Mottech
Water Management

Mottech Decoder System (MDS) **Design Guide**

INTRODUCTION

Mottech Water Solutions Ltd. a worldwide master-distributor of Motorola Solutions provides advanced remote monitoring & control solutions for diverse markets and applications including Agricultural Irrigation, Turf & Landscape Irrigation and, Water Distribution. Mottech's solutions are based on Motorola's proven IRRInet platform supervised by the advanced central control system- ICC PRO.

The Mottech Decoder System (MDS), is a reliable, high efficiency, 2-wire decoder solution for monitoring and control of 24 VAC valves and a variety of sensors. Each decoder connected to the 2-wire cable, functions as both a switching mechanism providing 24 VAC to each valve and in a supervisory role monitoring critical solenoid parameters.

True two-way communications between the interface and the decoders, provide diagnostic capabilities for monitoring the general health of the 2-wire cable, decoders and valve solenoids.

This design guide provides the information needed to facilitate a proper design and outlines the required installation procedures for a reliable, long-term, sustainable system.

1. System components, including ICC PRO, controllers, decoder interface, decoders and 2-wire cable.
2. Structure of the field installation, layout etc.
3. 2-wire cable requirements
4. Surge and corrosion protection requirements
5. Installation requirements
6. Integrity check.

1. SYSTEM COMPONENTS

The decoder system consists of various components described below.

ICC PRO & WEB APPLICATION

ICC PRO serves as a remote water and irrigation management tool and is an integral part of the Motorola IRRInet system. The ICC PRO software provides a reliable, centralized & remote irrigation control platform communicating with the system's components while monitoring and controlling all sites. It provides real-time status reporting of all irrigation, fertilizer pump stations and enables accurate operation of the irrigation programs and schedules.

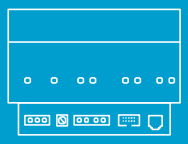
The ICC PRO web application allows a system operator to manage the control system from anywhere at any time. The application seamlessly links the web-enabled device to ICC PRO and displays the information in a mobile-friendly format.

Main components of the MDS

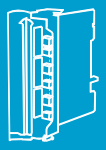
ICC PRO &
Web Application

IRRInet M

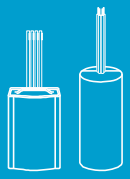
IRRInet ACE



Decoder
Interface



Decoder
Interface



Decoders

24 VAC Electric
Valves

Analog & Digital
Input

MOTTECH CONTROLLERS

The controllers are the link between decoders deployed in the field and the ICC PRO software.

The decoder interface connects the 2-wire path and decoders to the controller. Two IRRInet controllers are compatible with the MDS:

- IRRInet M –maximum of 200 decoders
- IRRInet ACE –maximum of 400 decoders

The IRRInet M & ACE units are remotely managed using ICC PRO software.

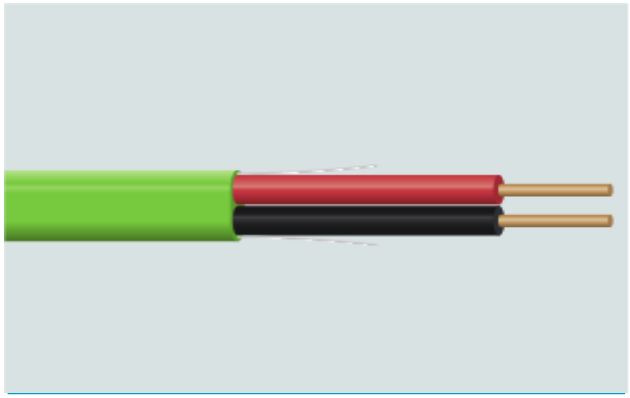
DECODER INTERFACE UNIT

The interface connects the controller to the 2-wire path and decoders. A powerful component of the MDS, optimizing power within the low voltage system for Output Decoders, Input Decoders, and also monitoring the vital parameters of the 2-wire system.

IRRInet M Interface: 200 Output Decoders

ACE Interface: 200 Output Decoders expandable to 400 Output Decoders

2-WIRE CABLE



In the MDS, the 2-wire cable serves as both a power source and communications path for field decoders.
A 2-wire decoder system drastically reduces the required amount of field wiring compared to a standard irrigation system.
Future system expansion is easily accommodated by extending the 2-wire path to the next group of valves.

Do not exceed the maximum length of the “Critical Wire Path” Guidelines.

OUTPUT DECODER

The output decoder is the device that drives the solenoid. Each decoder has a unique address which is used by ICC PRO to communicate with the decoder.

