XIAMEN OCULAR

# ITM1050-series

## SPECIFICATIONS OF TFT-LCD MODULE

This specification applies to the TFT-Module series ITM1050. This series supports the WVGA - 800(H) x 480(V) screen format and 65k colors. Furthermore the module support a lot of graphic commands, resistive touch screen, external keypad, backlight driving circuit and extended power supply.
The series ITM1050 is suited very well to realize own applications with very low expenditure in all current bus systems (8/16-bit, 3/4-wire SPI, I2C).

### Index

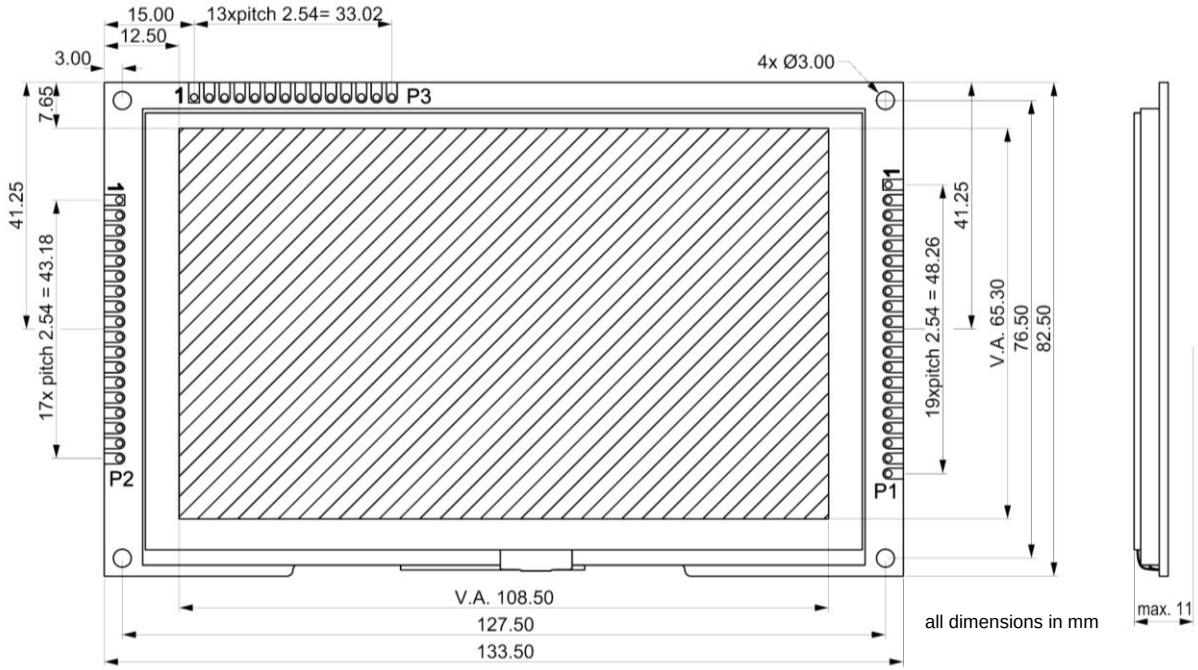
## 1. Features

| | | |
|---|---|---|
| 1. | Display format: | 800x480 dots matrix graphic (WVGA) |
| 2. | LCD controller: | RA8875 |
| 3. | Power supply: | +3.3VDC |
| 4. | Display Modes: | TFT |
| 5. | Colors: | 65k |
| 6. | Backlight: | LED-white |
| 7. | Interfaces: | 8/16-bit, SPI 3-wire/4-wire, IIC |
| 8. | General functions: | Touch control<br>Backlight control<br>Up to 20 key control<br>Graphic functions<br>Internal FONT-ROM (ISO/IEC 8859-1…8859-4) |
| 9. | Options: | Onboard DC/DC (max. 36VDC power supply)<br>Touch Screen (resistive, projective capacitive)<br>Up to 32MByte FLASH-memory on board<br>Additional Font-IC<br>Front bezel |

## 2. Mechanical Specifications

| | |
|---|---|
| **Module size** | 133.5mm(L) * 82.5mm(W) * Max11.0(H)mm |
| **Viewing area** | 108.5mm(L) * 65.3mm(W) |
| **Dot size (RGB)** | 0.135mm(L) * 0.135mm(W) |
| **Weight** | Tbd. |

## 3. Outline Dimensions




technical changes reserved

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## 4. Numbering System

**ITM1050A – TRBX – EIxxx**

(1) (2) (3) (4) (5) (6)

| | | | |
|---|---|---|---|
| (1) | **ITM** | Indicate the TFT Module products | |
| (2) | * | define series of TFT-module<br>• 1 included LCD controller only<br>• 2 included microcontroller for customer use<br>• 3 included microcontroller with interpreter (see item 6 in this table) | |
| (3) | *** | • 035 3.5” 320x240<br>• 043 4.3” 480x272<br>• 050 5.0” 800x480<br>• 056 5.6” 640x480<br>• 057 5.7” 320x240<br>• 060 6.0” 800x480<br>• 064 6.4” 640x480<br>• 070 7,0” 800x480<br>• 085 8.5” 800x480<br>• 102 10.2” 800x480 | |
| (4) | **Ax ~ Zx** | | Series No. |
| (5) | **TR** | with Touch Screen resistive | Extensions |
| | **TC** | with Touch Screen capacitive | |
| | **TP** | with Touch Screen projective capacitive | |
| | **DC** | with optional onboard power supply (max 36.0VDC) | |
| | **M16** | with additional onboard Memory 16MByte | |
| | **M32** | with additional onboard Memory 32MByte | |
| | **F** | additional font-IC (contact IbS Sperling) | |
| | **B** | with front bezel | |
| | **X** | for further options | |
| (6) | **EI000-999** | module series with extended intelligence and additional modules, such like:<br>• digital I/O-modules<br>• analog I/O-modules<br>• Interfaces (USB, RSxxx, CAN, Fast SPI,…)<br>• WEBserver<br>• Camera<br>• WLAN,… | Extensions |

## 5. Absolute Maximum Ratings

| Item | Symbol | Standard | | | Unit |
|---|---|---|---|---|---|
| Power voltage | VDD-VSS | 0 | - | 3.6 | V |
| Input voltage | VIN | VSS | - | VDD | |
| Operating temperature range | TOP | -20 | - | +70 | °C |
| Storage temperature range | TST | -30 | - | +80 | |

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DC characteristics

| Item | | Symbol | Condition | Standard value | | | Unit |
|---|---|---|---|---|---|---|---|
| | | | | Min. | Typ. | Max. | |
| Supply voltage for | Logic | $V_{DD} – V_{SS}$ | Ta =25°C VDD=3.3V | 3.0 | 3.3 | 3.6 | V |
| Supply current for | Logic | $I_{DD}$ | | - | tbd | | mA |
| Input voltage | | H: level | | 0.8VDD | VDD | - | V |
| Output voltage | L: level | $V_{IL}$ | | 0 | - | GND +0.4 | |
| | H: level | $V_{OH}$ | | 0.8x VDD | - | VDD | |

## 6. Interface Pin Description (see also Page 7/24)

Interface connector P1 (standard interface)

| Pin No. | Symbol | External connection | Function |
|---|---|---|---|
| 1 | UIN | Power supply | Power supply (+3.3VDC) for logic for LCM (see also options-DC) |
| 2 | GND | | Signal ground for LCM (GND) |
| 3 | A0 | MPU | Register select |
| 4 | /WR | MPU | Write enable signal |
| 5 | /RD | MPU | Read enable signal |
| 6 | GND | Power supply | Signal ground for LCM (GND) |
| 7 | /CS | MPU | Chip enable signal |
| 8 | GND | Power supply | Signal ground for LCM (GND) |
| 9 | /RES | MPU | Reset signal |
| 10~17 | DB0~DB7 | MPU | Data bus line |
| 18 | GND | Power supply | Signal ground for LCM (GND) |
| 19 | INT | MPU | Interrupt of module (see spec RA8875) |
| 20 | WAIT | MPU | Busy of module |

Interface connector P2 (extended interface)

| Pin No. | Symbol | External connection | Function |
|---|---|---|---|
| 1 | UIN | Power supply | Power supply (+3.3VDC) for logic for LCM (see also options -DC) |
| 2 | GND | | Signal ground for LCM (GND) |
| 3 | PWM2 | MPU | Output PWM2 |
| 4~11 | DB8~DB15 | MPU | Data bus line |
| 12 | CS | MPU | SPI chip select signal<br>IIC not used |
| 13 | SDO | MPU | SPI 3-wire: bidirectional Data<br>4-wire: Data output<br>IIC not used |
| 14 | SDI | MPU | SPI Data input<br>IIC bidirectional Data |
| 15 | SCL | MPU | SPI clock input<br>IIC clock input |
| 16 | GND | Power supply | Signal ground for LCM (GND) |
| 17 | PROG | MPU | Program memory of module |
| 18 | SELFLA | MPU | Select memory on module |

Interface connector P3/P3.1 (Key interface)

| Pin No. | Symbol | External connection | Function |
|---|---|---|---|
| 1 | UOUT | Power supply | Power supply output (3.3V/max 80mA) |
| 2~6 | KI0~KI4 | KEY | Keypad Data Line |
| 7~10 | KO0~KO3 | KEY | Keypad Strobe Line |
| 11 | GPIX | ~ | General Purpose Input |
| 12 | GPOX | ~ | General Purpose Output |
| 13 | GND | Power supply | Signal ground for LCM (GND) |
| 14 | GND | Power supply | Signal ground for LCM (GND) |

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## 7. Hardware Settings

Following pictures show the possibilities of hardware settings which customer could use to adjust interfaces, addresses a.s.o.

