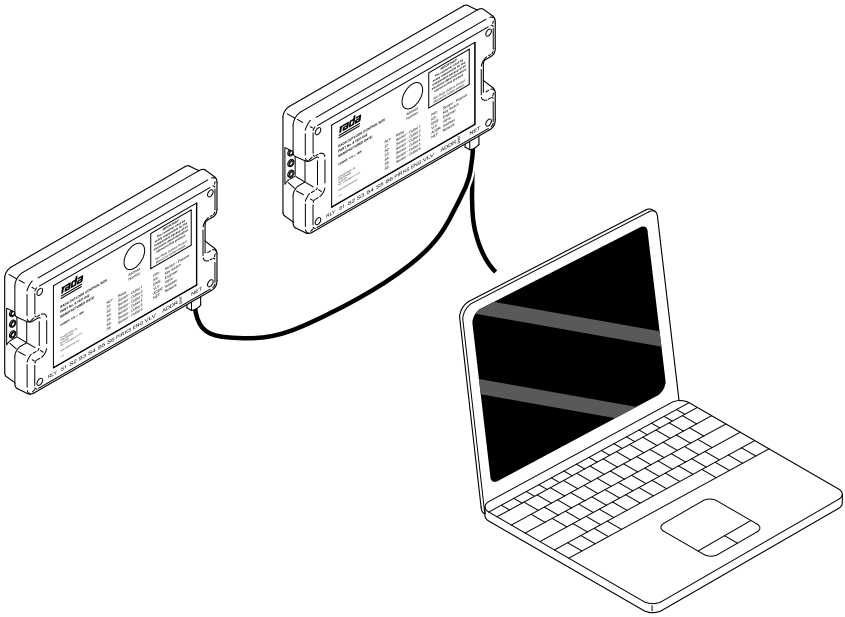
Guide to Rada Outlook Modbus Networking



Reference Guide

rada

INTRODUCTION

Modbus is a well established protocol that is commonly used and ideally suited for connecting multiple devices in a commercial/institutional or industrial environment. This is largely because of its resilience when it comes to electrical interference. The Rada Outlook interface is designed for serial communications protocols, but can be configured to communicate with a BMS (Building Management System) using Modbus protocols. When configured for Modbus, the Rada Outlook acts as an RTU (Remote Terminal Unit) that is monitored by the BMS.

The following is a guide for connecting the Rada Outlook to a BMS using a Modbus RTU protocol. Please review the Rada Outlook Product Manual available at **www.radacontrols.com** to familiarise yourself with the product specification and installation before attempting to connect the BMS.

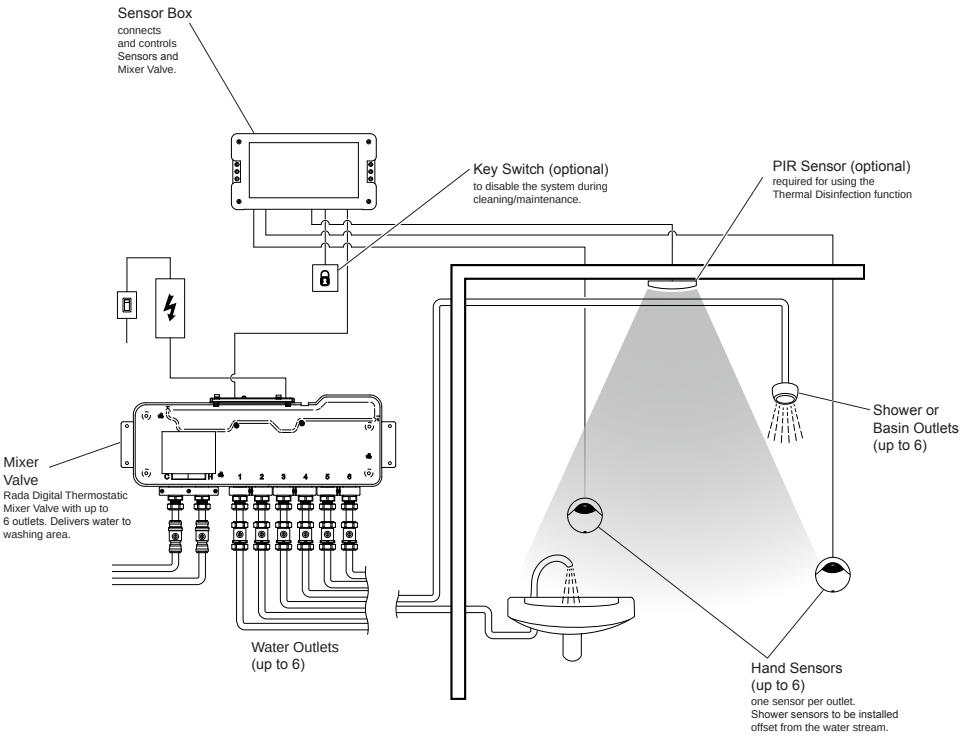


Figure 1:
Rada Outlook System Overview

Modbus Functions Supported

1. Read holding registers (0x03)
2. Write Single register (0x06)
3. Write Multiple registers (0x10)
4. Read File record (0x14) (File number 1 Duty Flush Record)

'holding' registers are sometimes referred to as 'analogue' registers.

NETWORKING

The Sensor Box NET Port

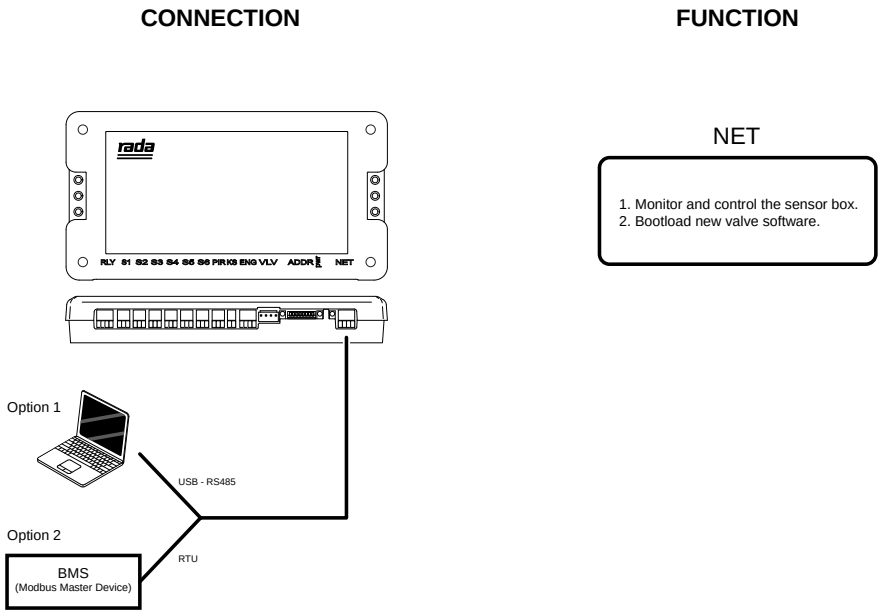


Figure 2:
Functional diagram of the Rada Outlook Sensor Box

The **NET** port connection can be used for: -

1. Connecting a laptop via the USB to RS485 cable and running the **'Rada Outlook Configuration Tool'** software (available on USB memory stick).

2. Connecting a Modbus Master Device and controlling the system using the Modbus registers.

Creating a Modbus Network

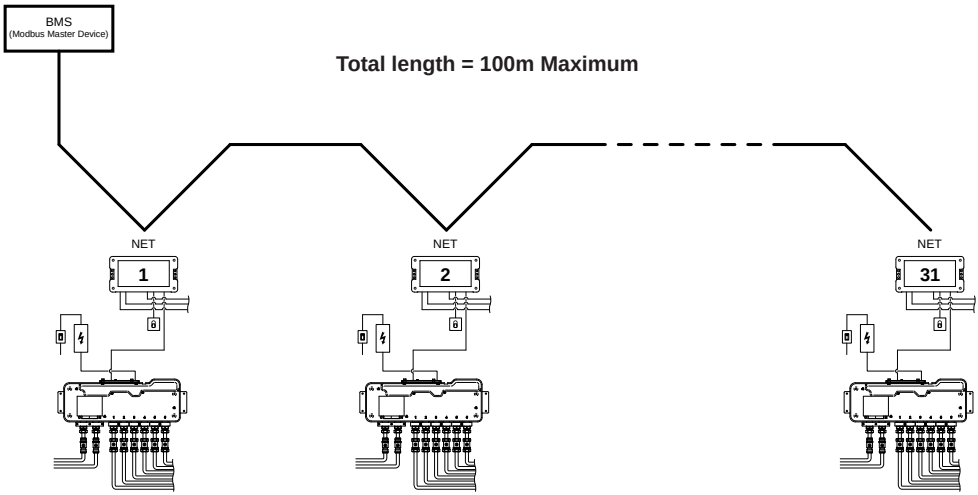
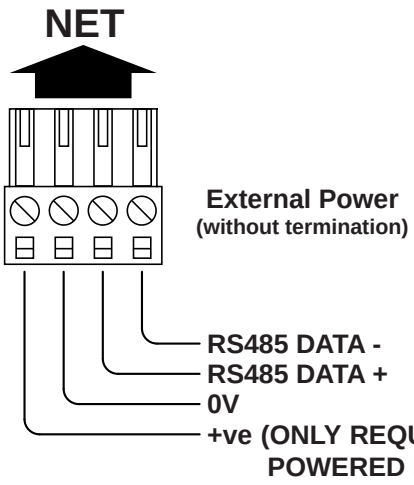


Figure 3

Figure 3 shows the arrangement for a single Modbus network. The cable connecting to the BMS should be twisted pair CAT 5 or alternative* and should be in a 'daisy chain' arrangement as shown, **do not** connect in a 'star formation' (all Sensor Boxes to one point). A single network may consists of up to 31 Sensor Boxes. The cables connect into the NET port of each Sensor Box.



Each Sensor Box draws 10mA of current. If there is a separate power supply for the connection from the Modbus Master Device, the supply must be sufficient to power the required number of Sensor Boxes on the Network.

*Cable alternatives:

1. Alpha Wire Xtra Guard 5262C SL005
2. Belden 9842 (shielded)

CONNECTING TO THE NET PORT

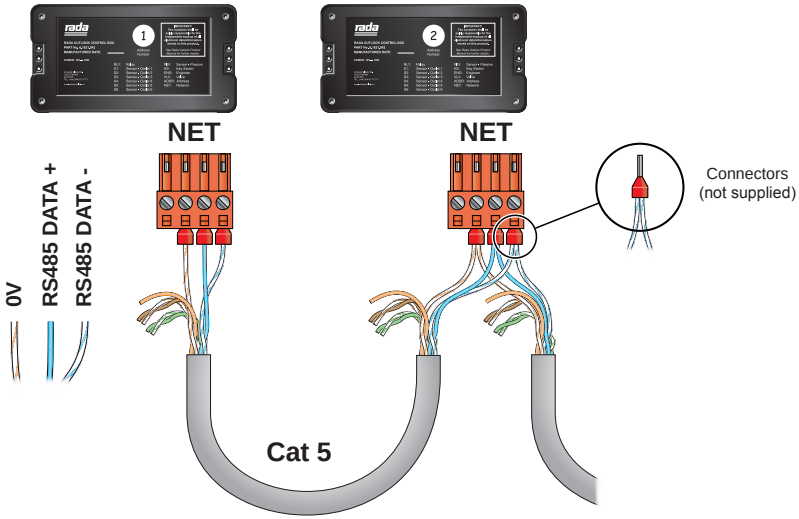


Figure 4

Figure 4 shows the recommended connection arrangement for the CAT 5 cable. The twisted pair CAT 5 cable is arranged to minimise any signal interference. The wiring is shown configured for INTERNAL POWER.

SENSOR BOX ADDRESS

Each Sensor Box has an individual address within the network. The address is set using the switch block on each Sensor Box.

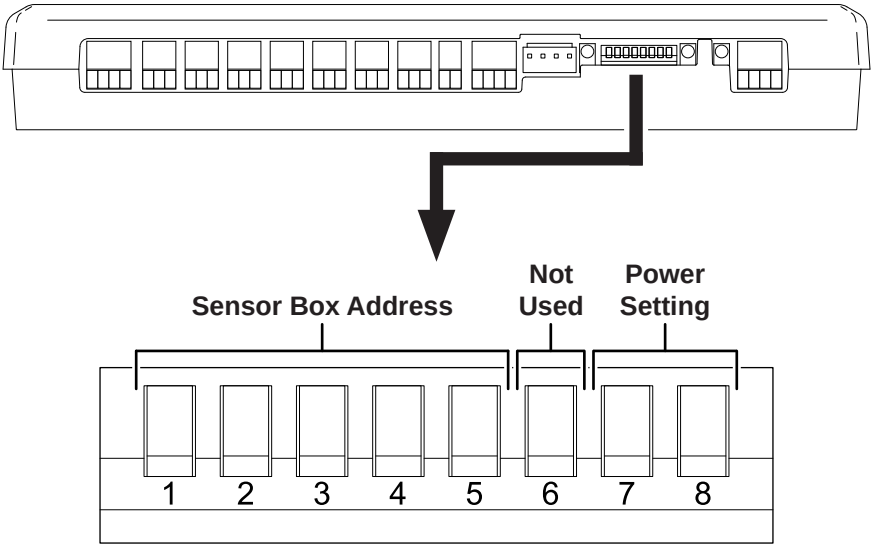
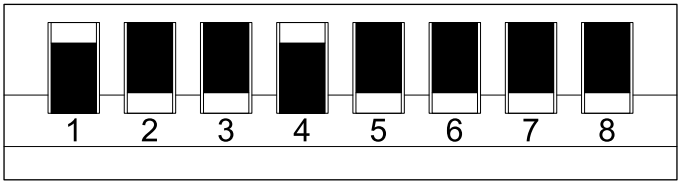


Figure 5:
Sensor Box Address Switch Block



Example: Address ‘9’ on Internal Power

Each Sensor Box must be set to a unique address with the switch block, see Figure 5. This should be done before the network is activated (or before each Sensor Box is connected to the network). The BMS will be able to control up to 31 Sensor Box addresses in total.

address table...

The following tables detail how the switch block can be set.

