Installation instructions
BasicController relay
ecomotion
CR0431
6 Indicators ................................................................. 24
7 Set-up ................................................................. 25
  7.1 Important notes on programming ................................. 25
     7.1.1 Start conditions ............................................ 25
  7.2 Programming ..................................................... 25
  7.3 Required documentation ......................................... 26
  7.4 Required hardware .............................................. 26
8 Operation ............................................................. 26
9 Technical data ........................................................ 27
10 Maintenance, repair and disposal .................................. 34
  10.1 Servicing .......................................................... 34
  10.2 Cleaning of the housing surface .............................. 34
  10.3 Repair .............................................................. 34
  10.4 Disposal ........................................................... 34
11 Approvals/standards ................................................. 34

This document is the original instructions.
All trademarks and company names are subject to the copyright of the respective companies.
1 Preliminary note

This document applies to devices of the type "BasicController relay" (art. no.: CR0431). These instructions are part of the device.

This document is intended for specialists. These specialists are people who are qualified by their appropriate training and their experience to see risks and to avoid possible hazards that may be caused during operation or maintenance of the device. The document contains information about the correct handling of the device.

Read this document before use to familiarise yourself with operating conditions, installation and operation. Keep this document during the entire duration of use of the device.

Adhere to the safety instructions.

1.1 Symbols used

► Instructions
> Reaction, result
[...] Designation of keys, buttons or indications
→ Cross-reference

⚠ Important note
Non-compliance may result in malfunction or interference.

Information
Supplementary note

1.2 Warnings used

⚠ WARNING
Warning of serious personal injury.
Death or serious irreversible injuries may result.

⚠ CAUTION
Warning of personal injury.
Slight reversible injuries may result.

NOTE
Warning of damage to property.
2 Safety instructions

2.1 General
These instructions contain texts and figures concerning the correct handling of the device and must be read before installation or use.

Observe the operating instructions. Non-observance of the instructions, operation which is not in accordance with use as prescribed below, wrong installation or incorrect handling can seriously affect the safety of operators and machinery.

2.2 Target group
These instructions are intended for authorised persons according to the EMC and low-voltage directives. The device must be installed, connected and put into operation by a qualified electrician.

2.3 Electrical connection
 Disconnect the unit externally before handling it. If necessary, also disconnect any independently supplied output load circuits.

If the device is not supplied by the mobile on-board system (12/24 V battery operation), it must be ensured that the external voltage is generated and supplied according to the criteria for safety extra-low voltage (SELV) as this voltage is supplied without further measures to the connected controller, the sensors and the actuators.

The wiring of all signals in connection with the SELV circuit of the device must also comply with the SELV criteria (safety extra-low voltage, safe electrical isolation from other electric circuits).

If the supplied SELV voltage is externally grounded (SELV becomes PELV), the responsibility lies with the user and the respective national installation regulations must be complied with. All statements in this document refer to the device the SELV voltage of which is not grounded.

The connections may only be supplied with the signals indicated in the technical data and/or on the device label and only the approved accessories of ifm electronic may be connected.

2.4 Tampering with the device
In case of malfunctions or uncertainties please contact the manufacturer. Any tampering with the device can seriously affect the safety of operators and machinery. This is not permitted and leads to the exclusion of any liability and warranty claims.
3 Functions and features

The freely programmable controllers of the "BasicController relay" series are rated for use under difficult conditions (e.g. extended temperature range, strong vibration, intensive EMC interference). They are suitable for direct installation in mobile vehicles.

By means of the application software the user can configure the inputs and outputs to adapt to the respective application. The controllers can be used as CAN controller, CANopen master or intelligent I/O module (→ 9 Technical data).

Application-specific extensions and adaptations are possible in conjunction with additional products of the modular Basic design.

⚠️ WARNING
The device is not approved for safety-related tasks in the field of operator protection.

NOTE
The device is intended for installation in vehicle bodies, not in engines.

3.1 Features at a glance
● Freely programmable to IEC 61131-3
● 2 CAN interfaces (incl. interface for BasicDisplay CR0451 or CR0452)
● Locations for 6 automotive micro relays and 8 automotive mini fuses
● Configurable inputs and relay switching outputs
● Protection IP 54 (with cover and cable seal)
● Status LEDs for controller and fuse states F0...F6
● Integrated fuse puller

3.2 Items supplied
The device is supplied with a fuse puller.
Relays, fuses, crimps, connectors, hexagon nuts and washers are not supplied with the device.

