mekoprint

# Display integration

## Display overview and construction examples

HMI design guide series


HemoCue
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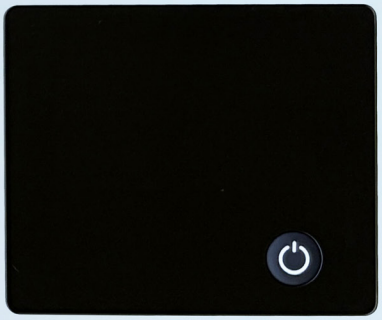


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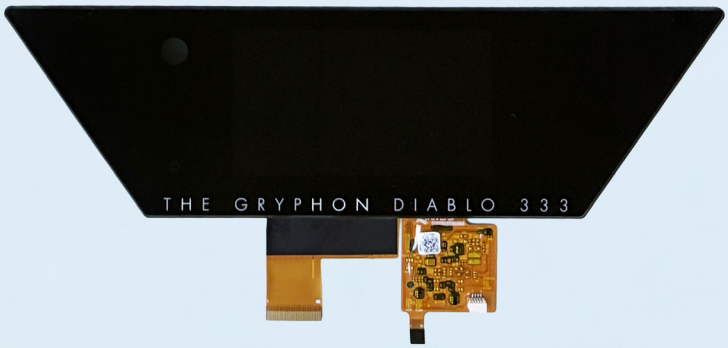
THE GRYPHON DIABLO 333

# Start with the complete HMI

A display should not be treated as a separate component for too long.

In an HMI solution, the display needs to work together with the keypad, front layer, sealing, mechanics, cables and housing. When these elements are considered early, it becomes easier to create a solution that fits the application and supports smooth assembly.

That is why display integration is more than display sourcing. The right display choice depends on the application, but also on how the display is built into the full HMI construction.

In this guide, we look at common display technologies, key selection parameters and practical construction examples for integrating displays into HMI solutions.

# Display technology overview

| | Character LCD | Segment LCD | Graphic LCD |
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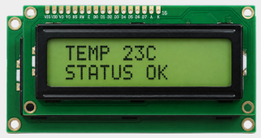
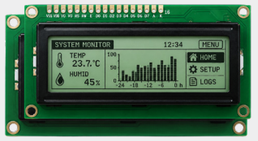
| |  |  |  |
| Typical sizes/ formats | Small standard modules, often 1–4 text lines, such as 16x2 or 20x4 characters | Custom sizes, often compact and designed around fixed symbols or numbers | Available in many sizes and formats, commonly including 128x64px |
| Colour | Monochrome, optional backlight colours | Monochrome, sometimes with icons and backlight | Mostly monochrome, commonly with backlight options |
| Power consumption | Low | Very low | Low to medium |
| Readability | Clear for simple text and numbers in controlled lighting | Very clear for fixed numbers, symbols and status information | Clear for icons, menus and simple graphics in controlled lighting |
| Operating temperature | Standard or extended ranges available. Cold conditions can affect contrast and response time. | Standard or extended operating ranges can be specified. | Standard or extended ranges available. Cold conditions can affect contrast and response time. |
| Response speed | Fast enough for basic information | Fast | Moderate to fast |
| Best suited for | Simple text and number displays where low complexity, low power consumption and clear status information are needed. | Fixed numeric readouts, symbols and status indicators where very low power consumption and high readability are important. | Monochrome interfaces with icons, menus, symbols and simple graphics, including access to larger icon and character libraries. |

