VWdot

Vibrating Wire Datalogger

User Manual

Model: VD-1002

Contents

I. Introduction

VWdot is a vibrating wire datalogger utilizing both NB-IoT and LTE-M wireless transmission capabilities. It is designed to measure vibrating wire sensors and Thermistor temperature signals. VWdot features a robust waterproof housing and energy-efficient design, powered by two 18650 lithium batteries, ensuring prolonged measurement recording and data uploading to the cloud. With a built-in 32 GB SD card, it can backup and store over one million records. Suitable for various applications such as urban civil engineering projects, river water management, bridge construction, slope engineering, measuring parameters like water level, water pressure, load, stress, strain, cracks, and landslide displacement.

Applications:

- Water level monitoring: Measurement using VW water level and pressure sensors.

- Stress monitoring: Measurement using VW strain gauges on steel structures.

- Strain monitoring: Measurement using VW strain gauges.

- Load monitoring: Measurement using VW load cells.

- Cracks monitoring: Measurement using VW crack gauges.

- Landslide monitoring: Measurement using VW displacement sensors for landslide detection.

II. Specification

Description	Note
Measurement Type	Vibrating Wire sensor
Channel	1
Measuring Range	450~6000 Hz
Accuracy	± 0.01% @ 3000 Hz
Resolution	0.01Hz
Storage	32 GB Micro SD card
LPWAN	NB-IoT / LTE-M (CAT M1)
Network Protocol	MQTT
Temperature Sensor	Thermistor (Resolution 0.1℃)
Power Supply	18650 Li-Ion Battery x2 (Provides 5-18 Vdc battery recharging function, can be connected to solar panel or external power supply)

III. Accessory

VWdot standard package includes:

(1) VWdot main unit (x1) + antenna (x1)

(2) 32 GB micro-SD card (x1)

(3) NB-IoT / LTE-M SIM card (customer to purchase separately)

(4) 18650 rechargeable lithium batteries (x2, excluded)

(5) Sanlien dot cloud platform license key

#	Description
1	Enclosure
2	SD Card Slot
3	Antenna Port
4	Battery Holder (x2)
5	SIM Card Slot
6	Terminal Socket
7	Cable Gland
8	Test Button
9	Com Port
10	LED Indicator Light
11	5-18 Vdc External Power Charging Terminal

+ Power	- Power
5-18 Vdc	GND
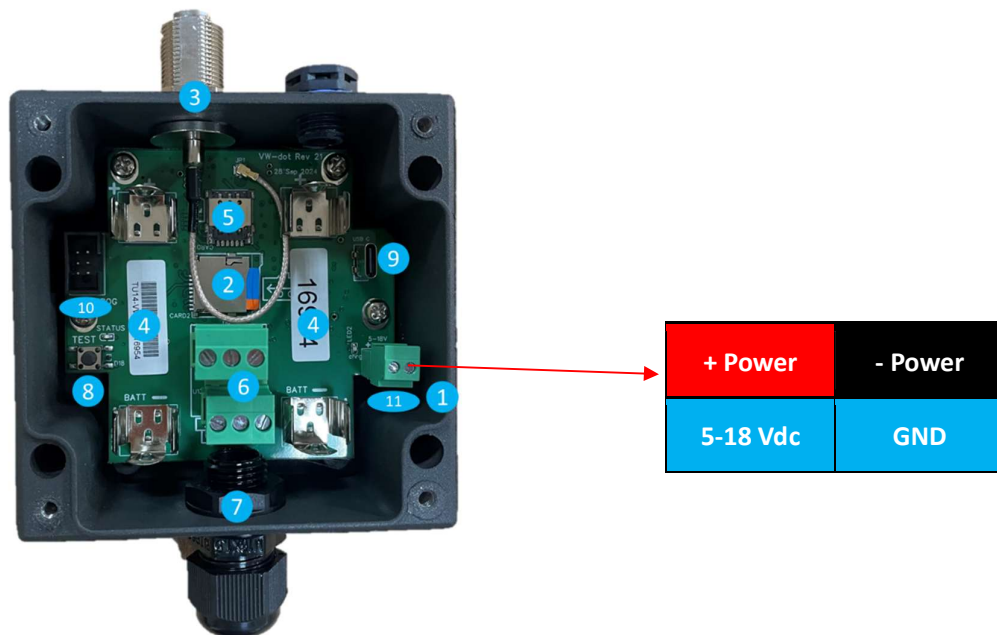
IV. SD Card Setup

The SD card utilizes a storage space of 32 GB and needs to be formatted to FAT32 with a unit size of 64 KB. The SD card can be configured and data downloaded via computer access. It contains three files:

(1) VW_setup.txt: This file is for configuring parameters related to the measurement and data transmission. Customers need to set it up themselves.

