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**PID-201 8-point or 4-point unit, with FMD1616-10 PLC: Operation Instruction.**

On the MHI-420 interface, there are 11-key keypad (**0, 1, …. 9, Backspace, Enter**), 4 function keys **F1, … F4**, 4 LEDs **F1-LED… F4-LED**, and 4 more LEDs **LED1 … LED4**.

Main functions of these keys:

**F1 – Setup**, to set the parameters of the data collection and processing;

**F3 – Calibrate**;

**F4 –Control of points and some other operations**

**F2 – Proceed (Next step) during setup and setting time; also, it is used to manually start autozero, to turn lamp and pump ON/OFF, to switch the ranges, to show analog inputs in volts.**

* On power on, the device is in its **Main (working) mode**, the lamp is ON. The display shows the measured concentration of VOC in ppm. At the end of the run for given point, the data is automatically sent out via RS232 port, in Modbus RTU mode. The data is sent to the client device (SCADA or something else) as pa packet of eleven 16-bit registers, starting with the register # selected in the setup. These 11 registers hold the following info for the run through given point:
* 1st register - the year
* 2nd register – the month
* 3rd register – the day
* 4th register – hour
* 5th register – minute
* 6th register – second.
* 7th holds the high two bytes, C4 C3, of the 32-bit number for concentration (in ppb),
* 8th register holds the low two bytes, C2C1, the 32-bit number for concentration (in ppb).
* Combine these two 16-bit registers into a 32-bit number, C4C3C2C1, and read it as a 32-bit number. The result is the concentration value in ppb. In that number, if read as a decimal number, move the decimal dot 3 position to the left to get the concentration value in units of ppm, with 3 decimal places after the dot.
* 9th register holds the point number where the data was just collected and sent out.
* 10th register holds a 16-bit number where the lowest 3 bits represents the errors as follows: bit0 = 1 indicates calibration failure; bit1 = 1 indicates that the cal gas needs to be replenished soon; bit2 = 1 indicates lamp is OFF. All the other bits are not used at this time.
* 11th register holds the PID-201 ID. You need it in case the data from not 1 but several devices is sent to your SCADA or other device that collects the data.

In this **main mode**, the following actions are available:

**F4\_key actions:**

* Hold **F4** and press **3** key to activate point auto sequencing. **F4-LED** will turn ON to indicate the auto sequencing mode, and the sequencing starts.
* Hold **F4** and press **Backspace** key to stop automatic sequencing. **F4-LED** will go OFF. The current active point will continue to be analyzed.
* Hold **F4** and press **5** key to send the current point data immediately to output via Modbus.

**F2\_key actions:**

* Hold **F2** and press **0** key to initiate zeroing process. **LED1** goes ON, lamp goes OFF; the process takes about 5 s (for the new value to be saved).
* Hold **F2** and press **2** key to turn OFF the pump and initiate the filter cleaning process. **LED4** goes ON.
* Hold **F2** and press **3** key to turn ON the pump and stop the filter cleaning process and return to the normal operation. **LED4** goes OFF.
* Hold **F2** and press **4** key to increase the range, from 100 ppm to 1000 ppm. **LED3** will go OFF indicating a lower sensitivity range. The program detects what the range was set during calibration and during measurements, and takes care of calculations of the calibration factor and the concentration.
* Hold **F2** and press **5** key to toggle the auto-range mode between ON and OFF.
* Hold **F2** and press **8** key to decrease the range from 1000 ppm to 100 ppm. **LED3** will go ON;
* Hold **F2** and press **6** key to turn the lamp ON. **F2\_LED** will go ON;
* Hold **F2** and press **7** key to turn the lamp OFF**. F2\_LED** will go OFF;
* Hold **F2** and press **9** key to toggle the display between concentration and analog input voltage. This can be done in both the **Main** and **Calibrate** modes of operation.

To see the calibration factors during the Main mode, hold **Enter** and **Backspace** keys.

**To set time:**

* Hold **ENTER** and press **0** key to initiate setting the date and time. Use **F2** key to proceed to the next parameter (in the order of year, month, day, hour, minute, seconds). Use **4** key to increase, **8** key to decrease the value. The program will exit from the process when all the sequence is finished, or any time by entering Enter +**0** keys combination again.
* **Setup:**

Press **F1** to enter the **Setup mode.** You will go through a sequence of steps to set different parameters; the current value of each parameter is displayed. You can agree with it (press **F2** to proceed to the next parameter) or you can key in its new value using keypad and pressing **Enter** to accept the new value. Press **F2** to proceed to the next parameter. The parameters to be set are:

* Active point (1-8 for 8-point unit, 1-4 for 4-point unit, or 0 for automatic scan through all points).
* Response factor relative to the cal gas.
* Run time interval, in seconds, for auto switching between the points and sending the data out at the end of that time interval.
* Time interval for automatic cleaning the filter, in hours (If 0 is selected, the cleaning can be initiated only manually).
* Duration of the cleaning process.
* Port number for the client (SCADA or other device which will receive the data). The data will be sent via a serial port to that port number.
* Start register # where the 1st 16-bit data will be stored in the client device. Start register 0 will write the data starting with the register 4001.
* Number of registers designated in the client’s device to store the data received from PID-201. Because each data packet consists of eleven 16-bit words and is stored in eleven 16-bit registers in the client’s device, the data packets will be written to the selected number of registers until the registers are all used (in increments of 11). After that, the data packets that follow will overwrite the registers, as the whole 11-register package. For example, if the 1st register # is 0 and the number of registers is set as 110, 10 data packets will be written until the original registers start to be overwritten by the following data packets.
* **Calibration:**

Because the calibration process can be done with only one standard, for the ranges of 50 ppm, select the range as described above. After that,

Press **F3** to start **Calibration**. The program will automatically go through a sequence (zeroing, measuring cal gas concentration using the previously determined calibration factor for the selected range as indicated on the display and also by **LED3**, and calculating new value of the cal factor. In case the cal gas signal at the input is less than 2% of the input range (1 V for 50 ppm range), the calibration is not accepted, you will see the message “Cal Gas Low!”, and you have to increase the cal gas input. Cal gas measurement will automatically end in 90 s. To end it sooner, when you see that the cal gas concentration value on the display is already stabilized, press **Enter** key.

* Finally, the cal gas valve will be closed, the new calibration factors will be displayed for several seconds, and the device will exit the calibration mode and return to the **Main** working mode.
* If the automatic calibration mode is selected during the setup, the system will automatically perform calibration at the 100 ppm range with the selected periodicity.

In the **Main** mode, the flow value (in ccm) is also shown.

Summary on LED indicators:

**F1-LED** indicates that the input voltage (if ON) or concentration (if OFF) is displayed;

**F2-LED** indicates that the Lamp is ON;

**F4-LED** indicates that the automatic switching the points is active;

**LED1** shows that zeroing is in progress;

**LED2** shows that the range selection is set to Auto;

**LED3** shows that the high sensitivity range (100 ppm) is active;

**LED4** indicates the pump (ON/OFF) and cleaning process in progress.

Note the feature useful for diagnostics and described above: During the **Main** screen or in **Calibration**, hold **F2** and press **9** key to show ch0 and ch2 input voltages. **F1\_LED** will go ON. Repeat F2 + **9** key combination to return to the normal display (concentration).

**Additional comments:**

* As described in the Setup above, you can set the period (in hours) for the calibration to start automatically. (In case that time is set to zero, calibration can be started only manually).
* Digital outputs of the PLC board turn ON by sinking current from the load to the GND terminal. Max allowed current is 1 A, and the max voltage is 50 V. But continuously the digital output can sink not more than 0.3 A.
* For example, during the calibration process, digital output 1 is ON (1.1 V @ 0.3 A maximum), and its LED is ON. All the other time, the digital output 1 is OFF, and it is pulled up to 12 V via resistor and LED. A 12-V potential is on it, via the cal valve coil. You can bring a wire from that output to an external indicator of calibration being ON/OFF, making sure that that indicator sinks not more than 0.3 A through the digital output to GND.
* The diagnostics alarm at the digital output 4 is ON in case of any of the error are indicated (bad calibration, cal gas cylinder needs to be replenished soon, lamp error).

**Additional comments for the 8-point 201, only:**

1. As the customer requests, this unit will measure the concentration in 4 installations, which having 2 cleaning stages. The output of the 2nd stage is expected to clean the output flow from the 1st stage to have the concentration of VOC at the output of the 2nd stage not more than 10% of the output of the 1st stage. The gas inlets (inputs) of the 201 units are assumed to be connected to the installation as follows:

For the installation 1, point 1 takes and analyzes the sample from the output of stage 1, point 5 takes and analyzes the sample from the output of stage 2.

For the installation 2, point 2 takes and analyzes the sample from the output of stage 1, point 6 takes and analyzes the sample from the output of stage 2.

For the installation 3, point 3 takes and analyzes the sample from the output of stage 1, point 7 takes and analyzes the sample from the output of stage 2.

For the installation 4, point 4 takes and analyzes the sample from the output of stage 1, point 8 takes and analyzes the sample from the output of stage 2.

**In the auto-scan mode**, point 1 is analyzed and the measured concentration is stored in the PLC memory. Then the system switches to point 5, point 5 data is measured and analyzed. If the concentration in point 5 is more than 10% of the value at point 1, the alarm is activated (digital output 7) and the system does not scan other points but continue with the points 1 and 5 sequence until the 2nd stage is fixed to produce not more than 10% of the stage 1 output.

If the stage 2 of the installation 1 works OK, the alarm is deactivated, and the system switches to the 2nd installation (points 2 and 6). The same way, the system proceeds through all the 4 installations.

1. The digital output 7 turns ON the alarm in case the concentration at the 2nd stage is more than 10% of the concentration at the 1st stage