



APPROVAL SHEET

Customer : _____

Part Name : **LCD MODULE**

Model No. : **DVF 40200-5S1FBLY**

Drawing No. : _____

Approved by : _____

Date : _____

| Approved | Checked | Prepared | Sheet Code: |
|----------|---------|----------|-----------------------|
| | | JUN | 335-71231-1008 |

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1. SCOPE

The DVF 40200-5S1FBLY, dot-matrix LCD unit of a 5 x 7- dot 40-character 2-line dot-matrix LCD panel, LCD driver, controller LSI and yellow green back-light LED fabricated on a single PCB. Incorporating mask ROM-based character generator and display data RAM in the controller LSI, the unit can efficiently display the desired characters under microprocessor control.

2. PRODUCT SPECIFICATIONS

2.1 General

- The LCD of the unit is STN yellow-green Transflective , Normal temperature type.
- Low power consumption with the dot-matrix LCD panel and CMOS LSI. Built-in back-light LED with high luminance and stable radiation.
- Thin, lightweight design permits easy installation in a variety of equipment.
- Allowing for being connected at general-purpose CMOS signal level, the unit can be easily interfaced to a microprocessor with common 4-bit and 8-bit parallel inputs and outputs.
- Multiplexing driving : 1/16duty, 1/4bias, 6 o'clock
- Built-in character generator ROM and RAM, and display data RAM:
 - Character generator ROM
 - 225 different 5 x 7 dot-matrix character patterns (Alphanumeric and symbols)
 - Character generator RAM
 - 8 different user programmed 5 x 7 dot-matrix patterns
 - Display data RAM
 - 80 x 8 bits
- Numerous instructions
 - Display clear, Cursor home, Display ON/OFF, Cursor ON/OFF, Blink character, Cursor shift, Display shift
- RoHS compliant

SPECIFICATIONS FOR LIQUID CRYSTAL DISPLAY MODULE

 MODEL NO: DVF 40200-5S1FBLY

2.2 Mechanical Characteristics

| Item | Characteristic |
|---|-------------------------|
| Number of Characters | 40 × 2 |
| Dot dimensions(mm) | 0.6 × 0.65 |
| Dot spacing (mm) | 0.05 |
| Character Size (mm) | 3.2 × 5.5 |
| Module dimensions (Horizontal × Vertical × Thickness, mm) | 182.0 × 33.5 × 13.6max. |
| Viewing area (Horizontal × Vertical, mm) | 154.0 × 16.5 |
| Active area (Horizontal × Vertical, mm) | 147.5 × 11.5 |

SPECIFICATIONS FOR LIQUID CRYSTAL DISPLAY MODULE



2.3 IC Absolute Maximum Ratings (Without LED back-light)

| Characteristics | Symbol | Value |
|-----------------------|-----------|-----------------------|
| Power Supply Voltage | V_{CC} | -0.3 to +7.0 |
| LCD Driver Voltage | V_{LCD} | -0.3V to +13.0V |
| Input Voltage | V_{IN} | -0.3V to $V_{CC}+0.3$ |
| Operating Temperature | T_A | -20°C to + 60°C |
| Storage Temperature | T_{STO} | -55°C to + 125°C |

2.4 IC Electrical Characteristics (Without LED back-light)

($T_A = 25$, $V_{CC} = 2.7 V - 5.5 V$)

| Symbol | Characteristics | Test Condition | Min. | Typ. | Max. | Unit |
|------------|---|-------------------------------------|-------------|------|-------------|------------|
| V_{CC} | Operating Voltage | - | 2.7 | - | 5.5 | V |
| V_{LCD} | LCD Voltage | $V_{CC}-V_5$ | 3.0 | - | 11.0 | V |
| I_{CC} | Power Supply Current | $f_{osc} = 270KHz$ $V_{CC}=5.0V$ | - | 0.3 | 0.6 | mA |
| V_{IH1} | Input High Voltage (Except OSC1) | - | 2.2 | - | V_{CC} | V |
| V_{IL1} | Input Low Voltage (Except OSC1) | - | - 0.3 | - | 0.6 | V |
| V_{IH2} | Input High Voltage (OSC1) | - | $V_{CC}-1$ | - | V_{CC} | V |
| V_{IL2} | Input Low Voltage (OSC2) | - | - | - | 1.0 | V |
| V_{OH1} | Output High Voltage (DB0 - DB7) | $I_{OH} = -0.1mA$ | 2.4 | - | V_{CC} | V |
| V_{OL1} | Output Low Voltage (DB0 - DB7) | $I_{OL} = 0.1mA$ | - | - | 0.4 | V |
| V_{OH2} | Output High Voltage (Except DB0 - DB7) | $I_{OH} = -0.04mA$ | $0.9V_{CC}$ | - | V_{CC} | V |
| V_{OL2} | Output Low Voltage (Except DB0 - DB7) | $I_{OL} = 0.04mA$ | - | - | $0.1V_{CC}$ | V |
| R_{COM} | Common Resistance | $V_{LCD} = 4V, I_d = 0.05mA$ | - | 2 | 20 | K Ω |
| R_{SEG} | Segment Resistance | $V_{LCD} = 4V, I_d = 0.05mA$ | - | 2 | 30 | K Ω |
| I_{LEAK} | Input Leakage Current | $V_{IN} = 0V$ to V_{CC} | -1 | - | 1 | μA |
| I_{PUP} | Pull Up MOS Current | $V_{CC} = 5V$ | 10 | 50 | 120 | μA |

