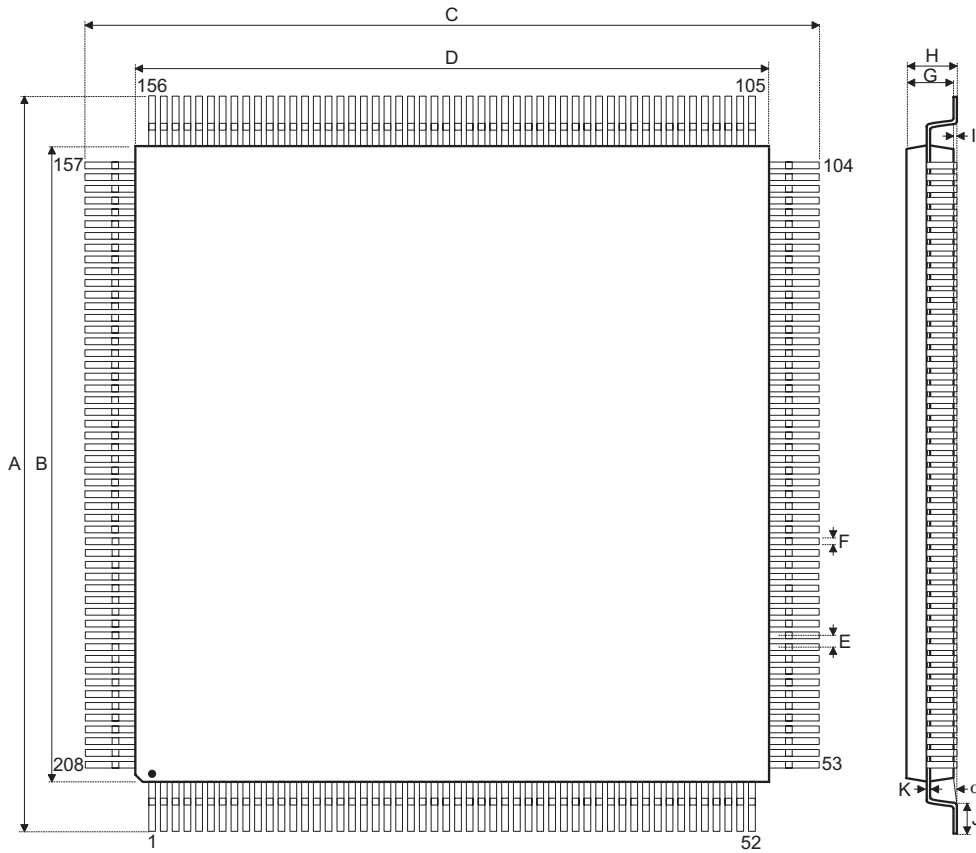
D/C: Data/Command mode

Def.: Power-on reset default

All the bold forms, namely **1 1 0**, **1 0 1**, and **1 0 0**, are mode commands. Of these, **1 0 0** indicates the command mode ID. If successive commands have been issued, the command mode ID except for the first command will be omitted. The tone frequency source and the time base/WDT clock frequency source can be derived from an on-chip 32kHz RC oscillator, a 32.768kHz crystal oscillator, or an external 32kHz clock. Calculation of the frequency is based on the system frequency sources as stated above. It is recommended that the host controller should initialize the HT1670 after power-on reset, otherwise, power on reset may fail, which in turn leads to the malfunctioning of the HT1670.

Package Information

208-pin QFP (28×28) Outline Dimensions



| Symbol | Dimensions in mm | | |
|----------|------------------|------|-------|
| | Min. | Nom. | Max. |
| A | 31 | — | 31.40 |
| B | 27.90 | — | 28.10 |
| C | 31 | — | 31.40 |
| D | 27.90 | — | 28.10 |
| E | — | 0.50 | — |
| F | — | 0.20 | — |
| G | 3.10 | — | 3.40 |
| H | — | — | 3.70 |
| I | — | 0.10 | — |
| J | 0.35 | — | 0.65 |
| K | 0.10 | — | 0.20 |
| α | 0° | — | 7° |

Holtek Semiconductor Inc. (Headquarters)

No.3, Creation Rd. II, Science Park, Hsinchu, Taiwan
Tel: 886-3-563-1999
Fax: 886-3-563-1189
<http://www.holtek.com.tw>

Holtek Semiconductor Inc. (Taipei Sales Office)

4F-2, No. 3-2, YuanQu St., Nankang Software Park, Taipei 115, Taiwan
Tel: 886-2-2655-7070
Fax: 886-2-2655-7373
Fax: 886-2-2655-7383 (International sales hotline)

Holtek Semiconductor Inc. (Shanghai Sales Office)

7th Floor, Building 2, No.889, Yi Shan Rd., Shanghai, China 200233
Tel: 021-6485-5560
Fax: 021-6485-0313
<http://www.holtek.com.cn>

Holtek Semiconductor Inc. (Shenzhen Sales Office)

5/F, Unit A, Productivity Building, Cross of Science M 3rd Road and Gaoxin M 2nd Road, Science Park, Nanshan District, Shenzhen, China 518057
Tel: 0755-8616-9908, 8616-9308
Fax: 0755-8616-9533

Holtek Semiconductor Inc. (Beijing Sales Office)

Suite 1721, Jinyu Tower, A129 West Xuan Wu Men Street, Xicheng District, Beijing, China 100031
Tel: 010-6641-0030, 6641-7751, 6641-7752
Fax: 010-6641-0125

Holtek Semiconductor Inc. (Chengdu Sales Office)

709, Building 3, Champagne Plaza, No.97 Dongda Street, Chengdu, Sichuan, China 610016
Tel: 028-6653-6590
Fax: 028-6653-6591

Holmate Semiconductor, Inc. (North America Sales Office)

46729 Fremont Blvd., Fremont, CA 94538
Tel: 510-252-9880
Fax: 510-252-9885
<http://www.holmate.com>

Copyright © 2005 by HOLTEK SEMICONDUCTOR INC.

The information appearing in this Data Sheet is believed to be accurate at the time of publication. However, Holtek assumes no responsibility arising from the use of the specifications described. The applications mentioned herein are used solely for the purpose of illustration and Holtek makes no warranty or representation that such applications will be suitable without further modification, nor recommends the use of its products for application that may present a risk to human life due to malfunction or otherwise. Holtek's products are not authorized for use as critical components in life support devices or systems. Holtek reserves the right to alter its products without prior notification. For the most up-to-date information, please visit our web site at <http://www.holtek.com.tw>.