# Bridge Input Detection Module

## Quick Start Guide

SHENZHEN INVT ELECTRIC CO., LTD.

# Preface

## Overview

Thank you for choosing the INVT bridge input detection module (FL3321: Single-channel bridge input detection module; FL3322: Dual-channel bridge input detection module). This module is compatible with INVT Flex series communication interface modules (such as FK1100, FK1200, and FK1300), TS600 series programmable controller, and TM700 series programmable controller. The features are as follows:

- The module supports the acquisition of single-channel or dual-channel bridge voltage input signals.
- Supports 4-wire and 6-wire bridge detection.
- Supports independent filter settings.
- Supports open wire detection and short-circuit detection functions.

This guide briefly describes the interface description, wiring examples, cable specifications, usage examples, common parameter descriptions, and common faults and solutions of the INVT bridge detection module.

## Audience

Personnel with electrical professional knowledge (such as qualified electrical engineers or personnel with equivalent knowledge).

## Change history

The manual is subject to change irregularly without prior notice due to product version upgrades or other reasons.

| No. | Change description | Version | Release date |
|---|---|---|---|
| 1 | First release. | V1.0 | September 2025 |

# Contents

# 1 Specifications

<table>
<tr><th>Item</th><th colspan="4">Specifications</th></tr>
<tr><td rowspan="6">Power supply</td><td>External input rated voltage</td><td colspan="3">24VDC (-15%–+20%)</td></tr>
<tr><td>External input rated current</td><td colspan="3">0.5A</td></tr>
<tr><td>Backplane bus rated output voltage</td><td colspan="3">5VDC (4.75VDC–5.25VDC)</td></tr>
<tr><td>Backplane bus current consumption</td><td colspan="3">120mA (Typical value)</td></tr>
<tr><td>Isolation</td><td colspan="3">Isolation</td></tr>
<tr><td>Power supply protection</td><td colspan="3">Protection against reverse connection and overcurrent</td></tr>
<tr><td rowspan="5">Indicators</td><td>Name</td><td>Color</td><td>Silk screen</td><td>Definition</td></tr>
<tr><td>Run indicator</td><td>Green</td><td>R</td><td>On: The module is operating.<br>Slow flashing (once every 0.5s): The module is establishing communication.<br>Off: The module is not powered on or it is abnormal.</td></tr>
<tr><td>Error indicator</td><td>Red</td><td>E</td><td>Off: No abnormalities were found during module operation.<br>Fast flashing (once every 0.1s): The module is offline.<br>Slow flashing (once every 0.5s): No power connected externally or incorrect parameter settings.</td></tr>
<tr><td>Enabling status indicator</td><td>Green</td><td>C0, C1</td><td>On: The channel is enabled.<br>Slow flashing (once every 0.5s): The input signal is out of range, beyond limits, or the channel configuration parameters are incorrect.<br>Off: The channel is disabled.</td></tr>
<tr><td>Open wire detection indicator</td><td>Red</td><td>B0, B1</td><td>ON: The signal wire is open.<br>Off: The signal wire is operating normally.</td></tr>
</table>

