# TM-220, TM-225, TM-229

## Application Document

## *Feature Summary*

The TM-220 includes the following features. Only one unit can be used in an installation.

**Aqua-Hot Control**

The TM-220 controls a four-zone Aqua-Hot system. Control is based on input from sensors in the unit, or from an external device broadcasting sensor data via RV-C.

**Radiant Heat Control**

The unit controls up to four simple heat elements. Control is based on input from sensors in the unit, or from an external device broadcasting sensor data via RV-C. Radiant heat is used in preference to Aqua-Hot when shore power is available.

**Tile Heat Control**

The unit can control up to four radiant floor heat mats, each with an individual sensor.

The TM-225 is the same as the TM-220 except that instead of tile heat control it controls the heat source of the aqua-hot (diesel burner, electric element) and engine preheat.

The TM-229 is the same as the TM-220 except that it only handled tile heat control. It also uses a different Source Address.

## *General Specifications*

| | |
|---|---|
| Input Voltage | 8 VDC - 18 VDC |
| Input Amperage | 60 mA @ 12V (idle)<br>110 mA @ 12V (all outputs on) |
| Temperature Range | -40 - 185 Deg F (Industrial) |
| Environmental Limitations | Not sealed for exterior mounting. |
| Flash Memory (code space) | 64K |
| EEPROM | 2K |
| RAM | 256 bytes RAM + 2048 bytes ERAM |
| External Dimensions | 5.55” (L) x 3.79” (W) x 1.25” (H) |
| Source Address | |
| - TM-220, TM-225, TM-226 | Static 100 (0x64) |
| - TM-229 | Static 97 (0x61) |
| Default Source Address | 97 (0x61) |

The TM226 is slightly modified. On the PCB, R15 is removed, and C13 is replaced with a 20K resistor (PN EL324). If the diesel burner status input is fed to an unmodified unit, the unit will be damaged.

## *Product ID*

The TM-220 transmits PRODUCT_ID PGN (0xFEEB) data upon request. Details on this PGN are found in the RV-C Protocol Manual. The format of the data appears as either:

SILVERLEAF*TM220-v.vv-V0*nnnnn** or
AQUAHOT*TM225-v.vv-V0*nnnnn**
SILVERLEAF*TM229-v.vv-V0*nnnnn** or

Where:

| | |
|---|---|
| v.vv | product version number |
| nnnnn | product serial number (currently 00000) |

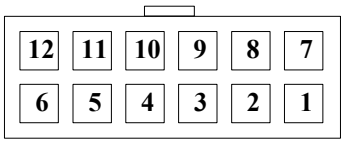
Product ID is determined by the OEM Identifier in the PGN PROP_CONFIGURE_HEAT.

## *Connectors*

### Connector Types

All diagrams are “wire-side” view.

*Molex 12-Pin*
Receptacle - Molex 5557 Series. Part #39-01-2120
Strain Relief - 41995 Series. Part #15-04-0345
Crimp-on Connectors - 5556 Series. Part #39-00-0039




### Connector Pinouts

*Main Connector* *12-pin Molex*

| Pin | Designation | Type | Notes |
|---|---|---|---|
| 1 | GROUND | Ground | |
| 2 | Unused | | |
| 3 | Unused | | |
| 4 | Unused | | |
| 5 | RV-C DATA + | CAN | Attach to RV-C Bus |
| 6 | RV-C DATA - | CAN | Attach to RV-C Bus |
| 7 | POWER | 12V Power Input | Attach to constant power source |
| 8 | Serial Transmit | RS-232 | Do Not Connect (Used for Diagnostic purposes) |
| 9 | Serial Receive | RS-232 | Do Not Connect (Used for Diagnostic purposes) |
| 10 | Serial Ground | RS-232 | Do Not Connect (Used for Diagnostic purposes) |
| 11 | Unused | | |
| 12 | Unused | | |