| | E-paper | TFT | OLED |
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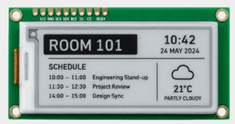
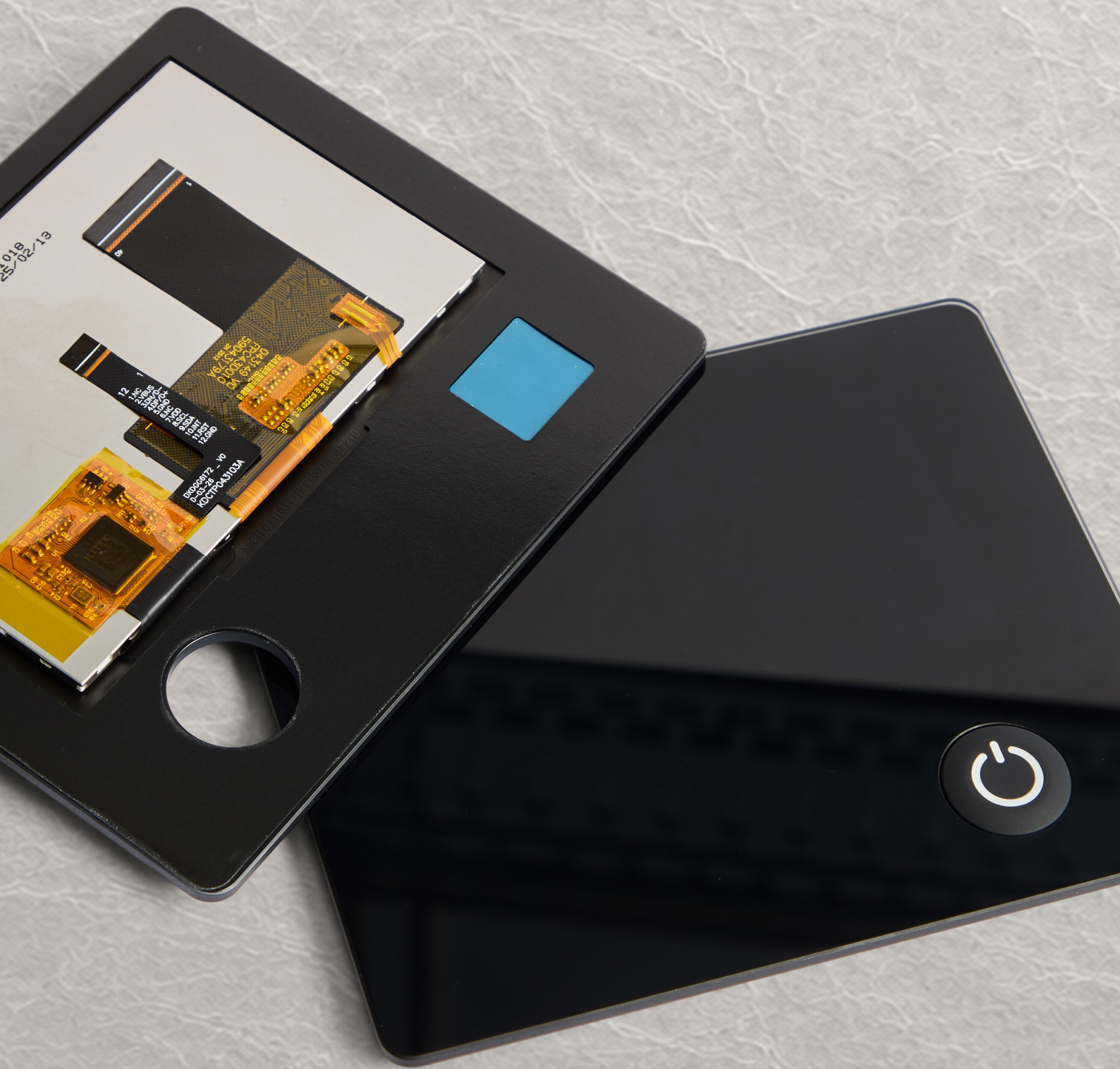
| |  |  |  |
| Typical sizes/ formats | Small to large modules, depending on application and supplier portfolio | Wide range of sizes, available in landscape or portrait formats | Mostly small to medium modules, depending on type and application |
| Colour | Monochrome or limited colour | Full colour | Monochrome or full colour |
| Power consumption | Very low, mainly uses power when updating | Medium to high | Low to medium, depending on content |
| Readability | Excellent in bright light and sunlight | Good for colour graphics; sunlight readability depends on brightness and construction | Excellent contrast; readability depends on brightness and ambient light |
| Operating temperature | Standard ranges available. Low temperatures can affect refresh speed. | Standard or wide ranges available. Brightness, touch function and backlight lifetime depend on the selected module. | Standard or extended ranges available. Heat, moisture and brightness level can affect lifetime. |
| Response speed | Very slow to slow | Fast | Very fast |
| Best suited for | Static or slowly changing information, such as labels, price tags, signs and information displays. | Modern HMIs with full-colour graphics, touch functionality, dynamic content and more advanced user interaction. | Compact HMIs with high contrast, deep blacks and a sharp visual appearance where design expression matters. |



# Fine-tune the display for the HMI

After choosing the display type, the solution can be fine-tuned in two ways: through display semi-customisation, and through the HMI construction around the display.

## Cusomisation options

Many TFT and OLED displays are selected from a standard portfolio and can then be adapted with selected semi-custom options.

- Connector and cable length
- Higher brightness
- Extended operating temperature range
- Viewing direction or viewing angle, where available
- Touch or non-touch version
- Cover glass options

