ELECTRONIC & TECHNICAL SERVICES LTD.

40 ACREVILLE ROAD, BEBINGTON,
WIRRAL. CH63 2HY
TEL/FAX: 0151 645 8491
www.ets-controls.co.uk
email john@ets-controls.co.uk

Soil Sensor Controller

Please check that you have:

1) One controller
2) Attached soil sensor
3) One pack of AA batteries.

Installation

Open the pack of 4 batteries and insert into the 2 X 2 way AA battery holders, following the battery pattern printed on the base of the battery holders.

Before connecting the relay output to the auto start of the irrigation controller it is advisable to check the operation of the Soil sensor controller. This is done by removing the link from the RUN position and putting into the TEST position.

Observe the steps described in the paragraph headed TEST in page 4 of the following instructions.

Note that if the soil sensor is saturated the SOIL CONDITION led will not illuminate, even when the SETPOINT is set to the saturated position. This is a safeguard to prevent continuous watering. The sensor will have to dry out to satisfy the TEST conditions.

When you are fully familiarized with the TEST operation, remove the link from the TEST position and refit into the RUN position and observe that the steps are followed.

Finally set the duration of the on time of the relay by adjusting VR2, fully a.c.w. 1 second, fully c.w. 25 seconds.

ETS MS2 SOIL SENSOR
ETS MCMK1 SOIL MOISTURE CONTROLLER

TO PRESERVE A VERY PRECIOUS COMMODITY - WATER!

Design Concept

To provide a control that prevents over watering of protected crops, external crops, flower beds, lawns and shrubberies etc. Suitable for commercial horiculture, landscaped gardens and the keen amateur gardener.
Can be utilised for:
1)Initiation of a control panel.
2)Skipping programmed stations, e.g. If the moisture level is to wet in a particular zone, the control panel can be programmed to miss the zone from the irrigation cycle.

Operation

The electrical resistance between two concentric electrodes embedded in a porous medium (gypsum) is proportional to its water content, which in turn is related to the soil water matrix potential of the surrounding soil. Electrical resistance rises as the soil and hence the block dries out

ETS MS2Sensor---How it works:

The sensor construction of a gypsum/matrix compound, constitutes an electro chemical cell. Embedded dual concentric stainless steel electrodes creates a balanced flow of current between the electrodes. Since changes to the soil electrical conductivity would affect readings, gypsum is used as a buffer and is not affected by changes in soil salinity. The particle size of the matrix enables the measurent of moisture range from 10 centibars through to 200 centibars, which covers the entire soil moisture range utilised in irrigated horticulture and agriculture. It can be used in any soil types from light sand to heavy clay. Whilst The gypsum acts as a buffer against changes in soil salinity the added granular matrix aids porosity. They require no maintenance and when correctly installed are trouble free. They are not physically affected by extremes of temperature
In automatic irrigation systems the **ETS MS2** sensor can be used either to initiate irrigation or to interrupt irrigation cycles.
When the sensor is buried in the soil it measures moisture by tension or suction measured in centibars (cb) and stabilises when the moisture content of the soil reaches equilibrium. The sensor changes resistance relative to the amount of moisture available to the plants and is indicative of how hard the plant root system has to work to extract water from the soil. The drier the soil, the higher the tension the higher the resistance value., the wetter the soil the lower the tension the lower the resistance.
For irrigation requirements the amount of water that can be extracted from the soil by the plants is more important than the percentage moisture of the soil, commonly referred to as ‘available moisture’. Finely textured soils such as fine sandy or clay loams hold a greater amount of water at field capacity than coarsely textured soils such as coarse sandy loams.
Each soil has a different capacity to hold water, depending on structure and texture, the maximum amount of water available to plants, commonly referred to as ‘Field capacity’ is the amount held by soil versus drainage by gravity: Sensor resistance values can be interpreted as percentage moisture versus soil tension, refer to fig 1.

SOIL SUCTION

0 - 15 centibars. Saturated soil, occurs after irrigation and remains for a day or two.

15 - 25 centibars. Range of Field capacity. Soil is still wet, except for coarse sands where water is becoming depleted. This range is normally maintained for drip irrigation

25 - 65 centibars. Normal range for irrigation in most soils.
Irrigate at 15 centibars for hot dry climates and coarsely textured soils and at the upper range for cooler climates for finely textured soils.

