



VanJee Low-speed Weigh-In-Motion Scale (DCS-30KII Joint Scale Technical Solution).



Contents

1. INTRODUCTION.....	2
2. ABOUT VANJEE.....	2
3. OVERVIEW OF DCS-30KII.....	2
4. WIM SYSTEM FUNCTION.....	3
5. DCS-30KIIWORKFLOW.....	3
6. DCS-30KIIPARAMETER SPECIFICATION.....	7
6.1 DUAL SCALE.....	7
6.2 WEIGHING SENSOR.....	8
6.3 INFRARED VEHICLE SEPARATOR.....	8
6.4 DATALOGGER.....	9
6.5 LOOP DETECTOR.....	10
7. VANJEE LOW SPEED WIM SCALE ADVANTAGES.....	11
8. CONCLUSION.....	13

1. Introduction

The main purpose of this proposal is to provide VanJee low-speed Weigh-In Motion System (Model:DCS-30KII)technical explanation. DCS-30KII is as one of the monitoring systems in intelligent transport systems with significant advantages in reducing damage to the road, protecting road and improving road safety. The proposal consists six parts:

1. About VanJee.
- 2.Overview of DCS-30KII
- 3.WIM System Function
- 4.DCS-30KII Workflow
- 5.DSC-30KII Parameter specification
- 5 VanJee low speed WIM system Advantages
- 6 Conclusion

2. About VanJee

VanJee Technology is an Intelligent Transport System (ITS) company which provides traffic solution and traffic products. VanJee has four major product lines: 1. Weighing-in-motion (WIM), 2. Electronic Toll Collection (ETC), 3. LIDAR, 4. Vehicle to Everything(V2X). Additionally, VanJee Technology is a public traded company at Shenzhen Stock Exchange (SHE:300552). VanJee Technology headquarter is located at Beijing ZhongGuanCun software park which known as the Chinese Silicon Valley because the best Chinese high-tech companies and several global companies are located here. VanJee has 9 regional branches and 32 technical service centers cover all over China to provide best and most efficient technical support for clients. VanJee has made great efforts and dedication on Weigh-In-Motion industry for 24 years and has achieve the largest market share in China. VanJee has distributed more than 16 thousand WIM equipment to the industry as well as has obtained more than 100 intellectual property rights in the WIM industry.

VanJee Technology tries best to provide the best weigh-in-motion system. VanJee insists the concept that "science and technology Serving Traffic" to design and develop a new intelligent weigh-in-motion system. VanJee launched the first WIM direct enforcement system in China. The WIM system can measure the weight of the vehicle and do not need the vehicle to reduce the speed or stop. The system can measure the vehicle weight up to speed 100 km/h. Up to 2018 December, VanJee has installed over 4550 sets of DCS-30 KIIon market.

3. Overview of DCS-30KII

VanJee DCS-30KII is to weigh the truck weight in toll plaza with the accuracy 98%, which obtained Chinese national patents. VanJee integrates dual scales, two infrared vehicle separator, a data acquisition controller, a loop detector and the necessary auxiliary materials into a complete low speed Weigh-In-Motion system. What' s more, VanJee DCS-30KIIcan

process and adapt any driver cheating behaviors such as: S-shaped driving path, jumping, high-speed rushing, the point brake, and installation suspension axle.

4. WIM System Function

- 1) VanJee DCS-30KII system can accurately weigh a truck's weight at static state or low speed (0-20km/h);
- 2) The system can automatically separate the vehicles and special vehicles such as trailers to ensure the one-to-one correspondence between the weight data and the weighed vehicle;
- 3) The system can generate complete vehicle weight information, including axle weight, coupling weight, total weight, axle type, coupling information and record the vehicle's passing time;
- 4) The system can measure the speed when the vehicle passes the weighed area and can recognize the forward/reverse state of the vehicle;
- 5) The system can accurately weigh all kinds of truck even they are irregular driving such as S-shaped driving path, reverse driving, side-path driving, acceleration and deceleration, vibration.