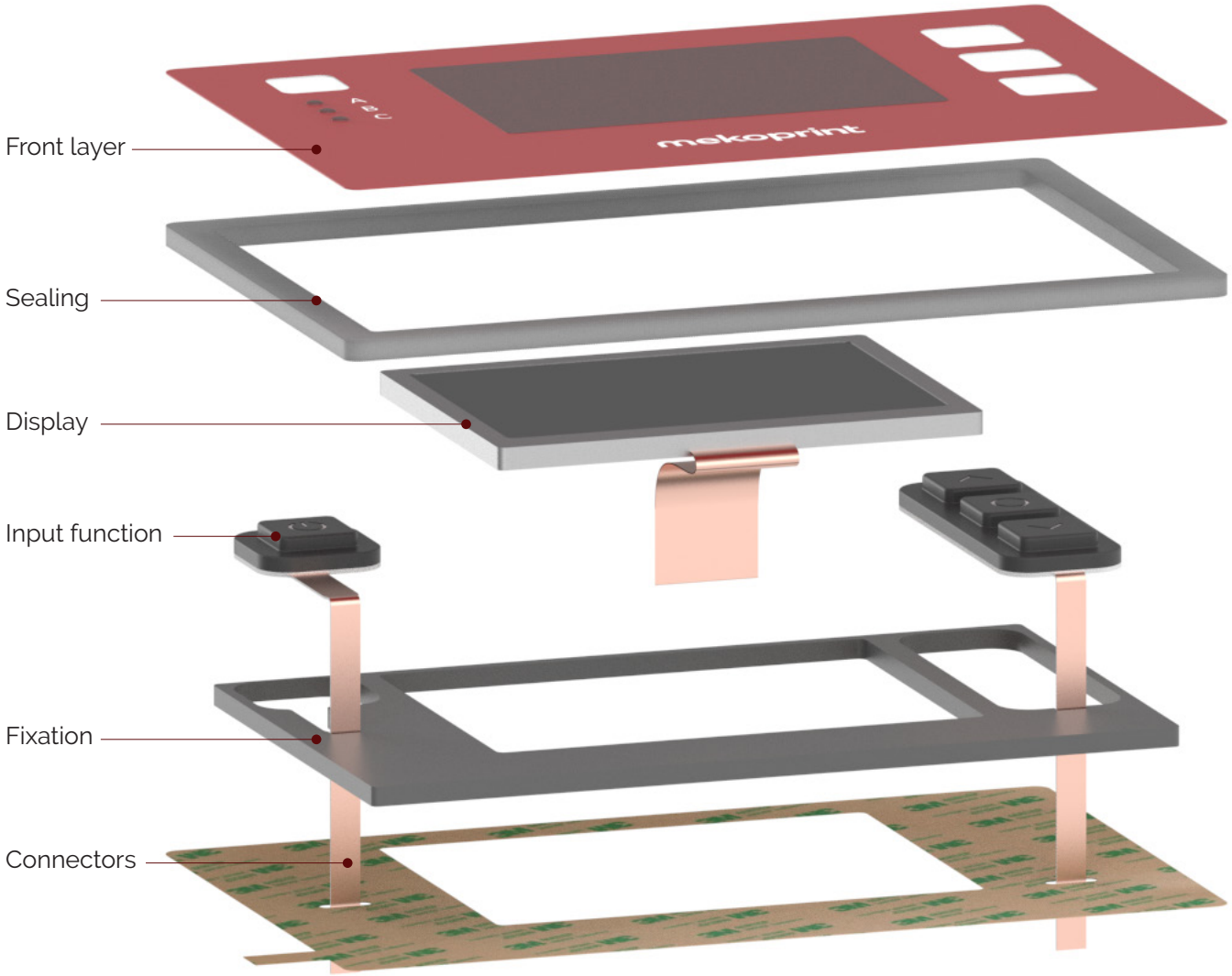
Monochrome graphic LCDs and custom LCDs can often allow more extensive customisation, depending on the display type, layout and volume.

## HMI construction options

Other requirements are handled in the way the display is integrated into the complete HMI construction:

- Bonding solutions
- Sealing
- Display protection
- Ruggedisation and vibration resistance
- Cleanability
- EMC/ESD shielding
- Tolerances between display, front layer and housing
- Housing fixation
- Integration with keypad or separate touch buttons

# HMI stack-up


Front layer
Sealing
Display
Input function
Fixation
Connectors
nekoprint

# Build the display into the HMI stack-up

Display integration is a stack-up decision.

The front layer, sealing, display, input function, housing fixation and cable routing all affect each other.

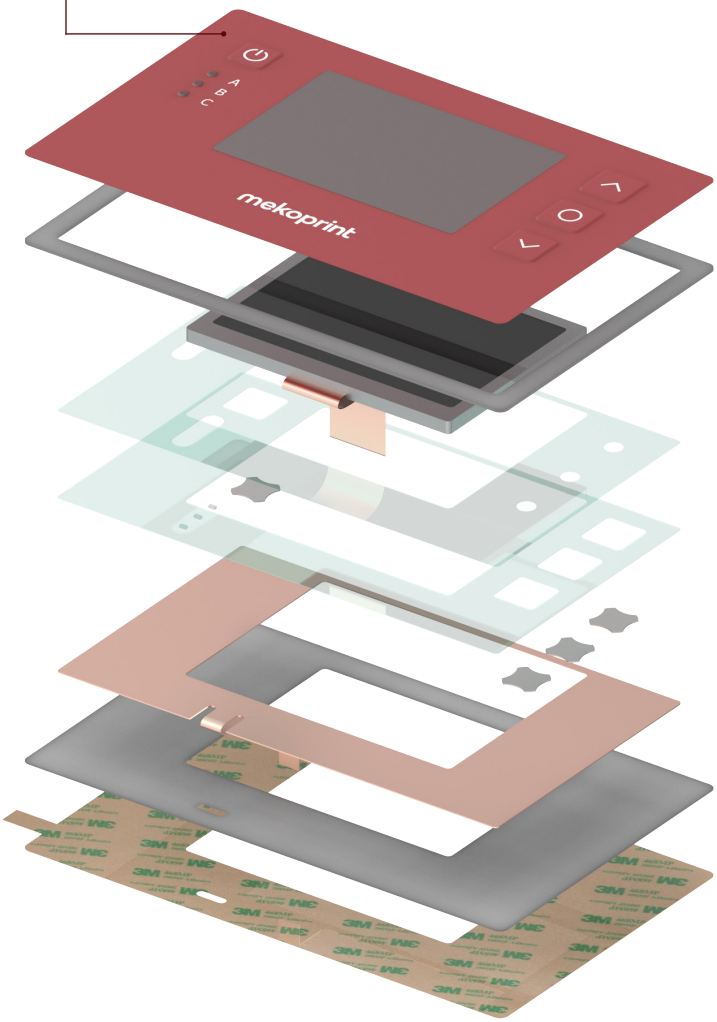
A typical HMI stack-up can include:

