Drainage Pond for Airport Fuel Storage

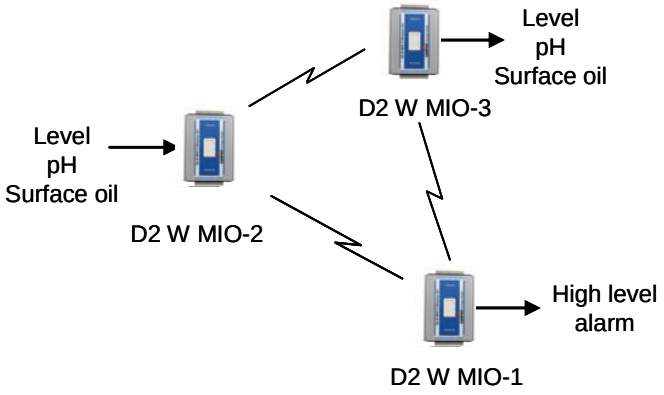
Keywords: D2 W MIO-2; D2 W MIO-3; D2 W MIO-1; loop powered AI; externally powered AI; analog setpoint; battery backup; communication failure outputs

Introduction

A pond collects drainage runoff from a fuel storage compound at an airport. For environmental reasons, it was decided to continuously monitor the pond by connecting level, pH and surface oil content signals to the airport services SCADA system. The SCADA provides indication, alarms and a historical record of the pond conditions.

A D2 W MIO-2 is installed to transmit these monitored values to an existing SCADA RTU (I/O device) approx 600' feet away. A D2 W MIO-3 module outputs the analog values to a SCADA input card.

The D2 W MIO-2 also transmits a high level alarm signal to a D2 W MIO-1 module mounted at the services compound gatehouse, approx 2000' away. The D2 W MIO-1 generates an audible alarm on a high level event.



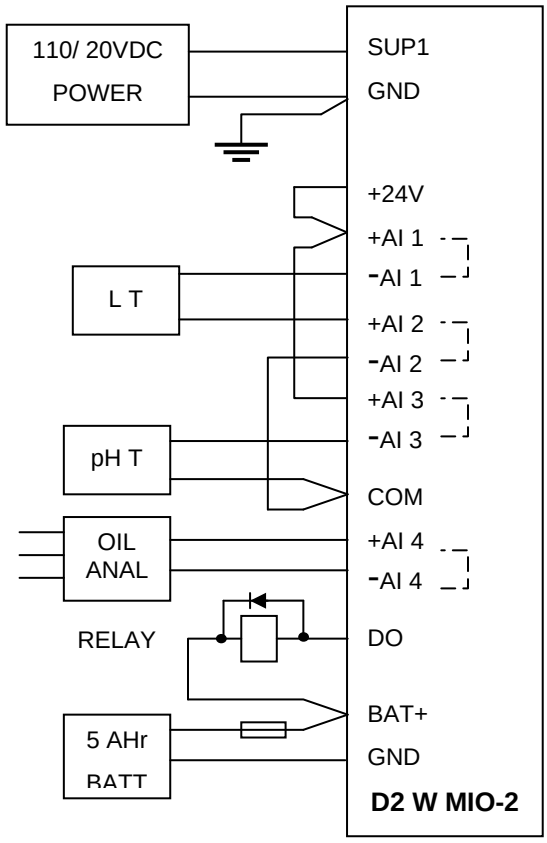
Drainage Pond

The monitored signals at the drainage pond are level, pH and surface oil. The level is measured using a submersible hydraulic pressure type level transmitter. The transmitter is loop powered from the D2 W MIO-2. The pH probe is also a submersible probe, loop powered from the D2 W MIO-2.

Surface oil is monitored using an oil-on-water analyzer. This analyzer uses a laser beam to measure the amount of surface oil on the water surface. The analyser is externally powered and provides a 4-20mA loop to the D2 W MIO-2.

As all three loops are slow changing, the default sensitivity and update times are accepted (3% and 10 minutes).

