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Modbus / DTU to Platform

MT7981 Platform

Customer Scenarios and Operation-Local Diagnostics

> Common02 -> 03 -> 04; choose05 (gateway acquisition) or06 (DTU + server); rejoin at07 for acceptance.

Prove one voltage point before expanding.

Each operation includes entry, settings, behavior, cautions, fault checks, evidence and retest.

Verify model-specific terminals/Serial; keep one master per physical port.

Main hardware example: YZW300L; example meter SDM120M; example platform ThingsBoard.

Examples, offline native forms and simulated230.0 V are not field acceptance. Record actual firmware, wiring, readings and recovery.

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01 | Reading Route: Common Setup, Then A or B

> Decide who owns polling. For a first installation, complete Chapters 2 -> 3 -> 4, choose only Chapter 5 (A) or Chapter 6 (B), then use Chapter 7 for acceptance. Chapters 8-10 are references.

This guide follows one practical task: continuously send the voltage of a cabinet-mounted energy meter to a platform. Start with one read-only point. Do not send control commands or change metering parameters. Add current, energy and further meters only after the first point passes acceptance.

Available evidence: native gateway Web forms, manufacturer terminal and register references, screenshots of a real isolated ThingsBoard instance, and software tests of both delivery paths. **Not yet verified:** the end-to-end combination of your physical gateway/DTU and meter. Record the actual firmware, wiring photographs and simultaneous field readings in Chapter 10. The example 230.0 V is simulated, not a site measurement.

1.1 Give One Application Ownership of the Serial Port

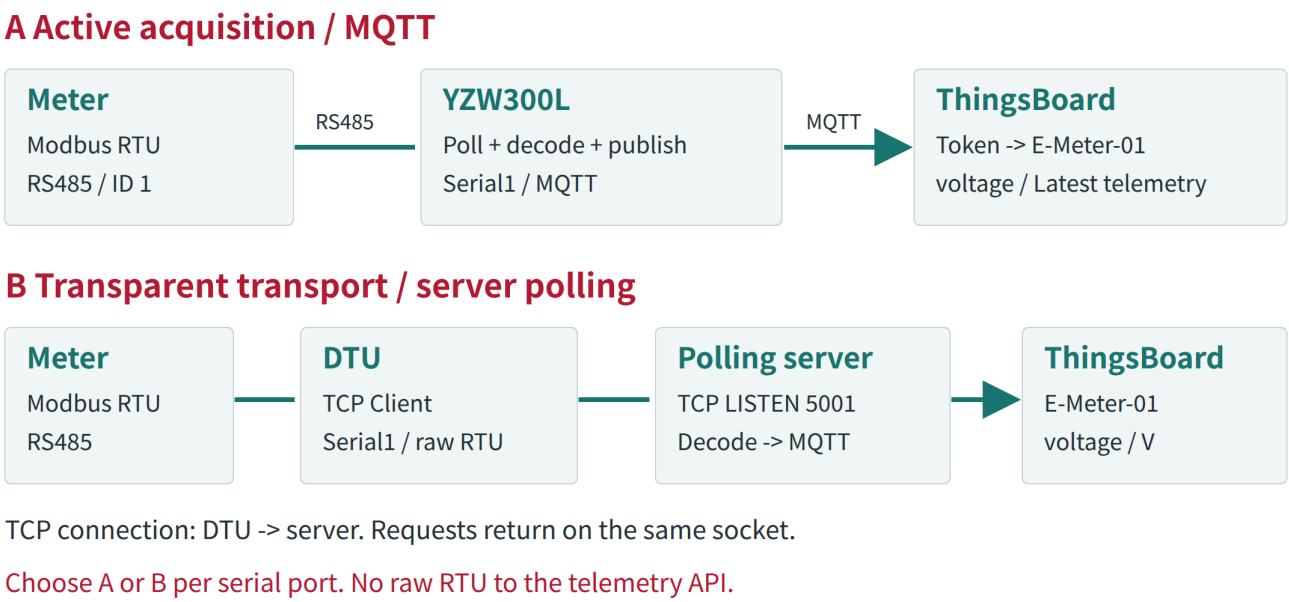


Figure 1-1 Data and connection directions. Arrows do not imply a completed field installation.

Your requirement	Path	Who polls the meter?	What else is required?
The gateway reads registers periodically and reports values	A: Modbus acquisition -> MQTT -> ThingsBoard	Gateway	The flat numeric example can connect directly; verify the actual payload.
Your server owns polling; the gateway transports serial bytes	B: DTU TCP Client -> server polling/decoding -> MQTT -> ThingsBoard	Server	A persistent listener, RTU parser and MQTT publisher. A single-meter read-only example is included.

Do not enable A and B on the same physical port simultaneously. A connected DTU does not make a passive Modbus meter transmit readings automatically. The ThingsBoard telemetry endpoint does not accept arbitrary raw RTU bytes.

G01 | Choose one serial master

Check	Judgment and Action
Expected behavior	A is polled by the gateway; B by the server. One application owns the physical port.
Precautions	Record A/B, physical/logical port and owner first. A TCP connection does not make a meter transmit.
Symptom and first check	All points time out or traffic is corrupted: inspect concurrent acquisition, DTU and remote-serial use first.
Ordered checks	1. Record applications. 2. Stop only the unselected path in a maintenance window. 3. Save/read back. 4. Retest one meter/master without killing unknown processes.
Evidence and acquisition	Capture both applications and port enable state in G01_port_owner.png. Record before/after ownership; use the actual configuration-export facility for backup.
Retest or roll back	Continue with sole ownership; stop testing if the production port cannot be released.

1.2 Implementation Order and Pass Conditions

Order	Action	Continue only when
1	Record meter settings, registers, gateway version and platform credentials	Every entry has a source; the station address is not guessed.
2	Isolate power, wire the equipment and identify a free RS485 port	Electrical interface, both terminal ends and supplies are confirmed.
3	Register E-Meter-01 in the platform and obtain its device token	The Web user account and device token are distinguished.
4	Configure A, or configure the DTU and server for B	One read-only request receives a valid response.
5	Inspect fresh platform values and compare with the meter	Device, value, unit, time and source match.
6	Test data-source interruption, uplink loss and recovery	Stale values are not presented as fresh samples; updates resume.

1.3 A Common Workflow, Not Universal Device Settings

This book applies to a gateway/DTU with the delivered port/application, a Modbus instrument with an authoritative register map, and a platform accepting engineering values. This edition keeps common operations together within its stated platform scope. Confirm model, firmware, physical terminals, logical-port

mapping, payload and TLS capability per project. YZW300L, SDM120M and ThingsBoard form a fill-in worked example, not a tested claim for other combinations.

For a first installation, follow the route above. For an installed system, return to the last working/first failing stage. Finish one point before replacing equipment/platform or expanding; then use Section 2.5 and Chapter 9. Do not factory-reset as a first fault response.

G01-G40 are retained diagnostic references, not execution numbers. Follow chapters and A1-A4/B1-B4 task headings for execution order. Each G checkpoint follows its operation and covers expected behavior, precautions, symptom/first check, ordered checks, evidence acquisition and retest/rollback. Written examples and software tests do not replace field acceptance.

1.4 Using Figures, Logs and Files

Language-matched native captures retain their numbered markers, with same-number instructions immediately below. Unmarked fields still need the documented values. If your interface differs, verify delivery/field meaning rather than editing browser labels or inventing a read-once button. Device forms are retained offline-filled references; ThingsBoard captures are from a real isolated instance, not a new operation on customer equipment.

Gxx_*.png,* .txt and *.json are suggested customer-created PC evidence names, not existing device paths. Collect only the tasks performed. Download only where a real Web export exists; otherwise capture the relevant panel or request administrator logs for the time window. Save complete terminal output as txt. JSON files contain only the complete payload, not time prefixes, topics or RX_AND_PUBLISH labels.

See Chapter 8 for evidence acquisition, ownership and redaction. Record actual results in Forms/Evidence_Record_EN.csv. Mark unavailable evidence pending, not passed.

1.5 Intended Customers: MT7981

Use this edition for MT7981 equipment delivered with Modbus acquisition/DTU and the required interface. YZW300L dual RS485 illustrates the hardware. Modbus/DTU images are offline previews emitted by the MT7981 native page source, not newly accessed device screenshots or firmware acceptance. Verify the actual model, menus and firmware first. YZW900 has no external serial interface for this example; YZW900L uses an internal port, not the 300L 7-pin drawing.

Customer situation	Route in this edition	Always-on owner / acceptance
Cabinet meter reporting without a permanent site PC	Common Chapters 02-04 -> A in 05 -> 07	Gateway polls/publishes; only the platform must run on the server
Existing server polls through a cellular DTU	Common Chapters 02-04 -> B in 06 -> 07	Server listens, requests RTU, decodes and publishes; DTU only transports bytes
Web also offers PLC acquisition, Node-RED or remote serial	Choose the application and release the intended port first	This book uses Applications -> Modbus acquisition, not the independent reporting below the PLC page; one master per physical port

Customer situation	Route in this edition	Always-on owner / acceptance
No values, tenfold scaling error or failed recovery	Return to the relevant G reference; locate last working/first failing stages	Verify wiring/reads, transport, authentication, parsing/storage and freshness separately

PLC and Node-RED are not prerequisites and do not replace the Modbus map. Use their separate guides when needed. This edition first completes one read-only voltage point that can be checked at the site.

1.6 Which Application Opens Each Screen

Application	Open in this order	Expected screen / return
Commissioning-PC browser: gateway Web	Actual management URL -> sign in -> Applications -> Modbus acquisition -> Add device in its list -> Add command	Global configuration is on the parent page. Command/device are two dialog layers: save command -> save device -> save global on the parent
Commissioning-PC browser: gateway DTU	Actual management URL -> Applications -> DTU -> verified Serial tab	Tab and page title identify the same port. Set TCP/client, server and serial, save and refresh/read back
Commissioning-PC browser: gateway logs	System Management -> Log -> refresh -> inspect relevant programs around the fault -> use the real export control	Keep the original downloaded name/extension. gateway_runtime.txt is an archive suggestion, not an assumed device path
Server PC: PowerShell	Open a terminal in supplied Tools -> create the environment and run 6.2	LISTEN/CONNECTED/TX/RX belong to the server terminal. server_bridge.jsonl is in that working folder, not gateway Web
PC browser: ThingsBoard	Administrator-provided platform URL -> tenant login -> Entities -> Devices -> E-Meter-01	Credentials, connectivity and Latest telemetry belong to the platform, not the router account
Optional manufacturer Modbus master	On an approved PC, open the actual tool and select the isolated USB-RS485 COM port	Follow 3.3 for TX/RX/value/time. Vendor menus differ; no invented universal successful-read button

Obtain the actual URLs from the project. The Modbus parent is /gui/application_modbuscollect.cgi. DTU selection is /gui/application_dtu.cgi?serial=N, with N verified in 2.6; logs use /gui/system_log.cgi. Enter through real menus first, never put these paths into the MQTT host field. Stop for supplier confirmation if menus/permissions are missing; do not flash firmware to add an assumed feature.

02 | Common Setup: Equipment, Register Map and Endpoints

> Entry: choose A or B. Order: identify hardware/firmware -> obtain instrument settings -> define the first point -> distinguish management, MQTT and DTU endpoints. Exit: every setting has an actual source; continue to Chapter 3.

2.1 Equipment and Verification Status

Item	Example or required material	Evidence and current status
Gateway/DTU	YZW300L, standard dual-RS485 build, Serial1	Hardware follows existing YZW300L specifications; software images are MT7981 native-source previews, not acceptance of this unit/firmware/wiring.
Gateway firmware	Copy the full model, software version and date from the actual Overview/System Information page into Chapter 10	Your unit's information has not been supplied. Do not mark a guessed version as verified. Document V1.2 is not a firmware version.
Meter reference	Eastron SDM120M matching manufacturer User Manual V2.9	Terminals and voltage register checked against the manufacturer; no new physical-meter test. Do not assume other suffixes are identical.
Meter software	Photograph its nameplate and record the startup/scrolling software-version page	Pending. The manual revision is not the meter firmware.
Power	Gateway 2-pin input 9–36 V DC, nominal 12 V DC; verify supply/polarity against nameplate/order. Qualified personnel supply the meter at its rating.	RS485 does not power the meter. Never connect meter mains to the gateway DC socket.
Commissioning PC	Browser; Path B also needs Python 3.10 or newer and two dependencies	Run the tools on a PC/server. Gateway Python or Node-RED is not required.
Cables and tools	Shielded twisted pair, Ethernet cable, suitable stripping/crimping tools and screwdriver; optional isolated USB-RS485 adapter	Follow terminal-specific conductor, strip length and torque requirements. No universal torque is assumed.
Platform	An existing ThingsBoard tenant with device-management permission; documentation instance is isolated CE 3.9.1	Software reception tested. The old isolated version is not a recommendation for a new production deployment.

Relevant models may share acquisition procedures, but **only delivered builds with the required port and application qualify**. This is not evidence that all models were tested with this meter. YZW900 lacks the serial interface required here. YZW900L has an internal serial connection, not this exposed terminal

arrangement. Use the appropriate terminal table and logical-port mapping for every other model.

G02 | Verify device and firmware evidence

Check	Judgment and Action
Expected behavior	Actual model, serial option, firmware, meter map and platform version are traceable; the field result is not prefilled.
Precautions	7981 forms are offline native-source previews; 300L hardware follows existing specifications. Obtain firmware from actual Overview/System Information; V1.2 is not firmware.
Symptom and first check	Missing menu/field/interface: first check order, actual firmware and manual; another model page does not prove delivery.
Ordered checks	1. Compare nameplate/order. 2. Record firmware. 3. Check the model interface. 4. Read actual menus. 5. Resolve differences with the supplier.
Evidence and acquisition	Capture actual Overview/System Information as Gateway_Identity.png. Verification_Matrix records version/date/scope/evidence; unknowns stay pending.
Retest or roll back	Wire only after delivery confirmation. Offline previews/software simulation are not this unit passing physical end-to-end acceptance.

2.2 Find the Meter Address and Serial Settings

On SDM120M, use the front scroll button to find voltage V, station ID, baud rate, parity and software version; photograph the settings. For changes, follow the matching manufacturer's setup procedure and record before/after values. Do not write metering, reset or tariff registers merely to obtain readings.

Parameter	Example entry	Where to confirm / why
Station address	1	Read the meter ID page. This is neither the gateway IP nor a platform device ID.
Baud rate	2400 bit/s	Manufacturer-default example only. A site meter may already use 9600 or another setting.
Data / parity / stop	8 / none / 1, or 8N1	Check the actual setting. Default descriptions differ between manufacturer pages; do not rely on the word "default" alone.
Logical port	Serial1	Standard dual-RS485 example: verified Serial1 RS485 A/B pair. This wiring is invalid if that interface was ordered as RS232.

Parameter	Example entry	Where to confirm / why
Timeout	Acquisition: 1000 ms; server polling: 3 s	Commissioning starting points, not guaranteed meter response times. Measure cellular/VPN behavior.

G03 | Obtain actual station and serial settings

Check	Judgment and Action
Expected behavior	Instrument ID, baud, data bits, parity and stop bits match the selected serial port.
Precautions	Station is not an IP/platform ID. 2400/8N1 is an example; capture existing settings before any authorized change.
Symptom and first check	No response for all registers: compare instrument settings and Web serial page first; a single failing point suggests its map.
Ordered checks	1. Check display/power. 2. Record serial parameters. 3. Exclude duplicate station IDs. 4. Match logical/physical port. 5. Save one change at a time.
Evidence and acquisition	Photograph ID/baud/parity/version as Meter_Settings.png and capture G03_serial.png from actual Web. Source inaccessible data/stop bits from the manufacturer/owner rather than guessing defaults.
Retest or roll back	Proceed with matching actual settings and unique station ID; restore the original instrument configuration on failure.

2.3 Complete Definition of the First Point

Register item	Example	Meaning
Point / published key	voltage	Keep the command and platform key case identical.
Function	04, read input registers	Not 03 in this example. Keep the point read-only.
Manual reference	30001	A register reference, not the literal PDU address entry.
PDU start address	0, hexadecimal 0x0000	In this 3xxxx table, 30001 maps to offset 0. Follow each other manufacturer's address convention; do not universally subtract one.
Count / type	Two 16-bit registers; Float32 ABCD	One 32-bit value occupies two registers. Confirm the protocol and a known value; do not enter count 1.
Scale / offset / unit	x1 / +0 / V	This float is already volts. Do not divide by 10 or apply x0.1 again.

Register item	Example	Meaning
Acquisition / report period	5 s / 5 s	Separate settings; start with equal periods.

G04 | Define the complete first point

Check	Judgment and Action
Expected behavior	FC04/PDU0/count2/Float32 ABCD/scale1/V match the referenced SDM120M map.
Precautions	30001 is a reference, not the literal PDU entry. Do not universally subtract one; a 32-bit value occupies two registers.
Symptom and first check	Exception02 or implausible value: check protocol address/count/type/order in the map before changing scale.
Ordered checks	1. Distinguish FC03/04. 2. Confirm decimal/hex. 3. Check count. 4. Validate ordering/signedness against a known value. 5. Apply scale once.
Evidence and acquisition	Retain original register_map.pdf with revision/page. Record reference, PDU, type, count and scale owner in Point_Map; an edited spreadsheet is not manufacturer evidence.
Retest or roll back	Read only after definitions are sourced; do not probe with writes or address scans.

For a different meter whose UInt16 raw value 2300 requires x0.1 to produce 230.0 V, use that meter's register definition and scale exactly once. The gateway command form shown here has no scale field: apply an approved platform rule or receiver conversion and record where it happens.