- Front layer: foil, cover glass or silicone
- Sealing: adhesive, gasket or glue
- Display
- Input function: membrane keys, silicone keys, touch surfaces or touchscreen
- Fixation to housing
- Cable routing and connection to the PCB

The goal is to make the display work smoothly with the front layer, keypad, sealing, mechanics and housing.

# Slim, sealed HMI with membrane keypad and display

**Construction principle:** Front foil with integrated membrane switch keypad



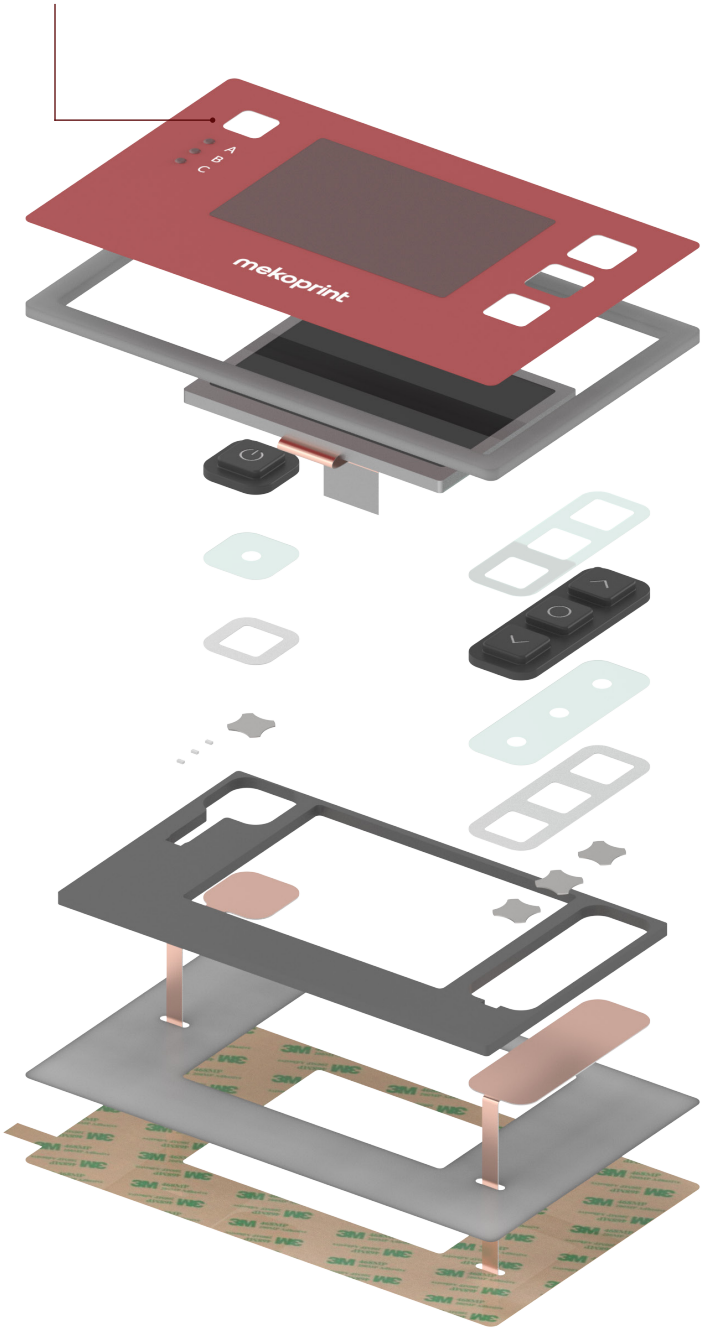

**Features**
Very low profile design
No gaps between buttons and display
Base stack-up thickness: 1.5 mm, excluding display module and keys.