<table>
<tr><th>Item</th><th colspan="4">Specifications</th></tr>
<tr><td></td><td>Short-circuit detection indicator</td><td>Red</td><td>S0, S1</td><td>On: The excitation power output is short-circuited.<br>Off: The excitation power output is not short-circuited.</td></tr>
<tr><td>Number of channels</td><td colspan="4">One or two</td></tr>
<tr><td>Input mode</td><td colspan="4">Differential</td></tr>
<tr><td>Voltage range</td><td colspan="4">±30mVDC</td></tr>
<tr><td>Input sensor type</td><td colspan="4">4-wire or 6-wire bridge sensors</td></tr>
<tr><td>Loadcell sensitivity</td><td colspan="4">(0.5/1/2/4/6) mV/V</td></tr>
<tr><td>Load resistance range</td><td colspan="4">40–4010Ω</td></tr>
<tr><td rowspan="3">Precision</td><td colspan="4">±0.01% FS (at 25°C, sampling rate ⩾ 80ms, and Loadcell sensitivity ＞ 2mV/V)</td></tr>
<tr><td colspan="4">±0.05% FS (-25°C to +55°C, sampling rate ⩾ 80ms, and Loadcell sensitivity ＞ 2mV/V)</td></tr>
<tr><td colspan="4">±1% FS (at 25°C, under CE standard interference conditions)</td></tr>
<tr><td>Maximum excitation power</td><td colspan="4">5V @ 250mA</td></tr>
<tr><td>Open wire detection</td><td colspan="4">Supported (signal wire)</td></tr>
<tr><td>Over-limit detection</td><td colspan="4">Supported</td></tr>
<tr><td>Over-range detection</td><td colspan="4">Supported</td></tr>
<tr><td>Isolation method</td><td colspan="4">No isolation between channels</td></tr>
<tr><td>Certification</td><td colspan="4">CE, RoHS</td></tr>
<tr><td rowspan="7">Environment</td><td>Ingress protection (IP) rating</td><td colspan="3">IP20</td></tr>
<tr><td>Working temperature</td><td colspan="3">-20°C–+55°C</td></tr>
<tr><td>Working humidity</td><td colspan="3">10%–95% (no condensation)</td></tr>
<tr><td>Air</td><td colspan="3">No corrosive gas</td></tr>
<tr><td>Storage temperature</td><td colspan="3">-40°C–70°C</td></tr>
<tr><td>Storage humidity</td><td colspan="3">RH < 90%, without condensation</td></tr>
<tr><td>Altitude</td><td colspan="3">Lower than 2000m (80kPa)</td></tr>
</table>

| Item | Specifications | |
|---|---|---|
| | Pollution degree | ≤2, compliant with IEC61131-2 |
| | Anti-interference | 2kV power cable, compliant with IEC61000-4-4 |
| | Electrostatic discharge level | 6kVCD or 8kVAD |
| | EMC anti-interference level | Zone B, IEC61131-2 |
| | Vibration resistance | IEC60068-2-6<br>5Hz–8.4Hz, vibration amplitude of 3.5mm, 8.4Hz–150Hz, ACC of 9.8m/s$^2$, 100 minutes at each direction of X, Y, and Z (10 times and 10 minutes each time, for a total of 100 minutes) |
| Impact resistance | Impact resistance | IEC60068-2-27<br>50m/s$^2$, 11ms, 3 times for each of 3 axes at each direction of X, Y, and Z |
| Installation method | Rail installation: 35mm standard DIN rail | |
| Dimensions | 12.5×95×105 (W×D×H, unit: mm) | |

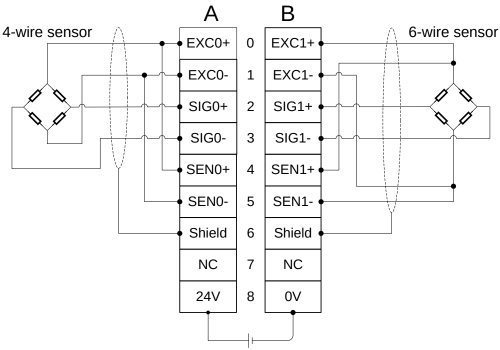
# 2 Interface description

| Diagram | Left signal | Left terminal | Right terminal | Right signal |
|---|---|---|---|---|
|  | EXC0+ | **A0** | **B0** | EXC1+ |
| | EXC0- | **A1** | **B1** | EXC1- |
| | SIG0+ | **A2** | **B2** | SIG1+ |
| | SIG0- | **A3** | **B3** | SIG1- |
| | SEN0+ | **A4** | **B4** | SEN1+ |
| | SEN0- | **A5** | **B5** | SEN1- |
| | Shield | **A6** | **B6** | Shield |
| | NC | **A7** | **B7** | NC |
| | 24V | **A8** | **B8** | 0V |

| Pin | Name | Description | Specifications |
|---|---|---|---|
| A0 | EXC0+ | Positive terminal of the excitation voltage output for Channel 0 | Input form: Differential input<br>Input voltage range: ±30mV |
| B0 | EXC1+ | Positive terminal of the excitation voltage output for Channel 1 | |
| A1 | EXC0- | Negative terminal of the excitation voltage output for Channel 0 | |
| B1 | EXC1- | Negative terminal of the excitation voltage output for Channel 1 | |
| A2 | SIG0+ | Positive terminal of the bridge input signal for Channel 0 | |
| B2 | SIG1+ | Positive terminal of the bridge input signal for Channel 1 | |
| A3 | SIG0- | Negative terminal of the bridge input signal for Channel 0 | |
| B3 | SIG1- | Negative terminal of the bridge input signal for Channel 1 | |

