Marine Grade Monitor Specification

21.5" Sunlight Readable Flush Mount Display

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Display Panel

- **Panel Type: IPS-class** wide viewing angle without color or image washout. Example:
  - IVO M215GWW1 R0
  - BOE DV215FHM-R10
- High Tni (110°C)
- **Size:** 21.5" diagonal, 16:9 aspect ratio
- **Resolution:** 1920 × 1080 FHD
- **Brightness:** 1500+ nit minimum before Touch sensor, A/R and UV layers, 1200 nit after layers applied
- **Contrast:** 1000:1 typical
- **Viewing Angle:** 89/89/89/89
- **Response Time:** 15ms G-to-G or better
- **Color Depth:** 16.7M (6-bit + FRC acceptable, 8-bit preferred)
- **Color Gamut:** 72% NTSC minimum
- **Polarizer:** Circular polarizer preferred but if linear, polarization lines must be aligned to allow readability in landscape mode with polarized sunglasses.
- **Panel front surface:** Smooth/glossy preferred (no anti-glare texture) to avoid screen sparkle but will accept rough AG finish if it does not cause excessive screen sparkle.
- **Backlight:** WLED, 50,000 hour minimum life
- **Backlight Driver:** Integrated

Touch System

- **Type:** Projected capacitive (PCAP)
- **Touch controller:** "Rugged" platform or outdoor kiosk rated which handles rain at various screen angles without ghosting
- **Touch Points:** 4-point multi-touch
- **Interface:** USB 2.0
- **Water Rejection:** Must work in heavy rain without "ghost touches"
- **Corrosion Resistance:** Standard panels are not salt-air resistant. **Acrylic or Silicone Conformal Coating** is required on the T-CON (Timing Controller) board and the LED driver. Target Standard: MIL-I-46058C or IPC-CC-830B.

Optical Bonding

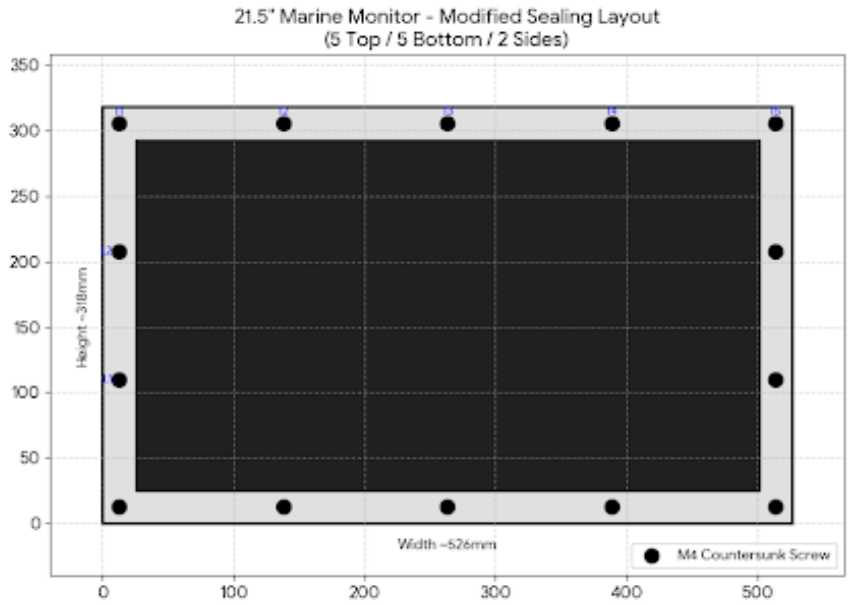
- **Silicone-based LOCA, not acrylic OCA tape.**
- Continuous operating temperature: -40°C to +80°C
- 85/85 testing (85°C, 85% RH, 1000 hours): pass, no delamination or yellowing
- UV exposure: 1000 hours xenon arc per ASTM G155, ΔYI < 2
- Light transmission: ≥99%
- Haze: ≤1%

Environmental

- **Operating Temperature:** -20°C to +80°C
- **Storage Temperature:** -30°C to +85°C
- **Operating Humidity:** Up to 90% RH non-condensing
- **IP Rating:** IP67 front panel (not entire unit)
- **Salt Fog Resistance:** Required - saltwater and freshwater spray, corrosion resistant bezel
- **UV Protection:** Anti-UV treatment on all exposed surfaces
- **Conformal Coating:** Required on all circuit boards
- **Optical Bonding:** Required for all layers. Sealed screen for anti-fog

Mechanical

- **Mounting:** Front-side mounting via countersunk through-holes in the bezel. **NO rear clamps or studs.**
    - Flush/panel mount using front-side through-holes (clearance for 4 mm screw).
    - **Hole Layout:** 14 mounting holes total to ensure IP67 front panel seal compression.
    - **Top Edge:** 5 holes (Equally spaced).
    - **Bottom Edge:** 5 holes (Equally spaced).
    - **Left/Right Edges:** 2 holes each (Centered vertically).
    - **Note:** Corners must be pinned.
    - Closed-cell neoprene/EPDM/silicone gasket between bezel and mounting surface (supplied).
    - 16 pcs (2 spares) Torx head 316 marine Stainless Steel Self-Tapping/Wood mounting Screws, 4mm, Black Oxide finish, included.
    - **Hole Finish:** Countersinks must be anodized/coated black (drilled before coating).