2.4 Do Not Confuse the Four Address Types

Purpose	Illustrative site LAN plan	Where used
Gateway management	Gateway 192.168.10.1, PC 192.168.10.10, /24	Only after configuring the LAN plan; not factory defaults. Back up before changing LAN and renew the PC address afterward.
Platform Web login	http://192.168.10.10:8080	Browser. An operational platform and valid tenant account are prerequisites.
Platform MQTT	192.168.10.10, port 1883, plain MQTT	Gateway server/port. Isolated LAN or approved protected VPN demonstration only.
DTU receiver	192.168.10.10, TCP 5001	DTU primary server/port. Server listens; gateway initiates.
Actual documentation lab	Web 127.0.0.1:18083; MQTT 127.0.0.1:11883; DTU 127.0.0.1:15001	Loopback ports on the documentation PC only, not addresses to enter into another gateway. Separate from the site plan above.

G05 | Separate management, platform Web, MQTT and DTU addresses

Check	Judgment and Action
Expected behavior	Addresses are recorded by purpose; the gateway can reach MQTT/DTU and the server listens on a reachable adapter.
Precautions	127.0.0.1 means each host itself. 8080/1883/5001 serve different roles. Use an approved protected path, not public raw TCP.
Symptom and first check	PC Web works but gateway data fails: inspect gateway-to-business-port direction/address; Web access does not prove MQTT reachability.
Ordered checks	1. Verify actual egress. 2. Check host/port. 3. Check listener binding. 4. Check route/firewall/DNS. 5. Then diagnose authentication.
Evidence and acquisition	Obtain host/port/TLS/topic in Platform_Endpoint.txt from the administrator; capture actual egress in G05_network.png and record only credential references.
Retest or roll back	Continue after reachability; retain backup/management access before network changes and roll back as planned.

Obtain the actual Web URL, tenant permissions, MQTT host/port and TCP/TLS mode, CA, device Access Token, network allowlist and naming rules from the platform administrator. Gateway Web password, platform user password and device token are different credentials. Do not put production secrets in screenshots or public files.

2.5 What to Replace for Another Device, Instrument or Platform

Change	Common method retained	Replace or confirm
Gateway model/firmware	Back up -> locate real menus -> read back -> test -> retain evidence	Delivered electrical interface, terminal order, logical-port mapping, application, field units and payload; processor family does not prove port layout
RS232 or Ethernet instrument instead of RS485	Confirm the physical layer/protocol before reading	RS232 cannot connect directly to RS485. Modbus TCP uses IP/port and MBAP, not this raw RTU frame
Instrument or point	Map station, FC, PDU address, count, type, ordering, scale and unit	2400, 8N1, FC04, address 0, Float32 and x1 are example values, not defaults for every meter
Acquisition application	Read back each actual save layer	Fields and save hierarchy may differ. Do not invent scale or read-monitor controls absent from the delivered Web
Cloud platform	Create device -> obtain device credentials -> confirm endpoint -> match topic/JSON -> inspect actual data	ThingsBoard token-as-username and telemetry topic are not universal; signatures, device triples, HTTP or proprietary protocols need adaptation

Change	Common method retained	Replace or confirm
DTU network mode	Identify listener, initiator and carried frame first	This book uses TCP Client with raw RTU. TCP Server, UDP and Modbus TCP conversion require more than changing a dropdown
Server software	Read one point, validate framing/CRC, reject stale values on timeout, verify persistence	The supplied tool fixes FC04/address0/two registers/ABCD/0-500 V. It is an example, not a general register-map engine

Record each actual model, options, firmware, instrument/protocol revision, platform version, test scope, evidence and outcome in Forms/Verification_Matrix_EN.csv. Existing evidence covers menus/register references and software, not a hardware/firmware end-to-end passed list to copy.

G06 | Confirm the boundary between method and example

Check	Judgment and Action
Expected behavior	Each project parameter has its own source; only operations with matching capabilities/protocols are reused.
Precautions	Neither a product list, processor nor brand proves compatibility. The tool reads this fixed voltage point, not arbitrary maps.
Symptom and first check	Different form or another meter failing: check the delivered application, protocol and tool scope first.
Ordered checks	1. Complete differences. 2. Confirm RS485/RS232/TCP. 3. Match map/platform envelope. 4. Approve adapters. 5. Retest rather than renaming devices.
Evidence and acquisition	Complete Verification_Matrix/Point_Map and attach the model manual, actual firmware capture and platform API. Do not label other instruments supported by this fixed tool.
Retest or roll back	Proceed with confirmed differences; do not claim unconfirmed functions delivered or tested.

2.6 MT7981: Map Actual Terminals to Logical Serial

Hardware/model	Confirm first	Used here / do not copy
YZW300L example	Two RS485 pairs share the 7-pin terminal with DI/DO; Serial1 and Serial2 are independent RS485 ports	Use only the verified Serial1 A/B pair, not DI/DO. The figure identifies interfaces; do not guess a left-to-right pin number
The second RS485 pair	Identify Serial2 A/B and signal reference from the delivered pinout	Change both the Modbus connection and DTU tab to Serial2, then retest; moving wires alone is insufficient

Hardware/model	Confirm first	Used here / do not copy
YZW1000 and other MT7981 models	Model-specific port count, pin order and software mapping	Do not copy the 300L 7-pin layout, supply or numbering; the 1000 has a different arrangement
YZW900 / YZW900L	900 lacks this external serial port; 900L uses an internal port	A Serial menu is not proof of external RS485. This guide does not instruct opening the enclosure

Complete Forms/Port_Mapping_EN.csv with model/options, firmware, terminal photo, A/B/reference, logical Serial, sole owner and verifier. Mark unconfirmed pin numbers pending; do not infer them by live rewiring.

G40 | Verify model-specific terminals, Serial and sole ownership

Check	Judgment and Action
Expected behavior	Physical A/B, electrical interface, logical Serial and application match, with a photograph and verifier.
Precautions	Processor family or a dropdown does not prove the physical port. Isolate all power and record previous service/ownership before wiring.
Symptom and first check	Connected without RX, all reads timing out or port-busy: first inspect the terminal photo, Port_Mapping and application state on that Serial.
Ordered checks	1. Verify model/options/interface. 2. Locate A/B in the official pinout. 3. Match local Serial. 4. Stop/save other masters in a maintenance window. 5. Retest one read-only meter without blind rewiring/scanning.
Evidence and acquisition	Installer completes Port_Mapping. Capture both labels/wire IDs in G40_terminals.jpg and actual acquisition/DTU/other ownership in G40_owner.png. Export the original backup through the real device control, preserving its name.
Retest or roll back	Proceed to 03/05/06 only with verified mapping and one master. Stop for supplier confirmation if ambiguous; do not record a pass.

03 | Common Operations: Safe Wiring, Network and First-Point Baseline

> Entry: Chapter 2 parameters and interfaces confirmed. Order: isolate power/identify terminals -> wire data and separate supplies -> check management/uplink -> optionally read one independent point. Exit: safe installation, reachable management and one serial owner; continue to Chapter 4.

3.1 Identify Physical Interfaces Before Wiring

> Application: physical site equipment and commissioning PC. Verify model terminals with power isolated before wiring. After safe power-up inspect gateway Overview/network status, then optional 3.3 or Chapter 4.

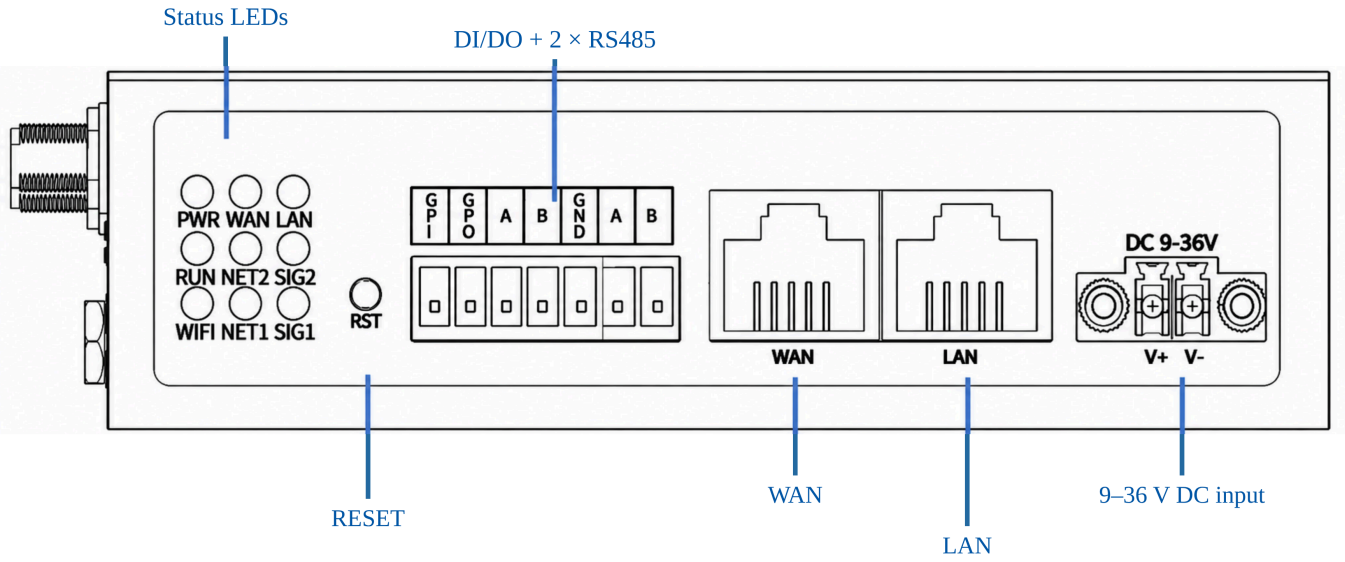


Figure 3-1 Existing YZW300L interface drawing: 7-pin dual RS485/DI/DO and separate 2-pin power; not an installed-site photograph.

Location / marking	Actual purpose	Use in this example
7-pin serial/I/O terminal	Two independent RS485 ports share the terminal with DI/DO	Connect only the verified Serial1 A/B; do not connect meter data to DI/DO
2-pin power terminal	9–36 V DC / nominal 12 V DC	Use a separate approved supply/rating/polarity; not a serial terminal
WAN / LAN	Two Ethernet ports; roles depend on actual configuration	PC to LAN; actual WAN for wired uplink, or a verified cellular uplink

G07 | Identify the physical port before choosing Serial

Check	Judgment and Action
Expected behavior	Verified the actual 7-pin A/B pair for Serial1; Serial2 is independent, with DI/DO and 2-pin power kept separate.
Precautions	YZW300L is dual RS485; do not copy 280 TX/A/RX/B or barrel DC. Obtain the delivered pinout before wiring.
Symptom and first check	TX without meter response: inspect physical interface/Serial mapping first, not the platform.
Ordered checks	1. Check ordered option. 2. Verify order facing the terminals. 3. Compare model pinout. 4. Confirm mapping with supplier. 5. Do not wire until confirmed.
Evidence and acquisition	Photograph labels/orientation as G07_gateway_ports.jpg. Record physical/logical port and manual page. Stock photos identify ports, not field wiring.
Retest or roll back	Wire only when hardware/options/mapping agree; stop for a correct interface solution otherwise.

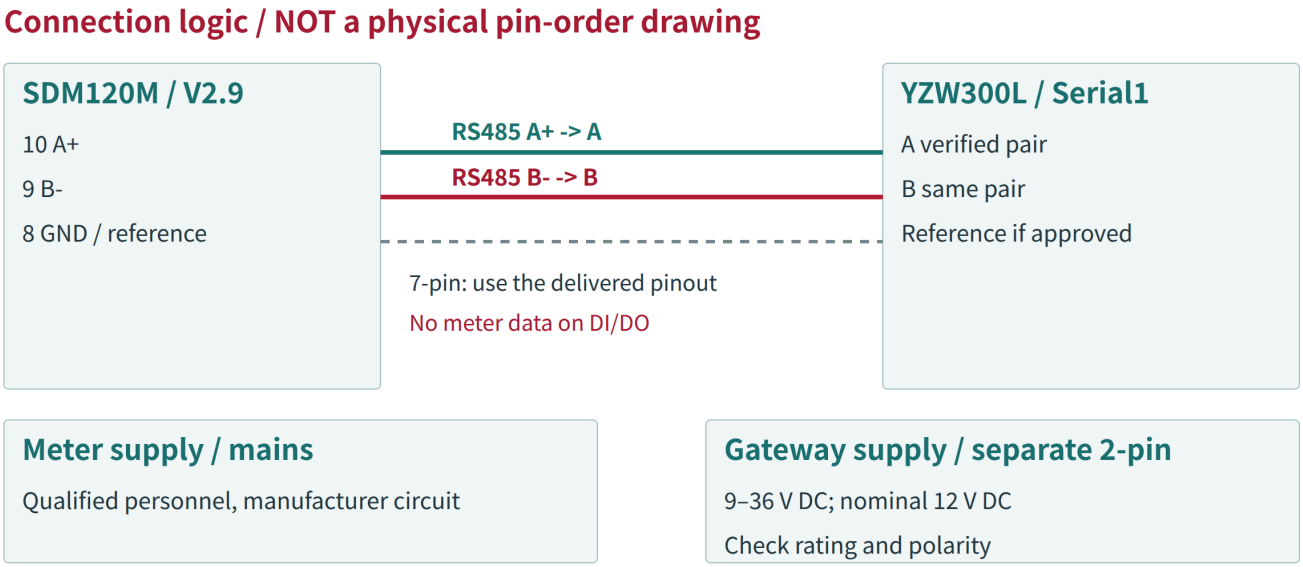


Figure 3-2 SDM120M to the selected YZW300L RS485: connection logic, not a site photo, complete mains design or guessed 7-pin pinout.

Both ends	Example connection	Confirm first
SDM120M 10 A+ -> YZW300L RS485 A	Use the verified Serial1 A	Use the delivered pinout, never DI/DO
SDM120M 9 B- -> YZW300L RS485 B	B from the same verified pair	Check electrical A/B definitions at both ends
SDM120M 8 GND / signal reference	Reference only under the approved grounding/isolation design	Not PE, mains N or a universal supply negative
Gateway 2-pin supply	9–36 V DC / nominal 12 V DC	Verify polarity/rating; RS485 is not the supply
SDM120M 1 L-in / 3 N	Qualified electrical personnel follow the complete manufacturer circuit	Isolate/test all power; this diagram does not replace protection/load design
WAN / SIM	Choose a verified wired or cellular uplink	SIM service/APN and actual cellular antenna; verify MQTT reachability after network access

G08 | Connect data and separate supplies with power isolated

Check	Judgment and Action
Expected behavior	SDM120M 10 A+ -> verified Serial1 A; 9 B- -> its B. Approved signal reference, separate correct 2-pin DC and meter mains.
Precautions	Qualified personnel isolate/test mains before work. Do not connect L/N/DC/PoE to RS485; signal GND is not PE or a universal neutral.

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Check	Judgment and Action
Symptom and first check	Blank meter, abnormal behavior or safety concern: check separate supplies and real labels; stop without live rewiring.
Ordered checks	1. Isolate all power. 2. Compare both official pinouts. 3. Check A/B definitions, wire IDs, shorts/loose ends. 4. Verify reference/shield grounding. 5. Energize only after electrical review.
Evidence and acquisition	Safely capture Wiring_Overview.jpg, Meter_Terminals.jpg, Gateway_Terminals.jpg and Power_Uplink.jpg with wire IDs, supplies and WAN/SIM. The schematic is not a physical installation record.
Retest or roll back	Test after electrical/terminal checks. Mark missing field photos pending; do not replace them with generated photographs.

> **Safety:** Isolate all meter and gateway supplies and verify de-energization before wiring. Only qualified electrical personnel may work on mains metering circuits. Keep RS485 away from mains and high-power switching conductors. Never connect mains L/N, DC supply or PoE to RS485 terminals.

3.2 Field Connection Checks

> Application: physical site equipment and commissioning PC. Verify model terminals with power isolated before wiring. After safe power-up inspect gateway Overview/network status, then optional 3.3 or Chapter 4.

Action 1. Verify the actual model, electrical build and terminal order. Start with one meter. For YZW300L verify the selected 7-pin A/B pair is Serial1; recheck other models against their own pinout.

Action 2. Wire A/B as one twisted pair, with secure ends and no exposed-copper short. Use a bus topology. Apply termination, bias and shield grounding according to the installed bus and device instructions, not a 120-ohm resistor on every node.

Action 3. Complete mounting and strain relief before powering each device according to its instructions. Confirm normal meter display and gateway login. Prevent DTU, Modbus acquisition and remote serial access from sharing the port.

G09 | Confirm instrument and management after power-up

Check	Judgment and Action
Expected behavior	The meter displays normally, gateway Web is accessible and no other application owns the selected port.
Precautions	Use model-specific LED guidance; do not copy another model's blink pattern or use platform status as an electrical check.
Symptom and first check	No display/Web login: check the respective supply, management adapter/address before changing multiple settings.
Ordered checks	1. Verify supply/connector. 2. Check management network. 3. Exclude address conflict. 4. Confirm device identity. 5. Record status and escalate persistent faults.

Check	Judgment and Action
Evidence and acquisition	Capture meter/device state as G09_power.png and logged-in identity/status as G09_management.png. Only qualified personnel measure/record actual supply values.
Retest or roll back	Continue to communication after management/display/sole-port ownership are confirmed.

Action 4. In network status, verify uplink IP, route and DNS. For cellular, check APN, data service and session state; for wired access, check the WAN role. Signal indication or SIM detection alone is insufficient.