5. DCS-30KII Workflow

The WIM data-logger receives the data of axle discriminator, infrared vehicle separator, dual scale and loop detector. After that, the WIM data logger upload the processed weight information including total weight, axle weight to the lane toll computer via the serial communication interface.

- 1) Dual scale installed high-precision beam load cell to weigh a trucks' weight.
- 2) Infrared vehicle separator is used to separate the vehicles and provide start and end signals.
- 3) Loop detector and infrared separator work together to achieve truck separation. Additionally, infrared separator would collect signal when truck drive into scale as well as leave the scale.
- 4) Data logger processes the signals of each sensor, calculates the weight result and uploads the relevant data to the computer through the serial port.

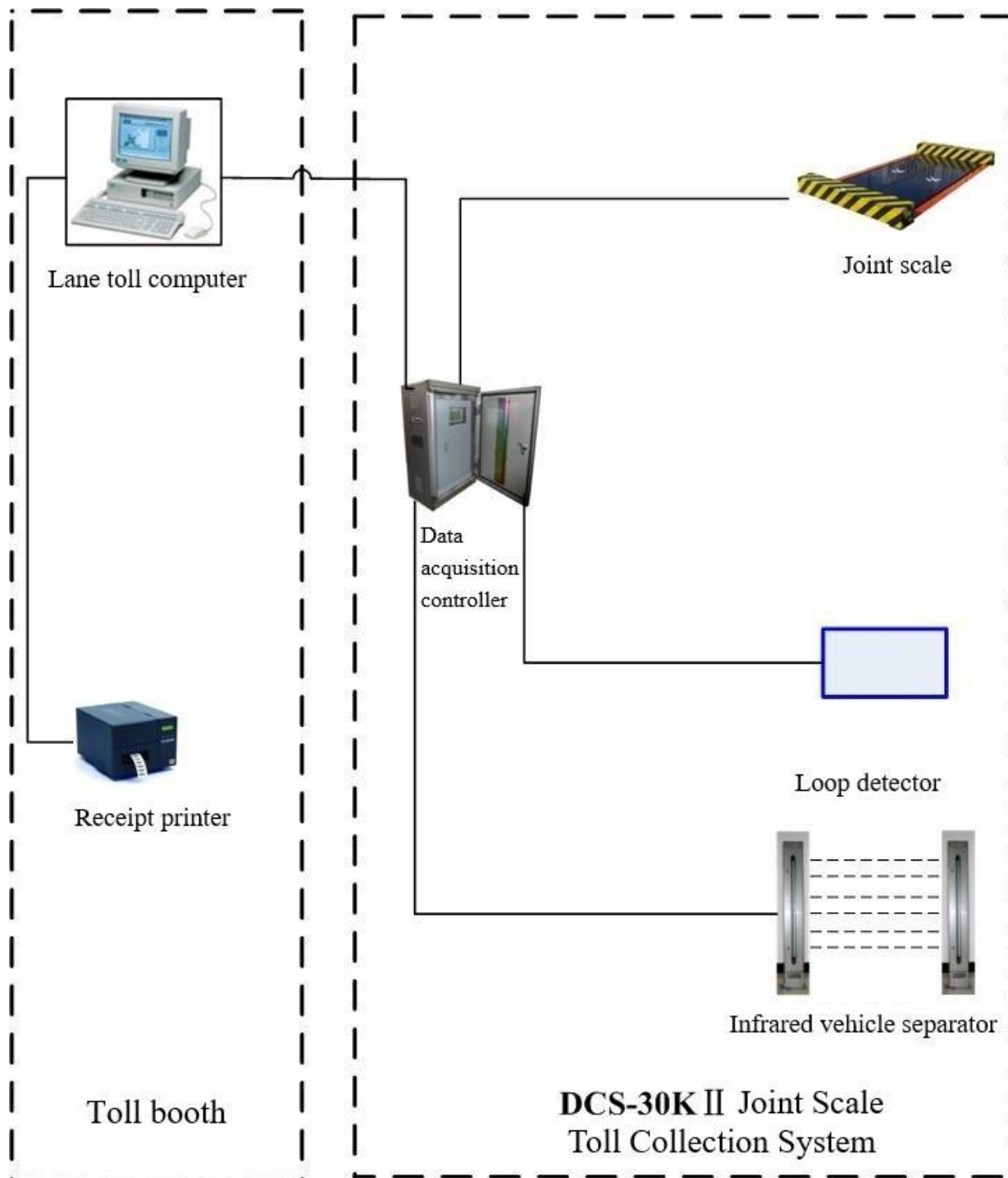


Figure 1, DCS-30KII Joint Scale Workflow diagram

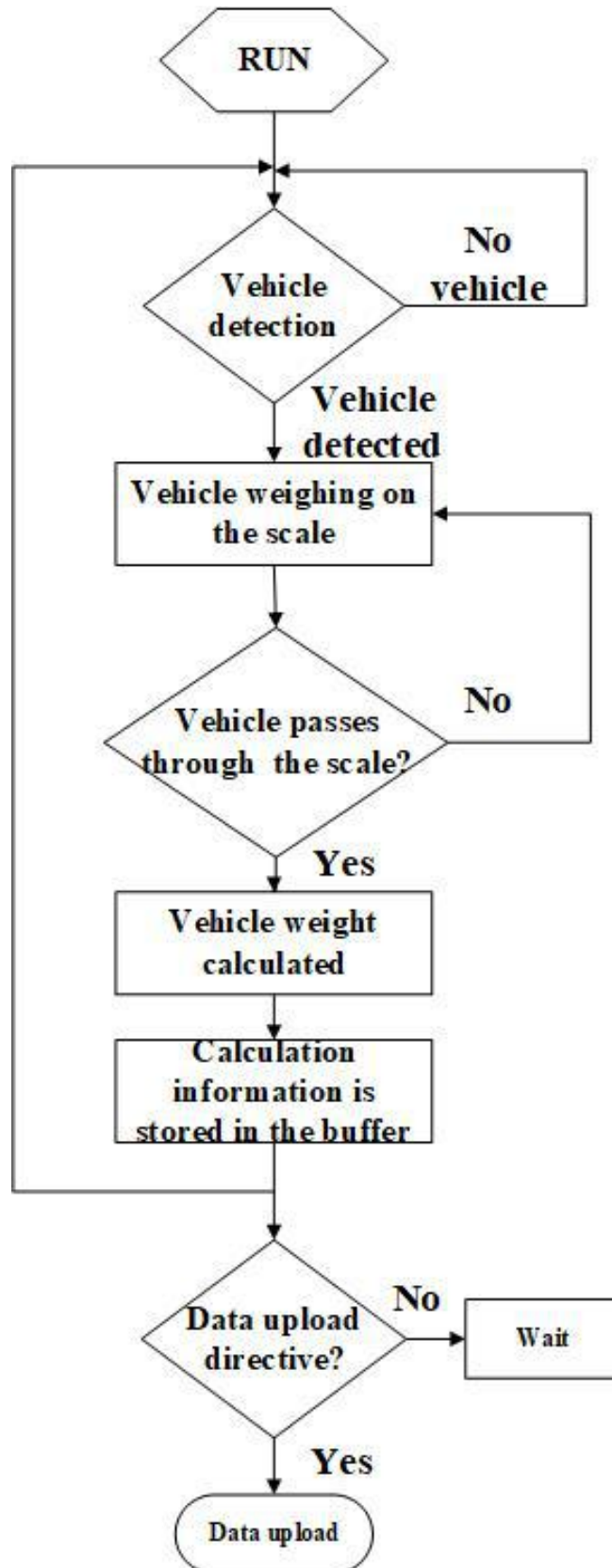


Figure 2, DCS-30KII Joint Scale WIM system workflow diagram

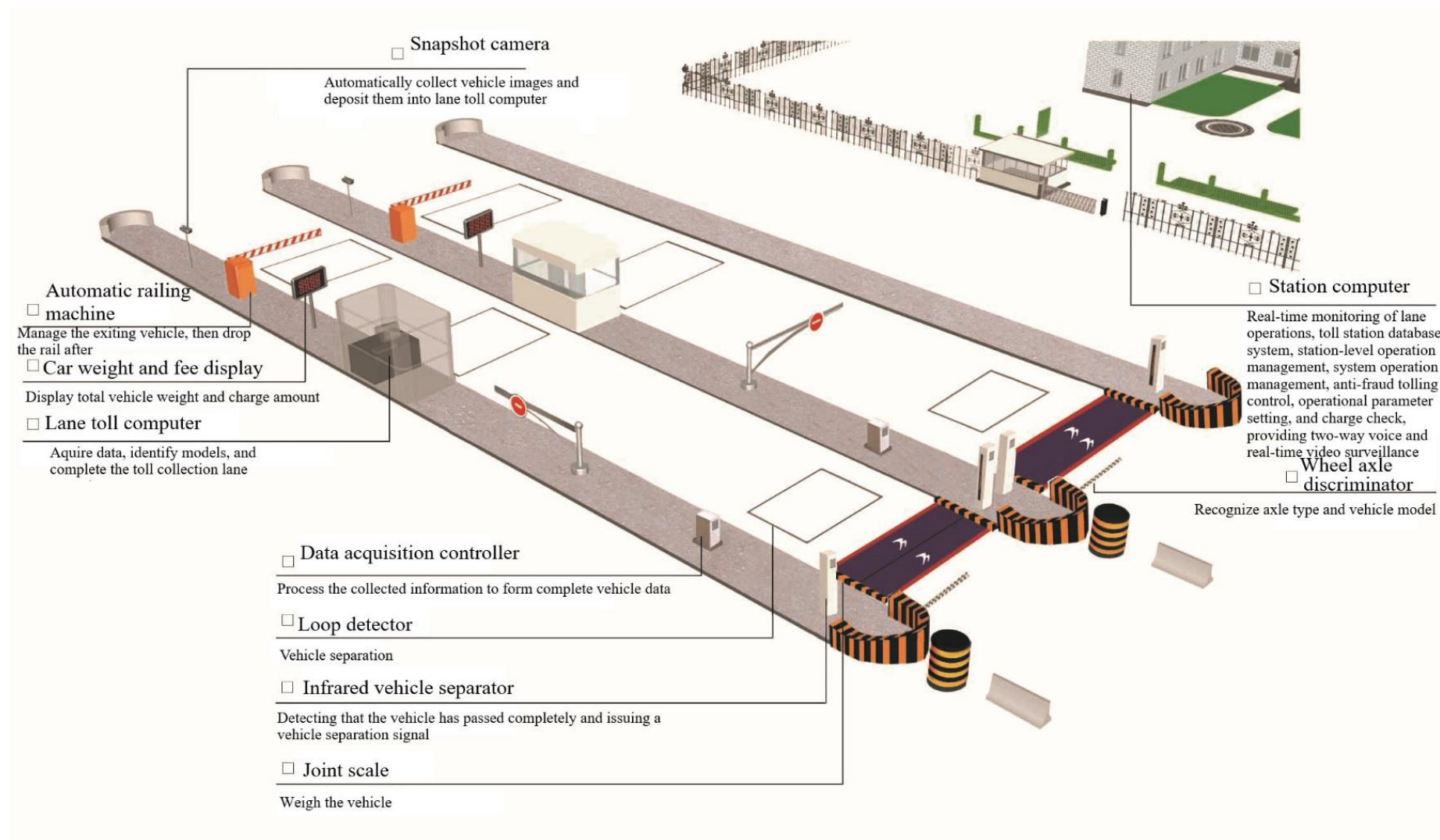
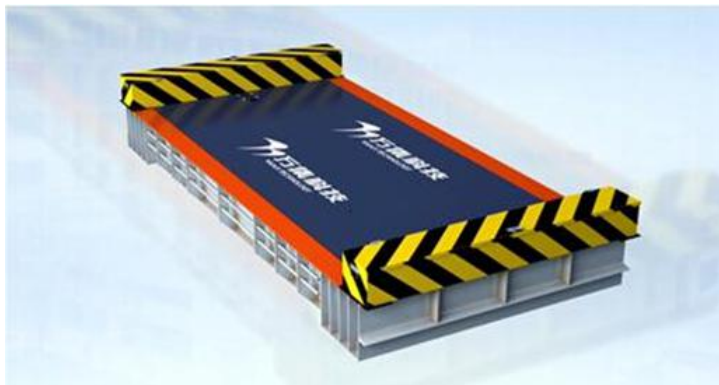