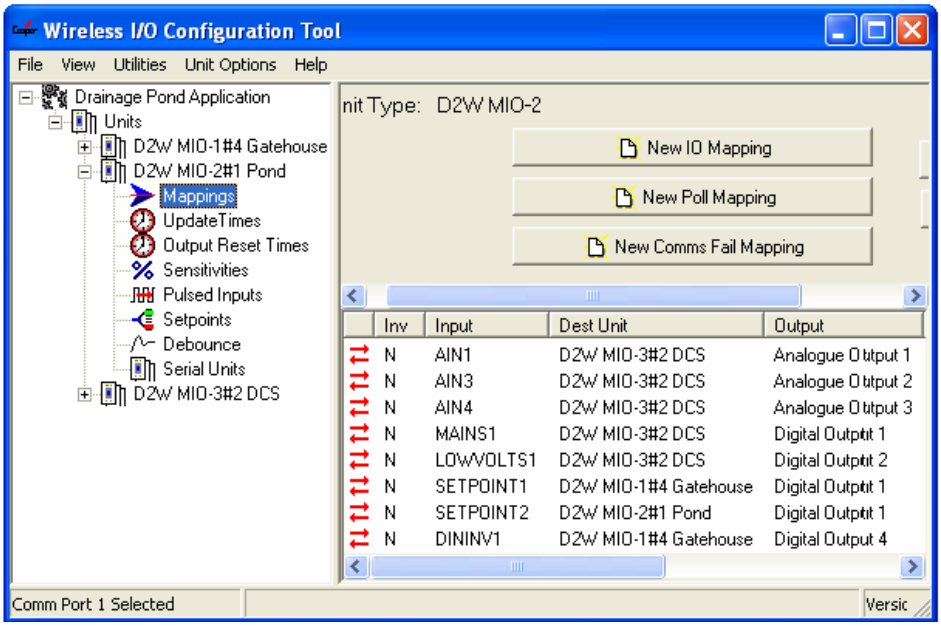
The level loop is connected to AI1 and AI2, pH is connected to AI3 and surface oil to AI4. The level loop is connected to two AI channels such that two independent setpoint alarms can be generated. The setpoints for AI1 are used to generate a high level alarm which is transmitted to the D2 W MIO-1 at the gatehouse. The setpoints are set at 98% (HI) and 90%

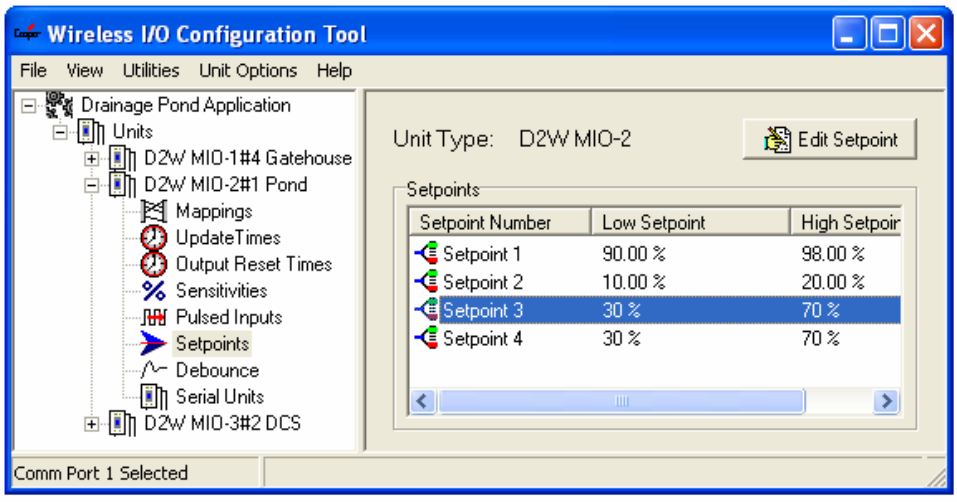


(LO) - that is, the high level alarm will activate at 98% and reset at 90% level. The setpoint status in the D2 W MIO-2 is "on" when the level is low - so the high level alarm transmitted to the D2 W MIO-1 will be the inverse of that required. As the D2 W MIO-2 does not provide an invert function for the setpoint status, the output at the D2 W MIO-1 is inverted by a relay.

The setpoints for AI2 is used to generate a low level cutoff for the local pond pump. The setpoint status for AI2 is mapped to its own discrete output on the D2 W MIO-2. In the event of low level, this DO will activate and cutoff the pump. The pump has its own cutoff level switch - the D2 W MIO-2 DO is a back-up cutoff to prevent the pond being pumped dry. The setpoint values are 20% (HI) and 10% (LO) - that is, the low level cutoff will occur at 10% level and reset at 20%. The DO is connected to a 12V relay, powered from the D2 W MIO-2 battery output.

The D2 W MIO-2 is mounted in a steel NEMA4 enclosure, on the side of a 10' galvanised post. A unity gain antenna (CFD890) is mounted at the top of the pole. Because of the high tanks around the pond, it is decided that a coaxial surge protector is not required for lightning protection.





Power is connected to a nearby lighting pole (110VAC). This power is used to power the oil-on-water analyzer and the D2 W MIO-2 via a 20VDC supply. A 5 amphour sealed "gellcell" battery is connected to the D2 W MIO-2 for backup power to protect against failure of the 110V power. The backup battery will provide approx 30 hours backup for the wireless I/O module, and level and pH loops, but not the oil-on-water analyzer. Both power failure and low battery voltage status are transmitted to the SCADA.