Decoders operate 24 VAC valves or relays and are available in 1, 2, 4 & 6 Output Configurations.

Each output decoder will operate one valve.

SENSOR INPUT DECODER

The sensor input decoder captures sensor data for the controller. An input decoder is configured to work with either digital or analog sensors.
Each input decoder has one address and monitors one sensor.

Digital Inputs may include Flow Sensors, Rain & Freeze Sensors (Dry Contact/Status Change)
Analog Inputs may include Pressure Transducers.

SURGE PROTECTION DECODER

The surge protection decoder is required to protect the system from lightning strikes, and electrical surges.

For additional information see Section 4.
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ADDITIONAL COMPONENTS

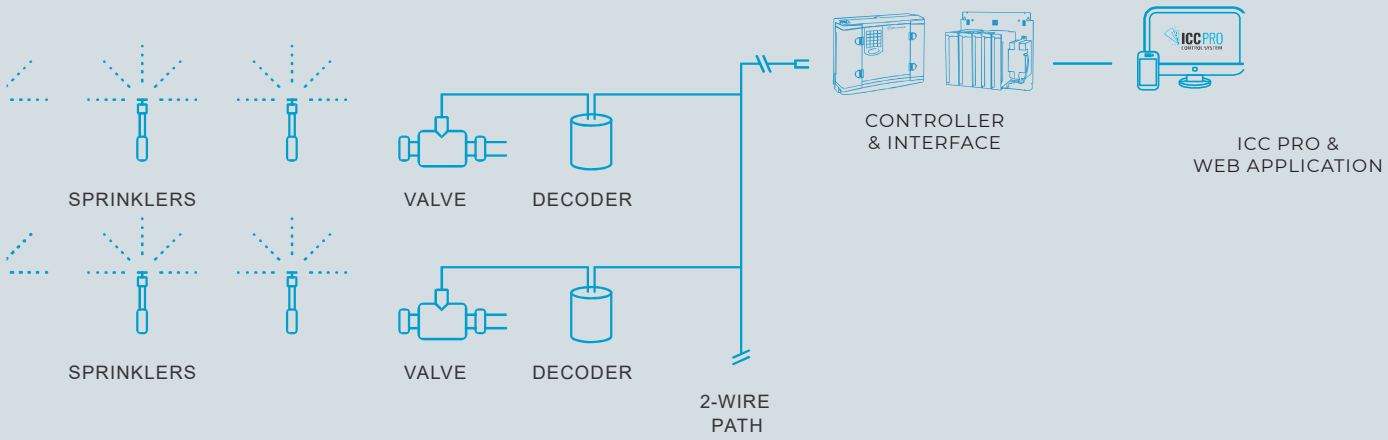
Installing these system components requires water-tight splice kits and ground rods or ground plates.

2. STRUCTURE OF THE FIELD INSTALLATION

The layout and installation of a 2-wire system is simple, but certain rules must be followed.

PRINCIPLE OF INSTALLATION FOR 2-WIRE, DECODERS AND VALVES

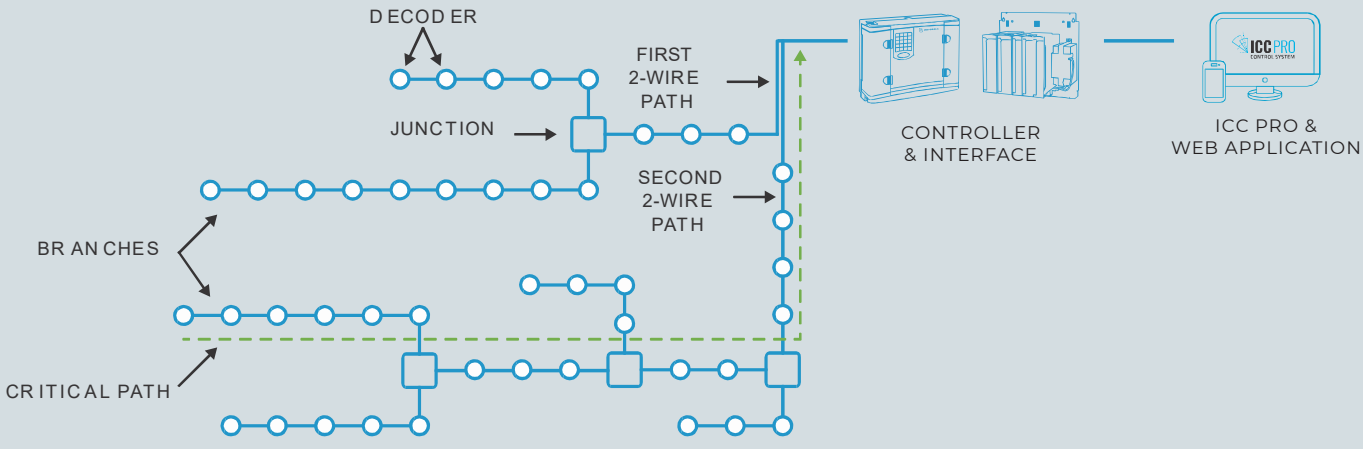
The diagram shows the basic concept of the interface, 2-wire cable, decoder and valve connections. Decoders can be installed anywhere on the 2-wire path. All decoders have a unique address and do not have to be installed in any particular order.



