SELECTRONICS

Innovative Solutions Through Electronic Technology

Multi-Function Precision Monitor

Model MPM-1

A liquid level monitoring system
Custom designed and constructed by Selectronics

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MULTI-FUNCTION PRECISION MONITOR

SYSTEM MODEL MPM-1

OVERVIEW

The Selectronics MPM-1 system is designed to provide remote display of the liquid level in a tank with exceptional precision and extreme immunity to magnetic, electromagnetic and electrostatic interference. Also, the robustness of the system allows for rugged-duty set-up and transportation especially suited for portable use.

The MPM-1 system is comprised of ten separate components:

1. **LEVEL SENSING PROBE** model **LSP-x** - mounted in the tank (the "x" is a number defining the length of the probe in inches)

2. **PROBE COUPLING CABLE** model **PCC** - connects the LSP-x to the LDT

3. **LEVEL DETECTING TRANSMITTER** model **LDT** - determines the tank's liquid level and converts it to coded light pulses which are transmitted to the FLC via the FOC

4. **FIBER OPTIC CABLE** model **FOC-x** - conducts the coded light impulses to the remotely-located FLC (the "x" is a number defining the length of the cable in feet)

5. **FIBER-to-LINE CONVERTER** model **FLC-2** - receives the coded light pulses from two LDTs via two separate FOCs and converts the signal from the selected input into differential data and sends it to the ORD

6. **DATA COUPLING CABLE** model **DCC** - couples the data signal from the FLC to the ORD (the "x" is a number defining the length of the cable in feet)

7. **OPTICAL RECEIVER & DISPLAY** model **ORD** - receives the differential data from the FLC and displays the digital value of the liquid level of the *selected* LDT and alerts the operator in the event of an alarm condition such as loss of signal or high liquid level

8. **AC POWER SUPPLY** model **APS-x** - powers the LDT from 120 VAC (the "x" is a number defining the length in feet of the cable between the APS and the LDT)

9. **AC POWER CABLE** model **APC-x** - supplies 120 VAC from a source's wire termination to the ORD (the "x" is a number defining the length of the cable in feet)

10. **ALARM CONTROL CABLE** model **ACC-x** - conducts signals to the ORD from the remote alarm, annunciator, silence, and input select auxiliary equipment (the "x" is a number defining the length of the cable in feet)

PRINCIPLE OF OPERATION

The MPM-1 system employs a unique and proprietary method of detecting the level of the liquid in the tank. The LEVEL DETECTION TRANSMITTER unit (LDT) fires a micro-power, extremely short-duration, electrical impulse that travels from the LDT through the PCC (cable) to the LSP (probe).

This impulse travels at the speed of light all the way to the bottom tip of the probe then bounces back to the LDT. At every point along its journey that it encounters a change in electrical impedance a portion of the impulse's energy is reflected back to the LDT as a weaker impulse. The point where the probe meets the top of the liquid level is just such an impedance change. Thus, a reflection occurs at this point. The traveling speed of the original impulse and all of its reflections is a constant. Therefore the distance between the tip of the probe and the top of the liquid is simply a matter of the timing difference between the arrivals of those two reflected impulses back at the LDT.

The LDT makes a calculation based on the parameters that have been programmed into it such as length of the probe and the distance from the tip of the probe to the floor of the tank (Offset). This calculation determines the level of the liquid with extreme accuracy. This value is then converted to the desired engineering units such as centimeters, inches, gallons, or percent. The value of this quantitative measurement is then coded into light pulses, which are fed into end of the Fiber Optic Cable (FOC) that is plugged into the LDT.

The light pulses travel through the plastic, electrically non-conductive, fiber optic cable to the remotely located Fiber-to-Line Converter (FLC) completely immune to the presence of any radio, electrical or magnetic disturbances in the vicinity. No external force can affect the integrity of these light pulses traveling safely inside their "light conduit". At the FLC the signal is turned into high-speed digital data and then passed on to the Optical Receiver & Display (ORD) via the short differential serial Data Coupling Cable (DCC).