- **Bezel:** 3mm aluminum alloy, flush style, powder coated for marine saltwater use.
  - Mounting flange must be 15mm minimum and 20mm preferred on each side in order to allow marine grade sealing against rain and salt water intrusion.
  - Corner Radius of 4mm/R4.
  - All sharp edges must be deburred; 0.5mm chamfer required on front-facing edges to prevent injury and ensure proper powder coat adhesion.
- **Bezel cover:** UV resistant black plastic screw cover snaps on crisply over the bezel to hide the screws and to provide an additional water barrier for the screws. When installed, this does not impede view of the display.
- **Sun Cover / Dust Cover:** This is a UV resistant snap-on plastic or silicone lid that protects the glass from UV damage and salt crystallization when the boat is docked. Removing the Sun Cover must not pull the bezel cover loose.
- **Cover Glass:** 7H hardness tempered glass, Grade A soda lime/Gorilla, 2.5 mm minimum thickness
- **Color:** Black
- **Cooling:** Fanless design using passive heatsink rated for 50W+ dissipation

Electrical

- **Input Voltage:** Wide 9-36VDC wide range (galvanically isolated to prevent ground loops).
- **Power Consumption:** 60W typical, 80W maximum
- **Video Inputs:** HDMI
- **Touch Interface:** USB 2.0.
- **Connectors:** All interface connections must be via marine style **screw-down keyed IP67 waterproof bulkhead pass-through couplers** mounted on the rear chassis, pointing straight back, not down.
  - **HDMI Input:** Waterproof HDMI Female-to-Female Feed-Through Coupler. (Internal monitor cable plugs into rear of coupler; User plugs male external cable into front and then screws down for IP67).

- **Touch & Data:** Waterproof USB Type-B (Female) Feed-Through Coupler.
  - Same style screw-down keyed IP67 waterproof connector
- **DC Power:** Waterproof 2-Pin or 3-Pin plastic screw down IP67 Connector.
  Pinout: Polarity must be clearly labeled on the rear chassis.
- **Sealing:** All bulkhead connectors must include tethered waterproof sealing caps for when ports are not in use.

Example (or equivalent):

Yes:

No:

Required Features

- **Manual dimming:** Full range 0-100%, 1% steps, accessible via touch screen based electronic external control
  - No front buttons allowed.
  - Back side buttons allowed but not required to be used during operation.
  - Like industry standard MFDs (MultiFunction Displays), software running on PC displays a slider, PC sends command(s) to control dimming, etc.
  - Auto dimming allowed but disabled by default. Prefer if NOT present.
- Mandatory Control Interface
  - **DDC/CI over HDMI**

- The display must support R/W DDC/CI (MCCS v2.2 or better) over HDMI and accessible via standard OS mechanisms on Windows and Linux, with no vendor drivers or background software required.
- Minimum R/W VCP feature code support:

VCP Code	Hex	Name	Function	Required
0x10	VCP_LUMINANCE	Luminance	Backlight/ brightness	One of these
0x6B	VCP_BACKLIGHT_ALT	Backlight Level	Alt backlight	One of these
0x12	VCP_CONTRAST	Contrast	Contrast control	Yes
0x14	VCP_COLOR_PRESET	Color Preset	Selects User1 mode	Yes
0x16	VCP_RED_GAIN	Red Video Gain	Red channel	Yes
0x18	VCP_GREEN_GAIN	Green Video Gain	Green channel	Yes
0x1A	VCP_BLUE_GAIN	Blue Video Gain	Blue channel	Yes
0x87	VCP_SHARPNESS	Sharpness	Image sharpness (0-4)	Yes
0xD6	VCP_POWER_MODE	Power Mode	DPMS power states	Yes
DDC/CI Command Opcodes				
0xE3	DDC_CAP_REPLY	Capabilities Reply	Response to cap request	Yes
0xF3	DDC_CAP_REQUEST	Capabilities Request	Query supported codes	Yes

Every SetVCPFeature() call must:

- **Apply immediately**
- **Be independent** (RGB channels must not influence each other)
- **Power-on state:** Automatically auto-on when power applied
- Display must pass DDC/CI compliance verification using softMCCS utility (https://www.entechtaiwan.com/lib/softmccs.shtm).

Application Environment

- Marine vessel use (boat/yacht)
- Outdoor bright direct sunlight - continuous exposure
- Saltwater and freshwater spray - continuous exposure
- Heavy rain operation required

Deliverables

- Panel date code photos before assembly
- Optical bonding verification photos
- IP67 front panel test certificate
- Salt spray test certificate (or material certification for corrosion resistance)

- Burn-in test (48 hours minimum at full brightness)
- Mounting template drawing (DXF/PDF)
- Cutout dimensions
- Wiring diagram

Cables & Connectors

- **Cables supplied with Monitor:**
- **USB Touch:** 6' cable, screw-down keyed IP67 waterproof both ends. USB Type-B on monitor side, USB Type-A on computer side.
- **HDMI:** 6' cable, screw-down keyed IP67 waterproof both ends. HDMI male on monitor side, HDMI male on computer side.
- **Power:** 6' pigtail, screw-down keyed IP67 waterproof on monitor side, flying leads on other end. Marine grade tinned copper wire.
- **Connector requirements:**
- All connectors: plastic/composite housing, no exposed bare metal
- Waterproof sealing caps included for all ports
- Must document vendor name and model number for all connectors
- Replacement cables must be available for separate purchase

Packaging

- High strength export carton
- Thick foam board inside
- ESD protection

HelmLogix • Marine Information Systems
www.helmlogix.com • dave@helmlogix.com