

Adena ZooRefTM

Refrigeration Monitoring System

Version R01

Reference Manual



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ZooRef Refrigeration Monitoring System Version R01

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System Overview

The ZooRef Refrigeration Monitoring System is a software program and hardware system designed to monitor the refrigerated and non refrigerated food storage zones in zoological facilities. ZooRef monitors the temperature in each of three designated zones, typically a walk-in freezer, walk-in fridge, and walk-in pantry. The temperatures are automatically measured, independent of the refrigeration system controls, and logged every ten minutes to provide an auditable record of the food storage conditions. A daily minimum, maximum and average temperature is also logged for each zone.

In addition to the temperature measurements, up to two kilowatt hour electricity meters can be installed to monitor electricity usage of the refrigeration equipment alone and/or the building generally. These kWh measurements are logged once each hour and once each day to provide management staff with detailed insights into the electricity use of the refrigeration equipment and/or the building generally.

A panic button is installed in each zone so that, in the event a person becomes trapped in a refrigerated zone, the trapped person can manually trigger the door alarm system to summon help. When activated a piezo alert sounds continuously outside the refrigerated zones to alert nearby staff, and the email alarm system sends an automated emergency email message to alert staff elsewhere on or off site.

ZooRef monitors the doors for each zone and if a door is open for more than two minutes a piezo alert chirps every two seconds to alert nearby staff that a door is open. If, after a further three minutes, a door still remains open the piezo alert will sound continuously until all doors are closed. The timers can be set to longer or shorter values as may be desired for any particular site. If staff need to keep a door open for an extended length of time, such as during maintenance operations, pressing and then releasing the panic button, while the door is open, will disable the door alert and door alarm functions until the door is closed again, at which time the system automatically returns to normal operation.

The ZooRef system provides automated alarms, via email messages, to alert staff of problems that require urgent attention. Alarms are provided for freezer temperature, fridge temperature, and pantry temperature with each of these having a high and a low setpoint to enable the system to be configured to meet the needs of any particular site. In addition to the temperature alarms, alarms are provided for refrigeration system electrical circuit breaker tripped which indicates an electrical failure of the refrigeration equipment, refrigeration door(s) left open, mains power failure, and the panic alarm.

The alarm email messages are designed to be conspicuous in a list of email messages and self explanatory to the recipients. Each message states the current alarm, or list of current alarms if multiple alarms are active, and gives the current temperature of each zone so staff can make informed decisions in respect of how quickly they need to attend to the problem(s). The system also sends a reminder email message at 08:00 each day to remind staff of any outstanding alarms that have not yet been cleared.

ZooRef can be operated as a standalone system or it can be an integral part of our networked, zoo-wide, control and monitoring system. A network connection with Internet email access is required for the alarm email messages to be sent.

As with all of our datalogger based systems, staff can connect to the datalogger across the local area network to view the current conditions of each zone and all of the operating parameters active in the datalogger. If the site's local area network is set up to allow remote access, dataloggers can also be configured to allow remote monitoring and support with password controlled access that can be unique to each datalogger in a zoo-wide system.

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Program Features

Data Logging

- Logs current temperature in walk-in freezer, fridge and pantry rooms every 10 minutes.
- Logs daily minimum, maximum and average temperature of each room at midnight.
- External max, min and average temperature and RH values logged daily. (Optional)
- Barometric pressure sensor with hourly logging. (Optional)
- Electricity use in kWh logged as hourly and daily totals.
- Event log of last 1000 alarm, and other system events.
- Datalogging memory in excess of 1 year between downloads before memory overwrite.
- Data logged to ring memory so oldest data is overwritten first when memory full.
- Data files downloadable to Windows based PC using Campbell Scientific LoggerNet software.
- Data graphing from Windows based PC using Campbell Scientific LoggerNet software.

Food Storage Temperature Monitoring

- Monitors air temperature in walk-in freezer, fridge and pantry rooms.
- Temperature monitoring range -35 to +50 degrees C.
- Each room has individual monitoring to accommodate different operating temperatures.
- Each room has individual high and low temperature alarm set-points.