*Aqua-Hot (AQUAHOT)* *12-pin Molex*

| Pin | Designation | Type | Notes |
|---|---|---|---|
| 1 | ZONE1+ | | Attach to Therm1+ |
| 2 | ZONE1- | Connects to zone1+ when active | Attach to Therm1- |
| 3 | ZONE2+ | | Attach to Therm2+ |
| 4 | ZONE2- | Connects to zone2+ when active | Attach to Therm2- |
| 5 | ZONE3+ | | Attach to Therm3+ |
| 6 | ZONE3- | Connects to zone3+ when active | Attach to Therm3- |
| 7 | ZONE4+ | | Attach to Therm4+ |
| 8 | ZONE4- | Connects to zone4+ when active | Attach to Therm4- |
| 9 | HEATER1_CONTROL | Active Low Output | |
| 10 | HEATER2_CONTROL | Active Low Output | |
| 11 | HEATER3_CONTROL | Active Low Output | |
| 12 | HEATER4_CONTROL | Active Low Output | |

If Using Tile Heat (TM220, TM229)*:*

*Tile Heat (TILE1, TILE2, TILE3, TILE4)* *4-pin Molex*

| Pin | Designation | Type | Notes |
|---|---|---|---|
| 1 | GROUND | Ground | Attach to Floor Control Relay |
| 2 | FLOOR CONTROL | Active High Output | Attach to Floor Control Relay |
| 3 | GROUND | Ground | Attach to Floor Sensor |
| 4 | TILE TEMP | Analog Input | Attach to Floor Sensor |

Else if Using Diesel, Electric, Preheat functions (TM225, TM226):

*DIESEL* *4-pin Molex*

| Pin | Designation | Type | Notes |
|---|---|---|---|
| 1 | GROUND | Ground | |
| 2 | DIESEL | Active High Output | Attach to DIESEL- |
| 3 | GROUND | Ground | Attach to Temperature Sensor |
| 4 | AMBIENT TEMP1 (TM225)<br>BURNER STATUS (TM226) | Analog Input<br>Discrete Input | Attach to Temperature Sensor<br>Attach to AquaHot Burner Indicator (IND LT B3+) |

*ELECTRIC* *4-pin Molex*

| Pin | Designation | Type | Notes |
|---|---|---|---|
| 1 | GROUND | Ground | |
| 2 | ELECTRIC | Active High Output | Attach to ELECTRIC- |
| 3 | GROUND | Ground | Attach to Temperature Sensor |
| 4 | AMBIENT TEMP2 | Analog Input | Attach to Temperature Sensor |

*ELECTRIC High/Low* *4-pin Molex*

| Pin | Designation | Type | Notes |
|---|---|---|---|
| 1 | GROUND | Ground | |
| 2 | ELECTRIC HIGH | Active High Output | Attach to VAC Element Relay #2 |
| 3 | GROUND | Ground | Attach to Temperature Sensor |
| 4 | AMBIENT TEMP3 | Analog Input | Attach to Temperature Sensor |

*PREHEAT* *4-pin Molex*

| Pin | Designation | Type | Notes |
|---|---|---|---|
| 1 | GROUND | Ground | |
| 2 | PREHEAT | Active High Output | Attach to PREHEAT- |
| 3 | GROUND | Ground | Attach to Temperature Sensor |
| 4 | AMBIENT TEMP4 | Analog Input | Attach to Temperature Sensor |

## *Supported Devices*

**Aqua-Hot**

| | |
|---|---|
| Zone 1+ | 12V, 4 mA When shorted to Zone 1- |
| Zone 1- | |
| Zone 2+ | 12V, 4 mA When shorted to Zone 2- |
| Zone 2- | |
| Zone 3+ | 12V, 4 mA When shorted to Zone 3- |
| Zone 3- | |
| Zone 4+ | 12V, 4 mA When shorted to Zone 4- |
| Zone 4- | |

**Temperature Sensors**

The unit supports the Aube/Honeywell AC112-1 temperature sensors.

