- **Product Name:** DH-Systems Input Module
- **Document Version:** v2.0 (2026)
- **SKU / Product ID:** DHS-MOD-INP02
- **Target Audience:** DIY Builders / System Integrators

Important Safety Notice & Disclaimer

⚠ **READ BEFORE INSTALLATION**

- **DIY Product Notice:** This module is sold as a Do-It-Yourself (DIY) component for custom electronics integration. It is not a certified commercial turn-key product. Final system housing, fuse protection, and overall electrical safety are the sole responsibility of the builder.
- **Risk of Damage:** Incorrect wiring, reversed polarity, or short circuits can cause immediate and permanent damage to the module, connected sensors, and the Master Unit. Always double-check all connections with a multimeter before powering up the system for the first time.
- **Qualified Installation:** Electrical systems in vehicles and off-grid environments carry inherent risks of short circuits, fire, or battery damage. It is strongly recommended that the installation, wiring, and integration of these modules are carried out by a qualified individual with a solid understanding of DC electronics.
- **Liability:** DH-Systems cannot be held liable for any hardware damage, data loss, physical injury, or vehicular damage resulting from the incorrect assembly, programming, configuration, or installation of this equipment.
- This product is an **open-component DIY Development Board (sub-assembly)**, not a finished consumer electronics appliance. It is designed exclusively for system integration by DIY builders and qualified individuals.

1. Introduction & Core Function

The **DH-Systems Input Module** is an industrial-grade, 8-channel digital input expansion board engineered to safely and reliably read physical switches, push buttons, or digital sensors within your vehicle network. To ensure absolute signal integrity over short distances, this module communicates via the local I2C bus and must be mounted directly adjacent to the Master Unit.

Car environments are notorious for high electromagnetic interference (EMI) caused by alternators, solar charge controllers, and heavy inverters. This module solves that problem by featuring full galvanic isolation on every channel via onboard optocouplers. This design ensures that external electrical noise or voltage spikes never reach your delicate control logic or the central Master Unit.

Key Features:

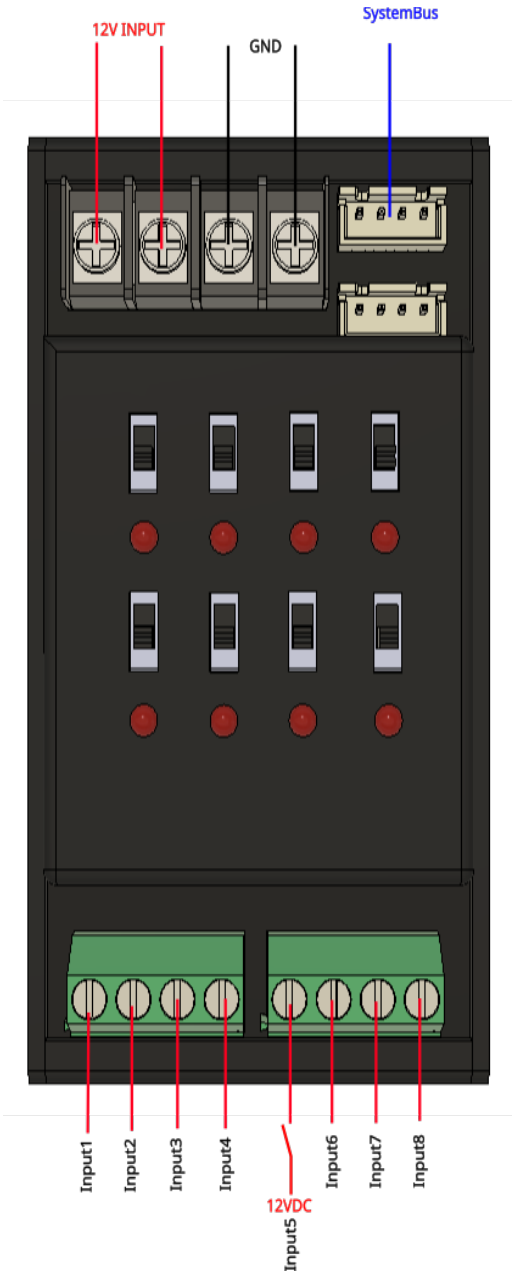
- **Optocoupler Isolation:** 8 independent channels equipped with high-quality optocouplers, providing comprehensive protection and noise-free signal reading.
- **Hardware Simulation Overrides:** 8 physical slide switches located on the top board allow installers to manually simulate or override any input state for quick hardware diagnostics and dry-testing.
- **Isolated Power Paths:** Clear separation between the low-power control bus (SystemBus) and the dedicated 12V input circuitry loop used to monitor the external switches.
- **Software Stabilization:** Fully compatible with ESPHome debounce filters to ensure crisp, accurate button presses with zero phantom triggers.
- **Industrial Terminals:** Vibration-resistant screw terminals designed to withstand the continuous movement of off-grid camper environments.