| Pin | Name | Description | Specifications |
|---|---|---|---|
| A4 | SEN0+ | Positive terminal of the bridge feedback voltage for Channel 0 | |
| B4 | SEN1+ | Positive terminal of the bridge feedback voltage for Channel 1 | |
| A5 | SEN0- | Negative terminal of the bridge feedback voltage for Channel 1 | |
| B5 | SEN1- | Negative terminal of the bridge feedback voltage for Channel 1 | |
| A6 | Shield | Shielding cable ground of the bridge Channel 0 | |
| B6 | Shield | Shielding cable ground of the bridge Channel 1 | |
| A7 | - | - | |
| B7 | - | - | |
| A8 | 24V | Positive terminal of the external 24V power input | Module power input:<br>24VDC (20.4VDC–28.8VDC) |
| B8 | 0V | Negative terminal of the external 24V power input | |

# 3 Wiring example




**Note:**

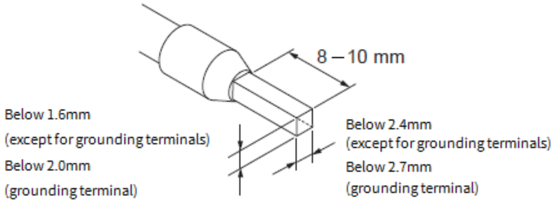
- Avoid bundling sensor cables together with power cables (high voltage and high current) or other cables that transmit strong interference signals. They should be routed separately and parallel routing should be avoided.
- The sensor and the module should be grounded at equipotential as much as possible.

# 4 Cable specifications

| Cable material | Cable diameter | | Crimping tool |
|---|---|---|---|
| | GB size/mm$^2$ | AWG size/AWG | |
| Tubular cable lug | 0.3 | 22 | Use a proper crimping plier. |
| | 0.5 | 20 | |
| | 0.75 | 18 | |
| | 1.0 | 18 | |
| | 1.5 | 16 | |

**Note:** The cable diameters of the tubular cable lugs in the preceding table is only for reference, which can be adjusted based on actual situations.

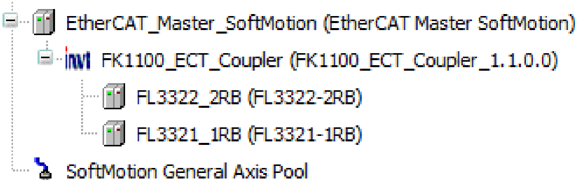
When using other tubular cable lugs, crimp multiple strands of cable, and the processing size requirements are as follows:



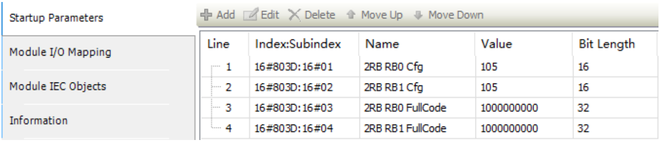
# 5 Application example

This chapter introduces the usage steps of the product using CODESYS as an example.

Step 1 Add the device and configure the network topology.




Step 2 In the startup parameters, configure the channel parameters according to actual requirements, including sensitivity, conversion time, and full-scale code value.




| Line | Index:Subindex | Name | Value | Bit Length |
|---|---|---|---|---|
| 1 | 16#803D:16#01 | 2RB RB0 Cfg | 105 | 16 |
| 2 | 16#803D:16#02 | 2RB RB1 Cfg | 105 | 16 |
| 3 | 16#803D:16#03 | 2RB RB0 FullCode | 1000000000 | 32 |
| 4 | 16#803D:16#04 | 2RB RB1 FullCode | 1000000000 | 32 |

AIx Cfg(x=0–7) is the channel configuration parameter of type USINT. Taking the configuration of channel 0 as an example, the data definitions are detailed in the following table of parameters.