G10 | Check wired or cellular egress

Check	Judgment and Action
Expected behavior	The active egress has IP/default route/required DNS; cellular is dialed, not merely SIM-detected.
Precautions	Do not renumber production LAN to copy examples. Obtain APN from carrier/project and verify actual WAN role.
Symptom and first check	SIM recognized but platform unreachable: inspect dial/IP/route first; Ethernet link does not prove an uplink address.
Ordered checks	1. Confirm approved egress. 2. Check APN/data or wired WAN. 3. Verify IP/route/DNS. 4. Check business endpoint. 5. Keep power loss separate from network loss.
Evidence and acquisition	Save actual network/dial status as G10_uplink.png and approved diagnostics/admin route evidence as G10_route.txt, retaining egress/time without SIM identity.
Retest or roll back	Continue with stable reachable egress; restore scoped network settings on failure rather than resetting everything.

Action 5. Verify the server listener and reachability from the gateway's actual network. The PC opening a platform Web page does not prove the gateway can reach MQTT.

G11 | Check listener and remote reachability separately

Check	Judgment and Action
Expected behavior	The server listens on the intended adapter/port and approved client direction is reachable, with evidence for gateway-to-target access.
Precautions	PC Test-NetConnection proves that PC direction only. TCP probes can occupy the single-session tool; do not continuously probe5001 during polling.
Symptom and first check	Reachable port without values: first check actual polling TX; refused versus timeout points to listener versus routing/firewall.

Check	Judgment and Action
Ordered checks	1. Inspect Get-NetTCPConnection listener. 2. Verify binding. 3. Check source-to-port policy. 4. Connect the actual DTU. 5. Use CONNECTED/TX to establish business direction.
Evidence and acquisition	Save server listener output as G11_listener.txt and connection source/time in server_bridge.jsonl. Obtain actual gateway reachability from diagnostics/admin, not only a PC browser capture.
Retest or roll back	Diagnose protocol after endpoint/direction/listener checks; release test connections before the DTU connects.

Field photos still required: close-ups of meter terminals, gateway terminals/DC socket, complete conductor routing, actual WAN/SIM connection and cabinet overview. Keep labels legible and redact SIM numbers and credentials; Chapter 10 defines the archive.

3.3 Optional: Read One Point Before Platform Binding

> Application: manufacturer/approved Modbus master on the site PC. Confirm its actual entry and adapter COM port. Stop gateway ownership first, close/release the tool afterward, then continue to Chapter 4.

To isolate instrument/cable faults first, arrange a maintenance window and stop gateway acquisition/DTU ownership of that serial port. Qualified personnel connect a matching isolated USB-RS485 adapter with power isolated. In a manufacturer/customer-approved Modbus master, use Section 2.3: unit1, 2400/8N1, FC04, PDU0, count2, Float32 ABCD, scale1 and V. Read once only; do not reset, write or control equipment.

Retain request, response/exception, decoded value and time, comparing with the meter V display in the same period. If the tool lacks a display, export only its real communication log rather than inventing a screenshot. Close the tool/release the port, restore approved wiring and return sole master ownership to the gateway before Chapters 4-7. A successful USB read proves only that test path, not gateway/platform acceptance.

G12 | Read one point independently and return serial ownership

Check	Judgment and Action
Expected behavior	The approved tool reads a fresh value matching the meter V display and releases the port afterward.
Precautions	Use USB only after approved master shutdown/power-isolated wiring. No production scans or writes.
Symptom and first check	No response: inspect the selected COM port/settings first; distinguish exceptions from wrong numeric values.
Ordered checks	1. Verify sole master/interface. 2. Inspect request. 3. For timeout check wiring/unit/settings. 4. For exceptions01/02 check FC/address. 5. Then inspect decode/scale.

Check	Judgment and Action
Evidence and acquisition	Export actual TX/RX/exception/value/time as G12_first_read.txt and retain same-period Meter_Voltage.jpg. Do not invent unsupported tool displays.
Retest or roll back	Record the independent result, close the tool and restore wiring/ownership; gateway/platform acceptance remains separate.

04 | Common Operations: Platform Device and Credentials

> Entry: access the correct platform tenant. Order: create the device -> obtain its token -> confirm MQTT host/port/topic -> locate Latest telemetry. Then use Chapter 5 for A or Chapter 6 for B, never both on the same serial port.

4.1 Create E-Meter-01

> Application: ThingsBoard in a PC browser. Open actual platform Web -> Entities -> Devices -> E-Meter-01, then the credentials/connectivity/telemetry view named at this step. Return to the same device or next subsection, not the router login.

P1 | Locate the device list, then create one device. Use the full-page location view before filling the dialog in Figure 4-1.

Log in with the tenant account supplied by the administrator. Navigate to **Entities -> Devices -> top-right "+" -> Add device**. Menu names can differ in newer versions. Confirm the correct tenant and device list; do not use a router Web account.

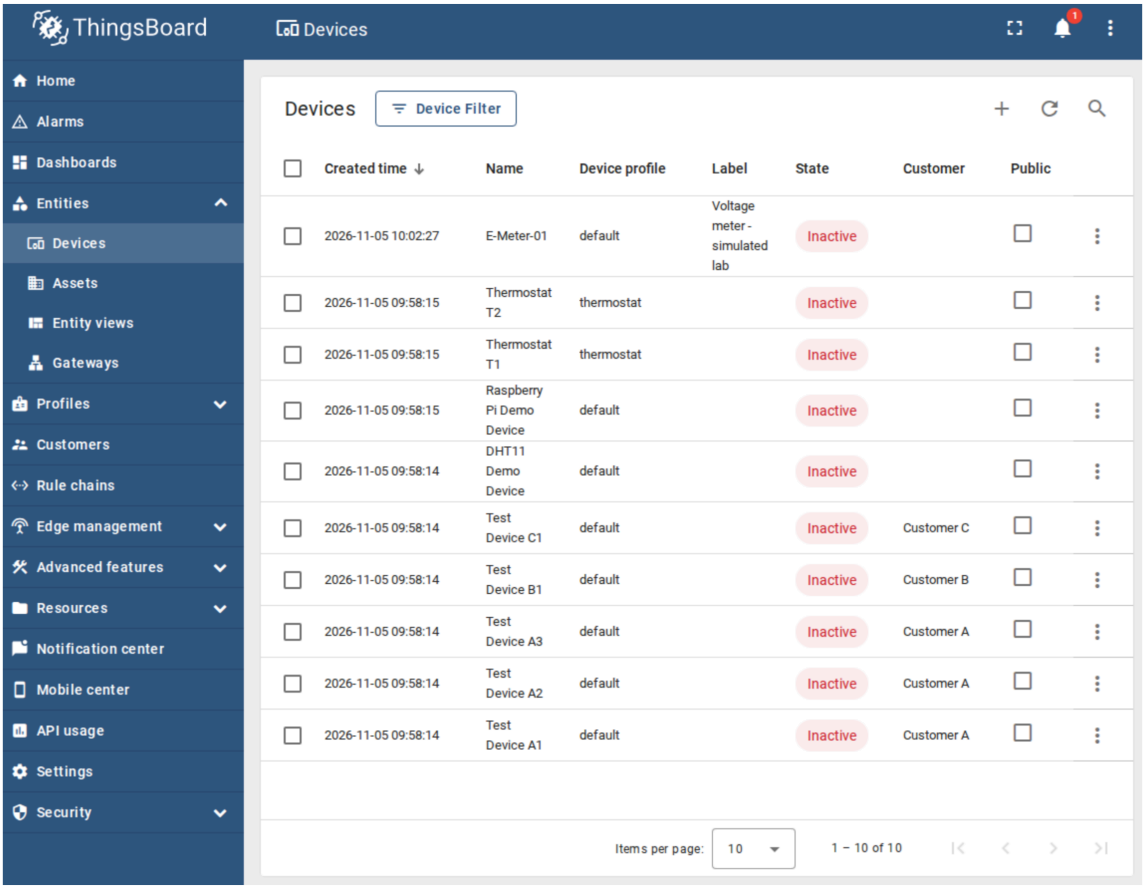


Figure 4-0 Platform location view: Entities/Devices navigation, device list and add control; isolated lab device.

Entry	Location in this view	Next action
Device navigation	Entities -> Devices on the left	Confirm the platform tenant/list, not the gateway Web login.
Add control	Plus at the upper-right of the device list	Use Figure 4-1 if the target does not exist; do not duplicate an existing device.
Target device	E-Meter-01 in the Name column	Use this same device for credentials, connectivity and Latest telemetry.

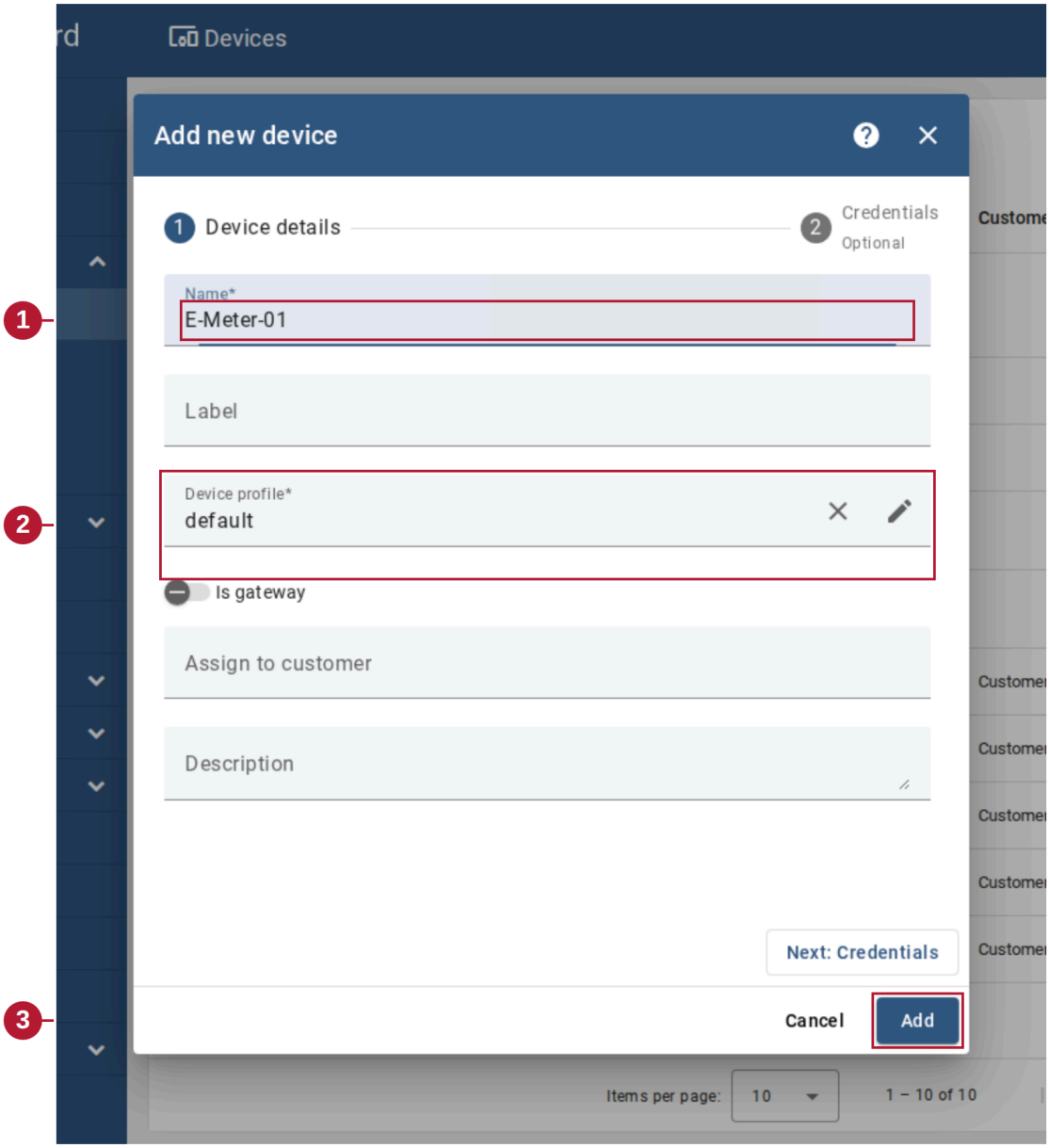


Figure 4-1 Native English ThingsBoard add-device dialog. The example form is not proof of a created field device.

Callout	Entry / action	Check after saving
1	Name: E-Meter-01. Assign each site meter a unique name.	Find the exact device in the correct project.
2	Device profile: default for this example; add cabinet/station context in label/description.	Leave "Is gateway" unchecked; this example uses the single-device telemetry API.
3	Click Add. If the name exists, open the correct existing device instead.	Confirm tenant, device name and ID in details.

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G13 | Create the device in the correct tenant

Check	Judgment and Action
Expected behavior	The device list contains the intended unique E-Meter-01 with correct tenant/device ID.
Precautions	This example uses single-device telemetry, not Is gateway. Physical gateway hardware and the ThingsBoard Gateway API role are different.
Symptom and first check	Missing Add/already exists: check role, tenant and list first; do not borrow another project's token.
Ordered checks	1. Confirm platform not router login. 2. Verify tenant permission. 3. Search name/ID. 4. Reuse the correct existing device or create with approval. 5. Save/read back.
Evidence and acquisition	Capture name/ID in G13_device.png and record tenant/device in the form. Request administrator audit evidence without account passwords.
Retest or roll back	Obtain this device's credentials after identity is verified; correct a wrong tenant rather than creating duplicates.

4.2 Obtain the Access Token, Not the User Password

> Application: ThingsBoard in a PC browser. Open actual platform Web -> Entities -> Devices -> E-Meter-01, then the credentials/connectivity/telemetry view named at this step. Return to the same device or next subsection, not the router login.

P2 | Obtain device-level credentials. Viewing/copying does not require changing the token.

In the device list, open the shield icon **Manage credentials**, or use device details. Select Access token and copy the token of **this device**. `LAB_ONLY_METER01_TOKEN` in the image is a public disposable lab token, not a production credential.

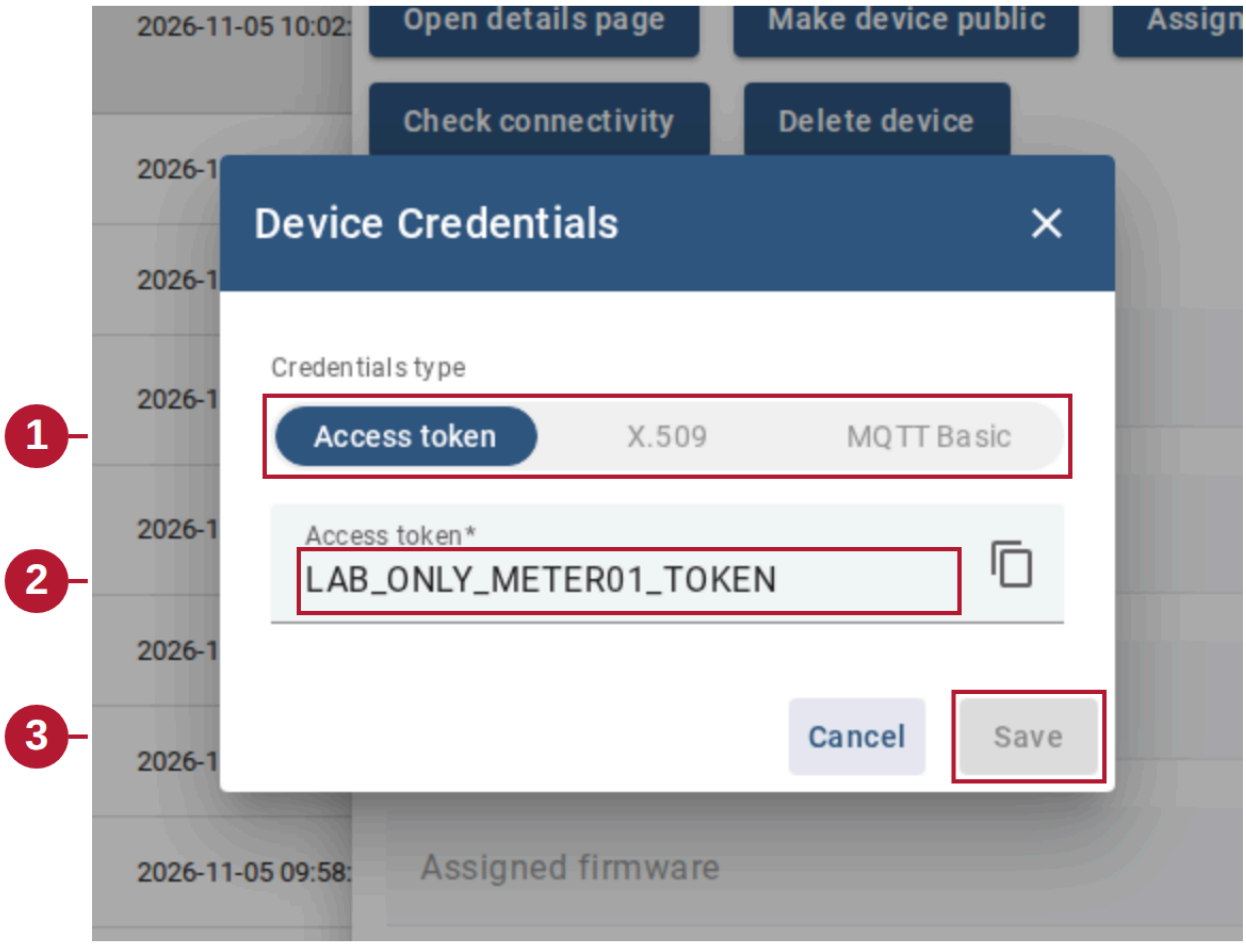


Figure 4-2 Native device credentials dialog. The displayed token belongs only to the isolated lab.

Callout	Action	Used later in
1	Confirm Access token credential type.	Do not apply unrelated X.509 or MQTT Basic fields.
2	Copy the complete token without spaces or line breaks.	Path A MQTT username; Path B TB_DEVICE_TOKEN environment variable.
3	Viewing/copying requires no change. Save only after creating/changing credentials.	Rotation invalidates old credentials; update the sender and reverify.