SPECIFICATIONS FOR LIQUID CRYSTAL DISPLAY MODULE



2.5 LCD Optical Characteristics

Absolute maximum ratings

| Item | Symbol | Rating | Unit | Remarks |
|-----------------------------|--------|--------|------|-----------------|
| Storage temperature range | Tst | -20~70 | °C | No condensation |
| Operating temperature range | Top | -10~60 | °C | No condensation |

2.6 LCD Optical Characteristics

1/16 duty, 1/4 bias, Vop=4.20

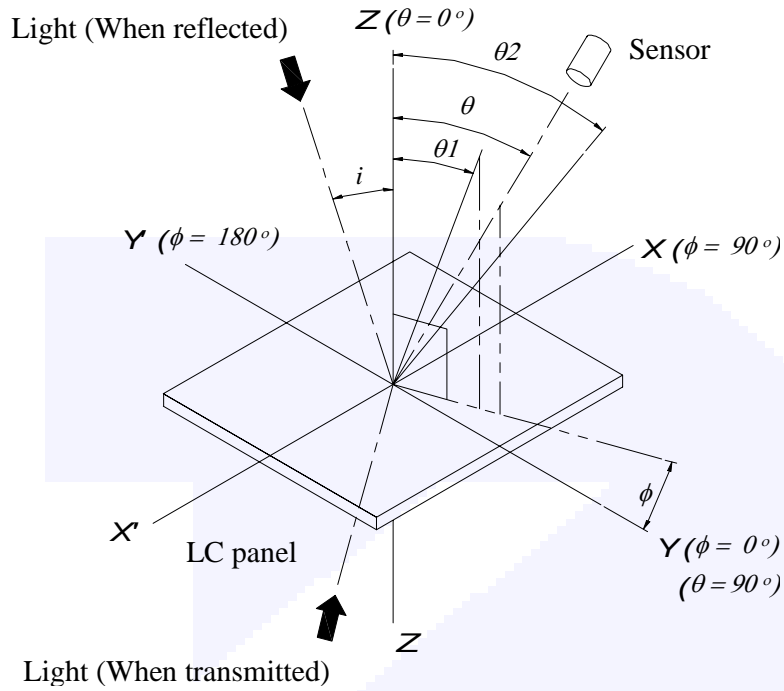
| Item | Symbol | Temp. | Min. | Typ. | Max. | Unit |
|-----------------|--------------------------------|-------|------|------|------|------|
| Driving voltage | Vop | 0 °C | 4.2 | 4.4 | 4.6 | V |
| | | 25 °C | 4.0 | 4.2 | 4.4 | |
| | | 50 °C | 3.8 | 4.0 | 4.2 | |
| Contrast | Cr | 25 °C | 3 | 11.5 | -- | -- |
| Frame freq. | f | -- | -- | 64 | -- | Hz |
| Response time | t _{on} | 25 °C | -- | -- | 200 | ms |
| | t _{off} | | -- | -- | 160 | |
| Viewing angle* | θ ₂ .θ ₁ | 25 °C | 20 | -- | -- | Deg. |
| | φ | | -- | 45 | -- | |

SPECIFICATIONS FOR LIQUID CRYSTAL DISPLAY MODULE

MODEL NO: DVF 40200-5S1FBLY

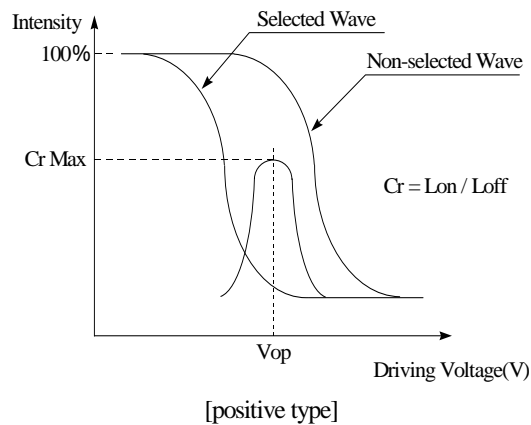
2.6.1 Definition of optical characteristics