Storage Room Door Monitoring

- Automatically monitors open/closed state for each food storage room door.
- When door(s) open in excess of two minutes a piezo alert chirps every two seconds to alert staff.
- When door(s) open in excess of five minutes piezo alert sounds continuously, and alarm email is sent.
- Piezo alert can be manually silenced if a door has to be kept open for maintenance such as cleaning.
- Piezo alert automatically silenced when all doors returned to closed state.

Alarms

- Power failure. (The electricity supply to the enclosure has failed)
- Temperature too high. Separate alarms for Freezer, Fridge, and Pantry.
- Temperature too low. Separate alarms for Freezer, Fridge, and Pantry.
- Sensor failure. Separate alarms for Freezer, Fridge, and Pantry.
- Panic button in each room to trigger piezo and email alarms if someone is trapped by a jammed door.

General

- Battery backup of datalogger 12V power so system keeps logging data during power failure.
- Alarms sent via email to staff if power fails, or if communications to a remote station fails.
- Communications to stations via LAN enables staff to monitor system operation.
- Communications to stations via LAN enables automated or manual collection of logged data.
- System maintenance from Windows based PC using Campbell Scientific LoggerNet software.

ZooRef is a module of ZooDAC, our zoo-wide, networked, data acquisition and control system. Each module is able to operate as a standalone station or as an integral part of a fully networked site-wide system. Using our modular approach, there is no practical limit to the number of stations or the geographic spread of any given site providing that network connectivity is available for each station.

Adena Scientific believes that accuracy and reliability are paramount requirements of any system used in animal welfare roles so we purpose designed our ZooDAC system to meet zoological needs and built it to run on dataloggers manufactured by Campbell Scientific in the USA and available worldwide. .

Uninterruptible Power Supply

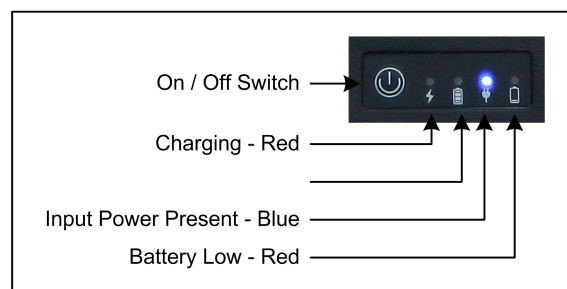


An uninterruptible power supply (UPS) ensures the datalogger continues to record data and transmit alarms during power failure events. The UPS is a DC-DC type, with an integral lithium-ion rechargeable battery. Its input is 12 Vdc, which comes from a mains powered power supply, and its output is 12 Vdc, which is used to power the datalogger and control system.

When the UPS input is receiving 12 Vdc from the mains power supply, the 12 Vdc is routed through the UPS to the UPS output to power the datalogger and control system. Up to approximately 0.6 Amp is simultaneously supplied to the battery charging circuit to keep the internal battery charged. If the input 12 Vdc power to the UPS is interrupted, the UPS battery automatically takes over supplying 12 Vdc to the UPS output to power the datalogger and its peripherals, and continues to do so until either the 12 Vdc input power is restored or the battery becomes fully discharged.

UPS Power Switch and LED Indicators

The UPS is fitted with an On/Off switch and four LED indicators as shown in the diagram below.



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On / Off Switch

The On/Off switch only operates when there is no input power available to the UPS. As long as the UPS battery is charged and input power is available, the UPS output will automatically switch ON to provide output power.

When input power is not available the On/Off switch can be used to shutdown the UPS. One press switches ON the UPS and two presses switches OFF the UPS. This function is provided to allow the system to be powered down for maintenance without discharging the UPS battery.

Charging Indicator

The charging indicator is a Red LED next to the lightning bolt symbol.

The indicator is lit while the battery being charged.

The indicator is off when the battery is fully charged.

Battery Power Only Indicator

The battery power only indicator is a Blue LED next to the battery symbol.

The indicator is lit while the UPS output power is being supplied only from the battery.

The indicator is off when input power is available.

Input Power Present Indicator

The input power present indicator is a Blue LED next to the power plug symbol.

The indicator is lit while the UPS output power is being supplied from the input power.

