

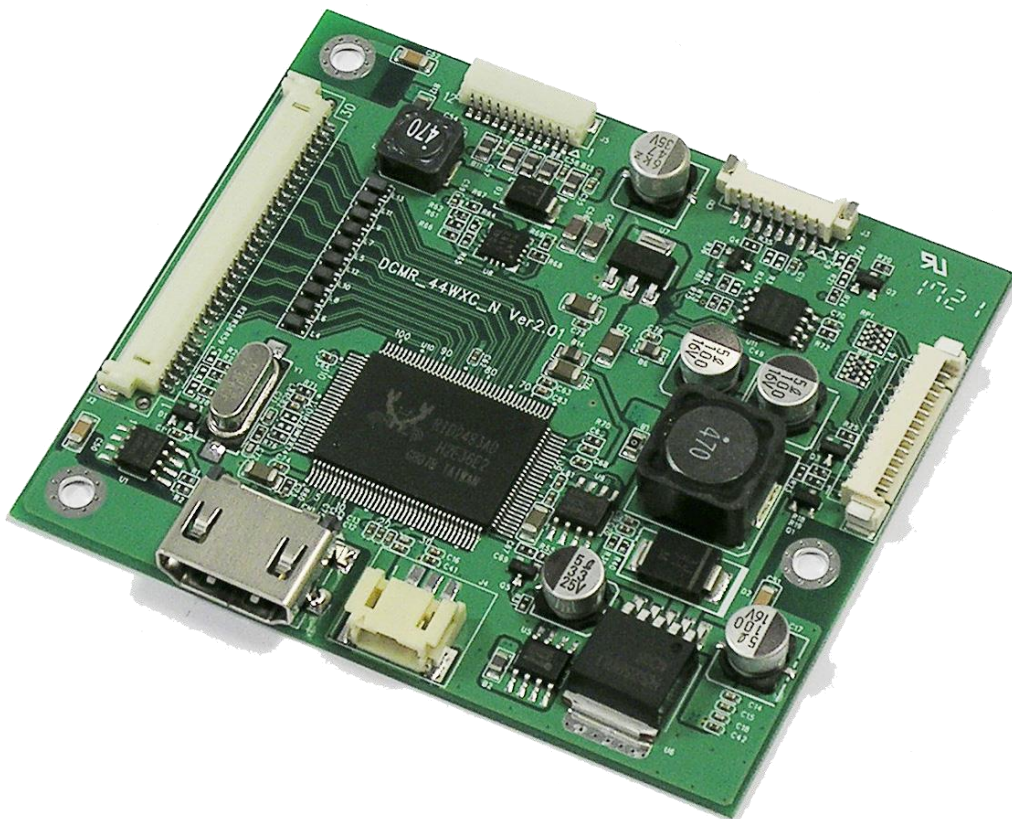
Specification for approval

(HDMI Interface Controller for TFT-LCD Interface)

Product Specification Status

- Preliminary
- Final

Model: DCMR-44



Customer

Approved by
(Name / Title)

Signature

Please return one of these to us immediately with your signature for approval.

This specification is subject to legal disclaimers.

1. Product Overview

This HDMI to LVDS converter board accepts common video signals. HDMI 1.4a and all backward compatible signals are supported. It generates all necessary control signals and panel data to drive TFT-LCDs with V_{DD} level 3.3V. This TFT-controller board supports resolutions up to 1920x1200 (WUXGA) at a vertical refresh rate up to 60Hz. The user interface includes brightness, contrast adjustment, etc. by on-screen programming. For automatic backlight adjustment an ambient light sensor is supported.

2. Features

General

- Support up to 1920x1200 (WUXGA) resolution @ 60Hz
- Support displays with LVDS V_{DD} 3.3V DDC/CI support by embedded DDC
- I²C-bus Interface
- Power management support (DPMS - VESA compliant)

HDMI 1.4a Compliant Digital Input Interface

- Single link on-chip TMDS receiver up to 225MHz
- High-Bandwidth Digital Content Protection (HDCP v1.3) support
- Support DVI 1.0

Auto Detection / Calibration

- Input format detection
- Compatibility with standard VESA Mode
- Smart engine for phase / image position / color calibration

Scaling

- Fully programmable zoom ratios
- Independent horizontal/vertical scaling

- Advanced zoom algorithm provides high image quality
- Sharpness/Smooth filter enhancement
- Support non-linear scaling from 4:3 to 16:9 or 16:9 to 4:3

Color Processor

- True 10-bit color processing engine
- sRGB compliance

Output Interface

- Dual-LVDS 24-bit output interface
- Spread-Spectrum DPLL to reduce EMI
- Support VESA and JEIDA Mapping

On Screen Display menu

- Backlight dimming
- Color adjustment (contrast, brightness, etc.)
- Several other settings