65 - 100 centibars. Heavy clay like soils, where water retention is common and long periods between irrigation can be tolerated. Proceed with caution

!00 - 200 centibars. Very dry. Only use this range for control with gained experience and knowledge

WHEN TO IRRIGATE
Soils have different levels of water retention, heavier clay soils for instance store much more water than sandy soils. More importantly the plant cannot extract all the stored water. It is generally accepted that that irrigation should commence when 50% of the stored water has been extracted, e.g.,.

Medium texture soil	irrigation to commence at 60 centibars
Fine texture soil	irrigation to commence at 45 centibars
Heavy clay soil	irrigation to commence at 100 centibars

HOW MUCH TO IRRIGATE
Experience and record keeping generally determines the amount of water replenishment

SENSOR INSTALLATION
Please note it is recommended to soak a new sensor in water for an hour and allowed to dry, this process will improve their uniformity
1)Soak the sensor for 2 to 3 minutes
2)Make a hole with a 2.5cm rod or soil auger, a 'snug fit' is preferable
3)Prepare a soil and water slurry of creamy consistency and pour 1 to 2 tablespoonfuls into the hole.
4)Use a 15mm plastic pipe or rod to push the sensor to the bottom of the hole. Ensure that the sensor fits snugly.
5)Backfill the hole with the remaining slurry mix. Tamp the down the soil, sufficiently to prevent water channeling back down the hole to the sensor.
6)Install one sensor to each hole and tie back the sensor leads to a stake for cleanliness and easy identificatiion

SENSOR LOCATION.
Locate the sensor in a representative area of the glasshouse or field. Numerous sensors can be located in different areas and depths. However for the purpose of controlling the irrigation automatically, remember that each sensor must be connected to an **ETSMCMK1** controller.
The location and depth of the sensors depends on the nature of the crop, its potential root zone and the type of soil texture.
Locate the sensors in areas that are sensible and reflect the plant population. Avoid low or high spots and ground slopes where excess water would migrate..
Keep the soil where the sensors are located in the same condition as that experienced by the plant.
Don't compact the soil around the sensor.
When utilising drip irrigation locate the sensor some 12" to 18" away from the emitter.
When utilising overhead sprays make sure that the sensor is not shielded by any low hanging branches..
Do not place sensors in areas where excessive run off is a problem

DEPTH OF INSTALLATION.
The active root zone of the plant determines the depth at which to place the sensor. Texture of soil and plant growth are also parameters which should be taken into account

Recommended depths for placing sensor for depth of active root zones:.

Depth of active root zone (inches)	Shallow sensors (inches)	Deep sensors (inches)
18	8	12
24	12	18
36	16	24
48	20	30

SENSOR MAINTENANCE
At the end of the growing season it is recommended that the sensors are removed, cleaned and stored over winter in a dry storage cupboard. Degradation to the sensor will occur if left in the ground for long periods of time due to clay deposition and gypsum dissolution

Advantages:
1)No maintenance required
2)Simple and inexpensive
3)Measuring range 10 centibars to 200 centibars
4)Salinity effects buffered to up to 6mS/m
5)Well suited to horticulture and agriculture use.
6)Suited to regulated-defecit irrigation

Disadvantages:
1)Life of device limited

SENSOR TROUBLESHOOTING:
The sensor works by completing an electric circuit. It would not be uncommon for a frayed cable to cause a short circuit that is equivalent to a satisfied sensor (wet) sensor and the irrigation controller would never sequence an irrigation cycle, Conversely it would not be uncommon for a cable to be cut, creating an open circuit that is equivalent to an extremely dry sensor, that would continuously send a start signal to the irrigation controller.
Even with correct maintenance, sensors have a limited lifetime and should be replaced.
Check sensors at the beginning of the growing season. Dry sensors should have a cb reading of 200+ or >30000 ohms, whist a thoroughly soaked sensor should have a cb reading of about 10cb
or 2000 to 3000 ohms.

ETS MCMK1 SOIL MOISTURE CONTROLLER

The ETS moisture controller is a comprehensive yet easy to use battery powered interface to the ETS MS2 soil sensor. Heart of the controller is a sophisticated micro controller which monitors all operational parameters. The analogue section maintains a constant output over the useful range of the battery life.. The output of the oscillator drives the soil moisture sensor with a pure sinusoidal amplitude constant signal, which prevents electrolytic action between the two electrodes. The output of the sensor is monitored and checked by a high accuracy comparator which compares the set point value to the actual value of measured moisture. When the moisture level falls below the set point the soil condition LED is illuminated and the relay is operated for a user adjustable time from 1 to 25 seconds. The closed voltage free contact of the relay can be used for a variety of purposes such as initiating the irrigation controller. The battery voltage is constantly monitored by a precision under voltage detector, when the battery voltage falls to a predetermined.level the ANALOGUE/LOW BATTERY and A to D LEDS flash as a warning that the batteries need to be changed as soon as possible.