G14 | Obtain and hand over the device token securely

Check	Judgment and Action
Expected behavior	Access token is selected and the sender uses this device's complete token without spaces/newlines.
Precautions	The token is the MQTT username with empty password, not tenant email/password. The public lab token is not production; rotation affects old clients.
Symptom and first check	MQTT unauthorized or data on another device: inspect token ownership, complete copy and recent rotation first.

Check	Judgment and Action
Ordered checks	1. Confirm device ID. 2. Check type. 3. Copy fully into controlled settings. 4. Inspect admin authentication errors. 5. Synchronize approved senders after rotation.
Evidence and acquisition	Credential_Handover.txt contains custodian/reference/device ID only. Mask tokens in G14_credentials.png and obtain exact authentication errors from the platform administrator.
Retest or roll back	Continue after authorized authentication and matching target device; rotate exposed credentials securely rather than sharing them for diagnosis.

4.3 Confirm the Receiver Address and Data Page

> Application: ThingsBoard in a PC browser. Open actual platform Web -> Entities -> Devices -> E-Meter-01, then the credentials/connectivity/telemetry view named at this step. Return to the same device or next subsection, not the router login.

P3 | Record the endpoint and data-view location. Never enter the documentation PC loopback address on a remote gateway.

In device details select Check connectivity, then MQTT to inspect the generated connection example. The administrator must advertise an endpoint reachable by the gateway. A remote gateway cannot copy localhost or 127.0.0.1 as its destination.

This view retains the complete connectivity dialog. Acquisition was not running during capture, so its inactive/empty live-data area is not a field-failure result. Opening the dialog does not produce meter values. After starting the sender, verify fresh samples in Latest telemetry as Chapter 7 requires.

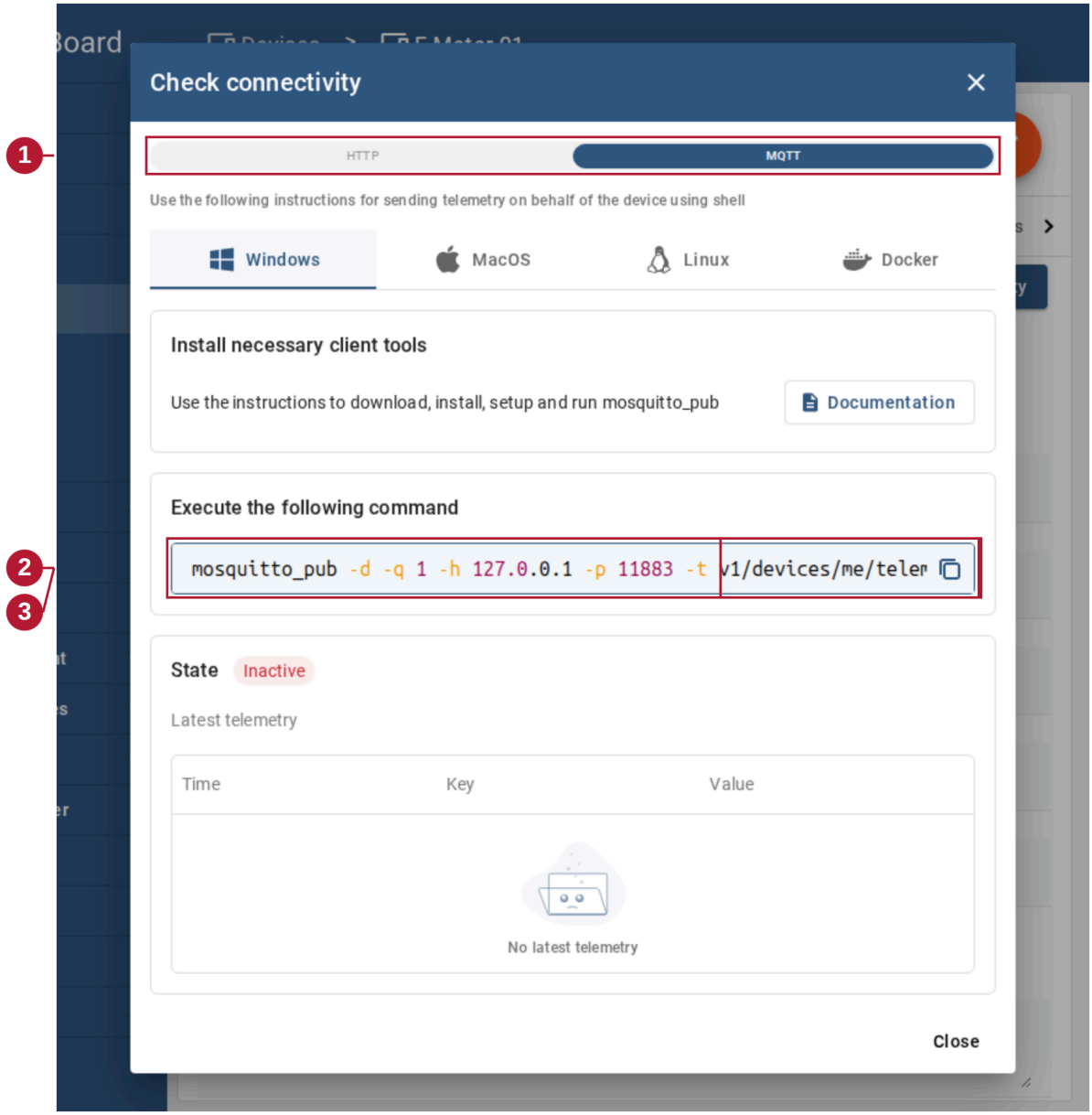


Figure 4-3 Native Check connectivity MQTT example. Documentation platform: 127.0.0.1:11883 on this PC, not a remote field destination.

Callout	Where to look / extract parameters	Do not confuse
1	Switch to MQTT and select the appropriate PC operating system.	Do not take an MQTT port from the HTTP curl example.
2	Read visible -h host and -p port arguments.	The image uses local lab address and port 11883; confirm the site's reachable advertised endpoint.
3	Use the right-side copy icon and inspect the complete command in a text editor: -u token, -t publish topic.	The command may extend beyond the visible area. Its temperature payload is a platform test, not a meter reading. Use Chapter 5 or 6 for acquisition.

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G15 | Extract endpoints instead of copying loopback values

Check	Judgment and Action
Expected behavior	Platform example, published endpoint and gateway-reachable address agree, with protocol/port confirmed.
Precautions	Figure4-3 uses historical loopback capture ports. Copy long commands to inspect fields; HTTP curl ports are not MQTT ports.
Symptom and first check	localhost/wrong-port endpoint: check the administrator-published business endpoint, not 127.0.0.1 on the gateway.
Ordered checks	1. Select MQTT. 2. Copy complete text securely. 3. Identify host/port/topic. 4. Compare administrator handover. 5. Strip the token before archiving.
Evidence and acquisition	Save sanitized address/transport/topic/owner in Platform_Endpoint.txt and selected protocol in G15_endpoint.png, hiding credentials.
Retest or roll back	Configure the gateway after confirming the real reachable MQTT endpoint, not a Web URL/loopback capture.

Item	Example	Source
Server	192.168.10.10	Administrator supplies an address reachable by the gateway; do not blindly extract it from a browser URL.
MQTT port / transport	1883 / plain MQTT, isolated network	Administrator or device Check connectivity example. Confirm production TLS port and CA separately.
MQTT username / password	Device Access Token / empty	Copy the previous token, not the tenant email/password.
Publish topic	v1/devices/me/telemetry	ThingsBoard device telemetry API, not an arbitrary plant/... topic.
Data page	Entities -> Devices -> E-Meter-01 -> Latest telemetry	Chapter 7 checks new values and timestamps here.

G16 | Confirm topic, ownership and data-view location

Check	Judgment and Action
Expected behavior	Use v1/devices/me/telemetry for token-bound E-Meter-01 and inspect voltage in its Latest telemetry.
Precautions	This is a ThingsBoard device topic, not an arbitrary broker. Other clouds require their authentication/topic/schema; raw RTU is not telemetry.
Symptom and first check	Online without points: inspect the correct device's Latest telemetry and outgoing JSON first, not a reset.

Check	Judgment and Action
Ordered checks	1. Match ID/token. 2. Verify host/topic. 3. Inspect voltage/type. 4. Check parser rejection. 5. If telemetry exists but dashboard is blank, inspect alias/key/window.
Evidence and acquisition	Capture G16_latest.png, save complete payload as G16_payload.json and request matching Platform_Receive.txt/Parser_Store.txt from the administrator.
Retest or roll back	Proceed with actual acquisition after parameters match; a platform connectivity-test payload is not meter acceptance.

The ThingsBoard device API is not a general-purpose arbitrary-topic broker. This example does not ask the platform to subscribe to an arbitrary topic. Do not use DTU port 5001 or Web port 8080 as MQTT. No downstream control topic is needed. One token identifies one platform device; multiple meters using it share that device unless a separate approved mapping is implemented.

05 | Path A: Gateway Acquisition -> MQTT Publishing

> Path A only. A1 fill the RTU connection -> A2 add/save the read-only command -> return/save the device -> A3 fill/save global MQTT -> A4 verify actual payload and fresh samples. Continue directly to Chapter 7; skip Chapter 6.

5.1 Add an RTU Connection; Save the Command Before the Device

> Application: gateway Web. Open actual management URL -> Applications -> Modbus acquisition. In 5.1 add device/command; in 5.2 return to global configuration on the parent. After Path A use Chapter 7, not a competing DTU on this port.

A1 -> A2 | Fill the connection, then open the command window. Save the command before saving the device. Save global settings last in 5.2.

Open **Application -> Modbus Collect -> Add Device**. Fill the connection first, then select Add Command. The native screenshots show offline form entries; nothing was submitted to a gateway.

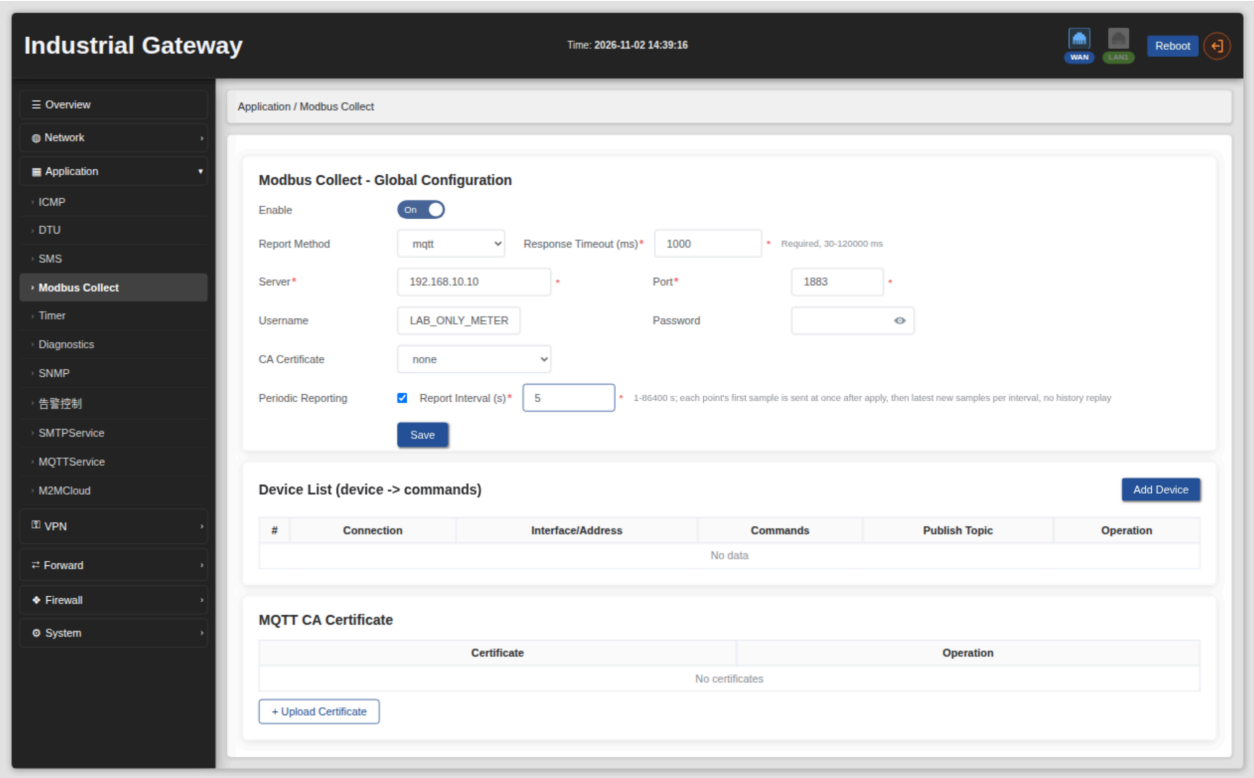


Figure 5-0 Gateway location view: Applications/Modbus acquisition, global settings, device list and save; offline unsaved form. Offline MT7981 native-source preview; no device access/save.

Operation area	Location in this view	Execution order
Current page	Applications -> Modbus acquisition on the left	Use Path A, never sharing its serial port with the DTU.
Device list	Add device in the middle of the page	A1 fill the RTU connection -> A2 save the command -> return/save the device.
Global configuration	Upper form and its Save button	Complete the device first; then configure MQTT and save globally in 5.2.

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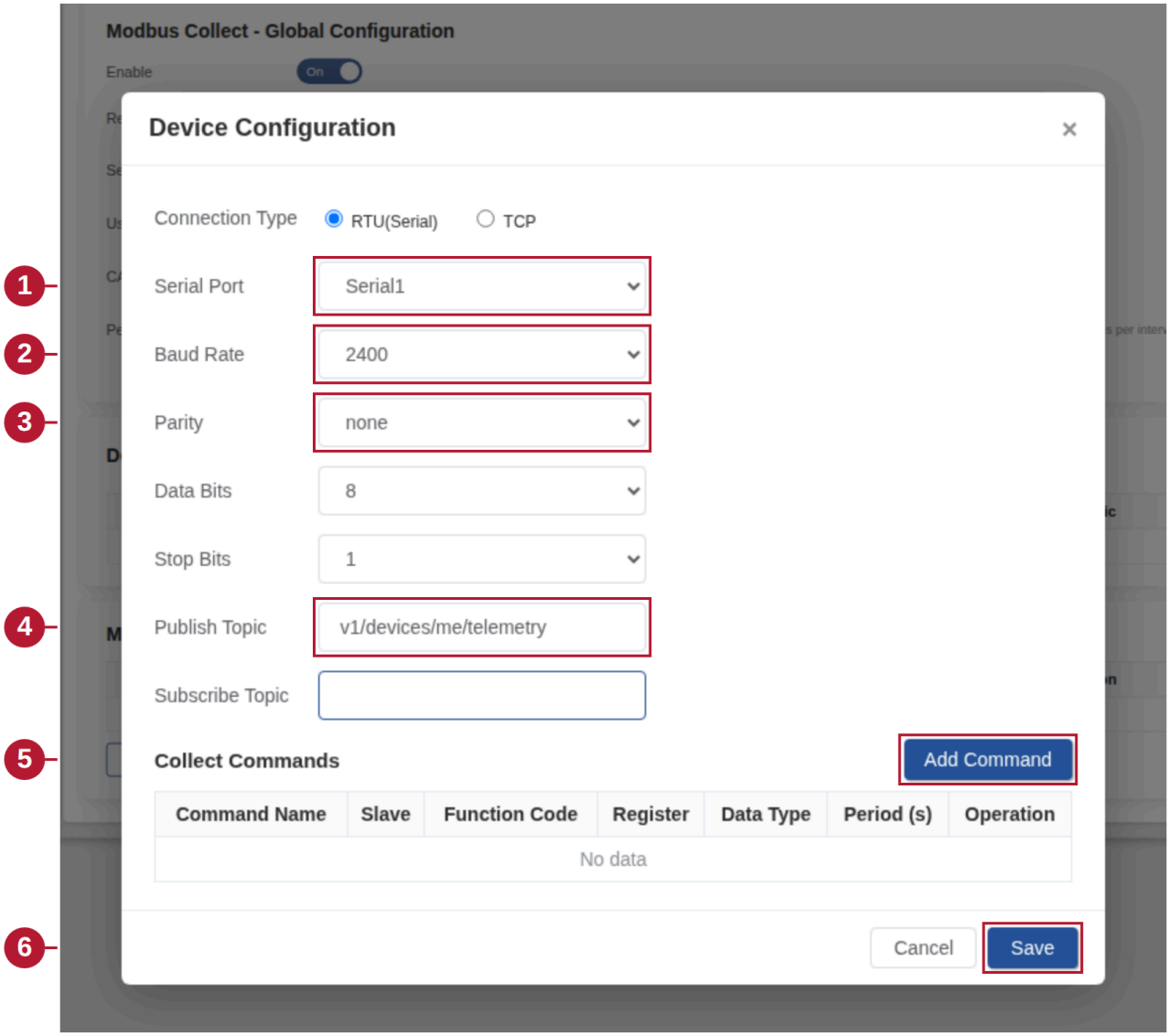


Figure 5-1 RTU connection for the verified Serial1 RS485 pair in this example. Offline MT7981 native-source preview; no device access/save.

Callout	Entry / action	Check
1	Connection RTU; Serial1.	Standard dual-RS485 build. Do not infer physical mapping from dropdown order.
2	Baud rate 2400.	Match the meter display.
3	Parity none, data bits 8, stop bits 1.	Match 8N1. Fill the unboxed data/stop fields too.
4	Publish topic v1/devices/me/telemetry; subscribe topic empty.	No remote writes. Match every slash and letter.
5	Select Add Command and use the next figure.	An unsaved connection is not a running connection.
6	Save the device after returning from the saved command.	Closing a dialog without saving loses that layer's edits.