STAR CONFIGURATION

The figure below shows a typical star installation. The interface has multiple 2-wire terminal sets and it is recommended to install additional 2-wire paths from the interface to the field. This provides an easier troubleshooting scenario for locating shorts since the wire paths can be tested individually.

It is important to be aware of the critical path, which is the length of the 2-wire cable from the controller to the farthest point. This distance may never exceed the specification for the size of the cable installed.



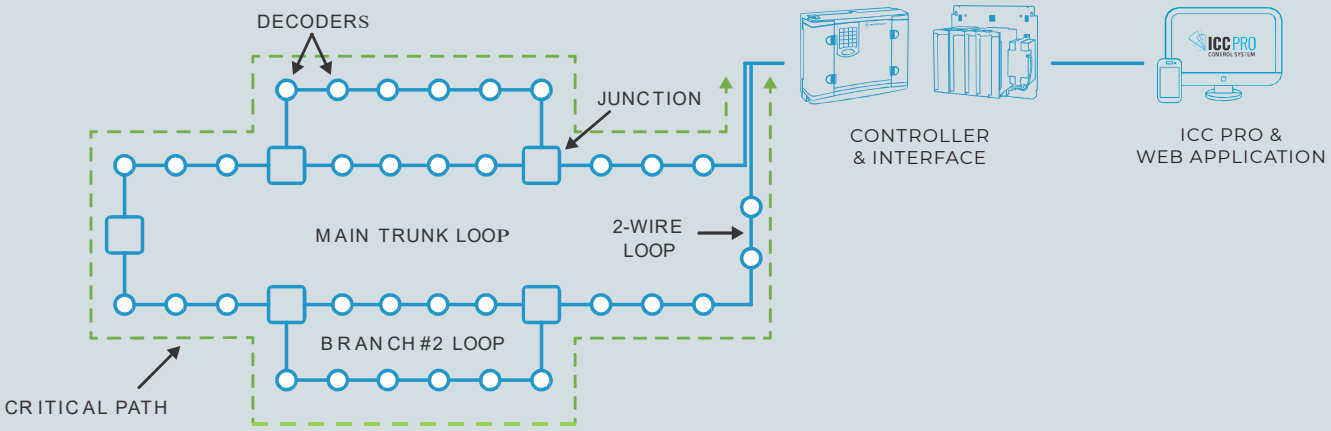
LOOP CONFIGURATION

The figure shows a typical loop installation. The interface has multiple 2-wire terminal sets, but it is recommended to loop the wire back to the same terminal set especially if more loops are used. It is important to use color-coded wire and make sure all splices along the wires are kept the same; i.e., black to black, and red to red.

In case of troubleshooting e.g., a short on the 2-wire, it is important to open the loop either at the interface or somewhere along the 2-wire path.

It is important to be aware of the critical path which is the cable length of the entire loop. This may never exceed the specification for the size of the cable installed, see below.

In general, it is recommended to use the star configuration over loop, for easier installation and troubleshooting.



BRANCHES

The 2-wire can be branched off at any place and in as many places as desired. Be aware that it may change the critical path.

On a star configuration, it might just be the new farthest point, but on a loop configuration with a branch that loops back at another point, it might extend the total cable length. If it is branched off on a loop configuration, but not looped-back, then the branch will be treated as a star in respect to the critical path

3. 2-WIRE CABLE

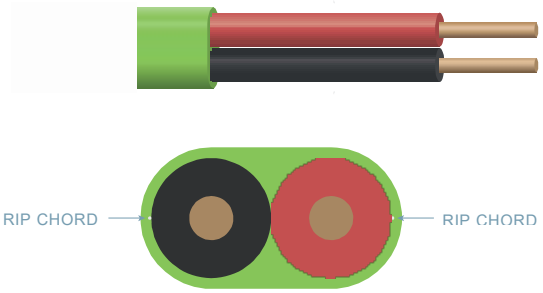
WIRE SPECIFICATION AND QUALITY

The 2-wire cable shall be jacketed solid parallel wires for direct burial. It is recommended to use e.g., Paige P7072D.