Table 1: Sensor Box Address

Address	1	2	3	4	5
1	UP	DOWN	DOWN	DOWN	DOWN
2	DOWN	UP	DOWN	DOWN	DOWN
3	UP	UP	DOWN	DOWN	DOWN
4	DOWN	DOWN	UP	DOWN	DOWN
5	UP	DOWN	UP	DOWN	DOWN
6	DOWN	UP	UP	DOWN	DOWN
7	UP	UP	UP	DOWN	DOWN
8	DOWN	DOWN	DOWN	UP	DOWN
9	UP	DOWN	DOWN	UP	DOWN
10	DOWN	UP	DOWN	UP	DOWN
11	UP	UP	DOWN	UP	DOWN
12	DOWN	DOWN	UP	UP	DOWN
13	UP	DOWN	UP	UP	DOWN
14	DOWN	UP	UP	UP	DOWN
15	UP	UP	UP	UP	DOWN
16	DOWN	DOWN	DOWN	DOWN	UP
17	UP	DOWN	DOWN	DOWN	UP
18	DOWN	UP	DOWN	DOWN	UP
19	UP	UP	DOWN	DOWN	UP
20	DOWN	DOWN	UP	DOWN	UP
21	UP	DOWN	UP	DOWN	UP
22	DOWN	UP	UP	DOWN	UP
23	UP	UP	UP	DOWN	UP
24	DOWN	DOWN	DOWN	UP	UP
25	UP	DOWN	DOWN	UP	UP
26	DOWN	UP	DOWN	UP	UP
27	UP	UP	DOWN	UP	UP
28	DOWN	DOWN	UP	UP	UP
29	UP	DOWN	UP	UP	UP
30	DOWN	UP	UP	UP	UP
31	UP	UP	UP	UP	UP
INVALID	DOWN	DOWN	DOWN	DOWN	DOWN

Table 2: Power Setting

Power	7	8
Internal (valve)	DOWN	DOWN
External	UP	UP

Important! Cycle the power to the Sensor Box off/on after any change to the Address switch block.

GENERAL SETTINGS

We recommend the initial setup and commissioning of the Mixer Valve is performed using the Rada Outlook Configuration Tool software (available on USB memory stick).

For details of all registers see 'MODBUS REGISTER SUMMARY'.

Valve Location (Reg's 139 - 154)

The Location is the name given to identify the Mixer Valve (for when there are multiple Mixer Valves on one site).

- String input.

Date and Time (Reg's 288 and 289)

The Rada Outlook internal clock. Does not update automatically for summer/winter time.

See **'GENERIC DATE AND TIME SPECIFICATION'** for details of the register input.

OUTLET CONFIGURATION

For details of all registers see 'MODBUS REGISTER SUMMARY'.

For day to day operation each water outlet is operated using a single hand sensor.

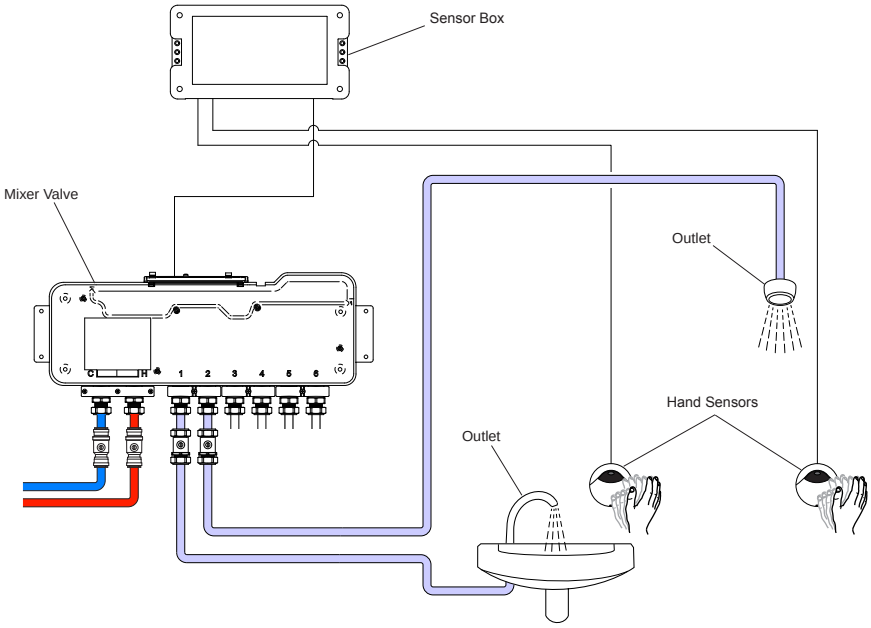


Figure 6

Default Settings

The outlets are preprogrammed with the following settings:

Outlet Type	**SHOWER**
Outlet Sub Type	**TIMED FLOW**
Outlet Temperature	**38°C**
Outlet Run Time	**30 seconds**
Fan Operation	**DISABLED**
Pump Operation	**DISABLED**
Number of Outlets to Trigger Fan	**1**
Fan Run On Time	**5 seconds**

Outlet Type (Reg's 46, 53, 60, 67, 74 and 81)

The intended use for each outlet.

- NOT USED
- SHOWER
- BASIN

Outlet Sub Type (Reg's 47, 54, 61, 68, 75 and 82)

How each outlet is operated.

- ON/OFF
  Operating the hand sensor will switch the outlet ON or OFF.
- TIMED FLOW
  The hand sensor switches the outlet ON, the water stops automatically after the **'Outlet Run Time'**.
- BLOCKING.
  The hand sensor switches the outlet ON, the water stops automatically after the **'Outlet Run Time'**. The outlet cannot be re-started until the **'Outlet Blocking Time'** has expired.

Outlet Temperature (Reg 31)

The water temperature from the Mixer Valve to all six outlets (see **Figure 7**). The Mixer Valve must be OFF (Reg 4 = 0) to alter this value. The temperature must be between the **'Maximum Setpoint' (Reg 29)** and the **'Minimum Setpoint' (Reg 30)**.

- Temperature in °C. (If Full Cold is required, use **'Outlet Disinfection, Duty Flush and Full Cold Configuration'** for the required outlets.)

Outlet Run Time (Reg's 50, 57, 64, 71, 78 and 85)

The length of time the water flows from each outlet before stopping automatically.

- Time in seconds.

Outlet Blocking Time (Reg's 51, 58, 65, 72, 79 and 86)

The length of time the operation of each hand sensor is suspended. The timer starts after the **'Outlet Run Time'** has expired. This requires the **'Outlet Sub Type'** for each outlet is set to BLOCKING (see **Figure 8**).

- Time in seconds.

Fan and Pump Operation (Reg's 48, 55, 62, 69, 76 and 83)

Controls the option of activating a ventilation fan or water pump whenever the outlet is turned ON.

- ENABLED
- DISABLED

Number of Outlets to Trigger Fan Operation (Reg 88)

The number of outlets required to be active for the ventilation fan to be switched on.

- INTEGER 1 - 6

Fan Run On Time (Reg 89)

The length of time the ventilation fan operates after all water outlets are switched OFF.

- Time in seconds.

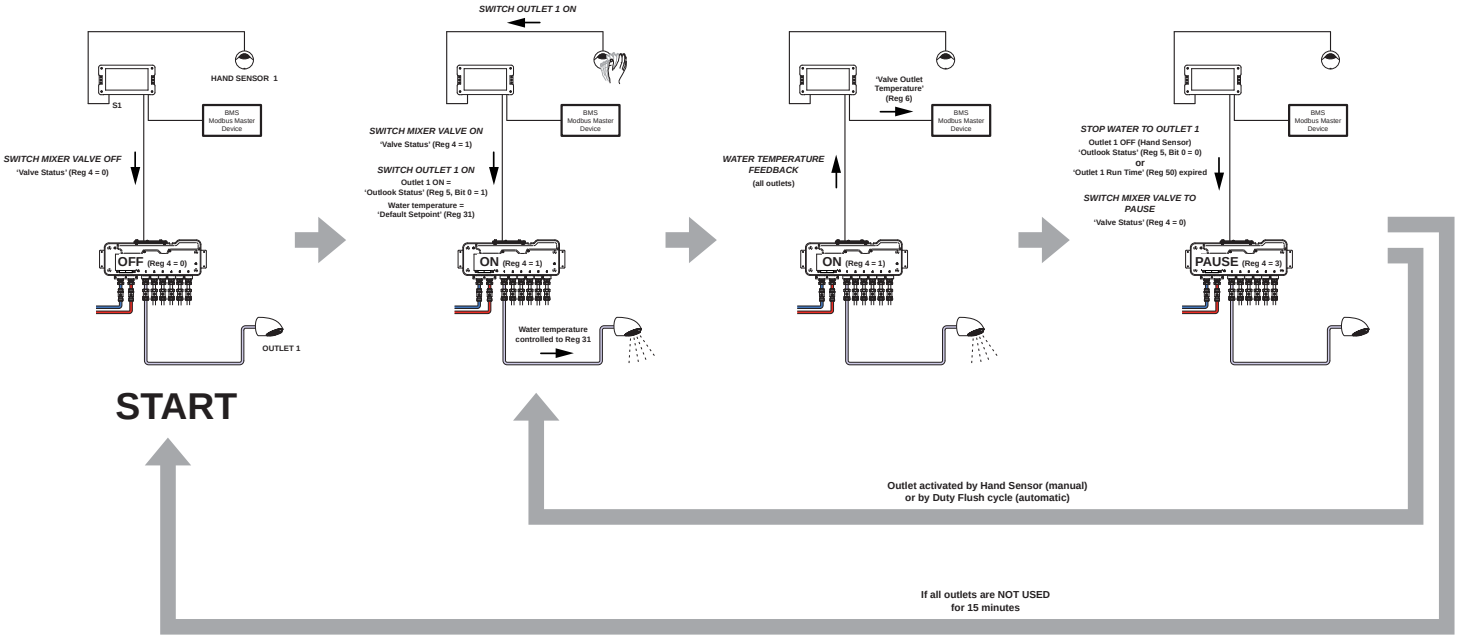

HAND SENSOR 1
S1
BMS Modbus Master Device
SWITCH MIXER VALVE OFF
'Valve Status' (Reg 4 = 0)
OFF (Reg 4 = 0)
OUTLET 1
START
SWITCH OUTLET 1 ON
SWITCH MIXER VALVE ON
'Valve Status' (Reg 4 = 1)
SWITCH OUTLET 1 ON
Outlet 1 ON =
'Outlook Status' (Reg 5, Bit 0 = 1)
Water temperature =
'Default Setpoint' (Reg 31)
ON (Reg 4 = 1)
Water temperature controlled to Reg 31
'Valve Outlet Temperature' (Reg 6)
WATER TEMPERATURE FEEDBACK
(all outlets)
ON (Reg 4 = 1)
STOP WATER TO OUTLET 1
Outlet 1 OFF (Hand Sensor)
'Outlook Status' (Reg 5, Bit 0 = 0)
or
'Outlet 1 Run Time' (Reg 50) expired
SWITCH MIXER VALVE TO PAUSE
'Valve Status' (Reg 4 = 0)
PAUSE (Reg 4 = 3)
Outlet activated by Hand Sensor (manual)
or by Duty Flush cycle (automatic)
If all outlets are NOT USED
for 15 minutes

Figure 7

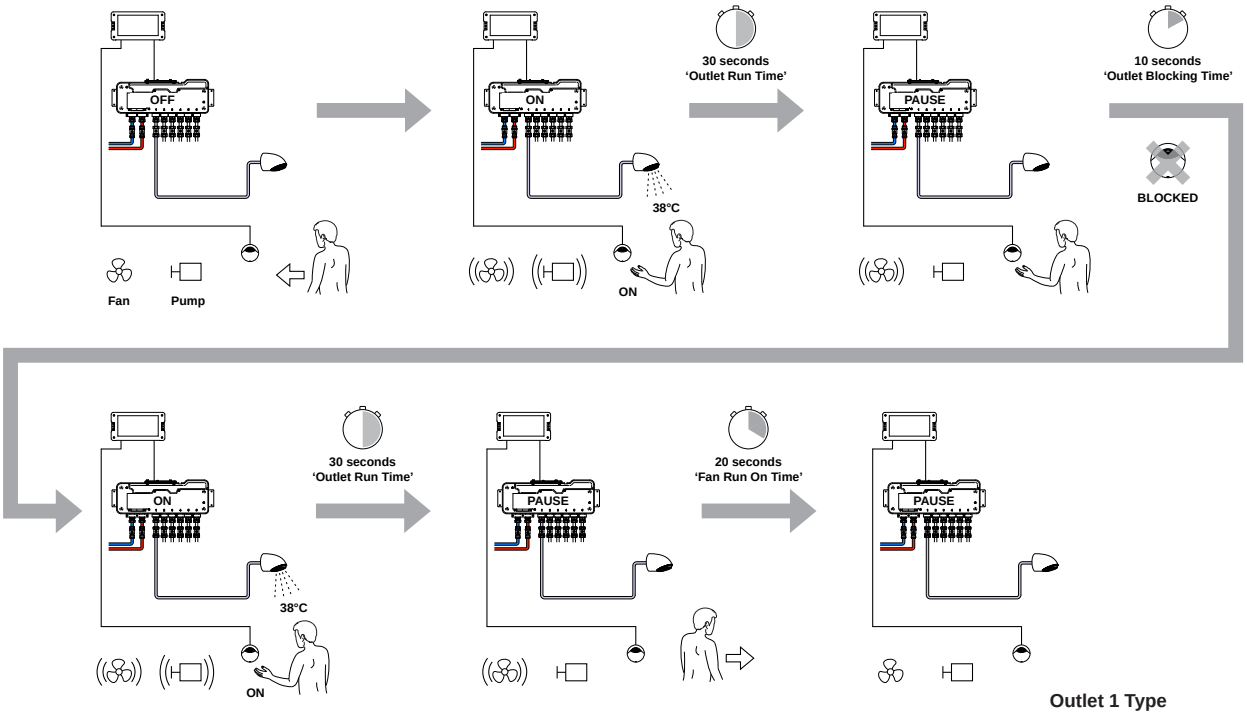


Figure 8

Outlet 1 Type	**SHOWER**
Outlet 1 Sub Type	**BLOCKING**
Outlet Temperature	**38°C**
Outlet Run Time	**30 seconds**
Outlet Blocking Time	**10 seconds**
Fan Operation	**ENABLED**
Pump Operation	**ENABLED**
Number of Outlets to Trigger Fan Operation	**1**
Fan Run On Time	**20 seconds**

QUICK GUIDES FOR OUTLET CONFIGURATION

SETTING WATER TEMPERATURE

1. Turn an outlet ON using the hand sensor.

2. Allow the water to flow and the temperature to stabilise.

3. Test the temperature of the water is suitable for washing.

4. If required, change the temperature by altering the value of Reg 31 (Mixer Valve must be OFF and temperature must be between **'Maximum Setpoint'** and **'Minimum Setpoint'**). If Full Cold is required, alter the value of bit 2 for the required outlet using **'Outlet Disinfection, Duty Flush and Full Cold Configuration' (Reg's 49, 56, 63, 70, 77 and 84)**. Bit 2 = 1.

