

GX-6

Intelligent Load Sensing Unit

Technical Manual

ISU™ Intelligent Load Sensing Unit

CAN Bus Interface

—— Technical Manual

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General Provisions, Scope of Application and Disclaimer

1. Purpose of Document

This technical manual provides essential information regarding the installation, calibration, operation, and maintenance of the ISU™ Intelligent Load Sensing Unit, aiming to ensure safe, reliable, and stable system operation in compliance with engineering specifications.

2. Scope of Application

This document applies to the Intelligent Load Sensing System comprising the following components:

- GX-6 Intelligent Load Sensing Unit Module (including sensor + signal processor)
- NEW-T3000 Display Terminal

Including all standard configurations and multi-axis installation schemes.

This manual covers key aspects throughout the system lifecycle, including:

- System Overview
- Technical Specifications
- Installation and Verification
- Calibration and Accuracy Verification
- Operating Instructions
- Maintenance and Diagnostics

3. Intended Use

The Intelligent Load Sensing System is used for vehicle load monitoring and on-board weighing applications.

4. User Responsibilities

The installation, calibration, and maintenance of the system shall be performed by trained professionals.

The user shall assume the following responsibilities:

- Ensure that installation environment and condition requirements are met

- Strictly follow the operating procedures specified in this manual
- Verify system performance after installation and calibration
- Perform routine maintenance and inspection as specified

Failure to comply with the above requirements may result in:

- Reduced measurement accuracy
- System malfunction
- Invalid measurement results

5. Installation and Usage Limitations

- System accuracy depends on the sensor installation position, bonding quality, and correctness of the calibration process.
- Environmental factors such as temperature, vibration, and mechanical stress may affect system performance.
- This system provides reference weight data and shall not replace certified legal weighing equipment in scenarios where certified metrological devices are legally required.

6. Disclaimer

The manufacturer shall not be liable for losses, damages, or inaccurate measurement results caused under the following circumstances:

- Installation or calibration not performed in accordance with specifications or the procedures specified in this manual
- Unauthorized modification or disassembly of the system
- Use beyond the intended scope of application
- Any deviation from the recommended procedures may affect system performance and safety.

The manufacturer reserves the right to continuously improve and update the product and technical parameters without prior notice.

7. Document Management

This document is part of the technical documentation for the Intelligent Load Sensing System.

Users shall ensure that the latest valid version is used. To obtain updated versions, please contact the manufacturer.

If the vehicle manufacturer has additional safety regulations, those requirements shall take precedence.

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1. Product Overview

The GX-6 Intelligent Load Sensing System is a next-generation distributed strain measurement system developed by Walkhorizon, providing high-precision, real-time load sensing capabilities for commercial vehicles and construction machinery. Based on metal strain measurement technology, the system acquires minute elastic deformations of load-bearing structures under load through distributed measurement nodes, and combines edge computing, temperature compensation, and digital filtering algorithms to achieve high-precision real-time measurement of vehicle axle loads, wheel loads, and structural stress states.

The GX-6 Intelligent Load Sensing System consists of the GX-6 Intelligent Load Sensing Unit and the NEW-T3000 industrial display terminal, adopting a system architecture of "distributed measurement, edge processing, centralized display, and cloud collaboration." The GX-6 Intelligent Load Sensing Unit integrates bridge-type strain sensors, signal conditioning, temperature compensation, data processing, and CAN bus communication functions. It can be deployed directly near the left and right wheels of each axle for real-time acquisition, processing, and load calculation of strain signals at each measurement point. The NEW-T3000 industrial display terminal handles the human-machine interaction display of vehicle load information and enables remote data management, status monitoring, and intelligent analysis through the connected vehicle platform.

The GX-6 Intelligent Load Sensing Unit employs a high-performance 32-bit ARM microcontroller with a built-in real-time operating system (RTOS), supporting various data processing algorithms including moving average, FIR, and Kalman filtering. It provides a standard CAN 2.0B extended frame communication interface for seamless integration into the vehicle CAN bus network. The system features high sensitivity, high measurement accuracy, high reliability, and excellent environmental adaptability, capable of long-term stable operation under extreme temperatures, strong vibration, shock, mud, salt spray, and other harsh conditions, enabling continuous online monitoring of vehicle axle loads and wheel loads without modifying the vehicle's load-bearing structure.