(2) VW_DATA.txt: This file serves as a backup for measurement reading data. When the system operates normally, it automatically generates this file. In case of unsuccessful data upload due to communication or MQTT server interruption, this file provides backup for measurement reading data and 20 data supplements.

(3) VW_ERROR.txt: This file records system execution error messages. When errors occur during system operation, the system automatically generates the VW_ERROR.txt file to record the error messages for user inspection and debugging purposes.

(4) SETUP2.txt: This file is generated automatically by the cloud software using the Device Setting feature to modify the measurement frequency. SETUP2.txt has a higher execution priority than VW_setup.txt. Therefore, when modifying the configuration file via the SD card, SETUP2.txt must be deleted if necessary.

Name	Date modified	Type	Size
VW_DATA	2000/01/01 上午 01:00	Text Document	1 KB
VW_ERROR	2000/01/01 上午 01:00	Text Document	1 KB
VW_setup	2019/12/24 上午 08:31	Text Document	1 KB

V. VW_setup Configuration

Write "VW_setup.txt" file commands with the symbol "#" as the parameter's end, and information after the symbol "$" as comments. The contents and instructions are as follows:

sweep_1=C#$ **A 450-1500, B 800-2000, C 1400-3500, D 2300-6000**

Remark: This is sweeping frequency setting, select「A」or「B」or「C」or「D」as above.

Interval_hr=0#$ **Unit: hours. Minimum must be 1. Maximum is 1000.**

Remark: Recording frequency, measured in hours. Minimum is 1 hour; maximum is 1000 hours.

Interval_min=5#$ **Unit: minutes. Minimum 5. Maximum 59.**

Remark: Recording frequency, measured in minutes. Input multiples of 5: 5, 10, 15, 20, 30 minutes.

Note: If the recording frequency is less than 1 hour, set interval_hr to "0"; if it is more than 1 hour, set interval_min to "0".

date_time=network#$ **Must enter "network" or "date_time=23/01/30/10/00/00"**

Remark: Time synchronization method. Use "network" for network synchronization. If network synchronization is unavailable, manually enter the time in the format "yy/mm/dd/hh/mm/ss". Time must be manually set each time the power is restarted.

GMT_offset=+0#$ **Local Offset +/- in minutes from GMT**

Remark: Network time calibration, the new VWdot will be linked to the corresponding time zone, so please enter "0"

disable_NBIOT=no#$ **Must enter "yes" or "no"**

Remark: Whether to disable the NB-IoT/LTE-M real-time data transmission function. To enable NB-IoT/LTE-M, enter "no". To disable NB-IoT/LTE-M, enter "yes" and configure the date_time setting.

catm_band=3#$ LTE-M band for Wireless service

nbiot_band=8#$ NB-IoT band for Wireless service

Remark: The nbiot_band and catm_band commands are used to set the wireless service frequency band. If users want to use NB-IoT communication, the relevant settings for nbiot_band should be used. If users want to use LTE-M communication, the catm_band command should be used. Please inquire with the telecommunications service company for these parameters.

APN=internet.iot #$ Access Point Name for Wireless service

Remark: NB-IoT/LTEM wireless service access point name. Please inquire the NB-IoT telecommunications service company for this parameter.

server_IP=SANLIEN#$ MQTT Server Name or IP address

Remark: IP address of the MQTT server for data upload. If using the Sanlien dot web service, set it to "SANLIEN". For a self-built MQTT server, additional settings are required:

server_port=????#$

user_name=????#$

password=????#$

**data_path=????#$ (MQTT subscription topic, example:
data_path=VWdot/test#$)**

wakeup_LED=yes#$ Must enter "yes" or "no"

Remark: Choose whether to enable the LED indicator function during frequency measurement. Input "yes" to turn on the LED indicator light. Input "no" to turn off the LED indicator light during frequency measurement. This setting does not affect the operation of the LED indicator light during initial boot and when using the TEST button.