2. Technical Specifications

Parameter	Specification
Main Controller	PCF8574 (8-Bit I2C I/O Expander)
Operating Voltage	12V DC Nominal (Cleaned via onboard L78L33 providing 3.3V for logic circuitry)
Input Loop Sensing Voltage	**12V DC Dedicated Power Terminals** *(Required to power the external input sensing loop)*
Input Channels	8 x Galvanically Isolated Channels via Optocouplers.
Transient Protection	SMBJ18A TVS Diodes on all outputs (Ideal for inductive loads) Line
Connectivity / Bus	Local SystemBus via JST connector

Parameter	Specification
Default I2C Address	0x21 (Configurable via onboard solder pads A0, A1, A2)
Terminal Type	Industrial-grade vibration-resistant screw terminals

3. Pinout & Wiring Diagram



Hardware Interfaces & Connections:

SystemBus Input (4-Pin JST Connector):

This port links the Relay Module to the central Master Unit or adjacent local modules, carrying primary power and data lines:

- **12V:** Main power input from the fused/protected system rail
- **GND:** Common System Ground
- **SDA:** I2C Data Line
- **SCL:** I2C Clock Line

Main Power Terminals (Screw Terminals)

- **12V IN / GND:** Connect the main power supply (12V) intended for the loads here. This power circuit must be correctly fused and is completely isolated from the SystemBus power supply to prevent overloading the bus cabling.

Digital Inputs (Screw Terminals 1 to 8)

- Connect your external dry contacts, wall switches, or pulse push-buttons to these terminals. When an external switch closes and loops the dedicated 12V power through the optocoupler channel, the isolated input is safely registered by the processor.

Top Board Controls & Diagnostic Switches:

- **Switches 1 to 8: Switches 1 to 8:** 8 dedicated mechanical slide switches. Moving any of these switches to the 'ON' position manually forces the corresponding input channel into an active state. This hardwired override allows you to comprehensively test system automations and configurations even if no physical wall button is wired up yet.

4. Hardware Configuration & Solder Jumpers

I2C Address Selection

I2C Address Selection

By default, the Input Module comes pre-configured with the hardware I2C address **0x21** (configured via the onboard address pads). If your system layout calls for multiple input expanders, you can run multiple boards on the same local SystemBus line.

To prevent addressing conflicts, alter the hardware address by bridging the dedicated solder pads (**A0, A1, and A2**) to either **GND** or **3.3V**.

(Note: Below is a standard selection matrix for the PCF8574. Ensure your physical PCB traces match this layout before assigning addresses in software).

A2 Pad	A1 Pad	A0 Pad	Resulting I2C Address

GND	GND	GND	**0x20 (Primary Module / Default)**
GND	GND	3.3V	0x21
GND	3.3V	GND	0x22
GND	3.3V	3.3V	0x23
3.3V	GND	GND	0x24
3.3V	GND	3.3V	0x25
3.3V	3.3V	GND	0x26
3.3V	3.3V	3.3V	0x27

⚠ **CRITICAL:** Always ensure that every module connected to the same Master Unit has a completely unique I2C address.

I2C Pull-Up Resistors (R3, R4)

The PCB includes dedicated solder pads for onboard I2C pull-up resistors (**R3** and **R4**).

- **Do Not Populate (Default):** In standard DH-Systems setups, the Master Unit provides the necessary bus pull-ups. These resistors should be left unpopulated.
- **When to Populate:** Only install these resistors if you are troubleshooting a custom bus layout where the overall resistance on the I2C data lines is too high, leading to signal degradation over multiple chained modules.