The indicator is off when input power is not available.

Battery Low Indicator

The battery low indicator is a Red LED next to the low battery symbol.

The indicator is lit when the UPS battery is almost flat.

The indicator is off when the battery is charged.

UPS Run Time

The length of time the UPS will operate to power the datalogger depends on several variables including the number of sensors that are connected, the amount of data communications activity, the age and condition of the battery, and how charged the battery is when the UPS starts operating.

Testing with a new and fully charged UPS has shown that the UPS can power the datalogger, and several sensors for about 20-24 hours.

Storing the UPS

To shutdown the UPS for an extended period of time, such as when being placed into storage, first disconnect the input power so the UPS begins operating from its internal battery power, then immediately press the On/Off switch two times to switch the UPS OFF. All the LEDs will switch OFF. The UPS can now be safely stored.

When stored, the UPS battery will self-discharge at a rate that is greatly affected by the ambient temperature. The UPS should therefore be fully charged before being placed into storage and, if it is to be kept stored for an

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extended period of time, the UPS should be periodically recharged to prevent the battery deteriorating and losing its original capacity.

As a guide the UPS should not be stored for longer than the periods of time below without being recharged...

6 months at 20° C

3 months at 30° C

2 months at 35° C

UPS Specifications

Input: 12 Vdc, 3 Amps

Output: 12 Vdc, 2.5 Amps (Rated), 3 Amps (Max)

Input Connector: 2.1 mm DC Socket

Output Connector: 2.5 mm DC Plug

Over Current Protection: 3.5 Amps +/- 0.5 Amp

Battery Capacity: 7.4 V, 4000 mAh (29.6 Wh)

Alternative Sealed Lead Acid Battery UPS

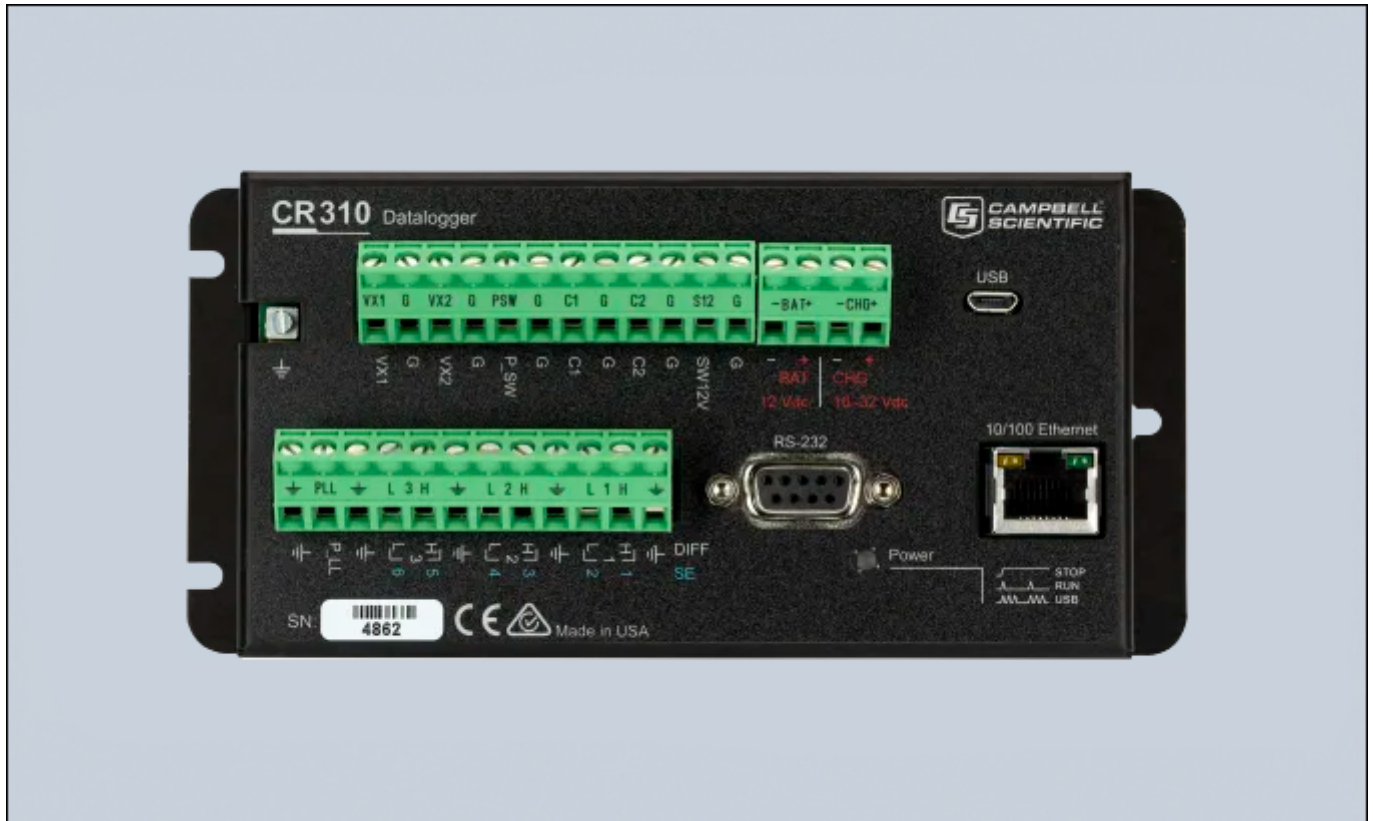
The CR310 datalogger has a built-in charging system for Sealed Lead Acid batteries. A mains power supply with 24 Vdc output is connected to the **CHG** terminals on the datalogger and a 1.3 AH Sealed Lead Acid battery is connected to the **BAT** terminals. The datalogger draws its power from the battery and, while mains power is available, the datalogger's charging system maintains the battery in a fully charged state. During a power failure the datalogger continues to draw its power from the battery until the battery becomes fully discharged.



