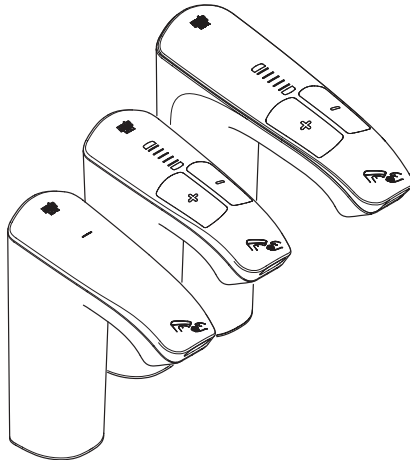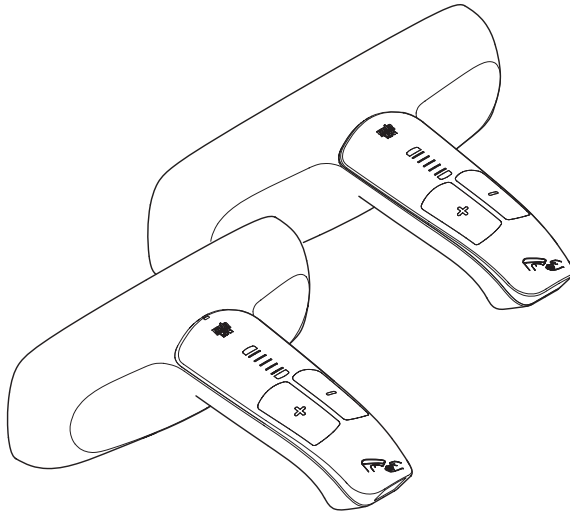# Intelligent Care
BMS Integration Guide

Programming Guide

Supplied upon request to system integrators

rada

General

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 **Intelligent Care** products are designed for serial communications protocols, but can be configured to communicate with a BMS (Building Management System) using the Modbus protocol. When configured for Modbus, the product acts as an RTU (Remote Terminal Unit) that is monitored by the BMS.

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

Each sub network can contain up to 31 Intelligent Care products (hereafter referred to as "valves").

Each valve requires commissioning via the Intelligent Care app "RADA AP1" available for Apple® iPad®. Commissioning must be done at the valve installation using Bluetooth® before it can be monitored. All settings for the valve are applied via the app. Links to download the "Rada AP1" app and the user guide can be found at **www.radacontrols.com**.

The Modbus RTU format and Functions relevant to Intelligent Care®

The BMS software will need to be configured in the following format in order to communicate with Intelligent Care®.

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 1: Modbus RTU format

Communications Standard
- Baud Rate 9600
- Parity None
- Data bits 8
- Stop Bits 1
- Mode RTU

Modbus Functions Supported
- Read Holding registers (0x03)
- Write Single register (0x06)
- Write Multiple registers (0x10)

Modbus Error Codes
- Illegal Address - Write Error 2
  Returned if the read or write register address is outside the address range.

- Illegal data - Write Error 3
  Returned if data written to a register is outside the bounds for that register or the valve is not configured to accept such data.

- Slave failure - Write Error 4
  Returned if the connected Intelligent Care cannot be identified.

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General Data Description

The Intelligent Care valve acts as a Modbus slave unit (or RTU) and keeps its holding registers synchronised with its internal database. Following a successful write command, the Intelligent Care internal database is updated with new settings/values. At least 5 seconds should be allowed between Modbus writes and subsequent reads to allow adequate time for the microprocessor to handle the command/requests as well as physical mechanical movement of parts to complete in response to the request.

Hardware Connections/Wiring

Please refer to companion guide 1260273-W2 (IC Networking Guide) for further details on how to physically network each valve to a BMS.
Each valve must be uniquely addressed (preferably using the Rada AP1 mobile app) prior to attempting communication with multiple devices using a BMS.

Functionality available to remote connection

See **"Modbus Register Summary"** on page 13 for details of the reading/writing requirement.

General Settings

Unit Address (Reg 0)

Valve Location (Reg's 139 - 154)

The Location is the name given to identify the valve (for when there are multiple valves on one site.

Date and Time (Reg's 288 and 289)

Note: The internal real time clock setting does not update automatically for daylight savings and thus will require manually adjusting.