3.3 Accessories
Information about available relays, fuses etc. at:www.ifm.com → Data sheet search → CR0431 → Accessories
3.4 Block diagram

1: Ignition switch
2: SUPPLY_SWITCH (CODESYS flag)

3.5 Devices of the Basic series (examples)

- BasicController (art. no.: CR040x) and BasicController plus (art. no.: CR0411)
  Mobile controller, freely programmable to IEC 61131-3
  2 CAN interfaces (incl. interface for BasicDisplay CR045x)
  Configurable inputs/outputs

- BasicDisplay (art. no.: CR0451) and BasicDisplay XL (art. no.: CR0452)
  Programmable display with graphics capabilities with 2.8" colour display
  5/6 freely programmable, backlit function keys
  1 navigation key for cursor function

- BasicRelay (art. no.: CR0421)
  Freely wirable relay and fuse carrier for 6 automotive relays and 10 automotive fuses

- Cover (art. no.: EC0401)
  incl. cable seal to obtain IP 54 protection

For information about the available Basic family see:
www.ifm.com → Product line → Systems for mobile machines
4 Installation

4.1 General installation instructions

4.1.1 Protection rating
The achievable protection rating of the device depends on the accessories used and the installation position.

<table>
<thead>
<tr>
<th>Protection rating</th>
<th>Accessories</th>
<th>Installation position</th>
<th>Art. no.</th>
</tr>
</thead>
<tbody>
<tr>
<td>IP 54</td>
<td>Cover with cable seal</td>
<td>Cable connection from the bottom</td>
<td>EC0401</td>
</tr>
<tr>
<td>IP 00</td>
<td>–</td>
<td>Any</td>
<td>–</td>
</tr>
</tbody>
</table>

– = not required

4.1.2 Mounting surface

NOTE
The housing must not be exposed to any torsional forces or mechanical stress.

▶ Mount the device on a flat surface.
▶ Use compensating elements if there is no flat mounting surface available.
4.2 Fixing

- Insert the enclosed tubular rivets from the back of the module in the 4 fixing holes.
- Fix the module using 4 washers and M4 screws. Tighten the screws alternately crosswise.

Use of the tubular rivets

Tightening torque: 1.5 Nm
Hole dimensions (→ 9 Technical data)

<table>
<thead>
<tr>
<th>Screws to be used (examples):</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cylinder screws with hexagon socket (M4 x L)</td>
<td>ISO 4762</td>
</tr>
<tr>
<td>Cylinder screws with hexagon socket and low head (M4 x L)</td>
<td>DIN 7984</td>
</tr>
</tbody>
</table>
4.3 Cover and cable seal

**NOTE**
Protection IP 54 can only be guaranteed if the cover is used together with the cable seal.

**NOTE**
The cover reduces the amount of heat to be dissipated and can increase the device temperature. With the cover the max. possible operating temperature decreases (→ 9 Technical data).

### 4.3.1 Max. overall height of the relay

⚠️ As a principle use automotive micro relays without mounting brackets. The mounting brackets cannot be used in conjunction with the device and would unnecessarily increase the height of the relay.

Base dimensions of the relays used (→ 5.4 Relay)

### 4.3.2 Installation of the cable seal

- Insert the cable seal into the locator from below.
- The locking of the cable seal audibly clips into place.

1. Locator for cable seal
2. Locking

⚠️ The cable seal cannot be used as strain relief of the cables.
(→ 5.1 General electrical connection)
4.3.3 Remove the cable seal

► Press the locking at the bottom of the device and remove the cable seal from the device by pulling downwards.

Bottom of the device

1. Cable seal
2. Locking
4.3.4 Installation of the cover

The covers of the Basic series feature a single-lever locking. Installation is done without tools.

1: Locking lever
2: Cover guides
3: Insertion slots for cover guides

► Pull out the locking lever and rotate it towards you.
► Place the cover diagonally onto the device.
   Insert the 2 cover guides, found at the bottom of the cover, into the slots.
► Close the cover onto the lower part.
   The 2 guides and slots provide a pivot point.
► Move the locking lever back into its initial position.
> The cover is locked.

1: BasicController™
2: Cover

4.3.5 Removing the cover

► Pull out the locking lever and rotate it towards you.
> The cover is unlocked and can be removed.
5 Electrical connection

5.1 General electrical connection

⚠️ WARNING
The user is responsible for the safe function of the circuits which he created himself. If necessary, he must additionally carry out an approval test by corresponding supervisory and test organisations according to the national regulations.

⚠️ WARNING
The user must ensure that malfunction due to bent cable connections or loose spade terminals does not impair the safety of people and equipment.

NOTE
Wrong connection may cause damage to the device.
► Observe the safety instructions (→ 2.3 Electrical connection).