Environmental

- ✓RoHS
- ✓REACH

3. Functional Diagram

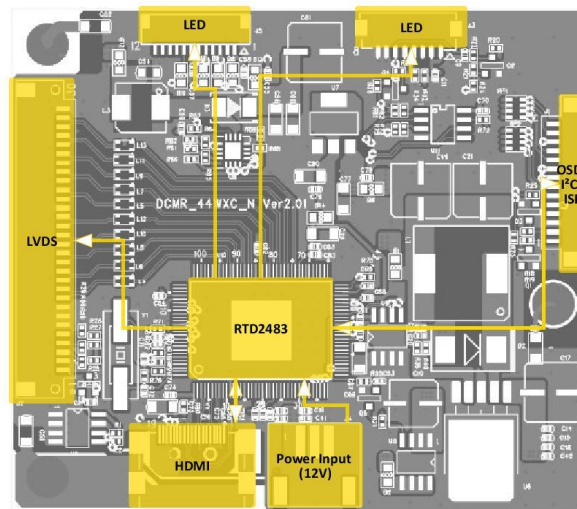


Fig 1. System Diagram

4. Typical Application

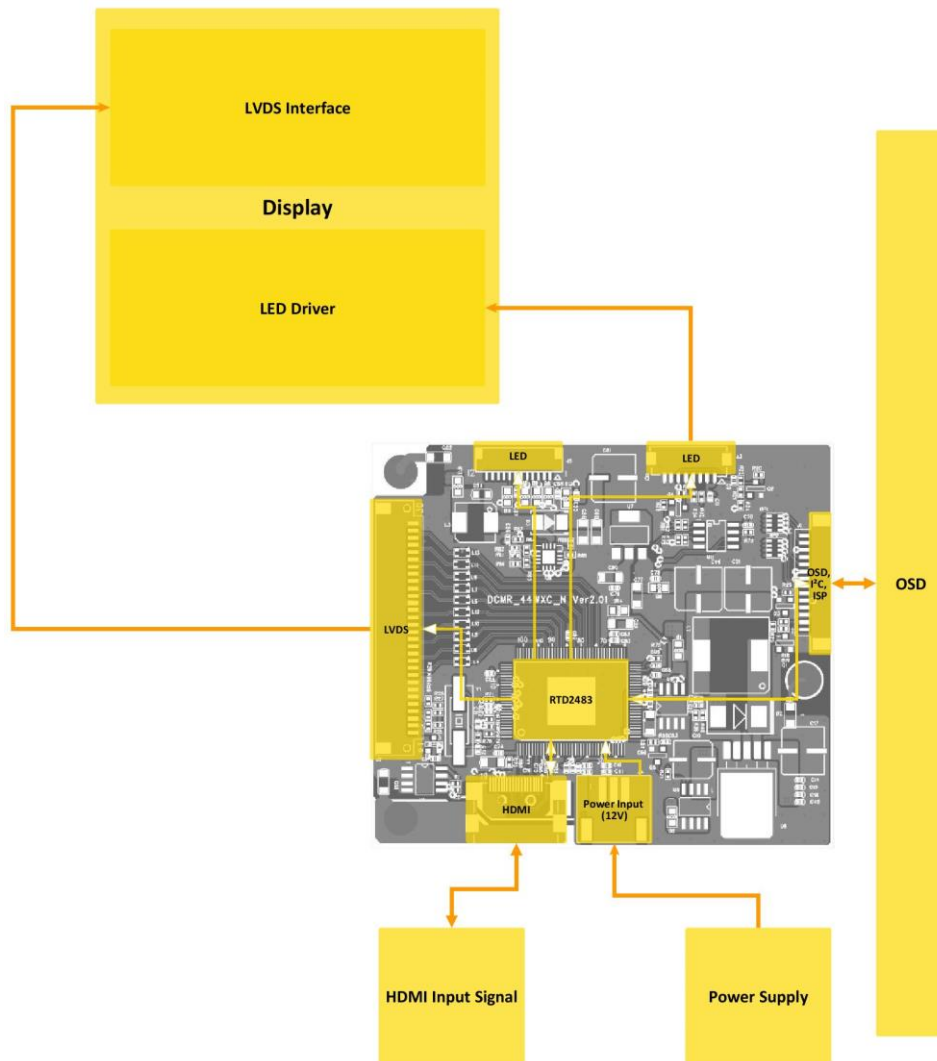


Fig 2. Application of DCMR-44

5. Electrical Characteristics

All ratings @ $V_{DD} = 12.0V$, $\vartheta = 25^{\circ}C$ unless otherwise noted.

5.1. Input

Table 1. Electrical Input Characteristics

| Symbol | Parameter | Test conditions | Min | Typ | Max | Unit |
|-------------|-----------------------------------|-----------------|------|------|------|------|
| V_{DD} | Operating Supply Voltage | - | 10.8 | 12.0 | 13.2 | V DC |
| V_{DDmax} | Absolute Max. Rating ¹ | - | -0.3 | - | 16.0 | V DC |

¹ Consider ratings of connected parts

| | | | | | | |
|--------------------------------|----------------------------------|--------------------------------|------|------|------|----|
| I _{DD} | Current Consumption ² | Board Only | 89 | 125 | 138 | mA |
| | | (active mode) | | | | |
| | | Board Only | - | 9 | - | mA |
| | | (sleep mode) | | | | |
| | | With WVGA Display ³ | 0.17 | 0.29 | 0.43 | A |
| With SXGA Display ⁴ | 0.25 | 0.74 | 1.27 | A | | |
| | | With FHD Display ⁵ | 0.34 | 0.80 | 1.16 | A |
| P _C | Power Consumption | Active mode | 1.07 | 1.50 | 1.66 | W |

5.2. Output

Table 2. Electrical Output Characteristics

| Symbol | Parameter | Test conditions | Min | Typ | Max | Unit |
|-----------------------|--|-----------------|------|------|------|------|
| V _{Panel} | Display Power Supply | - | 3.0 | 3.3 | 3.6 | V DC |
| V _{BKL} | Backlight Power Supply | - | 10.8 | 12.0 | 13.2 | V DC |
| V _{BKL_EN} | Backlight Enable Voltage | - | 3.0 | 3.3 | 3.6 | V DC |
| V _{BKL_ADJ} | Backlight Adjust Voltage | - | 3.0 | 3.3 | 3.6 | V DC |
| V _{LED} | LED String Forward Voltage per channel | - | - | 24 | 36 | V |
| P _{LED} | LED driver power output | - | - | 1.2 | 6 | W |
| I _{LED} | LED Channel current per pin | - | 10 | 50 | 175 | mA |
| ΔI _{LED} | LED Channel Matching | - | -5 | ±1 | 5 | % |
| V _{LED_FMAX} | LED string short-circuit voltage limit | - | - | 18 | - | V |
| V _{LED_FMAX} | LED string open-circuit voltage limit | - | - | 30 | - | V |

² Current consumption depends on the firmware used (resolution)

³ Test was performed with InnoLux G070Y2-L01 Rev. C6 (WVGA, 500cd/m²). Backlight PWM duty ratio min: 10%

⁴ Test was performed with CPT CLAA190EB01CW (SXGA, 450cd/m²). Backlight PWM duty ratio min: 5%

⁵ Test was performed with AUO G133HAN01.0 (FHD, 400cd/m²). Backlight PWM duty ratio min: 5%

6. OSD (On-Screen Display)

The user-friendly, intuitive controllable integrated OSD menu provides certain functions to change settings, adjust the image and others. It can be controlled by an OSD-keyboard. The status of the LCD controller can be checked by a LED which is integrated on the keyboard.

6.1.OSD-Keyboard

There are 5 buttons to control the OSD by the OSD-keyboard and one LED on it to show the board's status.

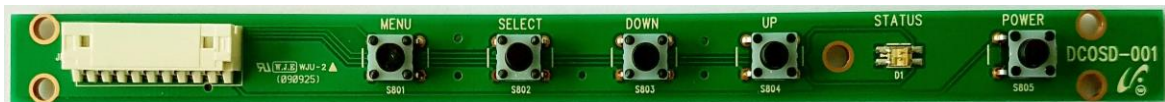


Fig 3. OSD-keyboard

Buttons

The function of each OSD key is shown in the following table.