Backside of module:



Set key interface (presetting):

| Jumper | Setting | Function |
|---|---|---|
| W6 | open | KI0 = H *1 |
| | closed | KI0 = L *2 |
| W7 | open | KI1 = H *1 |
| | closed | KI1 = L *2 |
| W8 | open | KI2 = H *1 |
| | closed | KI2 = L *2 |
| W9 | open | KI3 = H *1 |
| | closed | KI3 = L *2 |
| W10 | open | KI4 = H *1 |
| | closed | KI4 = L *2 |

*1 pulled with 47k to internal VDD(3.3V)
*2 direct connected to GND


Set interface and addresses:

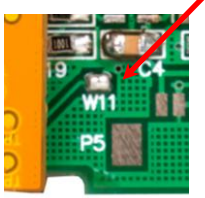
| Jumper | Setting | Function |
|---|---|---|
| W1 | open | I2C-address A0=H |
| | closed | I2C-address A0=L |
| W2 | open | I2C-address A1=H |
| | closed | I2C-address A1=L |

| Jumper | Setting | NC | I2C | 3-SPI | 4-SPI |
|---|---|---|---|---|---|
| W3 | open | - | x | - | x |
| | closed | x | - | x | - |
| W4 | open | - | x | x | - |
| | closed | x | - | - | x |

| Jumper | Setting | Function |
|---|---|---|
| W5 | open | select serial interface |
| | closed | select parallel interface |

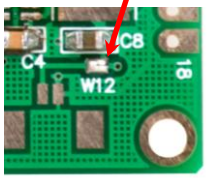
Set MCU interface:

| Jumper | Setting | Function |
|---|---|---|
| W11 | open | 6800 |
| | closed | 8080 |




Set $U_{IN}$ (Power supply):

| Jumper | Setting | Function |
|---|---|---|
| W12 | open | max. 36VDC (optional) |
| | closed | VDD=3.3VDC (default) |

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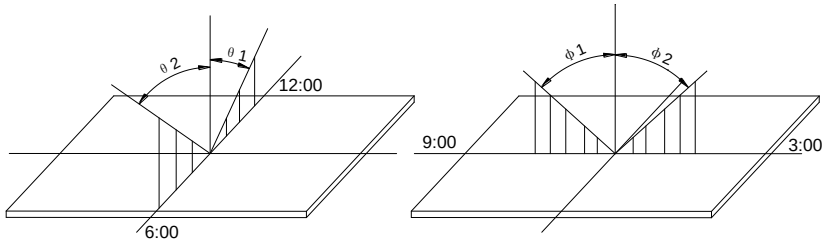
## 8. Optical Characteristics

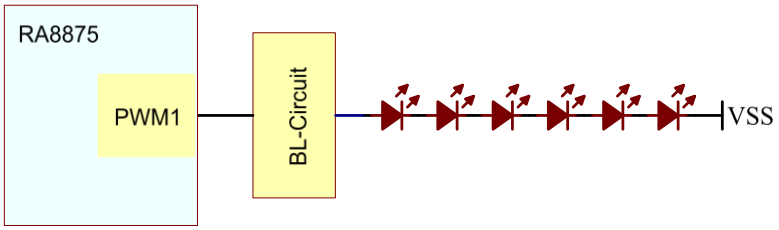



| Item | Symbol | Condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Viewing angle | Θ1 | Cr≥10 | 30 | 70 | - | deg |
| | Θ2 | | 50 | 50 | - | |
| | Φ1 | | 50 | 70 | - | |
| | Φ2 | | 50 | 70 | - | |
| Contrast ratio | Cr | Θ=0° | - | 600 | - | - |
| Response time (rise) | Tr | 25°C | - | 25 | 40 | ms |
| Response time (fall) | Tr | 25°C | - | 25 | 50 | |
| Uniformity | U | | 75 | 80 | - | % |
| Luminance | L | | - | 280 | - | $cd/m^2$ |

## 9. Electrical Characteristics

BACKLIGHT CIRCUIT DIAGRAM

Note: Backlight is driven direct from LCD controller with pin $U_{IN}$.
No external connection is possible!

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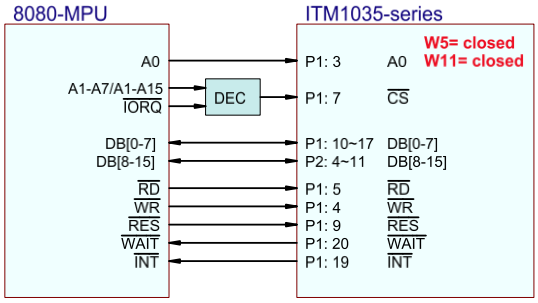
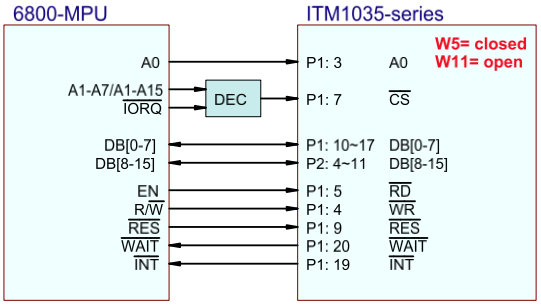
## 10. Interface Characteristics

**For full details, please refer to original spec of RA8875 V16!**

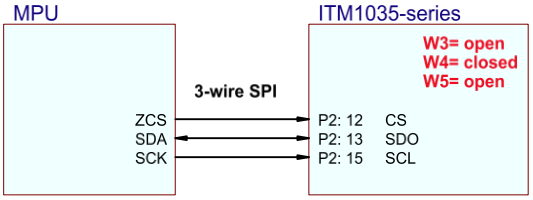
### *10.1 Parallel Interface*

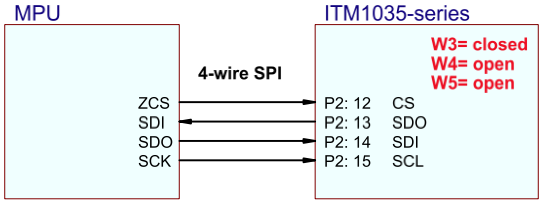


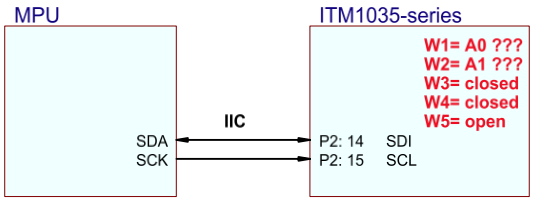

### *10.2 Serial Interface*

#### *10.2.1 Interfacing SPI*




#### *10.2.2 Interfacing $I^2C$*

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## 11. Instructions / Commands

For detailed information of RA8875, please refer also for original specification of controller!