## *Maintained States*

In the case of a power cycling, the TM-220 does not maintain its internal states. Instead it will resume based on its current configuration and schedule.

## *System Configuration*

System configuration is through a series of proprietary PGNs following the general RV-C guidelines.

**PGNs Supported**

*Proprietary - Calibrate Ambient Temperature*

| | | |
|---|---|---|
| Name: | PROP_CALIBRATE_AMBIENT_TEMP | |
| PGN: | 0xEF64 | |
| Byte 1: | Operation | Always 0xF9 |
| Byte 2: | Sensor | 1 - 4. |
| Byte 3,4: | Reference Temperature | Per RV-C |

Note that the sensor number is not the same as the Zone Instance. The sensor number refers to the physical sensor input. The Floor Heat Sensors cannot be calibrated. It will report THERMOSTAT_AMBIENT_STATUS upon successful calculation of calibration offsets.

*Proprietary - Configure Zone Instances*

| | | |
|---|---|---|
| Name: | PROP_CONFIGURE_HEAT_INSTANCES_1 | |
| PGN: | 0xEF64 | |
| Byte 1: | Operation | Always 0xB6 |
| Byte 2: | Aqua-Hot Zone 1 Instance | Per RV-C. 0 = Disabled. |
| Byte 3: | Aqua-Hot Zone 2 Instance | Per RV-C. 0 = Disabled. |
| Byte 4: | Aqua-Hot Zone 3 Instance | Per RV-C. 0 = Disabled. |
| Byte 5: | Aqua-Hot Zone 4 Instance | Per RV-C. 0 = Disabled. |

Note that the Aqua-Hot Control will always report using Instance 164-167. This determines the Instance of the THERMOSTAT_AMBIENT_STATUS monitored for feedback.

| | | |
|---|---|---|
| Name: | PROP_CONFIGURE_HEAT_INSTANCES_2 | |
| PGN: | 0xEF64 | |
| Byte 1: | Operation | Always 0xB5 |
| Byte 2: | Heater 1 Input Instance | Per RV-C. 0 = Disabled. |
| Byte 3: | Heater 2 Input Instance | Per RV-C. 0 = Disabled. |
| Byte 4: | Heater 3 Input Instance | Per RV-C. 0 = Disabled. |
| Byte 5: | Heater 4 Input Instance | Per RV-C. 0 = Disabled. |

Note that the Heater will always report using an Instance of 160 through 163, with the Instance corresponding to the physical unit. This PGN determines the Instance of the THERMOSTAT_AMBIENT_STATUS which the Heater will monitor.

| | | |
|---|---|---|
| Name: | PROP_CONFIGURE_HEAT_INSTANCES_3 | |
| PGN: | 0xEF64 | |
| Byte 1: | Operation | Always 0xB4 |
| Byte 2: | Temp Sensor 1 Instance | Per RV-C. 0 = Disabled |
| Byte 3: | Temp Sensor 2 Instance | Per RV-C. 0 = Disabled |
| Byte 4: | Temp Sensor 3 Instance | Per RV-C. 0 = Disabled |
| Byte 5: | Temp Sensor 4 Instance | Per RV-C. 0 = Disabled |

If the Temp Sensor Instance matches either the Heater or Aqua-Hot Instances, then that Temp Sensor will be used by that device for feedback. If not, then the Heater/AquaHot will operate using data from a THERMOSTAT_AMBIENT_STATUS PGN from any source on the bus using the same Instance.

| | | |
|---|---|---|
| Name: | PROP_REQUEST_HEAT_INSTANCES | |
| PGN: | 0xEF64 | |
| Byte 1: | Operation | Always 0xB3 |

TM-220 will reply with PROP_REPORT_HEAT_INSTANCES_1, PROP_REPORT_HEAT_INSTANCES_2and PROP_REPORT_HEAT_INSTANCES_3.