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G17 | Save the RTU connection and verify its port

Check	Judgment and Action
Expected behavior	Figure 5-1 uses Serial1/2400/none/8/1 with the verified 2.6 A/B mapping and no competing PLC, Node-RED, DTU or remote-serial owner.
Precautions	Stop DTU for Path A. Serial1/2400/8N1 are example values; use actual project settings. Use the telemetry uplink and no downlink.
Symptom and first check	No data after adding a device: inspect RTU selection, mapping and ownership first, not merely the dialog's presence.
Ordered checks	1. Read back RTU/port/settings. 2. Check exclusive A/B ownership. 3. Verify uplink. 4. Save the next command. 5. Save device/global.
Evidence and acquisition	Retain complete G17_rtu.png, actual before/after exports and Meter_Settings.png. A save notification is not a runtime log.
Retest or roll back	Continue after saved connection/command readback; never run A/B together on production serial.

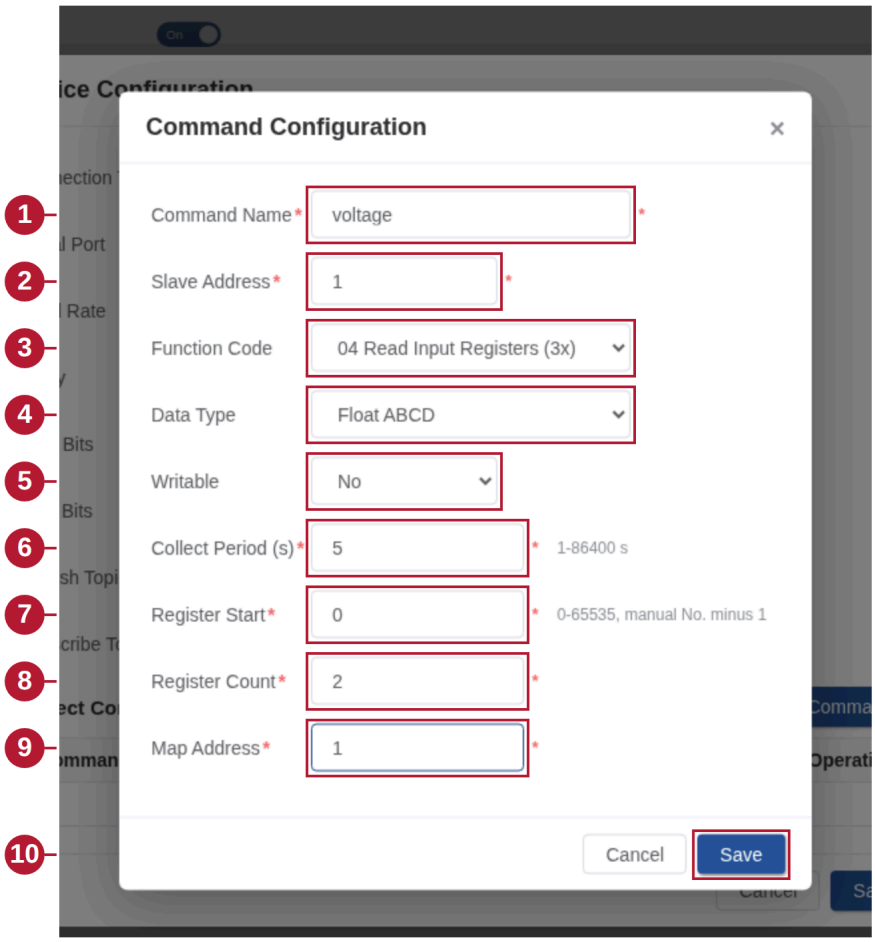


Figure 5-2 Read-only voltage command. This is configuration, not a gateway monitor showing a measured 230 V. The untranslated native address hint is explained in callout 7. Offline MT7981 native-source preview; no device access/save.

Callout	Field and entry	Reason / check
1	Command name voltage.	Defines the reported key; use voltage in the platform.
2	Slave address 1.	Match the meter ID.
3	Function 04, input registers.	Not 03; do not write metering settings.
4	Data type Float ABCD.	32-bit IEEE754. Match the delivered dropdown.
5	Writable: No.	Keep first-point acceptance read-only.
6	Acquisition interval 5 seconds.	Not the global report interval.
7	Register address 0.	PDU offset, not 30001 or 0x0000. The native hint is not universal.
8	Register quantity 2.	Two 16-bit registers form one voltage value.
9	Mapping address 1.	Mapping only, not the meter offset or MQTT key. Avoid conflicts.
10	Save command.	Return to Figure 5-1(6), save the device, then global settings.

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G18 | Enter the read-only command and save every layer

Check	Judgment and Action
Expected behavior	voltage/unit1/FC04/Float ABCD/PDU0/count2/read-only/5s are set; mapping address is planned separately.
Precautions	Mapping address is not the instrument address. Do not invent a missing scale field. Save command, device, then global.
Symptom and first check	Missing command/wrong value after readback: inspect save hierarchy, function, address and count first.
Ordered checks	1. Match point definition. 2. Save command/return. 3. Save/reopen device. 4. Save global. 5. Diagnose exceptions01/02 by FC/address, never by enabling writes.
Evidence and acquisition	Capture command fields and saved list as G18_command.png. Record FC/PDU/type/count/scale owner in Point_Map; obtain runtime timeouts from actual diagnostics/admin gateway_runtime.txt.
Retest or roll back	Start acquisition after full read-only readback; fix unsaved settings before changing platform credentials.

5.2 Configure Platform MQTT Access

> Application: gateway Web. Open actual management URL -> Applications -> Modbus acquisition. In 5.1 add device/command; in 5.2 return to global configuration on the parent. After Path A use Chapter 7, not a competing DTU on this port.

A3 | Fill global MQTT and complete the final save layer. Saved readback alone does not prove fresh acquisition.

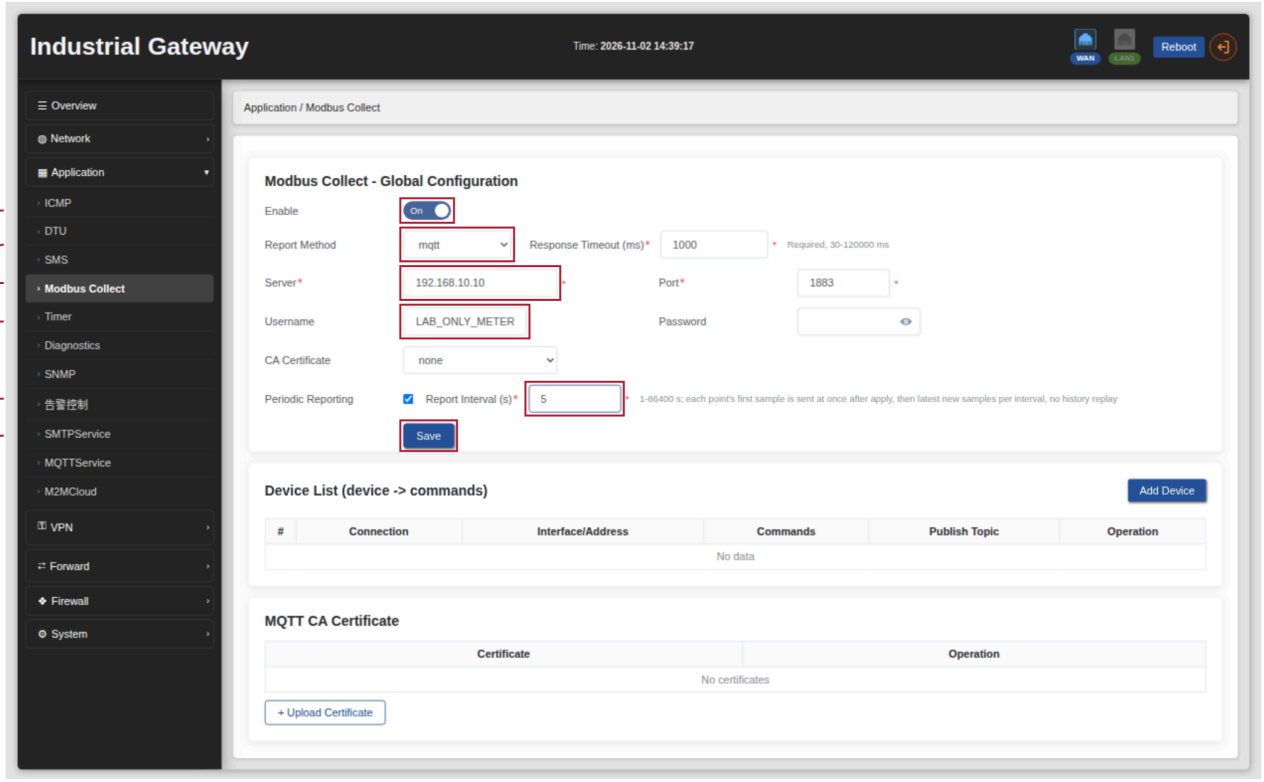


Figure 5-3 Global Modbus reporting configuration. Complete and save in numbered order. Offline MT7981 native-source preview; no device access/save.

Callout	Entry / action	Verification
1	Enable: On.	Confirm On, not merely that a device was added.
2	Report mode mqtt; response timeout 1000 ms.	Timeout waits for the slave; it is not the report interval.
3	Server 192.168.10.10; port 1883.	Replace with real access information. No http://, path or port in the server field.
4	Device token as username; empty password; CA none for the isolated test.	The input can show only part of the token; copy its full value. Apply actual production TLS requirements separately.
5	Enable periodic reporting; period 5 seconds.	Point acquisition is also 5 seconds. A first sample may report immediately, followed by fresh samples on cadence.
6	Save global settings, then reload and read them back.	Complete command -> device -> global saves. Check enable, topics, credentials and periods.

G19 | Enable acquisition and periodic MQTT publication

Check	Judgment and Action
Expected behavior	Enabled global MQTT, real endpoint/token/period read back correctly and at least three fresh samples reach the platform.
Precautions	Response timeout ms is not report period s. Acquisition/report periods differ; production TLS requires delivered support, not only a new port.
Symptom and first check	Saved but empty/online without point: inspect global enable, periods, MQTT authentication and actual acquisition errors first.
Ordered checks	1. Read back layers. 2. Check instrument timeout/port conflict. 3. Check MQTT rejection. 4. Verify topic/JSON. 5. Inspect fresh timestamps on the right device; change one item at a time.
Evidence and acquisition	Capture nonsensitive global fields in G19_global.png; obtain actual gateway_runtime.txt and matching Platform_Receive.txt with device/rejection details.
Retest or roll back	Continue after three fresh acquisition-correlated cycles; MQTT online alone proves a connection.

5.3 Verify the Actual Payload Shape

> Application: gateway Web. Open actual management URL -> Applications -> Modbus acquisition. In 5.1 add device/command; in 5.2 return to global configuration on the parent. After Path A use Chapter 7, not a competing DTU on this port.

A4 | Check valid acquisition, publishing and platform persistence separately.

The retained baseline MQTT test sent this **simulated payload with the native acquisition shape** and read voltage back from the real ThingsBoard API. It is not a capture from a physical gateway. `id` is a simulated identity; `ts` was generated dynamically in seconds during the test.

```
{"id":"SIMULATED_GATEWAY","voltage":230.0,"ts":1793844147}
```

The command name defines the point key. Native output may include id; inspect your actual message. Values may be numbers, arrays or other documented types depending on the command; do not force every case into a scalar. **Float32 with count 2 here represents one voltage value.**

Message / platform item	Interpretation	Common mistake
voltage	Numeric; project unit V; scale 1.	Treating numeric strings, arrays and nested objects as equivalent.
id	Optional gateway identity information.	This API identifies the platform device by token, not by auto-creating a device from id.

Message / platform item	Interpretation	Common mistake
Flat ts	Native acquisition time in Unix seconds; saved as a separate telemetry key in this test.	Not the ThingsBoard ts/values envelope. The voltage timestamp is server receive time.
Unit	No voltage_unit in this native payload; V is the point definition.	Configure V in a dashboard rather than claiming the gateway supplied that key.

G20 | Verify raw JSON, scale and time semantics

Check	Judgment and Action
Expected behavior	Actual voltage is numeric engineering data with scale1/V; a flat ts is not the platform timestamp envelope.
Precautions	The SIMULATED_GATEWAY sample is not a field capture; other acquisition modules may return arrays/nesting.
Symptom and first check	Tenfold error or only id/ts: first compare actual JSON, register scale and platform conversion/path.
Ordered checks	1. Obtain valid raw bytes/value. 2. Check decode. 3. Apply scale once. 4. Compare outgoing JSON/storage. 5. Check dashboard units/window; never guess x0.1 to match the display.
Evidence and acquisition	Save payload-only G20_payload.json, scale ownership in Point_Map and administrator parser/conversion results in Parser_Store.txt with the actual map.
Retest or roll back	Pass when raw/decode/send/store/display are explainable; mark unknown quality rather than publishing a fixed stale value.

If sample-time storage is required, use an approved receiver/adapter to convert seconds to milliseconds and form `{"ts":milliseconds,"values":{"voltage":number}}`. Path B demonstrates the envelope. Seconds interpreted as milliseconds produce dates near 1970; changing a port cannot fix a JSON-shape mismatch.

5.4 Decide Whether the First Point Is Working

> Application: gateway Web. Open actual management URL -> Applications -> Modbus acquisition. In 5.1 add device/command; in 5.2 return to global configuration on the parent. After Path A use Chapter 7, not a competing DTU on this port.

Path A gate | A valid fresh first point and advancing platform timestamps; continue directly to Chapter 7.

After saving, wait at least three acquisition/report periods and inspect voltage and its timestamp in Chapter 7. Record the physical meter V display and current time. An unchanged value with advancing time may be stable voltage; a non-advancing timestamp is not evidence of continued acquisition.

The native command page mainly configures reads; no invented Read Test button or successful 230 V result box has been added. To prove the meter separately, release the gateway port first and use a matching isolated USB-RS485 adapter with the manufacturer's software. Close that software before returning ownership to the gateway; avoid concurrent masters.

G21 | Prove reading, publication and reception separately

Check	Judgment and Action
Expected behavior	At least three cycles have valid fresh samples/platform times matching same-period instrument values.
Precautions	The native command page configures rather than monitors readings. Do not invent a read-test control; use the approved independent procedure in Section3.3 when needed.
Symptom and first check	No platform update: inspect acquisition-response evidence first; if reads succeed, inspect publication rather than repeatedly changing register definitions.
Ordered checks	1. Check poll period. 2. Obtain new sample/error evidence. 3. Inspect MQTT send/auth. 4. Inspect platform reception/field. 5. Compare same-period readings. Stable values may repeat, timestamps must advance.
Evidence and acquisition	Obtain G21_sample.txt from actual diagnostics/admin, G21_platform.png with identity/value/update time and same-period instrument evidence in Readings; mark unavailable data pending.
Retest or roll back	Accept the field chain only with all three evidence layers; simulation is not gateway acceptance.

06 | Path B: Server Listener -> DTU Transport -> Poll and Publish

> Path B only. B1 stop other serial masters and confirm direction -> B2 start the server and confirm LISTEN -> B3 configure/save the DTU and confirm CONNECTED -> B4 verify TX/valid RX and platform publishing. Then use Chapter 7. CONNECTED alone is not a meter-read pass.

6.1 Connection Direction and Responsibilities

> Application: polling PC/server, not gateway SSH. Open PowerShell in supplied Tools and inspect its terminal/server_bridge.jsonl. Return to 6.3 for DTU settings; use Chapter 7 for platform verification afterward.

B1 | Confirm sole ownership and direction: the DTU connects; the server polls over that same connection.

The **DTU is a TCP Client connecting to server port 5001**. After accepting it, the server sends an RTU request on that same connection. The DTU forwards it to serial and returns the meter response. For cellular NAT, the DTU initiates toward a reachable server; this does not require exposing the field gateway through public port forwarding.

The server needs a reachable address and listener. Use an approved VPN or other protected path over public networks. This raw-TCP example provides no production DTU identity scheme: do not expose port 5001 directly to the Internet. The supplied program handles one session and one read-only point, not a multi-customer production gateway service.

G22 | Specify reverse connection and carried RTU format

Check	Judgment and Action
Expected behavior	The server listens, DTU connects as TCP Client, and request/response use that same socket.
Precautions	Binary RTU has unit/CRC, not ASCII hex or Modbus TCP MBAP. The single-session example is not a public multi-DTU service.
Symptom and first check	DTU online without data: first inspect actual server TX; a listener/echo tool does not poll a passive meter.
Ordered checks	1. Confirm roles. 2. Check reachable listener. 3. Inspect same-socket TX. 4. Check RTU format. 5. Diagnose serial/response without dialing into a cellular-NAT gateway.
Evidence and acquisition	Record listener/initiator/format in G22_direction.txt and correlate CONNECTED/TX/RX/errors in server_bridge.jsonl. Obtain actual DTU status rather than drawing a successful state.
Retest or roll back	Continue with confirmed direction/format/master; use an approved separate implementation for MBAP or other modes.

6.2 B2: Start the Server Listener and Polling Program First

> Application: polling PC/server, not gateway SSH. Open PowerShell in supplied Tools and inspect its terminal/server_bridge.jsonl. Return to 6.3 for DTU settings; use Chapter 7 for platform verification afterward.

B2 | Start the server first. Expect at least LISTEN. No CONNECTED before enabling the DTU is normal. Keep the terminal running and continue to 6.3.