Table 3. OSD keyboard functions

| No. | Button | Switch Function | Hot-Key Function |
|-----|--------|--|---------------------|
| 1 | Menu | 1. Open / Close OSD Main Menu 2. Leave setting without change | - |
| 2 | Select | Select an item / leave setting and save | Change input source |
| 3 | Down | 1. Move to down / left in menu list 2. Decrease the value of selected item | - |
| 4 | Up | 1. Move to upside / right in menu list 2. Increase the value of selected item | Show signal info |
| 5 | Power | Turn power on / off | - |

LED

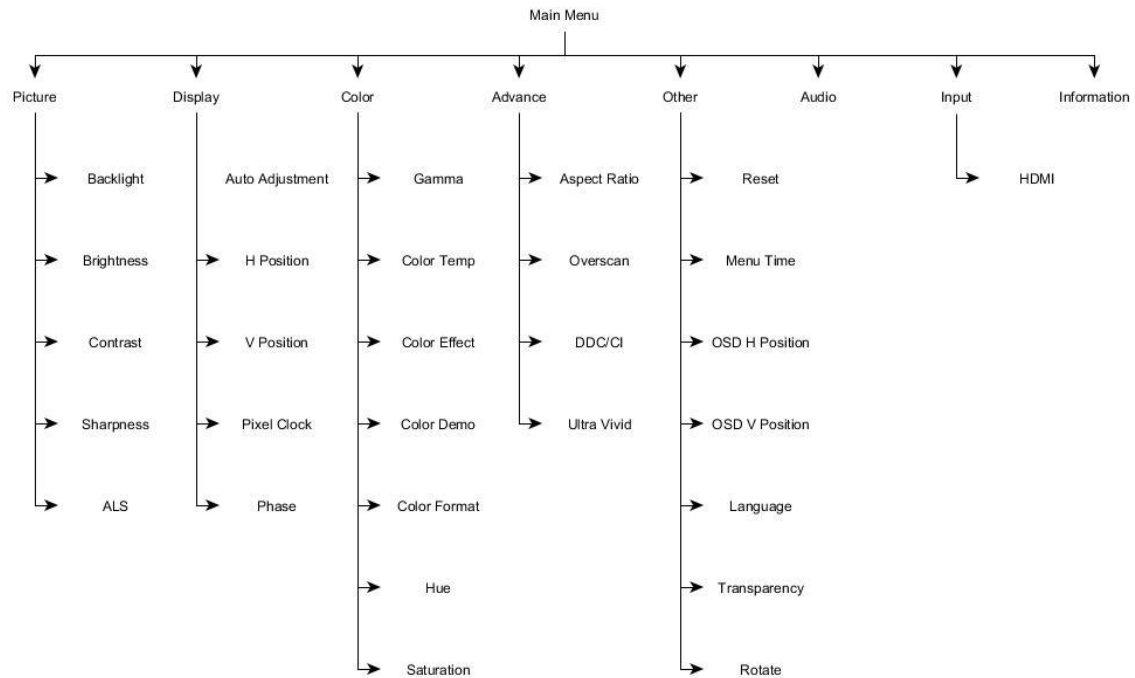
LED colors and their meanings are described in the table below.

Table 4. OSD-keyboard LED status lights

| LED Color | Status | Meaning |
|-----------|----------|-------------------------------|
| Green | Constant | Normal state |
| Amber | Flashing | DPMS mode (can't find signal) |
| Red | Constant | Searching signal |

6.2.OSD-menu

Menu Structure



Menu Items



Fig 4. Menu Items

Table 5. OSD Overview: Menu Items

| Title | Function |
|-------------|---------------------------------------|
| Picture | Adjust and optimize the image |
| Display | Adjust H- & V-Position of the image |
| Color | Adjust and optimize the color |
| Advance | Advanced settings |
| Input | Input source selection |
| Other | Adjust the On-Screen-Display settings |
| Information | Information about current timing |

Main-Menu: Picture

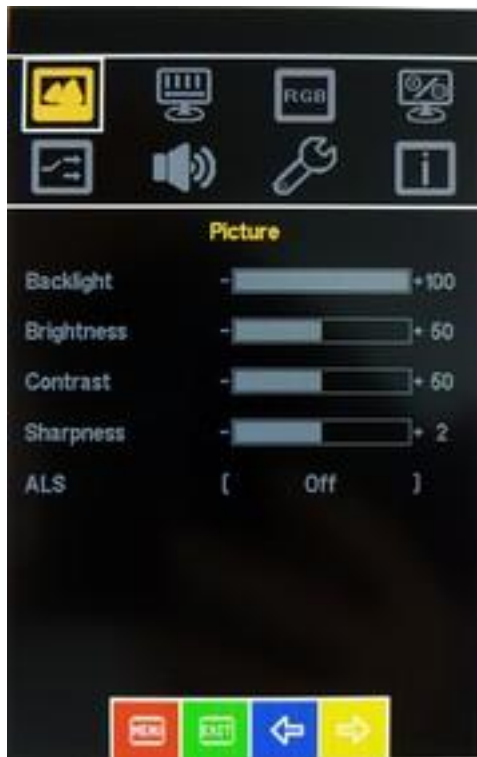


Fig 5. Main-Menu: Picture

Table 6. OSD Overview: Main-Menu Picture

| Title | Function |
|------------|------------------------------------|
| Backlight | Adjust the backlight-intensity |
| Brightness | Adjust the brightness of the image |
| Contrast | Adjust the contrast of the image |
| Sharpness | Adjust the sharpness of the image |
| ALS | Ambient Light Sensor settings |

Sub-Menu: ALS



Fig 6. Sub-Menu: ALS

Table 7. OSD Overview: Sub-Menu ALS

| Title | Function |
|-----------------------|--|
| Min. backlight at | Adjust the illuminance for minimal backlight |
| Max. backlight at | Adjust the illuminance for maximum backlight |
| Transition speed | Adjust the transition speed [ms] |
| Ignore Lux diff. less | Minimum difference in illuminance to trigger backlight adjustments |
| Current Lux value | Displays the current illuminance measured |