encryption=yes#$ Must enter "yes" or "no"

Remark: Specify whether the cloud (remote) modified settings service should be encrypted. Input "yes" if using the Sanlien dot web service.

new_key=no#$ Must enter "yes" or "no"

Remark: Encryption password setting. Input "no" if using the Sanlien dot web service. If using a self-built MQTT server, set according to encryption requirements. When set to "yes", create a key.txt file on the SD card.

sub_path=sanLienmq/VWdot/01234#$

Remark: Publish new subscription topics from the web to VWdot via the MQTT Server. Total limit of 35 characters. If using the Sanlien dot web service, set sub_path to sanLienmq/VWdot/01234, where 01234 is the VWdot serial number; ensure the serial number is correct.

conf_path=sanLienconf/VWdot/01234#$

Remark: After VWdot receives new subscription topics from the web, reply via the MQTT Server. Total limit of 35 characters. If using the Sanlien dot web service, set conf_path to sanLienconf/VWdot/01234, where 01234 is the VWdot serial number; ensure the serial number is correct.

"VW_setup.txt" Example

```
sweep=C#$
interval_hr=0#$
interval_min=5#$
date_time=network#$
GMT_offset=+0#$
disable_NBIOT=no#$
nbiot_band=8#$
APN=internet.iot#$
server_IP=SANLIEN#$
wakeup_LED=yes#$
encryption=yes#$
new_key=no#$
sub_path=sanLienmq/VWdot/01234#$
conf_path=sanLienconf/VWdot/01234#$
```

VI. VW_DATA Content Descriptions

The data values in VW_DATA are separated by commas, and their meanings in sequence are as follows:

VWdot serial number, Date, Time, S1 (Channel 1), Frequency (Hz), Temperature (℃), Battery capacity (%), RSSI strength, and Error code.

For example:

05720, 20/09/2020, 00:00:01, S1, 2955.2, 24.6, 90, 27, !REG.

```
05720,20/09/2020,00:00:01,S1,2955.2,24.6,90,27
05720,20/09/2020,01:00:01,S1,2955.3,24.6,90,26
05720,20/09/2020,02:00:01,S1,2954.6,24.6,90,!REG
05720,20/09/2020,03:00:01,S1,2954.8,24.6,90,26
05720,20/09/2020,04:00:01,S1,2954.9,24.6,90,!REG
05720,20/09/2020,05:00:01,S1,2954.6,24.6,90,26
05720,20/09/2020,06:00:01,S1,2954.8,24.6,90,26
05720,20/09/2020,07:00:01,S1,2954.7,24.6,90,26
05720,20/09/2020,08:00:01,S1,2955.0,24.7,90,!REG
05720,20/09/2020,09:00:01,S1,2954.9,24.7,90,25
05720,20/09/2020,10:00:01,S1,2955.1,24.7,99,25
05720,20/09/2020,11:00:01,S1,2954.4,24.7,99,24
05720,20/09/2020,12:00:01,S1,2954.6,24.8,99,25
05720,20/09/2020,13:00:01,S1,2954.8,24.8,99,26
05720,20/09/2020,14:00:01,S1,2954.8,24.7,99,26
05720,20/09/2020,15:00:01,S1,2954.8,24.7,99,25
05720,20/09/2020,16:00:01,S1,2954.5,24.7,99,26
05720,20/09/2020,17:00:01,S1,2954.5,24.6,90,26
05720,20/09/2020,18:00:01,S1,2954.2,24.6,90,26
05720,20/09/2020,19:00:01,S1,2954.1,24.6,90,26
05720,20/09/2020,20:00:01,S1,2953.8,24.6,90,27
05720,20/09/2020,21:00:01,S1,2953.8,24.6,90,26
05720,20/09/2020,22:00:01,S1,2953.7,24.6,90,26
05720,20/09/2020,23:00:01,S1,2953.7,24.6,90,26
05720,21/09/2020,00:00:01,S1,2953.8,24.6,90,26
05720,21/09/2020,01:00:01,S1,2953.8,24.6,90,26
05720,21/09/2020,02:00:01,S1,2954.0,24.6,90,26
05720,21/09/2020,03:00:01,S1,2953.8,24.6,90,26
05720,21/09/2020,04:00:01,S1,2953.4,24.6,90,26
05720,21/09/2020,05:00:01,S1,2953.3,24.6,90,26
```

VII. VW_Error Content Descriptions

The remarks in the VW_DATA file are also recorded in the VW_ERROR event log, with the following codes representing their meanings:

(a) !PWRx: NB-IoT / LTE-M module power supply problem.