► Basically all supply and signal cables must be laid separately.
► Lay supply and signal cables away from the device using the shortest possible route.
► All connected cables must be provided with a strain relief at least 100 mm behind the cable entry.
► Protect unused terminals with unpopulated sockets if no cover is used.
5.2 Supply voltage

► Establish voltage and GND connections via crimps and the M8/M6 threaded suspension rods.
► Observe max. tightening torques.
  - M8: ≤ 9.0 Nm
  - M6: ≤ 3.9 Nm

Connection supply voltage from battery
1: M8 threaded suspension rod
   Supply voltage BAT (+)
2: M6 threaded suspension rod
   GND BAT (-)

Crimps (e.g. for 16 mm² nominal cross section)
*) M8 design
**) M6 design

<table>
<thead>
<tr>
<th>Connection material to be used (examples):</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crimps</td>
<td>M8/M6 connection diameter up to 16 mm² nominal cross-section Material Cu-ETP</td>
</tr>
<tr>
<td>Hexagon nuts</td>
<td>M8/M6, tin-plated</td>
</tr>
<tr>
<td>Washers</td>
<td>Without phase</td>
</tr>
<tr>
<td></td>
<td>With phase</td>
</tr>
</tbody>
</table>

5.2.1 Short-circuit protection

NOTE
Plastic caps/sleeves are recommended for short-circuit protection between the M8/M6 threaded suspension rods and cables with damaged insulation. This applies especially if cables are guided via the threaded suspension rods when the cable seal is used.
5.2.2 Multiple assignment of the M6 threaded suspension rod BAT (-)

Only one wire is allowed on the M8 threaded suspension rod BAT (+). Several wires are allowed on the M6 threaded suspension rod BAT (-) (e.g. for GND return of the actuators).

► Place additional ring terminals on the screwed nut.
► Secure ring terminals with additional M6 hexagon nuts.
► Depending on the remaining thread length, place a protective cap on the M6 hexagon nut or a protective sleeve on the M6 thread.

NOTE

Max. total current via BAT (-) ≤ total current via BAT (+).
5.3 Fuses

5.3.1 Automotive mini fuses

The device is suited for automotive mini fuses to ISO 8820-3, type F.

![Dimensions [mm]](image1)

![Locations for fuses](image2)

<table>
<thead>
<tr>
<th>Colour coding to ISO 8820-3 (rated current [A])</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
</tr>
<tr>
<td>black</td>
</tr>
</tbody>
</table>

- The individual electric circuits must be protected in order to protect the whole system.
- Observe the maximum total currents.

**Fuses and total currents**

<table>
<thead>
<tr>
<th>Fuse</th>
<th>Nominal current</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>F0...5</td>
<td>Supply relay switching outputs K0...5</td>
<td>≤ 15 A (each)</td>
</tr>
<tr>
<td>F6</td>
<td>Supply external devices</td>
<td>V_EXT</td>
</tr>
<tr>
<td>F7</td>
<td>Supply sensors/module/trip coils</td>
<td>VBBs</td>
</tr>
</tbody>
</table>

*) For each relay switching output

**) Observe derating (→ 9 Technical data)
NOTE
For fuse dimensioning observe the manufacturer's indications, the nominal current derating and the cable cross-section.

NOTE
If the cable seal is used, the use of circuit breakers for the fuses F6 and F7 is not recommended. Cables fed close to the circuit breakers can cause false triggering or damage.

5.3.2 Fuse circuits F0, F1, F3 and F4
Fuses F0, F1, F3, and F4 are additionally led to connectors D and E. This enables use as fuse circuit without relay or use of the relay switching outputs K0, K1, K3 and K4 as volt-free changeover contacts.

NOTE
If a relay switching output is used as a volt-free change-over contact, the circuit has to be externally protected.

Example: Fuse circuits F1 and F4

1: Fuse circuit without relay
2: Volt-free change-over contact with external fuse
5.3.3 External protection VBB15 (clamp 15)

Usually the ignition switch is connected to the voltage VBBs protected via F7 (→ 3.4 Block diagram) and (→ 7.1.1 Start conditions).

► If an external voltage is used to start the device, protect this cable externally.

![Diagram](image)

*Ignition switch at external voltage*

5.3.4 Replace fuses

► Use the fuse puller to remove defective fuses.

![Diagram](image)

*Fuse puller*

5.3.5 Central main fuse

⚠️ A central main fuse in the supply to the device is recommended. For example directly on the battery via a battery terminal fuse of type CF8 (manufacturer: Littelfuse).

► Dimension fuse rate on the basis of the wire cross section.
5.4 Relay

The device is suited for automotive micro relays with a contact arrangement to ISO 7588-3.