OPERATION

The controller monitors moisture range from 15 to 200 centibars. The set point is fully adjustable across the whole range and is divided into easily understood sub sectors ranging from SATURATED through to ARID. Please note that the set points should be used as guide, the actual set point must be decided by experience, crop and growing conditions..

The controller has a run and test or set up facility, which is jumper link selectable, by default your controller is set to **RUN**. In this mode of operation the moisture sensor is powered for 6 seconds every 5 minutes. This is done because of the slow sensor reaction time, where any changes in soil moisture will not be recognised for at least 5 minutes. and for conservation of battery power.

RUN

1)Connect relay output
2)Fit jumper link into HDR2
3)Observe that the ANALOGUE/LOW BATTERY LED flashes every minute.
4)After 5 minutes the ANALOGUE/LOW BATTERY LED flashes on anf off for 6 seconds
5)If soil sensor wet repeat from (3), if dry the relay and the A to D SAMPLE LED are on for the time determined by VR2
6)When the relay and the A to D LED are extinguished, after a delay of 10 minutes to allow for sensor satutation, condition (3) to (5) are repeated. Note during the 10 minute delay the ANALOGUE/LOW BATTERY LED flashes every minute..

.

TEST

1)Disconnect relay output
2)Fit jumper link into HDR1
3)Adjust the Setpoint for a satisfied condition. (no water)
4)Observe that ANALOGUE POWER LED is flashing rapidly.
5)Carefully adjust the set point until the SOIL CONDITION LED is illuminated for 6 seconds and the ANALOGUE POWER LED flashes 3 times.
6)Observe that both the SOIL CONDITION and ANALOGUE POWER LED are extinguished and that the relay and the A to D SAMPLE LED are on for the time determined by VR2.
7)When the relay and the A to D LED are extinguished there follows a 6 second delay to allow the test link to be put in the RUN position.
8)Condition (5) to (7) repeats.

