Passive operator panel featuring an intelligent display and a keyboard; according to the model ordered the display can be LCD backlit or fluorescent, alphanumeric 2 or 4 rows by 20 characters or graphic 140x16 or 32 pixel. Such panel is a passive device therefore there is always need for an external CPU section to make it work. The display can be alphanumeric or graphic. Section to generate contrast for LCD display, set by a trimmer. 16 keys matrix keyboard. Size: 192.5 x 96.5 x 42.5 mm (L x H x D) with possibility of front panel panel mounting. Protection level of frontal is IP 54. On board resources management is performed completely by the firmware running on an external CPU board. Such board communicates with the operator panel through a 20 pins low profile connector. This latter is a standard I/O ABACO® connector that connects 16 I/O TTL signals to manage the operator panel. For the user, a great number of example programs for several different CPU's are available. On board power supply capable to accept input voltages in the range 8÷24 Vac or 12÷34 Vdc. QTP 16P can also supply +5 Vdc for external loads by a 4 pins specific connector.
**Vincoli sulla documentazione**  
grifo®  
**Tutti i Diritti Riservati**

Nessuna parte del presente manuale può essere riprodotta, trasmessa, trascritta, memorizzata in un archivio o tradotta in altre lingue, con qualunque forma o mezzo, sia esso elettronico, meccanico, magnetico ottico, chimico, manuale, senza il permesso scritto della grifo®.

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Tutte le informazioni contenute sul presente manuale sono state accuratamente verificate, ciononostante grifo® non si assume nessuna responsabilità per danni, diretti o indiretti, a cose e/o persone derivanti da errori, omissioni o dall’uso del presente manuale, del software o dell’ hardware ad esso associato.

grifo® altresì si riserva il diritto di modificare il contenuto e la veste di questo manuale senza alcun preavviso, con l’intento di offrire un prodotto sempre migliore, senza che questo rappresenti un obbligo per grifo®.

Per le informazioni specifiche dei componenti utilizzati sui nostri prodotti, l’utente deve fare riferimento agli specifici Data Book delle case costruttrici o delle seconde sorgenti.

**LEGENDA SIMBOLI**

Nel presente manuale possono comparire i seguenti simboli:

- ![Attenzione: Pericolo generico](image)
  - Attenzione: Pericolo generico

- ![Attenzione: Pericolo di alta tensione](image)
  - Attenzione: Pericolo di alta tensione

- ![Attenzione: Dispositivo sensibile alle cariche elettrostatiche](image)
  - Attenzione: Dispositivo sensibile alle cariche elettrostatiche

**Marchi Registrati**

GPC®, grifo®: sono marchi registrati della grifo®.

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INTRODUCTION

The use of these devices has turned - IN EXCLUSIVE WAY - to specialized personnel. This device is not a safe component as defined in directive 98-37/CE.

Pins of Mini Module are not provided with any kind of ESD protection. They are connected directly to their respective pins of microcontroller. Mini Module is affected by electrostatic discharges. Personnel who handles Mini Modules is invited to take all necessary precautions to avoid possible damages caused by electrostatic discharges.

The purpose of this handbook is to give the necessary information to the cognizant and sure use of the products. They are the result of a continual and systematic elaboration of data and technical tests saved and validated from the manufacturer, related to the inside modes of certainty and quality of the information.

The reported data are destined- IN EXCLUSIVE WAY- to specialized users, that can interact with the devices in safety conditions for the persons, for the machine and for the environment, impersonating an elementary diagnostic of breakdowns and of malfunction conditions by performing simple functional verify operations, in the height respect of the actual safety and health norms.

The informations for the installation, the assemblage, the dismantlement, the handling, the adjustment, the reparation and the contingent accessories, devices etc. installation are destined - and then executable - always and in exclusive way from specialized warned and educated personnel, or directly from the TECHNICAL AUTHORIZED ASSISTANCE, in the height respect of the manufacturer recommendations and the actual safety and health norms.

The devices can't be used outside a box. The user must always insert the cards in a container that respect the actual safety normative. The protection of this container is not threshold to the only atmospheric agents, but specially to mechanic, electric, magnetic, etc. ones.

To be on good terms with the products, is necessary guarantee legibility and conservation of the manual, also for future references. In case of deterioration or more easily for technical updates, consult the AUTHORIZED TECHNICAL ASSISTANCE directly.
To prevent problems during card utilization, it is a good practice to read carefully all the informations of this manual. After this reading, the user can use the general index and the alphabetical index, respectly at the begining and at the end of the manual, to find information in a faster and more easy way.
CARD VERSION

This handbook makes reference to card QTP 16P with printed circuit version 100703. The validity of the information contained in this manual is subordinated to the card version number.

**Figure 1: Location of revision number and card name**
GENERAL INFORMATION

The **QTP 16P** family card is composed by interesting boards that solve the operator interface problems inside the automation field, in a low cost and efficient way. All the cards are composed by two independent sections: one for an external **matrix keyboard** acquisition and the other for **LCD** or **Fluorescent (VFD) display** management. Both the sections are driven by only two 8 bit parallel ports, at TTL level. In this manner all the cards provided of at least 16 TTL lines on a standard 20 pins I/O **ABACO**® connector, can be connected to **QTP 16P** modules and they can easily exchange data and informations with the user.

The greater part of **grifo**® control cards can be connected to these cards with the possibility to use many different microprocessors (Z80, 8086, 8051, 68HC11, etc.) and proper software packages (BASIC, C, PASCAL, etc.). For some coupling of control cards and software tools, together with **QTP 16P** is provided a proper management firmware that drives the keyboard and the display at high level, with considerable facility and time saving. In fact this firmware let the user manage display and keyboard directly with the high level console instructions as PRINT, PRINTK, KBHIT, INPUT, SCANF, KEYHIT, etc.

The wide range of different displays models let the user select the best configuration according with the application requirements, in terms of: price, visibility, dimension, graphic, alphanumeric, consumption, etc.

The **QTP 16P** hardware structure is designed to simplify the software management of the card and to minimize the necessary lines for its management; moreover the connectors position and the mounting holes ensure a fast installation of the card inside the electric panel.

- **Dimension**: 192.5 x 96.5 x 42.5 mm (W x H x D)
- Mounting as front panel
- **Protection level** **IP 54**
- **Matrix keyboard** with 4 x 4 = 16 keys
- **Intelligent display**, in the following models (it must be specified during order phase):
  - **QTP 16P-C2** -> alphanumeric LCD display, backlit, with 2 lines for 20 characters;
  - **QTP 16P-C4** -> alphanumeric LCD display, backlit, with 4 lines for 20 characters;
  - **QTP 16P-F2** -> alphanumeric VFD display with 2 lines for 20 characters;
  - **QTP 16P-F4** -> alphanumeric VFD display with 4 lines for 20 characters.
  - **QTP 16P-GF2** -> graphic VFD display with 140x16 pixel;
  - **QTP 16P-GF4** -> graphic VFD display with 140x32 pixel;
- Section that generates **contrast** voltage for **LCD** display.
- Complete software management of the card sections with **16 TTL I/O lines** on standard 20 pins, low profile, I/O **ABACO**® connector.
- Wide range of management firmware supplied as **driver, library, console** input output **redirection**, etc., available for:
  - Z80 based cards through **G DOS** or **FG DOS** romate operating system,
  - I51 based cards through **BASIC 52, BASCOM 8051** and **µC/51**,
  - I86 based cards through **GCTR**,
  - AVR based cards through **BASCOM AVR** and **ICC AVR**
  - etc. etc.
- **Power supply** in the range 8÷24 Vac or 12÷34 Vdc
- **Possibility to supply external loads**

Here follows a description of the board's functional blocks, with an indication of the operations performed by each one.
FIGURE 2: BLOCKS DIAGRAM
KEYBOARD

**QTP 16P** has a matrix keyboard with 4 columns by 4 rows that can manage up to 16 keys. Some of the 10 lines necessary for keyboard acquisition are used also by display interface, so a specific firmware must solve this situation and avoid complications. A slot allows to customize the front panel by inserting a label with a custom writing. Thanks to this simple keyboard **QTP 16P** solves in an inexpensive way the problem of data input, even in case of several data.

DISPLAY

**QTP 16P** is available with **Fluorescent VFD** or backlit **LCD** displays provided of different features. In detaily, following **alphanumeric** displays can be connected:

- LCD 20x2 characters -> QTP 16P-C2
- LCD 20x4 characters -> QTP 16P-C4
- VFD 20x2 characters -> QTP 16P-F2
- VFD 20x4 characters -> QTP 16P-F4

and the following **graphic** displays:

- VFD 140x16 pixels -> QTP 16P-GF2
- VFD 140x32 pixels -> QTP 16P-GF4

LEDs backlighting of LCD models ensures a good visibility even when the environmental lighting changes and if it necessary the user can modify the contrast regulation by acting on a specific trimmer. Another important features of **QTP 16P** displays is their wide viewing angle that allows a good visibility from each frontal position. The user must choose the right display (so the right **QTP 16P** model) that is sufficient for the information to visualize and for his visibility requirements. For specific requirements on current consumption, visibility and price the card can be provided with LCD **display not backlit**: for detailed information about these options and their availability, please contact directly **grifo®** offices.

On the board there are three specific connectors that has been designed to simplify the connection of each displays, which is made through a direct soldering on the printed circuit (default configuration) or trough a simple flat cable. The user receives the board with the display already mounted and tested by **grifo®** technicians, so the board is ready to be used. Further information on each display are reported in DISPLAYS MANAGED chapter.
FIGURE 3: PHOTO OF QTP 16P WITHOUT DISPLAY
TECHNICAL FEATURES

GENERAL FEATURES

Resources:
- Alphanumeric or graphic display in six different models
- Trimmer to set LCD display contrast
- Matrix keyboard
- On board power supply

Displays:
- Alphanumeric
  - LCD: 20x2 or 20x4
  - Fluorescent VFD: 20x2 or 20x4
- Graphic
  - Fluorescent VFD: 140x16 or 140x32

Management lines:
- 16 digital I/O at TTL level: 12 outputs
  - 4 inputs

PHYSICAL FEATURES

Size:
- See outline dimension in figure 4

Weight:
- 715 g max.

Mounting:
- Front panel

Front panel protection:
- IP 54

Temperature range:
- From 0 to 50 °C

Relative humidity:
- 20% up to 90% (without condense)

Connectors:
- CN1: strip connector pods, male, 16 pins
- CN2: strip connector pods, male, 16 pins
- CN3: strip connector, male, vertical, 8 pins
- CN4: low profile connector, vertical, male, 20 pins
- CN5: quick release connector, vertical, 4 pins
DIMENSIONS OF OPERATOR PANEL QTP 16P

Here follow the dimensions, in millimeters, of operator panel QTP 16P seen from behind and by the side where input connectors are.
Please remark that figures are not scaled.

**Figure 4: Dimension of Operator Panel QTP 16P**
ELECTRIC FEATURES

Power voltage: 8±24 Vac, 12±34 Vdc or only OEM orders +5 Vdc ± 5% (without on board power supply)

Voltage for external loads: +5 Vdc

Power supply current: See next table (*)

Current for external loads: See next table (*)

Power consumption: See next table (*)

Here follows the list of QTP 16P power consumption referred to the different display types, in typical applications use.

To reduce consumptions of QTP 16P with LCD display it is possible to order them only OEM without backlighting, for further information please contact directly grifo®.

Standard power supply can erogate 380 mA of maximum current.

It is possible to order an optional power supply capable to erogate a greater current, up to 900 mA, specifying the option .SWLM2825 in the order.

(*) The data are referred to 20 C° work temperature (for further information please refer to chapter "POWER SUPPLY VOLTAGE").