| | | |
|---|---|---|
| Name: | PROP_CONFIGURE_HEAT | |
| PGN: | 0xEF64 | |
| Byte 1: | Operation | Always 0xAF |
| Bits 2.1-2.2 | Disable Aqua-Hot on Shore Power | 00 = Use Aqua-Hot on 50A Shore Power<br>01 = Use Radiant Heat Only |
| Bits 2.3-2.4 | Floor Heat Sensor Installed | 00 = Use Sensor for Thermostatic Control<br>01 = Control Heat by Timer Only |
| Byte 3 | Floor Heat Zones Enabled | 00 = Floor Heat Disabled<br>1–4 = Number of Floor Zones Enabled |
| Byte 4: | OEM Identifier | 0 = Generic Heat plus Floors (TM220)<br>1 = AquaHot Only (TM225)<br>2 = Tile Heat Only (TM229)<br>3 = AquaHot w/ Burner (TM226) |
| Byte 5: | Floor Heat AC Shed Instance | 0 = No Shedding<br>1-250 = AC_LOAD_STATUS Instance to control load shedding. |
| Byte 6: | AC Element 1 Shed Instance | 0 = No Shedding<br>1-250 = AC_LOAD_STATUS Instance to control load shedding. |
| Byte 7: | AC Element 2 Shed Instance | 0 = No Shedding ***(v.1.20+)***<br>1-250 = AC_LOAD_STATUS Instance to control load shedding. |

50A Shore power may be determined by looking at the ATS_STATUS Byte 2 (Source = 1) and ATS_AC_STATUS_3 Byte 2 (Phase Status = 2). Assume 30A service otherwise (see also TM200 documentation for more details). Thus, for “Radiant Heat Only”, disable Aqua-Hot if the 50A service is being used.

Note that if any floor heat zones are enabled, those temperature sensors should not be used for conventional climate control. Their Instances will be automatically disabled. The floor heat always uses the lowest numbered sensors. For example, if two floor zones and two ambient temperature readings are desired, the floor zones will always use sensors 1 and 2, and the ambient zones will use sensors 3 and 4.

The Floor Heat temperature can be controlled either through sensors installed in the floor or by a simple PWM scheme in which the element is turned on in proportion to the temperature setting.

The AC Shed Instance indicates the AC_LOAD_STATUS Instances monitored for load shed control. The unit will monitor as many AC Load instances as there are Floor Heat zones, starting with the indicated instance. So if the data byte is set to 11, and there are three floor zones, the unit will monitor AC Loads 11, 12, and 13. The AC Element is treated as two AC Loads.

Name: PROP_REQUEST_HEAT_CONFIGURATION
PGN: 0xEF64
Byte 1: Operation Always 0xAE
TM-220 will reply with PROP_REPORT_HEAT_CONFIGURATION

Name: PROP_AQUAHOT_COMMAND
PGN: 0xEF64
Byte 1: Operation Always 0xAB
Bits 2.1-2.2: Diesel Burner 0 = Off, 1 = On
Bits 2.3-2.6: Electric Element 0 = Off, 1 = Low, 2 = High
Bits 2.7-2.8: Engine Preheat 0 = Off, 1 = On
TM-220 will reply with PROP_REPORT_AQUAHOT_STATUS

Name: PROP_REQUEST_AQUAHOT_STATUS
PGN: 0xEF64
Byte 1: Operation Always 0xAA
TM-220 will reply with PROP_REPORT_AQUAHOT_STATUS

**PGNs Reported**

*Proprietary - Configure Zone Instances*
Name: PROP_REPORT_HEAT_INSTANCES_1
PGN: 0xEF64
Byte 1: Operation Always 0xB2
Follows same format as in PROP_CONFIGURE_HEAT_INSTANCES_1