5. Re-write the register values to the Sensor Box.

6. Re-test the water temperature.

SETTING WATER FLOW TIME

1. Turn an outlet ON using the hand sensor.

2. Record the length of time the water flows from each outlet.

3. Set the Run Time of each outlet by altering the values in the following registers:

   Outlet 1 (Reg 50)
   Outlet 2 (Reg 57)
   Outlet 3 (Reg 64)
   Outlet 4 (Reg 71)
   Outlet 5 (Reg 78)

Outlet 6 (Reg 85)

4. Re-write the register values to the Sensor Box.
5. Test each outlet is operating as expected.

DUTY FLUSH

For details of all registers see 'MODBUS REGISTER SUMMARY'.

Warm water can be flushed through the Mixer Valve, outlet pipework and fittings to reduce the risk of bacterial growth in 'still' water.

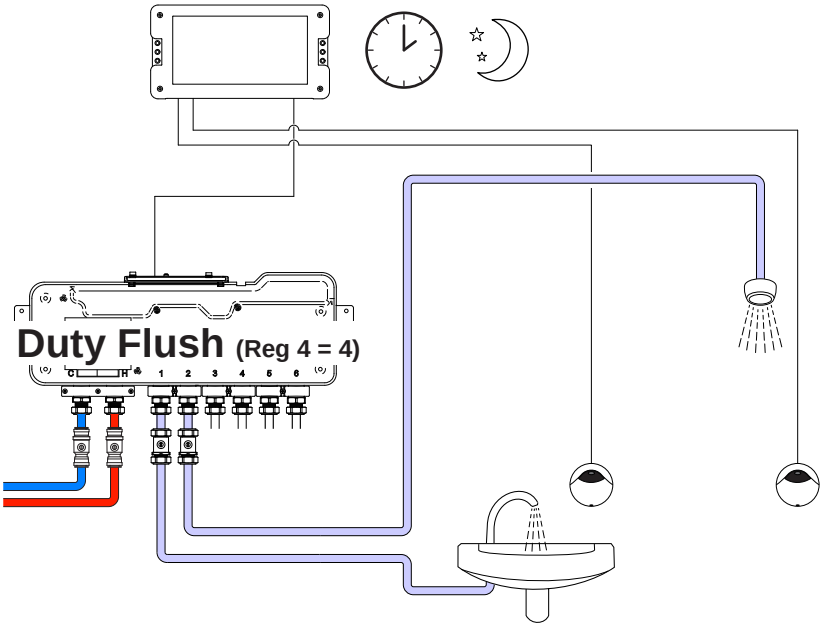


Figure 9

Default Settings

Each Sensor Box is supplied preprogrammed with the following settings:

Duty Flush Configuration	**DISABLED**
Duty Flush Type	**STANDARD**
Duty Flush Delay Time (hours)	**0**
Duty Flush Delay Time (days)	**3**
Duty Flush Activation Time	**02:00**
Duty Flush Setpoint	**38°C**
Duty Flush Warm Up Time	**1 minute**
Duty Flush Duration	**2 minutes**

Duty Flush Configuration (Reg's 49, 56, 63, 70, 77 and 84)

Controls the option of enabling the Duty Flush feature for each outlet.

- ENABLED
- DISABLED

Duty Flush Type (Reg 280)

Controls how the Duty Flush cycle is performed. Choose the option depending upon how often the water outlets are used, or the Health and Safety requirements for water flushing.

- OFF
  No Duty Flush cycle is performed.
- STANDARD
  The Duty Flush cycle operates according to the following registers:

  Duty Flush Delay Time (Hours) (Reg 118)
  Duty Flush Delay Time (Days) (Reg 281)
  Duty Flush Duration (Reg 282)
  Duty Flush Setpoint (Reg 283)
  Duty Flush Activation Time (Reg 284)
  Duty Flush Warm Up Time (Reg 285)
- SMART
  The Duty Flush cycle operates according to the same registers as STANDARD, but also according to the period of inactivity (see **'Duty Flush Delay Time'**).

Duty Flush Activation Time (Reg 284)

The time of day the system will perform a Duty Flush cycle automatically (24 hour clock).

- Time in minutes, input the number of minutes after midnight 00:00.

Duty Flush Setpoint (Reg 283)

The required temperature of the water during the Duty Flush cycle.

- Temperature in °C.

Duty Flush Warm Up Time (Reg 285)

The time allowed for the water temperature (**'Duty Flush Setpoint'**) to be reached during the Duty Flush cycle. If the temperature reaches the setpoint and is sustained during the warm up time, the **'Duty Flush Duration' (Reg 282)** will start earlier to help conserve water.

- Time in minutes.

Duty Flush Duration (Reg 282)

The length of time to flush water through the Mixer Valve, outlet pipework and fittings. Does not include the time for the water to reach the required temperature **'Duty Flush Warm Up Time'** (see **Figure 10**).

- Time in seconds.

Duty Flush Delay Time (Reg 118 or 281)

Flush Delay Time works in one of two ways depending upon the **'Duty Flush Type' (Reg 280)**. Only one register can be used, **hours (Reg 118)** or **days (Reg 281)**.

If **'Duty Flush Type'** is set to STANDARD.....

'Duty Flush Delay Time' is the length of time between each Duty Flush cycle regardless of how often the outlets are used (see **Figure 11**).

If **'Duty Flush Type'** is set to SMART.....

‘Duty Flush Delay Time (Hours)’ (Reg 118) is the length of time between each Duty Flush cycle provided the outlet has not been used less than 1 hour before the delay time (see **Figure 12**).

- Time in hours

‘Duty Flush Delay Time (Days)’ (Reg 281) is the length of time between each Duty Flush cycle provided the outlet has not been used less than 22 hours before the **‘Duty Flush Activation Time’ (Reg 284)**. If the outlet has been used, the Duty Flush is not performed to help conserve water (see **Figure 12**).

- Time in days

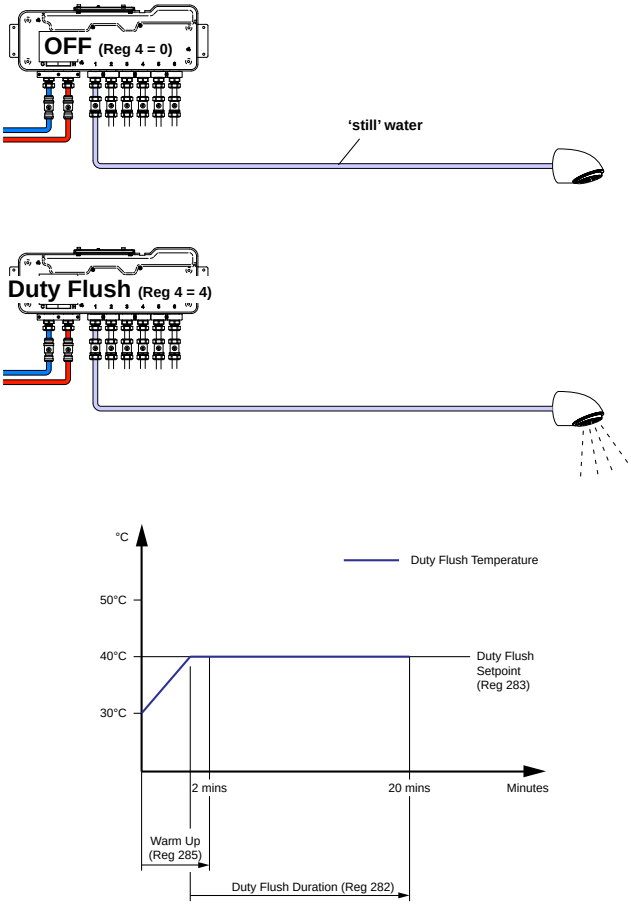
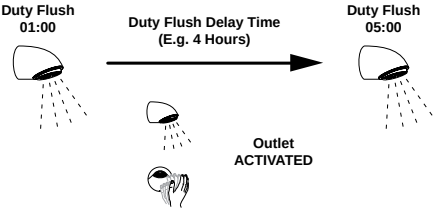


Figure 10

Duty Flush Delay Time (Hours)



Duty Flush Delay Time (Days)

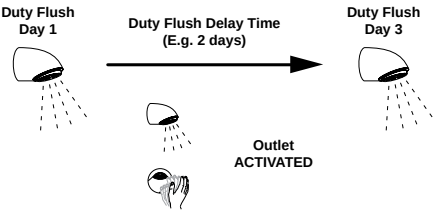
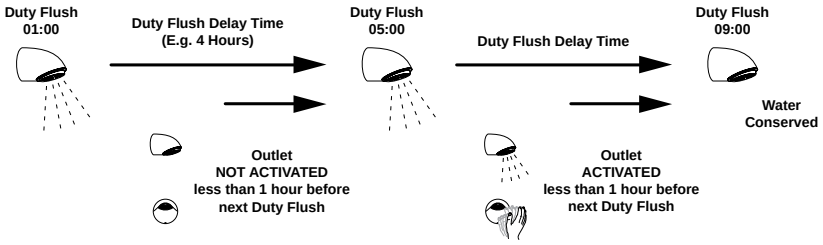


Figure 11:
Example of **'Duty Flush Type'** set to STANDARD

Duty Flush Delay Time (Hours)



Duty Flush Delay Time (Days)

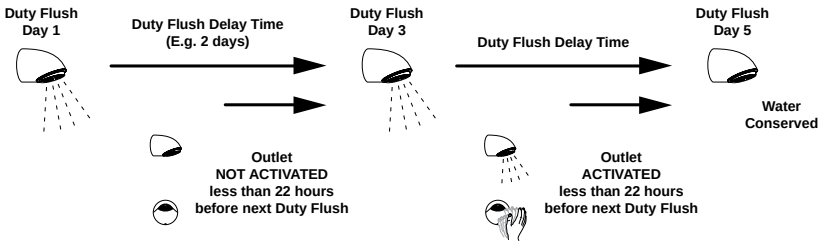


Figure 12:
Example of **'Duty Flush Type'** set to SMART

DUTY FLUSH LOG

For details of all registers see 'MODBUS REGISTER SUMMARY'.

The Sensor Box has a built in EEPROM for logging the results of each Duty Flush cycle. When the EEPROM is full, the oldest record is over written. Up to 1023 records can be stored, this is called the '**File Record List'**. Due to the amount of data stored in the log, the system is unable to allocate registers to each data point. The Modbus file READ command can be used to retrieve the data (see **'Reading the Duty Flush Log'**).

Date and Time of Last Duty Flush (Reg's 290 - 291)

Displays the date and time of when the last Duty Flush cycle was performed.

See **'GENERIC DATE AND TIME SPECIFICATION'** for details of the register input.

Duty Flush Status (Reg's 292 - 297)

The result of the last Duty Flush cycle for each water outlet.

- OK (Duty Flush successful)
- NOT APPLICABLE (Duty Flush not required)
- FAULT (NO HOT WATER)
- FAULT (NO FLOW)

Time Since Last Used - DF (Reg's 298 - 303)

The length of time the water outlet has been inactive before a Duty Flush cycle is performed.

- Time in hours

Reading the Duty Flush Log

File Record List
(Total number of files written = Reg 305)

The position of the last Duty Flush results: E.g. Reg 304 = 3

File Record Content (The registers for each File Record)

	File Record 0	File Record 1	File Record 2	File Record 3	File Record 4	File Record 5
Reg 290 Reg 291	Day/Month/ Year/Time	Day/Month/ Year/Time	Day/Month/ Year/Time	Day/Month/ Year/Time	Day/Month/ Year/Time	Day/Month/ Year/Time
Reg 292	0	0	0	0	2	0
Reg 293	1	1	1	1	1	1
Reg 294	3	3	3	0	2	0
Reg 295	0	0	0	0	2	0
Reg 296	0	0	0	0	2	0
Reg 297	0	0	0	0	2	0
Reg 298	10	0	5	6	13	2
Reg 299	0	0	0	0	0	0
Reg 300	10	13	26	3	0	0
Reg 301	5	5	5	5	4	5
Reg 302	5	5	5	5	4	5
Reg 303	5	5	5	5	4	5

(All Register data entries are for example only)

Table 3

Number of File Records = 0 - 1022 (after 1022 records have been filled, the list will overwrite starting with File Record ‘0’ again.

- Outlet 1 Registers
- Outlet 2 Registers
- Outlet 3 Registers
- Outlet 4 Registers
- Outlet 5 Registers
- Outlet 6 Registers

Duty Flush Log Without Modbus File Registers

For Building Management Systems that do not support Modbus file registers, the Duty Flush data may be logged by monitoring the **'Date and Time of the Last Duty Flush' (Reg 290)**. When a change is detected, the updated contents of registers 290 - 303 can be saved as required.

QUICK GUIDES FOR DUTY FLUSH

SETTING DUTY FLUSH

1. Enable Duty Flush feature for the required outlets using **Reg's 49, 56, 63, 70, 77 and 84**.

2. Set the **'Duty Flush Type'** by altering the value of **Reg 280**.

   1 = STANDARD
   2 = SMART

3. Set the Duty Flush parameters by altering the values in the following registers:

   'Duty Flush Duration' (Reg 282)
   'Duty Flush Setpoint' (Reg 283)
   'Duty Flush Activation Time' (Reg 284)
   'Duty Flush Warm Up Time' (Reg 285)

4. Set the **'Duty Flush Delay Time (Hours)' (Reg 118)** or **'Duty Flush Delay Time (Days)' (Reg 281)**.

5. Re-write the register values to the Sensor Box.

6. Test the Duty Flush cycle is operating as expected.

READING DUTY FLUSH RESULTS

The result of the last Duty Flush performed consists of the values in the following READ ONLY registers:

Reg 290
Reg 291 ─ The Date and Time of Last Duty Flush cycle.

continued...