(b) !CPIN: Issue with the NB-IoT SIM card.

(c) !REG: NB-IoT / LTE-M communication failure or no signal RSSI.

(d) !RSSI: NB-IoT / LTE-M signal RSSI too low or error.

(e) !RST: Problem encountered during NB-IoT module reset.

(f) !QNEW: No response from MQTT server.

(g) !QCON: MQTT server available, but login failed (incorrect username or password).

(h) !QPUB: MQTT server available and login successful, but data upload failed.

(i) !QSUB: Problem encountered when retrieving data from subscribed topics while connecting to MQTT server.

(j) !USUB: Problem encountered when unsubscribing from topics while connecting to MQTT server.

(k) !SDx: SD card installation failed.

(l) !LOWB: Battery voltage is too low, please replace the battery.

(m) !OFFB: Automatically shuts down due to low voltage, until the battery is replaced.

VIII. VWdot Installation

(1) Connect the antenna, please avoid applying excessive force during installation.

(2) Insert the NB-IoT / LTE-M SIM card after ensuring that the SIM card has been activated for service.

(3) Insert the SD card and ensure that the VW_setup.txt file is correctly configured and stored on the SD card. Note: The system will not verify whether the content of the file is correct.

(4) Refer to the table below to correctly connect the vibrating wire instrument signals to the VWdot terminal socket and lock them in place.

F (Bottom Row)	F (Bottom Row)	GND	T	T
Frequency (Red)	Frequency (Black)	Shield	Temperature (Green)	Temperature (White)

(5) Insert the lithium battery, ensuring the correct polarity. Wait for 3 seconds before reinserting the battery if it is removed. If an external power source is needed to charge the 18650 batteries, please replace the vent valve with the charging cable fixed head and provide a 5-18 Vdc power supply, paying attention to the Power (+) and Power (-) positions.

(6) The green LED indicator will remain steady until data is successfully uploaded to the MQTT server. The green LED will then turn off. During the initial use of a new SIM card, the wireless network registration may take approximately 2 to 3 minutes.

(7) If the green LED indicator turns off without flashing before, it indicates successful startup and data upload. If the green LED indicator flashes, please refer to Chapter IX for further instructions.

(8) After successful startup, VWdot will automatically measure and upload one set of data to the MQTT service platform. After uploading, it will enter sleep mode awaiting subsequent measurement and data upload according to the configured frequency.

(9) Check on the Sanlien MQTT service platform to confirm if the data has been correctly uploaded. If confirmed, the installation setup is complete.

(10) During the period when VWdot successfully uploads one set of data and enters sleep mode, pressing the TEST button once will illuminate the green LED indicator. This action triggers an immediate measurement and upload of one set of data to the MQTT service platform before returning to sleep mode. If any system errors are detected, the green LED indicator will flash.

IX. LED Light Indicator

VWdot reports various errors as follows: (1) Recorded in the remarks column of the VW_Data file and sent to the MQTT server. (2) Recorded in the VW_ERROR file. (3) Displayed through LED green light flashing messages. If the green light starts flashing (approximately 15 seconds) after installing the battery, it indicates operation failure, and the system will shut down automatically. Users can verify the corresponding situation based on the flashing pattern.

(a) If the LED green light remains steady for 2-3 minutes before turning off, it indicates normal operation. Users can check the MQTT service platform to confirm if the data has been successfully transmitted.

(b) If the LED green light flashes at intervals of 0.5 seconds (………), it may indicate an SD card reading issue or incorrect parameters set in the VW_setup.txt file.

(c) If the LED green light flashes continuously twice, followed by two seconds off (··___ ··___ ··___ ··), it indicates that there is no issue with SD card reading, but there may be a problem with the SIM card or NB-IoT / LTE-M module.

(d) If the LED green light flashes continuously three times, followed by two seconds off (…___…___…___…), it indicates that there are no issues with SD card or SIM card installation, but there may be a problem with network registration. Please check if the RSSI signal strength is greater than 0 and if the SIM card account is activated.