<table>
<thead>
<tr>
<th>CONSUMPTIONS OF QTP 16P</th>
<th>STANDARD POWER SUPPLY</th>
<th>OPTION .SWLM2825</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alphanumeric LCD 20x2 backlit Maximum current for external loads (&lt; 20° C)</td>
<td>160 mA 220 mA</td>
<td>160 mA 740 mA</td>
</tr>
<tr>
<td>Alphanumeric LCD 20x4 backlit Maximum current for external loads (&lt; 20° C)</td>
<td>110 mA 270 mA</td>
<td>110 mA 790 mA</td>
</tr>
<tr>
<td>Alphanumeric VFD 20x2 Maximum current for external loads (&lt; 20° C)</td>
<td>140 mA 240 mA</td>
<td>140 mA 760 mA</td>
</tr>
<tr>
<td>Alphanumeric VFD 20x4 Maximum current for external loads (&lt; 20° C)</td>
<td>230 mA 150 mA</td>
<td>230 mA 670 mA</td>
</tr>
<tr>
<td>Graphic VFD 140x16 Maximum current for external loads (&lt; 20° C)</td>
<td>270 mA 110 mA</td>
<td>270 mA 630 mA</td>
</tr>
<tr>
<td>Graphic VFD 140x32 Maximum current for external loads (&lt; 20° C)</td>
<td>470 mA 430 mA</td>
<td></td>
</tr>
</tbody>
</table>
FIGURE 6: SOME CONFIGURATIONS AVAILABLE FOR QTP 16P
INSTALLATION

In this chapter there are the information for a right installation and correct use of the QTP 16P card. In detail there are the locations and functions of each connector, of the user settable jumper, of the trimmer and some explanatory diagrams.

CONNECTIONS

QTP 16P terminal has 6 connectors that can be linkeded to other devices or directly to the field, according to system requirements.
In this paragraph there are connectors pin out, a short signals description (including the signals direction) and connectors location (see figure 9), that simplify and speed the installation phase. Connectors are accessible from top and bottom of the printed circuit board, to easy insertion and extraction.

CN5 - EXTERNAL POWER SUPPLY CONNECTOR

CN5 is a 4 pins screw terminal connector, with 5 mm pitch.
On CN5 can be connected an external power supply voltage for the high consumption sections of the card (LCD backligt, VFD, etc.) whenever the power available on the control card, connected through CN4, is not sufficient.
For further information please refer to chapter "POWER SUPPLY VOLTAGE".
QTP 16P features a power supply section capable to supply itself and an external load with a stabilized voltage of +5 Vdc.
This allows to reduce the cost of the application because QTP 16P can provide a remarkable current intensity to the external load also in the worst conditions.
For further information please refer to chapter "ELECTRIC FEATURES".

NOTE: Only for OEM orders, it is possible to obtain QTP 16P optionally without power supply. In this case it can be supplied providing +5 Vdc ± 5% through the pins of CN5 that here are used to fetch the voltage for external loads.
Fig 7: CN5 - External power supply connector

Signals description:

- **Vac, +Vdc pow** = O - Positive terminal of 8÷24 Vac or 12÷34 Vdc external power supply (see jumper J1)
- **Vac, GND** = - Ground signal of external power supply.
- **+5 Vdc OUT** = O - +5 Vdc to supply eventual external loads
- **GND** = - Ground signal.
CN3 - KEYBOARD CONNECTOR

CN3 is a 8 pins, vertical, male strip connector, with 2.54 mm pitch.
CN2 features all the signals needed to connect the matrix keyboard featuring 16 keys.

**Figure 8: CN3 - External keyboard connector**

Signals description:

<table>
<thead>
<tr>
<th>Col n</th>
<th>= O - Output line for n-th column of 4x6 external matrix keyboard.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Row n</td>
<td>= I - Input line for n-th row of 4x6 external matrix keyboard.</td>
</tr>
</tbody>
</table>

External keys must be connected so that pressing one key connects input Row n and output Col n.
FIGURE 9: JUMPER, CONNECTORS, TRIMMER, ETC. LOCATION
CN4 - DIGITAL I/O LINES CONNECTOR

CN4 is a 20 pins, male, vertical, low profile connector with 2.54mm pitch. On CN4 are connected the 16 digital I/O lines used to manage all the sections of QTP 16P interface. All these signals follow TTL standard and I/O ABACO® standard pin out.

|   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| PA.1 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| PA.3 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| PA.5 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| PA.7 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| PC.6 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |   |   |   |   |   |   |   |   |
| PC.4 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| PC.2 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| PC.0 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| GND  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| N.C. |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

**Figure 10: CN4 - Digital I/O lines connector**

Signals description:

- **PA.n** = I/O - Digital line n of first management port, named Port A
- **PC.n** = I/O - Digital line n of second management port, named Port C
- **+5 Vdc** = I - +5 Vdc power supply from control card (see jumper J1)
- **GND** = Ground signal
- **N.C.** = Not connected
**FIGURE 11:** QTP 16P COMPONENTS MAP (COMPONENT SIDE)

**FIGURE 12:** QTP 16P COMPONENTS MAP (SOLDER SIDE)
CN2 - FIRST DISPLAY CONNECTOR

CN2 is 16 pins strip connector pods, with 2.54 mm pitch. CN2 features all the control and command signals of LCD display (or LCD compatible) with standard pin out that allows direct connection to most of them. In detail this connector is used to interface the following displays:

- alphanumeric LCD 20x4  QTP 16P-C4
- alphanumeric VFD 20x4  QTP 16P-F4
- graphic VFD 140x32  QTP 16P-GF4

Figure 13: CN2 - First display connector

<table>
<thead>
<tr>
<th>Pin</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>GND, VSS</td>
</tr>
<tr>
<td>2</td>
<td>+5 Vdc, VDD</td>
</tr>
<tr>
<td>3</td>
<td>VDD, VSS</td>
</tr>
<tr>
<td>4</td>
<td>VO, VCL</td>
</tr>
<tr>
<td>5</td>
<td>R/W</td>
</tr>
<tr>
<td>6</td>
<td>E</td>
</tr>
<tr>
<td>7</td>
<td>DB0</td>
</tr>
<tr>
<td>8</td>
<td>DB1</td>
</tr>
<tr>
<td>9</td>
<td>DB2</td>
</tr>
<tr>
<td>10</td>
<td>DB3</td>
</tr>
<tr>
<td>11</td>
<td>DB4</td>
</tr>
<tr>
<td>12</td>
<td>DB5</td>
</tr>
<tr>
<td>13</td>
<td>DB6</td>
</tr>
<tr>
<td>14</td>
<td>DB7</td>
</tr>
<tr>
<td>15</td>
<td>A (+)</td>
</tr>
<tr>
<td>16</td>
<td>K (-)</td>
</tr>
</tbody>
</table>
Signals description:

- **A (+)** = O - Anod or positive terminal for LED backlighting of LCD display.
- **K (-)** = O - Kathod or negative terminal for LED backlighting of LCD display.
- **DBx** = I/O - Line x of display 8 bit data bus.
- **R/W** = O - Control signal to select read or write operation.
- **E** = O - Display enable signal.
- **RS** = O - Control signal to select between command or data operation.
- **Vo , VLc** = O - Contrast tension for LCD display.
- **+5 Vdc , VDB** = O - Display power supply voltage.
- **GND , VSS** = - Ground signal.

**Figure 14: Photo of QTP 16P-C4**

**Figure 15: Photo of QTP 16P-GF4**
CN1 - SECOND DISPLAY CONNECTOR

CN1 is 16 pins low profile connector pods, with 2.54 mm pitch. CN1 features all the control and command signals of LCD display (or LCD compatible) with standard pin out, that allows direct connection to most of them. In detail this connector is used to interface the following displays:

- alphanumeric LCD 20x2: QTP 16P-C2
- alphanumeric VFD 20x2: QTP 16P-F2
- graphic VFD 140x16: QTP 16P-GF2

**Figure 16: CN1 - Second display connector**

Signals description:

- **A (+)** = O - Anod or positive terminal for LED backlighting of LCD display.
- **K (-)** = O - Kathod or negative terminal for LED backlighting of LCD display.
- **DBx** = I/O - Line x of display 8 bit data bus.
- **R/W** = O - Control signal to select read or write operation.
- **E** = O - Display enable signal.
- **RS** = O - Control signal to select between command or data operation.
- **V_o , V_{LC}** = O - Contrast tension for LCD display.
- **+5 V_{dc} , V_{DD}** = O - Display power supply voltage.
- **GND , V_{SS}** = Ground signal.
Figure 17: Photo of QTP 16P-F2

Figure 18: Photo of QTP 16P-F4
JUMPERS

On QTP 16P there are 2 jumpers used for card configuration. By configuring this jumpers, the user can define the power supply modalities as below described:

<table>
<thead>
<tr>
<th>JUMPER</th>
<th>CONNECTION</th>
<th>PURPOSE</th>
<th>DEF.</th>
</tr>
</thead>
<tbody>
<tr>
<td>J1</td>
<td>not connected</td>
<td>Power supply of control board is not connected to power supply of QTP 16P through CN4.</td>
<td>*</td>
</tr>
<tr>
<td></td>
<td>connected</td>
<td>Power supply of control board is connected to power supply of QTP 16P through CN4.</td>
<td></td>
</tr>
<tr>
<td>J2</td>
<td>not connected</td>
<td>Does not connect the ground of QTP 16P to frontal and rear metallic carter.</td>
<td>*</td>
</tr>
<tr>
<td></td>
<td>connected</td>
<td>Connects the ground of QTP 16P to frontal and rear metallic carter.</td>
<td></td>
</tr>
</tbody>
</table>

**Figure 19: Jumper Table**

To recognize these valid connections, please refer to the board printed diagram (serigraph) or to figures 11 and 12 of this manual, where the pins numeration is listed; for recognizing jumper location, please refer to figure 9.

The "*" denotes the default connection, or on the other hand the connection set up at the end of testing phase, that is the configuration the user receives.

Further information about purpose of jumpers are reported in the paragraph “POWER SUPPLY”.

DISPLAYS MANAGED

Hardware structure of QTP 16P can use most alphanumeric and graphic intelligent displays currently in commerce, both LCD and VFD fluorescent.

<table>
<thead>
<tr>
<th>TYPE</th>
<th>MODEL</th>
<th>MANUFACTURER</th>
<th>CONNECTOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alphanumeric LCD 20x2</td>
<td>SSC2A20DLYY-02</td>
<td>SDEC</td>
<td>CN1</td>
</tr>
<tr>
<td>Alphanumeric LCD 20x2</td>
<td>CU20025ECBPB-U1J</td>
<td>NORITAKE ITRON</td>
<td>CN1</td>
</tr>
<tr>
<td>Alphanumeric LCD 20x4</td>
<td>SSC4A20DLYY-02</td>
<td>SDEC</td>
<td>CN2</td>
</tr>
<tr>
<td>Alphanumeric LCD 20x4</td>
<td>AC204AYILY02</td>
<td>AMPIRE</td>
<td>CN2</td>
</tr>
<tr>
<td>Alphanumeric VFD 20x4</td>
<td>CU20045SCBP8-U1J</td>
<td>NORITAKE ITRON</td>
<td>CN2</td>
</tr>
<tr>
<td>Graphic VFD 140x16</td>
<td>GU140x16G-7806</td>
<td>NORITAKE ITRON</td>
<td>CN1</td>
</tr>
<tr>
<td>Graphic VFD 140x32</td>
<td>GU140x32F-7806</td>
<td>NORITAKE ITRON</td>
<td>CN2</td>
</tr>
</tbody>
</table>

**Figure 20: Displays Connectable**
**Figure 21: Photo of QTP 16P-C2**

**Figure 22: Photo of QTP 16P-GF2**
CONTRAST REGULATION TRIMMER

On QTP 16P board there is a trimmer that defines the contrast on LCD displays. This trimmer, named RV1, is set by grifo® to obtain the best display visibility in each working conditions and normally the user must not change its position. In case of specific requirements, as external light very low or very high, it can be changed by little rotation in both directions until the visibility is improved. For recognizing the location of contrast regulation trimmer, please refer to figure 9.