**NOTE**

Adhere to the manufacturer's information for selecting the relay:
- Operating voltage limits
- Coil voltage for safe switching at high ambient temperature
- Impermissible power loss due to high coil voltage
- Maximum nominal current of the NO contacts

**NOTE**

Protective circuitry to avoid peak inductance on the NO contacts of the relay are not integrated (→ 9 Technical data).
5.4.1 Contact designations

<table>
<thead>
<tr>
<th>to ISO 7588-3</th>
<th>Contact</th>
<th>to DIN 72552 / 2 *</th>
<th>Contact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coil plus</td>
<td>1 Positive connection trip coil</td>
<td>86</td>
<td></td>
</tr>
<tr>
<td>Coil minus</td>
<td>2 Ground connection trip coil</td>
<td>85</td>
<td></td>
</tr>
<tr>
<td>Switching contact input (moving contact)</td>
<td>3 Continuous positive of the battery</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>Switching contact output (break contact)</td>
<td>4 NC contact to the load</td>
<td>87 a</td>
<td></td>
</tr>
<tr>
<td>Switching contact output (make contact)</td>
<td>5 NO contact to the load</td>
<td>87</td>
<td></td>
</tr>
</tbody>
</table>

*) Information only for comparison

Observe the wiring and the documentation of the relays used. The contact designations can vary.

In CODESYS and in the programming manual BasicController relay the following designations are used for the contacts:
Contact 4 (87a) = normally closed (NC)
Contact 5 (87) = normally open (NO)
5.5 Connectors

The connections of the CAN interfaces, the inputs/outputs and the supply cables for external devices are made via connectors on the front of the device.

Test standards and characteristic values (→ 9 Technical data)

![Connector Diagram]

<table>
<thead>
<tr>
<th>Connector</th>
<th>Connection</th>
<th>Number of poles</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Inputs</td>
<td>IN0...3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>8</td>
</tr>
<tr>
<td>B</td>
<td></td>
<td>IN4...7</td>
</tr>
<tr>
<td>D</td>
<td>Relay switching outputs</td>
<td>K0...2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>8</td>
</tr>
<tr>
<td>E</td>
<td></td>
<td>K3...5</td>
</tr>
<tr>
<td>V_EXT N2 GND N1</td>
<td>Supply external devices CAN interface 2 CAN interface 1</td>
<td>6</td>
</tr>
</tbody>
</table>

The mechanical coding of the connectors (A, B etc.) corresponds to the BasicController series.
5.5.1 Standard timer contacts

The device is suited for contacts of the standard timer and standard power timer AMP series and the respective standard timer housings.

![Standard timer contact](image1)

![Standard power timer contact](image2)

![Standard timer housing](image3)

**Figure shows standard timer housing with closed cover, view on the contact plug-in side**

1: Coding  
2: Snap spring

**NOTE**  
Individual non-insulated contacts are not permitted.

**NOTE**  
For current intensities exceeding 10 A use standard timer contacts.
5.5.2 Spade sockets

The device is suited for 6.3 x 0.8 mm spade sockets with full insulation to DIN 46245-3.

Spade socket

<table>
<thead>
<tr>
<th>Core cross-section [mm²]</th>
<th>Max. current intensity [A] *</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>7</td>
</tr>
<tr>
<td>0.75</td>
<td>8.5</td>
</tr>
<tr>
<td>1</td>
<td>10.5</td>
</tr>
<tr>
<td>1.5</td>
<td>12</td>
</tr>
<tr>
<td>2.5</td>
<td>15</td>
</tr>
</tbody>
</table>

*) at maximum ambient temperature, to pre-standard DIN 46249-1

**NOTE**

Only use fully insulated single contacts (loose pieces).

**NOTE**

For current intensities exceeding 10 A use suitable spade sockets.

Using all connections of a connector or the device with individual wires in spade sockets is not possible.

5.5.3 Frequency inputs

- Operate frequency inputs with screened cables so that useful signals are not affected by external interference.
6 Indicators

1: Status LED controller
2: Status LED fuses F0...F6
3: LED lighting in the cover (e.g. EC0401)

The status LEDs of the fuses are not visible when the cover is installed.

Operating states (→ 9 Technical data)
7 Set-up

7.1 Important notes on programming

► For the time of programming interconnect the connections B:1 (VBB15) and B:8 (VBBs).
► At least F7 must be fused

![Image of BasicController relay]

1: Bridge B:1 / B:8

7.1.1 Start conditions

⚠️ The device does not start before sufficient voltage is applied to the supply connection VBB15. In vehicles VBB15 is the plus cable switched by the ignition switch. A voltage >8 V DC is deemed sufficient.

The relay trip coil can only be switched when the protected voltage VBBs is applied and the CODESYS flag "SUPPLY_SWITCH" is closed (→ 3.4 Block diagram).

7.2 Programming

The user can easily create the application software by means of the IEC 61131-3 compliant programming system CODESYS 2.3.

