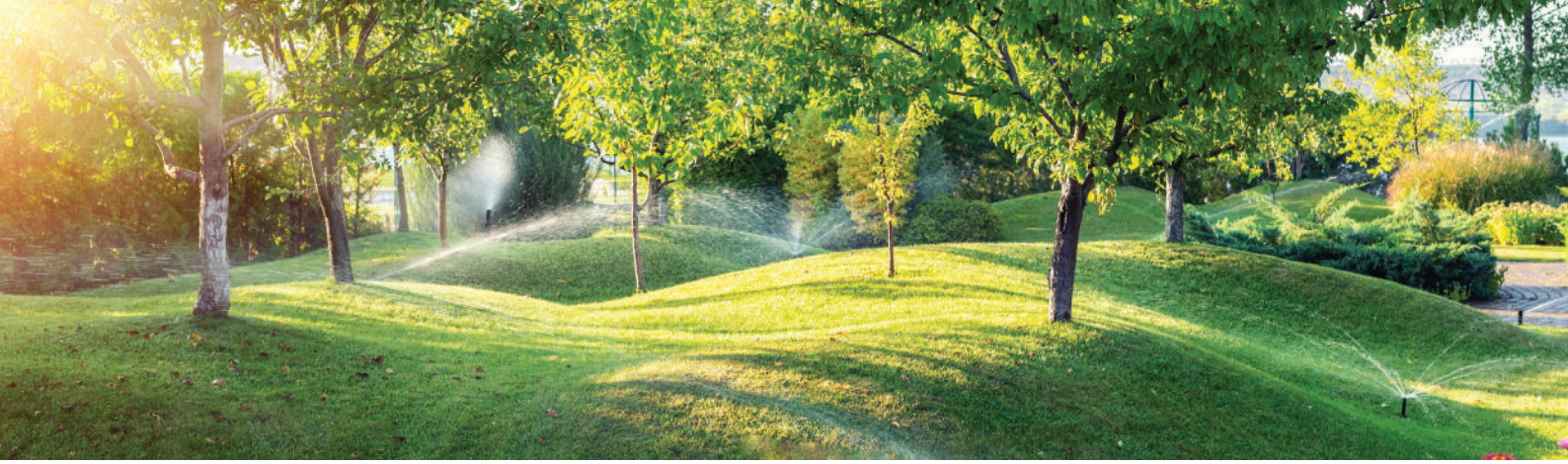
Decoder system guidelines

- Next Level Smart Irrigation

Crysberg



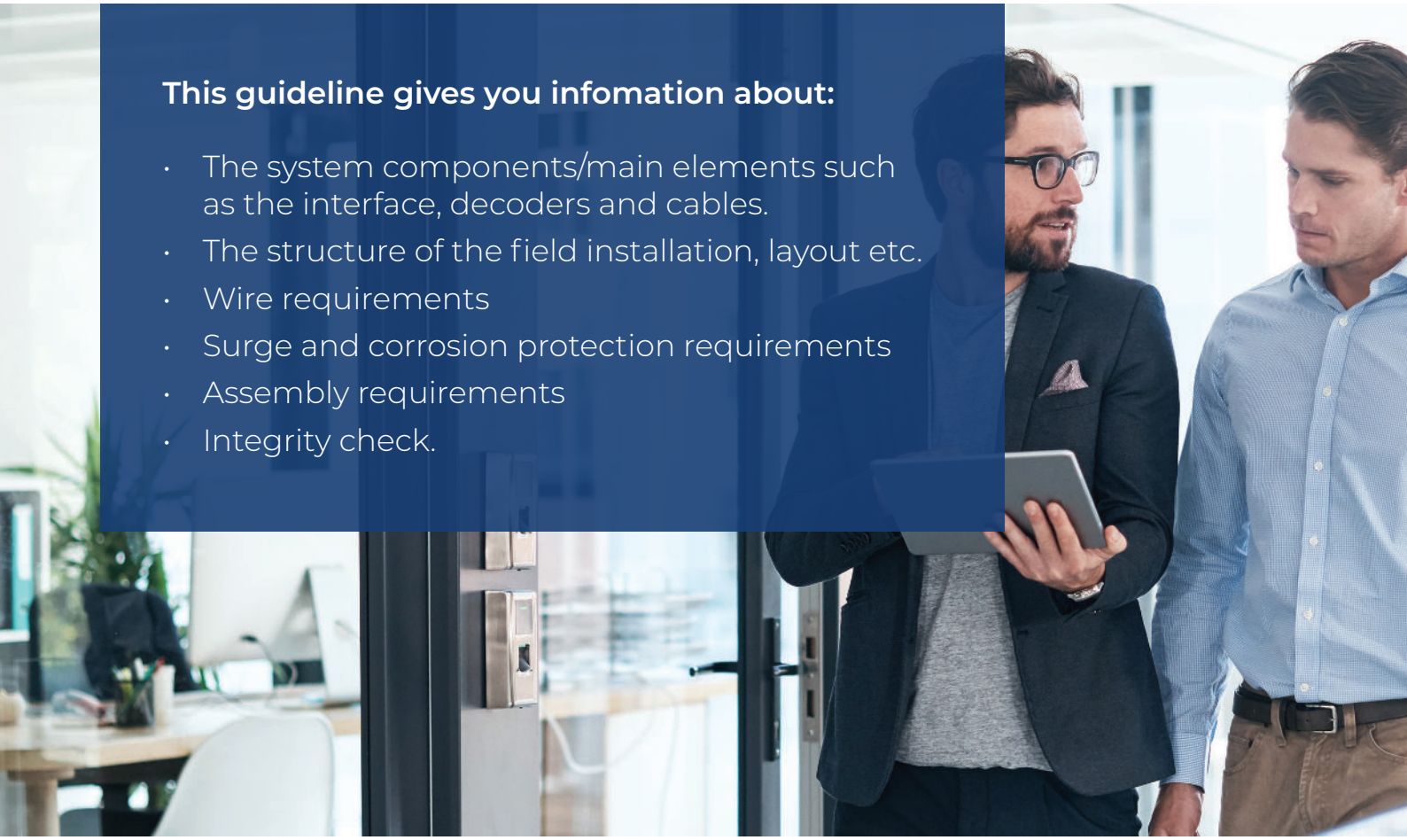
Introduction

Crysberg is the world leading manufacturer of 2-wire decoders and interfaces for professional irrigation. Crysberg has over the last three decades manufactured more than four million decoders.

This guideline serves to guide you to make a good and sustainable installation which will last for years and protect your investment.

This guideline gives you infomation about:

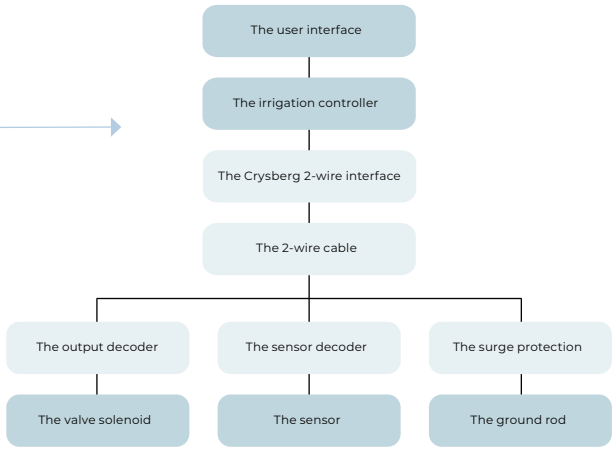
- The system components/main elements such as the interface, decoders and cables.
- The structure of the field installation, layout etc.
- Wire requirements
- Surge and corrosion protection requirements
- Assembly requirements
- Integrity check.



The system **components**

The decoder system consists of various components described below. The main elements in an irrigation system are:

The guideline does not cover the valve installation nor the controller part, but all the parts from the 2-wire interface to the solenoid driving the valve.



