

MOHR™ EFP-IL

Guided Ultra-Wideband (UWB) Radar Tank Level Indicator (TLI) System

Next-generation liquid level measurement system designed for nuclear applications

EFP System Key Features

- Industry's most accurate liquid level measurements
- System designed specifically for nuclear applications
- Characterize boiling / frothing environments
- Electronics can be >300 m (1000 ft.) from probe
- In-situ instrument calibration
- Inline probe signal-path integrity monitoring
- Ideal for use with MOHR SFP-1 spent fuel pool probe

MOHR EFP Series Guided UWB Radar sensors utilize MOHR's Electric Field Perturbation technology and are the industry's most accurate liquid level / TLI sensors. With thousands of hours of reactor system operation, EFP Series instruments are ideal for nuclear tank level monitoring applications including Spent Fuel Pool Instrumentation (SFPI).

Features and Benefits

Unmatched Precision and Accuracy

EFP signal processors offer precision and accuracy of approximately 0.1 mm (0.004 in.) and 1 mm (0.04 in.), respectively. Real-world TLI system accuracy, taking probe surface tension effects into account, is better than ± 12.5 mm (0.5 in.) for most industrial applications.

Measure Multiphase Flow Conditions

Characterize frothing / boiling environments that can fool legacy TDR / guided-radar systems. Optionally integrate true volumetric void fraction measurement for real-time estimation of total coolant inventory and enthalpy.

Rugged Performance For Any Environment

Wall-mount instrument with NEMA 4X enclosure designed to meet applicable MIL-SPEC and NRC seismic, shock, vibration, environmental, and EMC requirements.

Intuitive, Informative Interface

- Graphical user interface reports instantaneous level in units of length and/or calibrated volume.
- Level history graph lets the operator quickly evaluate recent trends in tank level and compare to level alarm settings. Stores historical data in flash memory.



EFP-IL panel-mount liquid level signal processor.



EFP-IL real-time level history graph with level alarms.

Multiple Interface and Configuration Options

- Ethernet, USB, 4-20 mA, 802.11 b/g/n WiFi
- Remote monitoring and configuration over Ethernet
- Single and dual channel configurations
- Optional military-grade level alarm relays
- Optional thermocouple signal processor

MOHR SFP-1 Spent Fuel Pool Probe Assembly

- Configurable lengths of 1.5 - 10+ m (5 - 32+ ft.)
- MIL-SPEC hardened, exceeds Seismic Category I
- Long term use at 250°C (480°F) or above
- Excellent long-term radiation resistance
- EFP-IL/HL interconnect cable >300 m (1000 ft.)
- Relative accuracy 2.5 mm (0.1 in.) at 300 m (typ.)
- Absolute accuracy ± 25 mm (1 in.) at 300 m (typ.)
- Compatible with EFP system in-situ calibration

Specifications

Level Measurement System

Advanced liquid level measurement capabilities:
Very low dielectric measurement capability ($\epsilon_r > 1.1$)
Liquid/liquid interface, boiling, and froth detection
Level measurement precision: 0.1 mm (0.004 in.)
Accuracy:
Absolute measurements: 1 mm (0.04 in., max.)*
Real-world accuracy: better than 12.5 mm (0.5 in., typ.)**
Response time: ~2 ms (min.)
Level alarms: multiple individually-configurable alarms
Level alarm hysteresis: user-configurable
Level display: length or calibrated volume units
Inline TDR signal path integrity verification
Raw backscatter data storage, post-processing capability
* Laboratory setting, excluding surface tension effects.
** Ruggedized probe in industrial setting, including surface tension effects.

Void Fraction Measurement System Option*

Accuracy: 1% (steam-water system, bubbly flow)**
Range: 0-100% void
Resolution: 0.1% void (typ.)
* Specialized system hardware/firmware and probe required.
** May vary by application due to flow characteristics and probe geometry.

Connectivity Options

USB host/client, 10/100 Ethernet, RS-232
2x 4-20 mA (loop-powered), 1x HART-compliant modem
802.11 b/g/n WiFi (WPA2 256-bit AES encryption)
Level alarm relays (optional):
2x SPDT 30 VDC/120 VAC relays

Thermocouple Signal Processor Option

K-type (Chromel/Alumel), cold-junction compensated
Range: -270°C to +1372°C
Resolution: 0.25°C
Accuracy: $\pm 2^\circ\text{C}$ (-200°C to +700°C)

RTD Signal Processor Option

Uses 100 Ω to 1k Ω platinum RTDs (PT100 to PT1000)
Compatible with 2-, 3-, and 4-wire sensor connections
Range: -200°C to +550°C (typ.)
Resolution: 0.03125°C (may vary due to RTD nonlinearity)
Accuracy: 0.5°C (0.05% of full scale) max.

Display

Color LED-BL 4.3 in. (10.9 cm) WQVGA TFT-LCD, > 600 cd/m²
Discrete LED status light

Data Storage

Standard 2 GB flash memory storage

Power System

AC Power: 90-264 VAC, 47-63 Hz
DC Power: 9-36 VDC, ~1.5A @ 24 VDC max.
Hybrid NiMH battery backup, >7d operation*
* Seamless transfer to backup power upon loss of external power.

Environmental and Mechanical

Operating / Non-Operating Temp.: -10°C to +55°C / -20°C to +85°C

Mechanical:

EFPI-IL Signal Processor:
30.5 (H) x 25.4 (W) x 21.0 (L) cm (12.0 x 10.0 x 8.3 in.)
12.7 kg (27.9 lbs.)
EFPI-BAT-44000 External Battery Enclosure:
36.5 (H) x 30.5 (W) x 16.30 (L) cm (14.0 x 12.0 x 6.3 in.)
18.9 kg (41.6 lbs.)
NEMA 4X 304 SS enclosure with ANSI 61 gray powder coat (optional)
Panel/wall or Unistrut P1000 mounting

Regulatory

SFPI System (EFPI-IL and EFPI-BAT-44000)

Tested to meet the following standards:
IEEE 344:2004 Seismic (14.0 g SSE, 9.8 g OBE)
IEC 60068-2-27 Shock
IEC 60068-2-8 Vibration
EPRI TR-102323-R3 EMC

Naval Version (EFPI-IL Only)

Designed to meet the following standards:
MIL-STD-108 Environmental, MIL-S-901D Shock,
MIL-STD-167-1 Vibration, MIL-STD-461F EMC,
MIL-STD-810G 509 Salt Fog, MIL-STD-810G 511.5 Expl. Atm.

Designed to meet relevant requirements for Naval shipboard liquid level indicating equipment pursuant to MIL-L-23886C and ASTM F 2044-00.



Complies with all applicable EU directives, as specified by the Declaration of Conformity supplied with the instrument.

Complies with Canadian ICES-003.

MOHR™

Test and Measurement Solutions for Industry™

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