WARNING: A fuse must always be installed, as close to the battery as possible, in the positive wire that runs from the datalogger to the battery to prevent risk of fire if a short circuit occurs. Do not bypass a blown fuse. Always replace fuses with the correct type.

The Sealed Lead Acid battery option offers a cost advantage over the lithium iron battery DC-DC UPS system but a Sealed Lead Acid battery is likely to need more frequent replacement, typically about once every three years. Lithium iron batteries can be discharged to about 85% of their capacity, whereas Sealed Lead Acid batteries can only be discharged to about 50% of their capacity, without causing damage to the battery. This may become a consideration in areas where mains power failures tend to be of a long duration, but in areas where mains power failures seldom extend over a prolonged period of time, Sealed Lead Acid batteries will provide a perfectly good UPS solution.

Datalogger CR310



This section is intended for maintenance and support purposes. There are no controls or adjustments on the datalogger, it's simply wired into the system and runs the software that is loaded into it.

The CR310 datalogger is the programmable heart of a ZooRef station. It has a range of inputs and outputs that send and receive sensor data and other control signals, and provides network connectivity so users can interrogate the control system from a computer via the network. It also records the measurements obtained from the sensors and retains that data in memory from where it can be downloaded to a computer at a later date.

The datalogger can be powered down, if necessary, by withdrawing the combined battery and charger connector. Always download the data from the datalogger before powering it down. The datalogger has an internal battery to maintain it's memory if power is removed but, if that battery has become weak due to age, data loss may occur.

Computer and Network Connections

The [10/100 Ethernet](#) connector is used to connect the datalogger to the local area network (LAN) so it can be accessed via other computers, either using the Campbell LoggerNet software or by using a web browser, and is able to transmit alarm email messages to recipients via the Internet.

Please refer to section "7. Setting up Communications with the Datalogger" in the CR310 Product Manual, which can be downloaded from the Campbell Scientific web site, for full information on set up procedures.

After being connected to a LAN for about one minute, the LEDs on the connector will indicate the status of the network connection as follows...

Orange LED - Off for no link, Solid for valid Ethernet link, Flashing for Ethernet activity.

Green LED - Off for 10 Mbps link, Solid for 100 Mbps link.