The ORD detects and decodes this digital data back into the liquid level value and displays that value on the digital LED readout on the face of the ORD. If the level value exceeds the ALARM value set in the ORD then an alert tone sounds, an indicator on the face of the ORD flashes, and a signal and a relay contact closure is fed out through the Alarm Control Cable (ACC) to external equipment and indicators that can alert personnel and take corrective steps.

INSTALLATION

Mount the Optical Receiver & Display (ORD) securely to, or in the vicinity of, the process control panel for easy monitoring. Connect the AC Power Cable (APC) to the power jack on the Optical Receiver & Display (ORD) and make its power plug accessible to a power outlet but do not plug it in yet. Locate the AC Power Supply (APS) conveniently close to the control panel with its power cord also accessible to a power outlet but not plugged in yet.

Route, but do not connect, the Fiber Optic Cable (FOC) between the tank location and the FLC at the control panel location. Secure both ends of the FOC to something sturdy in the immediate area of the LDT and the FLC to prevent the possibility that a sudden jerk on either cable will stress its connection to the LDT or FLC.

Install the Level Sensing Probe (LSP) into the tank by screwing it into a standard 2" NPT female pipe fitting on the "pan" tank lid. The LDT unit should be mounted securely by its bracket to any sturdy structure slightly outside the periphery of the top of the tank but close enough for the Probe Coupling Cable (PCC) to reach conveniently from the LSP to the LDT. One end of the PCC connects to the coax fitting on the top of the probe. The other end of the PCC connects to the in-line coax connector pigtail protruding from the bottom of the Level Detecting Transmitter (LDT). It is **VERY IMPORTANT** that the end of the flexible conduit of the PCC be securely immobilized near the bottom of the LDT such that the cable ends and connectors of the LDT and the PCC are in a relative straight line out of the bottom of the LDT.

SETTING HIGH LEVEL ALARM

The High Level Alarm Limit threshold at which the Optical Receiver Display (ORD) goes into audible and visual alarm is adjustable over the entire operating range. This value is factory set at "80%". If it is necessary to adjust this to a new value then follow these directions:

- Remove the six screws on the rear panel of the ORD in order to slide the rear panel / circuit assembly out of the rear of the ORD to expose the circuitry inside
- Move the **NORMAL/ALARM SET** jumper to "Alarm Set".
- While watching the digital LED readout on the front of the circuit board adjust the **ALARM** potentiometer on the internal circuit board until the desired High Level Alarm Limit is displayed on the readout.
- Move the jumper back to "NORMAL".
- Close the cover and replace the six screws on the rear panel.

SET-UP AND OPERATION

1. Go to the Optical Receiver Display (ORD) monitoring point at the process control panel. Power the ORD. Confirm that the alert tone sounds and the digital LED readout flashes and displays "EEE". Press the "**Silence**" pushbutton and confirm that the alert tone ceases but the "**Limit"** and "**Signal Loss**" lights remain illuminated.

2. Confirm proper and safe routing of the FOC. Insure that is free from the likelihood of damage from pinching or crimping. (NOTE: Only light pulses are present in this cables, which does not represent potential danger to personnel or property should the cable become damaged or cut.)

3. Confirm that the FOC is secured to something sturdy in the immediate area of the FLC to prevent the possibility that a sudden jerk on the cable will stress its connection to the FLC.

4. Go to the tank location. Confirm that the FOC is secured to something sturdy in the immediate area of the LDT to prevent the possibility that a sudden jerk on the cable will stress its connection to the LDT.

5. Confirm that the Probe Coupling Cable (PCC) is securely connected to the top of the probe and to the pigtail connector on the Level Detecting Transmitter (LDT).

6. Connect the plug on the cable from the APS to the power jack on the LDT and secure it by finger-tightening the connector's screw-on retainer ring. Confirm that the Liquid

Crystal Display, visible through the window on the LDT, is giving a reading. It will cycle through three values: the level in inches, the percentage of full-scale and a 4-20 milliamp reading that is of no concern.

7. Remove the dust cover plug from the optical port on the LDT. Red light should be visible emanating from the port when your line-of-sight is directly into the port. (This is low-power light and not harmful to the eyes.)