The Crysberg 2-wire interface
The interface serves as the link between your irrigation controller and the 2-wire system. The interface receives commands from the controller and transform them into 2-wire commands which the field components understand and react upon.

The result of these commands will be sent back to the controller. These commands can be activation of a solenoid, read a flow via a sensor decoder etc.

The interface works with a low voltage on the 2-wire; i.e. no need for certified electricians to install the system.

The 2 -wire cable
In a 2-wire decoder system the 2-wire cable serves both as power source and communication path for the field decoders.

The 2-wire cable installation makes the entire system installation much easier and neater. Just pull a 2-wire cable from the interface and install decoders along the wire where needed.

The output decoder
The output decoder is the device which drives the solenoid. The output decoders come in various sizes for driving one or more solenoids. Please see the data sheets for the various output decoders. The output decoder has an address which is used by the interface to communicate with the output decoder. The address must be known by the controller.

The sensor decoder
The sensor decoder is the device for capturing data from a sensor. The sensor decoder has one address and reads one sensor. The type of sensor must be configured from the controller. For more details on the sensor decoder, please see the data sheet here.

The surge protection decoder
The surge protection decoder is used to protect the installation in case of lightning strikes.

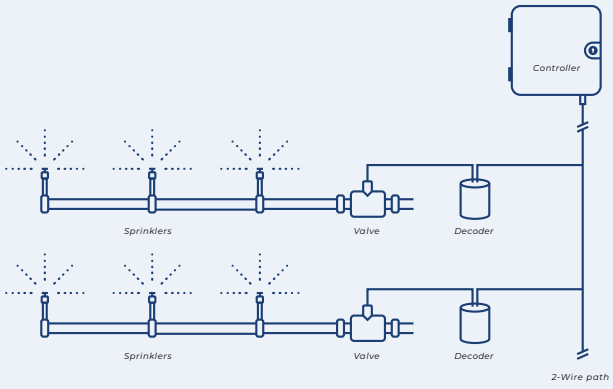
Various other components
To comprise the elements above you will need grounding rods and splice kits.

The structure of **field installation**

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

Principle of installation of 2-wire, decoders and valves

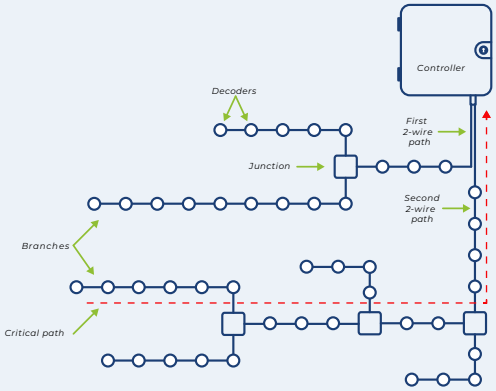
The figure shows the principle of the interface, 2-wire, decoder and valve connection. The decoders can be installed anywhere on the 2-wire. They all have a unique address and they don't have to be in any particular order.



Star configuration

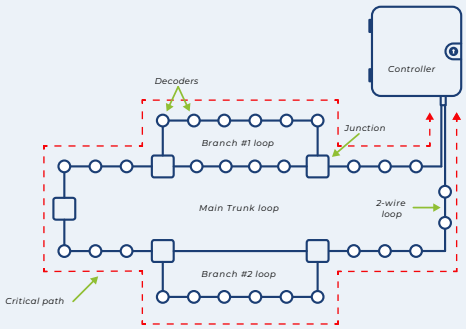
The figure shows a typical star installation. The interface has multiple 2-wire terminal sets and it is recommended to pull more 2-wires from the interface to the field. This serves an easier troubleshooting for e.g. shorts as the wires can be tested one at the time.

It is important to be aware of the critical path which is the cable distance to the farthest end. This may never exceed the specification for the cable used, see below.



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, red to red.



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

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 cable used, see below.

In general, it is recommended to use star 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 which loops back at another point it might prolong the total cable length. If it as branched off on a loop configuration, but not looped back, then the branch shall be treated as a star in respect to the critical path.