**Advantages**
Easy to clean
Slim construction
Durable HMI

**Best suited for**
Applications where the user needs clear function keys, but where the front should remain flat, sealed and cost-efficient to produce

# Tactile silicone keypad with integrated display

**Construction principle:** Front foil with protruding silicone keypad




## Features

Clear tactile buttons
Front foil cover - can be replaced with cover glass
Base stack-up thickness: 3.0 mm, excluding display module and keys.

## Advantages

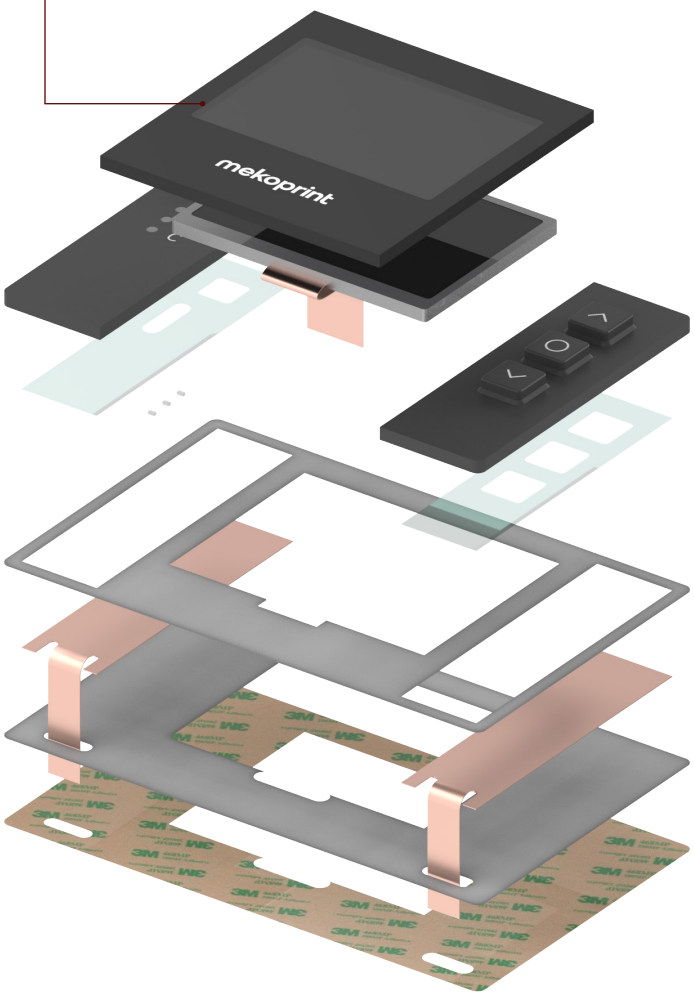
Easy to locate and operate keys by feel Freedom in button geometry and shape

## Best suited for

Applications where the user needs clear tactile feedback, for example when operating with gloves or in low-visibility environments.

# Protected display with dedicated tactile keys

**Construction principle:** Cover glass front with dedicated silicone rubber keys




## Features

Display protection cover
Tactile buttons next to display
Base stack-up thickness: 3.5 mm, excluding display module and keys.

## Advantages

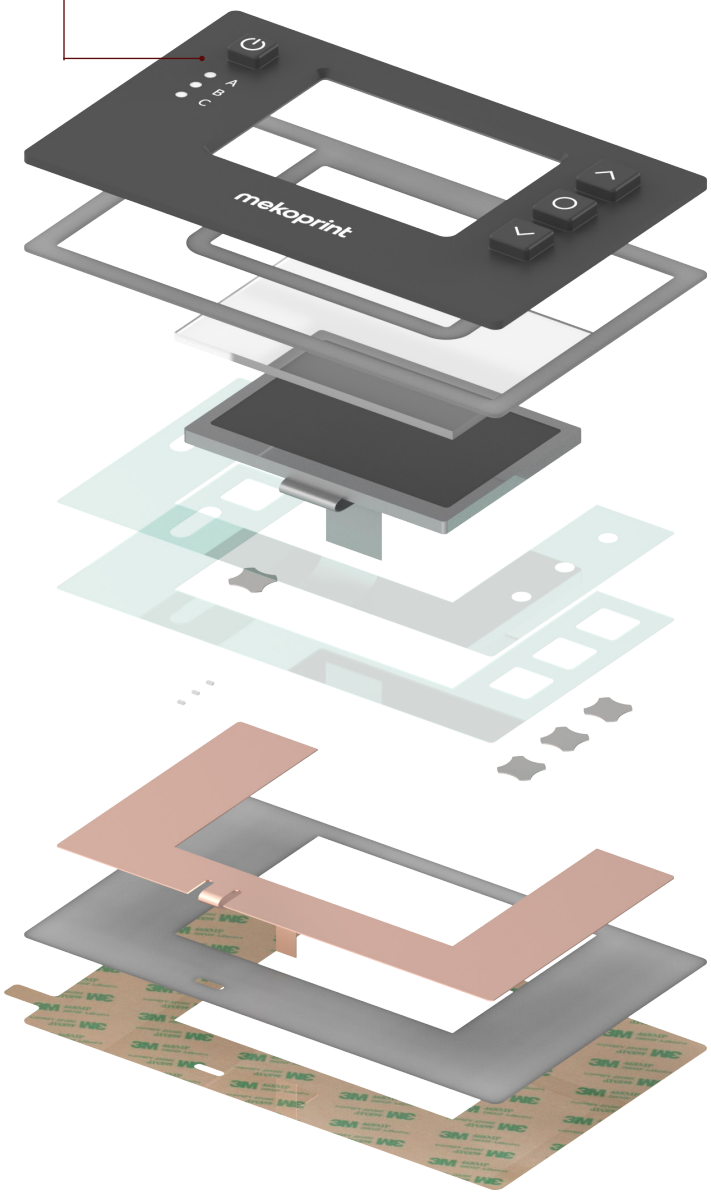
Robust, easy to clean display surface
Clear tactile buttons
Modular design can be adapted to different product versions