* Definition of angles ϕ and θ



*Definition of contrast Cr

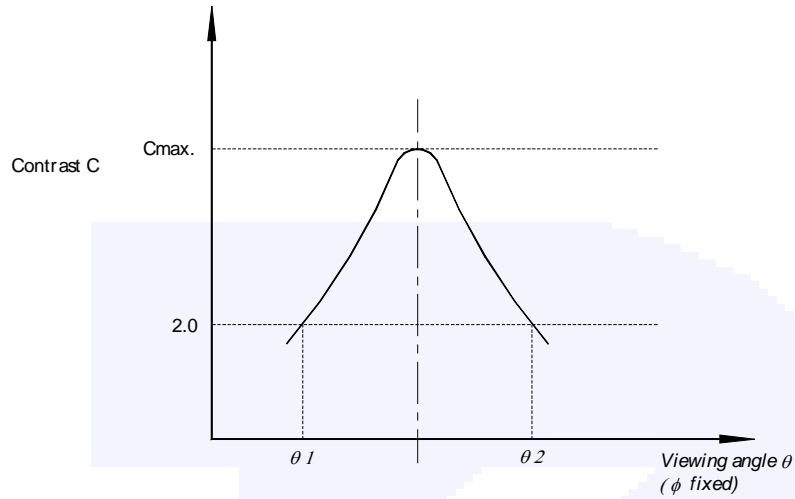
$$\text{Positive type } Cr = \frac{\text{Brightness of unselected portion(Bus)}}{\text{Brightness of selected portion(Bs)}}$$



SPECIFICATIONS FOR LIQUID CRYSTAL DISPLAY MODULE

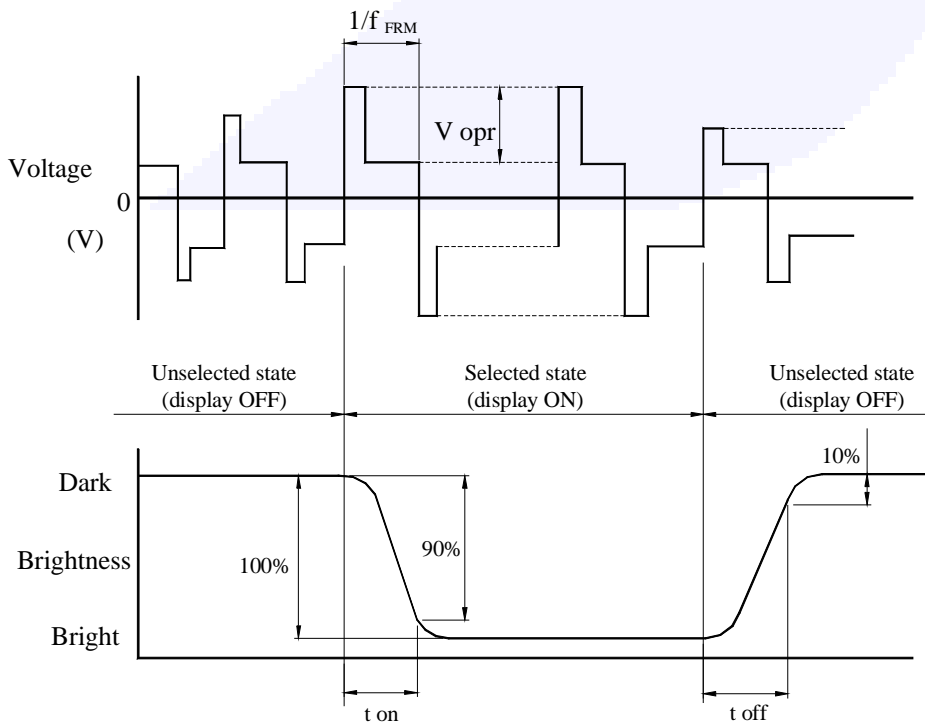
MODEL NO: DVF 40200-5S1FBLY

* Definition of viewing angles θ_1 and θ_2



Note : Optimum vision with the naked eye and viewing angle θ at C_{max} above are not always the same.