Based on distributed strain measurement technology, the GX-6 not only meets the real-time load management needs of commercial vehicles and construction machinery but also provides fundamental data support for vehicle operating condition perception. It can be widely applied in scenarios such as vehicle overload warning, anti-rollover warning for dump trucks and cranes, dynamic weighing of port and mining loading equipment, weighing compliance management for hazardous material transport, and real-time cargo weight management for logistics.

It is worth emphasizing that the core of the GX-6 Intelligent Load Sensing System is not designed for a specific vehicle or weighing application, but is founded on the fundamental physical principle of metal strain measurement. Any application object whose structural stress state can be reflected through minute elastic deformation of materials can adopt the GX-6 measurement architecture for extension. Therefore, in addition to vehicle load measurement, the system can be further applied to fields such as bridge health monitoring, railway track load analysis, building structural safety assessment, pressure vessel fatigue testing, and chemical equipment stress monitoring, providing high-precision stress, strain, and load measurement solutions for various load-bearing structures, demonstrating excellent versatility, scalability, and engineering application value.

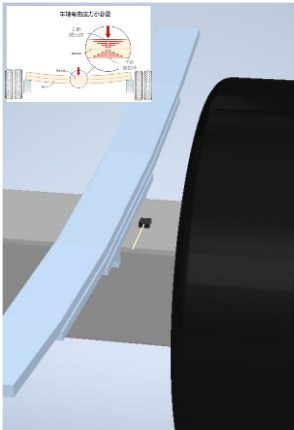
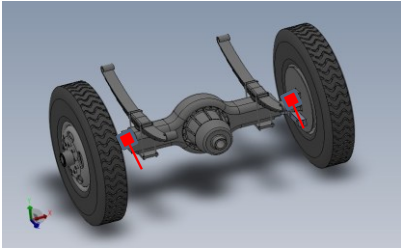
2. Product Description

2.1 Wheel Load Sensing System Overview

The GX-6 is installed at the load-bearing point of the vehicle axle, typically between the leaf spring and the wheel or on the inner side of the leaf spring, sensing axle load changes through strain gauges. Multiple sensor nodes are connected to the on-board ECU or display terminal via the CAN bus, enabling real-time acquisition of each axle's load, and obtaining the vehicle's payload after noise reduction, filtering, and data processing.

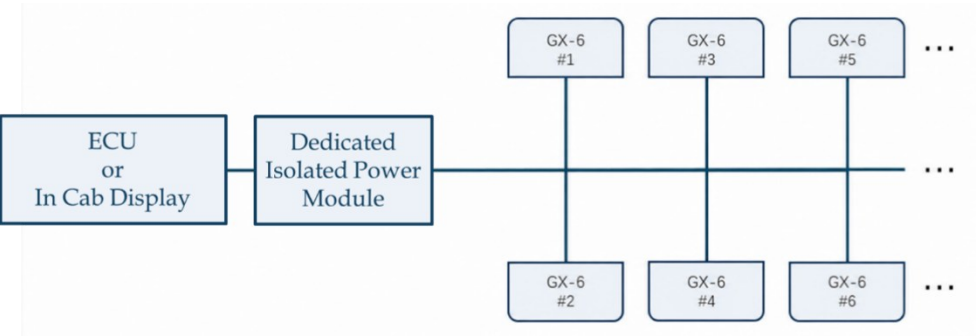
One GX-6 module is installed on each side of the axle
A compact axle load sensing module for heavy -duty vehicles

- **Sensor Mounting Location**
 - One sensor is installed on each side of the axle, close to the wheel hub.
- **Ultra-Compact Design**
 - Designed for space-constrained installation.