| Bit | Name | Description |
|---|---|---|
| Bit0 | Channel enabling flag | 1#0: Disable<br>1#1: Enable |
| Bit1 | Tare mode | 1#0: Automatic tare<br>1#1: Manual tare |
| Bit3–Bit2 | Sensor sensitivity | 2#00: 1mV/V<br>2#01: 2mV/V<br>2#10: 4mV/V<br>2#11: 6mV/V |

| Bit | Name | Description |
|---|---|---|
| Bit7–Bit4 | Channel conversion time | 2#0000: 1ms<br>2#0001: 2ms<br>2#0010: 5ms<br>2#0011: 10ms<br>2#0100: 20ms<br>2#0101: 40ms<br>2#0110: 80ms<br>2#0111: 200ms<br>2#1000: 400ms |
| Bit8 | Enable enhanced filter | 1#0: Disable<br>1#1: Enable |
| Bit9 | Enable open wire detection | 1#0: Disable<br>1#1: Enable |
| Bit15–Bit10 | Reserved | Reserved |

For example, if the channel is enabled, tare mode is set to automatic tare, the sensor sensitivity is set to 4mV/V, the channel conversion time is set to 80ms, and the enhanced filter is disabled, then the RB Cfg value is configured as 2#0000 0000 0110 1001 (16#0069, 105 in decimal).

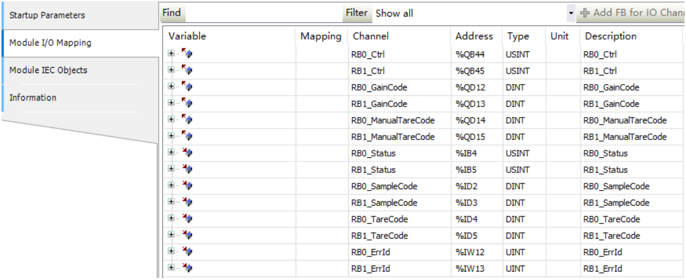
| Bit8 | Bit7 | Bit6 | Bit5 | Bit4 | Bit3 | Bit2 | Bit1 | Bit0 |
|---|---|---|---|---|---|---|---|---|
| Enhanced filter | Channel conversion time | | | | Sensor sensitivity | | Tare mode | Channel enabled |
| 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 1 |

RB.FullCode description: The full-scale code value of the channel, which can be configured by the user to correspond to the full-scale load of the channel. For example, if the full-scale load is 10kg and the full-scale code is set to 10,000,000, then the resolution is: 10kg/10,000,000=0.001g. With the current configuration, if the sampled value is 5683526, the corresponding weight is: 5683526×0.001g=5683.526g=5.683526kg

**Note:**

- Configure the channel full-scale code value according to the required resolution.
- After the full-scale code is set, the calibration value in subsequent channel gain calibration needs to be converted based on the full-scale code value.

Step 3 After completing the parameter configuration, map the program parameters in the I/O mapping interface, and perform control and sampling in the program.




| Variable | Mapping | Channel | Address | Type | Unit | Description |
|---|---|---|---|---|---|---|
| | | RB0_Ctrl | %QB44 | USINT | | RB0_Ctrl |
| | | RB1_Ctrl | %QB45 | USINT | | RB1_Ctrl |
| | | RB0_GainCode | %QD12 | DINT | | RB0_GainCode |
| | | RB1_GainCode | %QD13 | DINT | | RB1_GainCode |
| | | RB0_ManualTareCode | %QD14 | DINT | | RB0_ManualTareCode |
| | | RB1_ManualTareCode | %QD15 | DINT | | RB1_ManualTareCode |
| | | RB0_Status | %IB4 | USINT | | RB0_Status |
| | | RB1_Status | %IB5 | USINT | | RB1_Status |
| | | RB0_SampleCode | %ID2 | DINT | | RB0_SampleCode |
| | | RB1_SampleCode | %ID3 | DINT | | RB1_SampleCode |
| | | RB0_TareCode | %ID4 | DINT | | RB0_TareCode |
| | | RB1_TareCode | %ID5 | DINT | | RB1_TareCode |
| | | RB0_ErrId | %IW12 | UINT | | RB0_ErrId |
| | | RB1_ErrId | %IW13 | UINT | | RB1_ErrId |

# 6 Calibration

Before using the module to measure the load, perform the channel calibration first. After calibration, the channel stores the calibration data in the module’ s internal memory, which retains the data even when power is off. If the sensor is replaced, calibration must be performed again.

Step 1 Zero calibration

After the device is connected, apply an absolute load of 0 or a relative load of 0 (see Note 1). When the load is stable, trigger zero calibration (RB_Ctrl.bit0 rising edge). When the zero calibration complete flag (RB_Status.bit0) is set to 1, the zero calibration is completed.