* Definition of response time



V_{opr} : Operating voltage (V)

t_{on} : Response time (rise) (ms)

f_{FRM} : Frame frequency (Hz)

t_{off} : Response time (fall) (ms)

SPECIFICATIONS FOR LIQUID CRYSTAL DISPLAY MODULE



2.7 LED Back-light Characteristics

2.7.1 Absolute maximum ratings

Ta = 25°C

| Item | Symbol | Condition | Min. | Typ. | Max. | Unit |
|---------------------------------|-----------------|---------------------------|------|------|------|-------------------|
| Forward voltage | V_f | If=310mA, Yellow Green | 3.8 | 4.2 | 4.5 | V |
| *Luminous Intensity | I_v | If=310mA, Yellow Green | 123 | 190 | 257 | cd/m ² |
| Peak Emission Wavelength | λ_P | If=20mA, Yellow Green | -- | 573 | -- | nm |
| Spectrum Radiation Bandwidth | $\Delta\lambda$ | If=20mA, Yellow Green | -- | 30 | -- | nm |
| Reverse Current | I_R | VR=8V, Yellow Green | -- | -- | 3.1 | mA |

Note: * Measured at the bare LED back-light unit.

2.7.2 LED Maximum Operating Range

| Item | Symbol | Yellow Green | Unit |
|-------------------|----------|--------------|------|
| Power Dissipation | P_{AD} | 3.38 | W |
| Forward Current | I_F | 490 | mA |
| Reverse Voltage | V_R | 8 | V |

3. RELIABILITY

3.1 Reliability

| Test item | Test condition | Evaluation and assessment |
|--|--|---|
| Operation at high temperature and humidity | 40 °C±2 °C 90%RH for 240hours | No abnormalities in functions* and appearance** |
| Operation at high temperature | 50 °C±2 °C for 240 hours | No abnormalities in functions* and appearance** |
| Heat shock | 0 °C ~ +50°C Left for 1 hour at each temperature, transition time 5 min, repeated 10times | No abnormalities in functions* and appearance** |
| Operation at Low temperature | 0±2 °C for 240 hours | No abnormalities in functions* and appearance** |
| Vibration | Sweep for 1 min at 10 Hz, 55Hz, 10Hz, amplitude 1.5mm 2 hrs each in the X,Y and Z directions | No abnormalities in functions* and appearance** |
| Drop shock | Dropped onto a board from a height of 10cm | No abnormalities in functions* and appearance** |
| Storage Temperature Range Test | Low Temp :-20 °C High Temp:70 °C | No abnormalities in functions* and appearance** |

* Dissipation current, contrast and display functions

** Polarizing filter deterioration, other appearance defects

3.2 Liquid crystal panel service life

100,000 hours minimum at 25 °C±10 °C

3.3 Definition of panel service life

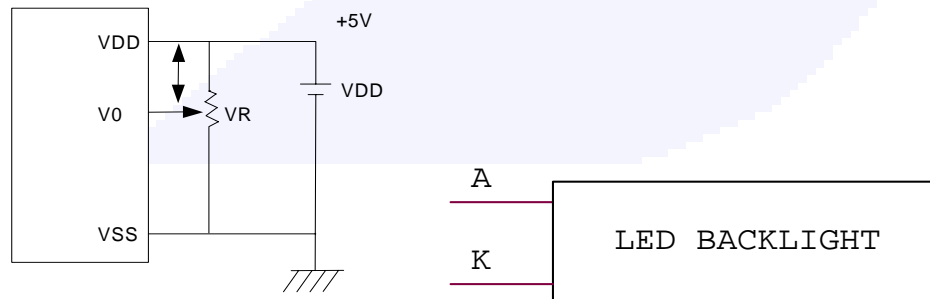
- Contrast becomes 30% of initial value
- Current consumption becomes three times higher than initial value
- Remarkable alignment deterioration occurs in LCD cell layer
- Unusual operation occurs in display functions

4. OPERATING INSTRUCTIONS

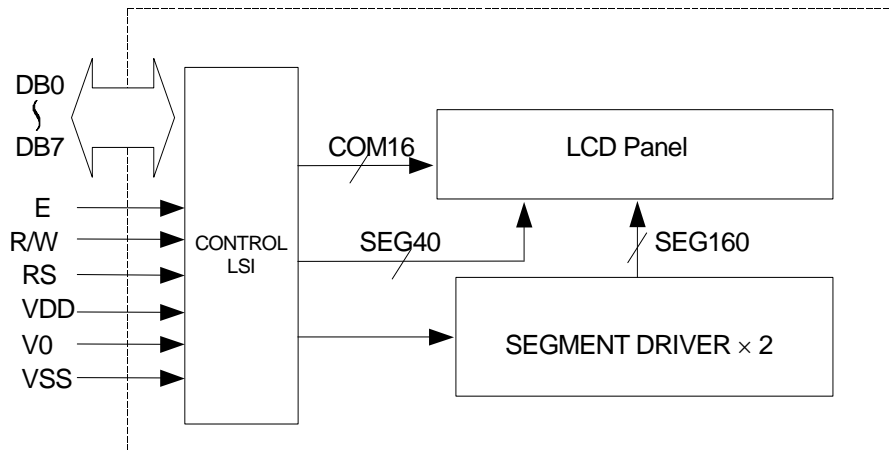
4.1 Input signal Function

| NO. | Symbol | Function |
|------|---------|---|
| 1 | VSS | 0V Power Supply (GND Level) |
| 2 | VDD | Power supply for Logic circuit |
| 3 | V0 | Power Supply for Driving the LCD Contrast |
| 4 | RS | Data / Instruction select |
| 5 | R/W | Read / Write select |
| 6 | E | Enable signal |
| 7~14 | DB0~DB7 | Data Bus line |
| 15 | LED A | Power supply for + |
| 16 | LED K | Power supply for - |