See **"Generic Date and Time Specification"** on page 23 for details of the register input.

Full Cold flow rate (Reg 34)
Controls the flow rate when the valve is operating in the full cold setting.

Valve Identity
Serial No (Reg's 106 and 107)
- Unique serial number programmed during the valve's manufacture.

Valve Type (Reg 46)
- Fixed or Adjustable Temperature version

Valve Firmware (Reg 110)
- Firmware Version Number

Operational State

Valve Status (Reg 4)

Valve outlet temperature (Reg 6)

Disable valve (Reg 313)

- Means of remotely disabling a valve for service or facility issue.

Valve Error Code (Reg 8)

Maintenance Settings

Last Temperature Check date (Reg 116 and 117)

Last Temperature Check Hot (Reg 130)

Last Temperature Check Cold (Reg 131)

Last Temperature Check Blend (Reg 132)

Disable valve (Reg 313)

Error History Time, Date, Error (435 – 464)

- Valve memory stores 10 error events. Overwrites earliest record once full

Usage

Number of valve operations (Reg 121 and 122)

Hours value unused (Reg 128 and 129)

Time since last used (133)

Outlet Set Up

Max Blend Temperature (Reg 36)

Min Blend Temperature (Reg 37)

Default Blend Temperature (Reg 38)

Valve Sub Type (Reg 47)

- Used to input the valves operational type
    1. On/ off
    2. Timed
    3. Blocking

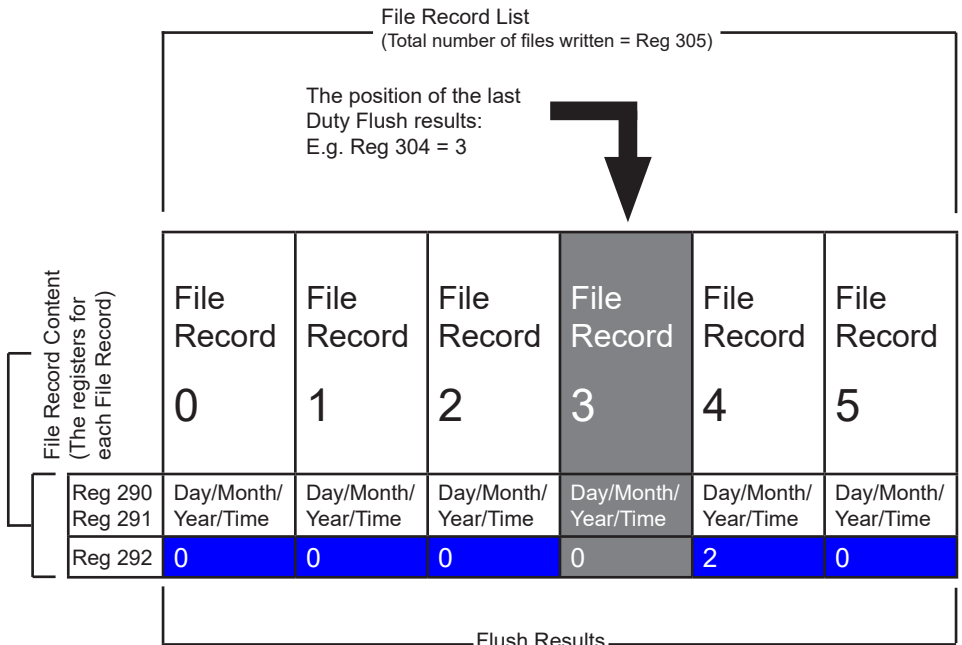Blocking Time (Reg 50)

Temperature Memory (51)

Run On Time (Reg 52)

Duty Flush Log

For details of all registers see "Modbus Register Summary" on page 13.

The Intelligent Care valve 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.

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

Flush Results

(All Register data entries are for example only)

Table 2: Duty Flush Log

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

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.

Reg 292

The result of the Duty Flush

0 = OK
2 = FAULT (No hot water)
3 = FAULT (No water flow)
4 = FAIL (Flush cancelled or interrupted)
6 = NOT REQUIRED [Valve used sufficiently enough to negate need of duty flush (smart flush only)].

Reg 298   The length of time valve has been used prior to a Duty Flush (seconds).

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'**.

Duty Flush Setting

See "Modbus Register Summary" on page 13 for details of the reading/writing requirement.