Step 2 Gain calibration

After zero calibration is completed, apply a standard load, such as 8kg (78.4N, $g=9.8m/s^2$), and set the gain code value to 8,000,000 (see Note 2). When the load is stable, enable gain calibration (RB_Ctrl.bit1 rising edge). When the gain calibration complete flag (RB_Status.bit1) is set to 1, the gain calibration is completed.

**Note:**

- If it is not possible to achieve absolute zero load during zero calibration under actual site conditions, use the current load as the relative zero load. In this case, during gain calibration, use the relative load value for calibration, and the subsequent measured values will also be relative to this load.
- According to the full-scale code conversion, for example, if the full-scale code is configured as 10kg corresponding to 10,000,000, then 8kg corresponds to 8,000,000.

# 7 Tare function

Tare is performed after calibration, according to the tare mode configured in RB_Cfg:

1. Automatic tare mode: On the rising edge of RB_Ctrl.bit2, the current measured value is taken as the tare value.

2. Manual tare mode: On the rising edge of RB_Ctrl.bit2, the value of RB_Manual Tare Code is taken as the tare value. The RB_Manual Tare Code also needs to be converted according to the full-scale code value.

# 8 Measurement function

After completing channel configuration and calibration, obtain the sampled code value from the RB_SampleCode variable, and convert it to the engineering value according to the full-scale code value.

# Appendix A Parameter description

| Parameter name | Meaning |
|---|---|
| Ctrl | [0]: Enable zero calibration (rising edge triggered)<br>[1]: Enable gain calibration (rising edge triggered)<br>[2]: Update tare via software (rising edge triggered)<br>[3]: Restore factory settings (rising edge triggered)<br>[7:4]: Reserved |
| Gain Code | Gain calibration code, converted according to the full-scale code value |
| Manual Tare Code | Manual tare code, converted according to the full-scale code value |
| Status | [0]: Zero calibration status<br>[1]: Gain calibration status<br>[2]: Tare status<br>[7:3]: Reserved |
| Sample Code | Channel measurement code value |
| Tare Code | Channel tare code value |
| Err Id | Channel error code |

# Appendix B Fault code

| Fault code (decimal) | Fault code (hexadecimal) | Fault type | Solution |
|---|---|---|---|
| 1 | 0x0001 | Module configuration fault | Check whether the network configuration corresponds to the physical configuration of the module |
| 2 | 0x0002 | Incorrect module parameter setting | Check whether the module parameter configuration is correct |
| 3 | 0x0003 | Module output port power supply fault | Check whether the module output port power supply is normal |
| 4 | 0x0004 | Module output fault | Check whether the module output port load exceeds the specification range |
| 18 | 0x0012 | Incorrect parameter setting for Channel 0 | Check whether the parameter configuration for Channel 0 is correct |
| 20 | 0x0014 | Output fault on Channel 0 | Check whether the output of channel 0 is short-circuited or open-circuited |
| 21 | 0x0015 | Signal source open circuit fault on Channel 0 | Check whether the physical connection of Channel 0 signal source is normal |
| 22 | 0x0016 | Sampling signal over-limit fault on Channel 0 | Check whether Channel 0 sampling signal exceeds the chip limit |
| 23 | 0x0017 | Sampling signal over-range fault on Channel 0 | Check whether Channel 0 sampling signal exceeds the measurement upper limit. |
| 24 | 0x0018 | Sampling signal under-range fault on Channel 0 | Check whether Channel 0 sampling signal is below the measurement lower limit. |
| 34 | 0x0022 | Incorrect parameter setting for Channel 1 | Check whether the parameter configuration for Channel 1 is correct |
| 36 | 0x0024 | Output fault on | Check if the output of Channel 1 is |

| Fault code (decimal) | Fault code (hexadecimal) | Fault type | Solution |
|---|---|---|---|
| | | Channel 1 | short-circuited or open-circuited |
| 37 | 0x0025 | Signal source open circuit fault on Channel 1 | Check the physical connection of Channel 1 signal source is normal |
| 38 | 0x0026 | Sampling signal over-limit fault on Channel 1 | Check whether Channel 1 sampling signal exceeds the chip limit |
| 39 | 0x0027 | Sampling signal over-range fault on Channel 1 | Check whether Channel 1 sampling signal exceeds the measurement upper limit. |
| 40 | 0x0028 | Sampling signal under-range fault on Channel 1 | Check whether Channel 1 sampling signal is below the measurement lower limit. |

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