## Best suited for

Applications where display protection and tactile feedback are both important.

# Recessed display with protective silicone front

**Construction principle:** Silicone front cover with integrated silicone rubber keypad




## Features

Recessed display
Integrated tactile buttons
Extra display protection
Base stack-up thickness: 2.8 mm, excluding display module and keys.

## Advantages

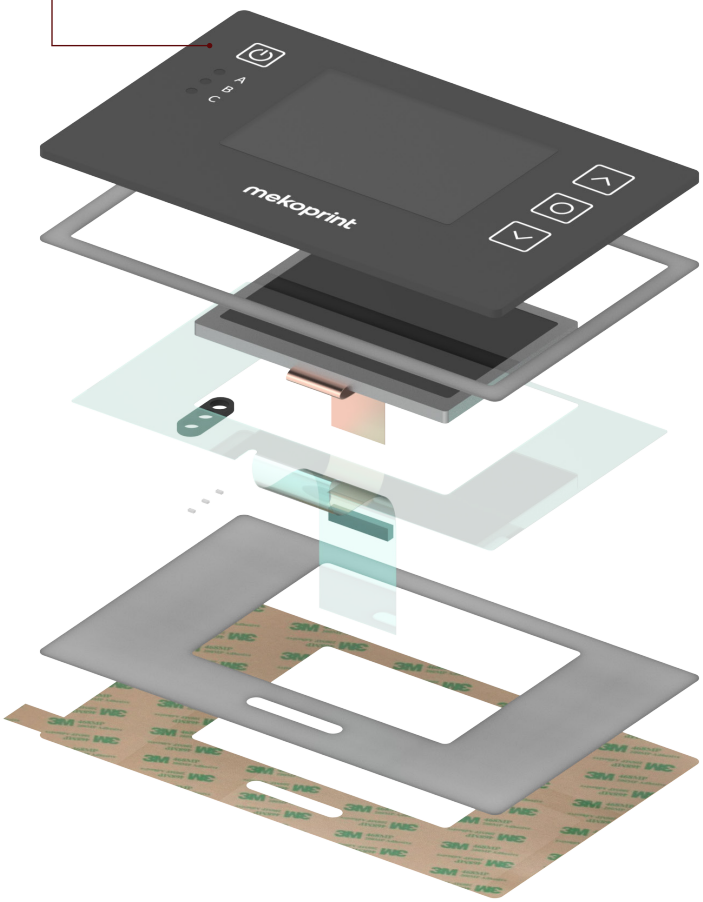
Extra protection around the display area
Softer and more robust front construction
Tactile guidance from raised silicone areas

## Best suited for

Applications where the HMI is exposed to impact, rough handling or demanding environments.

# Touch display with fixed touch controls

**Construction principle:** Touch display with fixed touch controls around the active display area




## Features

Touch display
Dedicated touch buttons
Base stack-up thickness: 2.5 mm, excluding display module.