Duty flush Type, Write Type to (Reg 280)
0 = Disabled
1 = Standard – Operates at a fixed time intervals regardless of usage
2 = Smart – Only flushes if the daily usage is less than flush duration.

Duty flush duration Reg (282)
Time in seconds of the flush.

Duty flush activation time (Reg 284)
Minutes past midnight when flush is to be activated.

Delay between flushes (Reg 281)
Hours between flushes.

Duty flush temperature (Reg 283)

Warm up time (Reg 285)
Time in seconds allowed for valve to reach flushing temperature.

Post Cold Flush (Reg 342)
Time in second full cold will run after a duty flush.

Note: Register 49 must have duty flushing enabled. See **"Event Configuration"** on page 21.

Immediate Duty Flush Reg (319)
An instantaneous duty flush can be triggered.

Reading Thermal Disinfection Results

See "Modbus Register Summary" page 13 for details of the reading/writing requirement.

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.

Reg 159 —— The result of the Thermal Disinfection.
0 = FAIL (Unknown reason)
1 = PASS
2 = FAIL (Could not warm up)
3 = FAIL (Loss of hot water)
4 = FAIL (Timed out)
5 = FAIL (Disinfection not enabled)
6 = FAIL (Abort command received)
7 = FAIL (Valve failure)
8 = FAIL (Valve not ready)
9 = FAIL (Disinfection coefficients not set)
10 = FAIL (Valve activated during disinfection)
11 = FAIL (Disinfection already in progress)
12 = FAIL (Triggering cancelled)
13 = FAIL (Cancelled by magnetic key)

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 Setting and Triggering

See "Modbus Register Summary" on page 13 for details of the reading/writing requirement.

⚠ **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.

Considering the safety implication automated timed triggering is not possible.

Disinfection Type (Reg 93)

Standard, Exponential, Standard Cold, Exponential Cold

Standard adheres to time and temperature inputs Reg, 95, 97, 98, 99

Exponential shortens flush time if a higher temperature can be attained.

Cold requires plumbing connection to temporarily divert hot water to the cold inlet of the valve.

- Disinfection temperature bottom (Reg 95)
- Disinfection temperature top (Reg 96) - Required for Exponential
- Disinfection timeout (Reg 97)
- Disinfection warmup time (Reg 98)
- Disinfection time (Reg 99)

To provide an additional level of security against delivering water at full hot, an arm and trigger function is added to reduce risk of inadvertent activation.

To initiate a thermal disinfection the following is required.

- Arm (Reg 306)

Within 10 seconds of arming, the trigger action must be completed.

- Trigger (Reg 307)

Note: Depending on the specific BMS being used, it may be necessary to send a 'null' or 'safe' value when not writing the arm or trigger values. In this instance, use the hex value 0xFFFF (dec 65535) which the product will acknowledge but will not interfere with the disinfection cycle.

Note: Register 49 must have thermal disinfection enabled. See **"Event Configuration"** on page 21.

Manual Abort (Reg 308)

- Valve stops immediately, return to safe temperature before normal operation.

System Temperature Check

See "Modbus Register Summary" on page 13 for details of the reading/writing requirement.

A temperature check can be triggered, these are used to record system water temperatures. Full hot supply temperature is delivered from the valve, safety protocols used for thermal disinfection must be followed.

- Arm temperature check (Reg 316)
- Triggering temperature check (Reg 310)
- Results from temperature check stored at:
  - Last temperature check date (Reg 116 and 117)
  - Last temperature check hot (Reg 130)
  - Last temperature check cold (Reg 131)
  - Last temperature check blend (Reg 132)

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Reading Cold Flush Results

See "Modbus Register Summary" on page 13 for details of the reading/writing requirement.

The result of the last cold flush performed consists of the values in the following READ ONLY registers:

Reg 385 ⎤— Date and Time last cold flush
Reg 386 ⎦— The result of the Cold Flush

Reg 393 ⎤—
    0 - PASS
    1 – FAIL (Could not achieve cold temperature)
    2 – FAIL (Could not maintain below cold temperature)
    3 – FAIL (User cancelled) Mag Key or Trigger IR sensor.