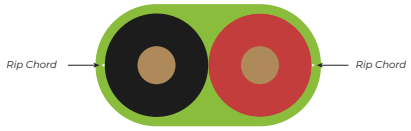
Wire requirements

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: Here

Similar, but twisted wires can be used.



Wire length of the 2-wire

The wire length depends on the diameter of the wire. The following tables show 2-wire wire length for a system with up to 300 decoders per 2-wire path, with 30 decoders active, and with the decoders evenly distributed.

Maximum length of critical wire path – metric wire size

Nominal wire size	Loop		Star	
	Km	Miles	Km	Miles
2.0 mm²	9.6	6.0	2.4	1.5
2.5 mm²	12.0	7.5	3.0	1.9
3.0 mm²	14.4	8.9	3.6	2.2
3.5 mm²	16.8	10.4	4.2	2.6

Maximum length of critical wire path – imperial wire size

Nominal wire size	Loop		Star	
	Km	Miles	Km	Miles
16 AWG	6.3	3.9	1.6	1.0
14 AWG	10.0	6.2	2.5	1.6
12 AWG	15.9	9.9	4.0	2.5

Wire length of the solenoid wire

The wire length depends on the diameter of the wire. In general, it is recommended to have as short solenoid wire as possible to limit lightning strikes.

Maximum length from decoder to solenoid

Nominal wire size	Meters	Feet
1.5 mm²	100	328
2.0 mm²	133	436
2.5 mm²	166	545
16 AWG	88	289
14 AWG	139	456
12 AWG	220	720

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 it is 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 it is not properly protected. Even though the installation is made perfect watertight, then rocks, shovels, animals etc. will over time be able to damage the insulation and expose the bare copper. If the mean voltage on the 2-wire is positive, then the copper will dissolve into the soil with 1g/mA/day. This can disconnect the wire in a few days. If the mean voltage on the 2-wire is negative, then the copper will stay intact, but will be covered by a black stuff. It indicates, that the wire is not water tight. It does not harm the wire, but water might penetrate into the decoder.

The interface drives an alternating voltage on the 2-wire and strives to keep it slightly negative. To do this it is important the interface is properly grounded.

The interface

The interface must be grounded with a ground rod or ground plate connected via a 6 AWG / 4 mm^2 wire. The resistance to the ground must be 10 Ω or less. Eventually place more ground rods in a Y configuration welded together to establish the desired resistance. It is also recommended to establish the grounding in an area which has a high soil moisture. It could even be in an area regularly irrigated by the system to keep a good connection to the soil.

> The grounding is important for both the surge and corrosion protection.

The field installation

The field installation must be grounded to protect against lightning surge. The installation must be grounded via special surge protection decoders (see below) or via the built-in surge protection in the larger decoders, please see datasheets for the decoders. In the following all noted as surge protection decoder.

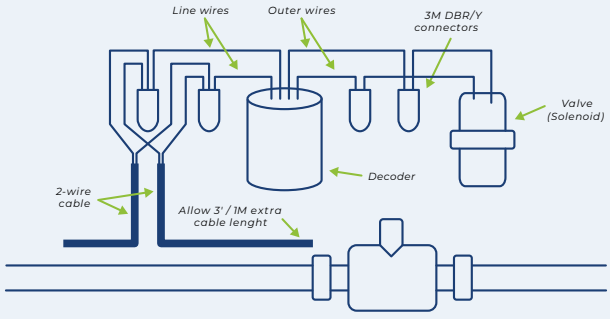
The surge protection decoders must be placed along the wires for every 150 m / 500’ plus at the end of each branch. The surge protection decoder must be grounded via a ground rod of 50 Ω or less.

> 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. This is harmful to the decoders.