(e) If the LED green light flashes continuously four times, followed by two seconds off (····___ ····___ ····___ ····) , it indicates that there are no issues with SD card or SIM card installation, and successful network registration has been achieved. However, there is a failure to connect to the MQTT Server. Please check for any issues with the MQTT service platform-related user parameters (IP address, network port, password, path) settings.

X. Battery Power

VWdot requires two 18650 lithium-ion batteries with a working voltage range of 3.5 V to 4.2 V. It is recommended to use PANASONIC NCR18650GA batteries with a capacity of 3450 mAh or higher. The battery power is expressed as a percentage (%), indicating the remaining charge level:

bat_volt > 4.149   bat_%=99

bat_volt <=4.15   bat_%=90

bat_volt <= 4.03   bat_%=80

bat_volt <= 3.88   bat_%=70

bat_volt <= 3.75   bat_%=60

bat_volt <= 3.70   bat_%=50

bat_volt <= 3.68   bat_%=40

bat_volt <= 3.65   bat_%=30

bat_volt <= 3.60   bat_%=20

bat_volt <= 3.56   bat_%=10

bat_volt <= 3.48   bat_%=5   // The message "!LOWB" indicates that the battery voltage is low, prompting the user to replace the batteries.

bat_volt <= 3.35   bat_%=2   // The message "!OFFB" indicates that the system has automatically shut down due to low voltage, and it prompts the user to replace the batteries.
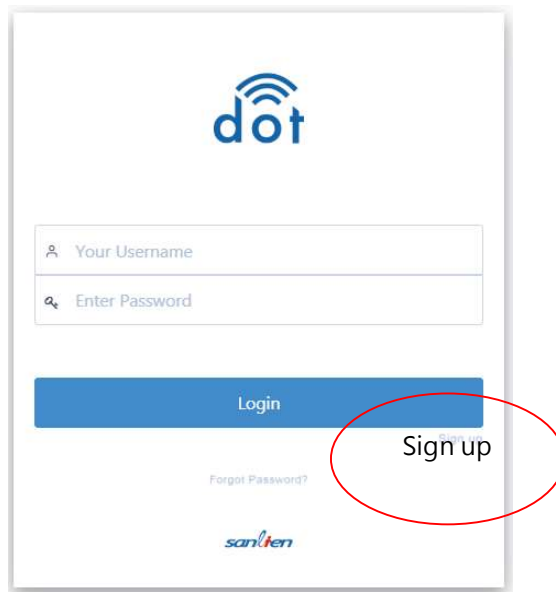
XI. SANLIEN "dot" Web Service

This section is the explanation for using the Sanlien Technology MQTT server dot web service platform. If users wish to set up their own MQTT server platform, please contact Sanlien Technology technical staff.
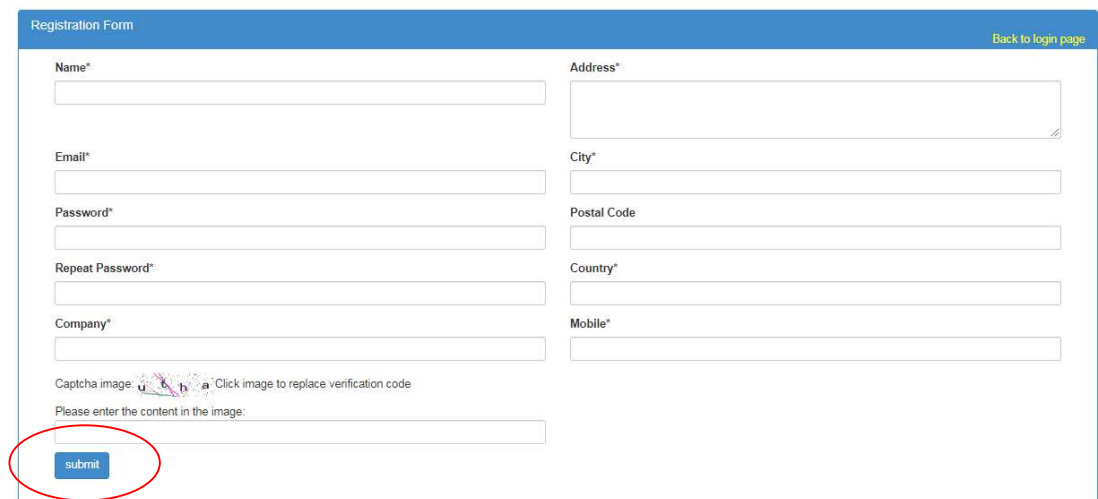
Sanlien Technology dot web service platform link: http://wms.sanlien.com.tw/dot

(1) For the first login, please sign up to register a new account.