Main-Menu: Display



Fig 7. Main-Menu: Display

Main-Menu: Color



Fig 8. Main-Menu: Color

Table 8. OSD Overview: Main-Menu Display

| Title | Function |
|-----------------|--|
| Auto Adjustment | Input format detection and phase / image position adjustment |
| H Position | Adjust horizontal position of the image |
| V Position | Adjust vertical position of the image |
| Pixel Clock | Adjust pixel clock |
| Phase | Adjust phase |

Table 9. OSD Overview: Main-Menu Color

| Title | Function |
|--------------|--|
| Gamma | Adjust gamma level of the image |
| Color Temp | Adjust the color temperature |
| Color Effect | Select a color effect |
| Color Demo | Select a mode to check hue and saturation settings |
| Color Format | Select a color space |
| Hue | Adjust the color balance |
| Saturation | Adjust the color intensity |

Sub-Menu: Color Temp - User



Fig 9. Sub-Menu: Color Temp - User

Sub-Menu: Color Effect - User

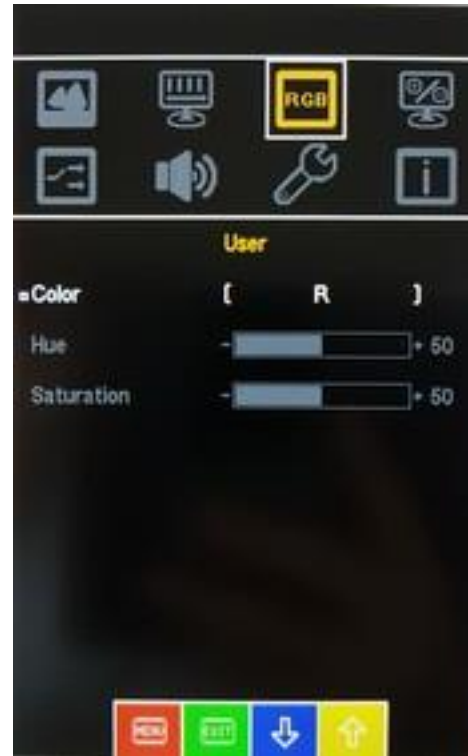


Fig 10. Sub-Menu: Color Effect - User

Table 10. OSD Overview: Sub-Menu: Color Temp - User

| Title | Function |
|-------|-------------------------|
| R | Adjust red video gain |
| G | Adjust green video gain |
| B | Adjust blue video gain |

Table 11. OSD Overview: Sub-Menu: Color Effect - User

| Title | Function |
|------------|---------------------------------------|
| Color | Select 6-axis color |
| Hue | Adjust hue of respective color |
| Saturation | Adjust saturation of respective color |

Main-Menu: Advance



Fig 11. Main-Menu: Advance

Table 12. OSD Overview: Main-Menu Advance

| Title | Function |
|--------------|--|
| Aspect Ratio | Select aspect ratio or scaling factor of the image |
| Overscan | Enable / Disable overscan function |
| DDC/CI | Enable / Disable DDC/CI function |
| Ultra Vivid | Select grades of Ultra Vivid color mode |

Main-Menu: Input

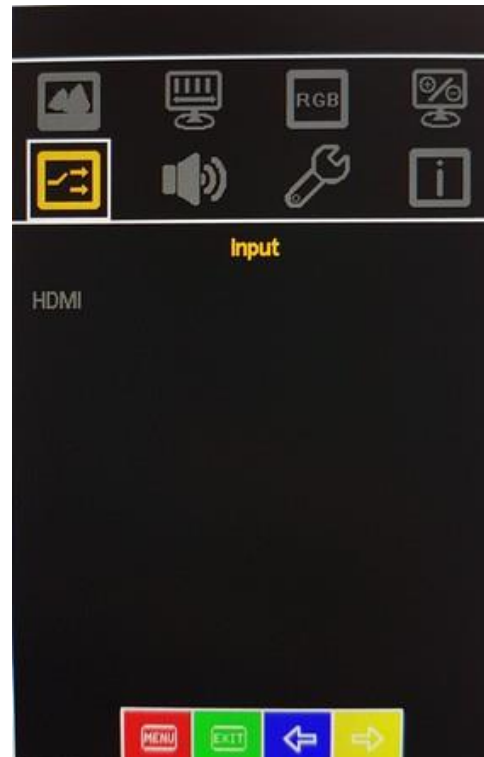


Fig 12. Main-Menu: Input

Table 13. OSD Overview: Main-Menu Input

| Title | Function |
|-------|----------|
| HDMI | n/a |

Main-Menu: Other



Fig 13. Main-Menu: Other

Main-Menu: Information

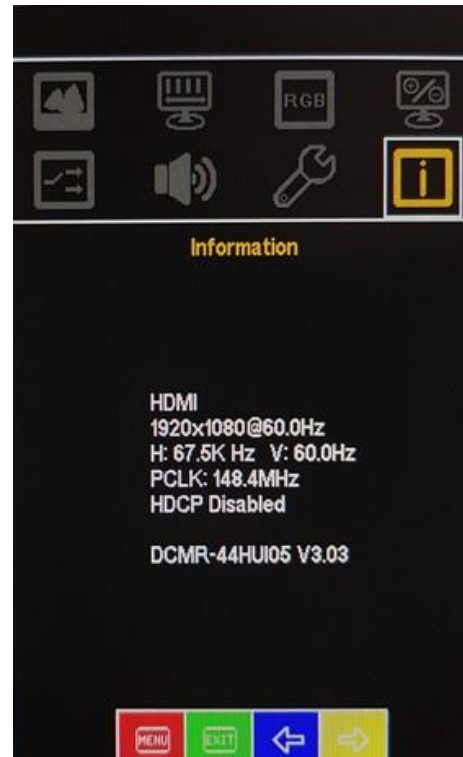


Fig 14. Main-Menu: Information

Table 14. OSD Overview: Main-Menu Other

| Title | Function |
|----------------|---|
| Reset | Reset all OSD settings to factory mode |
| Menu Time | Set the OSD duration [s] |
| OSD H Position | Set the horizontal position of OSD menu |
| OSD V Position | Set the vertical position of OSD menu |
| Language | Select the OSD language (EN/DE) |
| Transparency | Adjust the transparency of the OSD menu |
| Rotate | Enable / Disable 90° OSD rotation |

Table 15. OSD Overview: Main-Menu Information

| Title | Function |
|-----------------------------|----------------------|
| Signal Source | HDMI |
| Current resolution | 1920x1080@60.0Hz |
| H- & V-frequency | H: 67.5kHz V: 60.0Hz |
| Pixel clock frequency | PCLK: 148.4MHz |
| HDCP function state | HDCP Disabled |
| Firmware name and – version | DCMR-44HUI05 V3.03 |

7. Interfaces

7.1. LVDS Interface

At the LVDS-Interface, single- and dual-channel LVDS is supported. As the board is delivered pre-configured, no changes have to be made to the settings. Pixel clocks up to 186MHz and therefore a resolution up to WUXGA @ 60Hz are supported.