### *11.1 General Description*

| Parameter | Description | |
|---|---|---|
| X | X – position | 10bit |
| Y | Y – position | 9bit |
| X0 | X – position | 10bit, 1st position → left |
| Y0 | Y – position | 9bit, 1st position → top |
| X1 | X – position | 10bit, 2nd position → right |
| Y1 | Y – position | 9bit, 2nd position → bottom |
| Rad | Radius | 8bit |
| Rh | horizontal radius | 10bit |
| Rv | vertical radius | 9bit |
| Col | RAIO-color value | 8 or 16bit |
| Seg | Ellipse-segment | 2bit |
| R | color-red | 5bit |
| G | color-green | 6bit |
| B | color-blue | 5bit |

Agreements for colors:

| | | | |
|---|---|---|---|
| 8-bit colors: | | R2 - R1 - R0 - G2 - G1 - G0 - B1 - B0 | (Bit7…Bit0) |
| 16-bit colors: | 1st cycle: | R4 - R3 - R2 - R1 - R0 - G5 - G4 - G3 | (Bit7…Bit0) |
| | 2nd cycle: | G2 - G1 - G0 - B4 - B3 - B2 - B1 - B0 | (Bit7…Bit0) |

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## 11.2 Init of Module (ITM1050)

| Function | | Description Register | Name of Register | Register | Value | Notes |
|---|---|---|---|---|---|---|
| INIT | Reset | Hardware-Reset | Low for 1ms, then wait 10ms on High level | | | |
| | Must | PLL Control Register | **PLLC1** | 0x88 | 0x06 | wait 200µs |
| | | PLL Control Register | **PLLC2** | 0x89 | 0x02 | wait 200µs |
| | | System Configuration Register | **SYSR** | 0x10 | 0x0c | wait 200µs |
| | | Pixel Clock Setting Register | **PCSR** | 0x04 | 0x81 | wait 200µs |
| | | LCD Horizontal Display Register | **HDWR** | 0x14 | 0x63 | |
| | | | **HNDFTR** | 0x15 | 0x03 | |
| | | | **HNDR** | 0x16 | 0x03 | |
| | | | **HSTR** | 0x17 | 0x02 | |
| | | | **HPWR** | 0x18 | 0x00 | wait 100µs |
| | | LCD Vertical Display Register | **VDHR0** | 0x19 | 0xdf | |
| | | | **VDHR1** | 0x1a | 0x01 | |
| | | | **VNDR0** | 0x1b | 0x14 | |
| | | | **VNDR1** | 0x1c | 0x00 | |
| | | | **VSTR0** | 0x1d | 0x06 | |
| | | | **VSTR1** | 0x1e | 0x00 | |
| | | | **VPWR** | 0x1f | 0x01 | wait 100µs |
| | | Set active window X | **HSAW0 / HSAW1** | 0x30 | 0x00 | max size is 320 |
| | | | | 0x31 | 0x00 | |
| | | | | 0x34 | 0x1f | |
| | | | | 0x35 | 0x03 | wait 100µs |
| | | Set active window Y | **VSAW0 / VSAW1** | 0x32 | 0x00 | max size is 240 |
| | | | | 0x33 | 0x00 | |
| | | | | 0x36 | 0xdf | |
| | | | | 0x37 | 0x01 | wait 100µs |
| | Optional | Memory Clear Control Register | **MCLR** | 0x8e | 0x80 | check until bit7 of reg 0x8e is cleared |
| | | Key-Scan Control Register 1 | **KSCR1** | 0xc0 | 0x80 | KeyScan enable |
| | | Touch Panel register | **TPCR0 / TPCR1** | 0x70 | 0xd2 | |
| | | | | 0x71 | 0x05 | |
| | | Interrupt Control Register | **INTC1/ INTC2** | 0xf0 | 0x16 | Key/DMA/Touch Int |
| | | | | 0xf1 | 0x16 | wait 100µs |
| | | Memory Write Control Register 0 | **MWCR0** | 0x40 | 0x00 | Graphic mode |
| | | Display Configuration Register | **DPCR** | 0x20 | 0x80 | 0x00: 1 Layer<br>0x80: 2 Layer |
| | Must | PWM1 Register (Backlight) | **P1CR** | 0x8a | 0xc9 | |
| | | | | 0x8b | 0xff | 0xFF: max. backlight |
| | | Power & Display Contr. Register | **PWRR** | 0x01 | 0x80 | Display ON |
| | | | | | | |



## 11.3 Command - ***Drive Backlight***

| Function | Description | Register | Value | Notes |
|---|---|---|---|---|
| Set PWM for backlight | PWM Control Register | 0x8a | Bit 7 | PWM1 Enable |
| | | | Bit 6 | PWM1 Disable Level |
| | | | Bit 4 | PWM1 Function Selection |
| | | | Bit 3-0 | PWM1 Clock Source Divide Ratio |
| | PWM Duty Cycle Register | 0x8b | PWM Cycle Duty | 0…255 ⇨ 1/256...256/256 Duty with PWM1 clock source |

Note: PWM2 could used for external applications on connector P2/pin3 (control register: 0x8c / duty cycle reg: 0x8d)

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### 11.4 Command – *Set ACTIVE WINDOW*

| Function | Description | Register | Value | Notes |
|---|---|---|---|---|
| Set active window |  | 0x30 | Pos.X0 | Low byte |
| | | 0x31 | | High Byte |
| | | 0x32 | Pos.Y0 | Low byte |
| | | 0x33 | | High Byte |
| | | 0x34 | Pos.X1 | Low byte |
| | | 0x35 | | High Byte |
| | | 0x36 | Pos.Y1 | Low byte |
| | | 0x37 | | High Byte |

### 11.5 Command – *Draw PIXEL/DOT*

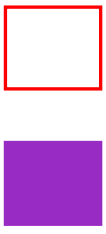
| Function | Description | Register | Value | Notes |
|---|---|---|---|---|
| Draw pixel/dot |  | 0x46 | Pos.X | Low byte |
| | | 0x47 | | High Byte |
| | | 0x48 | Pos.Y | Low byte |
| | | 0x49 | | High Byte |
| | | 0x02 | Color | High Byte → Low byte |

### 11.6 Command – *Draw LINE*

| Function | Description | Register | Value | Notes |
|---|---|---|---|---|
| Draw line |  | 0x91 | Pos.X0 | Low byte |
| | | 0x92 | | High Byte |
| | | 0x93 | Pos.Y0 | Low byte |
| | | 0x94 | | High Byte |
| | | 0x95 | Pos.X1 | Low byte |
| | | 0x96 | | High Byte |
| | | 0x97 | Pos.Y1 | Low byte |
| | | 0x98 | | High Byte |
| | | 0x63 | Color R | Color red 5-bit |
| | | 0x64 | Color G | Color green 6-bit |
| | | 0x65 | Color B | Color blue 5-bit |
| | | 0x90 | 0x80 | Execute draw line |

Note: After execute command 0x90:0x80, please check until bit7 of register 0x90 is cleared.

### 11.7 Command – *Draw RECTANGLE*

| Function | Description | Register | Value | Notes |
|---|---|---|---|---|
| Draw rectangle |  | 0x91 | Pos.X0 | Low byte |
| | | 0x92 | | High Byte |
| | | 0x93 | Pos.Y0 | Low byte |
| | | 0x94 | | High Byte |
| | | 0x95 | Pos.X1 | Low byte |
| | | 0x96 | | High Byte |
| | | 0x97 | Pos.Y1 | Low byte |
| | | 0x98 | | High Byte |
| | | 0x63 | Color R | Color red 5-bit |
| | | 0x64 | Color G | Color green 6-bit |
| | | 0x65 | Color B | Color blue 5-bit |
| | | 0x90 | 0x90 | Execute draw rect w/o fill |
| | | | 0xB0 | Execute draw rect with fill |

Note: After execute command 0x90:0x90 or 0x90:0xB0, please check until bit7 of register 0x90 is cleared.

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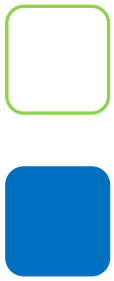
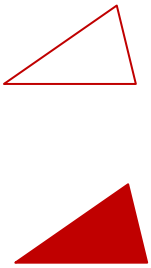
### 11.8 Command – *Draw RECTANGLE with rounded corners*

| Function | Description | Register | Value | Notes |
|---|---|---|---|---|
| Draw rectangle |  | 0x91 | Pos.X0 | Low byte |
| | | 0x92 | | High Byte |
| | | 0x93 | Pos.Y0 | Low byte |
| | | 0x94 | | High Byte |
| | | 0x95 | Pos.X1 | Low byte |
| | | 0x96 | | High Byte |
| | | 0x97 | Pos.Y1 | Low byte |
| | | 0x98 | | High Byte |
| | | 0xa1 | Long radius | Low byte |
| | | 0xa2 | | High Byte |
| | | 0xa3 | Short radius | Low byte |
| | | 0xa4 | | High Byte |
| | | 0x63 | Color R | Color red 5-bit |
| | | 0x64 | Color G | Color green 6-bit |
| | | 0x65 | Color B | Color blue 5-bit |
| | | 0xa0 | 0xa0 | Execute draw rectangle w/o fill |
| | | | 0xE0 | Execute draw rectangle with fill |

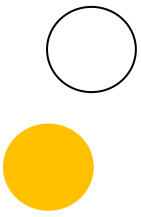
Note: After execute command 0xa0:0xa0 or 0xa0:0xE0, please check until bit7 of register 0xa0 is cleared.

### 11.9 Command – *Draw TRIANGLE*

| Function | Description | Register | Value | Notes |
|---|---|---|---|---|
| Draw triangle |  | 0x91 | Pos.X0 | Low byte |
| | | 0x92 | | High Byte |
| | | 0x93 | Pos.Y0 | Low byte |
| | | 0x94 | | High Byte |
| | | 0x95 | Pos.X1 | Low byte |
| | | 0x96 | | High Byte |
| | | 0x97 | Pos.Y1 | Low byte |
| | | 0x98 | | High Byte |
| | | 0xa9 | Pos.X2 | Low byte |
| | | 0xaa | | High Byte |
| | | 0xab | Pos.Y2 | Low byte |
| | | 0xac | | High Byte |
| | | 0x63 | Color R | Color red 5-bit |
| | | 0x64 | Color G | Color green 6-bit |
| | | 0x65 | Color B | Color blue 5-bit |
| | | 0x90 | 0x81 | Execute draw triangle w/o fill |
| | | | 0xA1 | Execute draw triangle with fill |

Note: After execute command 0x90:0x81 or 0x90:0xA1, please check until bit7 of register 0x90 is cleared.