Reg 292
Reg 293
Reg 294
Reg 295
Reg 296
Reg 297

The result of the Duty Flush for Outlets 1 - 6.

0 = OK
1 = NOT APPLICABLE
2 = FAULT (NO HOT WATER)
3 = FAULT (NO WATER FLOW)

Reg 298
Reg 299
Reg 300
Reg 301
Reg 302
Reg 303

The length of time Outlets 1 - 6 have been OFF before a Duty Flush (hours).

Reg 304 The position of the last Duty Flush results within the **'File Record List'**.

Reg 305 The number of records that have been written to the **'File Record List'**.

THERMAL DISINFECTION

Thermal Disinfection is used to flush high temperature water through the Mixer Valve, outlet pipework and fittings to reduce the amount of bacteria from an area of the plumbing system.

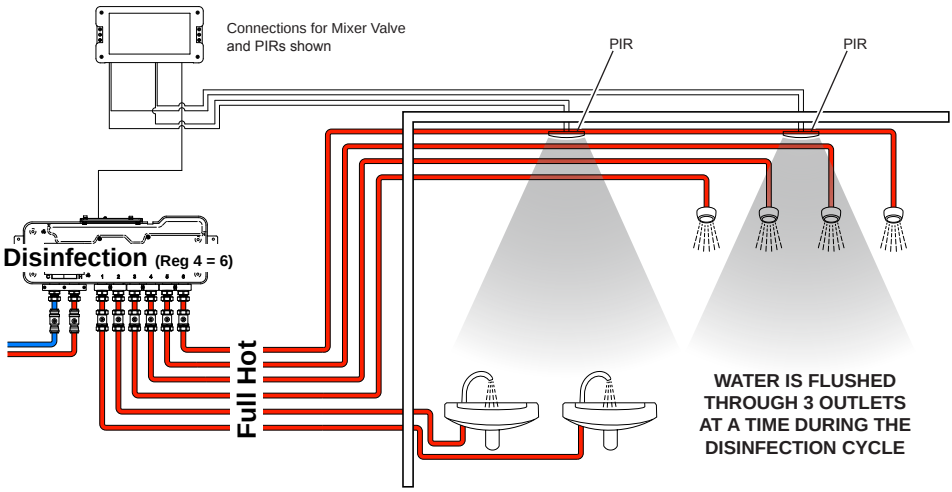


Figure 13

Each Sensor Box requires at least one PIR (Passive Infrared Sensor) is installed and connected for Thermal Disinfection to be used.

Warning! The Disinfection cycle involves water temperatures that exceed a safe level for washing. For safety reasons, the following must be observed:

- **The Disinfection feature is not to be used unless adequate systems are in place to ensure that the area is clear of any persons prior to and during the disinfection cycle. This includes any exposed or uninsulated pipework that will reach an unsafe temperature.**
  For this reason, the cycle is blocked for **15 minutes** after the Mixer Valve is switched to PAUSE.

- A PIR connected to the Sensor Box must be used to detect the presence of any person in the affected area. The PIR should be checked to make sure that the appropriate area is covered adequately and that the Disinfection cycle can be aborted successfully (see Figure 13). Also see **'Rada Outlook Digital Mixer**

Valve, Sensor Box and Sensor Product Manual' for further details.

- The operation of the PIR should be checked regularly and prior to every Disinfection cycle.

- Cold water will be flushed through the Mixer Valve, pipework and fittings automatically at the end of the Disinfection cycle to return the water temperature to a safe level.

To meet Legislative Guidelines, Thermal Disinfection must be carried out on a regular basis. Please consult the national or local authority Legionella Legislation or Guidelines as appropriate for your country/area.

Disinfection Options

The Thermal Disinfection feature has eight options available. The chosen option will depend upon the requirements of the disinfection (Legionella control) and the available hot water (plumbing system). Also see **Reg 93**.

STANDARD

The STANDARD option will perform the disinfection strictly according to the individual temperature and time settings (see Figure 14). The outlets are disinfected three at a time using full water flow.

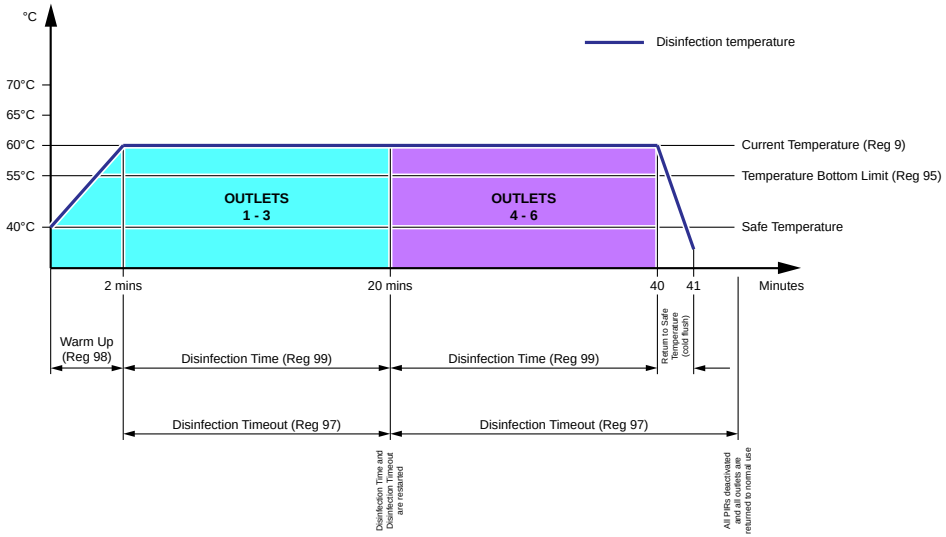


Figure 14:
Example of STANDARD **Thermal Disinfection**

EXPONENTIAL

If the water temperature during the cycle is between **'Disinfection Temperature Bottom Limit' (Reg 95)** and **'Disinfection Temperature Top Limit' (Reg 96)**, the cycle time is progressively reduced. The reduction is computed continuously and has the effect of halving the time for each 5°C increase above the **'Disinfection Temperature Bottom Limit'** value (see **Figure 15**). If the temperature rises above

the **‘Disinfection Temperature Top Limit’** then no further time reduction accrues. The outlets are disinfected three at a time using full water flow.

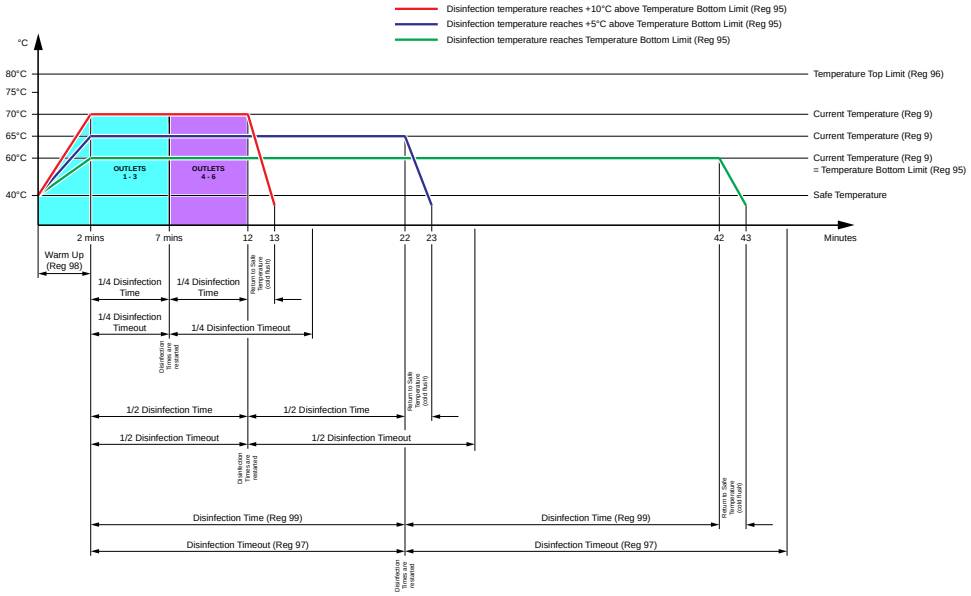


Figure 15:
Example of EXPONENTIAL **Thermal Disinfection**

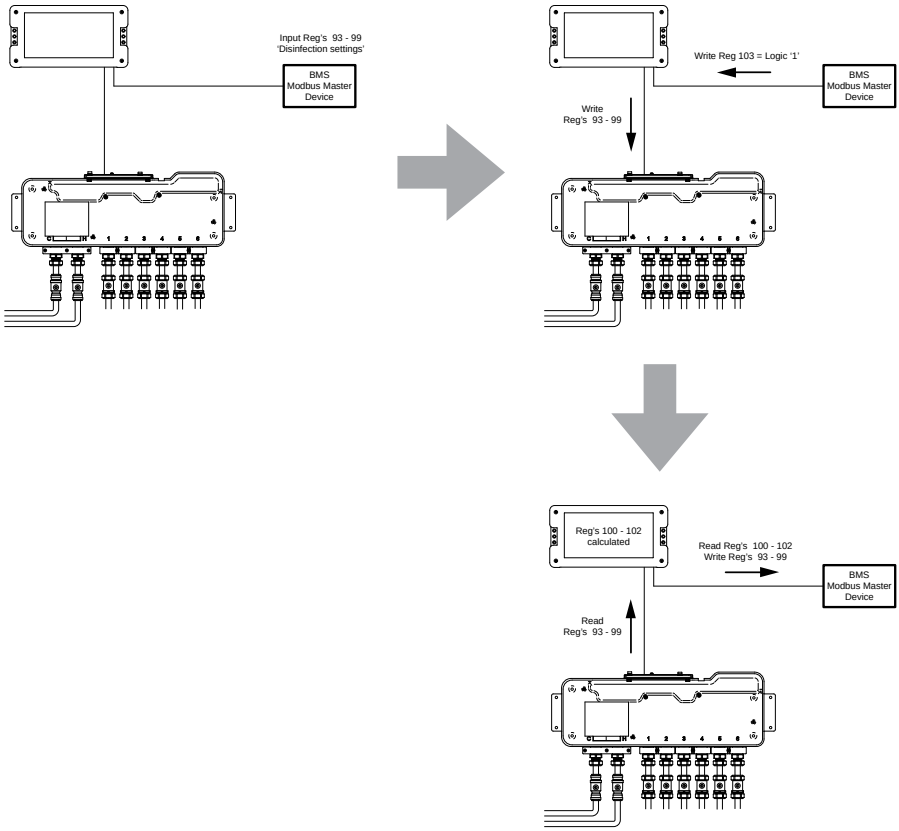
NOTES!

1. **Disinfection Time (Reg 99) is dependent upon type and size of plumbing system.**
2. **These diagrams do not represent the Return to Safe Temperature process for** STANDARD - COLD INLET SUPPLY, STANDARD - COLD INLET SUPPLY ECO EXPONENTIAL - COLD INLET SUPPLY **and** EXPONENTIAL - COLD INLET SUPPLY ECO**.**

ECO DISINFECTION

STANDARD ECO
EXPONENTIAL ECO

The outlets are disinfected using intermittent water flow.
30 seconds after the Temperature Bottom Limit (Reg 95) is reached, the water switches to a repeating 10 second flow from each outlet to reduce the amount of hot water used during the disinfection cycle. The Disinfection Log starts recording the results 2 minutes after the water switches to the 10 second flow. This is to allow the water temperature to stabilise before the **“Disinfection Log”** starts recording.



Writing the Thermal Disinfection values

The Active Disinfection Coefficients (Reg's 93 - 99) reside in the Mixer Valve, not the Sensor Box. The values maintained by the Sensor Box are copies of those in the Mixer Valve. The values of the coefficients (Reg's 93 - 99) may be accessed in a read/write format at any time. Writing a new value to these registers does not update the value in the Mixer Valve. The user must write the new values to the Modbus registers. When the registers are correct they are loaded into the Mixer Valve by writing a 'logic 1' command to **'Disinfection Coefficients Write' (Reg 103)**. This will cause the coefficients to be calculated and written to the Mixer Valve. The Mixer Valve coefficients are written back to the Modbus registers thus confirming the success or failure of the process.

Default Settings

Each Valve is preprogrammed with the following settings:

	UK	EU
Disinfection Type	**STANDARD**	**EXPONENTIAL**
Disinfection Warm Up Time	**2 minutes**	**2 minutes**
Thermal Disinfection Time	**5 minutes**	**20 minutes**
Disinfection Timeout	**10 minutes**	**25 minutes**
Disinfection Temperature Bottom Limit	**60°C**	**60°C**
Disinfection Temperature Top Limit	**60°C**	**70°C**

Disinfection Configuration **(Reg's 28, 49, 56, 63, 70, 77 and 84)**

Controls the option of enabling the Thermal Disinfection feature for all outlets.

- ENABLED
- DISABLED

Disinfection Type **(Reg 93)**

Controls how the Thermal Disinfection cycle is performed.

- STANDARD
- EXPONENTIAL
- STANDARD (COLD WATER SUPPLY)
- EXPONENTIAL (COLD WATER SUPPLY)
- STANDARD ECO
- EXPONENTIAL ECO
- STANDARD COLD SUPPLY ECO
- EXPONENTIAL COLD SUPPLY ECO

See **Figure 14** (STANDARD), **Figure 15** (EXPONENTIAL), **'Thermal Disinfection of Cold Supply'** and **'ECO DISINFECTION'**

Disinfection Temperature Bottom Limit (Reg 95)

The minimum temperature required to perform a successful disinfection cycle.

- Temperature in °C.
-

See **Figure 14** (STANDARD) and **Figure 15** (EXPONENTIAL)

Disinfection Temperature Top Limit (Reg 96)

The upper value for the Disinfection temperature range. Must be set for both STANDARD and EXPONENTIAL options.

- Temperature in °C.

