

# Memograph

A practical guide to memograph, covering the reader intent, the relationship to memograph, key evaluation criteria, common risks, and the information the intended project audience should confirm before taking the next step.



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In the landscape of industrial automation, the ability to record, visualize, and analyze process data is as critical as the measurement itself. A memograph, or more broadly, a high-end paperless recorder and data manager, serves as the central intelligence hub for level measurement systems. While sensors provide the raw data, the data manager transforms these signals into actionable insights, ensuring safety, compliance, and operational efficiency. For engineers managing complex tank farms or water treatment facilities, understanding how these devices integrate with various level measurement technologies is essential for building a robust monitoring architecture.

## **| Measurement Principles and Signal Integration**

Before selecting a data management solution, it is necessary to understand the underlying measurement principles of the sensors that provide the input. In level measurement, sensors utilize different physical properties to determine the height of a medium, which are then converted into electrical signals for the memograph to process.

### **#### Radar Level Measurement**

Radar level meters, such as those found on the Main Page of industrial instrument catalogs, operate on the Time-of-Flight (ToF) principle. The device emits high-frequency microwave pulses that travel at the speed of light. When these pulses hit the surface of the medium, they are reflected back to the sensor. The distance is calculated based on the time interval between transmission and reception.

Signal Output: Typically 4-20mA with HART protocol.

Data Manager Role: The memograph interprets the 4-20mA signal as a linear level and can use the HART digital layer to extract secondary variables like internal device temperature or signal strength.

### **#### Ultrasonic Level Measurement**

Similar to radar, ultrasonic sensors use ToF but rely on sound waves. A transducer emits an ultrasonic pulse that reflects off the liquid or solid surface. Because the speed of sound is affected by air temperature, these sensors often include integrated temperature compensation.

Signal Output: Analog 4-20mA or digital Modbus RTU.

Data Manager Role: The memograph must account for the "blanking zone" (the area immediately below the sensor where measurement is impossible) and can provide linearized volume calculations for non-linear tanks (e.g., horizontal cylinders).

#### #### Hydrostatic Level Measurement

This principle relies on the relationship between liquid height and the pressure exerted at the bottom of the vessel. The pressure is proportional to the density of the liquid and the height of the column ( $P = \rho gh$ ).

Signal Output: 4-20mA current loop.

Data Manager Role: Since hydrostatic pressure changes with liquid density, a memograph can be programmed to adjust level readings if the density of the process fluid fluctuates, providing a more accurate mass or volume calculation.

## **| Core Functions of a Memograph Data Manager**

A modern memograph is far more than a simple display. It acts as a secure data logger that meets stringent regulatory requirements (such as FDA 21 CFR Part 11). Its primary functions include:

1. **Data Acquisition:** Multi-channel inputs allow the device to collect data from radar, ultrasonic, and pressure transmitters simultaneously. It can handle analog inputs (mA, V), digital inputs, and pulse inputs (for flow measurement).
2. **Visualization:** High-resolution screens display real-time trends, digital values, and bar graphs. This allows operators to see at a glance if a tank level is approaching a high-alarm limit.
3. **Calculation and Math Functions:** Advanced units can perform complex mathematical operations, such as calculating the total volume in a tank farm or determining the average level across multiple sensors in a large basin.

4. Communication and Networking: Through Ethernet, RS485, or Profibus, the memograph transmits data to higher-level SCADA or ERP systems, ensuring that process data is available across the enterprise.

## Practical Selection Table

Choosing the right data manager depends on the scale of the application and the types of sensors in use. The following table provides a guideline for matching system requirements with device capabilities.

| Feature          | Entry-Level Data Logger | Advanced Memograph / Data Manager           |
|------------------|-------------------------|---------------------------------------------|
| Number of Inputs | 1 to 4 Channels         | Up to 20+ Universal Inputs                  |
| Input Types      | 4-20mA, 0-10V           | mA, V, RTD, TC, Pulse, Digital              |
| Communication    | USB, RS485              | Ethernet, Modbus TCP/RTU, Web Server        |
| Data Security    | Basic CSV logging       | Encrypted, Audit Trail (21 CFR Part 11)     |
| Display          | Monochrome or Small LCD | Large Color Touchscreen (TFT)               |
| Math Functions   | Basic (+, -, , /)       | Complex (Linearization, Integration, Logic) |
| Alarm Relays     | 1 or 2                  | Multiple (Configurable for High/Low/Rate)   |

## Installation Considerations

To ensure the accuracy of the data displayed on the memograph, proper installation of both the sensors and the data manager is required.