### 11.10 Command – *Draw CIRCLE*

| Function | Description | Register | Value | Notes |
|---|---|---|---|---|
| Draw circle |  | 0x99 | Pos.X0 | Low byte |
| | | 0x9a | | High Byte |
| | | 0x9b | Pos.Y0 | Low byte |
| | | 0x9c | | High Byte |
| | | 0x9d | Rad | Radius 8-bit |
| | | 0x63 | Color R | Color red 5-bit |
| | | 0x64 | Color G | Color green 6-bit |
| | | 0x65 | Color B | Color blue 5-bit |
| | | 0x90 | 0x40 | Execute draw circle w/o fill |
| | | | 0x60 | Execute draw circle with fill |

Note: After execute command 0x90:0x40 or 0x90:0x60, please check until bit6 of register 0x90 is cleared.

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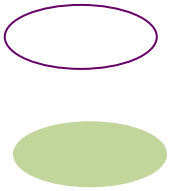
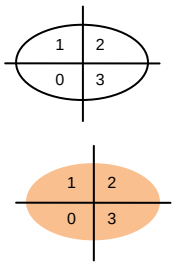
### 11.11 Command – *Draw ELLIPSE*

| Function | Description | Register | Value | Notes |
|---|---|---|---|---|
| Draw ellipse |  | 0xa5 | Pos.X0 | Low byte |
| | | 0xa6 | | High Byte |
| | | 0xa7 | Pos.Y0 | Low byte |
| | | 0xa8 | | High Byte |
| | | 0xa1 | Long radius | Low byte |
| | | 0xa2 | | High Byte |
| | | 0xa3 | Short radius | Low byte |
| | | 0xa4 | | High Byte |
| | | 0x63 | Color R | Color red 5-bit |
| | | 0x64 | Color G | Color green 6-bit |
| | | 0x65 | Color B | Color blue 5-bit |
| | | 0xa0 | 0x80 | Execute draw ellipse w/o fill |
| | | | 0xC0 | Execute draw ellipse with fill |

Note: After execute command 0xa0:0x80 or 0xa:0xC0, please check until bit7 of register 0xa0 is cleared.

### 11.12 Command – *Draw Segment of ELLIPSE*

| Function | Description | Register | Value | Notes |
|---|---|---|---|---|
| Draw segment of ellipse |  | 0xa5 | Pos.X0 | Low byte |
| | | 0xa6 | | High Byte |
| | | 0xa7 | Pos.Y0 | Low byte |
| | | 0xa8 | | High Byte |
| | | 0xa1 | Long radius | Low byte |
| | | 0xa2 | | High Byte |
| | | 0xa3 | Short radius | Low byte |
| | | 0xa4 | | High Byte |
| | | 0x63 | Color R | Color red 5-bit |
| | | 0x64 | Color G | Color green 6-bit |
| | | 0x65 | Color B | Color blue 5-bit |
| | | 0xa0 | 0x90 | Execute draw seg. ellipse w/o fill |
| | | | 0xD0 | Execute draw seg. ellipse with fill |
| | | | Bit0 and Bit1 define which segment is used<br>Values: 0xD0…0xD3 or 0x90…0x93 | |

Note: After execute command 0xa0:0x90 or 0xa:0xD0, please check until bit7 of register 0xa0 is cleared.

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### 11.13 Command – ***Draw Text*** *(with internal Font-ROM)*

| Function | Description | Register | Value | Notes |
|---|---|---|---|---|
| Draw text | Set Font write cursor position | 0x2a | Horizontal | Low byte |
| | | 0x2b | | High byte |
| | | 0x2c | Vertical | Low byte |
| | | 0x2d | | High byte |
| | Set background color | 0x60 | Color R | Color red 5-bit |
| | | 0x61 | Color G | Color green 6-bit |
| | | 0x62 | Color B | Color blue 5-bit |
| | Set foreground color | 0x63 | Color R | Color red 5-bit |
| | | 0x64 | Color G | Color green 6-bit |
| | | 0x65 | Color B | Color blue 5-bit |
| | Font control register 0 | 0x21 | Bit 7 | CGRAM/CGROM Font Selection Bit |
| | | | Bit 5 | External/Internal CGROM Selection Bit |
| | | | Bit 1..0 | Font Selection for internal CGROM |
| | Font control register 1 | 0x22 | Bit 7 | Full Alignment Selection Bit |
| | | | Bit 6 | Font Transparency |
| | | | Bit 4 | Font Rotation |
| | | | Bit 3..2 | Horizontal Font Enlargement |
| | | | Bit 1..0 | Vertical Font Enlargement |
| | Font Line Distance Setting | 0x29 | Bi7 4..0 | Font Line Distance Setting |
| | Font Write Type Setting | 0x2e | Bit 7..6 | Font Size Setting |
| | | | Bit 5..0 | Font to Font Width Setting |
| | Memory Write Control Reg0 | 0x40 | Bit 7 | 1: Text Mode Enable |
| | Memory Read/Write Command | 0x02 | Text char | data can be written (continuously) |
| | Memory Write Control Reg0 | 0x40 | Bit 7 | 0 : Graphic mode (if necessary) |

Note: Text-cursor-position should be in active window

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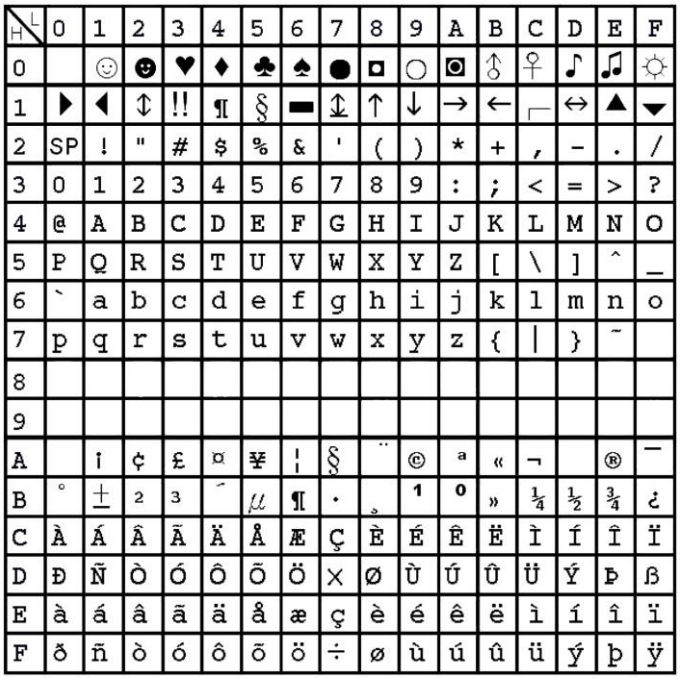
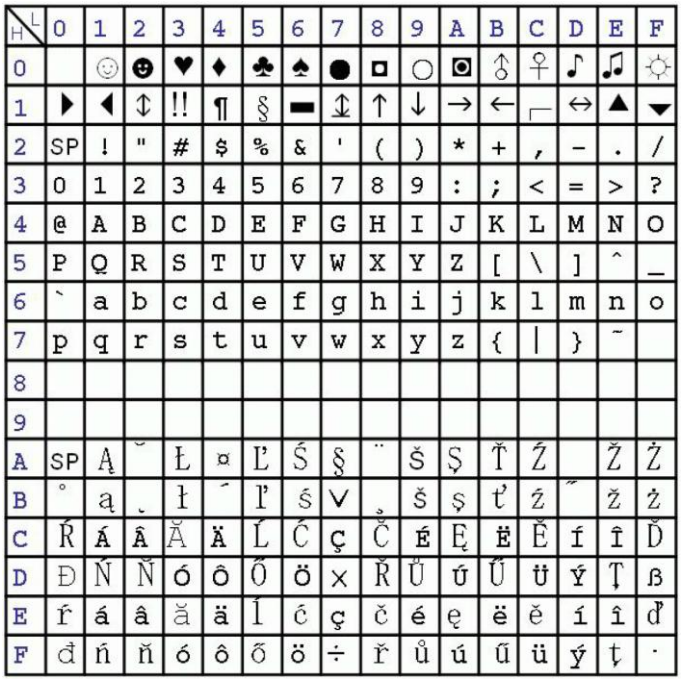
*11.13.1 ASCII Block 1 (ISO/IEC 8859-1→ LATIN1)*