`dtu_readonly_bridge.py` uses pinned PyModbus for RTU framing/CRC and Paho for MQTT. On the Windows PC/server running the receiver, open PowerShell in the supplied `Tools` directory and create an isolated environment:

TXT/JSONL files are created in the Tools working directory. Use Get-Location to confirm it. Inspect G26_install.txt for installation errors and server_bridge.jsonl for LISTEN/CONNECTED/TX/RX_CHUNK/RX_FRAME/RX_AND_PUBLISH. Stop with Ctrl+C, then Remove-Item Env:TB_DEVICE_TOKEN -ErrorAction SilentlyContinue. RX_FRAME is unvalidated; even RX_AND_PUBLISH still needs platform persistence verification.

```
py -3 -m venv .venv
.\.venv\Scripts\python.exe -m pip install -r requirements.txt 2>&1 |
  Tee-Object -FilePath .\G26_install.txt
$env:TB_DEVICE_TOKEN="REPLACE_WITH_ACTUAL_DEVICE_TOKEN"
.\.venv\Scripts\python.exe dtu_readonly_bridge.py bridge `
  --bind 192.168.10.10 --port 5001 `
  --mqtt-host 192.168.10.10 --mqtt-port 1883 `
  --unit 1 --period 5 2>&1 |
  Tee-Object -FilePath .\server_bridge.jsonl
```

G26 | Prepare the server environment and start securely

Check	Judgment and Action
Expected behavior	Pinned dependencies install in a separate environment; token stays in a controlled environment variable; MQTT authenticates before LISTEN appears.
Precautions	Do not install on the gateway. MQTT failure prevents the later DTU listener; use pinned requirements rather than arbitrary upgrades.
Symptom and first check	No LISTEN: first inspect startup/MQTT errors; ModuleNotFound points to the environment, Address in use to listener ownership.
Ordered checks	1. Match interpreter/pip. 2. Install requirements. 3. Set a nonempty device token. 4. Check MQTT endpoint/rejection. 5. Inspect5001 binding/ownership.
Evidence and acquisition	Save errors/versions in G26_install.txt without tokens. In PowerShell append 2>&1 | Tee-Object -FilePath .\server_bridge.jsonl to the invocation to retain output in the working directory.
Retest or roll back	Connect the DTU only after dependencies/auth/LISTEN succeed; do not disable the firewall or kill unknown processes.

The trailing PowerShell backtick continues the command; do not put spaces after it. On Linux use `python3 -m venv .venv`, `.venv/bin/python` and `export TB_DEVICE_TOKEN='ACTUAL_TOKEN'`; keep the same arguments but use backslash continuation or one line. Replace the listening interface and MQTT host independently if they are different servers. Keep the token out of source code and public screen recordings; clear the environment variable afterward.

Service item	Example	Successful observation
Listener / direction	PC/server TCP 5001; DTU -> server.	LISTEN followed by CONNECTED. DTU must connect to this listener.
Polling	Unit 1, FC04, address 0, count 2; every 5 s; response deadline 3 s.	One TX and one RX_AND_PUBLISH per valid poll. No concurrent masters.
Format	Binary RTU frame including station and CRC.	Not ASCII hex text, no CR/LF and no Modbus TCP MBAP header.

Service item	Example	Successful observation
MQTT	Platform host/port, token username, v1/devices/me/telemetry.	Example server uses QoS1, retain=false. Do not attribute that QoS to native gateway publishing without checking the firmware.
Period / time	Publish after each valid response, normally about every 5 s; slow responses/reconnects add delay.	UTC milliseconds when the server receives a valid reply, not the meter's internal sampling time.

G27 | Check LISTEN, CONNECTED and TX in order

Check	Judgment and Action
Expected behavior	LISTEN is followed by the actual DTU's CONNECTED, then periodic TX/valid RX_AND_PUBLISH.
Precautions	A probe PC can occupy the single-session tool; probe CONNECTED is not a field-device acceptance result.
Symptom and first check	CONNECTED without data: first inspect TX and peer identity. TX without RX returns diagnosis to DTU serial/instrument.
Ordered checks	1. Verify service/process. 2. Match peer. 3. Remove probe occupancy. 4. Inspect correct RTU TX. 5. Check timeout/exception/disconnect; echo is not polling.
Evidence and acquisition	Obtain server_bridge.jsonl via terminal Tee-Object/admin logs, retaining listener/peer/TX/session closure/time. Save listener process/port in G27_listener.txt.
Retest or roll back	Verify the platform after the real DTU produces valid replies; TCP reachability proves transport only.

Have the administrator start the listener and restrict TCP 5001 to approved source networks. On the server use `Get-NetTCPConnection -LocalPort 5001 -State Listen`; from an authorized peer use `Test-NetConnection 192.168.10.10 -Port 5001`. This proves TCP reachability, not meter communication. A probe can leave a short CONNECTED/disconnected entry in the log.

6.3 B3: Configure the DTU, Then Check Connection and Serial

> Application: gateway Web. Open actual management URL -> Applications -> DTU -> Serial verified in 2.6. Start the server LISTEN first. Save/refresh this page, then return to the 6.2 server terminal for connection/bytes.

B3 | Configure the DTU next: protocol/role -> server/timing -> serial -> save. Then check CONNECTED and TX on the running server.

Open **Application -> DTU -> Serial1**. Stop Path A ownership of Serial1 and record existing settings. Do not overwrite a running production service with example values.

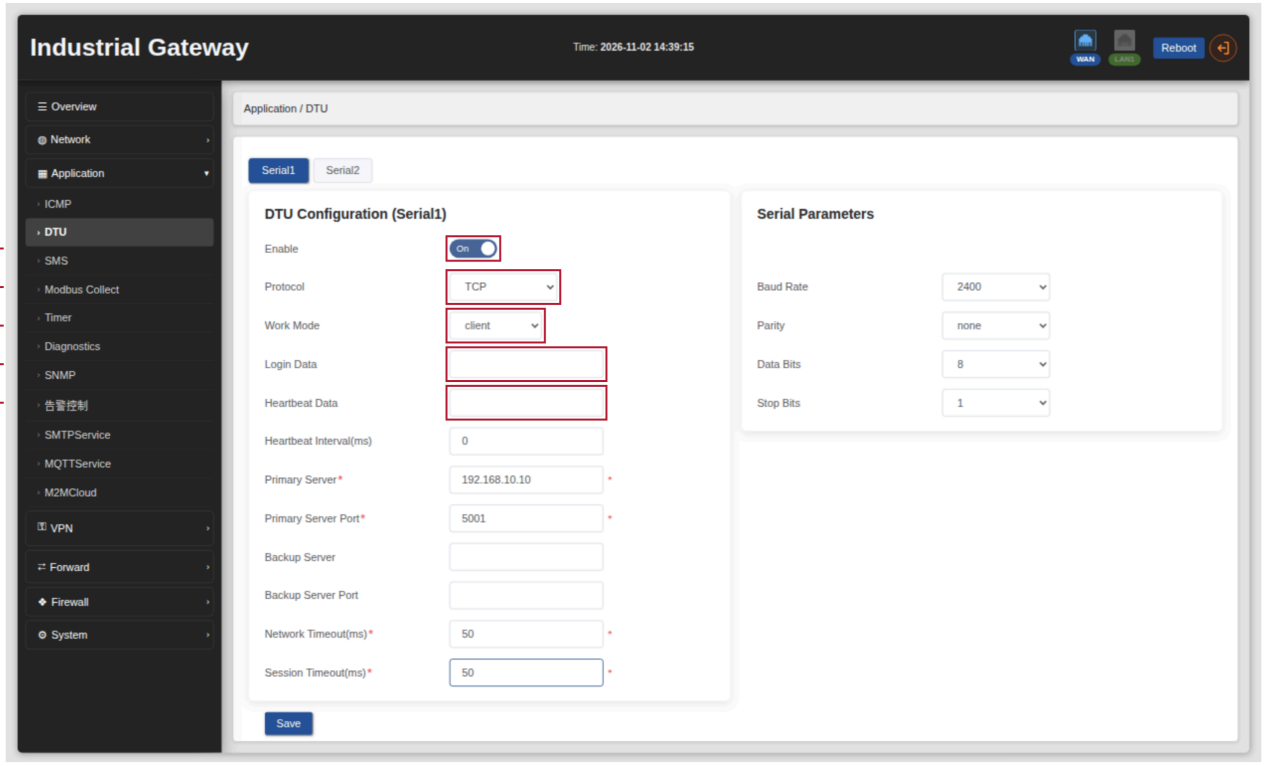


Figure 6-1 DTU protocol, role and extra-packet settings. Offline MT7981 native-source preview; no device access/save.

Callout	Entry	Why
1	Enable On.	Save after completing server and serial settings.
2	Protocol TCP.	Not MQTT and not the separate DTU MODBUS conversion mode.
3	Work mode client.	DTU initiates; server keeps listening.
4	Login data empty.	Do not insert registration bytes into the RTU stream.
5	Heartbeat data empty, interval 0.	Exclude extra bytes in the first test; design connection health separately.

G23 | Remove extra packets that corrupt RTU

Check	Judgment and Action
Expected behavior	TCP/client has empty login/heartbeat payloads and heartbeat interval0; the stream contains the intended RTU traffic.
Precautions	Record originals and stop Path A. Empty heartbeat applies to this first test; production keepalive/identity needs its own design.
Symptom and first check	CRC/Extra bytes/text in first frame: inspect DTU login/heartbeat and multiple masters first; never bypass CRC.
Ordered checks	1. Preserve extras. 2. Clear/save/read back for this example. 3. Exclude another master. 4. Inspect raw RX hex. 5. Then diagnose serial/electrical/framing.

Check	Judgment and Action
Evidence and acquisition	Capture G23_dtu_mode.png and retain complete error/RX bytes in server_bridge.jsonl to identify extra registration text; sanitize sensitive registration data.
Retest or roll back	Continue only with the approved validated stream; restore original registration/keepalive when returning to production.

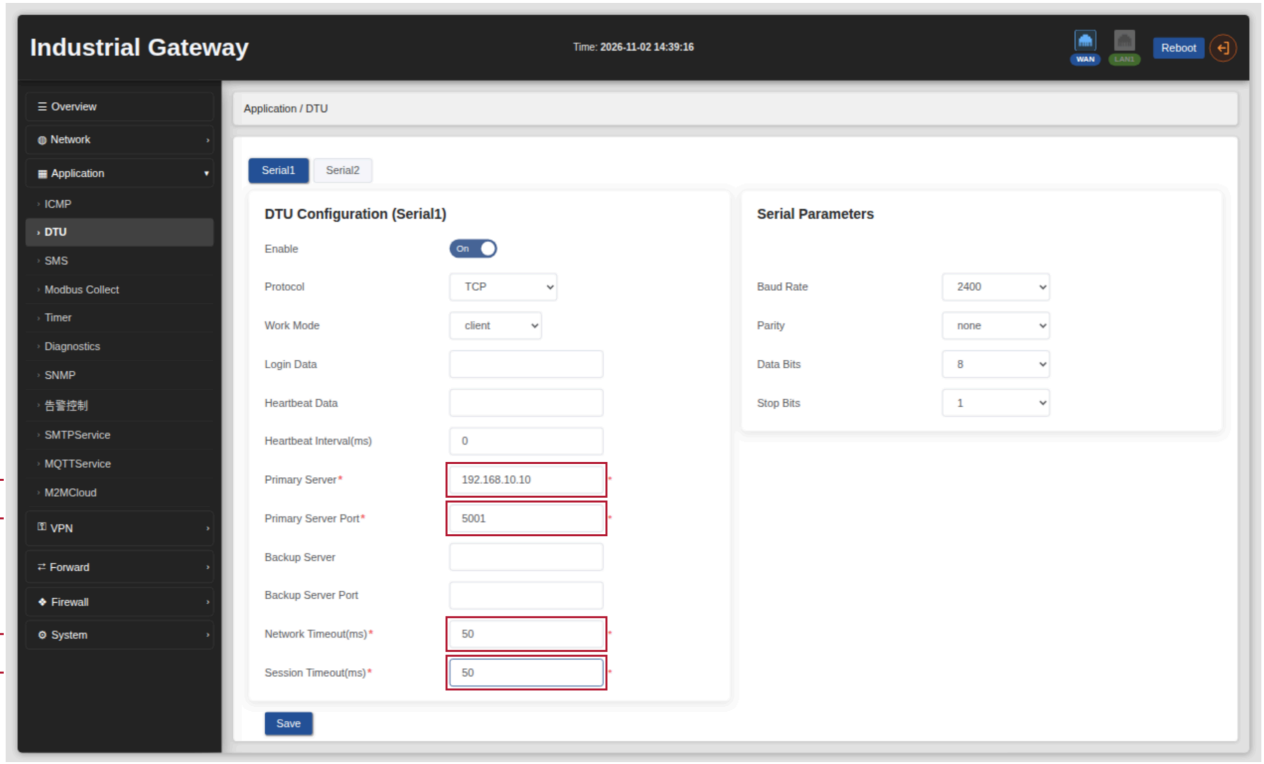


Figure 6-2 DTU server and framing-related timing. Both 50 values are milliseconds. Offline MT7981 native-source preview; no device access/save.

Callout	Entry	Check
1	Primary server 192.168.10.10.	Host running the polling program, not the platform Web URL.
2	Primary port 5001; backup host/port empty.	Match the real listener. Backup switching needs separate session/polling design.
3	Network timeout 50 ms.	DTU forwarding/framing setting, not the three-second meter-response timeout.
4	Session timeout 50 ms.	Follow this firmware's field meaning; not a 50-second reconnect or poll interval.

G24 | Set server and millisecond timing fields

Check	Judgment and Action
Expected behavior	The primary server is the reachable poller, matching listener5001; both50 values use this reference form's millisecond semantics.
Precautions	Do not interpret50ms as a50-second reconnect or the3-second instrument timeout. Verify units on other firmware.
Symptom and first check	Repeated connect/disconnect/incomplete receive: inspect actual units, target listener and session logs before increasing every timeout.
Ordered checks	1. Check host/port. 2. Exclude unintended backup target. 3. Check field units. 4. Separate transport framing, instrument timeout and poll period. 5. Adjust/save/read back one item.
Evidence and acquisition	Capture field names/units/readback as G24_dtu_network.png; inspect connection frequency and SESSION_CLOSED reason/time in server_bridge.jsonl and attach actual firmware inventory.
Retest or roll back	Pass after correct readback, stable connection and valid RX; restore known-stable settings on failure.

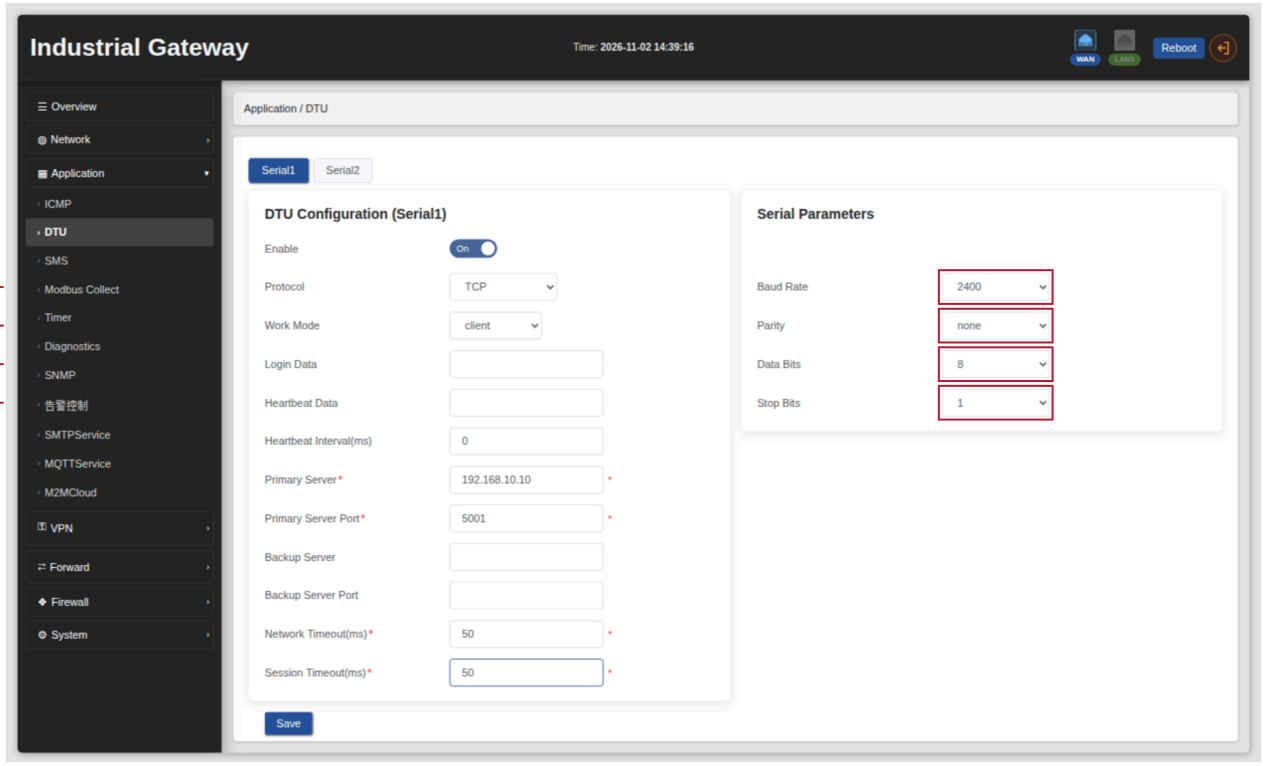


Figure 6-3 DTU serial settings must match the meter. Offline MT7981 native-source preview; no device access/save.

Callout	Field	Example
1	Baud rate	2400.
2	Parity	none.
3	Data bits	8.
4	Stop bits	1.