I/O CONNECTION

To prevent possible connecting problems between QTP 16P and the external systems, the user has to read carefully the previous paragraph information and he must follow these instructions:

- For all TTL signals the user must follow the rules of this electric standard. The connected digital signal must be always referred to card digital ground. For TTL signals, the 0V level corresponds to logic state 0, while 5V level corresponds to logic state 1.

- To avoid driving problems and minimize the effects of eventual noises from the field, connector CN4 can be connected with cables of maximum length 40 cm.

POWER SUPPLY

QTP 16P interface is provided of two different connectors that solve in an efficient and comfortable way the problem to supply the boards in any situation. On the boards there are some different sections (keyboard interface, display, LCD backlight, LCD contrast, etc) featured by different consumptions but with the same power supply voltage: \(+5 \text{ Vdc } \pm 5\%\). Connector CN5 allows to connect, to pins 3 and 4, 8÷24 Vac or 12÷34 Vdc that the on board power supply in the above mentioned +5 Vdc.

In case of 12÷34 Vdc, pin 3 must be the positive terminal.

Also, jumper J1 can connect on board generated +5 Vdc and the +5 Vdc voltage on connector CN4, allowing to supply the control card too. So:

- If the control card connected to CN4 does not have its power supply source, J1 must be connected to allow QTP 16P to supply it. Please refer to paragraph “ELECTRIC FEATURES” for further information.

- If the control card connected to CN4 has its own power supply source, J1 must be not connected to avoid conflicts. Alternatively, the control card can supply QTP 16P if no power supply is connected to this latter and J1 is connected.

The card is also provided with a distributed filtering circuitry that saves the terminal from disturbs or noise from the field, improving the overall system performances.
FIGURE 23: KEYS MAP
SOFTWARE DESCRIPTION

In the previous paragraphs all the hardware lines have been described and here follows a detailed description of function and meaning of digital I/Os (please always refer to the connectors figures to understand completely the following informations or to electric diagram in APPENDIX A).

In the following paragraphs the indications D0÷D7 or .0+.7 are used to refer the bits of the byte involved in the I/O operations. Obviously this manual doesn't report information about the management of the 16 digital I/O lines in fact these depend on the used control system and the user must search them in the proper technical manual.

The software management of QTP 16P can be performed in two different manners: high level and low level mode as described in the following paragraphs.

HIGH LEVEL MANAGEMENT

This modality coincide with a firmware already developed and supplied by grifo® under the form of drivers or libraries.

By adding this firmware to the used high level programming language (C, BASIC, PASCAL, etc.) the user can manage the keyboard as a console input device and the display as a console output device.

So all the high level instructions dedicated to console management are available for QTP 16P management too, and the typical problems of data insertion, functions execution, formatted information visualization, and so on, are easily solved.

In detail, according with programming languages, the following instructions directly act on QTP 16P resources:

BASIC -> Print ; Input ; Inkey
C -> printf ; Puts ; Putch ; Getch ; Getche ; Scanf ; Kbhit
PASCAL -> Write ; Writeln ; Read ; Readln ; Keypressed

Thanks to the high level management the part of application software dedicated to operator interface, that often is one of the most important and difficult problems, is easily solved by any user with a great reduction of development time.

Actually grifo® has several ready to use high level management firmware for many microprocessors and some different software tools, as:

- Z80 based cards through GDOS or FGDOS romate operating system,
- I51 based cards through BASIC 52, BASCOM 8051 and µC/51,
- I86 based cards through GCTR,
- AVR based cards through BASCOM AVR and ICC AVR.

and detailed information about firmware integration, initialization procedures, console redirection, etc. are reported in the user manual of the same software tools.
LOW LEVEL MANAGEMENT

In this modality all the **QTP 16P** resources are managed directly by user application program that must use the 16 digital I/O lines to drive display and acquire keyboard. Thus the application development will require more time and more knowledge, because everything (timing, lines, interrupts, formatting, ....) must be realized by the user.

KEYBOARD

The keyboard management coincide with a periodic operation that checks if there is a pressed key in that specific sample time or, in other words, if there is a cross row - column of the matrix connected by a closed contact of the relative key. Each sampling time the scan procedure composed by the following steps, must be performed:

a) Disable the connected display by setting properly its control signals.
b) Set the first column (Col 1) to low level by resetting the relative output lines to 0 logic state, and maintain all the other columns to high level (logic state 1).
c) Acquire the four rows status (Row 4 ÷ Row 1) by reading the status of the relative input lines.
d) Check if some of the four acquired Rows are at low level (logic state 0): in this condition the key connected on the cross Col 1 - Row n is pressed and viceversa.
e) Save an index, counter, number, code according with software requirements, of the found pressed keys.
f) Repeat the steps b, c, d, e for the remaining columns (Col 2 ÷ Col 4).

To ensure that no key pressed are lost it is suggested to perform the described scan at regular time interval, for example each 5 msec, by using a periodic interrupt response routine associated to a presetted hardware Timer. To avoid wrong identifications of not stable pressed keys (recoils are typical in these conditions) it must be used a debouncing technique that defines the key really pressed when it has been found closed for at least 20 msec, equals to 4 successive scannings.

The correspondences between the matrix keyboard lines and the digital I/O lines on CN3 are below reported:

<table>
<thead>
<tr>
<th>PA.3</th>
<th>PA.2</th>
<th>PA.1</th>
<th>PA.0</th>
<th>PC.7</th>
<th>PC.6</th>
<th>PC.5</th>
<th>PC.4</th>
</tr>
</thead>
<tbody>
<tr>
<td>-&gt; Col 1</td>
<td>-&gt; Col 2</td>
<td>-&gt; Col 3</td>
<td>-&gt; Col 4</td>
<td>-&gt; Row 1</td>
<td>-&gt; Row 2</td>
<td>-&gt; Row 3</td>
<td>-&gt; Row 4</td>
</tr>
</tbody>
</table>
DISPLAY

The intelligent display management is based on a parallel communication performed through an 8 bit data BUS and 3 control signals. The software must drive all these lines according with display specifications, in order to send commands and/or data to be displayed. The correspondences between the display lines and the digital I/O lines on CN3 are below reported, both for standard display, FUTABA display:

| PA.n -> | DBn , DBn | PC.0 -> | RS , ---- |
| PC.1 -> | R/W , /WR | PC.2 -> | E , /SEL |

When the software busy status of the display must be acquired, PA.n lines must be bidirectional, viceversa if proper delays are inserted in the software the 11 signals can be simple output lines. In normal applications the following operations must be executed to correctly use any type of display:

a) Defines the digital I/O lines functionality according with signals direction.
b) Initialize the display by sending proper commands.
c) Send characters to display or command to be executed (i.e. clear, cursor shift, set addresses) according to application requirements.

A complete description of control signals waveforms, display commands, initialization sequence, characters locations and characters fonts are available in APPENDIX C of this manual.
**FIGURE 24: AVAILABLE CONNECTIONS DIAGRAM**

- **Display:**
  - Alphanumeric LCD 20x2; 20x4
  - Alphanumeric VFD 20x2; 20x4
  - Graphic VFD 140x16; 140x32

- Slot to insert name personalization label

- Front panel mounting

- 16 TTL I/O lines on I/O ABACO® connector

- PLC, GPC® 4 type, GPC® 3 type, GPC® Euro, Peripheral I/O, GPC® Block
BIBLIOGRAPHY

In this chapter there is a complete list of technical books, where the user can find all the necessary documentations on the components mounted on **QTP 16P**.

**Manual TEXAS INSTRUMENTS:**  
*The TTL Data Book - SN54/74 Families*

**Data sheets NORITAKE-ITRON:**  
*Vacuum Fluorescent Display module specification*

**Manual SDEC:**  
*LCD MODULE*

**Manual TECDIS:**  
*Liquid Crystal Display Modules*

The described manual can be requested directly to manufacturer or local dealers. Alternatively this information and/or upgrades can be found in specific internet web pages, of the listed companies.
APPENDIX A: ELECTRIC DIAGRAM

FIGURE A1: ELECTRIC DIAGRAM

- Standard I/O 20 pin connector
- DISPLAY 2x20
- DISPLAY 4x20
- DC Power supply
- AC Power supply
- Keyboard connector
- Matrix Keyboard 4x4
- Stabilizer

Title: QTP 16P-100703
Date: 01-07-03
Rel. 2.0
Page: 1 of 1
APPENDIX B: DISPLAY CHARACTERS

The following tables shows the characters sets displayed on **QTP 16P** for all the possible received characters, according with ordered display and model. Even the not ASCII characters (or special characters) change when the display type changes and if the user requires a character set different from those described in the following figures, he can take a direct contact with **grifo®**.

![Character Table](https://example.com/character-table.png)