| H \ L | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | A | B | C | D | E | F |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | ☺ | ☻ | ♥ | ♦ | ♣ | ♠ | ● | ◘ | ○ | ◙ | ♂ | ♀ | ♪ | ♫ | ☼ |
| 1 | ► | ◄ | ↕ | !! | ¶ | § | ▬ | ↨ | ↑ | ↓ | → | ← | ⌐ | ↔ | ▲ | ▼ |
| 2 | SP | ! | " | # | $ | % | & | ' | ( | ) | * | + | , | - | . | / |
| 3 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | : | ; | < | = | > | ? |
| 4 | @ | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O |
| 5 | P | Q | R | S | T | U | V | W | X | Y | Z | [ | \ | ] | ^ | _ |
| 6 | ` | a | b | c | d | e | f | g | h | i | j | k | l | m | n | o |
| 7 | p | q | r | s | t | u | v | w | x | y | z | { | \| | } | ~ | |
| 8 | | | | | | | | | | | | | | | | |
| 9 | | | | | | | | | | | | | | | | |
| A | | ¡ | ¢ | £ | ¤ | ¥ | ¦ | § | ¨ | © | ª | « | ¬ | | ® | ¯ |
| B | ° | ± | ² | ³ | ´ | µ | ¶ | · | ¸ | ¹ | º | » | ¼ | ½ | ¾ | ¿ |
| C | À | Á | Â | Ã | Ä | Å | Æ | Ç | È | É | Ê | Ë | Ì | Í | Î | Ï |
| D | Ð | Ñ | Ò | Ó | Ô | Õ | Ö | × | Ø | Ù | Ú | Û | Ü | Ý | Þ | ß |
| E | à | á | â | ã | ä | å | æ | ç | è | é | ê | ë | ì | í | î | ï |
| F | ð | ñ | ò | ó | ô | õ | ö | ÷ | ø | ù | ú | û | ü | ý | þ | ÿ |

Possible languages: Western Europe, includes Albanian, Afrikaans, Breton, Danish, Faroese, Frisian, Galician, German, Greenlandic, Icelandic, Irish, Italian, Latin, Luxembourgish, Norwegian, Portuguese, Rhaeto-Romanic, Scottish Gaelic, Spanish, Swedish.

*11.13.2 ASCII Block 2 (ISO/IEC 8859-2 → LATIN2)*



| H \ L | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | A | B | C | D | E | F |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | ☺ | ☻ | ♥ | ♦ | ♣ | ♠ | ● | ◘ | ○ | ◙ | ♂ | ♀ | ♪ | ♫ | ☼ |
| 1 | ► | ◄ | ↕ | !! | ¶ | § | ▬ | ↨ | ↑ | ↓ | → | ← | ⌐ | ↔ | ▲ | ▼ |
| 2 | SP | ! | " | # | $ | % | & | ' | ( | ) | * | + | , | - | . | / |
| 3 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | : | ; | < | = | > | ? |
| 4 | @ | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O |
| 5 | P | Q | R | S | T | U | V | W | X | Y | Z | [ | \ | ] | ^ | _ |
| 6 | ` | a | b | c | d | e | f | g | h | i | j | k | l | m | n | o |
| 7 | p | q | r | s | t | u | v | w | x | y | z | { | \| | } | ~ | |
| 8 | | | | | | | | | | | | | | | | |
| 9 | | | | | | | | | | | | | | | | |
| A | SP | Ą | ˘ | Ł | ¤ | Ľ | Ś | § | ¨ | Š | Ş | Ť | Ź | | Ž | Ż |
| B | ° | ą | ˛ | ł | ´ | ľ | ś | ˇ | ¸ | š | ş | ť | ź | ˝ | ž | ż |
| C | Ŕ | Á | Â | Ă | Ä | Ĺ | Ć | Ç | Č | É | Ę | Ë | Ě | Í | Î | Ď |
| D | Đ | Ń | Ň | Ó | Ô | Ő | Ö | × | Ř | Ů | Ú | Ű | Ü | Ý | Ţ | ß |
| E | ŕ | á | â | ă | ä | ĺ | ć | ç | č | é | ę | ë | ě | í | î | ď |
| F | đ | ń | ň | ó | ô | ő | ö | ÷ | ř | ů | ú | ű | ü | ý | ţ | ˙ |

Possible languages: Croatian, Czech, Hungarian, Polish, Slovak, Slovenian and Upper Sorbian. The Serbian, English, German, Latin can use ISO/IEC 8859-2 as well. It is suitable to represent some western European languages like Finnish (with the exception of å used in Swedish and Finnish)

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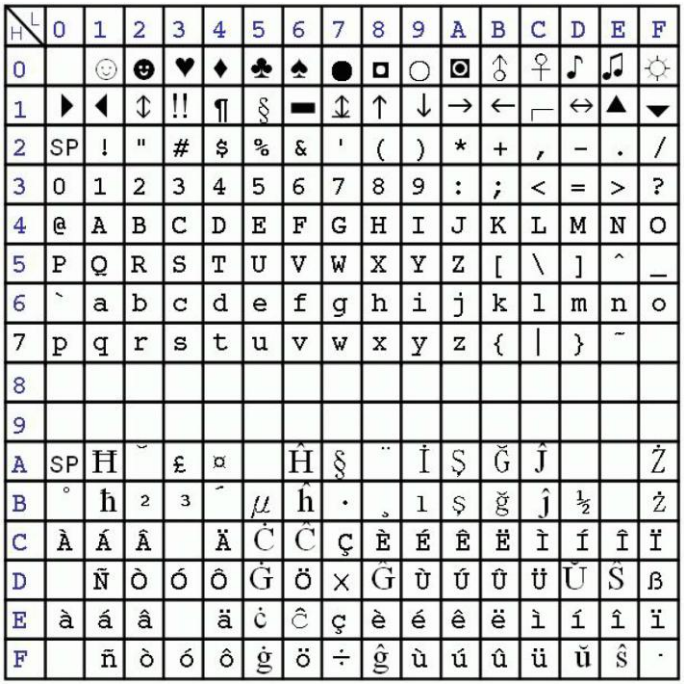
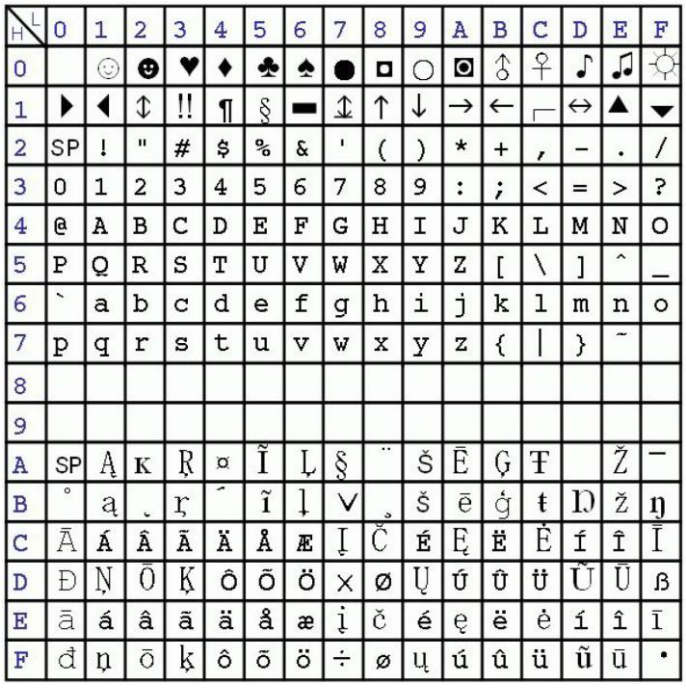
*11.13.3 ASCII Block 3 (ISO/IEC 8859-3 → South European)*



Possible languages: Turkish, Maltese and Esperanto
It also supports English, German, Italian, Latin and Portuguese.