(2) After filling out the information, click on 'submit'. The system will send an email with the Sanlien Technology dot service platform link to the registered email address. Users need to access the platform through the login link in the email to activate the account.

(3) After creating an account, users can log in to the dot web service platform. Here are the main functions:

(a) Latest Record: Displays the latest data records.

(b) Record Query: Allows for data query and download services.

(c) Chart Query: Provides curve query and download services.

(d) Map: Displays location and measurement-related information on a map.

(e) Company Setting: Configures basic information, including company name and project name.

(f) FTP Setting: Enables automatic data transmission via FTP.

(g) FTP Log: Records errors that occur during FTP transmission.

(h) SMS Setting: Provides SMS notification for values exceeding certain thresholds.

(i) Project User Setting: Allows adding client accounts for remote login.

(j) Device Setting: Allows cloud-based settings modification.

(k) Admin: Configures device information.

(4) When logging in to the dot web service platform for the first time, users need to set up the device information through "Company Setting" and "Admin" to use related services on the platform.

(A) Company Setting

(a) Click on 'Company Setting'.

(b) Click on 'Add' to add new data.

(c) Enter the Company name.

(d) Enter the Project name.

(e) Click on 'save' to add the data.

(B) Admin Setting

(a) Click on 'Admin'.

(b) Click on 'Add' to add new data.

(c) Type: Select the type of instrument, choose the option VWdot.

(d) S/N: Enter the device serial number, please input a 5-digit serial number, for example, 01234.

(e) License key: Enter the license key for the service platform provided by Sanlien Technology.

(f) Company: Select the company name from the dropdown menu.

(g) Project: Select the project name from the dropdown menu.

(h) Sensor Name: Enter the instrument identifier directly, for example, OW-01.

(i) After completing the entries, click 'save' to add the new configuration to the data table.

(C) After completing the configuration, users may use the functions on the right side of the table, such as modify, settings, delete, renew, etc.

(a) Modify function: Modify the Company or Project data.

(b) Settings function: Configure measurement physical quantities, threshold values, Email notifications, SMS notifications, etc.

(c) Delete function: Each VWdot data provides only one VWdot service platform account. If users want to change to another account, the original account needs to delete the configured data first.

(d) Renewal function: Purchase the rental service before the expiration of the platform rental period, and enter the key to extend the platform rental period.

(D) Settings Function:

(a) Physical Quantity Calculation: Check 'Use engineering units' to perform physical quantity calculation for measured values. Enter the units in the "Units" field. Enter coefficients A~F for the instrument. Enter the initial reading value (R0), the measured reading (Ri), and the offset value (M).

- Engineering unit $(Hi)=A(Ri)5+B(Ri)4+C(Ri)3+D(Ri)2+E(Ri)+F$
- Engineering unit Change= Current Engineering unit (Hi) - Initial Engineering unit (H0) +M

(b) Alert notification configuration: Check the 'Alert notification' box to configure management values. The colors of the indicator lights represent the following:

Value < Level 3	Value < Level 2	Value < Level 1	Normal Value	Value > Level 1	Value > Level 2	Value > Level 3

(c) Email notification setup: Check the 'Mail notification' box to configure email notification. When the physical change exceeds the set Level 1 to Level 3 thresholds, the system will automatically send notifications to the specified email addresses.

(d) SMS notification setup: This feature requires the purchase of SMS sending services for mobile phones. Before using it, users need to configure various settings in the "SMS Setting" section (details in section 5). Check the 'SMS notification' box to configure SMS notification. When the physical change exceeds the set Level 1 to Level 3 thresholds, the system will automatically send notifications to the specified mobile phone numbers.

(e) The "SMS Remaining" field indicates the remaining number of SMS notification service instances, which the system calculates automatically. The "Phone Number" field is where users input the mobile phone number. Phone number settings need to be configured in the "SMS Setting" section.

Sanlien Technology Corp.