⚠️ WARNING

The user is responsible for the safe function of the application programs which he created himself. If necessary, he must additionally carry out an approval by corresponding supervisory and test organisations according to the national regulations.

⚠️ WARNING

After completing component assembly and wiring, check the function of the device at max. operating conditions in normal operation and in fault condition.
7.3 Required documentation
In addition to the CODESYS programming system, the following documents are required for programming and set-up of the device:

- Programming manual CODESYS V2.3
  (alternatively as online help)
- System manual BasicController\text{\textsuperscript{relay}}
  (alternatively as online help)

The manuals can be downloaded from the internet:
www.ifm.com → Data sheet search → CR0431 → More information

Online help CODESYS and BasicController\text{\textsuperscript{relay}}:
www.ifm.com → Service → Download → Systems for mobile machines*

*) Download area with registration

7.4 Required hardware
A CAN interface for the connection to a PC or a notebook is required to load the application program to the device.

Example:

- CAN/RS232 USB interface CANfox (art. no.: EC2112)
- Adapter cable for CANfox (art. no.: EC2113)

You can find more information about the available accessories at:
www.ifm.com → Data sheet search → CR0431 → Accessories
or directly
www.ifm.com → Data sheet search → EC2112

8 Operation

\textbf{NOTE}

The max. temperatures at the metal or plastic parts of the device must not exceed 110°C.
9 Technical data

**CR0431**

Mobile controller
BasicController relay

8 inputs
Locations
for 6 automotive micro relays
and 8 automotive mini fuses

2 CAN interfaces
Programming
according to IEC 61131-3
8...32 V DC

**Technical data**

**Mechanical data**

- **Housing**
  - Dimensions (H x W x D)
  - unpopulated with EC0401 cover

- **Installation**

- **Connections**
  - **Relay**
  - **Fuses**

- **Operating voltage**

- **Connectors**

- **Inputs**
  - Relay switching outputs
  - External supply, CAN-Bus

- **Protection rating**

- **Operating temperature**

- **Storage temperature**

- **Weight**

**Electrical data**

- **Operating voltage**
- **Current consumption**

---

**Modular control system**

Usable as CANopen master or intelligent I/O module

- plastic housing (black)
  - 163 x 112 x 46.1 mm
  - 163 x 112 x 68 mm

- fixing by means of 4 M4 screws to DIN 4762 or DIN 7984 and 4 tubular rivets to DIN 7340 (tubular rivets are supplied)

- 6 locations for automotive micro relay
  - (23 x 15.5 x 26 mm (H x W x D), without contacts, with cover installed)

- 8 locations for automotive fuses up to 30 A

- M8 threaded suspension rod for supply voltage to the fuses

- M6 threaded suspension rod for ground connection (GND)
  - core cross-section 0.5...16 mm²

- AMP blade male terminals 6.3 mm,
  - contacts AMP standard timer or AMP standard power timer, CuZn pre-tin-plated
  - with timer contact housing, protected against reverse polarity to be clipped into place and thus vibration-resistant
  - core cross-section 0.5...2.5 mm²

- 2 x 8 poles
  - 2 x 8-poles
  - 1 x 6-poles

- IP 00 (PCB without housing to DIN EN 60529)
  - IP 54 (with cover and cable seal)
  - -40...75° C (without cover)
  - -40...65° C (with cover and cable seal)
  - -40...85° C

- 0.50 kg (unpopulated)

- 8...32 V DC
  - 45 mA (at 24 V DC, relay not switched)
### Technical data

<table>
<thead>
<tr>
<th>Overvoltage</th>
<th>36 V for t ≤ 10 s if U_B ≤ 7.8 V if U_B &lt; 7.0 V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Undervoltage detection</td>
<td></td>
</tr>
<tr>
<td>Undervoltage shutdown</td>
<td></td>
</tr>
<tr>
<td>Processor</td>
<td>Freescale PowerPC, 50 MHz</td>
</tr>
<tr>
<td>Memory (total)</td>
<td>208 Kbytes RAM / 1536 Kbytes Flash / 1 Kbyte FRAM</td>
</tr>
<tr>
<td>Memory allocation</td>
<td>see BasicController Relay system manual</td>
</tr>
<tr>
<td>Device monitoring</td>
<td><a href="http://www.ifm.com">www.ifm.com</a> → Data sheet search → e.g. CR0431 → More information</td>
</tr>
<tr>
<td>CAN interfaces 1/2</td>
<td>CAN interface 2.0 A/B, ISO 11898</td>
</tr>
<tr>
<td>Baud rate</td>
<td>20 Kbits/s...1 Mbits/s (default CAN1: 250 Kbits/s, CAN2: 250 Kbit/s)</td>
</tr>
<tr>
<td>Communication protocol</td>
<td>CANopen, CiA DS 301 version 4, CiA DS 401 version 1.4 or SAE J 1939 or free protocol</td>
</tr>
<tr>
<td>Software/programming</td>
<td>CODESYS version 2.3 (IEC 61131-3)</td>
</tr>
</tbody>
</table>