*11.13.4 ASCII Block 4 (ISO/IEC 8859-3 → North European)*



Possible languages: Estonian, Greenlandic, Latvian, Lithuanian, and Sami.
It also supports Danish, English, Finnish, German, Latin, Norwegian, Slovenian and Swedish

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### 11.14 Command – **Draw Text** *(with optional external Font-ROM)*

For detailed information's about available external FONT-ROM IC please contact IbS Sperling.

| Function | Description | Register | Value | Notes |
|---|---|---|---|---|
| Draw text | Set Font write cursor position | 0x2a | Horizontal | Low byte |
| | | 0x2b | | High byte |
| | | 0x2c | Vertical | Low byte |
| | | 0x2d | | High byte |
| | Set background color | 0x60 | Color R | Color red 5-bit |
| | | 0x61 | Color G | Color green 6-bit |
| | | 0x62 | Color B | Color blue 5-bit |
| | Set foreground color | 0x63 | Color R | Color red 5-bit |
| | | 0x64 | Color G | Color green 6-bit |
| | | 0x65 | Color B | Color blue 5-bit |
| | Font control register 0 | 0x21 | Bit 7 | CGRAM/CGROM Font Selection Bit |
| | | | Bit 5 | External/Internal CGROM Selection Bit |
| | | | Bit 1..0 | Font Selection for internal CGROM |
| | Font control register 1 | 0x22 | Bit 7 | Full Alignment Selection Bit |
| | | | Bit 6 | Font Transparency |
| | | | Bit 4 | Font Rotation |
| | | | Bit 3..2 | Horizontal Font Enlargement |
| | | | Bit 1..0 | Vertical Font Enlargement |
| | Font Line Distance Setting | 0x29 | Bit 4..0 | Font Line Distance Setting |
| | Font Write Type Setting | 0x2e | Bit 7..6 | Font Size Setting |
| | | | Bit 5..0 | Font to Font Width Setting |
| | Serial Font ROM Setting | 0x2f | Bit 7..5 | Serial Font ROM Select |
| | | | Bit 4..2 | FONT ROM Coding Setting |
| | | | Bit 1..0 | ASCII/Latin/Greek/Cyrillic/Arabic |
| | Serial Flash/ROM Configuration | 0x05 | | See Spec RA8875 |
| | Serial Flash/ROM CLK Setting | 0x06 | | |
| | Memory Write Control Reg0 | 0x40 | Bit 7 | 1: Text Mode Enable |
| | Memory Read/Write Command | 0x02 | Text char | data can be written (continuously) |
| | Memory Write Control Reg0 | 0x40 | Bit 7 | 0 : Graphic mode (if necessary) |

Note: Text-cursor-position should be in active window

### 11.15 Command – **SCROLL**

| Function | Description | Register | Value | Notes |
|---|---|---|---|---|
| SCROLL | Set scroll window | 0x38 | Left | Low byte |
| | | 0x39 | | High Byte |
| | | 0x3a | Top | Low byte |
| | | 0x3b | | High Byte |
| | | 0x3c | Right | Low byte |
| | | 0x3d | | High Byte |
| | | 0x3e | Bottom | Low byte |
| | | 0x3f | | High Byte |
| | Horizontal Scroll Offset Register | 0x24 | Horizontal Scroll-Offset | Low byte |
| | | 0x25 | | High Byte |
| | Vertical Scroll Offset Register | 0x26 | Vertical Scroll-Offset | Low byte |
| | | 0x27 | | High Byte |

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## 11.16 Command – *WRITE transparent BTE*

BTE → Block Transfer Engine
ROP→ Raster Operation

| Function | Description | Register | Value | Notes |
|---|---|---|---|---|
| WRITE transparent BTE | Memory Write Control Reg0 | 0x40 | Bit7 | 0: Graphic mode |
| | Destination Point of BTE | 0x58 | Horizontal | Low byte |
| | | 0x59 | | High Byte |
| | | 0x5a | Vertical | Low byte |
| | | 0x5b | | High Byte |
| | BTE Width Register | 0x5c | Width | Low byte |
| | | 0x5d | | High Byte |
| | BTE Height Register | 0x5e | Height | Low byte |
| | | 0x5f | | High Byte |
| | Set transparent color | 0x63 | Color Red | Color red 5-bit |
| | | 0x64 | Color Green | Color green 6-bit |
| | | 0x65 | Color Blue | Color blue 5-bit |
| | BTE Function Control Register1 | 0x51 | Bit 7..4 (0xc0) | BTE ROP Code |
| | | | Bit 3..0 (0x04) | BTE Operation Code |
| | BTE Function Control Register0 | 0x50 | Bit 7 (0x80) | BTE Function Enable / Status |
| | | | Bit 6 (0x00) | BTE Source Data Select |
| | | | Bit 5 (0x00) | BTE Destination Data Type Select |
| | *Now you must write all your image-data to RAIO in a loop:*<br>*- Select RAIO-register 0x02 and send 16-bit-color-data (for 16-bit-color) of image-pixel to RAIO.*<br>*- Wait while RAIO is busy.*<br>*- Repeat for all pixel* | | | |
| | *Check BTE-busy in RAIO-status register and wait while busy.* | | | |

## 11.17 Command – *MOVE transparent BTE*

| Function | Description | Register | Value | Notes |
|---|---|---|---|---|
| MOVE transparent BTE | Memory Write Control Reg0 | 0x40 | Bit7 | 0: Graphic mode |
| | *Place your picture now* | | | |
| | Source Point of BTE (the left/top position of your picture) | 0x54 | Horizontal | Low byte |
| | | 0x55 | | High Byte |
| | | 0x56 | Vertical | Low byte |
| | | 0x57 | | High Byte |
| | Destination Point of BTE | 0x58 | Horizontal | Low byte |
| | | 0x59 | | High Byte |
| | | 0x5a | Vertical | Low byte |
| | | 0x5b | | High Byte |
| | BTE Width Register | 0x5c | Width | Low byte |
| | | 0x5d | | High Byte |
| | BTE Height Register | 0x5e | Height | Low byte |
| | | 0x5f | | High Byte |
| | Set transparent color | 0x63 | Color Red | Color red 5-bit |
| | | 0x64 | Color Green | Color green 6-bit |
| | | 0x65 | Color Blue | Color blue 5-bit |
| | BTE Function Control Register1 | 0x51 | Bit 7..4 (0x00) | BTE ROP Code |
| | | | Bit 3..0 (0x05) | BTE Operation Code |
| | BTE Function Control Register0 | 0x50 | Bit 7 (0x80) | BTE Function Enable / Status |
| | | | Bit 6 (0x00) | BTE Source Data Select |
| | | | Bit 5 (0x00) | BTE Destination Data Type Select |
| | *Check BTE-busy in RAIO-status register and wait while busy!* | | | |

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## 11.18 *IMAGE handling*

Following definitions are made for IbS Terminal tool named “ITM Picture converter”.

### 11.18.1 Store picture in FLASH

The optional FLASH memories on module series ITM1035 could be written by SPI 4-wire mode with file in binary format. A tool for easy handling is available at IbS Sperling – please contact!

Following handling is necessary!:

1. Connect as follows:

| Signal | Description | Connector:Pin |
|---|---|---|
| $U_{IN}$ (3.3VDC) | Power supply | P2:1 |
| VSS (0V) | | P2:16 |
| SPI-/CS | Chip select | P2:12 |
| SPI-SDO | Serial data out | P2:13 |
| SPI-SDI | Serial data in | P2:14 |
| SPI-SCL | Serial clock | P2-15 |
| /PROG | Program mode | P2-17 |
| SELFLA | Select Flash-IC 1 or 2 | P2-18 |

2. Select Flash memory you want by signal SELFLA (max 2 IC are optional possible)
3. Set signal /PROG to LOW (now is no function of module possible)
4. Please send data to FLASH (for timing please refer spec of FLASH IC)
5. After program FLASH set signal /PROG to high (functions of module are reactivated)

### 11.18.2 Show picture from FLASH

Agreements for images in FLASH:

1. All picture are stored in FLASH memory in binary format
2. Each picture consist of header and image data

Header consist of:

| Item | Value | Excample |
|---|---|---|
| Identifier | 8 Byte | “ITMIMAGE” |
| Size | 4 Byte | 0xFFFFFFFF |
| Width | 2 Byte | 320 |
| Height | 2 Byte | 240 |
| Flag | 2 Byte | 2x 2Byte for color (16Bit-Farben) |
| Name | 12 Byte | “name of your picture” |
| Checksum | 2 Byte | Checksum of header (issues above) |

Data consist of:

| Item | Value | Excample |
|---|---|---|
| Data of image | As requested | Data of image |
| Checksum | 4 Byte | at present unused |

3. 1st picture starts with address 0x1000
4. Header of each following image in FLASH begins at address alignment 0x?????**0**

e.g. 1st picture starts at 0x1000
calculation of 1st picture:
size: 163x51 pixel (2Byte/pixel) → 16626Byte (0x40F2)
total size: 16626Byte + 32Byte(Header) + 4Byte(Checksum)=16662Byte (0x4116)
address of 1st picture ends at: 0x1000(start 1st pic) + 0x4116 = 0x5116
address of header 2nd picture starts at: 0x5120