## Advantages

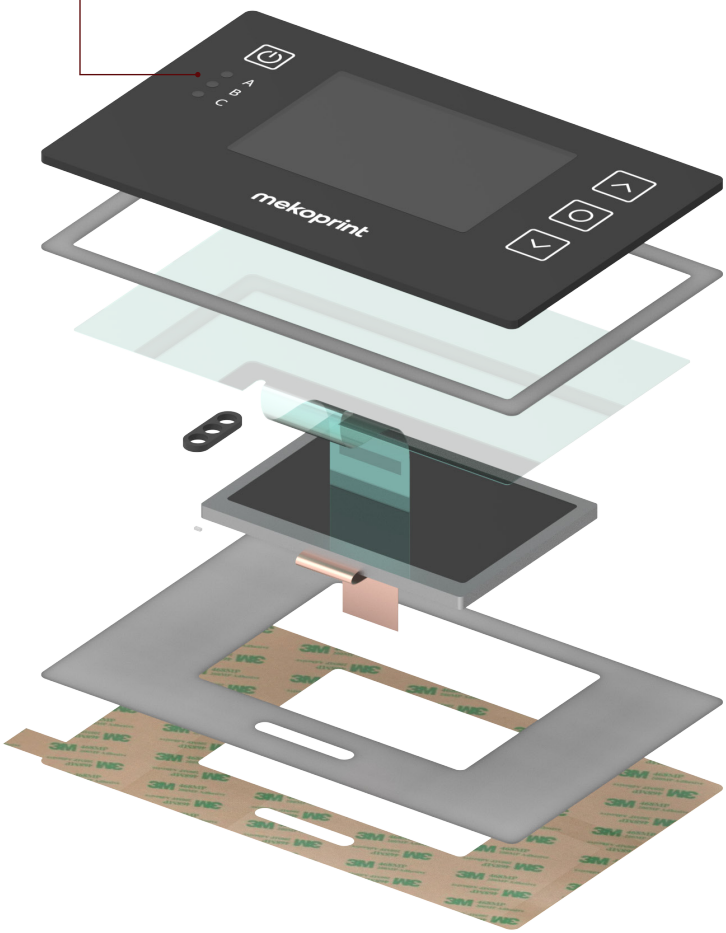
Flexible user interface
Minimalistic, seamless front
Simplified cable connector to main PCB
Fast access to main function with dedicated touch buttons

## Best suited for

Applications where the user needs a dynamic touchscreen interface, but still benefits from fixed controls for key functions.

# Standard display with integrated touch front

**Construction principle:** Standard display with capacitive touch integrated in the front construction




## Features

Standard display
Capacitive touch foil between display and glass cover
Base stack-up thickness: 2.5 mm, excluding display module.

## Advantages

Cost-efficient alternative to touch display
Touch function handled in the HMI construction
Wider choice of standard displays

## Best suited for

Applications where the display does not need to be touch-enabled, but where the HMI benefits from a flat front with integrated touch controls.

# Compare the construction options

| | Slim, sealed HMI with membrane keypad and display | Tactile silicone keypad with integrated display | Protected display with dedicated tactile keys |
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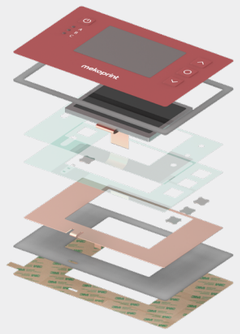
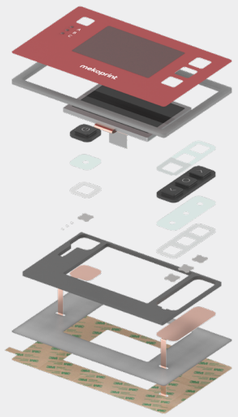
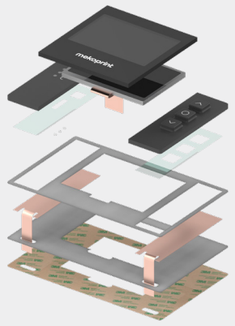
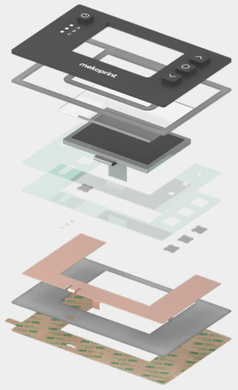
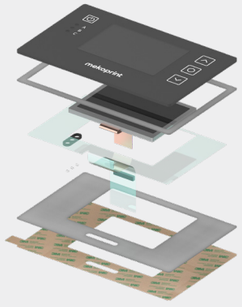
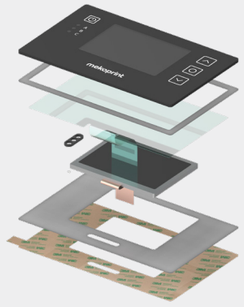
| |  |  |  |
| Front build-up | Flat membrane front with sealed display area | Raised silicone key front with integrated display area | Cover glass display area with separate tactile silicone keys |
| Base stack-up thickness | 1.5 mm, excluding display module and keys | 3.0 mm, excluding display module and keys | 3.5 mm, excluding display module and keys |
| Input method | Membrane switch keypad with tactile keys | Silicone rubber keys with clear tactile feedback | Dedicated silicone rubber keys next to the display |
| Display protection | Protected by front foil and sealed surface | Protected by front foil or cover glass | Protected by cover glass |
| Display choice flexibility | Medium. Best suited for standard display modules that fit the flat front construction | Medium. Display choice depends on front design, keypad layout and available space | High. Display and key layout can be adapted to different product versions |
| Design considerations | Very slim and easy to clean, but with limited key height and shape options | Clear tactile feedback, but with a higher front profile | Strong display protection and tactile control, but requires space for separate key areas |