**Figure B1: QTP 16P-F2, F4, F24, GF2, GF4 Characters Table in Alphanumeric Mode**
<table>
<thead>
<tr>
<th>H</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>User chr 0</td>
<td>00P</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>User chr 1</td>
<td>1AQa</td>
<td>a</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>User chr 2</td>
<td>BRb</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>User chr 3</td>
<td>3Cs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>User chr 4</td>
<td>4DT</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>User chr 5</td>
<td>5Ee</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>User chr 6</td>
<td>6Ft</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>User chr 7</td>
<td>7Gw</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>User chr 0</td>
<td>8HXh</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>User chr 1</td>
<td>9IYi</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>User chr 2</td>
<td>JZj</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>User chr 3</td>
<td>KCKc</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>User chr 4</td>
<td>L\NN</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>User chr 5</td>
<td>M^i</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>User chr 6</td>
<td>N^n</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>User chr 7</td>
<td>?0^</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Figure B2: QTP 16P-C2, C4 Characters Table**
<table>
<thead>
<tr>
<th>L</th>
<th>00</th>
<th>10</th>
<th>20</th>
<th>30</th>
<th>40</th>
<th>50</th>
<th>60</th>
<th>70</th>
<th>80</th>
<th>90</th>
<th>A0</th>
<th>B0</th>
<th>C0</th>
<th>D0</th>
<th>E0</th>
<th>F0</th>
</tr>
</thead>
<tbody>
<tr>
<td>00</td>
<td>0</td>
<td>3</td>
<td>I</td>
<td>7</td>
<td>!</td>
<td>2</td>
<td>G</td>
<td>9</td>
<td>B</td>
<td>4</td>
<td>D</td>
<td>T</td>
<td>6</td>
<td>U</td>
<td>W</td>
<td>N</td>
</tr>
<tr>
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<td>1</td>
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<td>8</td>
<td>L</td>
<td>2</td>
<td>E</td>
<td>C</td>
<td>3</td>
<td>9</td>
<td>F</td>
<td>V</td>
<td>7</td>
<td>G</td>
<td>0</td>
<td>H</td>
</tr>
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<td>7</td>
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<td>H</td>
<td>N</td>
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</tr>
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<td>1</td>
<td>7</td>
<td>9</td>
<td>J</td>
<td>V</td>
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<td>E</td>
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<td>9</td>
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<td>3</td>
<td>9</td>
<td>1</td>
<td>J</td>
<td>V</td>
<td>2</td>
<td>E</td>
<td>X</td>
<td>W</td>
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<td>D</td>
<td>X</td>
<td>W</td>
</tr>
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<td>A</td>
<td>G</td>
<td>2</td>
<td>Q</td>
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<td>K</td>
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<td>1</td>
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<td>L</td>
<td>V</td>
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<td>C</td>
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<td>W</td>
</tr>
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<td>8</td>
<td>B</td>
<td>H</td>
<td>3</td>
<td>R</td>
<td>9</td>
<td>L</td>
<td>6</td>
<td>2</td>
<td>4</td>
<td>M</td>
<td>V</td>
<td>5</td>
<td>B</td>
<td>X</td>
<td>W</td>
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<td>9</td>
<td>C</td>
<td>I</td>
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<td>M</td>
<td>7</td>
<td>3</td>
<td>5</td>
<td>N</td>
<td>V</td>
<td>6</td>
<td>A</td>
<td>X</td>
<td>W</td>
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<tr>
<td>0A</td>
<td>A</td>
<td>D</td>
<td>J</td>
<td>5</td>
<td>T</td>
<td>1</td>
<td>N</td>
<td>8</td>
<td>4</td>
<td>6</td>
<td>L</td>
<td>V</td>
<td>7</td>
<td>B</td>
<td>X</td>
<td>W</td>
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<tr>
<td>0B</td>
<td>B</td>
<td>E</td>
<td>K</td>
<td>6</td>
<td>U</td>
<td>2</td>
<td>O</td>
<td>9</td>
<td>5</td>
<td>7</td>
<td>M</td>
<td>V</td>
<td>8</td>
<td>A</td>
<td>X</td>
<td>W</td>
</tr>
<tr>
<td>0C</td>
<td>C</td>
<td>F</td>
<td>L</td>
<td>7</td>
<td>V</td>
<td>3</td>
<td>P</td>
<td>0</td>
<td>6</td>
<td>8</td>
<td>N</td>
<td>V</td>
<td>9</td>
<td>B</td>
<td>X</td>
<td>W</td>
</tr>
<tr>
<td>0D</td>
<td>D</td>
<td>G</td>
<td>M</td>
<td>8</td>
<td>W</td>
<td>4</td>
<td>Q</td>
<td>1</td>
<td>7</td>
<td>9</td>
<td>L</td>
<td>V</td>
<td>0</td>
<td>A</td>
<td>X</td>
<td>W</td>
</tr>
<tr>
<td>0E</td>
<td>E</td>
<td>H</td>
<td>N</td>
<td>9</td>
<td>X</td>
<td>5</td>
<td>R</td>
<td>2</td>
<td>8</td>
<td>0</td>
<td>K</td>
<td>V</td>
<td>1</td>
<td>B</td>
<td>X</td>
<td>W</td>
</tr>
<tr>
<td>0F</td>
<td>F</td>
<td>I</td>
<td>O</td>
<td>0</td>
<td>Y</td>
<td>6</td>
<td>S</td>
<td>3</td>
<td>9</td>
<td>1</td>
<td>J</td>
<td>V</td>
<td>2</td>
<td>C</td>
<td>X</td>
<td>W</td>
</tr>
</tbody>
</table>

**Figure B3: QTP 16P-GF2, GF4 Characters Table with Minifont Graphic Mode**
<table>
<thead>
<tr>
<th>L/H</th>
<th>00</th>
<th>10</th>
<th>20</th>
<th>30</th>
<th>40</th>
<th>50</th>
<th>60</th>
<th>70</th>
<th>80</th>
<th>90</th>
<th>A0</th>
<th>B0</th>
<th>C0</th>
<th>D0</th>
<th>E0</th>
<th>F0</th>
</tr>
</thead>
<tbody>
<tr>
<td>00</td>
<td>!</td>
<td>0@P</td>
<td>'</td>
<td>P</td>
<td>Ä</td>
<td>E</td>
<td>-</td>
<td>9</td>
<td>5</td>
<td>0P</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>01</td>
<td>!</td>
<td>!1A0</td>
<td>a3</td>
<td>*</td>
<td>*</td>
<td>#</td>
<td>7</td>
<td>4</td>
<td>a9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>02</td>
<td>&quot;</td>
<td>2BR</td>
<td>b</td>
<td>r</td>
<td>Ä</td>
<td>'</td>
<td>い</td>
<td>っ</td>
<td>し</td>
<td>で</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>03</td>
<td>#</td>
<td>3CS</td>
<td>Cs</td>
<td>3</td>
<td>A</td>
<td>R</td>
<td>ウ</td>
<td>テ</td>
<td>カ</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>04</td>
<td>$</td>
<td>4DT</td>
<td>dt</td>
<td>a</td>
<td>#</td>
<td>、</td>
<td>イ</td>
<td>ト</td>
<td>ハ</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>05</td>
<td>%</td>
<td>5E</td>
<td>eu</td>
<td>E</td>
<td>o</td>
<td>オ</td>
<td>ナ</td>
<td>1</td>
<td>6</td>
<td>u</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>06</td>
<td>&amp;</td>
<td>6F</td>
<td>Fu</td>
<td>v</td>
<td>0</td>
<td>キ</td>
<td>ナ</td>
<td>キ</td>
<td>ノ</td>
<td>ヨ</td>
<td>ノ</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>07</td>
<td>!</td>
<td>7GW</td>
<td>gw</td>
<td>w</td>
<td>オ</td>
<td>ア</td>
<td>ラ</td>
<td>9</td>
<td>れ</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>08</td>
<td>()</td>
<td>8HX</td>
<td>hx</td>
<td>0</td>
<td>1</td>
<td>イ</td>
<td>ネ</td>
<td>リ</td>
<td>カ</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>09</td>
<td>＃</td>
<td>9I</td>
<td>V</td>
<td>i</td>
<td>9</td>
<td>¥</td>
<td>美</td>
<td>ノ</td>
<td>リ</td>
<td>リ</td>
<td>リ</td>
<td>リ</td>
<td>リ</td>
<td>リ</td>
<td>リ</td>
<td>リ</td>
</tr>
<tr>
<td>0A</td>
<td>8</td>
<td>JZ</td>
<td>jz</td>
<td>U</td>
<td>4</td>
<td>エ</td>
<td>コ</td>
<td>ノ</td>
<td>ヴ</td>
<td>ヴ</td>
<td>ヴ</td>
<td>ヴ</td>
<td>ヴ</td>
<td>ヴ</td>
<td>ヴ</td>
<td>ヴ</td>
</tr>
<tr>
<td>0B</td>
<td>'</td>
<td>KIK</td>
<td>k</td>
<td>(</td>
<td>ü</td>
<td>オ</td>
<td>サ</td>
<td>ハ</td>
<td>ハ</td>
<td>ハ</td>
<td>ハ</td>
<td>ハ</td>
<td>ハ</td>
<td>ハ</td>
<td>ハ</td>
<td>ハ</td>
</tr>
<tr>
<td>0C</td>
<td>、</td>
<td>KL</td>
<td>L</td>
<td>/</td>
<td>シ</td>
<td>フ</td>
<td>フ</td>
<td>フ</td>
<td>フ</td>
<td>フ</td>
<td>フ</td>
<td>フ</td>
<td>フ</td>
<td>フ</td>
<td>フ</td>
<td>フ</td>
</tr>
<tr>
<td>0D</td>
<td></td>
<td>=</td>
<td>M</td>
<td>J</td>
<td>n</td>
<td>チ</td>
<td>ユ</td>
<td>ス</td>
<td>メ</td>
<td>メ</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0E</td>
<td>\</td>
<td>N</td>
<td>^</td>
<td>n</td>
<td>+</td>
<td>ト</td>
<td>モ</td>
<td>ホ</td>
<td>ホ</td>
<td>ホ</td>
<td>ホ</td>
<td>ホ</td>
<td>ホ</td>
<td>ホ</td>
<td>ホ</td>
<td>ホ</td>
</tr>
<tr>
<td>0F</td>
<td>=</td>
<td>/</td>
<td>？</td>
<td>D</td>
<td>O</td>
<td>L</td>
<td>O</td>
<td>ソ</td>
<td>ニ</td>
<td>ソ</td>
<td>ソ</td>
<td>ソ</td>
<td>ソ</td>
<td>ソ</td>
<td>ソ</td>
<td>ソ</td>
</tr>
</tbody>
</table>

**Figure B4: QTP 16P-GF2, GF4 Characters Table with Katakana Graphic Font**
**Figure B5:** QTP 16P-GF2,GF4 Characters Table with European Graphic Font
APPENDIX C: ON BOARDS COMPONENTS DESCRIPTION

grifo® provides a free technical documentation service through its manuals and/or web site, where on board components data sheet can be found. In this chapter are reported the information about display management.

DISPLAY

1. Mechanical Specification

<table>
<thead>
<tr>
<th>ITEM</th>
<th>STANDARD VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>NUMBER OF CHARACTERS</td>
<td>20 CHARACTERS X 2 LINES</td>
</tr>
<tr>
<td>CHARACTER FORMAT</td>
<td>5 X 8 DOTS</td>
</tr>
<tr>
<td>MODULE DIMENSION</td>
<td>115.0 (W) X 36.0 (H) X 15.0 (T)</td>
</tr>
<tr>
<td>VIEWING DISPLAY AREA</td>
<td>83.0 (W) X 18.6 (H)</td>
</tr>
<tr>
<td>ACTIVE DISPLAY AREA</td>
<td>73.5 (W) X 11.5 (H)</td>
</tr>
<tr>
<td>CHARACTER SIZE</td>
<td>3.20 (W) X 5.55 (H)</td>
</tr>
<tr>
<td>CHARACTER PITCH</td>
<td>3.70 (W) X 5.95 (H)</td>
</tr>
<tr>
<td>DOT SIZE</td>
<td>0.60 (W) X 0.65 (H)</td>
</tr>
<tr>
<td>DOT PITCH</td>
<td>0.65 (W) X 0.70 (H)</td>
</tr>
</tbody>
</table>

LMC-SSC2A20DRG-01        STN , Gray , 1/16 Duty , 6 O’clock
LMC-SSC2A20DRY-01        STN , Yellow Green , 1/16 Duty , 6 O’clock
LMC-SSC2A20DEGB-01       STN , Gray , 1/16 Duty , 6 O’clock , EL Backlight ( color is Blue )
LMC-SSC2A20DEYW-01       STN , Yellow Green , 1/16 Duty , 6 O’clock , EL Backlight ( color is White )
LMC-SSC2A20DLGY-01       STN , Gray , 1/16 Duty , 6 O’clock , LED Backlight
LMC-SSC2A20DLYY-01       STN , Yellow Green , 1/16 Duty , 6 O’clock , LED Backlight

EL. Use Inverter Type     SDEC-R002A

Inverter Input             DC +5V   V  40 mA
Inverter Output            AC 90 ~ 110 V  400 ~ 700 Hz
Backlight Half-Lift Time   3,000 HR.
Backlight Input            DC +5.0V   V  140 mA
Backlight Half-Lift Time   50,000 HR.