Cold Flush Setting

Cold flush Type, Write Type to (Reg 345)

    0 = Cold Flush Scheduling Disabled
    1 = Cold Flush Scheduling Enabled

Cold flush duration Reg (351)

    Time in seconds of the flush.

Cold flush activation time (Reg 346)

    Minutes past midnight when flush is to be activated.

Delay between flushes (Reg 347)

    Hours between flushes.

Cold flush Cool down temperature (Reg 348)

    Temperature required before flush duration timer starts.

Cold flush maintained temperature (Reg 350)

    Temperature that cannot be exceeded

Cold flush flow rate (Reg 352)

Note: Register 49 must have cold flushing enabled. See **"Event Configuration"** on page 21.

Modbus Register Summary

DO NOT alter any registers not included in the following table.

Reg	Description	Number of Registers	Units	Read / Write Read Only Write Only
	Each valve in a network must have unique address number.			
0	Valve Address	1	Address 1 - 31	R W
	Bit 0-4 Modbus Address in the range of 1-31.			
4	Valve Status	1	Number 0 - 17	R W & R O

The current status of the Valve.

0 = OFF (R/W value)
Command to switch the Valve OFF.

1 = ON (R/W value)
Command to switch the Valve ON at default temperature.

2 = FULL COLD (R/W value)
Command to switch the Valve ON, outlet temperature = FULL COLD.

3 = PAUSE (R/W value. Valve must be ON prior to switching to pause.)
Command to the Valve to stop water flow to all outlets.
The Valve switches to this state automatically when there is no water flow from any of the outlets under normal operation. After a period of inactivity the status changes to OFF automatically.

4 = DUTY FLUSH (R O value)
The Duty Flush cycle is active.

6 = DISINFECTION (R O value)
The Thermal Disinfection cycle is active.

7 = ERROR (R O value)
An error has occurred and the error code value of Reg 8 has changed (see **Reg 8** on page 22 for details).

8 = DISABLED (R O value)
The valve has been disabled.

15 = CLEANING/PROGRAMMING (R O value)
The valve is in the cleaning/programming mode and currently inoperable.

16/17 = FLOW CALIBRATION
The valve is currently calibrating flow.

| 6 | Valve Outlet Temperature | 1 | 0.1 Degree C | R O |

The current water outlet temperature. The reading is taken from a temperature sensor located in the Valve.

Note: The value is not measured below 25°C or above 65°C.

Reg	Description	Number of Registers	Units	Read / Write Read Only Write Only
8	Valve Error Code	1	Address 0 -6	R O
The error status of the Mixer Valve. See **"Error Codes"** on page 22 for more details on the cause of the corresponding result returned by the Valve.				
34	Set Cold Flow Rate		Percentage	
15-100% Means of controlling full cold flow rate				
35	Outlet Timeout		Seconds	R W
10-3600 Seconds				
36	Max Blend Temperature	1	0.1 Degree C	R W
Input 33-45 Degree C x 10.				
37	Min Blend Temperature	1	0.1 Degree C	R W
Input 33-45 Degree C x 10.				
38	Default Blend Temperature	1	0.1 Degree C	R W
Input 33-45 Degree C x 10.				
46	Valve Type	1		R O
2 = Fixed Temperature Tap 8 = Adjustable Temperature Tap				
47	Valve Sub Type	1		R W
1 = On/Off 2 = Timed Flow 3 = Blocking				
49	Configuration of Duty, Cold Flush, Thermal Disinfection and Full Cold Mode	1		R W
See **"Event Configuration"** on page 21.				
50	Blocking Time	1	Seconds	R W
1-1500				
51	Temperature Memory	1	Seconds	R W
1-300				
52	Run On Time	1	0.1 Seconds	R W
1-600				
93	Disinfection Type	1		R W
0 = Standard, 1 – Exponential, 2 - Standard Cold, 3 – Exponential Cold				