#### Inputs

**Configurations**

<table>
<thead>
<tr>
<th>Number</th>
<th>Version</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>digital for positive / negative sensor signals analogue (0…10/32 V DC, 0..20 mA, ratiometric) frequency (≤ 30 kHz) B_L/B_H A FRQ</td>
</tr>
<tr>
<td>4</td>
<td>digital for positive sensor signals resistance measurement (0.016...30 kΩ) B_L R</td>
</tr>
</tbody>
</table>

positive sensor signals have diagnostic capabilities

#### Outputs

**Relay connection**

<table>
<thead>
<tr>
<th>Number</th>
<th>Version</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>binary switching B</td>
</tr>
</tbody>
</table>

### Relay switching outputs

<table>
<thead>
<tr>
<th>Number</th>
<th>Version</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>normally open function with voltage readback NO</td>
</tr>
<tr>
<td></td>
<td>normally closed function with voltage readback NC</td>
</tr>
</tbody>
</table>

Two-colour LED (red/green)

### Status LEDs

**Controller**

Operating states freely programmable by the user (table shows presetting)

<table>
<thead>
<tr>
<th>Colour</th>
<th>Status</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>permanently off</td>
<td>no operating voltage</td>
</tr>
<tr>
<td>Orange</td>
<td>1 x on</td>
<td>initialisation or reset checks</td>
</tr>
<tr>
<td>Green</td>
<td>5 Hz</td>
<td>no operating system loaded</td>
</tr>
<tr>
<td></td>
<td>permanently on</td>
<td>application is running (RUN)</td>
</tr>
<tr>
<td>Red</td>
<td>10 Hz</td>
<td>application stopped (STOP with error)</td>
</tr>
<tr>
<td></td>
<td>5 Hz</td>
<td>application stopped due to undervoltage</td>
</tr>
<tr>
<td></td>
<td>permanently on</td>
<td>system fault (fatal error)</td>
</tr>
</tbody>
</table>

One-colour LEDs (orange)

<table>
<thead>
<tr>
<th>Colour</th>
<th>Status</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orange</td>
<td>permanently out</td>
<td>fuse faulty or not populated</td>
</tr>
<tr>
<td></td>
<td>permanently on</td>
<td>fuse OK</td>
</tr>
</tbody>
</table>

### Fuses F0...6

Operating states freely programmable by the user (table shows example)

### Fuse characteristics

<table>
<thead>
<tr>
<th>Version</th>
<th>automotive mini fuses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuse rate</td>
<td>≤ 30 A</td>
</tr>
<tr>
<td>Nominal current</td>
<td>≤ 15 A</td>
</tr>
<tr>
<td>Total current</td>
<td>≤ 60 A</td>
</tr>
<tr>
<td>Voltage readback range</td>
<td>0...32 V DC</td>
</tr>
<tr>
<td>Accuracy</td>
<td>10 %</td>
</tr>
</tbody>
</table>
### Input characteristics

Analogue inputs (A, B/L, B/L, FRQ)
Connection A: 02, 03, 06, 07
IN0...IN3 configurable as...

<table>
<thead>
<tr>
<th>Technical data</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Analogue inputs (A, B/L, B/L, FRQ)</strong></td>
<td></td>
</tr>
<tr>
<td>Connection A: 02, 03, 06, 07</td>
<td>IN0...IN3 configurable as...</td>
</tr>
</tbody>
</table>

#### Analogue inputs (A, B/L, B/L, FRQ)

- **Input characteristics**
  - **Analogue inputs (A, B/L, B/L, FRQ)**
    - Connection A: 02, 03, 06, 07
    - IN0...IN3 configurable as...

<table>
<thead>
<tr>
<th><strong>Analogue inputs (A, B/L, B/L, FRQ)</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Analogue inputs (A, B/L, B/L, FRQ)</strong></td>
<td></td>
</tr>
<tr>
<td>Connection A: 02, 03, 06, 07</td>
<td>IN0...IN3 configurable as...</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Input characteristics</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Analogue inputs (A, B/L, B/L, FRQ)</strong></td>
<td></td>
</tr>
<tr>
<td>Connection A: 02, 03, 06, 07</td>
<td>IN0...IN3 configurable as...</td>
</tr>
</tbody>
</table>

- **Input voltage** 0...10 V or 0...32 V
- **Resolution** 12 bits
- **Accuracy** ± 1% FS
- **Input resistance** 65.6 kΩ (0...10 V), 50.7 kΩ (0...32 V)
- **Input frequency** ≤ 500 Hz

- **Current inputs, with diagnostic capability**
  - **Input current** 0...20 mA
  - **Resolution** 12 bits
  - **Accuracy** ± 1% FS
  - **Input resistance** 400 Ω
  - **Input frequency** ≤ 500 Hz
  - **Input frequency** ≤ 500 Hz

  At a current of > 23 mA the input is switched to the voltage input!

