

OPERATING INSTRUCTIONS
FOR
MODEL ZT-100-C
Digital Water In Oil Monitor

All Rights Reserved. No part of this manual may be reproduced, transmitted, transcribed, stored in a retrieval system, or translated into any other language or computer language in whole or in part, in any form or by any means, whether it be electronic, mechanical, magnetic, optical, manual, or otherwise, without the prior written consent of Zelentech Pte Ltd, Singapore.

Warranty

This equipment is sold subject to the mutual agreement that it is warranted by us free from defects of material and of construction, and that our liability shall be limited to replacing or repairing at our factory (without charge, except for transportation), or at customer plant at our option, any material or construction in which defects become apparent within one year from the date of shipment. Components manufactured by others bear the warranty of their manufacturer. This warranty does not cover defects caused by wear, accident, misuse, neglect or repairs other than those performed by Zelentech or an authorized service center.

Important Notice

This instrument provides measurement readings to its user, and serves as a tool by which valuable data can be gathered. The safety of personnel is ultimately the responsibility of those who control process conditions. Zelentech Pte Ltd cannot accept responsibility for conditions beyond its knowledge and control.

Safety Messages

Your safety and the safety of others are very important. Please read these messages carefully.



WARNING/CAUTION: Refer to the instructions for details on the specific danger. These cautions warn of specific procedures which if not followed could cause bodily injury and/or damage the instrument. The analyzer should only be used for the purpose and in the manner described in this manual.



Technician Symbol: All operations marked with this symbol are to be performed by qualified maintenance personnel only.



NOTE: Additional information and comments regarding a specific component or procedure are highlighted in the form of a note.

This manual provides information designed to guide you through the installation, calibration and operation of your new analyzer. Please read this manual and keep it available.

Table of Contents

Introduction	1
Specifications	2
Installation	3
Terminal Block	3
Wiring Connections	4
USB-RS485 Cable Connection	5
Operation	6
Configuration	7
Field Calibration	8
MODBUS Communication	9
HART Communication	10
ZT-100-C Interface Application	11
Troubleshooting	12
Maintenance	13

Introduction

The Model ZT-100-C is a digital Water-In-Oil Monitor designed to provide continuous online measurement of water content in oil. It uses capacitance measurement technology with automatic temperature compensation.

Key Features

- Water cut measurement range: 0–100%
- Temperature compensated readings
- 4-20 mA analog output
- HART protocol communication (Rev 6)
- MODBUS RTU interface
- Field calibration capability via application or CLI

System Architecture

The ZT-100-C consists of two interconnected boards communicating over an internal RS485 bus:

Component	Function
CoreCap (Measurement Board)	Capacitance sensor, PT100 temperature measurement
CoreSignal (Signal Board)	4-20mA DAC output, HART modem, MODBUS RTU, external RS485

Operating Principle

The dielectric properties of Oil and Water are vastly different and the ZT-100-C determines the water/oil ratio by measuring the capacitance of the passing stream. The ZT-100-C constantly measures the temperature and compensates for capacitance changes due to temperature fluctuations.

The ZT-100-C is available in Standard Version capable of 0–25% water as well as High Range versions capable of 0–100% water.

Specifications

Parameter	Specification
Water Cut Range	0–100%
Accuracy	±0.1% (typical)
Process Temperature Range	-20°C to +85°C
Operating Temperature	-40°C to +70°C
Power Supply	24 VDC (18–32V)
Power Consumption	150mA typical, 250mA max
Current Output	4-20 mA
Max Loop Resistance	600Ω @ 24VDC
HART Protocol	Revision 6
MODBUS	RTU, 9600 baud, 8N1
External RS485	9600 baud, 8N1

Communication Interfaces

Interface	Purpose	Protocol
4-20mA	Analog process output	Proportional to water cut
HART	Process control integration	HART Rev 6 (superimposed on 4-20mA)
External RS485	PC application or MODBUS	9600 baud
USB Serial	Debug/configuration	CLI terminal (115200 baud)

Installation

Terminal Block

The ZT-100-C mounts inside an enclosure. Field wiring connects to a 10-position terminal block arranged in a horseshoe pattern.



Terminal	Function	Direction
9	24VDC (+)	Input
8	24VDC (-) / GND	Input
7	RS485 A (Data+)	I/O
6	RS485 B (Data-)	I/O
5	4-20mA (+)	Output
4	4-20mA (-)	Output
3	Internal RS485 B	Internal
2	Internal RS485 A	Internal
1	Reserved	—
0	Reserved	—

Internal Wire Colors

Terminal	Function	Wire Color
9	24VDC (+)	Brown
8	24VDC (-) / GND	White
7	External RS485 A	Yellow
6	External RS485 B	Orange
5	4-20mA (+)	Green
4	4-20mA (-)	Blue
3	Internal RS485 B	Purple
2	Internal RS485 A	Grey

Wiring Connections

Power Supply

Connect 24VDC power to the enclosure terminal block:

Terminal	Connection
9	+24VDC (positive)
8	0V / GND (negative)



CAUTION: Verify correct polarity before applying power. Reverse polarity may damage the electronics.