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The datalogger can obtain a dynamic IP address from the DHCP server on the LAN, but we strongly recommend that it be configured with a static IP address. When multiple stations are installed on a site, a static address makes it easier to set up stations to communicate with one another across the LAN and simplifies routing to the Internet for off-site access. These network settings are configured using the “Device Configuration Utility” in the LoggerNet software.

The USB connector allows direct connection, using a ordinary USB cable, to any Windows 10 computer that has the Campbell LoggerNet software installed on it. This is used when carrying out the initial configuration of the datalogger, and for maintenance or data collection as an alternative to a LAN connection when desired.

Inputs and Outputs

Users need not be concerned with the datalogger inputs and outputs for the usual operation of the system. This information is provided to assist with diagnostic tests in case it is needed.

Analog Inputs

The datalogger has six single ended (SE) analog inputs, labelled 1 to 6 with blue numbers on the datalogger panel, all of which are used. The voltages measured on single ended inputs are measured with respect to datalogger ground. The datalogger measures the analog inputs once each time the program scans, which is every two seconds.

SE1 - Freezer Electrical Fault (Circuit Breaker Trip) Signal.

Auxiliary contacts on the freezer circuit breakers are wired in parallel between SE1 and ground so that when the circuit breaker(s) are tripped SE1 is pulled to ground. When the freezer circuit breakers are all in their normal operating position 2400 mV pulses will be present on SE1. When a circuit breaker is tripped SE1 will be held at 0 V.

A 1K Ohm pull-up resistor is connected between SE1 and excitation channel VX1.

SE2 - Fridge Electrical Fault (Circuit Breaker Trip) Signal.

Auxiliary contacts on the fridge circuit breakers are wired in parallel between SE2 and ground so that when the circuit breaker(s) are tripped SE2 is pulled to ground. When the fridge circuit breakers are all in their normal operating position 2400 mV pulses will be present on SE2. When a circuit breaker is tripped SE2 will be held at 0 Vs.

A 1K Ohm pull-up resistor is connected between SE2 and excitation channel VX1.

SE3 - Door Open/Closed Detector Signal.

Each of the normally closed door sensors is wired in series to form a door loop circuit between SE3 and ground. A 1K Ohm resistor is connected in parallel with each door sensor so that when a door is opened a 1K Ohm resistor is placed in series with the loop circuit. One door open will produce a loop resistance of 1K Ohms, two doors open 2K Ohms, and three doors open 3K Ohms, enabling the datalogger to determine any change state of the doors.

A 1K Ohm pull-up resistor is connected between SE3 and excitation channel VX1.

SE4 - Freezer Temperature Sensor.

A Campbell 107 sensor is wired between VX2, SE4, and Ground to provide for temperature measurements in the Freezer room. The sensor and its excitation voltage is controlled by the Therm107 measurement instruction in the datalogger program.

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SE5 - Fridge Temperature Sensor.

A Campbell 107 sensor is wired between [VX2](#), [SE5](#), and Ground to provide for temperature measurements in the Fridge room. The sensor and its excitation voltage is controlled by the [Therm107](#) measurement instruction in the datalogger program.

SE6 - Pantry Temperature Sensor.

A Campbell 107 sensor is wired between [VX2](#), [SE6](#), and Ground to provide for temperature measurements in the Pantry room. The sensor and its excitation voltage is controlled by the [Therm107](#) measurement instruction in the datalogger program.

Pulse Inputs

The datalogger has two pulse counter inputs labelled P_SW and P_LL.

P_SW - Panic Buttons Input.

The pulse input P_SW operates on pull-to-ground switch closure. A normally closed panic button is installed in each food storage room and connected in a series loop circuit between P_SW and Ground. When a panic button is pressed P_SW rises to approximately 3.2 Vdc until the panic button is released. This signal is used in the datalogger software to trigger an alarm if a person becomes trapped in the room due to for example a jammed door. The panic buttons are also used to silence the piezo alert when a door needs to be kept open for an extended length of time for maintenance purposes.

P_LL - Power Good Input.

The pulse input P_LL accepts low voltage (20 V max) AC signal and the datalogger software measures the frequency of that signal. A small mains transformer with a 9 Vac output is connected to the AC mains so that a 9 Vac signal is presented to P_LL while mains power is available. The datalogger software measures the frequency which will be 50 Hz in New Zealand. If the 50 Hz signal disappears the power failure alarm is triggered.