Specification of the Paige cable can be found in the QR link

Similar, but twisted wires can be used.

TWO-WIRE CROSSECTION



WIRE LENGTH OF THE 2-WIRE PATH

The maximum allowable wire length depends on the diameter of the wire.

The following tables show a maximum 2-wire wire length for a system with up to 200 decoders per 2-wire path, with 30 active decoders, and with the decoders evenly distributed.

When using Sensor Input Decoders configured as Analog Sensors, please consult your Authorized Reseller for additional information.

MAXIMUM LENGTH OF CRITICAL WIRE PATH

Metric wire size	Loop		Star	
	km	Miles	km	miles
2.0 mm	11.6	7.2	2.9	1.8
2.5 mm	14.8	9.2	3.7	2.3
3.0 mm	17.6	10.8	4.4	2.7
3.5 mm	20.4	12.8	5.1	3.2

Imperial wire size	Loop		Star	
	km	miles	km	miles
16 AWG	9.2	5.6	2.3	1.4
14 AWG	14	8.8	3.5	2.2
12 AWG	22.4	14	5.6	3.5

4. SURGE AND CORROSION PROTECTION REQUIREMENTS

Grounding of the system is important to protect the installation against lightning surge and corrosion.

A lightning surge will damage the system, if not properly protected. A lightning surge can be induced anywhere in the system. The lightning will be induced in both wires as a common surge, the induced surge will traverse along the wires until it can pass on to the ground.

A bare copper wire is vulnerable to corrosion if not properly protected. Even though the installation is made perfectly, over time, rocks, excavation, or animals may damage the insulation and expose the bare copper wire to the elements.
If the mean voltage on the 2-wire is positive, then the copper will dissolve into the soil at a rate of 1g / mA / day. This can quickly corrode the copper wire and interrupt the circuit in a few days. If the mean voltage on the 2-wire is negative, then the copper will stay intact but may be coated with black oxidation. While the oxidation indicates, that the wire is not watertight, it does not harm the wire, but water may penetrate the decoder. The decoder interface drives an alternating voltage on the 2-wire path and strives to keep it slightly negative. For this to work properly, the decoder interface must be properly grounded.

THE INTERFACE

The interface must be grounded with a ground rod or ground plate connected to a 6 AWG / 4 mm2 wire.
The resistance to ground must be 10 Ω or less. If needed, additional ground rods should be installed in a "Y" configuration, welded together to establish the desired resistance. It is also recommended to establish the grounding in an area that has a high soil moisture content. Ground rods installed in regularly irrigated areas, typically perform best due to improved soil contact with the grounding medium.

Proper grounding is important for both the surge and corrosion protection

THE FIELD INSTALLATION

The field installation must be grounded to protect against lightning surges. The installation must be grounded using special surge protection decoders (see below) or using the built-in surge protection in the larger station count Output Decoders.

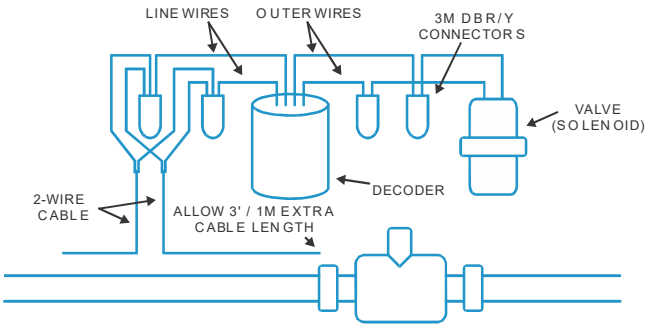
NOTE: 2, 4, & 6 Station Output Decoders have built-in surge protection. The surge protection must be grounded as listed below to protect the system.

Surge protection decoders must be placed along the 2-wire path every 150 m / 500', plus at the end of each branch. The surge protection decoder must be grounded via a ground rod of 50 Ω or less. Under no circumstances should the 2-wire path be unprotected by a surge protection device for a distance exceeding 150 m / 500'.
It is important not to deviate from the specified cable type above and use single wires. This can be tempting in a retrofit installation, but the two wires will most likely not run in parallel. Thus, a lightning surge will be induced as a differential surge that is harmful to the decoders.