Name: PROP_REPORT_HEAT_INSTANCES_2
PGN: 0xEF64
Byte 1: Operation Always 0xB1
Follows same format as in PROP_CONFIGURE_HEAT_INSTANCES_2

Name: PROP_REPORT_HEAT_INSTANCES_3
PGN: 0xEF64
Byte 1: Operation Always 0xB0
Follows same format as in PROP_CONFIGURE_HEAT_INSTANCES_3

Name: PROP_REPORT_HEAT_CONFIGURATION
PGN: 0xEF64
Byte 1: Operation Always 0xAD
Follows same format as in PROP_CONFIGURE_HEAT

Name: PROP_REPORT_AQUAHOT_STATUS
PGN: 0xEF##
Byte 1: Operation Always 0xA9
Bits 2.1-2.2: Diesel Burner 0 = Off, 1 = On
Bits 2.3-2.6: Electric Element 0 = Off, 1 = Low, 2 = High
Bits 2.7-2.8: Engine Preheat 0 = Off, 1 = On
Bits 3.1-3.2 Burner Status 0 = Off, 1 = On (TM-226 Only)
Follows same format as in PROP_AQUAHOT_COMMAND

## *System Clock*

For the thermostat scheduling to work, the unit requires DATE_TIME_STATUS PGN to be broadcast on the RV-C bus. If the time status is not received the time scheduling features will be disabled, and the unit will generate a DM1 message (see Diagnostics below).

## *Ambient Temperature, Thermostat Control*

Calibration is provided via the proprietary PGN detailed in the Configuration section above.

**PGNs Supported**

*Thermostat Command*
Name: THERMOSTAT_COMMAND_1
PGN: 0x1FEF9
Byte 1: Instance 160-163 = Heater. 164-167 = Aqua-Hot
Bits 2.1-2.4: Operating Mode 0 = Off, 2 = Heat
Bits 2.7-2.8 Schedule Mode 0 = Scheduling Disabled. 1 = Enabled
Byte 4-5: Heat Set Point Supported per RV-C.

Name: THERMOSTAT_COMMAND_2
PGN: 0x1FEF8
Byte 1: Instance 160-163 = Heater. 164-167 = Aqua-Hot
Byte 2: Current Schedule Instance 0 - 3, 250.
249 = “One-Shot” to Wake Level
251 = Reset to “Current”. Per RV-C.
The One-Shot mode sets the set point to the Wake Set Point temporarily. When the temperature reaches that level, it the puts the Instance into Off mode. Any other Thermostat Commands will override the One-Shot command.

*Thermostat Scheduling Command*
Name: THERMOSTAT_SCHEDULE_COMMAND_1
PGN: 0x1FEF5
Byte 1: Instance 160-163 = Heater. 164-167 = Aqua-Hot
Byte 2: Schedule Mode Instance 0 = “Sleep”, 1 = “Wake”, 2 = “Away”, 3 = “Return”

| | | |
|---|---|---|
| | | 250 = “Storage” |
| Byte 3: | Start Hour | Per RV-C |
| Byte 4: | Start Minute | Per RV-C |
| Byte 5-6: | Heat Set Point | Per RV-C |

The unit supports only two sets of schedule points, one for the Aqua-Hot and one for the Heaters. Each Instance may have a different set point, but the Start Times for each must be the same. Setting any of the Start Hour/Minute values for any of the four Instances will affect the values for all four Instances of that type.

Note that the unit does not support the THERMOSTAT_SCHEDULE_COMMAND_2, which provides for scheduling per day. The scheduling applies to all days without distinction. The unit stores values for only the indicated five instances. Use of any other instance numbers will fail.