8. Insert the end of the FOC into the optical port, pushing gently until the connector "clicks". Gently slide the flexible plastic boot on the FOC end so that it covers and grips the optical port fitting. This provides additional strain relief for the FOC.

9. Go to the FLC. Remove the dust cover plug from the desired optical input port. Insert the end of the FOC into the optical port, pushing gently until the connector "clicks". Gently slide the flexible plastic boot on the FOC end so that it covers and grips the optical port fitting. This provides additional strain relief for the FOC.

10. Confirm that the "**Signal Loss**" and "**Limit**" lights are now NOT lit. Confirm that the value displayed on the digital LED readout is somewhere in the range of 0.0 and 100.0 (assuming the tank has some contents).

The Multi-Function Precision Monitoring System is now operating properly! As the tank is filled or drained the **"Percent of MAXIMUM level"** value displayed on the ORD will track the liquid level.

If the High Level Alarm Limit is exceeded the digital LED readout will flash and show the level value and the alert tone will sound.

If the coded light pulses from the LDT become interrupted due to any cable or electronics failure then the alert will sound the same as above except that the "**Signal Loss**" light will glow and the digital LED readout will flash "**EEE**" for error.

Pressing the "**Silence**" button for either type of alarm will cause the digital LED readout to stop flashing and the alert tone to silence. If the alarm condition still exists the "Limit" light will remain on. If "high level" was the cause of the alarm then the "Limit" light will extinguish when the level drops below the "High Level Alarm Limit". If "signal loss" was the cause of the alarm then the "**Signal Loss**" light and the "Limit" light will extinguish when the coded light signal from the LDT is restored. The alarm will not activate again until the conditions return to a non-alarm state and then a violation occurs again.

PARAMETERS

The Level Detecting Transmitter (LDT) is programmed to operate properly in different specific applications by means of a field-programmable table of parameters. The values entered for these parameters tell the LDT things such as the length of the Level Sensing Probe (LSP) being used (**Prb Ln**), the distance from the tip of the LSP to the floor of the tank (**Offset**), the sensitivity to artifacts received from materials and structures in the tank other than water (**Sensitiv),** the response of the unit to a fault (**Fault**) and the password required for entering the parameter-change mode (**New Pass**).

These parameters are viewed and set by the use of the three pushbuttons inside the windowed screw-on cover. These values are set at the factory for optimum performance. The need for field changes

of these parameter values is unlikely. However, should they be necessary Selectronics shall provide proper consultation.

SPECIFICATIONS

Level Detecting Transmitter (LDT)

Supply voltage:	20 VDC
Current consumption:	60 milliamperes
Input:	Coaxial connection to feedline PCC and probe LSP
Output:	Coded light pulses @ 420 nanometers to fiber-optic cable
Weight:	7.2 lbs
Dimensions:	13” x 6.1”
Enclosure:	Gasketed splash proof cast aluminum
Detection method:	Micropower impulse guided wave radar utilizing time domain reflectometry
Power source:	AC Power Supply (model APS-20) 120 VAC-to-20 VDC Or DC Power Supply (model DCS-20) lead-acid gel-type battery unit

Fiber-to-Line Converter (FLC)

Supply Voltage:	Powered by ORD
Input:	Coded light pulses @ 420 nanometers from fiber-optic cable
Output:	Differential digital data to ORD
Weight:	1.2 lbs
Dimensions:	4.5” x 2.75” x 2”
Enclosure:	Gasketed splash proof aluminum

Optical Receiver & Display (ORD-3)

Supply voltage:	120 VAC
Power consumption:	15 watts
Input:	Differential digital data from FLC
Output:	Digital LED readout Alarm relay contact closure rated at 2 amperes AC or DC 12 VDC @ 100 milliamperes for remote annunciator / indicator
Weight:	3.5 lbs
Dimensions:	7.25” x 6.5” x 3.5”
Enclosure:	Extruded aluminum

WARRANTY

Selectronics, Inc. warrants all elements free from defects in materials and workmanship for a period of one year from date of purchase.