See **Figure 14** (STANDARD) and **Figure 15** (EXPONENTIAL)

Disinfection Warm Up Time (Reg 98)

The time allowed for the water to reach the **'Disinfection Temperature Bottom Limit'**.

- Time in Minutes.

See **Figure 14** (STANDARD) and **Figure 15** (EXPONENTIAL).

Thermal Disinfection Time (Reg 99)

The minimum length of time to flush enough hot water through the Mixer Valve, outlet pipework and fittings to meet legislative guidelines. This does not include the time for the water to reach the correct temperature (see **'Disinfection Warm Up Time'**).The Disinfection cycle flushes water through three outlets at a time, this must be taken into consideration when calculating the disinfection time.

- Time in Minutes.

See **Figure 14** (STANDARD) and **Figure 15** (EXPONENTIAL).

Disinfection Timeout (Reg 97)

The maximum duration of the Thermal Disinfection cycle. The time starts when **'Disinfection Temperature Bottom Limit'** has been reached. Includes the time allowed for the water to return to safe temperature.

- Time in Minutes.

See **Figure 14** (STANDARD) and **Figure 15** (EXPONENTIAL).

Activating a Thermal Disinfection Cycle

Warning! Before using the Thermal Disinfection feature, make sure all safety warnings and conditions within this guide are observed.

The steps for a Disinfection cycle must be performed in the following order for a complete and safe disinfection of the Mixer Valve, outlet pipework and fittings.

1. **Arm Disinfection**
2. **Trigger Disinfection**
3. **Cool Down (return to safe temperature)**
4. **Write Disinfection Log (return to normal use)**

Requirements:
The Mixer Valve must be switched OFF (Reg 4 = 0).
The PIR must indicate there is no activity in the area of each outlet.
The hand sensors cannot be activated (area is restricted during disinfection).
All outlets must have been inactive for 15 minutes before disinfection.

Arm Disinfection (Reg 306)

To prepare the Mixer Valve for a Disinfection cycle to be activated.

- WRITE a value (hex) of **'0x6172'** to the register.

Trigger Disinfection (Reg 307)

Activates the Disinfection cycle.

- Within 10 seconds of arming, WRITE a value (hex) of **'0x5452'** to the register.

Cool Down (return to safe temperature)

The Mixer Valve flows FULL COLD water for approximately 1-2 minutes to all outlets to flush the hot water from the pipework.
(With early versions of the Mixer Valve, the Cool Down temperature will be the same as the **'Default Setpoint' (Reg 31)**).

The Mixer Valve stops automatically and switches OFF.

The Cool Down is not performed if the 'Disinfection Type' is set to either 'STANDARD - COLD INLET SUPPLY', 'STANDARD COLD SUPPLY ECO', 'EXPONENTIAL - COLD INLET SUPPLY' or 'EXPONENTIAL COLD SUPPLY ECO'. See **'Thermal Disinfection of Cold Supply'** for details on how to return to safe temperature.

Write Disinfection Log (return to normal use)

The temperature results for the Disinfection cycle are written into registers 160 - 279 automatically. Each reading is the lowest water temperature of every 30 seconds of the cycle.

- Temperature in °C.

Disinfection Time and Date **(Reg's 156 and 157)**

The time and date of the last Thermal Disinfection cycle performed

See **'GENERIC DATE AND TIME SPECIFICATION'** for details of the register input.

Disinfection Result **(Reg 159)**

The result of the last Thermal Disinfection cycle performed.

- PASS
- FAIL

Thermal Disinfection Abort

The Rada Outlook has an abort command to stop the Disinfection at any point during the cycle. The abort may be used manually by the supervisor, or automatically when the system detects a malfunction, error or unsafe condition.

Before allowing the Mixer Valve to return to normal use, the supervisor must make sure the outlet water has returned to a safe temperature.

Manual Abort (Reg 308)

The Thermal Disinfection may be aborted manually by performing a WRITE command to **'Abort Disinfection Command' (Reg 308)**.

The Mixer Valve stops, but water remains in the outlet pipes. **Either drain, flush, or allow the water to cool before the Mixer Valve is returned to normal use.**

Automatic Abort

The Thermal Disinfection cycle is aborted automatically by the Rada Outlook.

1. The Mixer Valve switches to Cool Down and returns to safe temperature under the following conditions:

    - The water does **NOT REACH** the **'Disinfection Temperature Bottom Limit'** within the **'Disinfection Warm Up Time'** (see Figure 14 and Figure 15).
    - The **'Disinfection Temperature Bottom Limit'** is **NOT MAINTAINED** within the **'Disinfection Timeout'** (see Figure 14 and Figure 15).

    A **'FAIL'** is indicated in the **'Disinfection Log'**.

2. The Mixer Valve stops and hot water remains in the outlet pipes under the following conditions:

    - The PIR detects activity in the area of any of the outlets.
    - The PIR malfunctions.
    - There is a power failure to the Mixer Valve.

    Either drain, flush, or allow the water to cool before the Mixer Valve is returned to normal use.

Thermal Disinfection of Cold Supply

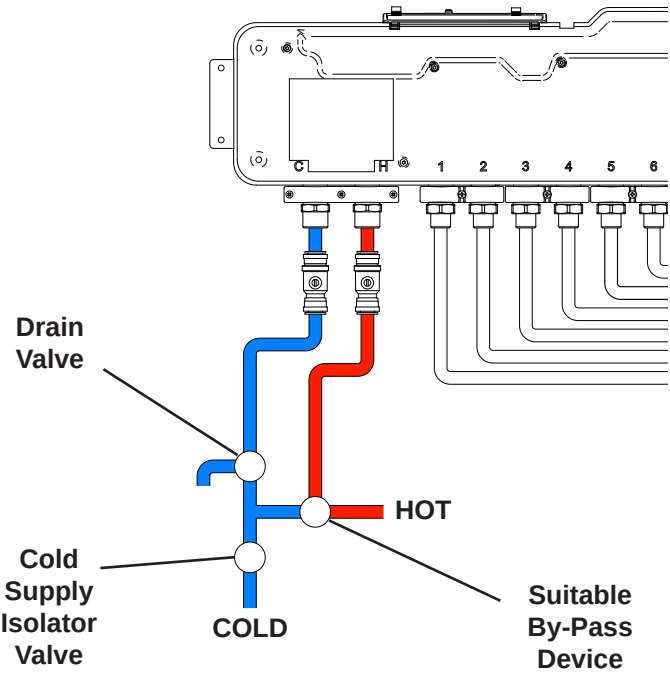


Figure 17

Rada Outlook is able to disinfect the cold supply pipes as well as the Mixer Valve and each of the outlets. The cold supply must have a suitable by-pass device to allow a feed from the hot supply (to disinfect the entire cold water supply of a building, the by-pass should be located close to the water meter or the stand pipe). The by-pass diverts the hot water flow into the cold supply pipe temporarily for the Disinfection cycle. Once the by-pass is installed, the Rada Outlook can be used to disinfect the cold supply.

The thermal disinfection of cold supply pipes is dependent upon local or national legislation and may not be required in every installation. The cold supply disinfection is generally required when the system is either used for the first time or has not been in use for a prolonged period (to make sure that the cold supply pipes are free from high levels of bacteria).

Warning! Before using the Thermal Disinfection feature, make sure all safety warnings and conditions within this guide are observed.

1. Close cold supply isolator valve.

2. Turn by-pass valve to allow hot water to flow into cold pipework.

3. Set **'Disinfection Type'** to either **'STANDARD - COLD WATER SUPPLY', 'STANDARD - COLD SUPPLY ECO', 'EXPONENTIAL - COLD WATER SUPPLY' or 'EXPONENTIAL - COLD SUPPLY ECO'**.

4. Perform a Disinfection cycle.

5. Turn by-pass valve to stop hot water entering cold supply pipe.

6. Open drain valve and remove residual hot water from cold supply pipe.

7. Close drain valve and re-open cold supply isolator valve.

8. **Allow up to 1 hour for Mixer Valve to cool down and return to safe temperature.**

9. Test the temperature and operation of all outlets before returning to normal use.

QUICK GUIDES FOR THERMAL DISINFECTION

SETTING THERMAL DISINFECTION

1. Enable the Disinfection feature for Rada Outlook by altering the value of bit 1 in **'Valve Disinfection - Configuration' (Reg 28)**. Bit 1 = 1.

2. Enable the Disinfection Feature for all outlets by altering the value of bit 1 in **'Outlet Disinfection, Duty Flush and Full Cold Configuration' (Reg's 49, 56, 63, 70, 77 and 84)**. Bit 1 = 1.

3. Set the **'Disinfection Type' (Reg 93)**.

4. Set the Disinfection parameters by altering the values in the following registers:

   'Disinfection Warm Up Time' (Reg 98)
   'Thermal Disinfection Time' (Reg 99)
   'Disinfection Timeout' (Reg 97)
   'Disinfection Temperature Bottom Limit' (Reg 95)
   'Disinfection Temperature Top Limit' (Reg 96)

5. Re-write the register values to the Sensor Box.

6. Performing a WRITE command to **'Disinfection Coefficient Write' (Reg 98)**.

RUNNING THERMAL DISINFECTION

WARNING! Each Sensor Box requires at least one PIR (Passive Infrared Sensor) is installed and connected for Thermal Disinfection to be used.
Make sure all safety precautions in this guide are observed before and during the Disinfection cycle.

The Disinfection is blocked for **15 minutes** after an outlet is used.

1. Turn the Mixer Valve OFF by altering the value of Reg 4 to '0'.

2. Re-write the registers to the Sensor Box.

3. Arm the Disinfection by performing a WRITE value (hex) of **'0x6172'** to Reg 306.

4. Re-write the register to the Sensor Box.

5. Trigger the Disinfection by performing a WRITE value (hex) of **'0x5452'** to Reg 307. Must be written within 10 seconds after **'Arm'**.

6. Re-write the register to the Sensor Box.

7. Confirm the **'Valve Status' (Reg 4)** has changed to DISINFECTION.

8. Allow the cycle to run, water will flow from 3 outlets at a time and return to safe temperature automatically.

The **'Abort Disinfection Command' (Reg 308)** can be used to stop the cycle manually.

WARNING! Full hot water may be present in the pipework after the abort!

Make sure the water has returned to a safe temperature before normal use of the outlets is allowed.

READING THERMAL DISINFECTION RESULTS

The result of the last Thermal Disinfection performed consists of the values in the following READ ONLY registers:

Reg 156
Reg 157 ─ Date and Time of last Thermal Disinfection.

continued...

Reg 159

The result of the Thermal Disinfection.

0 = FAIL
1 = PASS

Reg 160 to Reg 279

A record of the temperatures achieved during the Thermal Disinfection. Each register is a temperature reading at 30 second intervals during the cycle. The readings are accurate to 0.5°C.

THERMAL DISINFECTION ABORT

Manual Abort

1. Abort the Disinfection by performing a WRITE command to Reg 308.

   The Mixer Valve stops, but water remains in the outlet pipes.

Automatic Abort

The Thermal Disinfection cycle has stopped automatically. Cold water is flushed through the pipework automatically.

Possible reasons for the automatic abort with cool down:

1. **'Disinfection Temperature Bottom Limit' (Reg 95)** has not been reached.

2. **'Disinfection Temperature Bottom Limit' (Reg 95)** has not been maintained within the **'Thermal Disinfection Time' (Reg 99)**.

3. The outlet temperature has not returned to a safe temperature within the **'Disinfection Timeout' (Reg 97)**.

continued...

The Thermal Disinfection cycle has stopped automatically. The Mixer Valve stops, but water remains in the outlet pipes.

Possible reasons for the automatic abort without cool down.

1. The PIR has detected activity within the washing area during the Disinfection cycle.

2. The PIR has malfunctioned.

3. There is a power failure to the Mixer Valve.

WARNING, FOLLOWING ANY DISINFECTION ABORT! Before allowing the mixer valve to return to normal use, make sure the outlet water has returned to a safe temperature.

MODBUS DATA OVERVIEW

The register data is divided as follows:

1. Prime data section (Reg's 1 to 19).
   This is active data and represents the actual status of the Mixer Valve

2. Configuration and log data (Reg's 20 - 305)
   This data is typically stored in nonvolatile storage within the Mixer Valve or Sensor Box. Configuration data is used to control valve and unit operations. The log data is stored data for various units operation.

3. Commands (Reg's 103, 308 - 313)
   Writing a 'logic 1' to these registers will cause the command to be activated. The Sensor Box will clear the logic to '0' on completion.

4. Logic Registers (Reg 159)
   These registers allows the read/write of a Boolean value. True is taken as a 'logic 1' and False as 'logic 0'.

5. Temperature Conversion (Reg's 1, 6, 9, 29 - 31, 160 - 279, 283)

   Temperature (°C) = ***Register Input Value*** x ***Decimal (specific to register)***

   Deg C = Reg Value x 0.1

   40 °C = 400 x 0.1

6. Disinfection Arm / Trigger Commands (Reg's 306 - 307)
   Writing the specified hex value to the register will causes the command to be activated. The sensor box will set the logic to '0' on completion.

7. Comments
   Prime data is scanned at 1 second intervals. In general, configuration data is scanned at power-up and is only updated when the configuration parameters are written to by the Modbus Master Device. The data is updated after a successful write. Logged data is generally read at a slower rate. Thermal Disinfection and Duty Flush log data is updated after either a Duty Flush or Disinfection cycle has been completed.

MODBUS REGISTER SUMMARY

DO NOT ALTER ANY REGISTERS NOT INCLUDED IN THE FOLLOWING TABLE

Table 4

Reg	Description	Number of Registers	Units	Read / Write Read Only Write Only
0	Sensor Box Address	1	Address 1 - 31	R O
Set using the Sensor Box Address Switch Block. See **'SENSOR BOX ADDRESS'** for switch block settings. Each Sensor Box in a network must have a separate address number.				
1	Setpoint Temperature	1	Deg C = Reg Value x 0.1	R/W
Can be used to change the outlet temperature while the Mixer Valve is ON. This is not recommended for normal operation and is for specialist applications only. Please contact Rada for advice before utilising this feature.				
4	Valve Status	1	Number 0 - 7	R/W & R O
The current status of the Mixer Valve. 0 = OFF (R/W value) Command to switch the Mixer Valve OFF. 1 = ON (R/W value) Command to switch the Mixer Valve ON, outlet temperature = Reg 31. 2 = FULL COLD (R/W value) Command to switch the Mixer Valve ON, outlet temperature = FULL COLD. 3 = PAUSE (R/W value. Mixer Valve must be ON before switching) Command to the Mixer Valve to stop water flow to all outlets. The Mixer Valve switches to this state automatically when there is no water flow from any of the outlets under normal operation. After 15 minutes the status changes to OFF automatically. 4 = DUTY FLUSH (R O value) The Duty Flush cycle is active (see **'DUTY FLUSH'**). 5 = COMMISSIONING (R O value) Not required for Rada Outlook.				

continued...