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5. Calculation for address of requested image in FLASH with RAIO registers:

| Register | Name of Register | Register | Value | Notes |
|---|---|---|---|---|
| Serial Flash/ROM Configuration Register | **SROC** | 0x05 | 0x04 | FLASH1 |
| | | | 0x84 | FLASH2 |
| Serial Flash/ROM CLK Setting Register | **SFCLR** | 0x06 | 0x03 | |
| Serial Flash/ROM Direct Access Mode | **SACS_MODE** | 0xe0 | 0x01 | direct access |
| Serial Flash/ROM Direct Access Mode Address | **SACS_ADDR** | 0xe1 | addr16..23 | 24-bit address data (0x1000) |
| | | 0xe1 | addr8..15 | |
| | | 0xe1 | addr0..7 | |
| Serial Flash Direct Access Data Read | **SACS_DATA** | 0xe2 | read 33 Byte, ignore 1st Dummy byte! Header has 32 byte | |
| Serial Flash/ROM Direct Access Mode | **SACS_MODE** | 0xe0 | 0x00 | disable direct access mode |
| Following instruction must realized by microcontroller:<br>• Check for valid first header (starts at 0x1000)<br>• If check is valid, in header you find dim of image (see issue 2 above)<br>• Now you could calculate for address of next image (see issue 4 above)<br>• After this calc you could calculate for next picture a.s.o. | | | | |

6. Show the selected picture with RAIO registers:

(example: image 1 has 320x240pixel at position 0,0)

| Register | Name of Register | Register | Value | Notes |
|---|---|---|---|---|
| Memory Write Control Register 0 | **MWCR0** | 0x40 | Bit7=0 | Graphic mod |
| Set active window | **HSAW0 / HSAW1** | 0x30 | 0x00 | Start left (0) |
| | | 0x31 | 0x00 | |
| | | 0x34 | 0xa2 | End right (162 (W)) |
| | | 0x35 | 0x00 | |
| | **VSAW0 / VSAW1** | 0x32 | 0x00 | Start top (0) |
| | | 0x33 | 0x00 | |
| | | 0x36 | 0x32 | End bottom (50 (H)) |
| | | 0x37 | 0x00 | |
| Memory Write Cursor Horizontal Position Register | **CURH0** | 0x46 | 0x00 | Set cursor to position 0,0 |
| | **CURH1** | 0x47 | | |
| Memory Write Cursor Vertical Position Register | **CURV0** | 0x48 | | |
| | **CURV1** | 0x49 | | |
| Serial Flash/ROM CLK Setting Register | **SFCLR** | 0x06 | 0x03 | |
| Serial Flash/ROM Configuration Register | **SROC** | 0x05 | 0x04 | FLASH1 |
| | | | 0x84 | FLASH2 |
| Source Start Address | **SSAR** | 0xb0 | 0x40 | Start-addr of image in Flash |
| | | 0xb1 | 0x51 | |
| | | 0xb2 | 0x00 | |
| Block Width | **BWR0/ BWR1** | 0xb4 | 0xa3 | Image= 163pixel (W) |
| | | 0xb5 | 0x00 | |
| Block Height | **BHR0/ BHR1** | 0xb6 | 0x33 | Image= 51pixel (H) |
| | | 0xb7 | 0x00 | |
| Source Picture Width | **SPWR0/ SPWR1** | 0xb8 | 0xa3 | Image= 163pixel (W) |
| | | 0xb9 | 0x00 | |
| DMA Configuration | **DMACR** | 0xbf | 0x03 | Start DMA |

Note: After execute command 0xbf:0x03, please check until bit0 of register 0xbf is cleared.

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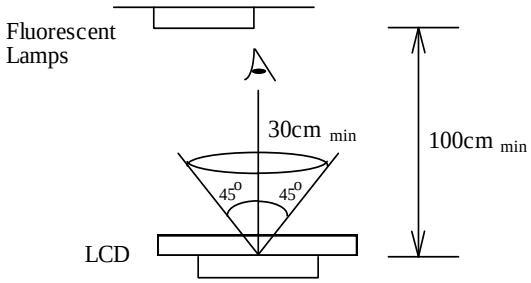
## 12. Quality Specifications

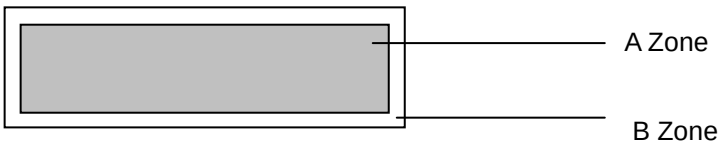
### *12.1 Standard of the product appearance test*

Manner of appearance test: The inspection should be performed in using 20W x 2 fluorescent lamps. Distance between LCM and fluorescent lamps should be 100 cm or more. Distance between LCM and inspector eyes should be 30 cm or more.

Viewing direction for inspection is 45° from vertical against LCM.




LCM Definition of zone:




A Zone: Active display area (minimum viewing area)
B Zone: Non-active display area (outside viewing area).

### *12.2 Specification of quality assurance*

AQL inspection standard
Sampling method: MIL-STD-105E, Level II, single sampling
Defect classification (Note: * is not including)

| Classify | Item | | Note | AQL |
|---|---|---|---|---|
| Major | Display state | Short or open circuit | 1 | 0.65 |
| | | LC leakage | | |
| | | Flickering | | |
| | | No display | | |
| | | Wrong viewing direction | | |
| | | Contrast defect (dim, ghost) | 2 | |
| | | Back-light | 1,8 | |
| | Non-display | Flat cable or pin reverse | 10 | |
| | | Wrong or missing component | 11 | |
| Minor | Display | Background color deviation | 2 | 1.0 |
| | state | Black spot and dust | 3 | |
| | | Line defect, Scratch | 4 | |
| | | Rainbow | 5 | |
| | | Chip | 6 | |
| | | Pin hole | 7 | |
| | | Protruded | 12 | |
| | Polarizer | Bubble and foreign material | 3 | |
| | Soldering | Poor connection | 9 | |
| | Wire | Poor connection | 10 | |
| | TAB | Position, Bonding strength | 13 | |



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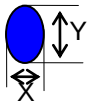
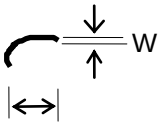
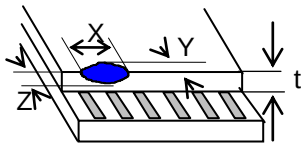
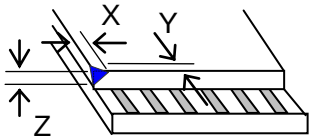
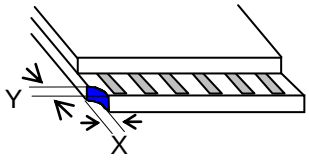
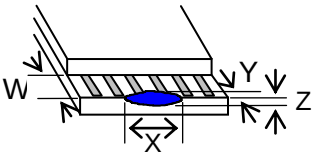
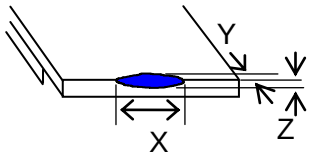
Note on defect classification

<table>
<tr><th>No.</th><th>Item</th><th>Criterion</th></tr>
<tr><td rowspan="6">1</td><td>Short or open circuit</td><td rowspan="6">Not allow</td></tr>
<tr><td>LC leakage</td></tr>
<tr><td>Flickering</td></tr>
<tr><td>No display</td></tr>
<tr><td>Wrong viewing direction</td></tr>
<tr><td>Wrong Back-light</td></tr>
<tr><td rowspan="2">2</td><td>Contrast defect</td><td rowspan="2">Refer to approval sample</td></tr>
<tr><td>Background color deviation</td></tr>
<tr><td>3</td><td>Point defect,<br>Black spot, dust<br>(including Polarizer)<br><br>ϕ = (X+Y)/2</td><td>  <br>Unit：mm<br><table><tr><th>Point Size</th><th>Acceptable Qty.</th></tr><tr><td>ϕ≤0.10</td><td>Disregard</td></tr><tr><td>0.10<ϕ≤0.20</td><td>3</td></tr><tr><td>0.20<ϕ≤0.25</td><td>2</td></tr><tr><td>0.25<ϕ≤0.30</td><td>1</td></tr><tr><td>ϕ>0.30</td><td>0</td></tr></table></td></tr>
<tr><td>4</td><td>Line defect,<br>Scratch</td><td>  <br>Unit: mm<br><table><tr><th colspan="2">Line</th><th>Acceptable Qty.</th></tr><tr><td>L</td><td>W</td><td></td></tr><tr><td>---</td><td>0.015≥W</td><td>Disregard</td></tr><tr><td>3.0≥L</td><td>0.03≥W</td><td rowspan="2">2</td></tr><tr><td>2.0≥L</td><td>0.05≥W</td></tr><tr><td>1.0≥L</td><td>0.1＞W</td><td>1</td></tr><tr><td>---</td><td>0.05<W</td><td>Applied as point defect</td></tr></table></td></tr>
<tr><td>5</td><td>Rainbow</td><td>Not more than two color changes across the viewing area.</td></tr>
<tr><td>6</td><td>Chip<br><br>Remark:<br>X: Length direction<br>Y: Short direction<br>Z: Thickness direct.<br>t: Glass thickness<br>W: Terminal Width</td><td>  <br>Acceptable criterion<br><table><tr><td>X</td><td>Y</td><td>Z</td></tr><tr><td>≤2</td><td>0.5mm</td><td>≤t/2</td></tr></table><br>  <br>Acceptable criterion<br><table><tr><td>X</td><td>Y</td><td>Z</td></tr><tr><td>≤2</td><td>0.5mm</td><td>≤t</td></tr></table><br>  <br>Acceptable criterion<br><table><tr><td>X</td><td>Y</td><td>Z</td></tr><tr><td>≤3</td><td>≤2</td><td rowspan="2">≤t</td></tr><tr><td colspan="2">shall not reach to ITO</td></tr></table><br>  <br>Acceptable criterion<br><table><tr><td>X</td><td>Y</td><td>Z</td></tr><tr><td>Disregard</td><td>≤0.2</td><td>≤t</td></tr></table><br>  <br>Acceptable criterion<br><table><tr><td>X</td><td>Y</td><td>Z</td></tr><tr><td>≤5</td><td>≤2</td><td>≤t/3</td></tr></table></td></tr>
</table>