Edge Intelligence

2.2 System Architecture



2.3 Appearance and Dimensions

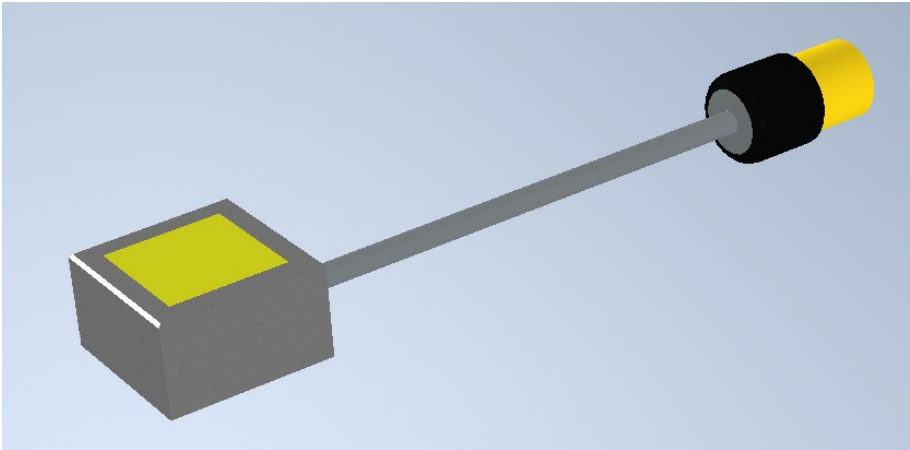
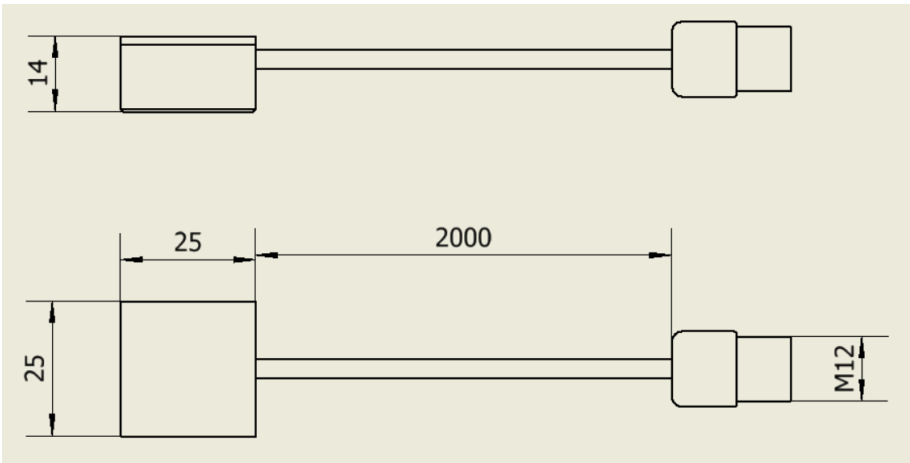


Figure 2 GX-6 Intelligent Load Sensing Unit



Length L	25 mm
Width W	25 mm
Height H	14 mm
Cable Length	2000mm
Cable Outer Diameter	Φ4 mm with nylon protective sleeve
Cable Connector	4-pin M12 waterproof anti-loosening aviation connector
Cable Exit Position	Side, 10 mm from bottom

3. Core Features

3.1 Precision by Design

The GX-6 employs a low-noise analog front-end and a high-performance 12-bit analog-to-digital converter (ADC), capable of stably acquiring minute strain signals generated by structural materials. By optimizing the analog signal chain design and data acquisition process, it provides a stable and reliable data foundation for real-time load calculation.

3.2 Integrated Temperature Compensation

The GX-6 features built-in dual temperature sensors that monitor temperature changes of the module and installation environment in real time. Combined with temperature compensation algorithms, it effectively reduces the impact of ambient temperature variations on strain measurement results, improving the long-term stability of measurement results under different environmental conditions.

3.3 Distributed CAN Network Communication Architecture

Adopting the CAN 2.0B extended frame communication protocol with a default baud rate of 500 kbps, it supports up to 32 GX-6 nodes CAN network, meeting the deployment requirements for multi-axle and multi-point measurement applications.

3.4 Intelligent Signal Processing

The GX-6 incorporates various digital filtering algorithms including moving average, FIR low-pass, and Kalman filtering, which can be flexibly selected for different operating conditions, achieving a reasonable balance between dynamic response speed and measurement stability to meet load measurement requirements under various conditions.

3.5 Software Configurable Calibration

The system supports software-based gain and zero-point calibration without mechanical zeroing. All configuration parameters are stored in internal Flash, and Bootloader-based online firmware upgrades are supported, facilitating product maintenance, parameter adjustment, and future feature expansion.

3.6 Designed for Harsh Industrial Environments

The GX-6 features industrial-grade hardware design, supporting +5 V power supply with integrated reverse polarity protection, ESD protection, and voltage monitoring. The communication interface employs a CAN extended frame filtering mechanism, effectively improving data communication reliability in complex electromagnetic environments, meeting the application requirements for long-term stable operation of vehicles and construction machinery.