Assembly **requirements**

Decoder installation

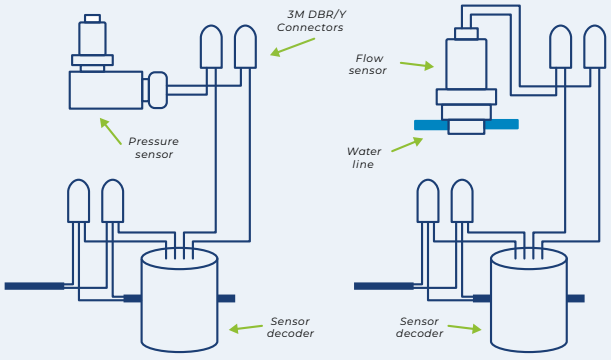
It is recommended to install the decoders as shown. Leave about 1 m / 3' 2-wire cable to allow future work or troubleshooting on the installation. Leave 30 cm / 1' of 2-wire wires without the outer jack to allow using a clamp meter for troubleshooting. Ensure watertight connections on both the 2-wire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



Sensor decoder installation

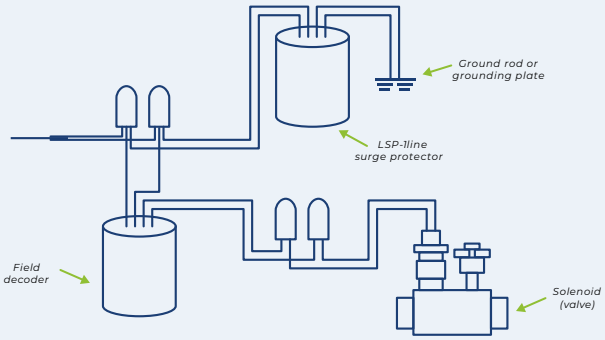
The sensor decoder must be installed similar to any other decoder in respect to spare wire, connections etc.

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, simply 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 shall be connected to the ground rod/plate. If there is a nearby valve in a conductive metal, then one of the green/yellow wires can be connected to the valve to create an alternative surge path.



Connectors

An important factor to ensure a long-lasting system is to make the ALL the connections are watertight – not only the 2-wire connections, but also the solenoid connections. This also counts for sensor decoders and surge protection decoders. It is recommended to use 3M DBR/Y-6 or similar.

Do not reuse the gel caps after dismantling as parts the silicone will be removed when pulling the cables out.

Valve boxes

Even though the decoders are designed for direct burial, it is recommended to install the decoders in valve boxes. It makes future troubleshooting much easier.

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 you need to perform an integrity check is a leakage clamp meter.

The clamp meter shown above is just an example. It is important it is able to measure in mA resolution. Some clamp meters are also able to measure resistance of a ground rod/plate.

To perform the integrity check you need to set the system in short finding mode (50/60 Hz) via the controller. Follow the same procedures as in the 2-wire troubleshooting manual.

Note the current draw of each branch of the 2-wire. Check the actual current draw against the expected draw, which can be calculated upon 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	Generation	Expected current (mA)
1 address, 1 solenoid per output	MK3	0.3
1 address, 2 solenoids per output	MK3	0.3
2 address, 2 solenoids per output	MK3	0.3
4 address, 1 solenoid per output	MK3	0.3
6 address, 1 solenoid per output	MK3	0.3
Sensor decoder	MK3	0.5
Surge protection	MK3	0

Crysberg is the irrigation industry's **leading business partner**

Crysberg has more than 30 years of experience in the development and production of high-quality irrigation controllers, interfaces, web solutions, and decoders for 2-wire solutions.

Back in the 1980's we developed the technology of letting decoders control sprinklers, drip irrigation, valves, and nozzles. A technology we now take to the next level.

We are proudly based in Denmark and have our production facility in Kvistgaard – just outside Copenhagen. Crysberg is owned 100% by Indutrade, an international private equity group listed on the stock exchange in Stockholm, Sweden.

At Crysberg we focus on protecting the environment. Our products are designed for saving water and optimizing irrigation. During our production process we constantly aim at using parts and components which can be recycled and are sustainable. We have carefully selected 4 UN Goals which have our full attention. Those are:

If you want to hear more about Crysberg's solutions and the new ground-breaking MK3 technology, please contact us.

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