*Furnace Command*

| | | |
|---|---|---|
| Name: | FURNACE_COMMAND | |
| PGN: | 0x1FFE3 | |
| Byte 1: | Instance | 160-163 = Heater. 164-167 = Aqua-Hot |
| Bit 2.1-2.2: | Operating Mode | 0 = Automatic, 1 = Manual |
| Byte 4: | Heat Output Level | 0 = Off, 200 (100%) = On. |
| Byte 5: | Dead Band | Supported per RV-C. Default is 1 Deg C. |

This PGN is provided primarily for troubleshooting. The unit should be returned to Automatic Mode after testing. The Output Level setting is only used in Manual mode.

**PGNs Reported**

*Thermostat Status*

| | | |
|---|---|---|
| Name: | THERMOSTAT_STATUS_1 | |
| PGN: | 0x1FFE2 | |
| Byte 1: | Instance | 160-163 = Heater. 164-167 = Aqua-Hot |
| Bits 2.1-2.4: | Operating Mode | 0 = Off, 2 = Heat |
| Bits 2.7-2.8: | Schedule Mode | 0 = Disabled. 1 = Enabled |
| Byte 4-5: | Heat Set Point | Supported per RV-C. |

| | | |
|---|---|---|
| Name: | THERMOSTAT_STATUS_2 | |
| PGN: | 0x1FEFA | |
| Byte 1: | Instance | 160-163 = Heater. 164-167 = Aqua-Hot |
| Byte 2: | Current Schedule Instance | Supported per RV-C. |

*Furnace Status*

| | | |
|---|---|---|
| Name: | FURNACE_STATUS | |
| PGN: | 0x1FFE4 | |
| Byte 1: | Instance | 160-163 = Heater. 164-167 = Aqua-Hot |
| Bit 2.1-2.2: | Operating Mode | 0 = Automatic, 1 = Manual |
| Byte 4: | Heat Output Level | 0 = Off, 200 (100%) = On. |
| Byte 5: | Dead Band | Supported per RV-C. Default is 1 Deg C. |

*Ambient Temperature Status*

| | | |
|---|---|---|
| Name: | THERMOSTAT_AMBIENT_STATUS | |
| PGN: | 0x1FF9C | |
| Byte 1: | Instance | As Configured. |
| Byte 2-3: | Ambient Temperature | Supported per RV-C |

*Thermostat Scheduling Status*

| | | |
|---|---|---|
| Name: | THERMOSTAT_SCHEDULE_STATUS_1 | |
| PGN: | 0x1FEF7 | |
| Byte 1: | Instance | 160-163 = Heater. 164-167 = Aqua-Hot |
| Byte 2: | Schedule Mode Instance | Per RV-C |
| Byte 3: | Start Hour | Per RV-C |
| Byte 4: | Start Minute | Per RV-C |
| Byte 5-6: | Heat Set Point | Per RV-C |

## *Tile Heat Control*

The unit supports four floor mats, using Instances 1 - 4. The Instances are not associated in any way with the furnace Instances.

Time Modes and Set Points are always the same for all zones. However, each zone has its own Operating Mode, Schedule Mode, and Current Set Point. Thus the user can set different levels for each mat manually, but can only schedule them at the same level within the same time periods. Note that one mat may be on the schedule, while another is not.

**PGNs Supported**

*Floor Heat Command*

| | | |
|---|---|---|
| Name: | FLOOR_HEAT_COMMAND | |
| PGN: | 1FEFB | |
| Byte 1: | Instance | 1 - 4 |
| Bit 2.1-2.2: | Operating Mode | 00 = Automatic, 01 = Manual |
| Bit 2.3-2.4: | Operating Status | 00 = Off, 01 = On |
| *Bit 2.5-2.6: | Schedule Mode | 00 = Manual, 01 = Scheduled Set Point Changes |
| Byte 3,4: | Set Point | Supported per RV-C |

Note: Byte 5 - Dead Band is not supported.
* Not official RV-C.

All of these settings are unique for each zone, if multiplexed.