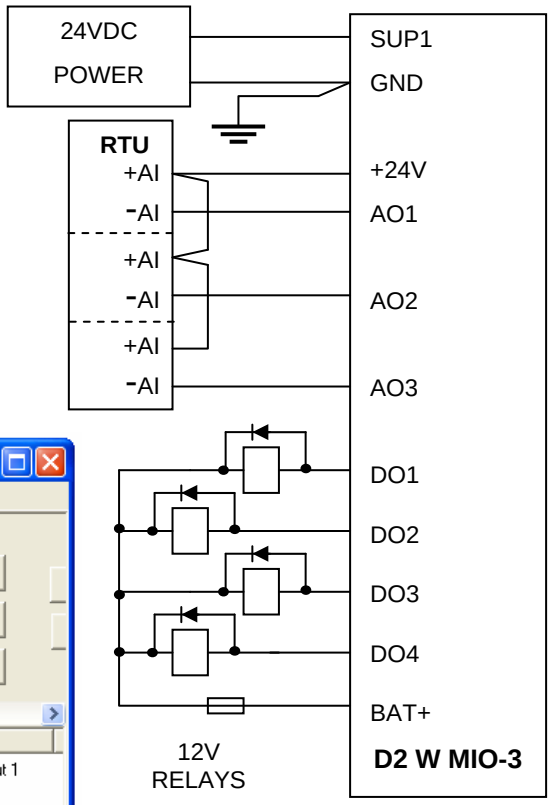
Discrete input 1 (DI1) is used to test the communications to the gatehouse D2 W MIO-1 module (refer "Gatehouse")

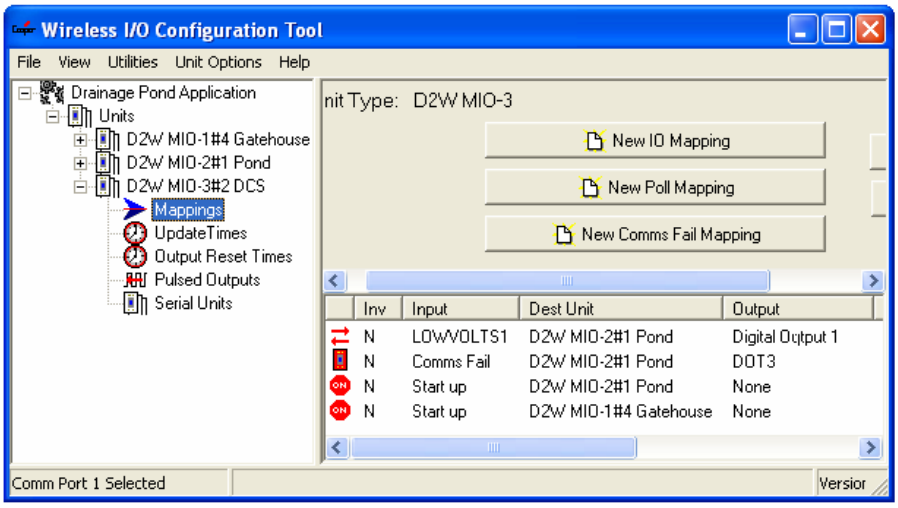
SCADA

A D2 W MIO-3 provides analog and discrete outputs to input cards in an existing RTU (remote terminal unit) in the airport SCADA system. Interposing relays are used with the discrete outputs to provide voltage-free contacts for the RTU inputs. The D2 W MIO-3 is powered by the RTU 24VDC power supply.

A previous radio test showed that reliable radio paths were possible using a unity gain CFD890 antenna mounted on the eaves of the RTU building.

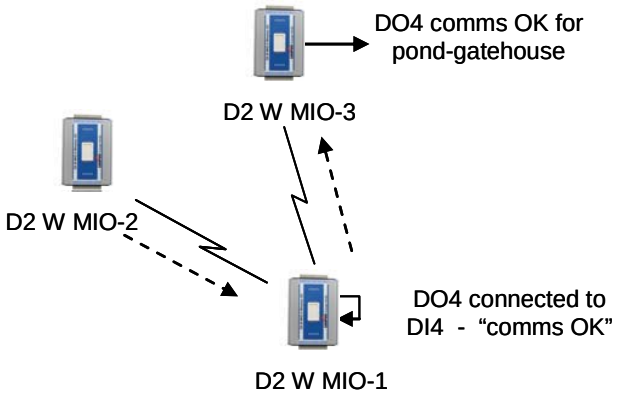
Four discrete outputs are connected to the RTU via interposing relays. DO1 and DO2 are power failure and low battery voltage for the D2 W MIO-2 module at the pond. DO3 is used to detect communications failure to the pond, and DO4 is used for communications status of the Gatehouse.