2. Mechanical Diagram

3. Interface Pin Connections

<table>
<thead>
<tr>
<th>NO</th>
<th>SYMBOL</th>
<th>LEVEL</th>
<th>FUNCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>VSS</td>
<td>–</td>
<td>GND (0V)</td>
</tr>
<tr>
<td>2</td>
<td>VDD</td>
<td>H/L</td>
<td>DC +5V</td>
</tr>
<tr>
<td>3</td>
<td>VO</td>
<td>H/L</td>
<td>Contrast Adjust</td>
</tr>
<tr>
<td>4</td>
<td>R/S</td>
<td>H/L</td>
<td>Register select</td>
</tr>
<tr>
<td>5</td>
<td>R/W</td>
<td>H/L</td>
<td>Read/Write</td>
</tr>
<tr>
<td>6</td>
<td>E</td>
<td>H,H-&gt;L</td>
<td>Enable signal</td>
</tr>
<tr>
<td>7</td>
<td>DB0</td>
<td>H/L</td>
<td>Data Bit 0</td>
</tr>
<tr>
<td>8</td>
<td>DB1</td>
<td>H/L</td>
<td>Data Bit 1</td>
</tr>
<tr>
<td>9</td>
<td>DB2</td>
<td>H/L</td>
<td>Data Bit 2</td>
</tr>
<tr>
<td>10</td>
<td>DB3</td>
<td>H/L</td>
<td>Data Bit 3</td>
</tr>
<tr>
<td>11</td>
<td>DB4</td>
<td>H/L</td>
<td>Data Bit 4</td>
</tr>
<tr>
<td>12</td>
<td>DB5</td>
<td>H/L</td>
<td>Data Bit 5</td>
</tr>
<tr>
<td>13</td>
<td>DB6</td>
<td>H/L</td>
<td>Data Bit 6</td>
</tr>
<tr>
<td>14</td>
<td>DB7</td>
<td>H/L</td>
<td>Data Bit 7</td>
</tr>
<tr>
<td>15</td>
<td>A+/t</td>
<td>DC+5V</td>
<td>LED Backlight +</td>
</tr>
<tr>
<td>16</td>
<td>K-/t</td>
<td>0V</td>
<td>LED Backlight -</td>
</tr>
</tbody>
</table>

4. Black Diagram
7. Functional Descriptions

### 7.1 Instruction table

<table>
<thead>
<tr>
<th>Instruction</th>
<th>CODE</th>
<th>Cycle Time</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Display clear</td>
<td>0 0 0 0 0 0 0 0 0 1</td>
<td>2.3 ms Max.</td>
<td>Clears all display and sets DD RAM address 0 in the address counter.</td>
</tr>
<tr>
<td>Cursor home</td>
<td>0 0 0 0 0 0 1 *</td>
<td>1+ICYC</td>
<td>Sets DD RAM address 0 in the address counter. Also returns the display being shifted to the original position. DD RAM contents remain unchanged.</td>
</tr>
<tr>
<td>Entry mode set</td>
<td>0 0 0 0 0 0 0 1 I/D S</td>
<td>1+ICYC</td>
<td>Sets the cursor direction and specifies display shift. These operations are performed during writing/reading data.</td>
</tr>
<tr>
<td>Display ON/OFF control</td>
<td>0 0 0 0 0 0 0 1 D C B</td>
<td>1+ICYC</td>
<td>Sets all display ON/OFF(O), cursor ON/OFF(C), cursor blink of character position (B).</td>
</tr>
<tr>
<td>Cursor or display shift</td>
<td>0 0 0 0 0 1 S/C R/L * *</td>
<td>1+ICYC (2+ICYC)</td>
<td>Shifts display or cursor keeping DD RAM contents.</td>
</tr>
<tr>
<td>Function set</td>
<td>0 0 0 0 1 IF * * *</td>
<td>1+ICYC</td>
<td>Sets data length (IF).</td>
</tr>
<tr>
<td>Brightness control</td>
<td>1 0 * * * * BR1 BR0</td>
<td>1+ICYC</td>
<td>Accepts 1 byte data of just after “Function set” as brightness control data.</td>
</tr>
</tbody>
</table>

### CODE

<table>
<thead>
<tr>
<th>Instruction</th>
<th>RS</th>
<th>R/W</th>
<th>DB7</th>
<th>DB6</th>
<th>DB5</th>
<th>DB4</th>
<th>DB3</th>
<th>DB2</th>
<th>DB1</th>
<th>DB0</th>
<th>Time</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CG RAM address setting</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>ACG</td>
<td>1+ICYC</td>
<td>Sets the CG RAM address.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DD RAM address setting</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>ADD</td>
<td>1+ICYC</td>
<td>Sets the DD RAM address.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Busy flag &amp; address reading</td>
<td>0 1 BF</td>
<td>ACC</td>
<td>1+ICYC</td>
<td>Reads busy flag (BF) and address counter.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Data writing to CG or DD RAM</td>
<td>1 0</td>
<td>Data writing</td>
<td>1+ICYC</td>
<td>Writes data into CG RAM or DD RAM.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Data reading from CG or DD RAM</td>
<td>1 1</td>
<td>Data reading</td>
<td>1+ICYC</td>
<td>Reads data from CG RAM or DD RAM.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note:

* : don't care
ICYC: ICYC is read/write cycle (Min) of HOST SYSTEM.
() : If RAM read is a next operation, needs execution time indicated by "( )".
7.2 Display Clear

```
DB7 DB6 DB5 DB4 DB3 DB2 DB1 DB0
0 0 0 0 0 0 0 0 1 01H
```

RS=0

This instruction.
1. Fills all locations in the display data (DD) RAM with 20H (blank character).
2. Clears the contents of the address counter to 0H.
3. Sets the display for zero character shift.
4. Sets the display counter to point to the DD RAM.
5. If the cursor is displayed, moves the cursor to the left most character in the top line (line 1).
6. Sets the address counter to increment on each access of DD RAM or CG RAM.

7.3 Cursor Home

```
DB7 DB6 DB5 DB4 DB3 DB2 DB1 DB0
0 0 0 0 0 0 0 1 02H to 03H
```

RS=0

*: don't care

This instruction.
1. Clears the contents of the address counter to 0H.
2. Sets the address counter to point to the DDRAM.
3. Sets the display for zero character shift.
4. If the cursor is displayed, moves the left most character in the top line (line 1).

7.4 Entry Mode Set

```
DB7 DB6 DB5 DB4 DB3 DB2 DB1 DB0
0 0 0 0 0 0 1 I/D S 04H to 07H
```

RS=0

The I/D bit selects the way in which the contents of the address counter are modified after every access to DDRAM or CGRAM.
I/D=1: The address counter is incremented.
I/D=0: The address counter is decremented.

The S bit enables display shift, instead of cursor shift, after each write or read to the DDRAM.
S=1: Display shift enabled.
S=0: Cursor shift enabled.

The direction in which the display is shifted is opposite in sense to that of the cursor. For example if S=0 and I/D=1, the cursor would shift one character to the right after a CPU writes to DD RAM. However if S=1 and I/D=1, the display would shift one character to the left and the cursor would maintain its position on the panel.

The cursor will already be shifted in the direction selected by I/D during reads of the DD RAM, irrespective of the value of S. Similarly, reading and writing the CG RAM always shifts the cursor. Also both lines are shifted simultaneously.

<table>
<thead>
<tr>
<th>Cursor move</th>
<th>Display shift by the &quot;Entry Mode Set&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>I/D</td>
<td>S</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

7.5 Display ON/OFF

```
DB7 DB6 DB5 DB4 DB3 DB2 DB1 DB0
0 0 0 0 0 1 0 08H to 0FH
```

RS=0

This instruction controls various features of the display.
The D bit turns the entire display on or off.
D=1: Display on
D=0: Display off

Note: When display is turned off, power converter also inhibited and reduce a power consumption.

The C bit turns the cursor on or off.
C=1: Cursor on
C=0: Cursor off

The B bit enables blinking of the character the cursor coincides with.
B=1: Blinking on
B=0: Blinking off

Blinking is achieved by alternating between a normal and all on display of a character. The cursor blinks with a frequency of about 1.1 Hz and DUTY 50%.
7.6 Cursor/Display Shift

<table>
<thead>
<tr>
<th>S/C</th>
<th>R/L</th>
<th>Cursor shift</th>
<th>Display shift</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>Move one character to the left</td>
<td>No shift</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>Move one character to the right</td>
<td>No shift</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>Shift one character left with display</td>
<td>Shift one character to the left</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>Shift one character right with display</td>
<td>Shift one character to the right</td>
</tr>
</tbody>
</table>

This instruction shifts the display and/or moves the cursor, on character to the left or right, without reading or writing DD RAM. The S/C bit selects movement of the cursor or movement of both the cursor and the display.

- S/C=1: Shift both cursor and display
- S/C=0: Shift cursor only

The R/L bit selects left or right movement of the display and/or cursor.
- R/L=1: Shift one character right
- R/L=0: Shift one character left

This instruction initializes the system, and must be the first instruction executed after power-on. The IF bit selects between an 8-bit or a 4-bit bus width interface.

7.7 Function Set

This command sets width of data bus line by itself, and sets screen brightness by following one byte data.

7.7.1 Function Set Command

<table>
<thead>
<tr>
<th>DB7</th>
<th>DB6</th>
<th>DB5</th>
<th>DB4</th>
<th>DB3</th>
<th>DB2</th>
<th>DB1</th>
<th>DB0</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>1</td>
<td>IF</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

This instruction initializes the system, and must be the first instruction executed after power-on. The IF bit selects between an 8-bit or a 4-bit bus width interface.

7.7.2 Brightness Control

One byte data (RS = 1) which follows the 'Function Set Command' is considered as brightness data. When a command (RS = 0) is written after the 'Function Set Command', the brightness control function is not initiated. Screen brightness is as follows:

<table>
<thead>
<tr>
<th>BR1</th>
<th>BR0</th>
<th>Brightness</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>100 % (Default)</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>75 %</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>50 %</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>25 %</td>
</tr>
</tbody>
</table>

7.8 Set CG RAM Address

<table>
<thead>
<tr>
<th>DB7</th>
<th>DB6</th>
<th>DB5</th>
<th>DB4</th>
<th>DB3</th>
<th>DB2</th>
<th>DB1</th>
<th>DB0</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>ACG</td>
</tr>
</tbody>
</table>

This instruction
1. Loads a new 8-bit address into the address counter.
2. Sets the address counter to address CG RAM.

Once 'Set CG RAM Address' has been executed, the contents of the address counter will be automatically modified after every access of CG RAM, as determined by the '7.4 Entry Mode Set' instruction. The active width of the address counter, when it is addressing CG FAM, is 6-bits so the counter will wrap around to 00H from 3FH if more than 64 bytes of data are written to CG RAM.

7.9 Set DD RAM Address

<table>
<thead>
<tr>
<th>DB7</th>
<th>DB6</th>
<th>DB5</th>
<th>DB4</th>
<th>DB3</th>
<th>DB2</th>
<th>DB1</th>
<th>DB0</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>ADD</td>
</tr>
</tbody>
</table>

This instruction
1. Loads a new 7-bit address into the address counter.
2. Sets the address counter to point to the DD RAM.
7.10 Write Data

<table>
<thead>
<tr>
<th>DB7</th>
<th>DB6</th>
<th>DB5</th>
<th>DB4</th>
<th>DB3</th>
<th>DB2</th>
<th>DB1</th>
<th>DB0</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**DATA WRITE**

00H to FFH

RS=1

This instruction writes the data in DB7 to DB0 into either the CG RAM or the DD RAM. The RAM space (CG or DD), and the address in that space, that is accessed depends on whether a "Set CG RAM Address" or a "Set DD RAM Address" instruction was last executed, and on the parameters of that instruction. The contents of the address counter will be automatically modified after each Write Data, as determined by the '7.4 Entry Mode Set'. When data is written to the CG RAM, the DB7, DB6 and DB5 bits are not displayed as characters.