Master Control Registers
Outlet 1 Registers
Outlet 2 Registers
Outlet 3 Registers
Outlet 4 Registers
Outlet 5 Registers
Outlet 6 Registers

6 = DISINFECTION (R O value)
The Thermal Disinfection cycle is active (see '**THERMAL DISINFECTION**').

7 = ERROR (R O value)
An error has occurred and the unit value of Reg 8 has changed (see Reg 8 for details).

5	Outlook Status	1	Bitfield	R/W

The status of water outlets 1 - 6. The status of the Pump, Fan, PIR and Key Switch options. Controlled by bitfield.

Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
				Key Switch (R O)	Thermal Disinfection PIR (R O)	Fan (R O)	Pump (R O)			Outlet 6 (R/W)	Outlet 5 (R/W)	Outlet 4 (R/W)	Outlet 3 (R/W)	Outlet 2 (R/W)	Outlet 1 (R/W)

Bits 0 - 5 are R/W
Bit value 0 = OFF
Bit value 1 = ON

Bits 8 - 11 are R O
Bit value 0 = INACTIVE
Bit value 1 = ACTIVE

Note! When this register is written, the active outlets will run for up to 10 seconds to confirm the active state before switching off automatically.

6	Valve Outlet Temperature	1	Deg C = Reg Value x 0.1	R O

A feedback of the current water temperature to all outlets. The reading is taken from a temperature sensor located in the Mixer Valve.

Note! The value is not measured below 25°C or above 65°C.
Use Reg 9 to measure the water temperature during Thermal Disinfection.

8	Valve Error Code	1	Number 0 - 6	R O

The error status of the Mixer Valve.

0 = NO ERROR

1 = OVER TEMPERATURE
The temperature of the water to the outlets is too high. The Mixer Valve has shut down to reduce the risk of scalding injury. (Also see Reg 309.)

2 = STUCK MOTOR
The stepper motor that controls the water mixing mechanism is malfunctioning. Maintenance is required to the Mixer Valve.

continued...

Master Control Registers
Outlet 1 Registers
Outlet 2 Registers
Outlet 3 Registers
Outlet 4 Registers
Outlet 5 Registers
Outlet 6 Registers

3 = MOTOR CALIBRATION
The Mixer Valve fails a self test operation when powered on. Maintenance is required to the Mixer Valve.

4 = VALVE FAILURE
There is an unspecified malfunction with the Mixer Valve. Maintenance is required to the Mixer Valve.

5 = THERMISTOR FAILURE.
The temperature sensor in the Mixer Valve has failed. Maintenance is required to the Mixer Valve.

6 = UNCONFIGURED.
Registers requiring initial values have not been set before power up. Mixer Valve may require reprogramming.

9	Current Disinfection Temperature	1	Deg C = Reg Value x 0.5	R O

A feedback of the current water temperature to all outlets during a Thermal Disinfection cycle. The reading is taken from a temperature sensor located in the Mixer Valve. The register is valid only when the Mixer Valve is in DISINFECTION (Reg 4 = 6).

28	Valve Disinfection - Configuration	1	Bitfield	R/W

Enables the Thermal Disinfection feature to be used. Controlled by bitfield.

Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
														Disinfection	Duty Flush

Bit value 1 = ENABLED
Bit value 0 = DISABLED

Duty Flush must always be set to '0' for this register. Use Registers 49, 56, 63, 70, 77 and 84 to enable the Duty Flush feature.

29	Maximum Setpoint	1	Deg C = Reg Value x 0.1	R/W

The maximum temperature for the setpoint range.

30	Minimum Setpoint	1	Deg C = Reg Value x 0.1	R/W

The minimum temperature for the setpoint range.

31	Default Setpoint	1	Deg C = Reg Value x 0.1	R/W

The water temperature to all of the outlets from the Mixer Valve. The register value must be between the **'Maximum Setpoint' (Reg 29)** and the **'Minimum Setpoint' (Reg 30)** values. The Mixer Valve must be OFF (Reg 4 = 0) to alter this register.

Master Control Registers
Outlet 1 Registers
Outlet 2 Registers
Outlet 3 Registers
Outlet 4 Registers
Outlet 5 Registers
Outlet 6 Registers

Reg	Description	Number of Registers	Units	Read / Write Read Only Write Only
46	**Outlet 1 Type**	1	Number 0 - 2	R/W

To set the outlet for a specific use.

0 = UNUSED
1 = SHOWER
2 = BASIN

47	**Outlet 1 Sub Type**	1	Number 0 - 2	R/W

How the water outlet operates.

0 = ON/OFF
Hand sensor turns the outlet ON or OFF. If the outlet is not turned OFF with the hand sensor, water flow will stop automatically after the **'Outlet Run Time' (Reg 50)**.

1 = TIMED FLOW
Hand sensor turns the outlet ON, water flow stops automatically after the **'Outlet Run Time' (Reg 50)**.

2 = BLOCKING
Hand sensor turns the outlet ON, water flow stops automatically after the **'Outlet Run Time' (Reg 50)**, water flow cannot be restarted until the **'Outlet Blocking Time' (Reg 51)** has expired (see **Figure 7**).

48	**Outlet 1 Fan and Pump Configuration**	1	Bitfield	R/W

Enables a ventilation fan to be activated when the outlet is used.
Enables a pump to be activated when the outlet is used.
Controlled by bitfield.

Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
														Fan	Pump

Bit value 0 = DISABLED
Bit value 1 = ENABLED

49	**Outlet 1 Disinfection, Duty Flush and Full Cold Configuration**	1	Bitfield	R/W

Enables or disables the Thermal Disinfection and Full Cold features for all outlets (also set Reg 28 to enable Disinfection). Enables or disables the Duty Flush function for the individual outlet. Controlled by bitfield.

Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
													Full Cold	Disinfection	Duty Flush

Master Control Registers
Outlet 1 Registers
Outlet 2 Registers
Outlet 3 Registers
Outlet 4 Registers
Outlet 5 Registers
Outlet 6 Registers

Bit value 0 = OFF Bit value 1 = ON				
50	**Outlet 1 Run Time**	**1**	**Seconds**	**R/W**
The maximum length of time the water can flow from the outlet when operated with a hand sensor. The water then stops automatically. Valid when **'Outlet Sub Type' (Reg 47)** = TIMED FLOW or BLOCKING. Maximum value = 20 minutes.				
51	**Outlet 1 Blocking Time**	**1**	**Seconds**	**R/W**
After the water flow has stopped, the blocking timer begins. The outlet cannot be restarted until this time has expired. Valid when **'Outlet Sub Type' (Reg 47)** = BLOCKING. Maximum value = 65535 seconds.				
53	**Outlet 2 Type**	**1**	**Number 0 - 2**	**R/W**
See Reg 46.				
54	**Outlet 2 Sub Type**	**1**	**Number 0 - 2**	**R/W**
See Reg 47.				
55	**Outlet 2 Fan and Pump Configuration**	**1**	**Bitfield**	**R/W**
See Reg 48.				
56	**Outlet 2 Disinfection, Duty Flush and Full Cold Configuration**	**1**	**Bitfield**	**R/W**
See Reg 49.				
57	**Outlet 2 Run Time**	**1**	**Seconds**	**R/W**
See Reg 50.				
58	**Outlet 2 Blocking Time**	**1**	**Seconds**	**R/W**
See Reg 51.				
60	**Outlet 3 Type**	**1**	**Number 0 - 2**	**R/W**
See Reg 46.				
61	**Outlet 3 Sub Type**	**1**	**Number 0 - 2**	**R/W**
See Reg 47.				
62	**Outlet 3 Fan and Pump Configuration**	**1**	**Bitfield**	**R/W**
See Reg 48.				
63	**Outlet 3 Disinfection, Duty Flush and Full Cold Configuration**	**1**	**Bitfield**	**R/W**
See Reg 49.				

Master Control Registers
Outlet 1 Registers
Outlet 2 Registers
Outlet 3 Registers
Outlet 4 Registers
Outlet 5 Registers
Outlet 6 Registers

Reg	Description	Number of Registers	Units	Read / Write Read Only Write Only
64	Outlet 3 Run Time	1	Seconds	R/W
See Reg 50.				
65	Outlet 3 Blocking Time	1	Seconds	R/W
See Reg 51.				
67	Outlet 4 Type	1	Number 0 - 2	R/W
See Reg 46.				
68	Outlet 4 Sub Type	1	Number 0 - 2	R/W
See Reg 47.				
69	Outlet 4 Fan and Pump Configuration	1	Bitfield	R/W
See Reg 48.				
70	Outlet 4 Disinfection, Duty Flush and Full Cold Configuration	1	Bitfield	R/W
See Reg 49.				
71	Outlet 4 Run Time	1	Seconds	R/W
See Reg 50.				
72	Outlet 4 Blocking Time	1	Seconds	R/W
See Reg 51.				
74	Outlet 5 Type	1	Number 0 - 2	R/W
See Reg 46.				
75	Outlet 5 Sub Type	1	Number 0 - 2	R/W
See Reg 47.				
76	Outlet 5 Fan and Pump Configuration	1	Bitfield	R/W
See Reg 48.				
77	Outlet 5 Disinfection, Duty Flush and Full Cold Configuration	1	Bitfield	R/W
See Reg 49.				
78	Outlet 5 Run Time	1	Seconds	R/W
See Reg 50.				
79	Outlet 5 Blocking Time	1	Seconds	R/W
See Reg 51.				

Master Control Registers
Outlet 1 Registers
Outlet 2 Registers
Outlet 3 Registers
Outlet 4 Registers
Outlet 5 Registers
Outlet 6 Registers

Reg	Description	Number of Registers	Units	Read / Write Read Only Write Only
81	Outlet 6 Type	1	Number 0 - 2	R/W
See Reg 46.				
82	Outlet 6 Sub Type	1	Number 0 - 2	R/W
See Reg 47.				
83	Outlet 6 Fan and Pump Configuration	1	Bitfield	R/W
See Reg 48.				
84	Outlet 6 Disinfection, Duty Flush and Full Cold Configuration	1	Bitfield	R/W
See Reg 49.				
85	Outlet 6 Run Time	1	Seconds	R/W
See Reg 50.				
86	Outlet 6 Blocking Time	1	Seconds	R/W
See Reg 51.				
88	Number of Outlets Required to Trigger Fan Operation	1	Integer 0 - 6	R/W
Controls the number of outlets required to be active simultaneously for the ventilation fan to be switched on. If the register value is greater than '0', then the **'Outlet Fan and Pump Configuration' (Reg's 48, 55, 62, 69, 76 and 83)** are required to be set to activate the fan. Reg 89 will set the length of time the fan will continue to run after all the outlets have stopped flowing water.				
89	Fan Run On Time	1	Seconds	R/W
The length of time the ventilation fan will continue to run after all the outlets have stopped flowing water. The fan then switches off automatically. Maximum value = 3599 seconds				

Master Control Registers
Outlet 1 Registers
Outlet 2 Registers
Outlet 3 Registers
Outlet 4 Registers
Outlet 5 Registers
Outlet 6 Registers

Reg	Description	Number of Registers	Units	Read / Write Read Only Write Only
93	Disinfection Type	1	Number 0 - 7	R/W

The settings for the Thermal Disinfection cycle. Also see **Figure 14** and **Figure 15**.

NOTES!

STANDARD (Reg = 0), EXPONENTIAL (Reg = 1), STANDARD ECO (Reg = 4) and EXPONENTIAL ECO (Reg = 5)

After the Disinfection has ended, cold water is flushed through the pipework to remove the hot water before allowing the outlets to return to normal use. This is an automated part of the cycle and is active for approximately 2 minutes.

STANDARD - COLD INLET SUPPLY (Reg = 2), EXPONENTIAL - COLD INLET SUPPLY (Reg = 3), STANDARD COLD SUPPLY ECO (Reg = 6) and EXPONENTIAL COLD SUPPLY ECO (Reg = 7)

After the disinfection cycle has ended, the water in the pipework will remain at an unsafe temperature for washing. See **'Thermal Disinfection of Cold Supply'** and follow the steps to return the cold water pipework to a safe temperature.

0 = STANDARD

Requires that the following registers are set:

'Disinfection Temperature Bottom Limit' (Reg 95)

'Disinfection Temperature Top Limit' (Reg 96) (Value Reg 96 = Reg 95 for STANDARD.)

'Disinfection Timeout' (Reg 97)

'Disinfection Warm Up Time' (Reg 98)

'Thermal Disinfection Time' (Reg 99)

1 = EXPONENTIAL

Requires that the following registers are set:

'Disinfection Temperature Bottom Limit' (Reg 95)

'Disinfection Temperature Top Limit' (Reg 96)

'Disinfection Timeout' (Reg 97)

'Disinfection Warm Up Time' (Reg 98)

'Thermal Disinfection Time' (Reg 99)

2 = STANDARD - COLD INLET SUPPLY (see **'Thermal Disinfection of Cold Supply'**)

Requires that the following registers are set:

'Disinfection Temperature Bottom Limit' (Reg 95)

'Disinfection Temperature Top Limit' (Reg 96) (Value Reg 96 = Reg 95 for STANDARD.)

'Disinfection Timeout' (Reg 97)

'Disinfection Warm Up Time' (Reg 98)

'Thermal Disinfection Time' (Reg 99)

continued...