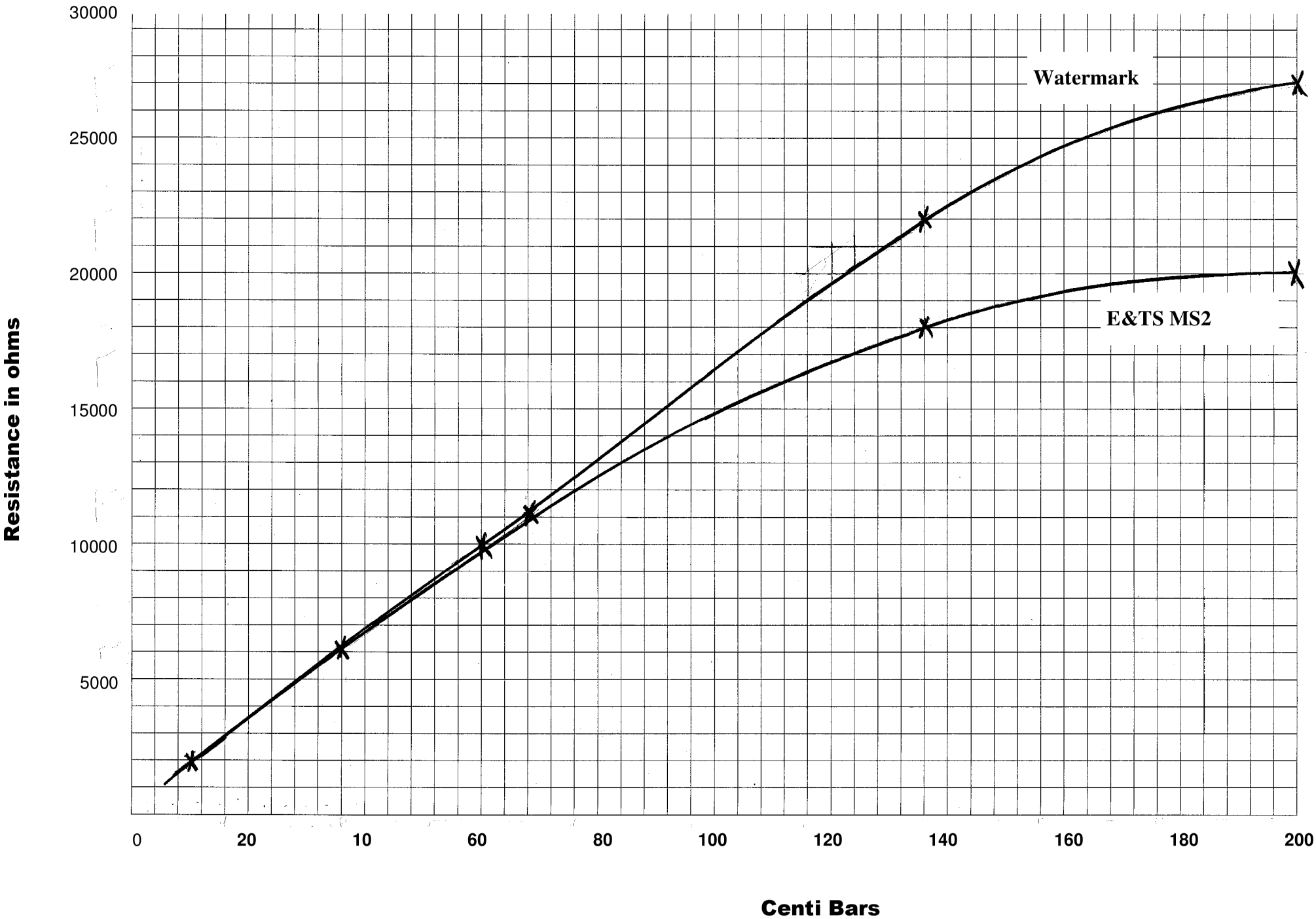
NOTE, if the sensor is fully saturated in the range 0 -15 centibar, the SOIL CONDITION LED will not illuminate even when the set point is set to 10 CENTIBARS. The ANALOGUE POWER LED will flash continuously. Set the setpoint to the desired level of water depletion and fit the jumper link into the RUN (HDR2) position.