4 Mechanical Performance

4.1 Structural Parameters

Housing Material	Carbon fiber reinforced engineering plastic
Sealing Method	Potting, IP67
Mounting Method	Dedicated adhesive bonding
Wiring Method	4-core shielded cable, 2000 mm lead length
Cable Outer Diameter	Φ4 mm cable, nylon protective sleeve
Housing Color	Black
Net Weight	Approx. 5 g (excluding cable)

4.2 Environmental Adaptability

Test Item	Test Conditions	Acceptance Criteria
Vibration Endurance	5-2000 Hz, 5 g rms XYZ axes, 8 h each	Normal function, no structural damage
Mechanical Shock	30 g, 11 ms, 3 times per axis	Normal function
Temperature Cycling	-40°C ↔ +85°C, 5 cycles	Normal function, accuracy qualified
Damp Heat Test	40°C, 95% RH, 96 h	Insulation resistance ≥ 100 MΩ
Salt Spray Test	5% NaCl, 35°C, 48 h	No corrosion, normal function
IP Protection	IP67, 1 m water depth, 30 min	Waterproof qualified, normal function

5 Technical Specification

5.1 Power Characteristics

Parameter	Min	Typical	Max	Unit
Supply Voltage	4.5	5.0	7.2	V DC
Operating Current (5V supply)	—	80	150	mA
Startup Inrush Current	—	—	500	mA, < 5 ms
Reverse Polarity Protection	—	Yes	—	—

5.2 Weighing Performance

Parameter	Min	Typical	Max	Unit
Measurement Range	—	2000	2200	με
Resolution	—	0.03	—	% F.S.
Sensor Overall Accuracy	—	±0.3	±0.5	% F.S.
Zero-point Thermal Drift	—	—	±0.01	% F.S./°C
Span Thermal Drift	—	—	±0.01	% F.S./°C
Hysteresis	—	—	0.1	% F.S.
Repeatability	—	0.1	—	% F.S.
ADC Resolution	—	12	—	bit
Sampling Interval (Configurable)	100	—	6000	ms

5.3 CAN Bus Electrical Characteristics

Parameter	Min	Typical	Max	Unit
Baud Rate	—	500	—	kbps
Bus Termination Resistor	—	120	—	Ω (per end)

Differential Voltage (Dominant)	1.5	2.0	3.0	V
Differential Voltage (Recessive)	−0.5	0	0.05	V
Max Nodes	—	32	—	units
Max Bus Length (500 kbps)	—	50	—	m
ESD Protection	—	±8	—	kV (IEC 61000-4-2)

5.4 Absolute Maximum Ratings

[WARNING] Exceeding absolute maximum ratings may cause permanent damage to the product. In actual use, no parameter shall exceed the limits listed in the table below.

Parameter	Min	Max	Unit	Remarks
Supply Voltage VCC	—	9	V DC	Overvoltage will damage the chip
CAN Bus Voltage	−0.3	+16	V	Relative to GND
Operating Temperature	−40	+85	°C	
Storage Temperature	−40	+120	°C	
Relative Humidity	5	95	% RH	Non-condensing
Vibration (Operating)	—	5	g (rms)	10-2000 Hz
Shock (Non- operating)	—	30	g	11 ms half-sine
Protection Rating	—	IP67	—	Dust and water protection rating
Terminal Pull Force	—	20	N	Single lead axial

6. Installation and Integration

6.1 Mechanical Installation

6.1.1 Installation Surface Preparation

- The installation location shall be selected in a structurally stable area and meet the product installation requirements.
- The installation surface shall be flat, with a recommended flatness better than 0.2 mm, to avoid poor local contact or additional installation stress affecting measurement performance.
- Before installation, surface rust, oil contamination, and impurities shall be removed to ensure a reliable bonding interface between the sensor and the measured structure.

6.1.2 Sensor Mounting Procedure

- The recommended dedicated two-component structural adhesive must **be** used for installation.
- Before bonding, surface treatment shall be performed on the sensor base and installation surface in accordance with process requirements.
- Use 120#-150# grit sandpaper for surface treatment and an appropriate cleaning agent to remove residual contaminants.
- Mix the two-component adhesive in the specified ratio, ensuring a uniform adhesive layer and avoiding air bubbles or local adhesive deficiency.
- After bonding, curing shall be performed in accordance with the adhesive process requirements.

6.1.3 Cable Routing

- During cable installation, continuous tension, compression, or mechanical friction shall be avoided.
- The cable bending radius is recommended to be no less than 5 times the cable outer diameter.
- Cable routing shall avoid moving parts, high-temperature areas, and potential mechanical impact zones.