- **Voltage inputs, 0...32 V, ratiometric**
  - **Function** \((U_{IN} - U_B) \times 1000 \text{%}\)
  - **Value range** 0...1000 %
  - **Input resistance** 50.7 kΩ

- **Binary voltage inputs for positive sensor signals**
  - **Switch-on level** > 0.7 U_B
  - **Switch-off level** < 0.3 U_B
  - **Input resistance** 3.2 kΩ
  - **Input frequency** 50 Hz
  - **Diagnostics wire break** > 0.95 U_B
  - **Diagnostics short circuit** < 1 V

- **Binary voltage inputs for negative sensor signals**
  - **Switch-on level** > 0.7 U_B
  - **Switch-off level** < 0.3 U_B
  - **Input resistance** 3.2 kΩ
  - **Input frequency** 50 Hz

- **Frequency inputs**
  - **Input resistance** 3.2 kΩ
  - **Input frequency** ≤ 30 kHz
  - **Switch-on level** > 0.35...0.48 U_B
  - **Switch-off level** < 0.29 U_B

---

We reserve the right to make technical alterations without prior notice!
## Technical data

### Binary voltage inputs for positive sensor signals
- **Switch-on level**: > 0.7 \( U_B \)
- **Switch-off level**: < 0.3 \( U_B \)
- **Input resistance**: 3.2 k\( \Omega \)
- **Input frequency**: 50 Hz
- **Diagnostics wire break**: > 0.95 \( U_B \)
- **Diagnostics short circuit**: < 1 V

### Resistor input
- **Measuring current**: < 2.0 mA
- **Input frequency**: 50 Hz
- **Measuring range**: 0.016...30 k\( \Omega \)
- **Accuracy**: ± 2% FS: 16 Ω...3 k\( \Omega \)  
  ± 5% FS: 3...15 k\( \Omega \)  
  ± 10% FS: 15...30 k\( \Omega \)

### Semiconductor outputs, short-circuit proof and overload protected
- **Switching voltage**: 5.5...32 V DC (configurable)
- **Switching current**: ≤ 0.5 A

<table>
<thead>
<tr>
<th>Switching voltage</th>
<th>≤ 32 V DC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Switching current</td>
<td>≤ 15 A</td>
</tr>
<tr>
<td>Total current</td>
<td>≤ 45 A</td>
</tr>
<tr>
<td>Voltage readback range</td>
<td>0...32 V DC</td>
</tr>
<tr>
<td>Accuracy</td>
<td>10 %</td>
</tr>
</tbody>
</table>

### Protective circuits
- **for trip coils**: integrated free wheel diodes  
  - **for switching outputs**: not integrated  
  - **Overload protection** (valid for all outputs): ≤ 5 minutes (at 100% overload)  
  - **Short-circuit protection** (valid for all inputs and outputs): ≤ 5 minutes (contacts +VBB/GND)
<table>
<thead>
<tr>
<th>CR0431</th>
<th>Technical data</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Test standards and regulations</strong></td>
<td></td>
</tr>
<tr>
<td><strong>CE marking</strong></td>
<td>EN 61000-6-2 Electromagnetic compatibility (EMC) Noise immunity</td>
</tr>
<tr>
<td></td>
<td>EN 61000-6-4 Electromagnetic compatibility (EMC) Radiation of interference</td>
</tr>
<tr>
<td><strong>E1 marking</strong></td>
<td>UN/ECE-R10 Radiation of interference Immunity with 100 V/m</td>
</tr>
<tr>
<td><strong>Electrical testing</strong></td>
<td>ISO 7637-2 Pulse 1, severity level: IV; function state C Pulse 2a, severity level: IV; function state A Pulse 2b, severity level: IV; function state C Pulse 3a, severity level: IV; function state A Pulse 3b, severity level: IV; function state A Pulse 4, severity level: IV; function state A Pulse 5, severity level: III; function state C (data valid for the 24V system) Pulse 4, severity level: III; function state C (data valid for the 12 V system)</td>
</tr>
<tr>
<td><strong>Climatic tests</strong></td>
<td>EN 60068-2-30 Damp heat, cyclic Upper temperature 55°C, number of cycles: 6</td>
</tr>
<tr>
<td></td>
<td>EN 60068-2-78 Damp heat, steady state Test temperature 40°C / 93% RH, Test duration: 21 days</td>
</tr>
<tr>
<td></td>
<td>EN 60068-2-52 Salt spray test Severity level 3 (vehicle) Only with installed EC0401 or EC0402 cover</td>
</tr>
<tr>
<td><strong>Mechanical tests</strong></td>
<td>ISO 16750-3 Test VII; Vibration, random Mounting location: vehicle body</td>
</tr>
<tr>
<td></td>
<td>EN 60068-2-6 Vibration, sinusoidal 10...500 Hz; 0.72 mm/10 g; 10 cycles/axis</td>
</tr>
<tr>
<td></td>
<td>ISO 16750-3 Bumps 30 g/6 ms; 24,000 shocks</td>
</tr>
<tr>
<td><strong>Tests for railway applications</strong></td>
<td>EN 50121-3-2 Electromagnetic compatibility (EMC)</td>
</tr>
<tr>
<td></td>
<td>EN 50155 clause 12.2 Electronic equipment used on rolling stock</td>
</tr>
<tr>
<td><strong>Note</strong></td>
<td>The EC declaration of conformity and approvals can be found at: <a href="http://www.ifm.com">www.ifm.com</a> → Data sheet search → CR0431 → More information</td>
</tr>
</tbody>
</table>
Wiring
Connectors
A/B: Inputs
D/E: Relay switching outputs
V_EXT: Supply external devices
N2: CAN interface 2:
N1: CAN interface 1