Wiring and Shielding: Level sensors, particularly radar and ultrasonic units, are sensitive to electromagnetic interference (EMI). Use shielded twisted-pair cables for 4-20mA loops. The shield should be grounded at only one end (usually the data manager side) to prevent ground loops.

**Power Supply:** Many memographs provide a loop power supply (usually 24V DC) for the transmitters. Ensure the total current draw of all connected sensors does not exceed the data manager's power rating.

**Mounting Environment:** While many data managers are designed for panel mounting in a control room, they may be installed in the field. If installed outdoors, an additional NEMA 4X or IP66 rated enclosure is required to protect the electronics from moisture and UV radiation.

**Cable Lengths:** For analog signals (4-20mA), cable runs can typically extend up to 1,000 meters (3,280 feet) depending on the wire gauge and external interference. For digital communication like Modbus RS485, the limit is generally 1,200 meters without a repeater.

## **| Limitations and Risks**

While a memograph is a powerful tool, engineers must be aware of its limitations to avoid data loss or inaccurate reporting.

1. **Signal Latency:** In high-speed processes, the sampling rate of the data manager must be considered. While most level applications are relatively slow, a sampling rate that is too low may miss rapid pressure spikes or level surges.
2. **Storage Capacity:** Although modern devices use SD cards or internal flash memory, data will eventually be overwritten if not backed up. It is critical to configure a routine data export via FTP or a manual USB download.
3. **Sensor Compatibility:** Not all data managers support all digital protocols. If you are using a specialized HART-based radar meter, ensure the memograph has a HART gateway or can at least process the 4-20mA analog component.
4. **Environmental Extremes:** The operating temperature for most data managers is typically 0°C to 50°C (32°F to 122°F). In extreme cold or heat, the LCD display may become sluggish or fail, requiring climate-controlled housing.

## **| Frequently Asked Questions (FAQ)**

Q: Can a memograph power my level sensors directly?

A: Yes, most industrial data managers include integrated 24V DC power supplies specifically designed to power two-wire 4-20mA transmitters.

Q: How does a memograph handle non-linear tanks?

A: Advanced units include linearization tables. You can input a set of coordinates (e.g., 10% height = 15% volume) or select standard tank shapes (horizontal cylinder, spherical) to automatically convert level into volume.

Q: Is the data stored in a memograph legally valid for environmental reporting?

A: If the device supports secure, tamper-proof data formats and audit trails (like those compliant with 21 CFR Part 11), the data is generally accepted by regulatory bodies for environmental and safety reporting.

Q: Can I view the data remotely?

A: Most modern memographs include an integrated web server. By connecting the device to a local area network (LAN), you can view the "Main Page" of the recorder's interface through a standard web browser on a PC or tablet.

## **| Summary of Project Audience Requirements**

Before finalizing a system design involving a memograph and level sensors, project managers and engineers should confirm the following:

**Channel Count:** Account for all current sensors plus 20% spare capacity for future expansion.

**Integration Protocol:** Confirm if the system will use analog (4-20mA) or digital (Modbus/HART) communication.

**Data Access:** Determine if data needs to be accessed locally, via a network, or through a cloud-based interface.

**Regulatory Needs:** Identify if the application requires specific certifications for explosive atmospheres (ATEX/IECEx) or data security compliance.

By carefully matching the capabilities of the data manager with the precision of Welk level measurement instruments, facilities can achieve a seamless flow of information from the tank to the control room. For more information on specific sensor technologies and their integration, visit the [Welk Main Page](#).