Use engineering units ☑

Type
VWdot

S/N
76279

Sensor Name
PZ-2

Formula
Raw data(Hz) 5th order polynomial ˅

$$H = A(R_i)^5 + B(R_i)^4 + C(R_i)^3 + D(R_i)^2 + E(R_i) + F$$

H:Converted data in units
R_i:Current reading
$\Delta = H_i - H_0 + M$

Units:(ie:kg/cm^2,mm)
psi

A:Polynomial gauge factor
0

B:Polynomial gauge factor
0

C:Polynomial gauge factor
0

D:Polynomial gauge factor
-0.0000179221

E:Polynomial gauge factor
0.0196004

F:Polynomial gage factor
111.006

R_0:Initial reading
3100

M:Offset
0

Alert notification ☑

Alert level 1(<)
-5

Alert level 1(>=)
0

Alert level 2(<)
-25

Alert level 2(>=)
0

Alert level 3(<)
-30

Alert level 3(>=)
0

Mail notification (Alert level 1) ☐　　Mail notification (Alert level 2) ☐　　Mail notification (Alert level 3) ☐

Notification mail(1)
sanlienbu1cs@gmail.com

Notification mail(2)

Notification mail(3)

Notification mail(4)

Notification mail(5)

SMS notification (Alert level 1) ☐　　SMS notification (Alert level 2) ☐　　SMS notification (Alert level 3) ☐

SMS Remaining
0

(5) To set up SMS sending phone numbers, click on "SMS Setting."

(a) SMS Recharge: This is an additional SMS service value-added function. Click on 'Add' to enable SMS value-added service. "Card Number" and "PIN Code" are the key numbers provided on the purchased SMS card.

(b) SMS Setting: Configure SMS transmission settings. Click on 'Add' to enter the phone numbers for SMS transmission. Do not include the first digit "0" in the "Phone Number" field. For example, for the phone number 0912-345678, only enter 912345678.

(c) SMS Sent Record: Records of SMS transmissions.

(6) To set up map display information, click on 'Map' to configure the settings. Map Setting: Configure map settings.

(a) Enter the location name or coordinates in the search field to search for the desired location.

(b) Use the map zoom, pan, and move functions to select the desired map area.

(c) Click on 'Add' to set the map name, company name, project name, etc., and then save the map information.

(d) Left-click on the map with the mouse to set the instrument position and number.

(e) Once the settings are completed, users can view the status of the instruments in the "Map" function.
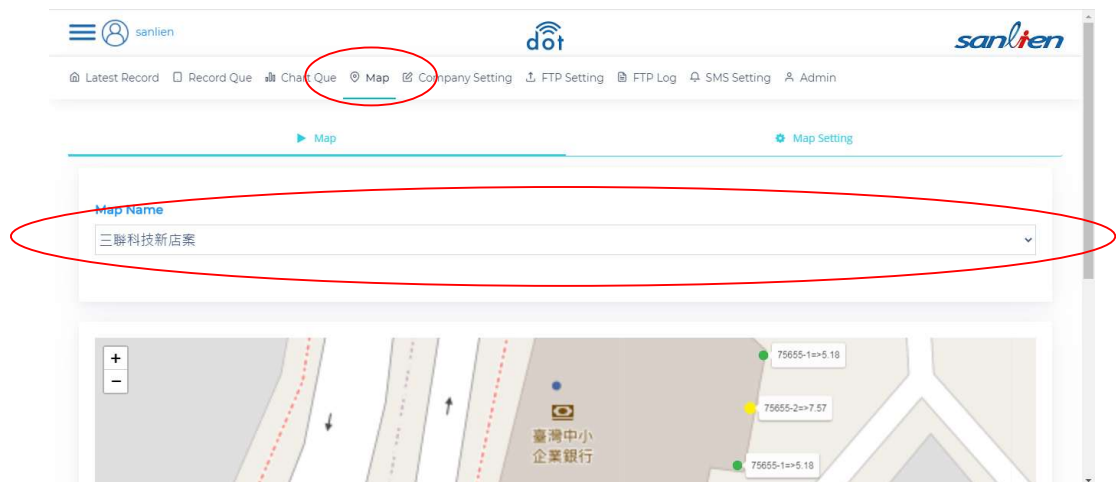
(7) To configure FTP data transmission settings, click on 'FTP Setting'.

(a) Company: Select the data to be transmitted.

(b) FTP Server: Enter the FTP login IP.

(c) FTP Port: Enter the FTP login port.