G25 | Save DTU serial settings without changing another instance

Check	Judgment and Action
Expected behavior	Logical port matches physical terminals and actual serial settings; saved values persist after refresh.
Precautions	Configure only the intended instance and stop native polling. Remote TCP connectivity does not prove serial correctness.
Symptom and first check	TX but no RX: check this page, meter settings/terminals, then station/request before MQTT credentials.
Ordered checks	1. Match physical/logical port. 2. Match serial parameters. 3. Verify station/sole master. 4. Check A/B and meter supply. 5. Retain timeout/exception text.
Evidence and acquisition	Save selected instance/settings in G25_serial.png, compare Meter_Settings.png and terminal photos, and retain TX/timeout in server_bridge.jsonl.
Retest or roll back	Continue after correct-instance readback and repeated valid replies; restore an accidentally changed instance from backup.

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Select Save after configuring network and serial settings. Reload and confirm Serial1, TCP, client and the correct destination. Enable only the required DTU instance; do not accidentally edit another port.

If the actual DTU serial panel also has Work Mode/electrical interface, retain RS485 for the 300L/1010 RS485 tasks; verify the actual 280 hardware option. Confirm unmarked data bits, stop bits and interface too, not only numbered fields.

6.4 One Actual Software Request and Response

> Application: polling PC/server, not gateway SSH. Open PowerShell in supplied Tools and inspect its terminal/server_bridge.jsonl. Return to 6.3 for DTU settings; use Chapter 7 for platform verification afterward.

B4 | Match one request, valid complete response, decoded value and MQTT publishing. Received bytes alone do not prove a correct value.

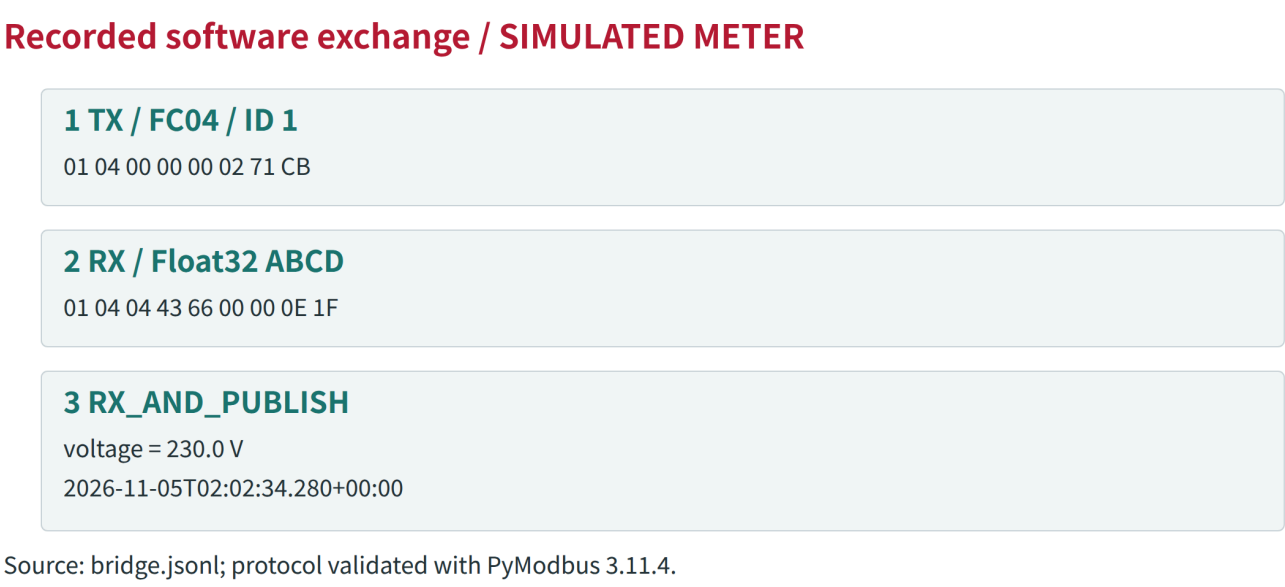


Figure 6-4 Extract from the isolated software exchange log. Values are simulated, not physical-meter readings.

Callout	Bytes / data	Meaning
1	TX: 01 04 00 00 00 02 71 CB	Station 01, FC04, address 0000, count 0002, then two CRC bytes.
2	RX: 01 04 04 43 66 00 00 0E 1F	Byte count 04; float bytes 43 66 00 00 mean 230.0; final two bytes are CRC.
3	voltage=230.0, unit V, followed by MQTT reporting.	Upload only after CRC, station, function and length validation; arbitrary received bytes are not a reading.

G28 | Inspect one RTU request and valid response

Check	Judgment and Action
Expected behavior	TX is01 04 00 00 00 02 71 CB; the known230V RX is01 04 04 43 66 00 00 0E 1F with valid CRC/unit/FC/length.

Check	Judgment and Action
Precautions	Voltage bytes vary;230 is not guaranteed. PyModbus handles frames; a TCP recv is not one RTU frame. This example expects a fixed9-byte reply.
Symptom and first check	01 84 exception, CRC failure or extra bytes: inspect raw TX/RX and heartbeat additions before decoding, not a forced first9-byte slice.
Ordered checks	1. Confirm binary not ASCII. 2. Check unit/FC/byte count. 3. Validate CRC. 4. For exceptions01/02 check FC/address; follow manufacturer for others. 5. Decode valid ABCD Float32.
Evidence and acquisition	Retain same-session TX/RX/time/error in G28_exchange.txt. In server_bridge.jsonl, RX_CHUNK is a fragment, RX_FRAME awaits validation, and RX_AND_PUBLISH means this example validated and acknowledged publication. Hex represents binary; do not transmit it as ASCII.
Retest or roll back	Publish only a valid new frame matching known meaning; reject invalid/missing frames without republishing an old value.

Real reply bytes change with voltage. An exception frame such as `01 84 ...` is not a Float32 value; record its exception code. TCP may split or combine data: one recv call is not necessarily one frame.

Path B publishes this shape:

```
{"ts":1793844150000,"values":{"voltage":230.0,"voltage_unit":"V"}}
```

G29 | Publish decoded values and separate acknowledgement from storage

Check	Judgment and Action
Expected behavior	Valid reply produces dynamic millisecond ts, numeric voltage and V; RX_AND_PUBLISH correlates with a fresh value on the intended platform device.
Precautions	The event proves parsing and MQTT publication acknowledgement, not platform rule/database acceptance. ts is server response-completion time, not internal meter sampling time.
Symptom and first check	RX_AND_PUBLISH without a platform point: inspect token/device, topic and platform parsing/time first, not serial settings.
Ordered checks	1. Obtain payload. 2. Check millisecond ts/values. 3. Match device/voltage. 4. Inspect reception/conversion/storage. 5. Exclude dashboard alias/window errors.
Evidence and acquisition	Save the payload object inside RX_AND_PUBLISH as G29_payload.json, not the full log record. Obtain matching Parser_Store.txt from admin and capture actual persistence in G29_latest.png.
Retest or roll back	Pass when log/payload/fresh platform value correlate; correct rejection causes without fake values to keep a device online.

The displayed timestamp illustrates the structure; the program generates it dynamically. ts is milliseconds. The receiver adds voltage_unit; it is not a native meter register. On timeout, invalid frame or disconnect, the example closes the session and waits for DTU reconnection rather than publishing old data as new. It promises no historical buffer, replay or automatic startup. Production needs service supervision, log rotation, identity, queues and monitoring.

6.5 Reproduce the Software Part Without Hardware

> Application: polling PC/server, not gateway SSH. Open PowerShell in supplied Tools and inspect its terminal/server_bridge.jsonl. Return to 6.3 for DTU settings; use Chapter 7 for platform verification afterward.

Optional software rehearsal | Use simulate only without physical equipment; stop it before physical acceptance.

On an isolated PC, run bridge with the actual listener and MQTT access information, then start the simulator in another PowerShell window. For a single PC, the listener can be 127.0.0.1:5001. Use your actual platform port, not the documentation-only ports by assumption.

```
.\.venv\Scripts\python.exe dtu_readonly_bridge.py simulate `
  --host 127.0.0.1 --port 5001 --value 230 --count 6 --split
```

simulate emulates both a meter response and DTU outbound connection; it never opens a physical serial port. --split deliberately fragments the response. For field acceptance, stop the simulator and connect the real DTU. A successful simulation is not a hardware pass.

G30 | Record simulation separately from physical tests

Check	Judgment and Action
Expected behavior	Simulator records hardware=false and exercises split replies; it is stopped for physical tests with the real DTU peer.
Precautions	simulate models both meter and DTU without accessing a serial port; it proves no wiring, firmware, cellular or actual230V reading.
Symptom and first check	A fixed230 platform value: first exclude a still-running simulator, not assume a stable physical supply.
Ordered checks	1. Inspect process invocation. 2. Check SIMULATED events/peer. 3. Stop simulator and verify test updates stop. 4. Connect actual DTU. 5. Record new TX/RX and contemporaneous meter value.
Evidence and acquisition	Retain events/peer/time in separate G30_simulation.txt/G30_physical.txt; separate software and physical outcomes in Verification_Matrix.
Retest or roll back	Do field acceptance only with confirmed provenance; without hardware retain software evidence and mark physical tests pending.

07 | Common Acceptance: Values, Time and Recovery

> Entry: A or B produces valid fresh data. Order: inspect the correct device -> compare same-period value/unit/time -> test source/uplink recovery. Exit: at least three physical comparison records and the first fresh recovery sample; archive evidence in Chapter 8.

7.1 Verify Storage in Latest Telemetry

> Application: ThingsBoard in a PC browser. Open actual platform Web -> Entities -> Devices -> E-Meter-01, then the credentials/connectivity/telemetry view named at this step. Return to the same device or next subsection, not the router login.

Acceptance 1 | Confirm device, field, value and update time. Online state does not replace telemetry.

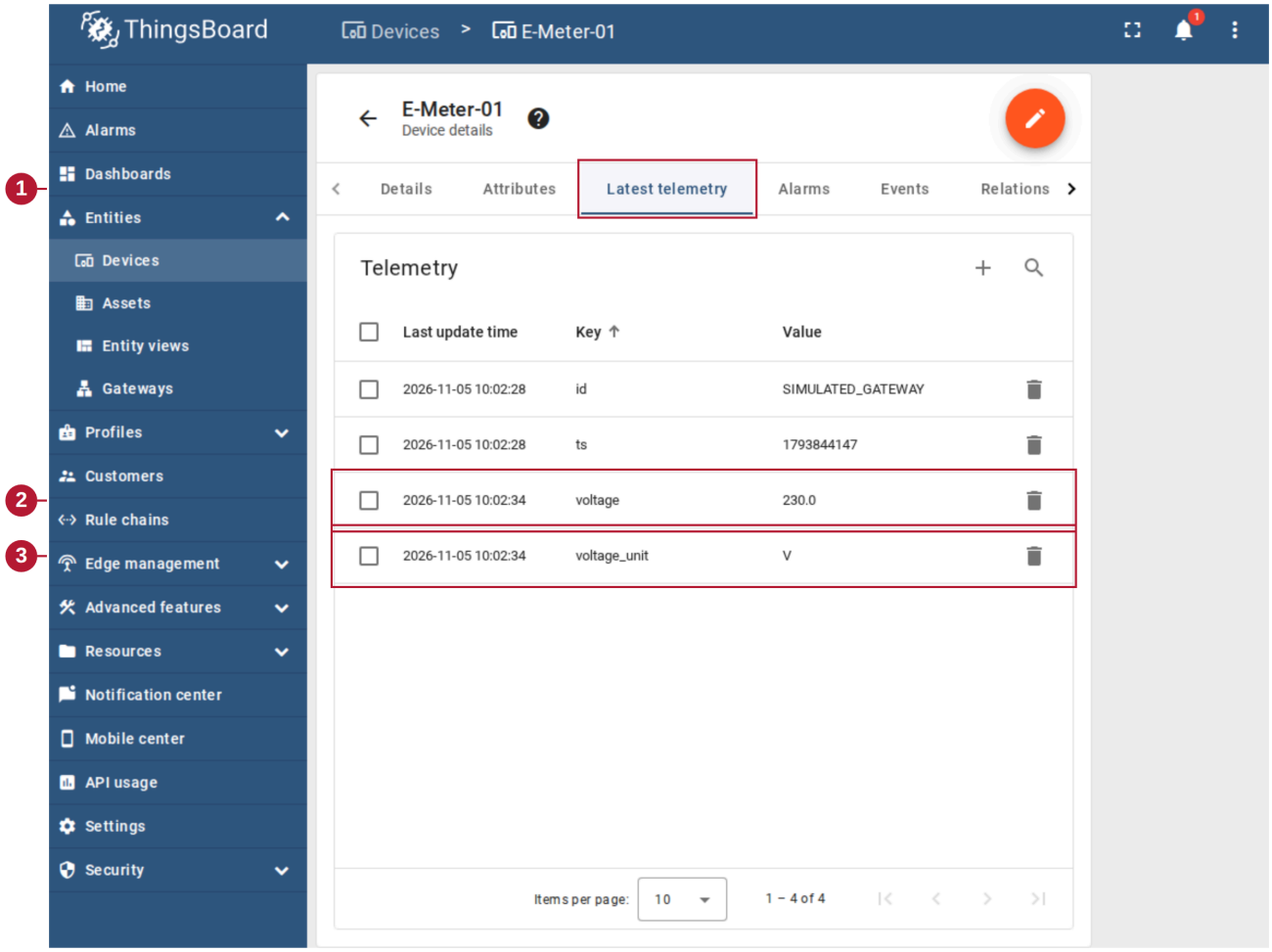


Figure 7-1 Real English ThingsBoard telemetry page from isolated software testing, not a field device.

Callout	Where to look	Pass condition
1	Latest telemetry in E-Meter-01 details.	Correct tenant and device, not a similar name.
2	voltage row: key, latest value and timestamp.	Example 230.0. Observe at least three advancing timestamps. A uses platform receive time; B uses receiver reply-completion time.
3	voltage_unit row.	B shows V. A may not have this row; configure V in the point definition/dashboard rather than declaring a missing unit row a communication fault.

G31 | Inspect the correct device, point and fresh update time

Check	Judgment and Action
Expected behavior	The intended E-Meter-01 has fresh voltage timestamps; B adds voltage_unit=V, while A uses map/dashboard units.
Precautions	Active does not prove a good point. A stable value can be normal; an unchanged timestamp is not fresh acquisition.

Check	Judgment and Action
Symptom and first check	Online without voltage: inspect id/ts-only telemetry and actual JSON first. Telemetry present/dashboard blank points to visualization settings.
Ordered checks	1. Confirm tenant/device ID. 2. Check voltage case/type/path. 3. Observe3 updates. 4. Inspect parsing rejection. 5. Check dashboard alias/key/window/unit.
Evidence and acquisition	Capture device/key/value/time/timezone in G31_latest.png and actual payload in G31_payload.json. Obtain admin reception/storage evidence, not only online status.
Retest or roll back	Proceed to same-period acceptance after3 fresh updates on the right device; preserve working network/serial settings while diagnosing missing points.

Online/Active indicates recent connectivity activity, not that every point works. If only id and ts appear, first check the command name, valid samples and JSON structure instead of repeatedly recreating credentials.

7.2 Compare Readings from the Same Time Period

> Applications: platform Web, physical instrument and server records. Compare the same period; online indicators are not fresh telemetry. Record results in Forms and restore/handover through Chapter 8.

Acceptance 2 | Compare the same period, units and source; retain at least three physical records.

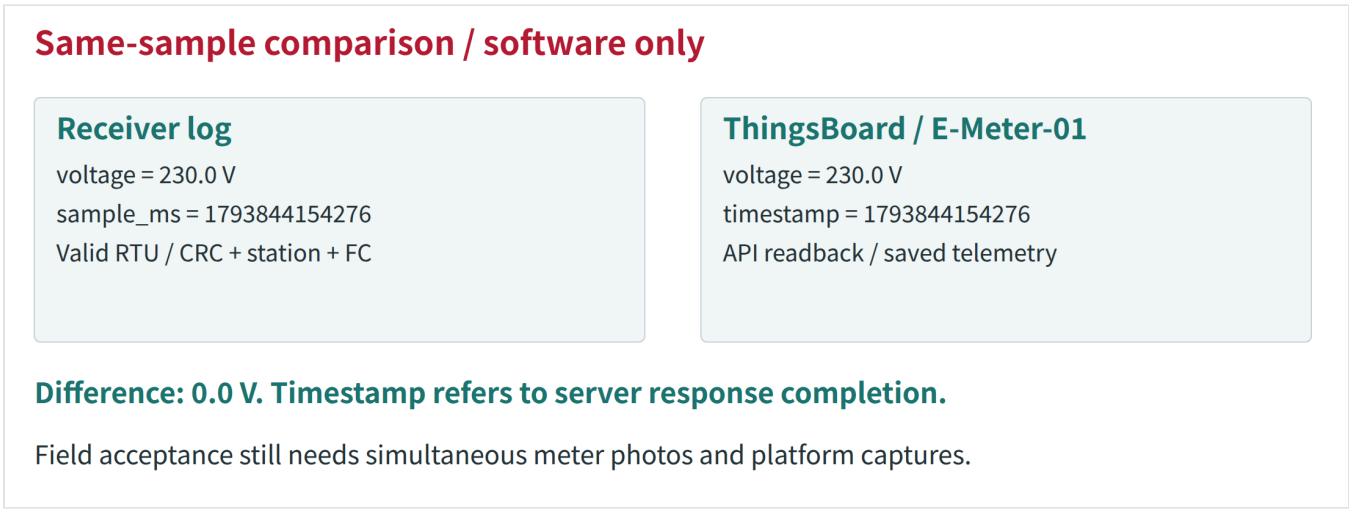


Figure 7-2 Same-sample software comparison: log 230.0 V and platform 230.0 V. Not a replacement for a physical-meter photo.

The log uses UTC 02:02:34; the platform screenshot shows 10:02:34 in a UTC+8 browser. These represent the same instant. Record both time zones so an eight-hour offset is not mistaken for network delay.

