ARQ CONTROLS

FIELD COMMUNICATION

RS-485 Modbus Communication Manual

Field wiring, grounding, termination, and troubleshooting guide.

ARQ CONTROLS · INDUSTRIAL ENERGY CONTROL

RS485

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1. Overview

RS-485 is a robust serial communication standard commonly used for Modbus RTU networks. Poor wiring, grounding issues, and electrical interference can lead to communication failures such as CRC errors or timeouts. This guide ensures stable communication between the ARQ Controls EMS and field devices.

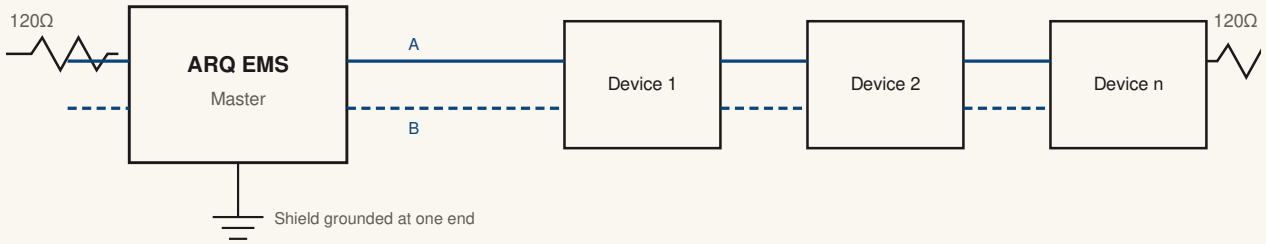
2. Basic RS-485 Wiring Principles

- Topology: use a daisy-chain (bus) topology. Do not use star or T-shaped branches.
- Max cable length: 200 meters.
- Max devices: 32 devices per segment without repeaters.
- For best results, given the number of sensors to monitor, limit RS-485 to one device per segment.

3. Recommended Cable

PROPERTY	REQUIREMENT
Type	Twisted-pair, shielded (e.g., Belden 9841, Mylar or equivalent)
Gauge	0.5 mm^2 or thicker
Shield	Foil or braid shield, grounded at ONE end only
Pairs	1 pair for A/B data, optional second pair for ground if needed

4. Connection Diagram



Daisy-chain (bus) topology. Twisted pair for A/B. 120Ω termination at both ends.

FIGURE 1: RS-485 CONNECTION DIAGRAM

5. Termination and Biasing

COMPONENT	REQUIREMENT
Termination	120Ω resistor at both ends of the bus
Bias resistors	If no master device provides them, add 680Ω–1kΩ pull-up on A and pull-down on B to +5V/GND
Stub lengths	Keep device drop lines < 30 cm

6. Grounding and Shielding

- Only ground one end of the cable shield, ideally at the EMS or central controller.
- RS-485 does not require a common ground, but a reference (via shield or isolated ground wire) can improve stability.
- If devices are powered from different transformers, use opto-isolated RS-485 converters or isolated repeaters.

7. Reducing Electrical Noise

RISK AREA	MITIGATION
Nearby power cables	Route RS-485 cables away from AC and switchgear
Long runs	Use a lower baud rate (9600–19200)
EMI from transformers	Ferrite cores at both ends of the cable
Ground loops	Use isolated converters or break loops at the shield

FIGURE 2: TERMINATION AND NOISE MITIGATION EXAMPLES

Field photos of termination resistors and ferrite core placement. Screenshot to be supplied.

8. Baud Rate and Settings

- Recommended: 9600 or 19200 baud for high reliability.
- Settings: 8 data bits, no parity, 1 stop bit (8N1).
- All devices must use identical serial settings.

9. Troubleshooting Tips

SYMPTOM	LIKELY CAUSE	SOLUTION
CRC errors	Electrical noise	Check shielding, grounding, cable path
Timeouts	Wrong termination or baud mismatch	Verify settings and topology
Intermittent comm	Ground loop or overloaded bus	Add isolation, reduce device count
No data	Incorrect A/B wiring or config	Swap A/B lines or check Modbus ID

10. Field Verification Checklist

- Daisy-chain topology confirmed.
- Twisted-pair shielded cable used.
- Shield grounded at one end only.
- Termination resistors on both ends.
- Biasing resistors present (if required).
- Baud rate and parity consistent across all devices.
- A/B wires not reversed.
- No cable stubs > 30 cm.
- RS-485 runs routed away from AC lines.
- Ferrite cores installed on both ends.

11. Diagnostic Tools

- USB-RS485 dongle with ModScan or ModPoll for diagnostics.
- Oscilloscope to verify a clean differential signal.
- Field test meter (e.g., Extech or Fluke RS-485 tester).

FOR FURTHER ENQUIRIES

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