### Technical data

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>D</th>
<th>E</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>8 poles</td>
<td>VBB15</td>
<td>VBB15</td>
<td>F0 (K0:3)</td>
<td>F3 (K3:3)</td>
<td>V_EXT</td>
</tr>
<tr>
<td>1</td>
<td>IN0</td>
<td>IN4</td>
<td>K0:5</td>
<td>K3:5</td>
<td>CAN2_H</td>
</tr>
<tr>
<td>2</td>
<td>IN1</td>
<td>IN5</td>
<td>K0:4</td>
<td>K3:4</td>
<td>CAN2_L</td>
</tr>
<tr>
<td>3</td>
<td>GND</td>
<td>GND</td>
<td>F1 (K1:3)</td>
<td>F4 (K4:3)</td>
<td>GND</td>
</tr>
<tr>
<td>4</td>
<td>GND</td>
<td>GND</td>
<td>K1:5</td>
<td>K4:5</td>
<td>CAN1_H</td>
</tr>
<tr>
<td>5</td>
<td>IN2</td>
<td>IN6</td>
<td>K1:4</td>
<td>K4:4</td>
<td>CAN1_L</td>
</tr>
<tr>
<td>6</td>
<td>IN3</td>
<td>IN7</td>
<td>K2:5</td>
<td>K5:5</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>VBB15</td>
<td>VBBs</td>
<td>K2:4</td>
<td>K5:4</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Operating voltage via battery

<table>
<thead>
<tr>
<th>BAT (+)</th>
<th>BAT (-)</th>
</tr>
</thead>
<tbody>
<tr>
<td>M8</td>
<td>M6</td>
</tr>
<tr>
<td>8...32 V DC</td>
<td>GND</td>
</tr>
</tbody>
</table>

### Abbreviations

- A: Analogue
- B: Binary
- BAT: Battery
- BH: Binary high side
- BL: Binary low side
- F: Fuse
- FRQ: Frequency/pulse inputs
- K: Relay
- NC: Normally closed function
- NO: Normally open function
- PWM: Pulse width modulation
- R: Resistor input
- VBBs: Supply sensors/module/trip coils
- VBB15: Supply via ignition lock (clamp 15)
- V_EXT: Supply external devices
10 Maintenance, repair and disposal

10.1 Servicing
The device does not contain any components that need to be maintained by the user.

10.2 Cleaning of the housing surface
► Disconnect the device.
► Clean the device from dirt using a soft, chemically untreated and dry cloth.
► In case of heavy dirt, use a damp cloth.

⚠️ The following agents are not suited for cleaning the device:
Chemicals dissolving plastics such as methylated spirit, benzine, thinner, alcohol, acetone or ammonia.

ℹ️ Micro-fibre cloths without chemical additives are recommended.

10.3 Repair
► The device must only be repaired by the manufacturer. Observe the safety instructions (→ 2.4 Tampering with the device)

10.4 Disposal
► Dispose of the camera in accordance with the national environmental regulations.

11 Approvals/standards
Test standards and regulations (→ 9 Technical data)
The EC declaration of conformity and approvals can be found at: www.ifm.com → Data sheet search → CR0431 → Approvals