7.11 Read Data

<table>
<thead>
<tr>
<th>DB7</th>
<th>DB6</th>
<th>DB5</th>
<th>DB4</th>
<th>DB3</th>
<th>DB2</th>
<th>DB1</th>
<th>DB0</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**DATA READ**

RS=1

This instruction reads data from either CG RAM or DD RAM, depending on the type of "Set RAM Address" instructions last sent. The address in that space depends on the "Set RAM Address" instructions parameters. Immediately before executing "Read Data", "Set CG RAM Address" or "Set DD RAM Address" must be executed. The contents of the address counter are modified after each "Read Data", as determined by the '7.4 Entry Mode Set'. Display shift is not executed, as described at of the '7.4 Entry Mode Set'.

7.12 Read Busy Flag/Address Counter

<table>
<thead>
<tr>
<th>DB7</th>
<th>DB6</th>
<th>DB5</th>
<th>DB4</th>
<th>DB3</th>
<th>DB2</th>
<th>DB1</th>
<th>DB0</th>
</tr>
</thead>
<tbody>
<tr>
<td>BF</td>
<td>ACC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

RS=0

Reading the instruction register yields the current value of the address counter and the busy flag. This instruction must be executed prior to any other instructions. ACC, the address counter value, will be pointed to a location in either CG RAM or DD RAM, depending on the type of "Set RAM Address" instruction last sent. In "Busy Flag Check" immediately after executing "Write Data" instruction, a valid address counter value can be ready as soon as BF goes low. The BF bit shows the status of the busy flag.

BF = 1: busy
BF = 0: ready for next instruction/command receivable.

8 Other Features

8.1 CG RAM

The display module equips CG RAM as user's are 320 bit = (5 x 8 bit /char) x 8 chars of store etc. user definable character fonts. The character fonts consists of 8 x 7 dots with underline. The number 1 ~ 96 corresponds to character fonts.

<table>
<thead>
<tr>
<th>Character code</th>
<th>CG RAM address</th>
<th>CG RAM data (character pattern)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DB7</td>
<td>DB6</td>
<td>DB5</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Character code</th>
<th>CG RAM address</th>
<th>CG RAM data (character pattern)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DB7</td>
<td>DB6</td>
<td>DB5</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

REMARKS: *: Don't care   0: Turned off   1: Turned on.
8.2 Power-on reset

Internal status of the module is initialized, when controller detects rising power supply up. The status are as follows:

1. Display Clear
   - Fill the DD RAM with 20Hex (Space code).
   - During executing of "Display Clear" (Max 410 internal clock), the busy flag (BF) is "1".

2. Set the address counter to 0H.
   - Sets the address counter to point the DD RAM.

3. Display ON/OFF
   - D=0: Display OFF
   - C=0: Cursor OFF
   - B=0: Blink OFF

4. Entry Mode Set
   - I/D = 1: Increment (+1)
   - S=0: No display shift

5. Function Set
   - IF=1: 8-bit interface

6. Brightness Control
   - BR0 = BR1 = 0: 100%

- Remarks
  - There is a possibility that reset doesn’t work by slow start power supply causes.
  - Therefore the initializing by commands needs.
12. Initialization of LCM

The LCM automatically initializes (reset) when power is turned on using the internal reset circuit. If the power supply conditions for correctly operating the internal reset circuit are not met, initialization by instruction is required. Use the procedure in next page for initialization.

**Internal Power Supply reset**

<table>
<thead>
<tr>
<th>Item</th>
<th>Symbol</th>
<th>Test condition</th>
<th>Limit (Min.)</th>
<th>Limit (Max.)</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power supply rise time</td>
<td>$\text{trcc}^*$</td>
<td>--</td>
<td>0.1 ms</td>
<td>10 ms</td>
<td></td>
</tr>
<tr>
<td>Power supply off time</td>
<td>$\text{toff}^*$</td>
<td>--</td>
<td>1 ms</td>
<td>1 ms</td>
<td></td>
</tr>
</tbody>
</table>

(Note 1) $\text{trcc}^*$ and $\text{toff}^*$ are required for momentary power supply dip or when power supply cycles ON and OFF.

(Note 2) $\text{toff}$ is the time of power OFF for momentary power supply dip or when power supply cycles ON and OFF.

---

10. Characters addresses

<table>
<thead>
<tr>
<th>Line</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
<th>16</th>
<th>17</th>
<th>18</th>
<th>19</th>
<th>20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Line 1</td>
<td>00</td>
<td>01</td>
<td>02</td>
<td>03</td>
<td>04</td>
<td>05</td>
<td>06</td>
<td>07</td>
<td>08</td>
<td>09</td>
<td>10</td>
<td>11</td>
<td>12</td>
<td>13</td>
<td>14</td>
<td>15</td>
<td>16</td>
<td>17</td>
<td>18</td>
<td>19</td>
</tr>
<tr>
<td>Line 2</td>
<td>00</td>
<td>01</td>
<td>02</td>
<td>03</td>
<td>04</td>
<td>05</td>
<td>06</td>
<td>07</td>
<td>08</td>
<td>09</td>
<td>10</td>
<td>11</td>
<td>12</td>
<td>13</td>
<td>14</td>
<td>15</td>
<td>16</td>
<td>17</td>
<td>18</td>
<td>19</td>
</tr>
<tr>
<td>Line 3</td>
<td>00</td>
<td>01</td>
<td>02</td>
<td>03</td>
<td>04</td>
<td>05</td>
<td>06</td>
<td>07</td>
<td>08</td>
<td>09</td>
<td>10</td>
<td>11</td>
<td>12</td>
<td>13</td>
<td>14</td>
<td>15</td>
<td>16</td>
<td>17</td>
<td>18</td>
<td>19</td>
</tr>
<tr>
<td>Line 4</td>
<td>00</td>
<td>01</td>
<td>02</td>
<td>03</td>
<td>04</td>
<td>05</td>
<td>06</td>
<td>07</td>
<td>08</td>
<td>09</td>
<td>10</td>
<td>11</td>
<td>12</td>
<td>13</td>
<td>14</td>
<td>15</td>
<td>16</td>
<td>17</td>
<td>18</td>
<td>19</td>
</tr>
</tbody>
</table>

11. Timing Control

11.1 Write and Read Operation

**Write Operation**

**Read Operation**

<table>
<thead>
<tr>
<th>Item</th>
<th>Symbol</th>
<th>Limit (Min.)</th>
<th>Limit (Max.)</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enable Cycle Time</td>
<td>$\text{ECCY}$</td>
<td>1000</td>
<td>--</td>
<td>ms</td>
</tr>
<tr>
<td>Enable Pulse Width (High level)</td>
<td>$\text{PWEL}$</td>
<td>450</td>
<td>--</td>
<td>ms</td>
</tr>
<tr>
<td>Enable Rise/Fall Time</td>
<td>$\text{ERF}$</td>
<td>25</td>
<td>--</td>
<td>ms</td>
</tr>
<tr>
<td>Address Set-Up Time (Rs, RW, W)</td>
<td>$\text{AS}$</td>
<td>10</td>
<td>--</td>
<td>ns</td>
</tr>
<tr>
<td>Data Set-Up Time</td>
<td>$\text{DSW}$</td>
<td>100</td>
<td>--</td>
<td>ns</td>
</tr>
<tr>
<td>Data Hold Time</td>
<td>$\text{DHB}$</td>
<td>20</td>
<td>--</td>
<td>ns</td>
</tr>
</tbody>
</table>

11.2 Busy flag check timing

Busy flag is checked after instructions are completed. If busy flag isn't checked, the waiting time between instructions should be longer than execution time of these instructions.
IMPORTANT PRECAUTIONS

* All VFD Modules contain MOS LSI. Anti-Static handling procedures are always required. Tools required for assembly, such as soldering irons, must be properly grounded.

* VF Display consists of Soda-lime glass. Heavy shock more than 10G, thermal shock greater than 10°C/minute, direct hit with hard material to the glass surface -- especially to the EXHAUST PIPE -- may CRACK the glass.

* Do not PUSH the display strongly. At mounting to the system frame, slight gap between display glass face and front panel is necessary to avoid a contact failure of lead pins of display. Twist or warp mounting will make a glass CRACK around the lead pin of display.

* Neither DATA CONNECTOR or POWER CONNECTOR should be connected or disconnected while power is applied. As is often the case with most subsystems, caution should be exercised in selectively disconnecting power within a computer based system. The modules receive high logic on strobe lines as random signals on all data ports. Removal of primary power with logic signals applied may damage input circuitry.

* Stress more than specification listed under the Absolute Maximum Ratings may cause PERMANENT DAMAGE of the modules.

* +5 volts power line must be regulated completely since all control logics depend on this line. Do not apply slow-start power. Provide sufficient output current power source to avoid trouble of RUSH CURRENT at power on. (At least output current of double figure of Icc, listed on the specification of each module, is required.)

* Data cable length between module and host system is recommended within 300 mm to be free from a miss-operation caused by noise.

* Do not place the module on the conductive plate just after the power off. Due to big capacities on the module, more than 1 min. of discharging time is required to avoid the failure caused by shorting of power line.

* 2 hours pre-running with the test mode operation may help the stability of the brightness of the VFO when power was not applied more than 2 months.

* Steady repeating of a fixed (static) message displaying, longer than 5 hours in a day may cause the phosphor burn-out problem. An automatic shut down Programming, scrolling message using DC2 mode or 2 hours test mode operation during the idling of the host is recommended.
Dot Graphic VFD Module

GU140x16G-7806

- 140x16 Dot Graphic (2x20 characters)
- Single 5V Supply
- High Brightness Blue Green Display
- Operating Temp: -40°C to +85°C
- 3 Multi Sized Fonts
- 4/8 Bit Parallel LCD & Serial Interfaces

The module includes the Vacuum Fluorescent Display glass, VF drivers and micro-controller ICs with refresh RAM, character generator and interface logic. The 4/8 bit parallel & serial bi-directional interfaces are 5V TTL/CMOS compatible. The command set is LCD compatible with extended graphic functions.

**ELECTRICAL SPECIFICATION**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Value</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Supply Voltage</td>
<td>VCC</td>
<td>5.0VDC ±10%</td>
<td>GND=0V</td>
</tr>
<tr>
<td>Power Supply Current</td>
<td>ICC</td>
<td>≤ 250mA</td>
<td>VCC=5V</td>
</tr>
<tr>
<td>Logic High Input</td>
<td>VIL</td>
<td>0.6VDC min.</td>
<td>VCC=5V</td>
</tr>
<tr>
<td>Logic Low Input</td>
<td>VIH</td>
<td>0.8VDC max.</td>
<td>VCC=5V</td>
</tr>
<tr>
<td>Logic High Output</td>
<td>VOH</td>
<td>3.5VDC max.</td>
<td>VCC=5V</td>
</tr>
<tr>
<td>Logic Low Output</td>
<td>VOL</td>
<td>0.8VDC min.</td>
<td>VCC=5V</td>
</tr>
</tbody>
</table>

**OPTICAL and ENVIRONMENTAL SPECIFICATIONS**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Display Area (XxY mm)</td>
<td>69.85 x 11.45</td>
</tr>
<tr>
<td>Dot Size/Pitch (XxY mm)</td>
<td>0.35 x 0.575</td>
</tr>
<tr>
<td>Luminance</td>
<td>700 cd/m² Typ.</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>-40°C to +85°C</td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>-40°C to +85°C</td>
</tr>
<tr>
<td>Operating Humidity</td>
<td>20 to 90% RH</td>
</tr>
</tbody>
</table>

**SOFTWARE COMMAND SUMMARY**

**CON1 – SERIAL INTERFACE**

<table>
<thead>
<tr>
<th>Pin</th>
<th>Sig</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>GND</td>
<td>VCC</td>
</tr>
<tr>
<td>2</td>
<td>VCC</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>NC</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>RS</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>R/W</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>E</td>
<td>(IND)</td>
</tr>
<tr>
<td>7</td>
<td>D0</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>D1</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>D2</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>D3</td>
<td></td>
</tr>
</tbody>
</table>