Reg	Description	Number of Registers	Units	Read / Write Read Only Write Only
95	Disinfection Temperature Bottom	1	Degree C	R W
96	Disinfection Temperature Top	1	Degree C	R W
97	Disinfection Timeout	1	Minutes	R W
98	Disinfection Warmup Time	1	Minutes	R W
99	Disinfection Time	1	Minutes	R W
110	Valve Firmware Type Number	1	Integer	R O
	Valve type number.			
111	Valve Firmware Version Number	1	Integer	R O
	The version number of the Valve firmware.			
116	Last Temperature Check Date		Date/Time Long	R O
	The time and date of the last temperature check			
117				R O
	Continuation of 116			
121	Number of Valve Operations	2	Number (long)	R O
	Number of times the 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 Valve has been switched ON (Reg 4 = 1).			
124				
	Continuation of Reg 123.			
128	Hours Valve has been Unused	2	Hours	R O
	The length of time no usage has occurred. Includes Duty Flush and Disinfection cycles.			
129				
	Continuation of Reg 128.			
130	Last Temperature Check Hot		0.1 Degree C	R O
131	Last Temperature Check Cold		0.1 Degree C	R O
132	Last Temperature Check Blend		0.1 Degree C	R O

Reg	Description	Number of Registers	Units	Read / Write Read Only Write Only
133	**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.

Reg	Description	Number of Registers	Units	Read / Write
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"** on page 23 for details of the register input.

157				

Continuation of Reg 156.

159	**Disinfection Result**	**1**	**Logic**	**R O**

The result of the last Thermal Disinfection cycle performed.

0 = FAIL (Unknown reason)
1 = PASS
2 = FAIL (Could not warm up)
3 = FAIL (Loss of hot water)
4 = FAIL (Timed out)
5 = FAIL (Disinfection not enabled)
6 = FAIL (Abort command received)

7 = FAIL (Valve failure)
8 = FAIL (Valve not ready)
9 = FAIL (Disinfection coefficients not set)
10 = FAIL (Valve activated during disinfection)
11 = FAIL (Disinfection already in progress)
12 = FAIL (Triggering cancelled)
13 = FAIL (Cancelled by magnetic key)

Reg	Description	Number of Registers	Units	Read / Write Read Only Write Only
160 to 279	**Disinfection Temperature Log**	**120**	**Degree 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.				
280	**Duty Flush Type**	**1**		**R W**
0 = Disabled 1 = Standard 2 = Smart				
281	**Duty Flush Delay Time**	**1**	**Hours**	**R W**
Time between flushes. 1 hr – 168 hrs				
282	**Flush Duration**	**1**	**Seconds**	**R W**
Length of flush. 0 -1500				
283	**Duty Flush Temperature**	**1**	**0.1 Degree C**	**R W**
310- 450 – Limited by max settings currently applied to tap				
284	**Duty Flush Activation Time**	**1**	**Minutes**	**R W**
Minutes past midnight. 0 - 1439				
285	**Duty Flush Warm Up Time**		**Seconds**	**R W**
0 – 1500 Seconds				
288	**System Date and Time**	**2**	**Date/Time (long)**	**R/W**
Sets the current time and date. See **"Generic Date and Time Specification"** on page 23 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"** on page 23 for details of the register input.				
291				
Continuation of Reg 290.				

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

The result of the last duty flush. Reg's 290, 291, 292 and 298 are written to the **"Duty Flush Log"** on page 6 as a single file record.

0 = OK
Duty flush successful.

2 = FAULT (No hot water)
Duty Flush unsuccessful. The water failed to reach the required temperature during Duty Flush Warm Up Time.

3 = FAULT (No flow)
The Duty Flush failed or was interrupted. Check for the following:
  • Blocked outlet.
  • Power failure to the Valve.
  • Hot or cold water draw off from supplies to the Valve.
  • No water supply to Valve.
  • Malfunction of the Valve.

4 = FAIL (User cancelled)
The Duty Flush failed due to user operation of the valve mid-way through the cycle.

6 = NOT REQUIRED
The Duty Flush was not carried out as it was used sufficiently between flushes (smart flush only).

298	Usage Time Since Last Duty Flush	1	Seconds	R O

The length of time the water outlet has been active between Duty Flush cycles.

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 - 292, see **Table 2**) on page 6.

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 Control		Command	W O

To run a thermal disinfection the tap must be armed by writing 0x6172 to register 306.
Note: Thermal disinfection must be enabled. See **"Event Configuration"** on page 21.

307	Trigger Thermal Disinfection		Command	W O

Once Armed (Reg 306) write 0x5452 to trigger disinfection

308	Abort Thermal Disinfection	1	Command	R W

Write 1 to register to reset.