Master Control Registers

Outlet 1 Registers

Outlet 2 Registers

Outlet 3 Registers

Outlet 4 Registers

Outlet 5 Registers

Outlet 6 Registers

3 = EXPONENTIAL - COLD INLET SUPPLY (see **'Thermal Disinfection of Cold Supply'**)
Requires that the following registers are set:
'Disinfection Temperature Bottom Limit' (Reg 95)
'Disinfection Temperature Top Limit' (Reg 96)
'Disinfection Timeout' (Reg 97)
'Disinfection Warm Up Time' (Reg 98)
'Thermal Disinfection Time' (Reg 99)

4 = STANDARD ECO
Requires that the following registers are set:
'Disinfection Temperature Bottom Limit' (Reg 95)
'Disinfection Temperature Top Limit' (Reg 96) (Value Reg 96 = Reg 95 for STANDARD.)
'Disinfection Timeout' (Reg 97)
'Disinfection Warm Up Time' (Reg 98)
'Thermal Disinfection Time' (Reg 99)

5 = EXPONENTIAL ECO
Requires that the following registers are set:
'Disinfection Temperature Bottom Limit' (Reg 95)
'Disinfection Temperature Top Limit' (Reg 96)
'Disinfection Timeout' (Reg 97)
'Disinfection Warm Up Time' (Reg 98)
'Thermal Disinfection Time' (Reg 99)

6 = STANDARD COLD SUPPLY ECO (see **'Thermal Disinfection of Cold Supply'**)
Requires that the following registers are set:
'Disinfection Temperature Bottom Limit' (Reg 95)
'Disinfection Temperature Top Limit' (Reg 96) (Value Reg 96 = Reg 95 for STANDARD.)
'Disinfection Timeout' (Reg 97)
'Disinfection Warm Up Time' (Reg 98)
'Thermal Disinfection Time' (Reg 99)

7 = EXPONENTIAL COLD SUPPLY ECO (see **'Thermal Disinfection of Cold Supply'**)
Requires that the following registers are set:
'Disinfection Temperature Bottom Limit' (Reg 95)
'Disinfection Temperature Top Limit' (Reg 96)
'Disinfection Timeout' (Reg 97)
'Disinfection Warm Up Time' (Reg 98)
'Thermal Disinfection Time' (Reg 99)

95	Disinfection Temperature Bottom Limit	1	Deg C	R/W
The minimum temperature required to perform a successful Disinfection cycle.				

Master Control Registers
Outlet 1 Registers
Outlet 2 Registers
Outlet 3 Registers
Outlet 4 Registers
Outlet 5 Registers
Outlet 6 Registers

Reg	Description	Number of Registers	Units	Read / Write Read Only Write Only
96	Disinfection Temperature Top Limit	1	Deg C	R/W

For EXPONENTIAL disinfection:
If the water temperature is between **'Disinfection Temperature Bottom Limit' (Reg 95)** and **'Disinfection Temperature Top Limit' (Reg 96)**, the Disinfection cycle time is progressively reduced. The reduction is computed continuously and has the effect of halving the time for each 5°C increase above the **'Disinfection Temperature Bottom Limit'** value (see **Figure 15**). Should the temperature rise above the **'Disinfection Temperature Top Limit'** then no further time reduction accrues.

For STANDARD disinfection
The register MUST have the same unit value as Reg 95.

Reg	Description	Number of Registers	Units	Read / Write Read Only Write Only
97	Disinfection Timeout	1	Minutes	R/W

The maximum duration of the Disinfection cycle (**'Thermal Disinfection Time'** + time for the water temperature to return to a safe level). If the cycle has not been completed according to the plumbing requirements within this time, then the cycle will be aborted. The timeout will vary depending upon the configuration of the system. When determining the timeout value, the following must be taken into account:

- The length of the pipework between the Mixer Valve and the farthest water outlet.
- The hot water flow rate.
- The amount of hot water available for Thermal Disinfection.
- The length of time since the last Thermal Disinfection.

The outlets should not be available for normal use during the **'Disinfection Timeout'** period

Default values:
Standard = 10 minutes
Exponential = 25 minutes

Reg	Description	Number of Registers	Units	Read / Write Read Only Write Only
98	Disinfection Warm Up Time	1	Minutes	R/W

The time allowed to reach the **'Disinfection Temperature Bottom Limit'**. If the temperature is not reached within this time, then the disinfection cycle will abort automatically.

Default value = 2 minutes

Master Control Registers
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Outlet 2 Registers
Outlet 3 Registers
Outlet 4 Registers
Outlet 5 Registers
Outlet 6 Registers

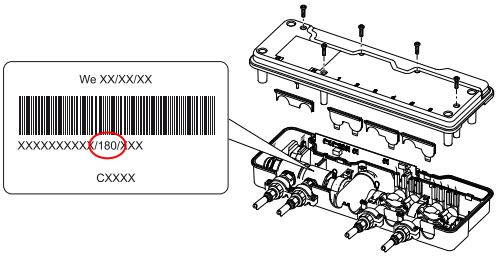
Reg	Description	Number of Registers	Units	Read / Write Read Only Write Only
99	Thermal Disinfection Time	1	Minutes	R/W
The minimum length of time to flush enough hot water through the Mixer Valve, outlet pipework and fittings to meet legislative guidelines. This does not include the time for the water to reach the correct temperature (see **'Disinfection Warm Up Time'**). Default values: STANDARD = 5 minutes EXPONENTIAL = 20 minutes				
Registers 100 - 102 are for diagnostic purposes. Used as a check to make sure all disinfection values have been set correctly (see Figure 16).				
100	Disinfection Target	1	Deg C Minutes	R O
Calculated from Reg's 93 - 99. Requires that Reg 103 = Logic 1.				
101	Disinfection Coefficient Minimum	1	Deg C Minutes	R O
Calculated from Reg's 93 - 99. Requires that Reg 103 = Logic 1.				
102	Disinfection Coefficient Maximum	1	Deg C Minutes	R O
Calculated from Reg's 93 - 99. Requires that Reg 103 = Logic 1.				
103	Disinfection Coefficient Write	1	Command	W O
Calculates the disinfection settings of Reg's 93 - 99 and writes the values of Reg's 100 - 102. Perform a WRITE command to the register to activate.				
106	Valve Serial Number	2	Serial Number (long)	R O
The serial number of the Mixer Valve. Assigned when assembled at factory, stored in the Mixer Valve PCB (circuit board). See **'Long'** for value format.				
107				
Continuation of Reg 106.				
108	Date and Time of Manufacture	2	Date/Time (long)	R O
The date and time of Mixer Valve manufacture, value stored in the Mixer Valve PCB (circuit board). See **'GENERIC DATE AND TIME SPECIFICATION'** for details of the register input.				

Master Control Registers
Outlet 1 Registers
Outlet 2 Registers
Outlet 3 Registers
Outlet 4 Registers
Outlet 5 Registers
Outlet 6 Registers

Reg	Description	Number of Registers	Units	Read / Write Read Only Write Only
109				
Continuation of Reg 108.				
110	**Valve Firmware Type Number**	**1**	**Integer**	**R O**
Product type number. E.g. 20 = Rada Outlook Mixer Valve.				
111	**Valve Firmware Version Number**	**1**	**Integer**	**R O**
The version number of the Mixer Valve software.				
114	**Sensor Box Firmware Type**	**1**	**Integer**	**R O**
Product type number. E.g. 21 = Rada Outlook Sensor Box.				
115	**Sensor Box Firmware Version**	**1**	**Integer**	**R O**
The version number of the Sensor Box.				
116	**Date and Time of Valve Commissioning**	**2**	**Date/Time (long)**	**R/W**
The date and time of the Mixer Valve setup. See **'GENERIC DATE AND TIME SPECIFICATION'** for details of the register input.				
117				
Continuation of Reg 116.				
118	**Duty Flush Delay Time (Hours)**	**1**	**Integer 1 - 23**	**R/W**
The length of time between Duty Flush cycles in hours. Duty Flush will activate only when this time has expired. Writing a value will set Reg 281 to '0'.				
120	**Valve Spool Calibration**	**1**	**Integer 120 - 200**	**R/W**

Must be set if the following components are ever replaced:
Mixer Valve Assembly
Mixer Valve PCB (circuit board)

Turn Mixer Valve OFF (Reg 4 = 0) before changing this register.



The Calibration Number can be found on the Mixer Valve body.

Master Control Registers
Outlet 1 Registers
Outlet 2 Registers
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Outlet 4 Registers
Outlet 5 Registers
Outlet 6 Registers

Reg	Description	Number of Registers	Units	Read / Write Read Only Write Only
121	Number of Valve Operations	2	Number (long)	R O
Number of times the Mixer Valve has been switched ON (Reg 4 = 1). The counter starts when assembled at the factory.				
122				
Continuation of Reg 121.				
123	Total Valve ON Time	2	Minutes	R O
The cumulative length of time the Mixer Valve has been switched ON (Reg 4 = 1).				
124				
Continuation of Reg 123.				
125	Date and Time of Valve Service	2	Date/Time (long)	R/W
A record of when maintenance was performed on the Mixer Valve. Set by the user at the time of maintenance.				
126				
Continuation of Reg 125.				
127	Identification of Valve Service Engineer	1	Number Integer	R/W
A record to identify the person responsible for performing maintenance on the Mixer Valve. Set by the user at the time of maintenance.				
128	Hours Valve has been Unused	1	Hours	R O
The length of time that none of the water outlets are activated. Includes Duty Flush and Disinfection cycles.				
133	Outlet 1 Time Since Last Used	1	Hours	R O
The length of time that this water outlet has not been activated. Example of operation: 1. Outlet is turned ON (includes the operation of Duty Flush or Thermal Disinfection). 2. Outlet is turned OFF manually or automatically. 3. Timer is started. 4. Outlet is turned ON (length of time is recorded in Reg 133). 5. Outlet is turned OFF manually or automatically. 6. Reg 133 is reset and timer is restarted.				
134	Outlet 2 Time Since Last Used	1	Hours	R O
See Reg 133.				

Master Control Registers

Outlet 1 Registers

Outlet 2 Registers

Outlet 3 Registers

Outlet 4 Registers

Outlet 5 Registers

Outlet 6 Registers

Reg	Description	Number of Registers	Units	Read / Write Read Only Write Only
135	Outlet 3 Time Since Last Used	1	Hours	R O
See Reg 133.				
136	Outlet 4 Time Since Last Used	1	Hours	R O
See Reg 133.				
137	Outlet 5 Time Since Last Used	1	Hours	R O
See Reg 133.				
138	Outlet 6 Time Since Last Used	1	Hours	R O
See Reg 133.				
139 to 154	Valve Location	16	String (1 character per register)	R/W

A description to identify the Mixer Valve or location (for when there are multiple Mixer Valves on one site).
Note! The string value is null terminated (ends in zero).

Example: 'Men's Toilet'

	Reg 139	Reg 140	Reg 141	Reg 142	Reg 143	Reg 144	Reg 145	Reg 146	Reg 147	Reg 148	Reg 149	Reg 150	Reg 151	Reg 152	Reg 153	Reg 154
	M	E	N	S		T	O	I	L	E	T	null				
ascii codes	77	69	78	83	32	84	79	73	76	69	84	0				

155	Hours Since Last Disinfection	1	Hours	R O
The length of time elapsed after a Thermal Disinfection cycle has been performed.				
156	Disinfection Time and Date	2	Date/Time (long)	R O
The time and date of the last Thermal Disinfection cycle performed. See **'GENERIC DATE AND TIME SPECIFICATION'** for details of the register input.				
157				
Continuation of Reg 156.				
158	User Identification for Disinfection	1	Integer	R/W

A record to identify the person responsible for performing the last Thermal Disinfection cycle. Set by the user at the time of disinfection.

Master Control Registers
Outlet 1 Registers
Outlet 2 Registers
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Outlet 4 Registers
Outlet 5 Registers
Outlet 6 Registers

Reg	Description	Number of Registers	Units	Read / Write Read Only Write Only
159	Disinfection Result	1	Logic	R O
The result of the last Thermal Disinfection cycle performed. 0 = FAIL 1 = PASS				
160 to 279	Disinfection Temperature Log	120	Deg C = Reg Value x 0.5 (values logged at 30 second intervals)	R O
A record of the temperatures achieved during the last disinfection cycle. Each register is the lowest water temperature reading of every 30 seconds period during the cycle. The register values are multiplied by 0.5°C to give the correct temperature. E.g. 120 = 60°C.				

Registers 280 - 285 must be written simultaneously using the 'write multiple registers' command. Writing data to a single register of this series will cause the Duty Flush to malfunction.

280	Duty Flush Type	1	Enumeration 7	R/W

The type of Duty Flush cycle required.
Also see **'DUTY FLUSH'**.

0 = OFF
No Duty Flush cycle is performed

1 = STANDARD
Requires that the following registers are set:
'Duty Flush Delay Time' (Reg 281)
'Duty Flush Duration' (Reg 282)
'Duty Flush Setpoint' (Reg 283)
'Duty Flush Activation Time' (Reg 284)
'Duty Flush Warm Up Time' (Reg 285)

2 = SMART
The Duty flush cycle operates according to the same registers as STANDARD, but also according to the period of inactivity. If the outlet has been used less than 22 hours before the **'Duty Flush Activation Time' (Reg 284)**, the Duty Flush is not performed to help conserve water (see **Figure 12**).

Master Control Registers
Outlet 1 Registers
Outlet 2 Registers
Outlet 3 Registers
Outlet 4 Registers
Outlet 5 Registers
Outlet 6 Registers

Reg	Description	Number of Registers	Units	Read / Write Read Only Write Only
281	Duty Flush Delay Time	1	Days	R/W
The length of time between Duty Flush cycles in days. Duty Flush will activate only when this time has expired. Writing a value will set Reg 118 to '0'.				
282	Duty Flush Duration	1	Seconds	R/W
The length of time to flush water through the Mixer Valve, outlet pipework and fittings. This value does not include the time for the water to reach the correct temperature (see **'Duty Flush Warm Up Time'**).				
283	Duty Flush Setpoint	1	Deg C = Reg Value x 0.1	R/W
The required temperature of the water during the Duty Flush cycle. The minimum temperature must be at least 30°C and the maximum must be at least 5°C below the **'Maximum Setpoint' (Reg 29)**.				
284	Duty Flush Activation Time	1	Minutes	R/W
The time of day set to perform the Duty Flush cycle. Input the time as the number of minutes after midnight (00:00).				
285	Duty Flush Warm Up Time	1	Seconds	R/W
The time allowed for the water to reach the **'Duty Flush Setpoint' (Reg 283)**.				
286	Valve Outlets On Time Cumulative	2	Seconds	R O
The length of time water has been flowing from the Mixer Valve. The timer starts when assembled at the factory. Includes Duty Flush and Thermal Disinfection cycles.				
287				
Continuation of Reg 286.				
288	System Date and Time	2	Date/Time (long)	R/W
Sets the current time and date. Value stored in the Sensor Box. See **'GENERIC DATE AND TIME SPECIFICATION'** for details of the register input.				
289				
Continuation of Reg 288.				
290	Date and Time of Last Duty Flush	2	Date/Time (long)	R O
A record of when the Duty Flush was activated last. See **'GENERIC DATE AND TIME SPECIFICATION'** for details of the register input.				
291				
Continuation of Reg 290.				