*Proprietary – Configure Floor Heat*

| | | |
|---|---|---|
| Name: | PROP_CONFIGURE_FLOOR_HEAT_1 | |
| PGN: | PDU_F = 239, PDU_S = Destination (0xEF##) | |
| Byte 1: | Operation | 0xE6 = Configure Floor Heat 1 |

Format is identical to PROP_REPORT_FLOOR_HEAT_1.

| | |
|---|---|
| Name: | PROP_CONFIGURE_FLOOR_HEAT_2 |
| PGN: | PDU_F = 239, PDU_S = Destination (0xEF##) |

Byte 1: Operation 0xE5 = Configure Floor Heat 2
Format is identical to PROP_REPORT_FLOOR_HEAT_2.

Name: PROP_CONFIGURE_FLOOR_HEAT_3
PGN: PDU_F = 239, PDU_S = Destination (0xEF##)
Byte 1: Operation 0xBD = Configure Floor Heat 3
Format is identical to PROP_REPORT_FLOOR_HEAT_3.

Name: PROP_CONFIGURE_FLOOR_HEAT_4
PGN: PDU_F = 239, PDU_S = Destination (0xEF##)
Byte 1: Operation 0xBC = Configure Floor Heat 4
Format is identical to PROP_REPORT_FLOOR_HEAT_4.

Name: PROP_REQUEST_FLOOR_HEAT
PGN: PDU_F = 239, PDU_S = Destination (0xEF##)
Byte 1: Operation 0xE4 = Request Floor Heat Configuration Report
The TM-220 will reply to this PGN with PROP_REPORT_FLOOR_HEAT_1, PROP_REPORT_FLOOR_HEAT_2, PROP_REPORT_FLOOR_HEAT_3 and PROP_REPORT_FLOOR_HEAT_4.

To put the mats into “Storage” mode, put the set point to a suitably low number and put the unit in Manual Schedule Mode. To turn Off altogether, set Status to Off. (Setting Status to On and Mode to Manual will turn on the heat elements.)

If Set Point is included and the unit is in Scheduled Mode, the set point will be changed at the next day/night mode change.

The controller waits for the measured temperature to fall below the set point. It then triggers the floor output for the configured dwell time. At the end of the dwell period it again checks the heat level and repeats the process if necessary.

Most implementations will use just two Time Modes - “Day” and “Night”. The unit supports up to four Time Modes, allowing for a “Morning”,”Day”,”Evening”,”Night” cycle. To disable the use of unwanted time modes, set the mode start to an invalid hour or minute.

**PGNs Reported**

*Floor Heat Status*

| | | |
|---|---|---|
| Name: | FLOOR_HEAT_STATUS | |
| PGN: | 1FEFC | |
| Byte 1: | Instance | 1 - 4 |
| Bit 2.1-2.2: | Operating Mode | 00 = Automatic, 01 = Manual |
| Bit 2.3-2.4: | Operating Status | 00 = Off, 01 = On |
| Bit 2.5-2.6: | Heat Element Status | 00 = Off, 01 = On |
| *Bit 2.7-2.8: | Schedule Mode | 00 = Manual, 01 = Scheduled Set Point Changes |
| Byte 3,4: | Measured Temperature | Supported per RV-C |
| Byte 5,6: | Set Point | Supported per RV-C |

*Proprietary – Report Floor Heat Configuration*
Name: PROP_REPORT_FLOOR_HEAT_1
PGN: PDU_F = 239, PDU_S = Destination (0xEF##)
Byte 1: Operation 0xE3 = Report Floor Heat Configuration

| | | |
|---|---|---|
| Byte 2: | Mode 1 (Day / Morning) Begin Hour | 0 - 23 |
| Byte 3: | Mode 1 (Day / Morning) Begin Minute | 0 – 59 |
| Byte 4: | Mode 2 (Night / Away) Begin Hour | 0 - 23 |
| Byte 5: | Mode 2 (Night / Away) Begin Minute | 0 – 59 |
| Bit 6.1-6.2 | Thermostat Control | 00 = Thermostatic |