Check	Field action	Acceptance rule
Same equipment	Photograph meter nameplate/cabinet and open its platform device.	Model, station and cabinet agree with the project record.
Same quantity	Display V on the meter, not kWh, A or a different line/phase voltage.	Quantity and unit match.

Check	Field action	Acceptance rule
Same period	Photograph the meter near a sample/report event and capture platform key/time.	Record actual time separation; do not compare unrelated times during rapid changes.
Value agreement	Record at least three meter, gateway/receiver and platform sets.	Tolerance follows meter accuracy, resolution and project agreement. Zero software difference is not a site-wide guarantee.
Continuous freshness	Observe at least three report periods and compare natural changes or authorized test inputs.	Correct device and advancing time, without repeated stale values posing as new samples.

G32 | Compare instrument, program and platform in the same period

Check	Judgment and Action
Expected behavior	At least3 comparable same-device/quantity/unit/time samples meet the project-agreed tolerance.
Precautions	The shown0.0 difference is simulation, not an accuracy guarantee. Align UTC/local time and allow for display/report timing.
Symptom and first check	Tenfold difference: inspect scale/conversion ownership first. Eight-hour difference: inspect timezone before changing the instrument.
Ordered checks	1. Match voltage, not current/energy/another voltage quantity. 2. Align time. 3. Trace bytes/decode/JSON/store/display. 4. Check V/kV/order/repeated scaling. 5. Retest against agreed tolerance.
Evidence and acquisition	Complete3 actual rows in Readings_and_Recovery with timezone/difference/tolerance; attach Meter_Voltage_01-03.jpg and matching platform captures. Leave missing values blank, not simulated230.
Retest or roll back	Sign off only when provenance/time/unit/tolerance agree; do not alter scale to disguise mismatched quantities.

7.3 Source Interruption and Network Recovery

> Applications: platform Web, physical instrument and server records. Compare the same period; online indicators are not fresh telemetry. Record results in Forms and restore/handover through Chapter 8.

Acceptance 3 | Retain a baseline, test source and uplink outages separately, then identify the first fresh recovery sample.

Action 1. Record normal device, key, value and timestamp. Qualified personnel may interrupt the test source only under safe conditions. Do not casually unplug energized metering or RS485 wiring; first exercise failure branches in an isolated software environment.

G33 | Record a baseline before a safe interruption

Check	Judgment and Action
Expected behavior	Normal device/point/value/time are recorded with an approved interruption plan and field owner.
Precautions	Do not unplug live RS485, mains or combined power/data links; exercise failure behavior in isolation first.
Symptom and first check	Cannot distinguish network/power loss: inspect the interruption location and retained gateway power first.
Ordered checks	1. Choose approved case. 2. Record3 normal cycles. 3. Confirm business/safety impact. 4. Interrupt only source or uplink at once. 5. Record time without unauthorized field action.
Evidence and acquisition	Retain G33_baseline.png and Readings/Evidence_Record with device/station/location/timezone/owner; qualified personnel document electrical work.
Retest or roll back	Test physically only with baseline/safety approval; otherwise simulate without claiming field acceptance.

Action 2. Confirm no new valid point values appear. The platform can retain the last value and remain connected; classify it as stale/unknown using its update time, not as live healthy data.

G34 | Identify stale values when data stops

Check	Judgment and Action
Expected behavior	No new valid samples arrive; the platform may retain its last value with an old timestamp, and configured stale-quality rules indicate it.
Precautions	The guide does not create a30-second alarm automatically; the administrator must configure/test thresholds and notification. Connected is not instrument health.
Symptom and first check	Source stopped but still healthy: inspect valid update times and simulator/other publishers republishing old values first.
Ordered checks	1. Record last actual sample. 2. Inspect acquisition/session error. 3. Check platform timestamps stop. 4. Verify an enabled stale rule. 5. Separate data validity from connection activity.
Evidence and acquisition	Save last value/time in G34_stale.png and timeout evidence in bridge/runtime logs. Obtain actual rule/alarm records from admin without inventing notifications.

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Check	Judgment and Action
Retest or roll back	Restore source after stale data is not treated fresh and the agreed policy works; record missing rules pending.

Action 3. Restore the source and confirm new readings. Then separately interrupt the uplink while maintaining gateway power to avoid mixing network loss with a reboot.

G35 | Restore the source before separately testing uplink

Check	Judgment and Action
Expected behavior	Restored source yields valid fresh values/times; the separate uplink test retains power to isolate network effects.
Precautions	On timeout the example closes its session and waits for DTU reconnect without old-value publication; no fixed recovery time is promised.
Symptom and first check	Restored source but no update: inspect A acquisition/ownership or B new CONNECTED/TX/RX before recreating the platform device.
Ordered checks	1. Confirm source recovery. 2. Check sole serial ownership. 3. Check A enable or B listener/reconnect. 4. Verify a new valid frame. 5. Inspect platform update.
Evidence and acquisition	Record source restoration/first fresh value in Readings; obtain G35_recovery.txt with actual connection/frame/time evidence and correlate platform timezone.
Retest or roll back	Start uplink interruption only after3 source-recovery cycles; do not mask an unresolved source fault with the next test.

Action 4. After restoration, check network and MQTT authentication/DTU reconnection, then observe at least three fresh records. Record loss, restoration, first new data and actual recovery duration.

G36 | Trace fresh data layer by layer after reconnection

Check	Judgment and Action
Expected behavior	Actual egress recovers, MQTT reauthenticates or DTU reconnects, then valid samples/platform times update at least3 times.
Precautions	Retain logs before a targeted service restart; do not factory-reset, erase maps or recreate credentials first.
Symptom and first check	Green connection but no update: first inspect gateway IP/route/DNS, then A acquisition or B fresh TX/RX, then platform time.
Ordered checks	1. Check uplink/APN/data. 2. Check target/auth/TLS clock. 3. Inspect A config or B listener/old-session cleanup. 4. Verify new raw/decode. 5. Check device/window/3 fresh updates.
Evidence and acquisition	Retain G36_network.png, actual runtime/bridge logs and G36_platform.png with loss/recovery/first sample; record each stage in Readings, not merely reboot fixed it.

Check	Judgment and Action
Retest or roll back	Pass after3 fresh cycles and healthy original business; otherwise isolate the first failing layer and use approved rollback.

Action 5. This example does not guarantee historical replay. Keep outage gaps visible. Specify buffering, original sampling time and recovery deadlines separately if required.

G37 | Accept fresh-data recovery separately from backfill

Check	Judgment and Action
Expected behavior	Fresh post-recovery values work while outage gaps/backfill requirements/results are recorded separately.
Precautions	Periodic publication, QoS1 or reconnect is not a persistent queue/power-loss retention; this tool has no backfill.
Symptom and first check	History has gaps: first verify whether caching/backfill was delivered; online recovery is not complete history.
Ordered checks	1. Define gap. 2. Verify sample timestamp source. 3. Inspect actual queue/replay evidence. 4. Check order/dedup/time. 5. Record gaps honestly when unsupported.
Evidence and acquisition	Record outage/reconnect/first fresh/backfill result in Readings_and_Recovery; actual backfill needs administrator Queue_Replay.txt and platform history, not a retained-message capture.
Retest or roll back	Conclude against the agreed scope: sign fresh recovery only, not gap-free history, if backfill is unverified.

For the 5 s example, "no new voltage timestamp for 30 s" can be a demonstration stale threshold, not a product guarantee. Adjust for bus loading, latency and rules. Reading this section does not create a platform inactivity alarm; the administrator must configure and test one.

08 | Support Reference: Evidence, Handover and Rollback

> Use as needed. Preserve evidence under the relevant G reference, then hand it to the responsible party. Restore the original service when testing ends. Fault checks remain beside their operations, not collected here.

Faults are already beside the relevant G checkpoints. Return to the last working/first failing stage. This chapter organizes evidence and ownership rather than collecting troubleshooting at the end.

8.1 Where to Obtain Field Evidence

File/photo	Acquisition and owner	What to inspect
Gateway_Identity.png, Verification_Matrix_EN.csv	Installer captures the actual Overview/System Information and completes the matrix	Model/options, firmware, instrument/platform versions; document revision is not firmware
Meter_Settings.png, manufacturer register_map.pdf	Photograph nameplate/ID/baud/parity/version; instrument owner supplies the register map	Matching revision, station, PDU base, count, type, ordering and scale
Wiring_Overview.jpg and both terminal close-ups	Qualified electrical personnel capture safely	Both labels, wire numbers, supplies, WAN/SIM and complete route; photos do not replace electrical review
Gateway_Before/Gateway_After backups	Use the real configuration-export facility and retain original name/custodian	Change scope, port ownership, network and restore revision; backups may contain secrets
Gxx_*.png configuration captures	Relevant Web panels with menu, fields, enabled state and time	Readback of command/device/global saves, units and actual logical port
gateway_runtime.txt	Export from actual diagnostics/log controls if present; otherwise request supplier/admin time-window logs	Port ownership, timeout, exception, MQTT/TLS error and restart; no assumed internal directory
server_bridge.jsonl	PowerShell Tee-Object or administrator-managed service logs, without token commands	LISTEN, CONNECTED, TX, RX_CHUNK fragments, unvalidated RX_FRAME, valid RX_AND_PUBLISH, SESSION_CLOSED, time and source
Gxx_payload.json	Copy complete payload from sender/receiver/platform records as UTF-8 JSON	Identity, fields, number/string/array, scale and ts unit; omit terminal labels
Platform_Endpoint.txt, Credential_Handover.txt	Platform administrator supplies endpoints and controlled credential references	Host/port/TLS/topic, ownership and permissions; no plaintext token/password
Platform_Receive.txt, Parser_Store.txt	Platform administrator supplies specified device/time-window records	Distinguish connection, reception, parsing and storage; retain rejection text and device ID
Readings_and_Recovery form and platform captures	Installer retains at least three same-period instrument/program/platform readings	Units, timezone, actual updates, agreed tolerance and first fresh recovery sample

8.2 Minimum Support Handover and Path Ownership

Use Evidence_Record_EN.csv for G checkpoint, cabinet/instrument/station, time/timezone, last working/first failing stages, expected/actual result, changes, files, owner and recovery. Path A needs connection/command/global captures and actual JSON; B needs one TX/RX pair, same-session log and platform record. Remove tokens, Cookie, private keys, full SIM identifiers and personal data.

Names such as gateway_runtime.txt and server_bridge.jsonl are archive suggestions. Actual device, Windows-service or container log locations come from their administrators. Do not enable unauthorized SSH, modify firmware or publicly share full backups to obtain them. Mark missing physical wiring/same-period readings pending; never substitute the simulated 230.0 image.

8.3 Stop Tests and Restore the Original Service

Preserve evidence, stop simulator/test polling, disable test instances under the maintenance plan and save. Restore only changed port/application/server/topic settings and keep one serial master. Check network/access policy against the original backup; revoke temporary rules/test credentials and clear TB_DEVICE_TOKEN. Recheck at least three original business update cycles and record recovery time, remaining issues and custody. Factory reset is not a substitute for scoped rollback.

09 | Project Expansion: Multiple Meters, Data and Security

> Use after first-point and recovery acceptance. Expand one category at a time: meters/points, platform or security. Revisit Chapter 7 after each change; the example program is not a production acquisition system.

9.1 Add Meters and Points

Assign a unique address to every meter on a bus. Record function, PDU address, count, type, word order, scale and unit for every point. Prove each meter before estimating total polling time. A slow meter delays a shared bus; a five-second full scan is not guaranteed for arbitrary device counts.

Expansion	Resolve first	Do not reuse without redesign
Multiple meters on one gateway.	Device identity, tokens/topics/keys and register-map conflicts.	Global authentication plus a single device topic does not automatically provide separate per-device credentials.
Multiple DTUs to one server.	Identity, session routing, poll queue and disconnect cleanup.	The supplied single-session program is not a public multi-customer service.
Remote register writes.	Separate approval, write allowlist, feedback, failures and replay prevention.	This guide is read-only; no control, reset, DO, pump or valve actions.
Historical replay.	Capacity, outage duration, original time, ordering, deduplication and platform rules.	Periodic reporting and MQTT QoS alone do not provide history replay.

G38 | Plan identity and total polling budget before expansion

Check	Judgment and Action
Expected behavior	Each meter has a unique station and complete point/platform identity, with slow replies/timeouts included in cycle budgeting.
Precautions	The single-session tool is not a multi-DTU service; one token can merge meter data and a slow meter affects a shared bus.
Symptom and first check	Crossed values/missing points/slow cycles after expansion: inspect duplicate stations, identity and poll scheduling before adding concurrent masters.
Ordered checks	1. Accept meters individually. 2. Assign station/field/device identity. 3. Budget requests/failures. 4. Plan session routing. 5. Add load gradually without a universal5-second promise.
Evidence and acquisition	Update Point_Map, Verification_Matrix and poll plan. Record per-meter time/error/platform ownership in G38_rate.csv and retain software/configuration versions.
Retest or roll back	Expand in approved batches; roll back to the last accepted scale while preserving single-point settings.

9.2 TLS, Credentials and Restoration

Plain 1883 and raw TCP 5001 are for isolated or approved protected networks. Production requires administrator-approved TLS/VPN, least network privilege and credential rotation. MQTT TLS needs real support, correct CA, hostname and clock, not merely changing 1883 to 8883. The server tool accepts --mqtt-ca ca.pem with the platform's actual TLS port. TLS/public-network acceptance was not performed in this run.

Before handover, export gateway configuration, platform device information, point definitions and receiver version/arguments. Do not store plaintext tokens in ordinary backup folders. To undo the experiment, stop simulator/poller, disable test DTU or acquisition, restore prior port ownership/settings, remove temporary firewall access, clear TB_DEVICE_TOKEN and confirm the original service operates.

G39 | Verify security, backups and restoration

Check	Judgment and Action
Expected behavior	Only approved sources reach the service; delivered TLS/VPN works; configuration/map/software/controlled credentials can be restored and tests are stopped.
Precautions	Port8883 alone does not enable TLS; verify CA/hostname/chain/time. Environment/config backups may contain secrets and stay outside public ZIP.
Symptom and first check	TLS failure or broken restore: inspect certificate/clock/credentials/backup scope first, not disabled verification or reset.
Ordered checks	1. Confirm delivered security. 2. Verify CA/hostname/time/rights. 3. Verify backups/rollback. 4. Stop simulations/tests. 5. Restore port/access policy. 6. Retest original business.

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Check	Judgment and Action
Evidence and acquisition	Backup_Inventory.csv records original name/version/custodian/restore result. Credential_Handover stores references only; G39_restoration.txt records stop/revocation/3-cycle retest without secrets.
Retest or roll back	Handover after restoration/security acceptance; assign remaining items and never mark untested field behavior passed.

10 | Project Records: Forms, Pending Evidence and Sources

> Record actual results and mark missing evidence pending. Find forms and source references here. Keep document revision, simulated software evidence and actual device firmware separate.

10.1 Project and Acceptance Record

The implementation owner must fill this in. Blank means unverified, not passed. The supplied `Forms` directory contains parameter, point-map and contemporaneous reading/recovery CSVs. Archive these with photographs, gateway configuration and platform captures; include cabinet, device, time and time zone in filenames.

Record	Field entry / attachment
Project / cabinet / engineer / date.	_____
Actual gateway / electrical port build / full firmware version.	_____
Meter model / serial last four / software / register-map revision.	_____
Terminal correspondence / Serial port / station / serial settings.	_____
Key / FC / PDU address / count / type / order / scale / unit.	_____
Platform device / Web URL / MQTT host-port / credential custody.	_____
Path A or B / acquisition / reporting / response timeout.	_____

Record	Field entry / attachment
Contemporaneous meter / platform / difference / times and zones.	_____
Source outage / uplink outage / first fresh recovery timestamp.	_____
History requirement / result / open issues / sign-off.	_____

10.2 Physical Evidence Still Required

Required evidence	How to obtain	Suggested archive
Actual gateway version.	Overview/System Information capture with model, full firmware and date; redact sensitive identity.	01_Equipment_and_Versions.
Meter and registers.	Nameplate, software, ID/baud/parity photos and original manufacturer register map.	02_Meter_and_Registers.
Complete physical wiring.	Both terminal close-ups, conductor labels, power, WAN/SIM and overview; legible labels.	03_Physical_Wiring. Review electrical safety and terminals before replacing this guide's schematic.
Hardware first-point exchange / raw JSON.	Capture with customer authorization, retaining time and removing tokens/session information.	04_Communication_and_Payload.
Meter/platform comparison.	Meter V photo and voltage row capture, at least three sets; record time separation.	05_Value_and_Recovery_Acceptance.
Outage/recovery proof.	Loss, restoration, first fresh record and platform timestamps; sign-off.	05_Value_and_Recovery_Acceptance.

10.3 Sources and Verification Boundary

Hardware follows the existing YZW300L V1.5 specification and current serial manual. Modbus/DTU forms are emitted offline by MT7981 native source with local example parameters and an authorized native frame. They are not running screenshots from this 300L unit. Confirm the actual firmware/hardware combination; no platform source was modified.

Meter terminals and voltage register: Eastron SDM120M User Manual V2.9, PDF pages 3 and 5-9. Confirm Float32 ordering against the matching protocol and a known physical value. Similar names do not prove identical new suffixes/firmware.

Platform actions and schema: ThingsBoard Devices, MQTT Telemetry API. Screenshots use ThingsBoard CE 3.9.1 on local experimental ports. Use a currently maintained production version, not this old documentation version by default.

The retained baseline records eighteen passed isolated software checks: flat JSON reception, timestamp distinction, fragmented RTU, two connections, fresh recovery values, and rejection of bad CRC/length/station/function. **No physical meter, gateway firmware, RS485 electrical, cellular, TLS, production-load or historical-replay acceptance was performed.** PDF provides fixed pagination; Word supports later field evidence. Windows Word/WPS pagination remains to be checked.