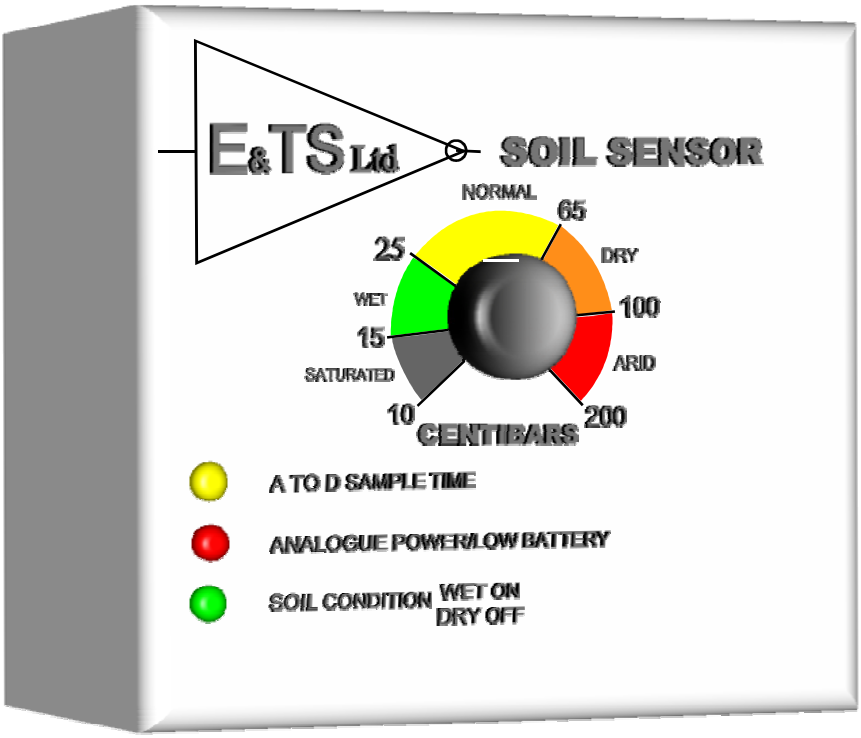
ALWAYS RETURN THE JUMPER TO THE HDR2 RUN POSITION

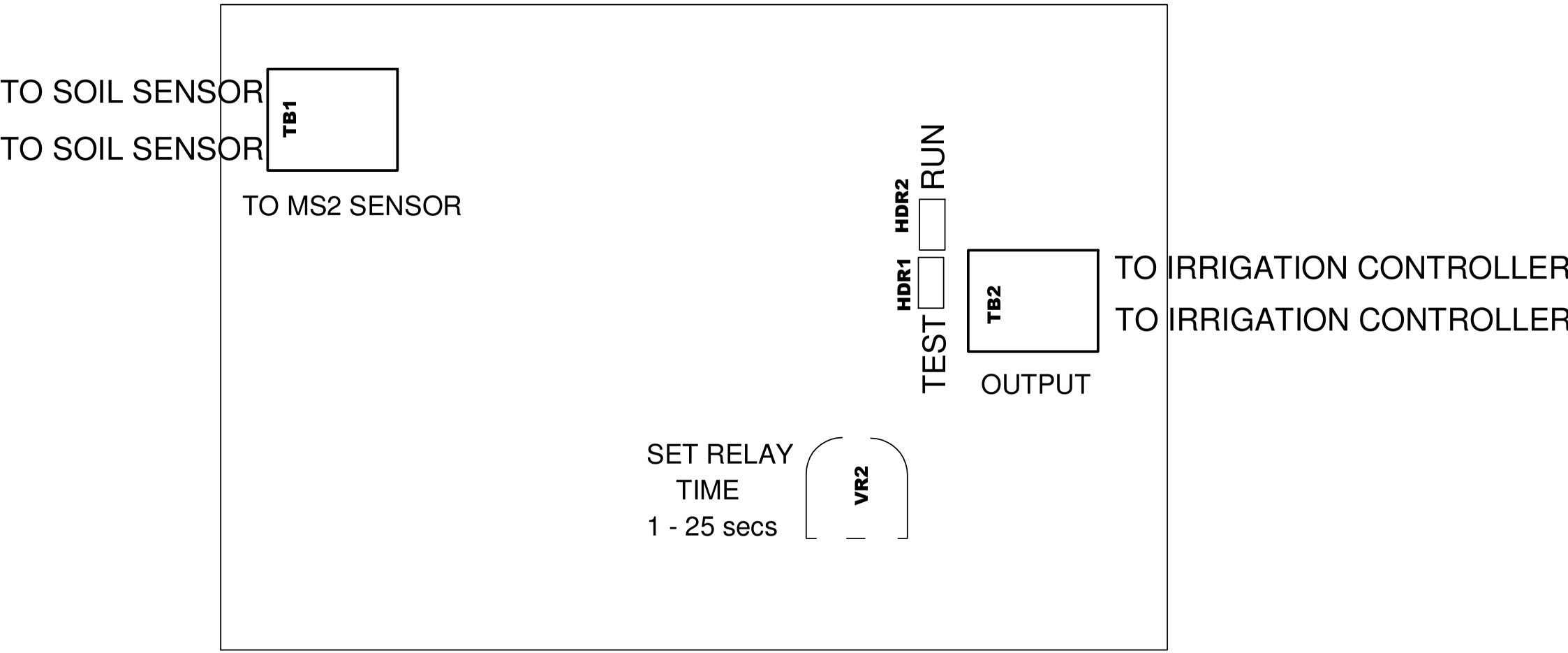
MAINTENANCE

Check the battery condition, weekly, by observation of the ANALOGUE/LOWBATTERY and A to D LEDS, if they flash in unison, change the battery.

At the end of the growing season, if the soil sensor is showing signs of wear, replace.


30000
25000
20000
15000
10000
5000
Resistance in ohms
Watermark
E&TS MS2
0
20
10
60
80
100
120
140
160
180
200
Centi Bars


E&TS Ltd
SOIL SENSOR
NORMAL
65
DRY
100
ARID
200
CENTIBARS
10
SATURATED
15
WET
25
A TO D SAMPLE TIME
ANALOGUE POWER/LOW BATTERY
SOIL CONDITION WET ON
DRY OFF


TO SOIL SENSOR
TO SOIL SENSOR
TB1
TO MS2 SENSOR
HDR2
RUN
HDR1
TEST
TB2
TO IRRIGATION CONTROLLER
TO IRRIGATION CONTROLLER
OUTPUT
SET RELAY
TIME
1 - 25 secs
VR2