Figure 3, The layout of 30KII Joint Scale WIM System in the toll plaza

6. DCS-30KIIParameter specification

6.1Dual Scale



Brand:	VanJee Technology
Model:	DCS-30KII
Dimension (length* width):	Ordinary lane: 1600mm*3500 (mm); Extra wide lane: 1600mm *4200 (mm).
Single-axle rated load:	30t
Maximum overload capacity:	200%
Accuracy level of total weight:	98%
Accuracy level of uniaxial load and axle-group load:	Class C
Speed measurement accuracy (without obvious acceleration and deceleration):	When the vehicle speed is 1~20km/h, the maximum error is $\pm 5\%$
Axle spacing measurement accuracy (without obvious acceleration and deceleration):	two axles: $\pm 0.15\text{m}$;
Working temperature:	$-40^{\circ}\text{C} \sim +80^{\circ}\text{C}$
Relative humidity:	0 ~ 95%
Weighing sensor protection level:	IP68
MTBF	$\geq 20000\text{h}$
Accuracy and stability:	the equipment calibration period is 12 months

6.2 Weighing Sensor

Weighing sensor is a key component in the system which is used for weigh-in-motion and converting digital signals..



This weighing system adopts the HM8-20t sensor of China Aviation Electric Survey, which has excellent quality and is suitable for frequent rolling of heavy-duty vehicles. This sensor can work stably in extremely harsh environments such as high temperature, damp heat and corrosion.

Model:	HM8-20t
Rated capacity:	20t
Working Temperature:	-40 ° C ~ +80 ° C
Safe overload:	150% FS
Extreme overload:	300% F.C.
Protection level:	IP68 (can be immersed in water)
Warning function	When it comes to the fault

6.3 Infrared Vehicle Separator



Brand:	VanJee Technology
Model:	D-10W
Accuracy of separation and judgment reaches:	In good weather, accuracy of separation and judgment reaches 99.9% or more In bad weather (including direct light), the separation and judgment accuracy rate is over 99%
Minimum distance:	100mm
Working voltage:	24V DC \pm 20%
Maximum recognition distance:	17m
Scanning height:	1230 mm
Minimum recognition distance:	30mm
Protection:	with transient overvoltage and reverse polarity protection;
Protection level:	IP65
Shell material:	Stainless steel casing
Working temperature:	-40 ° C - 80 ° C
Relative humidity:	0-95%;
Lightning protection grounding resistance:	$\leq 4\Omega$.

6.4 Datalogger



Brand:	VanJee Technology;
Model:	D-01W;
Power supply:	220V AC (-15%, +10%), 50Hz \pm 2%;
Working Temperature:	-40 ° C ~ +80 ° C
Relative humidity:	0 ~ 95%;
Protection level:	IP65;
MTBF	\geq 20000h.