Settings

In order to achieve reliable communication when using longer cables, pre-emphasis may be applied to the LVDS signal lines. On the other hand the spread spectrum function can enhance the behavior in an EMI sensitive environment.

For further information please contact Beck GmbH & Co. Elektronik Bauelemente KG.

Mapping

6-bit and 8-bit per color (18-bit or 24-bit color depth) VESA- and JEIDA-mappings are supported at the LVDS-interface. The bit numbering of pixels is big endian, where the most significant bit has the largest bit number.

Table 16. LVDS Bit Number Mappings

| VESA | | JEIDA | |
|-------|-------|-------|-------|
| 6-bit | 8-bit | 6-bit | 8-bit |
| 5 | 7 | 5 | 5 |
| 4 | 6 | 4 | 4 |
| 3 | 5 | 3 | 3 |
| 2 | 4 | 2 | 2 |
| 1 | 3 | 1 | 1 |
| 0 | 2 | 0 | 0 |
| | 1 | | 7 |
| | 0 | | 6 |

The following tables are identical for odd and even lines.

Table 17. VESA Data Packing

| LVDS Data Line | Bit position | | | | | | |
|-------------------|--------------|----|----|----|----|----|----|
| | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| D 0 | G0 | R5 | R4 | R3 | R2 | R1 | R0 |
| D 1 | B1 | B0 | G5 | G4 | G3 | G2 | G1 |
| D 2 | DE | VS | HS | B5 | B4 | B3 | B2 |
| D 3 (for 8-bit) | - | B7 | B6 | G7 | G6 | R7 | R6 |

Table 18. JEIDA Data Packing

| LVDS Data Line | Bit position | | | | | | |
|-------------------|--------------|----|----|----|----|----|----|
| | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| D 0 | G2 | R7 | R6 | R5 | R4 | R3 | R2 |
| D 1 | B3 | B2 | G7 | G6 | G5 | G4 | G3 |
| D 2 | DE | VS | HS | B7 | B6 | B5 | B4 |
| D 3 (for 8-bit) | - | B1 | B0 | G1 | G0 | R1 | R0 |

7.2. I²C Interface

DCMR-44 can control various slave devices via a general purpose I²C-bus interface. For further information about I²C usage, please contact your local sales partner.

Ambient Light Sensor

DCMR-44 can control an ambient light sensor via an I²C-bus or SMBus interface. Various light sensors are supported which are Plug & Play ready and therefore do not require additional modifications. For further information about ambient light sensor usage, please contact your local sales partner.

Electrical Characteristics

DC Characteristics

Table 19. I²C Interface DC Characteristics

| Symbol | Characteristic | Test conditions | Min | Typ | Max | Unit |
|-----------------|---|--------------------|---------------------|-----|--------------------|------|
| V _{CC} | I ² C-bus operating voltage (internal pull-up) | 3.3V configuration | 3.0 | 3.3 | 3.6 | V |
| V _{IH} | High-level input voltage | | 0.7 V _{CC} | - | - | V |
| V _{IL} | Low-Level input voltage | | - | - | 0.3V _{CC} | V |

AC Characteristics

Table 20. I²C Interface AC Characteristics

| Symbol | Characteristic | Min | Typ | Max | Unit |
|-------------------|-----------------|------|-----|-----|------|
| f _{CLK} | Clock Frequency | - | 100 | 400 | kHz |
| t _{HIGH} | Clock high time | 600 | - | - | ns |
| t _{LOW} | Clock low time | 1300 | - | - | ns |

Operations

In general the I²C-bus operations have to follow the I²C-bus standard. For further information about I²C usage, please contact your local sales partner.

Write

A write operation looks the following way:

| | | | | | | | | |
|-------|----------------|-------|-----|--------------|-----|------|-----|------|
| Start | Device Address | Write | Ack | Word Address | Ack | Data | Ack | Stop |
|-------|----------------|-------|-----|--------------|-----|------|-----|------|

Read

A random read operation looks the following way:

| | | | | | | | | | | | | |
|-------|----------------|-------|-----|-----------------|-----|-------|----------------|------|-----|---------|--------|------|
| Start | Device Address | Write | Ack | Word Address(n) | Ack | Start | Device Address | Read | Ack | Data(n) | No Ack | Stop |
|-------|----------------|-------|-----|-----------------|-----|-------|----------------|------|-----|---------|--------|------|

7.3. DDC

This LCD controller provides a serial communications link between the video adapter and the controller, the DDC (Display Data Channel). Properties such as maximum resolution, color depth and supported video timing modes can be transmitted using DDC.

EDID

The DCMR-44 controller board supports the Extended Display Identification Data (EDID 1.4) standard.

EDID contains basic information about a monitor and its capabilities, including vendor information, maximum image size, color characteristics, factory pre-set timings, frequency range limits, a characters string for the monitor name and serial number. The video adapter uses this information for configuration purposes, so that the monitor and system can work together.

DDC/CI

The display controller complies with the MCCS 2.2 standard. It supports a standard set of MCCS VCP codes to adjust the displayed image or control the display. Read and write commands are available for the following categories:

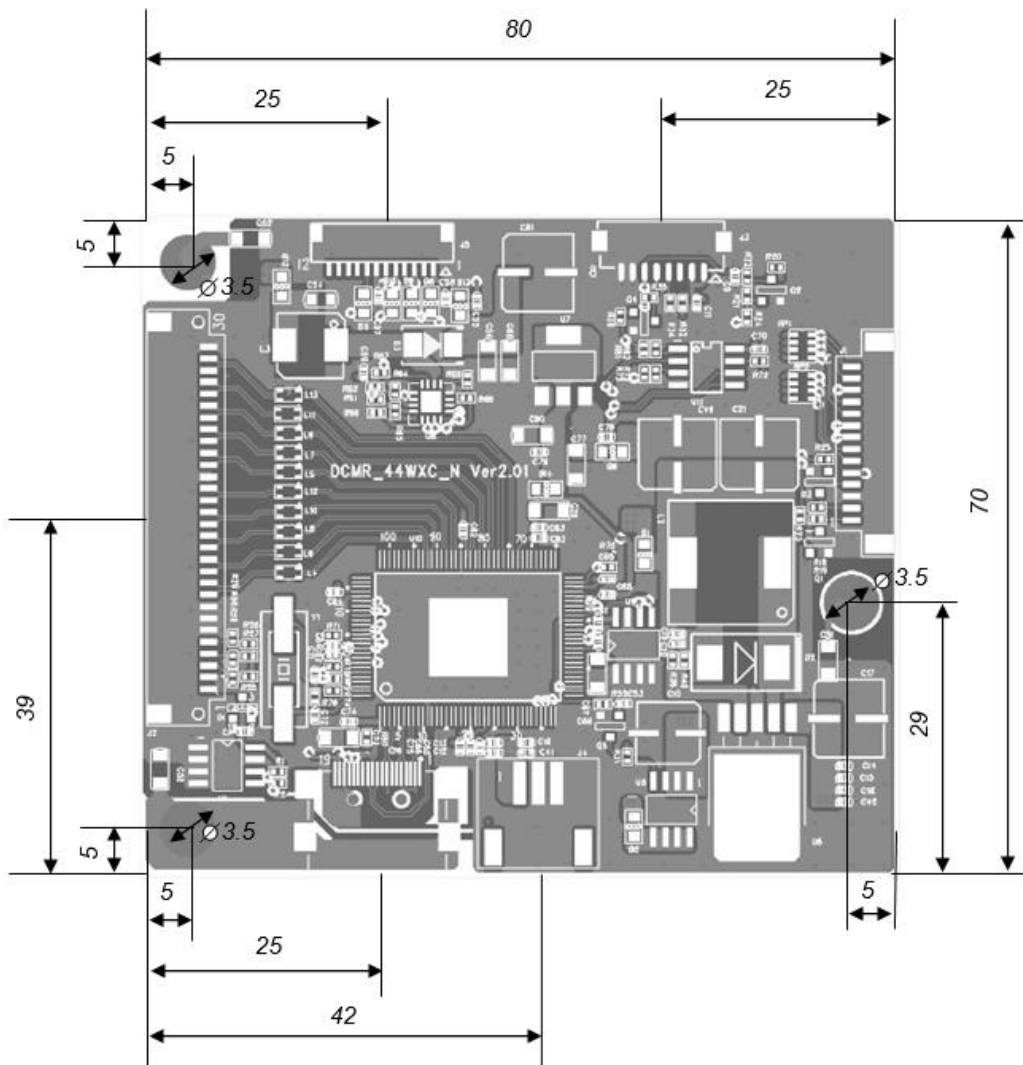
- Image Adjustments
- Color Adjustments
- Image Geometry Adjustments
- Audio Adjustments
- Window Operations
- DPVL Support

For detailed information about the supported MCCS VCP codes, please contact your local sales partner.

8. Mechanical Characteristics

Table 21. Mechanical Characteristics

| Parameter | Value |
|-----------------------|---|
| Dimensions (H x V) | 81.0mm x 70.0mm (80.0mm PCB + 1.0mm connectors) |
| Contour | Rectangular |
| Production technology | SMT |
| Total height | 8.7mm |
| Weight | 29g |



9. Connectors

Abbreviations used within this chapter are listed in the table below.

Table 22. Signal Assignment Abbreviations

| Abbreviation | Description |
|--------------|--------------------------------|
| GND | Ground |
| PWR | Power |
| I | Input |
| O | Output |
| I/O | Bi-directional |
| n.c. | Not connected (do not connect) |

9.1. Connector Overview

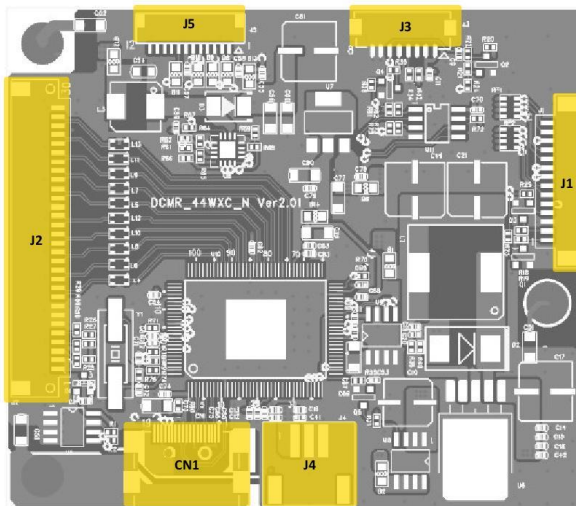


Fig 15. Connector Overview

9.2. Input Connectors

Power Connector (J4)

The Power Connector (J4) supplies the board with power. The connection is mandatory.

Table 23. Power Connector (J4)

| Parameter | Value |
|-----------------------------------|---|
| Manufacturer: Connector model no. | JST: S3B-PH-K-S |
| Pin amount | 3 pins (use Pin 1 as marked on connector) |
| Mating housing part | JST: PHR-3 |



Fig 16. JST: S3B-PH-K-S

Table 24. Power Connector Pin Assignment

| Pin | Signal | Description | Type |
|-----|--------|-----------------|------|
| 1 | VIN | 12V power input | PWR |
| 2 | GND | Ground | GND |
| 3 | GND | Ground | GND |

HDMI Connector (CN1)

The HDMI Connector (CN1) can be used to provide a digital video signal to the board. The connection is mandatory.