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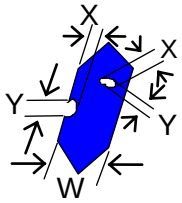
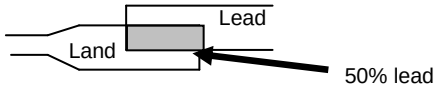
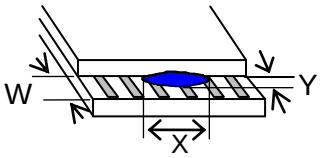
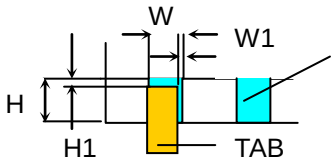
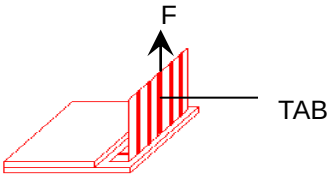
<table>
<tr><th>No.</th><th>Item</th><th>Criterion</th></tr>
<tr><td>7</td><td>Segment<br>pattern<br>W = Segment width<br>ϕ = (X+Y)/2</td><td>(1) Pin hole<br>ϕ < 0.10mm is acceptable.<br> 

<table>
<tr><th>Point Size</th><th>Acceptable Qty</th></tr>
<tr><td>ϕ≤1/4W</td><td>Disregard</td></tr>
<tr><td>1/4W< ϕ≤1/2W</td><td>1</td></tr>
<tr><td>ϕ＞1/2W</td><td>0</td></tr>
</table>
Unit: mm</td></tr>
<tr><td>8</td><td>Back-light</td><td>The color of backlight should correspond its specification.<br>Not allow flickering</td></tr>
<tr><td>9</td><td>Soldering</td><td>Not allow heavy dirty and solder ball on PCB.<br>(The size of dirty refer to point and dust defect)<br>Over 50% of lead should be soldered on Land.<br> 
</td></tr>
<tr><td>10</td><td>Wire</td><td>Copper wire should not be rusted<br>Not allow crack on copper wire connection.<br>Not allow reversing the position of the flat cable.<br>Not allow exposed copper wire inside the flat cable.</td></tr>
<tr><td>11</td><td>PCB</td><td>Not allow screw rust or damage.<br>Not allow missing or wrong putting of component.</td></tr>
<tr><td>12</td><td>Protruded<br>W: Terminal Width</td><td> 

Acceptable criteria: Y ≤ 0.4</td></tr>
<tr><td>13</td><td>TAB</td><td>1. Position<br> 

W1≤1/3W<br>H1≤1/3H<br>B bonding strength test<br> 

P (=F/TAB bonding width) ≥650gf/cm ,(speed rate: 1mm/min)<br>5pcs per SOA (shipment)</td></tr>
<tr><td>14</td><td>Total no. of acceptable<br>Defect</td><td>A. Zone<br>Maximum 2 minor non-conformities per one unit.<br>Defect distance: each point to be separated over 10mm<br>B. Zone<br>It is acceptable when it is no trouble for quality and assembly<br>in customer’s end product.</td></tr>
</table>



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### *12.3 Reliability of LCM*

Reliability test condition:

| Item | Condition | Time(hrs) | Assessment |
|---|---|---|---|
| High temp. Storage | 80°C | 48 | No abnormalities in functions and appearance |
| High temp. Operating | 70°C | 48 | |
| Low temp. Storage | -30°C | 48 | |
| Low temp. Operating | -20°C | 48 | |
| Humidity | 40°C/ 90%RH | 48 | |
| Temp. Cycle | 0°C ← 25°C →50°C (30 min ← 5 min → 30min) | 10cycles | |

Recovery time should be 24 hours minimum. Moreover, functions, performance and appearance shall be free from remarkable deterioration within 50,000 hours under ordinary operating and storage conditions room temperature (25°C), normal humidity (below 65% RH), and in the area not exposed to direct sun light.

### *12.4 Precaution for using LCD/LCM*

LCD/LCM is assembled and adjusted with a high degree of precision. Do not attempt to make any alteration or modification. The followings should be noted.

#### *12.4.1 General Precaution*

LCD panel is made of glass. Avoid excessive mechanical shock or applying strong pressure onto the surface of display area.
The polarizer used on the display surface is easily scratched and damaged. Extreme care should be taken when handling. To clean dust or dirt off the display surface, wipe gently with cotton, or other soft material soaked with isoproply alcohol, ethyl alcohol or trichlorotriflorothane, do not use water, ketone or aromatics and never scrub hard.
Do not tamper in any way with the tabs on the metal frame.
Do not make any modification on the PCB without consulting OCULAR ENTERPRISES
When mounting a LCM, make sure that the PCB is not under any stress such as bending or twisting. Elastomer contacts are very delicate and missing pixels could result from slight dislocation of any of the elements.
Avoid pressing on the metal bezel, otherwise the elastomer connector could be deformed and lose contact, resulting in missing pixels and also cause rainbow on the display.
Be careful not to touch or swallow liquid crystal that might leak from a damaged cell. Any liquid crystal adheres to skin or clothes, wash it off immediately with soap and water.

#### *12.4.2 Static Electricity Precaution*

CMOS-LSI is used for the module circuit; therefore operators should be grounded whenever he/she comes into contact with the module.
Do not touch any of the conductive parts such as the LSI pads; the copper leads on the PCB and the interface terminals with any parts of the human body.
Do not touch the connection terminals of the display with bare hand; it will cause disconnection or defective insulation of terminals.
The modules should be kept in anti-static bags or other containers resistant to static for storage.
Only properly grounded soldering irons should be used.
If an electric screwdriver is used, it should be grounded and shielded to prevent sparks.
The normal static prevention measures should be observed for work clothes and working benches. Since dry air is inductive to static, a relative humidity of 50-60% is recommended.



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### *12.4.3 Soldering Precaution*

Soldering should be performed only on the I/O terminals.
Use soldering irons with proper grounding and no leakage.
Soldering temperature: 280°C+10°C
Soldering time: 3 to 4 second.
Use eutectic solder with resin flux filling.
If flux is used, the LCD surface should be protected to avoid spattering flux.
Flux residue should be removed.

### *12.4.4 Operation Precautions*

1. The viewing angle can be adjusted by varying the LCD driving voltage Vo.
2. Since applied DC voltage causes electro-chemical reactions, which deteriorate the display, the applied pulse waveform should be a symmetric waveform such that no DC component remains. Be sure to use the specified operating voltage.
3. Driving voltage should be kept within specified range; excess voltage will shorten display life.
4. Response time increases with decrease in temperature.
5, Display color may be affected at temperatures above its operational range.
6. Keep the temperature within the specified range usage and storage. Excessive temperature and humidity could cause polarization degradation, polarizer peel-off or generate bubbles.
7. For long-term storage over 40°C is required, the relative humidity should be kept below 60% and avoid direct sunlight.

## *12.5 Limited Warranty*

OCULAR ENTERPRISES LCDs and modules are not consumer products, but may be incorporated by OCULAR ENTERPRISES's customers into consumer products or components thereof, OCULAR ENTERPRISES does not warrant that its LCDs and components are fit for any such particular purpose.

1. The liability of OCULAR ENTERPRISES is limited to repair or replacement on the terms set forth below. OCULAR ENTERPRISES will not be responsible for any subsequent or consequential events or injury or damage to any personnel or user including third party personnel and/or user. Unless otherwise agreed in writing between OCULAR ENTERPRISES and the customer, OCULAR ENTERPRISES will only replace or repair any of its LCD which is found defective electrically or visually when inspected in accordance with OCULAR ENTERPRISES general LCD inspection standard . (Copies available on request)
2. No warranty can be granted if any of the precautions state in handling liquid crystal display above has been disregarded. Broken glass, scratches on polarizer mechanical damages as well as defects that are caused accelerated environment tests are excluded from warranty.
3. In returning the LCD/LCM, they must be properly packaged; there should be detailed description of the failures or defect.

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