6.5 Loop detector



Brand:	VanJee Technology
Type:	D-02W
Dimension:	1m \times 2m; It can be applied to ordinary lanes and super wide lanes;
Speed detection range:	1 ~ 200km / h;
Judgment accuracy:	\geq 99%(When the closing stitch is not less than 2m)
Coil detector frequency:	50 ~ 200KHz(the sensitivity is adjustable)
Inductance range:	20~1000 μ H
Frequency range:	50~200 KHz
Cable length:	50m (expandable to 150m)
Wire specification:	1.5mm ² copper wire
When the coil fails, the fault message can be sent through hardware and software.	
Working temperature:	-40 ° C ~ +80 ° C
Relative humidity:	0 ~ 95%

7. VanJee Low Speed WIM Scale Advantages

- This Solution is suitable for bad weather such as rain, snow and condensation

DCS-30KII can accurately weigh even in bad weather such as rain and condensation due to its scientific design. Firstly, Infrared vehicle separator shell material is stainless steel sheet to against corrosion, cracking, and falling off.

Secondly, the WIM scales is adopts box-type structure which is scale surface is paint with an anticorrosive and wear-resisting resin paint. Thirdly, the glass surface of the infrared vehicle separator is designed to open the door for easy wiping and cleaning. The separator is also equipped with automatic electric heating tempered glass with temperature and humidity control switch

As a result, the separator can effectively solve the condensation in the extreme cold weather. **Advanced weighing algorithm**

DCS-30KII adopted the wavelet fitting and the trigonometric quadratic fitting. A large number of experimental data prove that the algorithm effectively reduces the error caused by vehicle vibration and road surface unevenness.