Table 25. HDMI Connector (CN1)

| Parameter | Value |
|-----------------------------------|---|
| Manufacturer: Connector model no. | Standard HDMI Type A (Single Link) receptacle |
| Pin amount | 19 pins |
| Mating housing part | Standard HDMI Type A (Single Link) plug |

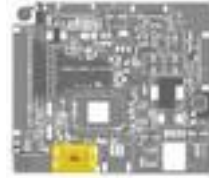


Fig 17. Standard HDMI Type A (Single Link) receptacle

Table 26. HDMI Connector (CN1) Pin Assignment

| Pin | Signal | Description | Type |
|-----|--------|-----------------------|------|
| 1 | D2+ | T.M.D.S. Data2+ | I |
| 2 | GND | T.M.D.S. Data2 shield | GND |
| 3 | D2- | T.M.D.S. Data2- | I |
| 4 | D1+ | T.M.D.S. Data1+ | I |
| 5 | GND | T.M.D.S. Data1 shield | GND |
| 6 | D1- | T.M.D.S. Data1- | I |
| 7 | D0+ | T.M.D.S. Data0+ | I |
| 8 | GND | T.M.D.S. Data0 shield | GND |
| 9 | D0- | T.M.D.S. Data0- | I |
| 10 | RXC+ | T.M.D.S. Clock+ | I |
| 11 | GND | T.M.D.S. Clock shield | GND |
| 12 | RXC- | T.M.D.S. Clock- | I |
| 13 | n.c. | - | n.c. |
| 14 | n.c. | - | n.c. |
| 15 | SCL | DDC Clock | I/O |
| 16 | SDA | DDC Data | I/O |
| 17 | GND | DDC/CEC Ground | GND |
| 18 | VCC | +5V Power | PWR |
| 19 | HPD | Hot-plug detect | I |

OSD, I²C, ISP Interface Connector (J1)

The OSD, I²C, ISP Interface Connector (J1) can be used for different purposes. An OSD-keyboard can be connected, the I²C-bus accessed or the board programmed by this interface. The connection is optional.

Table 27. OSD, I²C, ISP Interface (J1)

| Parameter | Value |
|-----------------------------------|--|
| Manufacturer: Connector model no. | Molex: 53261-1471 |
| Pin amount | 14 pins (use Pin 1 as marked on connector) |
| Mating housing part | Molex: 51021-1400 |



Fig 18. Molex: 53261-1471

Table 28. Pin description

| Pin | Signal | Description | Type |
|-----|----------------------|-----------------------------|------|
| 1 | LED_GN | LED Green | O |
| 2 | LED_RD | LED Red | O |
| 3 | GND OSD/ISP | Ground | GND |
| 4 | Power Key | OSD Key Power | I |
| 5 | 3.3V | Power | O |
| 6 | Menu Key | OSD Key Menu | I |
| 7 | Down Key | OSD Key Down | I |
| 8 | ISP DATA | ISP-I ² C SDA | I/O |
| 9 | ISP CLK | ISP-I ² C SCL | I/O |
| 10 | Up Key | OSD Key Up | I |
| 11 | Sel Key | OSD Key Select | I |
| 12 | n.c. | - | n.c. |
| 13 | I ² C SDA | EEPROM I ² C SDA | I/O |
| 14 | I ² C SCL | EEPROM I ² C SDA | I/O |

9.3. Output Connectors

LVDS Interface (J2)

The LVDS Interface (J2) is the video output interface. The connection is mandatory.

Table 29. LVDS Interface (J2)

| Parameter | Value |
|-----------------------------------|--------------------------------------|
| Manufacturer: Connector model no. | Hirose: DF14-30P1.25H |
| Pin amount | 30 pins (use Pin 1 as marked on PCB) |
| Mating housing part | Hirose: DF14-30S-1.25C |



Fig 19. Hirose: DF14-30P1.25H

Table 30. Pin description

| Pin | Signal | Description | Type |
|-----|---------|---|-------|
| 1 | V_Panel | Panel Power | O |
| 2 | V_Panel | Panel Power | O |
| 3 | DSP | 0Ω to V _{CC} or GND; standard: 0Ω to V _{CC} | O/GND |
| 4 | FRC | 0Ω to V _{CC} or GND; standard: 0Ω to V _{CC} | O/GND |
| 5 | MSL | 0Ω to V _{CC} or GND; standard: 0Ω to V _{CC} | O/GND |
| 6 | GND | Ground | GND |
| 7 | GND | Ground | GND |
| 8 | GND | Ground | GND |
| 9 | TXO0- | Negative LVDS differential data output – Line 0 (odd) | O |
| 10 | TXO0+ | Positive LVDS differential data output – Line 0 (odd) | O |
| 11 | TXO1- | Negative LVDS differential data output – Line 1 (odd) | O |
| 12 | TXO1+ | Positive LVDS differential data output – Line 1 (odd) | O |
| 13 | TXO2- | Negative LVDS differential data output – Line 2 (odd) | O |
| 14 | TXO2+ | Positive LVDS differential data output – Line 2 (odd) | O |
| 15 | TXOCLK- | Negative LVDS differential clock output (odd) | O |
| 16 | TXOCLK+ | Positive LVDS differential clock output (odd) | O |
| 17 | TXO3- | Negative LVDS differential data output – Line 3 (odd) | O |
| 18 | TXO3+ | Positive LVDS differential data output – Line 3 (odd) | O |
| 19 | GND | Ground | GND |
| 20 | TXE0- | Negative LVDS differential data output – Line 0 (even) | O |
| 21 | TXE0+ | Positive LVDS differential data output – Line 0 (even) | O |
| 22 | TXE1- | Negative LVDS differential data output – Line 1 (even) | O |
| 23 | TXE1+ | Positive LVDS differential data output – Line 1 (even) | O |
| 24 | TXE2- | Negative LVDS differential data output – Line 2 (even) | O |
| 25 | TXE2+ | Positive LVDS differential data output – Line 2 (even) | O |
| 26 | TXECLK- | Negative LVDS differential data output (even) | O |
| 27 | TXECLK+ | Positive LVDS differential data output (even) | O |

| | | | |
|----|-------|--|-----|
| 28 | TXE3- | Negative LVDS differential data output – Line 3 (even) | O |
| 29 | TXE3+ | Positive LVDS differential data output – Line 3 (even) | O |
| 30 | GND | Ground | GND |

Backlight Power Connector (J3)

The Backlight Power Connector (J3) is one of two possible ways to power backlight units. When using an (in the display) integrated LED-driver, the connection is mandatory.

Table 31. Backlight Connector (J3)

| Parameter | Value |
|-----------------------------------|---|
| Manufacturer: Connector model no. | Molex: 53261-0871 |
| Pin amount | 8 pins (use Pin 1 as marked on connector) |
| Mating housing part | Molex: 51021-0800 |



Fig 20. Molex: 53261-0871

Table 32. Pin description

| Pin | Signal | Description | Type |
|-----|-----------|-----------------------------------|------|
| 1 | 12V (VIN) | Backlight Power | O |
| 2 | 12V (VIN) | Backlight Power | O |
| 3 | n.c. | - | - |
| 4 | n.c. | 0Ω to 12V or GND; standard: n. c. | - |
| 5 | BKL_EN | Backlight Enable | O |
| 6 | BKL_ADJ | Backlight Adjust | O |
| 7 | GND | Ground | GND |
| 8 | GND | Ground | GND |

Backlight Power Connector (J5)

The Backlight Power Connector (J5) is one of two possible ways to power backlight units. It can be used to directly connect the on-board multi-channel LED-driver to the BLU of the display. The connection is optional.