6.2 Electrical Integration

The GX-6 system shall be powered through the matched isolated power supply module to ensure electrical isolation between the sensor nodes and the vehicle electrical system, improving the system's operational reliability in complex vehicle electromagnetic environments. The following shall be noted during installation:

- The GX-6 power supply shall be provided through the matched isolated power supply module, and the input power shall meet the vehicle power supply system requirements.
- The isolated power supply module features power isolation, overvoltage protection, reverse polarity protection, and transient protection, reducing the impact of vehicle power fluctuations and electromagnetic interference on the measurement system.
- When connecting the power supply, ensure correct polarity of VCC and GND to avoid equipment damage caused by reverse connection.
- CAN_H and CAN_L shall not be reversed; otherwise, communication abnormalities will occur.
- The CAN bus shall be routed in a standard linear topology with correctly configured termination resistors.

6.3 CAN Network Configuration

When the system includes multiple GX-6 nodes, each node shall be arranged according to the system topology diagram. 120Ω termination resistors shall be installed at both ends of the CAN bus to ensure communication stability.

6.4 System Calibration and Validation

After completing mechanical installation and electrical connections, system zero-point calibration and load calibration shall be performed to ensure measurement results meet application requirements. (For detailed calibration procedures, please refer to the *Calibration Operation Guide*.)

All calibration, adjustment, and configuration functions can be performed directly through the NEW-T3000 CAN industrial display terminal.

Screenshots of the industrial display interface are shown below:



7 Electrical Interface

7.1 Cable Definition

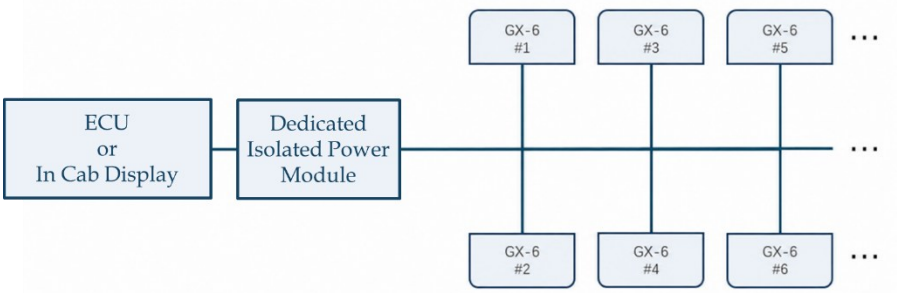
The GX-6 electrical interface is an M12 5-pin waterproof connector (female), with function definitions as follows:

	Pin No.	Function Description	Remarks
	1	VCC	≤ +9V
	2	GND	Grounded at host end
	3	CAN_H	
	4	CAN_L	
	5	NC	

[NOTE] CAN_H and CAN_L shall not be reversed; otherwise, communication will fail. The shield shall be single-point grounded at the host end only, and floating at the sensor end to avoid ground loop interference.

7.2 Bus Topology

The CAN bus adopts a linear (daisy-chain) topology, with a 120Ω termination resistor at each end of the bus. Each sensor node is connected to the branch bus through its own cable.



8 CAN Communication Protocol

8.1 Bus Basic Parameters

Protocol Standard	CAN 2.0B, Extended Frame (29-bit ID)
Baud Rate	500 kbps
Data Length	Max 8 bytes
Byte Order	Big-endian (MSB first)

8.2 Frame ID Structure

Field definitions of the 29-bit extended frame ID (from MSB to LSB):

Field Name	Bit Range	Bits	Description
Device Identifier	bit28–21	8	Fixed value 0x5E, identifies GX-6 device
IDE	bit20	1	Fixed to 1 (extended frame)
SSR	bit19	1	Fixed to 1
Device Address	bit18–14	5	Local address, 0-31, distinguishes devices on the same bus
DIR	bit13	1	0 = Host→Device (command); 1 = Device→Host (response)
Command Code	bit12–7	6	Operation type, 0x00–0x20
Data Sequence	bit6–1	6	Packet sequence number, 0 for single frame
RTR	bit0	1	0 = Data frame; 1 = Remote frame (no data, used for query)