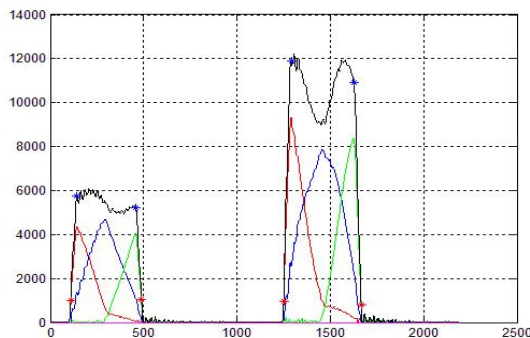


Figure 4 12 car waveform

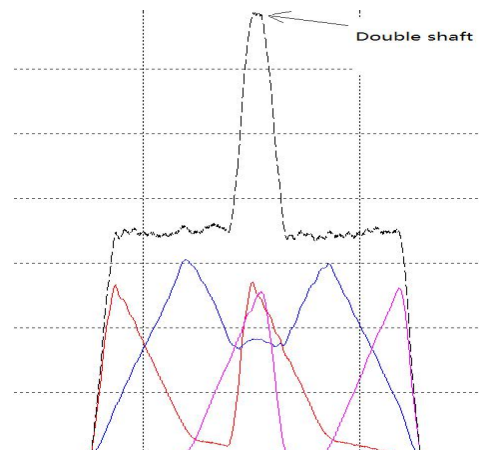


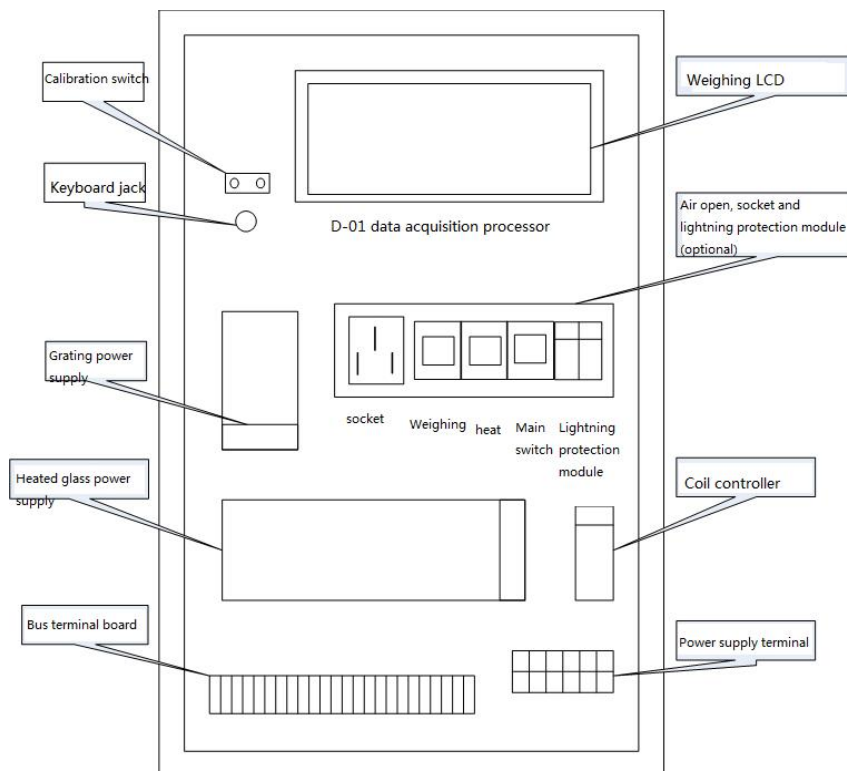
Figure 5 15 car axle waveform

Data logger



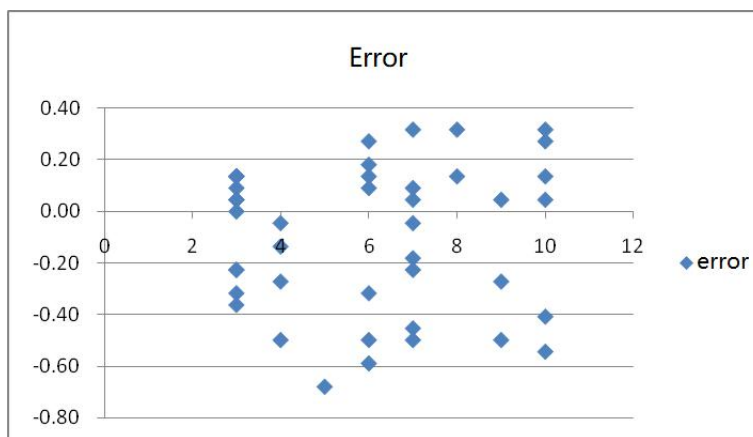
The data logger adopts the modular designer and the functions between the modules do not affect each other.

The layout of the instrument is as follows:



In the measurement of the dual scale, through the discrete analysis of the data, VanJee dual scale showed excellent precision and stability. The error dispersion diagram is as following:

- **Higher precision**



Error dispersion diagram

- **Anti-cheating function**

VanJee DCS-30KII can process and adapt any driver cheating behaviors such as: S-shaped driving path, jumping, high-speed rushing, the point brake, installation suspension axle and hydraulic equipment.

8. Conclusion

DCS-30KII is as one of the monitoring systems in intelligent transport systems with significant advantages in reducing damage to the road, protecting road and improving road safety. What's more, DCS-30KII is cost-effective system which can not only regulate the overloaded trucks, but also reduce the cost of the road maintenance and labor cost.

Additionally, DCS-30KII can maximize effective measuring truck route distance in the scale because it adopts tracking algorithms based on real-time data. The scale can identify and measure axle distance and axle weight. Furthermore, the scale can adapt any driving behaviors and has strong anti-cheat features such as acceleration, deceleration, vehicle jump, braking and steering. The scale measuring error is within $\pm 2.5\%$ with for any driving behaviors which ensure the stability of equipment

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