4-20mA Analog Output

Terminal	Connection
5	4-20mA (+) → Analog Input (+) on control system
4	4-20mA (-) → Analog Input (-) on control system

Default scaling: 4mA = 0% water cut, 20mA = 100% water cut.

HART Connection

HART communication is superimposed on the 4-20mA loop. Connect a HART modem across the current loop terminals (5 and 4).

External RS485 Connection

Terminal	Connection
7	RS485 A (Data+)
6	RS485 B (Data-)

Use shielded twisted pair cable. Shield connected to enclosure ground. Termination: 120Ω at each end of bus. Maximum bus length: 1200m.

USB-RS485 Cable Connection

The ZT-100-C can be connected to a PC using an FTDI USB-RS485 cable for configuration and monitoring via the ZT-100-C Interface application.

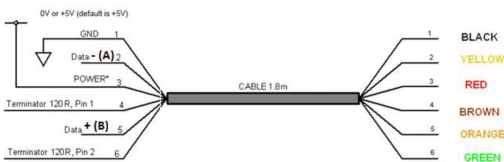


FTDI USB-RS485 Cable

FTDI Wire	Connect To
Yellow (Data- A)	Terminal 7 (RS485 A)
Orange (Data+ B)	Terminal 6 (RS485 B)
Black (GND)	Terminal GND (optional)



NOTE: The FTDI cable uses non-standard RS-485 labeling where (A) represents Data- and (B) represents Data+. This is opposite to typical industry convention. Connect by function: **Yellow to Terminal 7, Orange to Terminal 6.**



FTDI Cable Wire Pinout

FTDI Driver Installation

If the USB-RS485 cable is not recognized by Windows:

1. Download VCP drivers from ftdichip.com
2. Install the driver package
3. Reconnect the USB cable
4. Verify the COM port appears in Device Manager

Operation

Status LED

The red LED on the device blinks to indicate the number of connected network nodes:

Blink Pattern	Meaning
1 blink, pause	Single device (standalone mode)
2 blinks, pause	2 devices connected — normal operation
3 blinks, pause	3 devices connected (with optional display)

Each blink: ~100ms ON, 100ms OFF. Pause between patterns: ~1 second.

Reading Water Cut

Via 4-20mA Output

Current	Water Cut
4 mA	0%
12 mA	50% (mid-range)
20 mA	100%

Formula: Water Cut (%) = (mA - 4) × (Range / 16)

Via MODBUS

Read holding registers 30001–30002 for water cut value (Float32 format, big-endian).

Via HART

Use Command 1 (Read Primary Variable) to read water cut.

Via the ZT-100-C Interface Application

Connect to the device, navigate to the **Monitor** screen, and click **Start** to view live data including water cut, temperature, capacitance, and 4-20mA output.

Configuration

Output Range

The output range determines how water cut maps to the 4-20mA output. The default is 0–100%.

Range	4mA =	20mA =	Resolution
100% (default)	0% WC	100% WC	6.25% per mA
25%	0% WC	25% WC	1.56% per mA
10%	0% WC	10% WC	0.625% per mA
5%	0% WC	5% WC	0.3125% per mA
1%	0% WC	1% WC	0.0625% per mA

Configure via the ZT-100-C Interface application: Monitor screen → **Range (4-20mA)** card → select preset.



NOTE: If water cut exceeds the configured range, the output saturates at 20mA and the Status indicator shows “Saturated”. Choose the smallest range that covers your expected water content for best resolution.

Output Damping

Damping controls how quickly the output responds to changes. Higher damping provides smoother output but slower response.

Setting	Time	Description
Fast	2 sec	Quick response, some noise
Std	5 sec	Balanced (recommended)
Med	10 sec	Smoother output
Slow	20 sec	Very smooth, slow response

Configure via the application: Monitor screen → **Damping** card → select preset.

Via CLI: `damping <seconds>` (e.g., `damping 5`)

Field Calibration

Field calibration adjusts the device readings to match laboratory analysis results (shake-out test).

When to Calibrate

- During initial commissioning
- When readings differ significantly from lab samples
- After oil type or process changes
- Periodically as part of maintenance

Calibration Workflow

Step 1: Capture Sample

1. Take an oil sample from the process at the probe location
2. In the application, navigate to the **Calibrate** screen
3. Click **Start** to see live readings
4. Click **Capture Sample** to save the current reading

The application stores: capacitance (pF), temperature, and device water cut reading at sample time.

Step 2: Lab Analysis

Send the sample to a laboratory for water content analysis (shake-out test).