Reg	Description	Number of Registers	Units	Read / Write Read Only Write Only
309	Valve Reset Command	1	Command	R W
Write 1 to register to reset.				
310	Trigger Temperature Check	1	Command	W O
Once temperature check armed (Reg 316) write 0x4354 to register 310 to trigger.				
313	Disable Valve	1		R W
1 – Disabled 0 - Enable				
316	Arm for Temperature Check	1	Command	W O
To run a temperature check the tap must be armed by writing 0x6361 to register 316. A temperature check operates the tap at full hot, full cold and bend temperature. Results are recorded to registers 130, 131 & 132.				
319	Trigger Duty Flush	1	Command	W O
To start a duty flush write 0x4466.				
320	Trigger Cold Supply Flush	1		W O
To trigger a cold flush write 0x6346 to register 320.				
342	Post Cold Flush	1	Seconds	R W
0 – 600 Seconds				
345	Cold Flush Type	1		R W
0 = Cold Flush Scheduling Disabled 1 = Cold Flush Scheduling Enabled				
346	Cold Flush Activation Time	1	Minutes	R W
Minutes from Midnight 0 - 1439 Minutes				
347	Cold Flush Interval Period	1	Hours	R W
1-168 Hours.				
348	Cold Flush Cool Down Temperature		0.1 Degree C	R W
15 – 45 Degree C.				
349	Cold flush cool down timeout		Seconds	R W
5-600 Seconds				
350	Cold Flush Maintained Temperature		0.1 Degree C	R W
15 – 30 Degree C. x 10 to input				
351	Cold Flush Maintain Duration		Seconds	R W
1-600 Seconds				
352	Cold Flush Flow Rate		Percentage	R W
15 – 100% Write 0x6346 to Register 320 to commit to valve.				

Reg	Description	Number of Registers	Units	Read / Write Read Only Write Only
394	Last Duty Flush Type	1		R O
Duty flush operation. 0 = OFF 1 = SIMPLE – Triggers at the given time 2 = SMART Triggers if usage requirement not met.				
395	Last Duty Flush duration		Seconds	R O
396	Last Duty Flush setpoint		0.1 Degree C	R O
397	Last Duty Flush warm time		Seconds	R O
398	Last Duty flush cold flush time		Seconds	R O
434	Reset error log			R W
Writing 1 to 434 clear all ten records.				
435	Error 1 Code		Enumeration 18	R O
436	Data & Time of Error 1		Date and Time (long)	R O
437	" "			R O
438-461	Error 2 – Error 9			R O
462	Error 10 code		Enumeration 18	R O
463	Data & Time of Error 10		Date and Time (long)	R O
464				R O
Stored Errors – 10 records 435 - 464. Example Entry. Error entry 1, error code in 435, data and time of error 1 register 436 & 437. See. Enumeration 18. Error codes. Get latest copy of Modbus register description.				

0 - Configuration Parameter Missing	1 - No Error
3 - Thermistor 1 Over Temperature	4 - Thermistor missing
5 - Basic A to D Fault	6 - A to D Timeout
2 - Thermistor Over Temperature	8 - RAM Checksum Incorrect
16 - EE Checksum Incorrect	17 - Ext EE Checksum Incorrect
32 - Flash Checksum Incorrect	36 - Solenoid Fault
37 - General Algorithm Fault	40 - General Fault
71 - Motor Homing After Valve Reset	100 - Incorrect Schedule Phase
105 - IR sensor has not yet been Calibrated	106 - Thermistors Do Not Agree

Reg	Description	Number of Registers	Units	Read / Write Read Only Write Only
465	Usage Activations Day 1	1	0 – 2^16	R O
466	Usage Total Time On Day 1	1	Minutes	R O
467 - 477	Usage Activations Day 2 – 7	1	0 – 2^16	R O
468 - 478	Usage Total Time On Day 2 - 7	1	Minutes	R O

Activations and Totals.
Example for day 1: Number of activations can be read from 465, number of minutes ON can be read from register 466. Day 7 is stored in Activations 477 and time on in 478.
0 – 2^16 is this a max of 65536 activations in a day

Event Configuration

Warning about writing multiple times to set an event as only needed once.

Configures tap functionality.

Warning! A Hex valve needs to be written once to register 49 to change the tap configuration. Repeated writing to register 49 with the same HEX value is likely to cause an error.