**CON2 – PARALLEL INTERFACE**

<table>
<thead>
<tr>
<th>Pin</th>
<th>Sig</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>RS</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>NC</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>NC</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>NC</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>NC</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>NC</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>NC</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>NC</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>NC</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>NC</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>NC</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>NC</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>NC</td>
<td>Do Not Connect</td>
</tr>
<tr>
<td>14</td>
<td>NC</td>
<td></td>
</tr>
</tbody>
</table>

**SERIAL/PARALLEL SELECTION**

*JF* | Interface | Link |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>J0</td>
<td>Parallel (default)</td>
<td>Serial</td>
</tr>
</tbody>
</table>

**CON3 – PARALLEL INTERFACE**

<table>
<thead>
<tr>
<th>Pin</th>
<th>Sig</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>GND</td>
<td>VCC</td>
</tr>
<tr>
<td>2</td>
<td>VCC</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>NC</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>RS</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>RS</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>RS</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>RS</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>NC</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>NC</td>
<td></td>
</tr>
</tbody>
</table>
SOFTWARE COMMANDS

<table>
<thead>
<tr>
<th>Instruction</th>
<th>Data Format (RS = 1)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data Write</td>
<td>FFH</td>
<td>Write user defined character 1-8 to the current cursor location on the display.</td>
</tr>
<tr>
<td>Data Write</td>
<td>F0H – FFH</td>
<td>Write data to the display. In normal (LCD compatible) mode of operation, data is written to the display data (DD RAM) or character generator (CG RAM). When using the graphical data commands (F0H, F1H &amp; F2H), data is written directly to the display and is not stored in DD RAM. Data write busy times will increase when using the graph-related functions.</td>
</tr>
</tbody>
</table>

Instruction Data Format (RS = 0) Description

<table>
<thead>
<tr>
<th>Instruction</th>
<th>Data Format (RS = 0)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Display Clear</td>
<td>01H</td>
<td>Fills all positions in the display data (DD RAM) with 00H (blank character). The address counter is set to 0 in the DD RAM. The address counter is set to increment on each data read/write. Any display offset (using the display shift command) is removed.</td>
</tr>
<tr>
<td>Cursor Home</td>
<td>02H</td>
<td>The address counter is set to 0 in the DD RAM. Any display offset (using the display shift command) is removed.</td>
</tr>
<tr>
<td>Entry Mode</td>
<td>04H – 07H</td>
<td>Bit 1 is used to select the direction of the address counter on each data read or write. If set to ‘1’, the address counter is incremented. If set to ‘0’, the address counter is decremented. Bit 0 enables the display to shift on each data read/write. If this bit is set to ‘1’, the display is shifted with the cursor. The display shift direction depends upon the address counter direction (01H). If this is set to increment, the display is shifted left, if the address counter is set to decrement, the display is shifted right.</td>
</tr>
<tr>
<td>Display Control</td>
<td>08H–0FH</td>
<td>Enables 8-bit communications. Data is received on DB0-DB7. The most significant nibble should be sent first.</td>
</tr>
<tr>
<td>Display Shift Left Right Shift Left Right</td>
<td>0AH</td>
<td>Shift the display left, one character position.</td>
</tr>
<tr>
<td>Display Shift Left Right</td>
<td>10H</td>
<td>Shift the display right, one character position.</td>
</tr>
<tr>
<td>Select 4 bit interface</td>
<td>20H + lum</td>
<td>Enables 4-bit communications. Data is received on DB4-DB7 only. Two writes are required to send one data byte. The most significant nibble should be sent first. The lum value sets the displays brightness. 00H = full brightness, 01H = 75%, 02H = 50% &amp; 03H = 25%.</td>
</tr>
<tr>
<td>Select 8 bit interface</td>
<td>00H + lum</td>
<td>Enables 8-bit communications. Data is received on DB0-DB7. The lum value sets the display brightness, 00H = full brightness, 01H = 75%, 02H = 50% &amp; 03H = 25%.</td>
</tr>
<tr>
<td>Set CG Address</td>
<td>40H – 7FH</td>
<td>Set the character generator address (CG RAM). All written data is placed within the user definable character area.</td>
</tr>
<tr>
<td>Set DD Address</td>
<td>80H – E7H</td>
<td>Set the display data address (DD RAM). 80H – 8FH = top line. C0H – CFF = bottom line.</td>
</tr>
<tr>
<td>Set Graphic Cursor</td>
<td>00H + xpos + ypos</td>
<td>Set the absolute cursor position. xpos = 0 – 139, ypos = 0 – 15. Co-ordinates should be written with RS line set high.</td>
</tr>
<tr>
<td>Set Font</td>
<td>2H + font</td>
<td>Select font type, font size and font spacing. Font commands: - ’A’ or ’a’ = proportional 64 character mini-font. ’B’ = 5x7 LCD compatible font with Katakana characters. ’C’ = 10x14 LCD compatible font with Katakana characters. ’b’ = 5x7 international font with European characters. ’c’ = 10x14 international font with European characters. ’1’ = set the inter-character pixel spacing to 1 pixel. ’2’ = set the inter-character pixel spacing to 2 pixels. Font command should be written with RS line set high.</td>
</tr>
</tbody>
</table>

Instruction Data Format Additional Serial Data Commands

<table>
<thead>
<tr>
<th>Instruction</th>
<th>Data Format (RS = 1)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Set RS Low</td>
<td>FFH</td>
<td>Set the RS line low for the following byte only. Used in serial communications only.</td>
</tr>
<tr>
<td>Read Cursor Position</td>
<td>FFH</td>
<td>Read current cursor position. This command is used with serial communications only.</td>
</tr>
</tbody>
</table>

Notes: - 1. When display shift is enabled, the data write busy time can increase by 200us. |
2. If the cursor is enabled, busy times can increase by 25us. |
3. After these commands are executed, the cursor will be disabled and any character data will be written to the display only, and not the DD RAM. Any subsequent LCD compatible command will re-enable the cursor and allow for DD RAM writing. 

GRAPHICAL DATA WRITES
PARALLEL COMMUNICATION

This module has a fast latching 8-bit data bus. Data is clocked in on the rising edge of the enable line 'E'. The busy line can be monitored on pin 3 if link J6 is set to 2&3. The data bus width can be selected for 4-bit operation, this is set-up using the 'Function Set' software command. When using 4-bit mode, use data lines D4-D7 only. Data should be clocked first with the high nibble (bits 4-7) followed by the low nibble (bits 0-3).

ASYNCHRONOUS SERIAL COMMUNICATION

Asynchronous & synchronous serial interfaces are provided at TTL level. Link J8 on the rear of the module to enable the serial communications. When using serial communications, the module is automatically initialised at power-up/reset with the cursor enabled. Jumper links J8 and J9 are used to select synchronous serial mode or asynchronous baud rate & parity.

The host busy line (HB) stops the module from sending data to the host. The use of the HB and MB lines are optional, and can be connected together if not required.

SYNCHRONOUS SERIAL COMMUNICATION

With synchronous communications enabled, data can be clocked into the VFD module on the rising edge of SCK, with the MSB sent first. The host must provide adequate delays for the module to process the data, these busy times are specified in the software command section. Alternatively the host can monitor the MB (Module Busy) line.

The /SS pin can be used as an enable pin if other devices are connected to the serial line, and also allows byte synchronisation. The use of the /SS line is optional, and can be permanently pulled low if required.
Dot Graphic VFD Module GU140x16G-7806

SERIAL CONTROL
An additional command has been included to distinguish between command and data writes when using serial communications. This command (0FH) will temporarily set the RS line low for the subsequent written byte. The following example displays two text messages using the serial communications and the ‘Set RS’ command:

- 0FH 01H NORITAKE ITRON
- 0FH 08H 07H VFD MODULES

LCD COMPATIBILITY
This module features a command set that is LCD compatible, allowing easy replacement in existing equipment with little or no modifications. Careful consideration should be taken regarding the command execution times of this module. Although the commands can be executed within 40us, which is normal for LCD, busy times are increased when using the scroll write modes and with the cursor enabled. Also reading back data in 4-bit parallel mode is not supported. DD RAM address locations 70H+ are used to access the extended graphic commands.

At power up and reset the module is automatically initialised and ready to receive data. The interface is set to 8-bit, the display is cleared, the cursor position is set to the top-left corner (DD RAM address = 00H), and the display luminance is set to 100%.

EXTENDED GRAPHIC COMMANDS
In addition to the standard LCD commands, this module includes additional commands to display graphical data and different font sizes. When any of these extended commands are executed, the module will change to the ‘graphics’ mode of operation. This graphics mode allows text to be written to any part of the display.

There are many differences the user should be aware of when the display is in this graphics mode:

- Written data may require additional busy times.
- Text data is not written into the DD RAM and therefore can not be read back.
- Graphical text can not be shifted onto the display.
- The cursor is disabled & cursor direction is set to increment only.
- UDF characters cannot be written.

The graphics mode is disabled as soon as any valid LCD command is received.

DISPLAYING GRAPHICAL TEXT
The module contains 3 font sizes, a proportional mini-font, 5x7 pixel, and a 10x14 pixel font. Graphical text can be written to any part of the display using the ‘Set Graphic Cursor’ command (F0H). Characters are positioned above the current cursor position. Each character written will include either a one pixel or two pixel space to the right side of the character. After each character is written to the display, the cursor position is automatically advanced. If the cursor position reaches the end of the display, the host must reposition to the next line.

The following example displays two text messages in the center of the display using the standard 5x7 character font. Command bytes that are underlined should be sent with RS line low.

- F2H ‘B’ F0H 1FH 07H NORITAKE ITRON
- F0H 1FH 0FH VFD MODULES

The next example displays one line of text using the 10x14 character font. Command bytes that are underlined should be sent with RS line low.

- F2H ‘C’ F0H 22H 0FH 140x16
DISPLAYING GRAPHICS

Graphical images can be displayed on the VFD module in either a horizontal or vertical byte orientation. After each graphical data write, the cursor is automatically advanced. All graphical data is contained within the defined area. Unused bits are masked where the screen area is not a byte multiple.

The following example displays a simple graphical image. The graphical data orientation is set to horizontal data format, with a vertical cursor movement. Command bytes that are underlined should be sent with RS line low.

```
F1H 30H 04H 37H 0BH 'h' 1CH 5CH 48H 3EH 1DH 1DH 14H 36H
```

The next example displays a simple graphical image using a vertical data format, with a horizontal cursor movement. Command bytes that are underlined should be sent with RS line low.

```
F1H 50H 00H 63H 0FH 'v' 00H 00H 00H 00H 07H 04H C7H FEH 72H 73H 32H 3EH 3FH 1DH 00H 00H 00H 07H 04H C7H C7H FEH 72H 73H
```

AREA COMMANDS

The VFD module contains commands to fill, clear and invert defined areas of the display. Also an outline command is available to draw rectangles around objects.