8.3 Command Overview

Command Code	Command Name	Frame Type	DLC	Function Description
0x00	Read Device Serial Number	Remote Frame	0	Query chip unique serial number (8 bytes)
0x01	Read Acquisition Data	Remote Frame	0	Query current weight, temperature, supply voltage
0x02	Filter Configuration	Data Frame	1	Set ADC signal filter algorithm
0x03	Phase Inversion Setting	Data Frame	1	Control sensor signal polarity
0x04	Zero Value Setting	Data Frame	2	Set baseline ADC value at no-load
0x05	Gain Setting	Data Frame	2	Adjust signal amplifier gain
0x06	Auto-Correction Interval	Data Frame	2	Set periodic auto-zero interval
0x07	Sampling Interval Setting	Data Frame	2	Set auto-sampling interval
0x08	K-Value Setting	Data Frame	4	Set ADC-to-weight conversion coefficient
0x09	Read Supply Voltage	Remote Frame	0	Read calibrated supply voltage ADC value
0x0A	Read System Configuration	Data Frame	1	Unified configuration read interface
0x0B	Set Temperature Compensation Coefficient	Data Frame	4	Write temperature compensation coefficient KTemp
0x0C	Measure Temperature Compensation Coefficient	Remote Frame	0	Automatically measure and calculate KTemp
0x0F	System Restart	Remote Frame	0	Trigger software reset
0x10	Jump to Bootloader	Remote Frame	0	Enter firmware upgrade mode

0x11	Programming Complete Confirmation	Data Frame	0	Notify firmware upgrade completion
0x20	Set Device Address	Data Frame	1	Broadcast command, assign new device address

8.4 Key Command Details

See document GX-6_CAN_Protocol_Spec.

8.5 Firmware Upgrade Procedure

See document GX-6_IAP_Spec.

[NOTE] Do not power off during the upgrade process; otherwise, the device will remain in Bootloader waiting for reprogramming.

9. Typical Application and Configuration

The GX-6 adopts a modular distributed sensing architecture, supporting multi-node CAN bus communication. It can be configured for single-point structural strain monitoring, vehicle axle load weighing, multi-axis load distribution analysis, and dynamic operating condition monitoring according to different application requirements.

The GX-6 supports a maximum data acquisition frequency of 20 Hz (50 ms sampling period), and the CAN data output period can be flexibly configured according to application requirements, optimizing vehicle communication bus load while meeting real-time requirements.

9.1 Overload Warning

The system can configure load thresholds based on vehicle type and operational requirements. When axle load or total vehicle load exceeds the set limits, the ECU can trigger audio-visual alarms or vehicle management system prompts via CAN messages, assisting drivers in reasonable cargo distribution and reducing the risk of traffic violations and vehicle structural damage caused by overloading.

9.2 Multi-Axis Distributed Weighing

A single CAN bus supports up to 32 GX-6 nodes, covering multiple key load positions including front axle, intermediate axle, rear axle, and trailer hitch connection points, enabling synchronized acquisition, centralized processing, and load distribution analysis of all axle loads.

Through multi-node collaborative operation, the system can not only obtain the total vehicle weight but also monitor axle load distribution, partial load conditions, and dynamic load changes in real time, providing fundamental data support for vehicle safe operation, intelligent transport management, and autonomous driving systems.

9.3 Typical System Configuration Examples

Application Type	Number of Sensors	Typical Installation Location	Recommended Sampling Interval
Single-Point Stress/Deformation Monitoring	1	Stress measurement point	100 ms
Truck Weighing	Number of axles x 2	Front axle + Rear axle	1000ms
Trailer Weighing	(Trailer axles + 1) x 2	Trailer axles and hitch point	1000 ms
Weighing + Road Condition Monitoring	Number of axles x 2	All axles	100 ms
Truck Crane Balance Monitoring	4	Outriggers	100 ms
Tower Crane Structural Monitoring	Multiple	Measurement points on steel beams	100ms-1000ms

9.4 Data Acquisition and Output Strategy

The GX-6 employs a high-frequency strain acquisition mechanism internally, supporting up to 20 Hz data sampling, meeting application requirements such as vehicle dynamic load changes, structural stress variations, and real-time safety monitoring.

Depending on application characteristics, the system can be configured with different data output periods:

- Static weighing applications: Recommended 500-1000 ms data update period, reducing communication load while meeting metrological requirements;
- Dynamic load monitoring applications: Recommended 50-100 ms data update period, for capturing load changes during braking, cornering, road impacts, and other conditions;
- Structural health monitoring applications: Data update period can be configured from 100-1000 ms based on monitoring objectives.