Table 33. Backlight Connector (J5)

| Parameter | Value |
|-----------------------------------|--|
| Manufacturer: Connector model no. | JST: SM12B-SRSS-TB |
| Pin amount | 12 pins (use Pin 1 as marked on connector) |
| Mating housing part | JST: SHR-12V-S-B |



Fig 21. JST: SM12B-SRSS-TB

Table 34. Pin description

| Pin | Signal | Description | Type |
|-----|---------------------|-------------|------|
| 1 | V _{LED_A1} | Anode 1 | O |
| 2 | LED_C1 | Cathode 1 | I |
| 3 | V _{LED_A2} | Anode 2 | O |
| 4 | LED_C2 | Cathode 2 | I |
| 5 | V _{LED_A3} | Anode 3 | O |
| 6 | LED_C3 | Cathode 3 | I |
| 7 | V _{LED_A4} | Anode 4 | O |
| 8 | LED_C4 | Cathode 4 | I |
| 9 | n.c. | - | - |
| 10 | n.c. | - | - |
| 11 | n.c. | - | - |
| 12 | n.c. | - | - |

10. Reliability

Table 35. Reliability test

| Symbol | Test item | Min | Max | Unit |
|------------------|------------------------------------|-----|-----|------|
| ϑ_{ST} | Storage temperature | -20 | 70 | °C |
| ϑ_{OP} | Operating temperature ⁶ | 0 | 60 | °C |

11. Absolute Maximum Ratings

Table 36. Absolute maximum ratings

| Symbol | Test item | Min | Max | Unit |
|------------------|-----------------------|-----|-----|------|
| ϑ_{ST} | Storage temperature | -35 | 70 | °C |
| ϑ_{OP} | Operating temperature | -10 | 65 | °C |

12. Application Information

12.1. Operating Precautions

- Be sure to ground yourself before handling the controller board.
- Turn off power supply before inserting or disconnecting any connector.
- Spike noise causes misoperation of circuits. It should be lower than following voltage: $\pm 200\text{mV}$ (over and under shoot voltage).
- This module has high frequency circuits. Sufficient suppression to the electromagnetic interference shall be done by system manufacturers. Grounding and shielding methods may be important to minimize the interference.

12.2. General Cautions

- The responsibility for the applicability of customer specific products and use in a particular customer design is always within the authority of the customer.
- An important factor for each system integration is the thermal design. System designers might need to implement a passive or active cooling system in their specific design to keep the temperatures of all parts within the specification.
- Be careful for condensation at sudden temperature change. Condensation damages electrical contacted parts.
- When preparing a cable for a specific display, always refer to appropriate cable pin-out and display specification. Always check the signals before connecting the cable. Any

⁶ Phase- or clock-shift can appear between -10°C and 0°C

incorrect pin connection may damage the display and the controller permanently.

- Take care of all the sensitive electronic components
- Do not modify the module assembly
- You must mount a module using its respective mounting holes and avoid any bend force during mounting.
- Be sure to do a reset in OSD if any problem occurs during operation
- Should you need any technical help, please contact Beck GmbH & Co. Elektronik Bauelemente KG

13. Packing / Labels

Serial number looks in general the following way:

ABCN.NN-YYMMDDXXXX

Table 37. S/N Encoding

| Code | Meaning |
|--------|-----------------------------------|
| ABC | Acronym for the SMT producer |
| N.NN | Firmware version VN.NN |
| YYMMDD | Manufacturing date (YY/MM/DD) |
| XXXX | Manufacturing sequence of product |

14. Abbreviations

Table 38. Abbreviations

| Abbr. | Description |
|-----------------------|--|
| ALS | Ambient Light Sensor |
| BLU | Backlight Unit |
| BPC | Bits Per Color |
| BPP | Bits Per Pixel |
| DDC | Display Data Channel |
| DDC/CI | Display Data Channel Command Interface |
| DDWG | Digital Display Working Group |
| DPLL | Digital Phase-Locked Loop |
| DPMS | Display Power Management Service |
| EDID | Extended Display Identification Data |
| EEPROM | Electrically Erasable Programmable Read-Only Memory |
| EMI | Electromagnetic Interference |
| GND | Ground |
| HDCP | High Digital Content Protection |
| HDMI | High Definition Multimedia Interface |
| I²C | Inter Integrated Circuit |
| ISP | In System Programming |
| JEIDA | Japan Electronic Industry Development Association |
| LCD | Liquid Crystal Display |
| LED | Light Emitting Diode |
| LVDS | Low Voltage Different Signaling |
| MCCS | Monitor Command Control Set |
| OSD | On Screen Display |
| PCB | Printed Circuit Board |
| PCLK | Pixel Clock |
| PWM | Pulse Width Modulation |
| REACH | Registration, Evaluation, Authorization and Restriction of Chemicals |
| RGB | Red, Green, Blue |
| RoHS | Restriction of Hazardous Substances |
| SMBus | System Management Bus |
| SMT | Surface Mounted Technology |

| | |
|-------------|--|
| SOG | Sync-On-Green |
| sRGB | Standard-RGB |
| TMDS | Transition-Minimized Different Signaling |
| TFT | Thin-Film Transistor |
| VCP | Virtual Control Panel |
| VESA | Video Electronics Standards Association |

15. Revision History

Table 39. Revision History

| Rev. | Date | Section | Specification Status | Description |
|------|--------------|---------|----------------------|---|
| 1.0 | Jan 31, 2014 | All | Final | Initial release |
| 1.1 | Jan 30, 2015 | 2 | Final | Added RoHS information |
| 1.2 | Jun 10, 2015 | 12 | Final | Extended descriptions |
| 1.3 | Jul 27, 2016 | 3 | Final | Added resolution tables |
| 1.4 | Feb 12, 2019 | All | Final | Specification update; New specification structure |
| 1.5 | Mar 4, 2019 | 8, 9 | Final | Changed J4 model no.; Changed total height |

16. Legal Information

16.1. Disclaimers

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Stress above one or more limiting values (as defined in section Absolute maximum ratings) may cause permanent damage and irreversibly affect the quality and reliability of the device.

16.2. Trademarks

All referenced brands, product names, service names and trademarks are the property of their respective owners.

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