5. Software Integration & ESPHome Configuration

To make deployment clean and modular, the DH-Systems ecosystem relies on a package-based software architecture. Your central Master Unit runs the primary core configuration, while each connected physical hardware module is represented by its own plug-and-play code package.

Configuration Example (Relay Module Package)

To integrate the Input Module, apply this code block to your ESPHome configuration file. Hardware debounce filters are implemented directly on the inputs to prevent double-triggering.

```
pcf8574:
  - id: 'Input_card_1'
```

```
    address: 0x21
    pcf8575: false

binary_sensor:
  - platform: gpio
    id: drukknop0
    name: "Input 8"
    filters:
      - delayed_on: 10ms
        delayed_off: 10ms
    pin:
      pcf8574: Input_card_1
      number: 0
      mode:
        input: true
      inverted: false

  - platform: gpio
    id: drukknop1
    name: "Input 1"
    filters:
      - delayed_on: 80ms
        delayed_off: 80ms
    pin:
      pcf8574: Input_card_1
      number: 1
      mode:
        input: true
      inverted: true

  - platform: gpio
    id: drukknop2
    name: "Input 2"
    filters:
      - delayed_on: 80ms
        delayed_off: 80ms
    pin:
      pcf8574: Input_card_1
```

```
    number: 2
    mode:
      input: true
    inverted: true

- platform: gpio
  id: drukknop3
  name: "Input 3"
  filters:
    - delayed_on: 80ms
      delayed_off: 80ms
  pin:
    pcf8574: Input_card_1
    number: 3
    mode:
      input: true
    inverted: true

- platform: gpio
  id: drukknop4
  name: "Input 4"
  filters:
    - delayed_on: 80ms
      delayed_off: 80ms
  pin:
    pcf8574: Input_card_1
    number: 4
    mode:
      input: true
    inverted: true

- platform: gpio
  id: PBdrukknop5
  name: "Input 5"
  filters:
    - delayed_on: 80ms
      delayed_off: 80ms
  pin:
```

```
    pcf8574: Input_card_1
    number: 5
    mode:
      input: true
    inverted: true

- platform: gpio
  id: PBbodrukknop6
  name: "Input 6"
  filters:
    - delayed_on: 80ms
      delayed_off: 80ms
  pin:
    pcf8574: Input_card_1
    number: 6
    mode:
      input: true
    inverted: true

- platform: gpio
  id: drukknop7
  name: "Input 7"
  filters:
    - delayed_on: 80ms
      delayed_off: 80ms
  pin:
    pcf8574: Input_card_1
    number: 7
    mode:
      input: true
    inverted: true
```

Exposed Home Assistant Entities

Once compiled and successfully connected to the native API, ESPHome exposes 8 binary sensors to Home Assistant:

- **Input 1** through **Input 8** (binary_sensor.input_x): Displays the real-time state of your physical push buttons or switches. These can be used immediately inside the Home Assistant automation engine to trigger relays, dimmers, or smart scenes.

6. Troubleshooting & Safety Warnings

- ⚠ **WARNING:** Never feed external power into the 4-pin SystemBus data lines. The SystemBus connection is strictly intended to power the internal I2C logic processing framework. External switches must only be powered via the dedicated, isolated 12V Main Power Terminal array.
- ⚠ **WARNING:** Always isolate the main 12V battery infrastructure before making structural modifications or changing device address maps to prevent ground loops or localized voltage arcing.

Common Issue - Sensor Status is Flatlined, Irresponsive or showing Unavailable:

- Verify that your data lines (SDA and SCL) are properly seated and not accidentally swapped at the JST connector.
- Inspect the top board mechanical slide switches. If a testing toggle is accidentally left in the manual 'ON' position, it will constantly force the state high, making it seem like the external wall switch is unresponsive.
- Ensure the physical A0, A1, and A2 solder selection path accurately aligns with the address: configuration key inside your active YAML block (Default: 0x21).
- Double-check that your external input loop has clean, fused 12V power arriving at the Main Power Terminal block, as the optocouplers cannot detect button states without an active sensing loop voltage.