Through flexible data acquisition and communication strategies, the GX-6 can balance high-precision weighing requirements with vehicle dynamic condition perception needs, providing a reliable data acquisition foundation for intelligent vehicles, construction machinery, and industrial structural monitoring.

10 Precautions

[WARNING] The vehicle power supply must be disconnected before installation to avoid short circuits or equipment damage caused by live operation.

10.1 Installation Location Requirements

- The sensor installation location shall avoid high-temperature components such as exhaust pipes and brake drums, ensuring the operating temperature does not exceed 85°C.
- For truck weighing applications, installation at recommended locations shall be prioritized. For special installation requirements, please consult the manufacturer.

10.2 Bonding Installation Requirements

- The installation base surface shall be free of rust, oil, and other impurities, and shall be ground and cleaned to ensure full contact with the sensor base. Surface flatness ≤ 0.2 mm.
- The sensor bonding surface shall be ground and cleaned before installation.
- Before bonding, apply primer evenly to the sensor bonding surface and installation base surface, and wait for it to dry before bonding.
- The dedicated adhesive specified by the manufacturer must be used, and installation process requirements shall be strictly followed.

10.3 Cable Routing Requirements

- Cables shall be securely fixed, avoiding friction with moving parts. Minimum cable bending radius ≥ 40 mm.
- Cable routing shall avoid locations susceptible to impact, pulling, or mechanical damage.

10.4 Multi-Node CAN Network Configuration Requirements

- For multi-sensor network installation, $120\Omega \pm 1\%$ termination resistors shall be connected in parallel at both ends of the CAN bus (host end and farthest node end).

10.5 Usage Precautions

- After power-on, wait approximately 5 s for the device to complete self-check and initialization before sending commands.
- After replacing a device, zero-point calibration (set_zero) and K-value calibration must be performed again to ensure measurement accuracy.
- When not in use for extended periods, it is recommended to disconnect the bus to prevent device damage from bus leakage current.
- Avoid applying impact or lateral force to the sensor during operation to prevent damage to the strain bridge.
- Do not apply loads exceeding the measurement range to the sensor; overloading may cause permanent deformation of the strain gauge.

10.6 Calibration Recommendations

- Perform zero-point calibration before first use: execute set_zero under no-load condition and record the zero-point temperature Set Zero Temp.
- It is recommended to perform temperature compensation coefficient measurement (Command 0x0C) within the rated operating temperature range.
- Periodically (recommended every 6 months or after each major overhaul) check the calibration K-value and recalibrate if necessary.
- If the auto-correction function (Command 0x06) is enabled, the interval is recommended to be set to 600-1800 s, and triggered only under no-load conditions.

10.7 CAN Bus Precautions

- CAN_H and CAN_L wiring shall not be reversed; otherwise, communication cannot be established.
- The bus shield shall be single-point grounded at the host end, and the sensor end shield shall be left floating to avoid ground loop interference.
- Node addresses on the same bus shall not be duplicated. It is recommended to assign addresses one by one using the 0x20 broadcast command.
- When the bus length exceeds 40 m, it is recommended to reduce the baud rate to 250 kbps and modify the device configuration accordingly.
- In industrial environments, it is recommended to install common-mode chokes (22 μ H) and TVS diodes at the bus ports to enhance interference immunity.

10.8 Storage and Transportation

- Storage conditions: -55°C to +125°C, relative humidity 5%-95% (non-condensing), no corrosive gases.
- Use original packaging for transportation; avoid hard impacts and compression.
- For long-term storage (exceeding 1 year), periodic power-on inspection (every 6 months) is recommended to confirm normal functionality.

10.10 Troubleshooting

Fault Symptom	Possible Cause	Recommended Action
No response frame received	Address configuration error; missing termination resistor; wiring error	Check address, wiring, and termination resistors
Large measurement deviation	Zero-point not calibrated; K-value error; uneven installation surface	Recalibrate zero-point and K-value
Measurement drifts with temperature	Temperature compensation coefficient not set	Execute Command 0x0C to measure temperature compensation coefficient
Severe data fluctuation	Filter disabled; cold solder joint; vibration interference	Enable Kalman filter; check wiring
Device does not respond to any command	Power supply abnormal; device damaged; address conflict	Check power supply; power cycle; check address
Frequent bus communication errors	Missing termination resistor; cable too long; connector oxidation	Check topology and connector quality

Contact Information

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