(d) User Name: Enter the FTP login username.

(e) Password: Enter the FTP login password.

(f) FTP Path: Enter the data storage location. If no subdirectory is set, leave this field blank. If storing in a subdirectory, enter the subdirectory name followed by a slash, for example, "VWdot/".

(g) ENABLE: Check to enable. Leave unchecked to disable.

(h) Once the entries are completed, click 'save' to finalize the FTP transmission settings.

(8) For data query and download, click on the 'Record Query' function. Select the company name, project name, instrument name, and query date. Then, click the 'Display data' button. The queried data will appear below, and users can export the data using the "Export Excel" function.

(9) For curve query and download, click on the 'Chart Query' function. Select the company name, project name, instrument name, and query date. Then, click the

'Display data' button. The queried data will appear below. Users can also use the functionality in the upper right corner of the graph to save it as various image files.
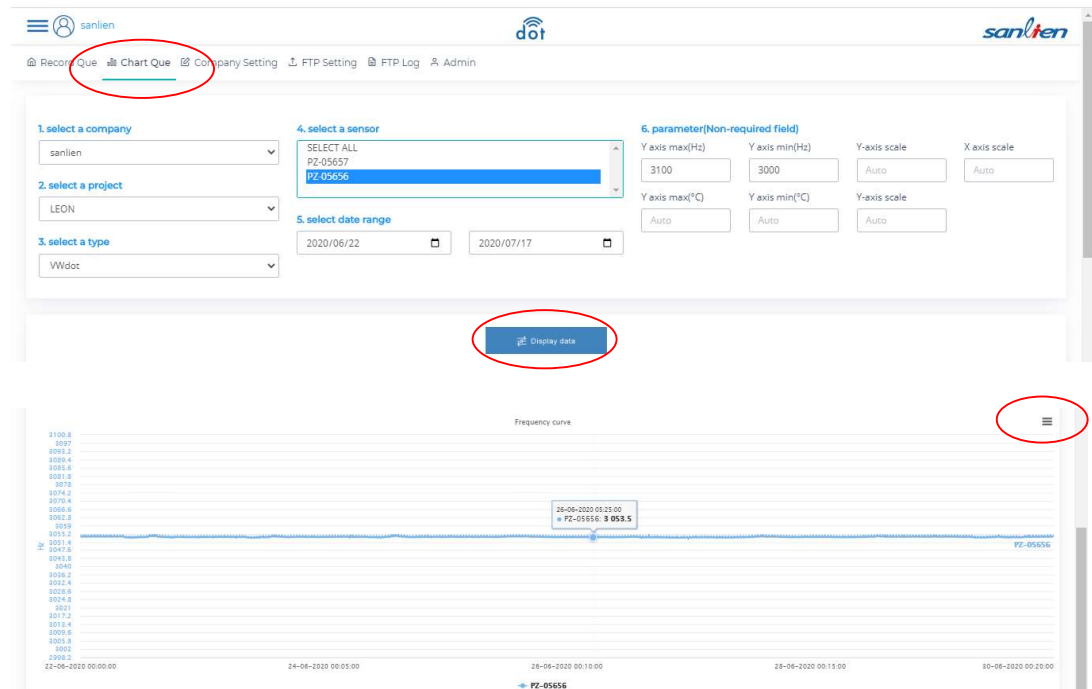
(10) To modify device settings from the cloud, access the "Device Setting" function. Click on 'Add', then select the instrument serial number to be modified. Users can adjust settings such as sweep, interval, and GMT_offset. After entering the details, click 'Save' to complete the process. Users can view the setting information and the effective modification time in the "Device Setting" screen.

Note: All modified settings will take effect after the next measurement by the device.

(11) To add a client for remote login, access the "Project User Setting" function. Select the Company and Project wanted to be shared, then click on 'Add'. Fill in the required information and click 'SAVE'. The system will send the link to the Sanlien dot client platform to the specified email address. Upon receiving the email, clients can use the provided link.

Note: The remote connection URL is
https://wms.sanlien.com.tw/dot/index.php?item=client

Please be aware that this remote connection URL is different from the original Sanlien dot management web service platform URL.

Name

EMAIL

Password*

Confirm Password*

Remark

After saving, send the account and password to the user. ☑

SAVE

Close

sanlien

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Be the frontier of environmental monitoring

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