| | | |
|---|---|---|
| Name: | PROP_REPORT_FLOOR_HEAT_2 | |
| PGN: | PDU_F = 239, PDU_S = Destination (0xEF##) | |
| Byte 1: | Operation | 0xE2 = Report Floor Heat Configuration |
| Byte 2,3: | Mode 1 Set Point | Supported per RV-C |
| Byte 4,5 | Mode 2 Set Point | Supported per RV-C |
| Byte 6: | Primary Dwell Time | 0 – 1250 Sec. 1 bit = 5 Sec |

| | | |
|---|---|---|
| Name: | PROP_REPORT_FLOOR_HEAT_3 | |
| PGN: | PDU_F = 239, PDU_S = Destination (0xEF##) | |
| Byte 1: | Operation | 0xBB = Report Floor Heat Configuration |
| Byte 2: | Mode 3 (Evening) Begin Hour | 0 - 23, Invalid values disable the mode. |
| Byte 3: | Mode 3 (Evening) Begin Minute | 0 – 59, Invalid values disable the mode. |
| Byte 4: | Mode 4 (Night) Begin Hour | 0 - 23, Invalid values disable the mode. |
| Byte 5: | Mode 4 (Night) Begin Minute | 0 - 59, Invalid values disable the mode. |

| | | |
|---|---|---|
| Name: | PROP_REPORT_FLOOR_HEAT_4 | |
| PGN: | PDU_F = 239, PDU_S = Destination (0xEF##) | |
| Byte 1: | Operation | 0xBA = Report Floor Heat Configuration |
| Byte 2,3: | Mode 3 Set Point | Supported per RV-C |
| Byte 4,5 | Mode 4 Set Point | Supported per RV-C |

Note that all of the proprietary configuration settings apply to all mode Instances. When in Dual Input mode only the primary dwell time is used.

**No Sensor Mode**

The following table shows the on and off time for the heat elements at various temperature settings when not using the temperature sensors.

| Setting (Raw RV-C) | On Time | Off Time |
|---|---|---|
| 9120 (53.6 F) | 0 min | 240 min |
| 9440 (71.6 F, 22.0 C) | 2 | 9 |
| 9480 (73.8 F) | 4 | 8 |
| 9520 (76.1 F) | 6 | 7 |
| 9560 (78.3 F) | 8 | 6 |
| 9600 (80.6 F) | 10 | 5 |
| 9640 (82.8 F) | 12 | 4 |
| 9680 (85.1 F) | 14 | 3 |
| 9720 (87.3 F) | 16 | 2 |
| 9760 (89.6 F) | 18 | 1 |

| | | |
|---|---|---|
| 9800 (91.8 F, 33.3 C) | 20 min | 0 min |

**Suspect Parameters**

The DSA for all DM1 reports is 97. The only SPN supported is for a fault in the temperature sensor, for which the SPN is constructed as MSB = 1, ISB = 1, and LSB = 0. The FMI is either 0 or 1 (Above/Below Normal Range).

## *Diagnostics*

The DSA for all DM1 reports is 97.

| *Cause* | *Lamp* | *SPN* | *MSB* | *ISB* | *LSB* | *FMI* | *Notes* |
|---|---|---|---|---|---|---|---|
| Time data not received over RV-C network | YELLOW | 9 | | | | 2 | Sent only if scheduling are enabled on any of the heaters |
| Temperature range error | RED | | 1 | zone instance | 0 | 0 or 1 | Temperature sensor missing or bad |
| NVRAM write error | RED | 4 | | | | 12 | Exceeded 100,000 write cycles/page – replace CPU |

# *Index*

# Document Revision History

| Date | By | Effective | Revision |
|---|---|---|---|
| 03/17/15 | CCR | NA | Documentation error fixed – PROP_REPORT_AQUAHOT_STATUS changed from EF64 to EF## |
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