4.2 Block diagram



$V_{DD} - V_0$: LCD Driving Voltage
 VR : 10K~20K



SPECIFICATIONS FOR LIQUID CRYSTAL DISPLAY MODULE



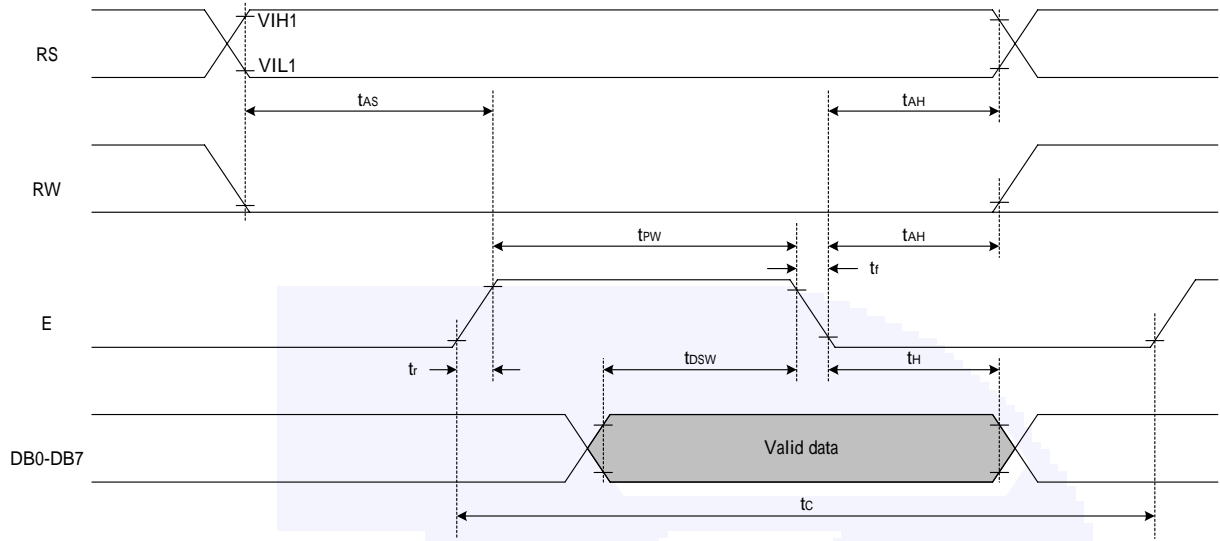
4.3 Timing Characteristics
(TA = 25 , VCC = 5V)

| Symbol | Characteristics | Test Condition | Min. | Typ. | Max. | Unit |
|--|------------------------|-----------------------|-------------|-------------|-------------|-------------|
| <i>Internal Clock Operation</i> | | | | | | |
| f _{OSC} | OSC Frequency | R = 91KΩ | 190 | 270 | 350 | KHz |
| <i>External Clock Operation</i> | | | | | | |
| f _{EX} | External Frequency | - | 125 | 250 | 350 | KHz |
| | Duty Cycle | - | 45 | 50 | 55 | % |
| T _R ,T _F | Rise/Fall Time | - | - | - | 0.2 | μs |
| <i>Write Mode (Writing data from MPU to ST7066U)</i> | | | | | | |
| T _C | Enable Cycle Time | Pin E | 400 | - | - | ns |
| T _{PW} | Enable Pulse Width | Pin E | 150 | - | - | ns |
| T _R ,T _F | Enable Rise/Fall Time | Pin E | - | - | 25 | ns |
| T _{AS} | Address Setup Time | Pins: RS,RW,E | 30 | - | - | ns |
| T _{AH} | Address Hold Time | Pins: RS,RW,E | 10 | - | - | ns |
| T _{DSW} | Data Setup Time | Pins: DB0 - DB7 | 40 | - | - | ns |
| T _H | Data Hold Time | Pins: DB0 - DB7 | 10 | - | - | ns |
| <i>Read Mode (Reading Data from ST7066U to MPU)</i> | | | | | | |
| T _C | Enable Cycle Time | Pin E | 400 | - | - | ns |
| T _{PW} | Enable Pulse Width | Pin E | 150 | - | - | ns |
| T _R ,T _F | Enable Rise/Fall Time | Pin E | - | - | 25 | ns |
| T _{AS} | Address Setup Time | Pins: RS,RW,E | 30 | - | - | ns |
| T _{AH} | Address Hold Time | Pins: RS,RW,E | 10 | - | - | ns |
| T _{DDR} | Data Setup Time | Pins: DB0 - DB7 | - | - | 100 | ns |
| T _H | Data Hold Time | Pins: DB0 - DB7 | 10 | - | - | ns |
| <i>Interface Mode with LCD Driver(ST7065)</i> | | | | | | |
| T _{CWH} | Clock Pulse with High | Pins: CL1, CL2 | 800 | - | - | ns |
| T _{CWL} | Clock Pulse with Low | Pins: CL1, CL2 | 800 | - | - | ns |
| T _{CST} | Clock Setup Time | Pins: CL1, CL2 | 500 | - | - | ns |
| T _{SU} | Data Setup Time | Pin: D | 300 | - | - | ns |
| T _{DH} | Data Hold Time | Pin: D | 300 | - | - | ns |
| T _{DM} | M Delay Time | Pin: M | -1000 | - | 1000 | ns |