| | Recessed display with protective silicone front | Touch display with fixed touch controls | Standard display with integrated touch front |
|---|---|---|---|
| |  |  |  |
| Front build-up | Protective silicone front with recessed display area | Flat touchscreen front with fixed touch zones | Flat front with standard display and separate capacitive touch layer |
| Base stack-up thickness | 2.8 mm, excluding display module and keys | 2.5 mm, excluding display module and keys | 2.5 mm, excluding display module and keys |
| Input method | Integrated silicone rubber keys | Touch display plus fixed touch controls around the active area | Capacitive touch integrated in the front construction |
| Display protection | Recessed display and protective silicone front | Protected by front glass or touch surface | Protected by cover glass or front layer |
| Display choice flexibility | Medium. Display choice depends on silicone design and recessed opening | Lower. Requires a touch display, so display choice is more specific | High. Wider choice of standard displays as touch is handled in the HMI construction |
| Design considerations | Extra display protection, but with a more built-up silicone front | Dynamic touch interface, but requires a touch display | Wider display choice and clean front, but touch is added as a separate layer |

# Display integration question guide

Use these questions as a starting point when specifying a display for an HMI solution.

### What should the display show?

Text, numbers, icons, graphics or dynamic content?
Is there a preferred display type, for example TFT, OLED or monochrome LCD?
Is colour needed?

### Where will the display be used?

Indoor or outdoor application?
Will the display be exposed to sunlight or changing light conditions?
Are there requirements for brightness or readability?
Outdoor use often requires high brightness, depending on the front construction and use environment.

### Which size is needed?

Display size in inches
Active area dimensions
Outline dimensions
Available space for connector, cable and fixation

### What resolution is required?

Simple text and symbols?
Icons and menus?
Detailed graphics or dynamic user interface?

### How will the display be connected?

Required interface
Connector position
Cable length or cable exit direction

### How should the display be viewed?

Main viewing direction, for example 12 o'clock or 6 o'clock
Need for wide viewing angles
Landscape or portrait orientation

### What are the environmental requirements?

Operating temperature range
Exposure to moisture, dust, cleaning, vibration or impact

### Is touch needed?

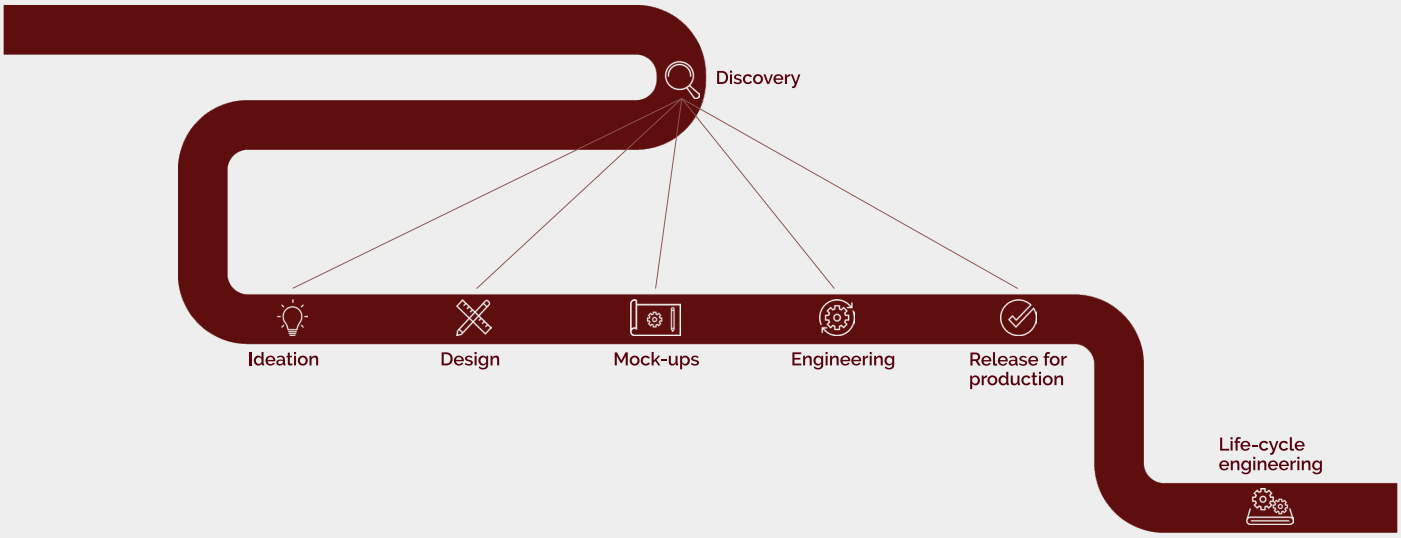
Touch or non-touch display?
Capacitive or resistive touch?
Operation with gloves, wet hands or in dirty environments?

# Need input on your HMI design?

The display needs to work smoothly with the front layer, keypad, sealing, mechanics, housing and cable routing.

Mekoprint supports customers with design and engineering input from early concept to release for production. We can help evaluate the HMI stack-up, display integration and construction principle — from sealed keypad solutions to touch-based HMI designs.

Our services are structured in stages, so support can be added where it creates the most value in your development process.



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