The following example displays a simple graphical image. The graphical data orientation is set to horizontal data format, with a vertical cursor movement. Command bytes that are underlined should be sent with RS line low.

```
F1H 30H 04H 37H 0BH 'h' 1CH 5CH 48H 3EH 1DH 1DH 14H 36H
```

The next example displays a simple graphical image using a vertical data format, with a horizontal cursor movement. Command bytes that are underlined should be sent with RS line low.

```
F1H 50H 00H 63H 0FH 'v' 00H 00H 00H 00H 07H 04H C7H FEH 72H 73H 32H 3EH 3FH 1DH 00H 00H 00H 07H 04H C7H C7H FEH 72H 73H
```

The next example uses the invert area command to select one of the options.

```
F1H 50H 01H 7DH 0BH 'i'
```

The next example displays three options for the user to select, each option is contained within a box with a shadow effect. Drawing horizontal and vertical lines using the fill area command creates the shadow effect. Command bytes that are underlined should be sent with RS line low.

```
F1H 0AH 02H 2CH 0CH 'O'
F1H 33H 02H 55H 0CH 'O'
F1H 5CH 02H 7EH 0CH 'O'
```

The next example uses the invert area command to select one of the options.
Dot Graphic VFD Module

GU140x32F-7806

The module includes the Vacuum Fluorescent Display glass, VF drivers and micro-controller ICs with refresh RAM, character generator and interface logic. The 4/8 bit parallel & serial bi-directional interfaces are 5V TTL/CMOS compatible. The command set is LCD compatible with extended graphic functions.

CON2 – SERIAL INTERFACE

CON1/3 – PARALLEL INTERFACE

ELECTRICAL SPECIFICATION

Software Command Summary

Character Set

Font Selection

Serial/Parallel Selection

CONTACT

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Chicago USA: +1-847-439-9020
Itron UK: +44 (0)1493 601144
Rest Europe: +49 (0)61-0520-9220

Dimensions in mm & subject to tolerances.
Mounting holes 3.2 mm dia.

Subject to change without notice.

IUK Doc Ref: 04135 Iss:3 19FEB03

Copyright 2003 Nortake Itron Corp. Japan
SOFTWARE COMMANDS

**Instruction** | **Data Format (RS = 1)** | **Description**
--- | --- | ---
Data Write | 00H – FFH | Write user defined character 1-8 to the current cursor location on the display.

**Instruction** | **Data Format (RS = 0)** | **Description**
--- | --- | ---
Display Clear | 01H | Puts all locations in the display data (DD RAM) with 2OH (blank character). The address counter is set to 0 in the DD RAM. The address counter is set to increment on each data read/write. Any display offset (using the display shift command) is removed.

**Instruction** | **Data Format**
--- | ---
Cursor Home | 02H | The address counter is set to 0 in the DD RAM. Any display offset (using the display shift command) is removed.

**Instruction** | **Data Format**
--- | ---
Select 8 bit interface | 20H + lum | Enables 8-bit communications. Data is received on DB4-DB7 only. Two writes are required to send one data byte. The most significant nibble should be sent first.

**Instruction** | **Data Format**
--- | ---
Select 4 bit interface | 04H + lum | Enables 4-bit communications. Data is received on DB4-DB7 only. Two writes are required to send one data byte. The most significant nibble should be sent first.

**Graphical Data Writes**

1. When display shift is enabled, the data write busy time can increase by 300us.
2. If the cursor is enabled, busy times can increase by 20us.
3. After these commands are executed, the cursor will be disabled and any character data will be written to the display only, and not the DD RAM. Any subsequent LCD compatible command will re-enable the cursor and allow for DD RAM writing.

**Notes:**

- **Dot Graphic VFD Module**
- **GU140x32F-7806**
- **SOFTWARE COMMANDS**
- **Read Cursor Position FFH**
- **Read Current Cursor Position FFH**
- **Read Data 0EH**
- **Hexadecimal Values**
- **Graphical Data Commands**
- **Dot Graphic VFD Module**
- **GU140x32F-7806**
- **Graphical Data Writes**
- **Notes:**
- **1. When display shift is enabled, the data write busy time can increase by 300us.**
- **2. If the cursor is enabled, busy times can increase by 20us.**
- **3. After these commands are executed, the cursor will be disabled and any character data will be written to the display only, and not the DD RAM. Any subsequent LCD compatible command will re-enable the cursor and allow for DD RAM writing.**
**PARALLEL COMMUNICATION**

This module has a fast latching 8-bit data bus. Data is clocked in on the rising edge of the enable line 'E'. The busy line can be monitored on pin 3 if link J6 is set to 2&3.

The data bus width can be selected for 4-bit operation, this is set-up using the 'Function Set' software command. When using 4-bit mode, use data lines D4-D7 only. Data should be clocked first with the high nibble (bits 4-7) followed by the low nibble (bits 0-3).

**ASYNCHRONOUS SERIAL COMMUNICATION**

Asynchronous & synchronous serial interfaces are provided at TTL level. Link J8 on the rear of the module to enable the serial communications. When using serial communications, the module is automatically initialised at power-up/reset with the cursor enabled. Jumper links J8 and J9 are used to select synchronous serial mode or asynchronous baud rate & parity.

The host busy line (HB) stops the module from sending data to the host. The use of the HB and MB lines are optional, and can be connected together if not required.

**SYNCHRONOUS SERIAL COMMUNICATION**

With synchronous communications enabled, data can be clocked into the VFD module on the rising edge of SCK, with the MSB sent first. The host must provide adequate delays for the module to process the data, these busy times are specified in the software command section. Alternatively the host can monitor the MB (Module Busy) line.

The /SS pin can be used as an enable pin if other devices are connected to the serial line, and also allows byte synchronisation. The use of the /SS line is optional, and can be permanently pulled low if required.
Displaying Graphical Text

The module contains 3 font sizes, a proportional mini-font, 5x7 pixel, and a 10x14 pixel font. Graphical text can be written to any part of the display using the 'Set Graphic Cursor' command (F0H). Characters are positioned above the current cursor position. Each character written will include either a one pixel or two pixel space to the right side of the character. After each character is written to the display, the cursor position is automatically advanced. If the cursor position reaches the end of the display, the host must reposition to the next line.

The following example displays two text messages in the center of the display using the standard 5x7 character font. Command bytes that are underlined should be sent with RS line low.

```
F2H  'B' F0H 0FH 'NORITAKE ITRON'
F0H 1FH 17H 'VFD MODULES'
```

DISPLAYING GRAPHICAL TEXT

The next example displays one line of text using the 10x14 character font. Command bytes that are underlined should be sent with RS line low.

```
F2H 'C' F0H 22H 17H '140x32'
```

LCD COMPATIBILITY

This module features a command set that is LCD compatible, allowing easy replacement in existing equipment with little or no modifications. Careful consideration should be taken regarding the command execution times of this module. Although the commands can be executed within 40us, which is normal for LCD, busy times are increased when using the scroll write modes and with the cursor enabled. Also reading back data in 4-bit parallel mode is not supported. DD RAM address locations 70H+ are used to access the extended graphic commands.

At power up and reset the module is automatically initialised and ready to receive data. The interface is set to 8-bit, the display is cleared, the cursor position is set to the top-left corner (DD RAM address = 00H), and the display luminance is set to 100%.

EXTENDED GRAPHIC COMMANDS

In addition to the standard LCD commands, this module includes additional commands to display graphical data and different font sizes. When any of these extended commands are executed, the module will change to the ‘graphics’ mode of operation. This graphics mode allows text to be written to any part of the display.

There are many differences the user should be aware of when the display is in this graphics mode: -

- Written data may require additional busy times.
- Text data is not written into the DD RAM and therefore cannot be read back.
- Graphical text cannot be shifted onto the display.
- The cursor is disabled & cursor direction is set to increment only.
- UDF characters cannot be written.

The graphics mode is disabled as soon as any valid LCD command is received.

SERIAL CONTROL

An additional command has been included to distinguish between command and data writes when using serial communications. This command (0FH) will temporarily set the RS line low for the subsequent written byte. The following example displays two text messages using the serial communications and the ‘Set RS’ command -

```
0FH 01H 'NORITAKE ITRON'
0FH C0H 'VFD MODULES'
```

DISPLAYING GRAPHICAL TEXT

The following example displays two text messages in the center of the display using the standard 5x7 character font. Command bytes that are underlined should be sent with RS line low.

```
F2H 'B' F0H 0FH 'NORITAKE ITRON'
F0H 1FH 17H 'VFD MODULES'
```

DISPLAYING GRAPHICAL TEXT

The following example displays two text messages in the center of the display using the standard 5x7 character font. Command bytes that are underlined should be sent with RS line low.

```
F2H 'B' F0H 0FH 'NORITAKE ITRON'
F0H 1FH 17H 'VFD MODULES'
```

DISPLAYING GRAPHICAL TEXT

The next example displays one line of text using the 10x14 character font. Command bytes that are underlined should be sent with RS line low.

```
F2H 'C' F0H 22H 17H '140x32'
```
DISPLAYING GRAPHICS

Graphical images can be displayed on the VFD module in either a horizontal or vertical byte orientation. After each graphical data write, the cursor is automatically advanced. All graphical data is contained within the defined area. Unused bits are masked where the screen area is not a byte multiple.

The following example displays a simple graphical image. The graphical data orientation is set to horizontal data format, with a vertical cursor movement. Command bytes that are underlined should be sent with RS line low.

```
F1H 50H 08H 63H 17H 'v' 00H 00H 00H 00H 07H 04H C7H FEH 72H 73H 32H 3EH 3FH 1DH 00H 00H 00H 00H 00H 00H 00H 3CH 42H 81H B9H C1H 42H 7CH 20H D8H FCH 3CH FCH CAH 49H B1H 89H 42H 3CH 00H
```

The next example displays a simple graphical image using a vertical data format, with a horizontal cursor movement. Command bytes that are underlined should be sent with RS line low.

```
F1H 30H 0CH 37H 13H 'h' 1CH 5CH 48H 3EH 1DH 1DH 14H 36H
```

AREA COMMANDS

The VFD module contains commands to fill, clear and invert defined areas of the display. Also an outline command is available to draw rectangles around objects.

The following example displays three options for the user to select, each option is contained within a box with a shadow effect. Drawing horizontal and vertical lines using the fill area command creates the shadow effect. Command bytes that are underlined should be sent with RS line low.

```
F1H 0AH 0AH 2CH 14H 'O'
F1H 33H 0AH 55H 14H 'O'
F1H 5CH 0AH 7EH 14H 'O'
F1H 0BH 15H 2DH 15H 'F'
F1H 34H 15H 56H 15H 'F'
F1H 5DH 15H 7FH 15H 'F'
```

The next example uses the invert area command to select one of the options.
APPENDIX D: INSTALLATION NOTES

LABEL INSERTION

The QTP 16P has a personalization label window where the user can put its own logo, identification code or anything else. By using a 80 g/m² paper sheet to create this label. In the following picture is shown the personalization label size express in mm. Note that in this picture the "grey part" is that one that can be read in the QTP 16P personalization window.

![Figure D1: Personalization Label Size](image1)

Note for inserting the label:

A) Unscrew the 2 black screws from the front panel (if any).

B) Take the panel out separating the back carter - frame group from the printed circuit - keyboard group. The user must press connectors on the QTP 16P to facilitate this operation.

C) Now the keyboard is ready to accept the personalization label (see figure D2).

D) Remount the panel following the previous instructions but on the back-way.

![Figure D2: Personalization Label Insertion](image2)
HOW TO FIX THE FRONT PANEL TO THE CARTER

The QTP 16P is supplied with the front panel (printed circuit - keyboard) fitted to the rear carter. If the User wants to improve the mechanical fixing between the panel and the carter, to avoid an accidental panel out-of-frame, then he/she must follow these instructions point by point:

1) Take the panel out separating the rear carter + frame group from the printed circuit + keyboard group. The User should press connectors on the QTP 16P to facilitate this operation.

2) Unscrew the 2 central screws to separate the frame from the rear carter.

3) On the front panel, in correspondence to those 2 central screws, there are 2 countersink holes which are visible only in the rear view. To get these two holes accessible, the user needs to hole the polycarbonate panel covering.

4) Remount the panel by using the two screws of point "2". They will be screwed on the front panel instead of the frontal frame.

AUXILIARY FIXING SCREW
APPENDIX E: ALPHABETICAL INDEX

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