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
N/A	N/A	N/A	N/A	N/A	N/A	N/A	Note F	N/A	Note E	N/A	N/A	Note D	Note C	Note B	Note A

Note A: Bit 0 - Duty Flush Auto (1) Manual (0)

Note B: Bit 1 - Thermal Disinfection Enabled (1) Disabled (0)

Note C: Bit 2 - Full Cold Enabled (1) Disabled (0)

Note D: Bit 3 - Start Cold (1) Start Blend (0)

Note E: Bit 6 - Cold Flush Auto (1) Manual (0)

Note F: Bit 8 - Temperature Scale 5 segment (1) 9 Segment (0)

Table 3 - Event Configuration

Note: When writing to register 49, ensure binary is converted to HEX.

Example writing a HEX value of 71 to register 49, configures the tap to:

- Enable Auto Duty Flush
- Enable Thermal disinfection
- Enable Full Cold
- Enable Auto Cold Flush

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Quick Guide for Error Codes

Error Codes

The listed values in the following registers are the result of ERRORS reported by the valve.

Reg 4   7 = ERROR
An error has occurred during Valve operation. The unit value of **'Valve Error Code' (Reg 8)** has changed.

Reg 8   **Note:** This list is non-exhaustive. If an error code is reported that does not appear on this list, please contact Customer Services for advice and support.

0 = NO ERROR
The valve is working without issue.

1 = OVER TEMPERATURE
The temperature of the water to the outlet is too high. The valve has shut down to reduce the risk of scalding injury. This can usually be resolved by power cycling the valve or clearing the error with the magnetic key/app.

2 = STUCK MOTOR
The stepper motors that control the water mixing mechanism have malfunctioned. Maintenance is required to the valve.

3 = MOTOR CALIBRATION
The valve has failed a self-test operation when powered on. Maintenance is required to the valve.

4 = VALVE FAILURE
There is an unspecified malfunction with the valve. Maintenance required.

5 = THERMISTOR FAILURE
The temperature sensor inside the valve has failed.

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

16 = IR CALIBRATION

The infrared detection system has not been calibrated. Contact Customer Services for support.

18 = INTERFACE FAULT

The capacitive touch sensors within the valve are not connected or have failed. Contact Customer service for support.

Generic Date and Time Specification

The input format for registers 156, 288 and 290. The value is a four byte variable (recorded in 2 registers) 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 4 - Date/Time Register Construction

Definition of a "Long data" variable

Consists of two Integers in two consecutive Modbus registers. The first register (lowest number) contains the two most significant bytes (MSB), and the second register contains the two least significant bytes (LSB).

Customer Service

Customer Services Guarantee

Your product has the benefit of Rada's comprehensive parts and labour manufacturer's guarantee which commences from date of purchase. Full guarantee terms and conditions can be found at **www.radacontrols.com** or contact your in region Rada representative or sales agent for further details.

Contact Us

If your product is not working correctly please refer to this manual for fault diagnosis and to check that it is installed and commissioned in accordance with our instructions. If this does not resolve the issue, then please contact our specialist teams who will be happy to help.

For UK based customers support please contact Rada Customer Services

T: **+ 44 (0)344 571 1777** Please note: UK calls cost 7p per minute plus your phone company's access charge

E: **RadaCustomerServices@RadaControls.com**

www.radacontrols.com

For customers based in the Republic of Ireland please contact our Rada Service agent

T: **+ 353 (0) 1 531 9337**

E: **CustomerServiceEire@mirashowers.com**

For customers based in all other geographical regions please get in touch with your local Rada representative or agent whose contact details can be found by visiting our website **www.radacontrols.com/en/contact-us/find-a-partner**

Services

Our UK Rada Customer Service Team can provide **pre-specification** information as well as details on the **UK Rada product Commissioning Service and Maintenance Service Plans** whilst our nationwide team of field-based technicians are here to help if you need a **Reactive Service Call**. We stock a full range of Rada spare parts and fittings which can be purchased over the telephone.

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Registered Office:
Cromwell Road,
Cheltenham,
Gloucestershire
GL52 5EP

EU Importer address
K/E S.A.S.
3 rue de Brennus,
93631, La Plaine Saint-Denis,
France

bsi.

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