Step 3: Apply Lab Result

1. In the application, navigate to the **Calibrate** screen
2. In the **Lab Result (Shake-out)** card, enter the lab water cut value
3. Select calibration method: **Scale** (recommended) or **Offset**
4. Click **Apply**

Method	Best For	Formula
Scale	Most cases	$\text{corrected} = \text{raw} \times (\text{lab} \div \text{device})$
Offset	Small constant bias	$\text{corrected} = \text{raw} + (\text{lab} - \text{device})$

Calibration via CLI

1. Take oil sample while device is running
2. Run `cal save` to capture the current reading
3. Send sample to lab, wait for result
4. Run `cal <lab_wc>` (e.g., `cal 5.2`)

To clear calibration: `cal clear`

Calibration Status

Status	Meaning
OFF	No field calibration active
PENDING	Sample captured, waiting for lab result
ACTIVE	Field calibration applied

MODBUS Communication

Enabling MODBUS Mode

By default, the external RS485 port operates in **App/CLI mode**. To use MODBUS RTU, switch the operating mode:

1. Connect via USB
2. Enter superuser mode: `su`
3. Switch to MODBUS mode: `serial2 modbus`
4. Restart the device: `reboot`

To return to App mode: `serial2 rs485` then `reboot` .



NOTE: The ZT-100-C Interface application cannot connect via RS485 while MODBUS mode is active. Use USB connection for application access when MODBUS is enabled.

Connection Settings

Parameter	Value
Address	1 (default)
Baud Rate	9600
Data Bits	8
Parity	None
Stop Bits	1

Register Map

Register	Variable	Format
30001–30002	Water Cut (%)	Float32
30003–30004	Temperature (°C)	Float32
30005–30006	Capacitance (pF)	Float32

Float32 values use big-endian (Motorola) byte order.

HART Communication

HART Variables

Variable	Value
PV	Water Cut (%)
SV	Temperature (°C)
TV	Capacitance (pF)
QV	Supply Voltage (V)

Basic Commands

Command	Description
0	Read device identification
1	Read water cut (primary variable)
2	Read loop current
3	Read all dynamic variables

Loop Current Trim

Function	Command
4mA Trim (Zero)	HART Command 45
20mA Trim (Span)	HART Command 46

HART communication is superimposed on the 4-20mA loop. Connect HART modem across the current loop terminals.

ZT-100-C Interface Application

The ZT-100-C Interface is a Windows desktop application for configuration and monitoring via RS485.

System Requirements

- Windows 10 or later
- FTDI USB-RS485 cable (or compatible USB-to-RS485 adapter)
- Available USB port

Installation

1. Extract `ZT-100-C-Interface-Windows.zip` to a folder
2. Run `zt100c_config.exe`

Application Screens

Screen	Purpose
Monitor	Live measurement display, range/damping settings, disk logging
Chart	Historical data visualization
Calibrate	Field calibration workflow
Terminal	Direct CLI command interface (advanced users)
Connect	Serial port selection and connection management

Connecting to the Device

1. Connect FTDI USB-RS485 cable to PC and ZT-100-C terminal block
2. Open the ZT-100-C Interface application
3. Navigate to the **Connect** screen
4. Select **RS485** mode, choose the COM port
5. Click **Connect**

Data Logging

On the Monitor screen, locate the **Log to Disk** card:

1. Select logging interval: **1s**, **5s**, or **10s**
2. Click **Start**
3. Click **Stop** when finished

Data is saved as CSV with timestamp, water cut, temperature, capacitance, 4-20mA output, and status.

Troubleshooting

No Output / Dead Loop

Check	Action
Power LED	Verify 24V supply at terminals 9 and 8
LED heartbeat	Should see double-blink pattern
Wiring	Check loop continuity on terminals 5 and 4
Loop resistance	Must be < 600Ω @ 24VDC

Erratic Readings

Symptom	Possible Cause	Solution
Fluctuating reading	Gas in oil	Install upstream of separator
	Probe fouling	Clean probe
	Water settling	Ensure adequate flow
Drifting reading	Temperature change	Verify PT100 sensor connected
	Probe contamination	Clean probe insulators

Communication Failures

Application not connecting: - Verify correct COM port selected - Check USB-RS485 cable connections (Yellow → 7, Orange → 6) - Try disconnecting and reconnecting USB cable

MODBUS not responding: - Verify MODBUS mode is enabled (`serial2` command via USB) - Check address = 1, baud rate = 9600 - Verify wiring polarity

HART not responding: - Verify loop current > 4mA - Check HART modem connection across loop terminals

Maintenance

Recommended Schedule

Interval	Action
Weekly	Compare reading with lab sample
Monthly	Check 4-20mA output against multimeter
Quarterly	Inspect probe for buildup
Annually	Full calibration verification

Cleaning the Probe

1. Remove probe from process
2. Clean with appropriate solvent
3. Inspect insulators for damage
4. Rinse with clean oil before reinstalling



WARNING: Follow proper isolation procedures before removing probe from pressurised piping. Process piping may be hot — use appropriate PPE.

Process Temperature



WARNING: Do not exceed the maximum process temperature specified in the product specification supplied with your model. Operating beyond the specified temperature limits may cause damage to the instrument and will void the warranty.

Manufacturer	Zelentech Pte Ltd
	55 Serangoon North Avenue 4
	#04-05, S9 Building
	Singapore 555859
Website	www.zelentech.co