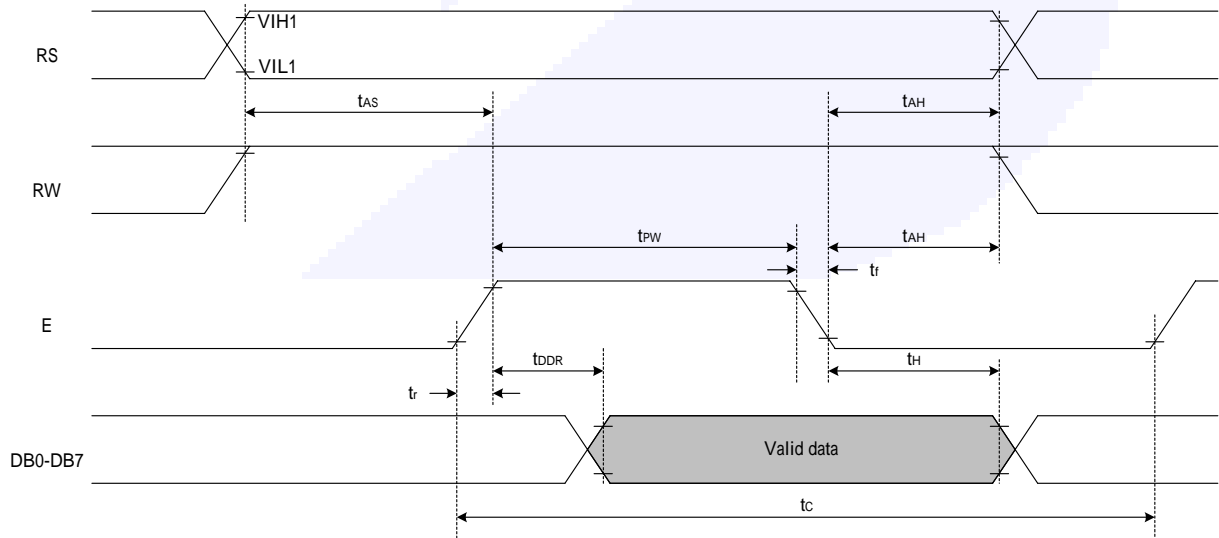
SPECIFICATIONS FOR LIQUID CRYSTAL DISPLAY MODULE

MODEL NO: DVF 40200-5S1FBLY

Writing data from MPU to ST7066U



Reading data from ST7066U to MPU



SPECIFICATIONS FOR LIQUID CRYSTAL DISPLAY MODULE



4.4 Instruction table

Instruction Table:

| Instruction | Instruction Code | | | | | | | | | | Description | Description Time (270KHz) | |
|----------------------------|------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-------------|--|---------|
| | RS | R/W | DB7 | DB6 | DB5 | DB4 | DB3 | DB2 | DB1 | DB0 | | | |
| Clear Display | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | Write "20H" to DDRAM. and set DDRAM address to "00H" from AC | 1.52 ms |
| Return Home | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | x | Set DDRAM address to "00H" from AC and return cursor to its original position if shifted. The contents of DDRAM are not changed. | 1.52 ms |
| Entry Mode Set | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | I/D | S | Sets cursor move direction and specifies display shift. These operations are performed during data write and read. | 37 us |
| Display ON/OFF | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | D | C | B | D=1:entire display on C=1:cursor on B=1:cursor position on | 37 us |
| Cursor or Display Shift | 0 | 0 | 0 | 0 | 0 | 0 | 1 | S/C | R/L | x | x | Set cursor moving and display shift control bit, and the direction, without changing DDRAM data. | 37 us |
| Function Set | 0 | 0 | 0 | 0 | 0 | 1 | DL | N | F | x | x | DL:interface data is 8/4 bits N:number of line is 2/1 F:font size is 5x11/5x8 | 37 us |
| Set CGRAM address | 0 | 0 | 0 | 1 | AC5 | AC4 | AC3 | AC2 | AC1 | AC0 | | Set CGRAM address in address counter | 37 us |
| Set DDRAM address | 0 | 0 | 1 | AC6 | AC5 | AC4 | AC3 | AC2 | AC1 | AC0 | | Set DDRAM address in address counter | 37 us |
| Read Busy flag and address | 0 | 1 | BF | AC6 | AC5 | AC4 | AC3 | AC2 | AC1 | AC0 | | Whether during internal operation or not can be known by reading BF. The contents of address counter can also be read. | 0 us |
| Write data to RAM | 1 | 0 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | | Write data into internal RAM (DDRAM/CGRAM) | 37 us |
| Read data from RAM | 1 | 1 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | | Read data from internal RAM (DDRAM/CGRAM) | 37 us |

Note:

Be sure the ST7066U is not in the busy state (BF = 0) before sending an instruction from the MPU to the ST7066U. If an instruction is sent without checking the busy flag, the time between the first instruction and next instruction will take much longer than the instruction time itself. Refer to Instruction Table for the list of each instruction execution time.

SPECIFICATIONS FOR LIQUID CRYSTAL DISPLAY MODULE



4.5 Font table

NO.7066-0A

| b7-b4 b3-b0 | 0000 | 0001 | 0010 | 0011 | 0100 | 0101 | 0110 | 0111 | 1000 | 1001 | 1010 | 1011 | 1100 | 1101 | 1110 | 1111 |
|----------------|------------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| 0000 | CG RAM (1) | | | 0 | 1 | P | \ | F | | | | - | 3 | E | o | p |
| 0001 | (2) | | ! | 1 | Q | a | q | | | | . | 7 | 7 | G | 3 | q |
| 0010 | (3) | | " | 2 | R | b | r | | | | 7 | 7 | 7 | x | P | 8 |
| 0011 | (4) | | # | 3 | S | c | s | | | | 7 | 7 | 7 | e | e | o |
| 0100 | (5) | | \$ | 4 | T | d | t | | | | 7 | 7 | 7 | 7 | 7 | o |
| 0101 | (6) | | % | 5 | U | e | u | | | | . | 7 | 7 | 7 | 7 | o |
| 0110 | (7) | | & | 6 | V | f | v | | | | 7 | 7 | 7 | 7 | 7 | o |
| 0111 | (8) | | ' | 7 | W | g | w | | | | 7 | 7 | 7 | 7 | 7 | o |
| 1000 | (1) | | (| 8 | X | h | x | | | | 7 | 7 | 7 | 7 | 7 | o |
| 1001 | (2) | |) | 9 | Y | i | y | | | | 7 | 7 | 7 | 7 | 7 | o |
| 1010 | (3) | | * | : | J | Z | j | z | | | 7 | 7 | 7 | 7 | 7 | o |
| 1011 | (4) | | + | : | K | L | k | l | | | 7 | 7 | 7 | 7 | 7 | o |
| 1100 | (5) | | , | < | L | * | l | l | | | 7 | 7 | 7 | 7 | 7 | o |
| 1101 | (6) | | - | = | M | I | m | i | | | 7 | 7 | 7 | 7 | 7 | o |
| 1110 | (7) | | . | > | N | ^ | n | * | | | 7 | 7 | 7 | 7 | 7 | o |
| 1111 | (8) | | / | ? | O | _ | o | * | | | 7 | 7 | 7 | 7 | 7 | o |

5 NOTES

Safety

- If the LCD panel breaks, be careful not to get the liquid crystal in your mouth. If the liquid crystal touches your skin or clothes, wash it off immediately using soap and plenty of water.

Handling

- Avoid static electricity as this can damage the CMOS LSI.
- The LCD panel is plate glass; do not hit or crush it.
- Do not remove the panel or frame from the module.
- The polarizing plate of the display is very fragile; handle it very carefully

Mounting and Design

- Mount the module by using the specified mounting part and holes.
- To protect the module from external pressure, leave a small gap by placing transparent plates (e.g. acrylic or glass) on the display surface, frame, and polarizing plate
- Design the system so that no input signal is given unless the power-supply voltage is applied.
- Keep the module dry. Avoid condensation, otherwise the transparent electrodes may break.