5. INSTALLATION REQUIREMENTS

DECODER INSTALLATION

It is recommended to install the decoders as shown. Leave about 1 m / 3' of 2-wire cable to allow future work or troubleshooting on the installation. Leave 30 cm / 1' of 2-wire wires without the outer jacket to allow using a clamp meter for troubleshooting. Ensure watertight connections on both the 2-wire connections and the solenoid connections.

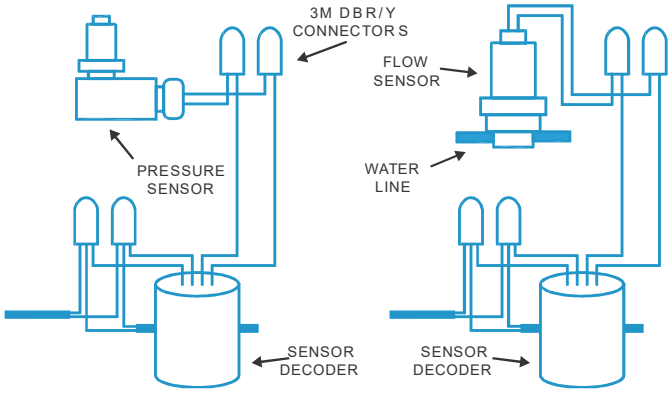


SENSOR DECODER INSTALLATION

The sensor decoder must be installed similar to any other decoder in respect to spare wire, connections etc.

For many types of sensors, the sensor decoder will be the power source regardless of whether it is pulse, voltage or mA input. In these cases, just connect the red (+) and black (-) wires to the sensor

If the sensor has its own power supply, then please consult the installation manual for the sensor.



SURGE PROTECTION DECODER

The surge protection decoder must be installed as mentioned above in the chapter about surge protection in the field.

Both the green/yellow wires will be connected to the ground rod/plate.

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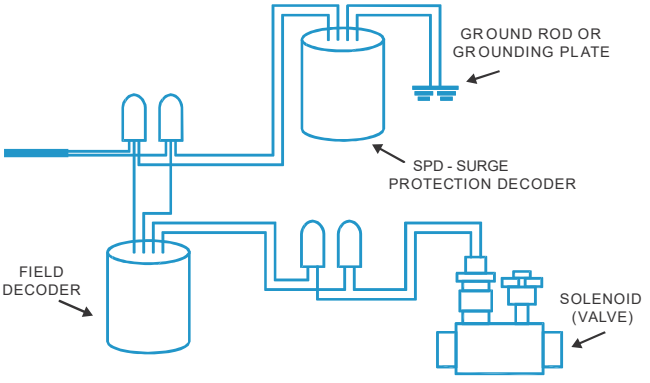

CONNECTORS

An important factor to ensure a long-lasting system is to make sure ALL the connections are watertight – not only the 2-wire connections, but also, the solenoid wire connections. This also applies to sensor decoders and surge protection decoders.

It is recommended to use 3M DBR/Y-6 or similar.

Never reuse the gel caps a second time as they will no longer seal properly.

VALVE BOXES

All valves and decoders must be installed in valve boxes for ease of troubleshooting and serviceability.

6. INTEGRITY CHECK

When finished with the installation it is recommended to perform an integrity check of the installation to establish a benchmark for future troubleshooting. All that is needed to perform an integrity check is a leakage clamp meter.

The clamp meter shown below is an example, and the meter must be capable of measuring in mA resolution. Some clamp meters are also able to measure the resistance of a ground rod/plate.

To perform the integrity check, place the system in short finding mode (50 / 60 Hz), and follow the procedure outlined in the 2-wire troubleshooting manual.

Document the current draw of each branch of the 2-wire path. Check the actual current draw against the expected draw, which can be calculated by the number of decoders on the branch and the type. The following table shows the expected standby current draw of the various decoder types. The expected current draw is +/- 10%.

EXPECTED STAND-BY CURRENT DRAW BY DECODER TYPE

Decoder	Part #	Expected Current (mA)
1 address, 1 solenoid per output	MDS-1001	0.3
2 address, 1 solenoid per output	MDS-1002	0.3
4 address, 1 solenoid per output	MDS-1004	0.3
6 address, 1 solenoid per output	MDS-1006	0.3
Sensor Input Decoder	MDS-SID	0.5
Surge Protection Decoder	MDS-SPD	0

Thank you for your interest in the Mottech Decoder System. Please contact your Authorized Value-Added Reseller or dpeters@mottech.com with any questions regarding this product and its application.