Communication Failure Alarms

It is necessary for every module to have at least one I/O mapping configured. As such, a mapping is made at the D2 W MIO-3 to the D2 W MIO-2 module at the pond (the Low Voltage status is used however any input could be used). This mapping fulfils the requirement that there must be at least one I/O mapping and also provides a regular test of the communications path to the D2 W MIO-2 module - this mapping will generate an update transmission every 10 minutes. A “comms fail” mapping is configured to DO3 - that is, if the D2 W MIO-3 module is not successful in transmitting a message to the D2 W MIO-2, then DO3 will activate as a “comms fail” output. An output reset time of 12 minutes is configured for DO3 - that is, DO3 will reset 12 minutes after the last “comms fail” occurs, provided the next 10 minute update transmission is



successful.

Determining the status of the communications path between the pond and the gatehouse is more difficult. It is not valid to assume that this radio path is working because the SCADA module can communicate with both the pond and gatehouse modules. In order to test this path, a mapping is made from the pond module to the gatehouse module such that a discrete output at the gatehouse is normally "on" - this is called a "comms OK" output, as an active output indicates communications is OK. At the pond module, DI1 is mapped to DO4 at the gatehouse. There is nothing connected to DI1 (it is "off"), so the mapping is inverted such that DO4 is normally "on". This mapping will generate an update message every 10 minutes.

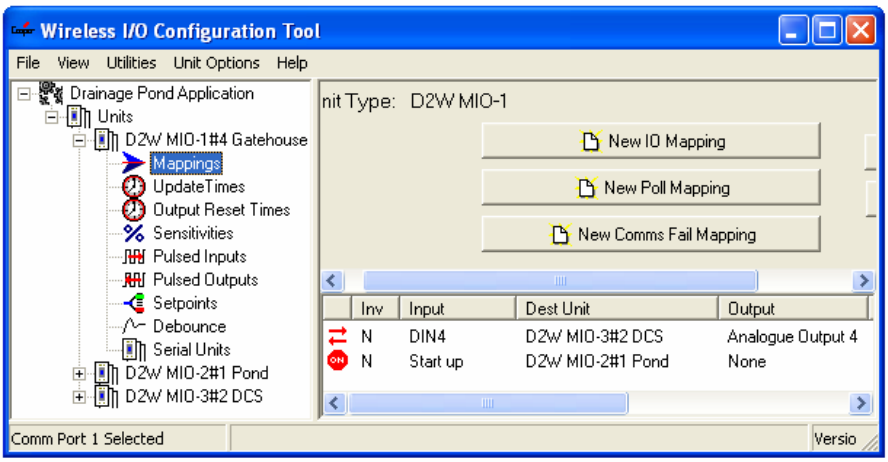
At the gatehouse, an output reset time of 12 minutes is configured for DO4 - that is, if a 10 minute update is not received, then DO4 will reset after 12 minutes.

DO4 indicates the comms-status of the radio path between the pond and the gatehouse. But it is necessary for this status to be connected to the SCADA. So DO4 is hard-wired to DI4 on the same module, and DI4 is mapped to DO4 at the SCADA unit. Now DO4 at the SCADA module (the D2 W MIO-3) indicates the comms-status of the pond-gatehouse path - when DO4 is "on", the communications status is OK.

Gatehouse

A D2 W MIO-1 is installed to provide a high level alarm for the pond. The high level alarm is mapped from the pond to DO1 at the gatehouse module - this output is connected to the gatehouse annunciator panel (the DO outputs on a D2 W MIO-1 are relay contacts as opposed to transistor outputs on the other modules).

The module is powered by a 110V/20VDC power supply. It was decided not to use a backup battery at this module. An 8dB collinear antenna was used as a radio test showed that the radio paths to the pond and SCADA station were weak using a unity gain antenna. The antenna is mounted 10' above the roof of the gatehouse and connected to the module using a 30' coaxial cable with 3dB loss. The net gain of the antenna/cable is 5dB. As the gatehouse is not surrounded by high steelwork, a lightning surge diverter was installed on the coaxial connector of the module and well connected to the grounding point of the gatehouse electrical supply.



As previously discussed, DO4 is mapped as a "comms OK" output. DO4 is wired to DI4 on the same module, and DI4 is mapped to the SCADA module for monitoring. This mapping fulfils the requirement that there be at least one I/O mapping at each module.