Storage

- Store the module in a dark place where the temperature is $25^{\circ}\text{C}\pm 10^{\circ}\text{C}$ and the humidity below 65% RH.
- Do not store the module near organic solvents or corrosive gases.
- Do not crush, shake, or jolt the module (including accessories).

Cleaning

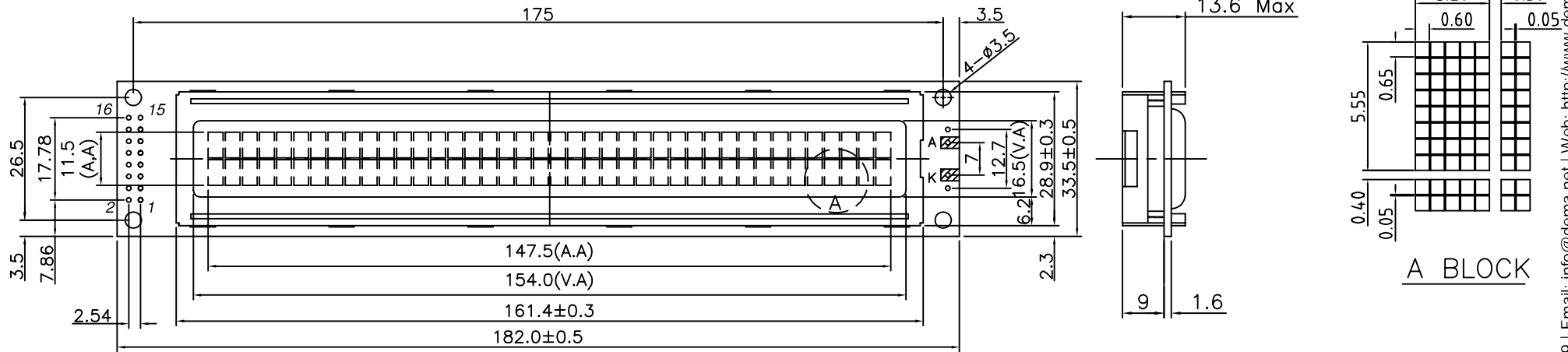
- Do not wipe the polarizing plate with a dry cloth, as it may scratch the surface.
- Wipe the module gently with soft cloth soaked with a petroleum benzine.
- Do not use ketonic solvents (ketone and acetone) or aromatic solvents (toluene and xylene), as they may damage the polarizing plate.

6 OPERATION PRECAUTIONS

Any changes that need to be made in this specification or any problems arising from it will be dealt with quickly by discussion between both companies.

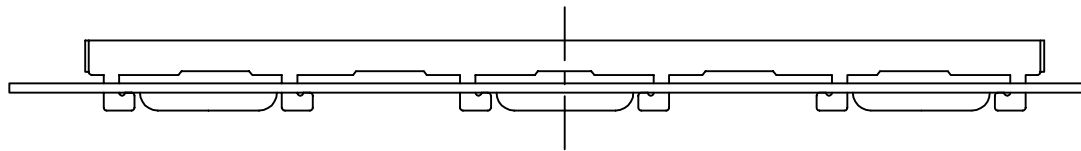
P / N

335-71231-1008



PIN

- 1. VSS
- 2. VDD
- 3. V0
- 4. RS
- 5. R/W
- 6. E
- 7. DB0
- ?
- 14. DB7
- 15.LED A
- 16.LED K



| TOLERANCE GRADE(±) | | |
|--------------------|------|------|
| GRADE | A | B |
| ~ 6 | 0.05 | 0.1 |
| 6 ~ 18 | 0.08 | 0.18 |
| 18 ~ 50 | 0.1 | 0.25 |
| 50 ~ 180 | 0.2 | 0.3 |
| 180 ~ | 0.3 | 0.4 |

DATA INTERNATIONAL CO.

| | | |
|-----------------|-------------------|-------------------|
| TITLE | DVF 40200-5S1FBLY | |
| | P88-7A | |
| DWG. NO. | 335-71231-1008 | SHEET 1 OF |

| | | | | | | | |
|------------------------|-------------|--------------|---------------------|-----------|--------------|-------------|-----------------------------|
| D | | 1 | TOLERANCE GRADE "B" | 7 | MECH. | DATE | TITLE |
| C | | 2 | | 8 | JASON | 5/22/'06 | DVF 40200-5S1FBLY P88-7A |
| B | | 3 | | 9 | ELEC. | DATE | |
| A | | 4 | | 10 | | | DVF 40200-5S1FBLY P88-7A |
| NEW RELEASE | 5/22/'06 | JASON | 5 | 11 | APPD. | DATE | |
| REVISION RECORD | DATE | NAME | 6 | 12 | | | |