Master Control Registers
Outlet 1 Registers
Outlet 2 Registers
Outlet 3 Registers
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Outlet 5 Registers
Outlet 6 Registers

Reg	Description	Number of Registers	Units	Read / Write Read Only Write Only
292	Outlet 1 Duty Flush Status	1	Number 0 - 3	R O

The result of the last duty flush. Reg's 290 - 303 are written to the **'Duty Flush Log'** as a single file record.

0 = OK
Duty flush successful.

1 = NOT APPLICABLE
Duty Flush not required for this water outlet. Due to one of the following:

- The Duty Flush is disabled for this outlet. Check Reg's 28,49, 56, 63, 70, 77 and 83.
- The **'Duty Flush Type'** is set to SMART (Reg 280 = 2), the Duty Flush cycle is not required if the outlet has been activated less than 22 hours before the **'Duty Flush Delay Time' (Reg 281)** has expired (see Figure 12).

2 = FAULT (NO HOT WATER)
Duty Flush unsuccessful. The water failed to reach the required temperature during **'Duty Flush Warm Up Time' (Reg 285)**.

3 = FAULT (NO FLOW)
The Duty Flush failed or was interrupted. Check for the following:

- Blocked outlet.
- Power failure to the Mixer Valve.
- Hot or cold water draw off from supplies to the Mixer Valve.
- No water supply to Mixer Valve.
- Malfunction of the Mixer Valve. Check PCB, wiring and solenoid valves.

293	Outlet 2 Duty Flush Status	1	Number 0 - 3	R O
See Reg 292.				
294	Outlet 3 Duty Flush Status	1	Number 0 - 3	R O
See Reg 292.				
295	Outlet 4 Duty Flush Status	1	Number 0 - 3	R O
See Reg 292.				
296	Outlet 5 Duty Flush Status	1	Number 0 - 3	R O
See Reg 292.				
297	Outlet 6 Duty Flush Status	1	Number 0 - 3	R O
See Reg 292.				

Master Control Registers
Outlet 1 Registers
Outlet 2 Registers
Outlet 3 Registers
Outlet 4 Registers
Outlet 5 Registers
Outlet 6 Registers

Reg	Description	Number of Registers	Units	Read / Write Read Only Write Only
298	Outlet 1 Time Since Last Used - DF	1	Hours	R O
The length of time the water outlet has been inactive between Duty Flush cycles. Example of operation: 1. Duty Flush performed. 2. Timer is started. 3. Outlet is turned ON manually (timer is paused). 4. Outlet is turned OFF manually or automatically (timer is restarted). 5. Duty Flush performed (timer is stopped. Total length of time is recorded in Reg 298). The time is recorded as completed number of hours only, e.g. 1 hour, 2 hours, 3 hours, etc...				
299	Outlet 2 Time Since Last Used - DF	1	Hours	R O
See Reg 298.				
300	Outlet 3 Time Since Last Used - DF	1	Hours	R O
See Reg 298.				
301	Outlet 4 Time Since Last Used - DF	1	Hours	R O
See Reg 298.				
302	Outlet 5 Time Since Last Used - DF	1	Hours	R O
See Reg 298.				
303	Outlet 6 Time Since Last Used - DF	1	Hours	R O
See Reg 298.				
304	Duty Flush First File Record Identification	1		R O
This register identifies the position, within the **'File Record List'**, of the last Duty Flush cycle results (Reg's 290 - 303, see Table 3).				
305	Duty Flush Number of File Records	1	File Length	R O
The number of records that have been written to the **'File Record List'**.				
306	Arm Disinfection Command	1	Hex Value	W O
Used to prepare the Mixer Valve for a Disinfection cycle to be **'Triggered'**. WRITE a value (hex) of **'0x6172'** to the register to activate. This requires that the Thermal Disinfection feature is enabled **'Valve Disinfection - Configuration' (Reg 28)** and the Mixer Valve is switched OFF (Reg 4 = 0). After the Arm command, the **'Trigger Disinfection Command' (Reg 307)** must be written within 10 seconds otherwise the cycle will abort automatically.				

Master Control Registers
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Outlet 3 Registers
Outlet 4 Registers
Outlet 5 Registers
Outlet 6 Registers

Reg	Description	Number of Registers	Units	Read / Write Read Only Write Only
307	Trigger Disinfection Command	1	Hex Value	W O

Activates the Thermal Disinfection cycle. It must be written less than 10 seconds after the **'Arm Disinfection Command' (Reg 306)** otherwise the cycle will abort automatically.

WARNING! FULL HOT WATER WILL BE DELIVERED TO ALL WATER OUTLETS. Before using the Thermal Disinfection feature, make sure all safety warnings and conditions within this guide are observed.

WRITE a value (hex) of **'0x5452'** to the register to activate.

There is a 10 second delay before the command is given to the Mixer Valve.

Any activity detected by the PIR sensor will cause the Disinfection cycle to abort automatically (see **'Automatic Abort'**).

If the Mixer Valve accepts the Arm and Trigger commands, then a normal Modbus response is received. **'Valve Status' (Reg 4)** will change to DISINFECTION, indicating the cycle has started.
If the conditions are not correct, then an invalid command message may be received.

'Valve Status' (Reg 4) may be monitored throughout the disinfection.

Water will flow for the time calculated by the disinfection algorithm. The actual time will depend upon the water temperature and the following disinfection parameters:

'Disinfection Type' (Reg 93)
'Disinfection Temperature Bottom Limit' (Reg 95)
'Disinfection Temperature Top Limit' (Reg 96)
'Disinfection Timeout' (Reg 97)
'Disinfection Warm Up Time' (Reg 98)
'Thermal Disinfection Time' (Reg 99)

When the conditions have been satisfied for the first three outlets, the flow will Mixer Valve will switch the flow to the next three. When these have been satisfied, the Mixer Valve will proceed to the Cool Down phase automatically.

Master Control Registers
Outlet 1 Registers
Outlet 2 Registers
Outlet 3 Registers
Outlet 4 Registers
Outlet 5 Registers
Outlet 6 Registers

Reg	Description	Number of Registers	Units	Read / Write Read Only Write Only
308	**Abort Disinfection Command**	**1**	**Command**	**W O**
Stops the Thermal Disinfection cycle. Register can be written at any time after the Arm command. **WARNING! FULL HOT WATER MAY BE PRESENT IN THE PIPEWORK AFTER THE ABORT!** Make sure the water has returned to a safe temperature before normal use of the outlets is allowed. Perform a WRITE command to the register to activate.				
309	**Reset Valve Command**	**1**	**Command**	**W O**
Resets the Mixer Valve from an Over Temperature Error **'Valve Error Code'** (Reg 8 = 1) without the need to cycle the power off/on. Perform a WRITE command to the register to activate.				
312	**Force Data Rescan**	**1**	**Command**	**W O**
Refreshes all of the registers with current values. Perform a WRITE command to the register to activate.				
313	**Disable Unit**	**1**	**Command**	**W O**
Will disable the system for cleaning and maintenance. This acts in the same way as the Rada Key Switch. See **'Rada Outlook Digital Mixer Valve, Sensor Box and Sensor Product Manual'** for further details. Perform a WRITE command to the register to activate.				

Master Control Registers

Outlet 1 Registers **Outlet 2 Registers**

Outlet 3 Registers **Outlet 4 Registers**

Outlet 5 Registers **Outlet 6 Registers**

QUICK GUIDE FOR ERROR CODES

ERROR CODES

The listed values in the following registers are the result of ERRORS reported to the Sensor Box.

Reg 4

7 = ERROR

An error has occurred during the Mixer Valve's operation. The unit value of **'Valve Error Code' (Reg 8)** has changed.

Reg 8

0 = NO ERROR

1 = OVER TEMPERATURE

The temperature of the water to the outlets is too high. The Mixer Valve has shut down to reduce the risk of scalding injury.
REG 309 can be used to reset the Mixer Valve from this error without the need to cycle the power off/on.

2 = STUCK MOTOR

The stepper motor that controls the water mixing mechanism is malfunctioning. Maintenance is required to the Mixer Valve.

3 = MOTOR CALIBRATION

The Mixer Valve fails a self test operation when powered on. Maintenance is required to the Mixer Valve.

4 = VALVE FAILURE

There is an unspecified malfunction with the Mixer Valve. Maintenance required.

5 = THERMISTOR FAILURE

The temperature sensor in the Mixer Valve has failed.

6 = UNCONFIGURED

Registers requiring initial values have not been set before power up. Mixer Valve may require reprogramming.

GENERIC DATE AND TIME SPECIFICATION

The input format for registers 108, 125, 156, 288 and 290. The value is a four byte variable treated by the system as a Long. The table specifies the byte definitions for the Long. The order is MS byte first, LS byte last.

Hex String Example	0				D				0				4				A				2				B				0			
Bit	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Binary	0	0	0	0	1	1	0	1	0	0	0	0	0	1	0	0	1	0	1	0	0	0	1	0	1	0	1	1	0	0	0	0
Meaning	Number of years after 2000								Day								Month				Time in minutes (high nibble)				Time in minutes (mid nibble)				Time in minutes (low nibble)			
Decoded Meaning	0x0D = 13 ‘2013’								0x04 = 4 ‘04’								0xA = 10 ‘October’				0x2B0 = 688 decimal 688 ÷ 60 = 11.466667											
																					hours = 11 minutes = 0.466667 x 60 = 28.00002											
																					Time = ‘11:28 am’											

Table 5

Long

Two Integers in two consecutive registers. The first register (lowest number) contains the two most significant bytes.

SPECIFICATIONS

Communications Standard

1. Baud Rate 9600
2. Parity None
3. Data Bits 8
4. Stop Bits 1
5. Mode RTU
6. Electrical Interface RS485 2-Wire cabling no pull-up
7. Mixer Valve box provides the DC power to the Sensor Box
8. DC isolation optional, set by Sensor Box Address Switch Block

    8.1. No DC isolation, Sensor Box DC is obtained from the Mixer Valve.

    8.2. DC isolation, an external Power Supply 5V - 12V DC is required to power the Sensor Box

9. Sensor Box Address range 1 - 31 set by Sensor Box Address Switch Block

START	ADDRESS	FUNCTION	DATA	CRC	END
3.5 Ch idle	8 bits	8 bits	N x 8 bits	16 bits	3.5 Ch idle
At least 3.5 character times of silence (MARK condition)	Station (RTU) Address	Function codes (E.g. Read coils / inputs)	Message data (length will depend on message type)	Error check	At least 3.5 character times of silence between frames

Table 6:
Modbus RTU format

Modbus Functions Supported

1. Read holding registers (0x03)

2. Write Single register (0x06)

3. Write Multiple registers (0x10)

4. Read File record (0x14) (File number 1 Duty Flush Record)

‘holding’ registers are sometimes referred to as ‘analogue’ registers.

Modbus Error Codes

1. Illegal Address
   Returned if the read or write register address is outside the address range of the unit

2. Illegal data
   Returned if data written to a register is outside the bounds for that register or the Sensor Box is not configured to accept such data

3. Slave failure
   One of four possible events can occur in response to the Modbus master’s (BMS) query:

   3.1. If the Sensor Box receives the query without a communication error, and can handle the query normally, it returns a normal response.

   3.2. If the Sensor Box does not receive the query due to a communication error, no response is returned. The master program will eventually process a timeout condition for the query.

   3.3. If the Sensor Box receives the query, but detects a communication error (parity CRC), no response is returned. The master program will eventually process a timeout condition for the query.

   3.4. If the Sensor Box receives the query without a communication error, but cannot handle it (for example, if the request is to read a nonexistent register), the Sensor Box will return an exception response informing the master of the nature of the error.

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CUSTOMER SERVICE

Guarantee

Your product has the benefit of our manufacturer's guarantee which starts from date of purchase.

Within the guarantee period we will resolve defects in materials or workmanship, free of charge, by repairing or replacing parts or product as we may choose.

This guarantee is in addition to your statutory rights and is subject to the following conditions:

- The product must be installed and maintained in accordance with the instructions given in this user guide.
- Servicing must only be undertaken by us or our appointed representative. **Note!** if a service visit is required the product must be fully installed and connected to services.
- Repair under this guarantee does not extend the original expiry date. The guarantee on any replacement parts or product ends at the original expiry date.
- For shower fittings or consumable items we reserve the right to supply replacement parts only.

This guarantee does not cover:

- Call out charges for non product faults (such as damage or performance issues arising from incorrect installation, improper use, inappropriate cleaning, lack of maintenance, build up of limescale, frost damage, chemical attack, corrosion, system debris or blocked filters) or where no fault has been found with the product.
- Water or electrical supply, waste and isolation issues.
- Compensation for loss of use of the product or consequential or indirect loss of any kind.
- Damage or defects caused if the product is repaired or modified by persons not authorised by us or our appointed representative.
- Routine maintenance or replacement parts to comply with the requirements of the TMV2 or TMV3 healthcare schemes.
- Accidental or wilful damage.
- Products purchased ex-showroom display.

What to do if something goes wrong

If your product does not work correctly, refer to this manual for fault diagnosis and check that it is installed and commissioned in accordance with our instructions.

If this does not resolve the issue, contact us for help and advice.

Technical Helpdesk Service

Contact our Customer Services Team for product advice, to purchase spare parts or accessories, or to set up a service visit.

You can contact us via phone or e-mail - contact details below.

Please provide your model name, power rating (if applicable) and date of purchase.

Rada Website (www.radacontrols.com)

From our website you can view our full product catalogue or download a brochure.

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No one knows our products better than our nationwide team of Service Technicians. We can carry out service or repair work to your product both during and after the guarantee period.

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