Excitation Outputs

The datalogger has two excitation outputs, labelled [VX1](#) and [VX2](#) on the datalogger panel. These excitation outputs are designed to be used to provide excitation voltage for various analog sensors that are typically used on the datalogger's analog measurement inputs.

VX1 - Loop Excitation (Door Switches and Circuit Breaker Trip Detectors).

The loop excitation voltage is 2400 mV. The datalogger switches ON the excitation voltage at the beginning of each program scan, carries out the input measurements, then switches OFF the excitation voltage at the end of the program scan. The program normally scans once every two seconds so [VX1](#) will produce one brief excitation pulse every two seconds that can be tested with an oscilloscope.

VX2 - 107 Temperature Sensors Excitation.

Each Campbell 107 temperature sensor's excitation is controlled by its respective [Therm107](#) measurement instruction in the datalogger program. The excitation voltage is switched ON, the sensor is measured, and the excitation is switched OFF. This process takes only a few milliseconds and is repeated for each of the 107 temperature sensors.

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Control Ports

The datalogger has two control ports labelled **C1** and **C2** on the datalogger panel. These are programmable ports that can be software configured for use as logic inputs, logic outputs, pulse counters, and other special functions.

C1 - Electricity kWh Meter 1.

The kWh meter produces one pulse for every 0.01 kWh of electricity that's consumed. These pulses are counted by the datalogger **C1** pulse input. Each time the datalogger program scans, the **C1** counter is read and reset. The datalogger program then accumulates the pulse count in kWh and logs an hourly total each hour and a daily total each day.

The pulse input is of the switch closure type and is suitable for meter outputs that have open collector pull-to-ground outputs when a 100K Ohm pull-up resistor is connected between **C1** and the dataloggers +12 Vdc battery supply.

C2 - External SDI-12 Sensors or Electricity kWh Meter 2. (Optional)

Port **C2** can be configured for either SDI-12 sensors for measuring external (outside) temperature, relative humidity, and/or barometric pressure, or for a second kWh electricity meter.

Setting the station constant **EXT_TRH_LOCAL** to True configures port **C2** as an SDI-12 port for measuring an optional SDI-12 temperature and Relative Humidity sensor, and/or an optional SDI-12 Barometric Pressure sensor.

Setting the station constant **EXT_TRH_LOCAL** to False configures port **C2** as a pulse counting input for the second electricity meter option allowing a second kWh meter to be connected to port **C2**. It can then be configured to the same 0.01 kWh per pulse as **C1** or to a different calibration as desired. The pulses are counted by the datalogger **C2** pulse input. Each time the datalogger program scans, the **C2** counter is read and reset. The datalogger program then accumulates the pulse count in kWh and logs an hourly total each hour and a daily total each day.

The pulse input is of the switch closure type and is suitable for meter outputs that have open collector pull-to-ground outputs when a 100K Ohm pull-up resistor is connected between **C1** and the dataloggers +12 Vdc battery supply.

RS232 Port

The datalogger includes an 9-pin D-sub connector labelled **RS-232**. This is a standard RS-232 interface for communications between Campbell Scientific dataloggers and various external devices.

This port is not currently used.

Data Storage Memory

Measurement data is normally stored in data tables within SRAM (Static Random Access Memory). During data table initialisation, memory is allocated to each data table according to parameters defined in the program.

An internal lithium battery retains the SRAM memory when primary power is removed.

WARNING: Always download data from the datalogger before making any program changes. Depending upon settings, data may be erased from this memory area when a program is sent to the datalogger.

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To preserve the existing data when sending a program update to the datalogger that does not affect the data tables, such as when changing temperature setpoints, simply select the [Preserve data if no table changed](#) radio button in the dialog box before clicking the [\[Send\]](#) button.

The data memory is organised as ring memory so that when the memory is full, oldest data is overwritten by newest data. To see the total number of records that can be stored in memory before data overwriting begins, or to reset the data tables, select [Station Status > Table Fill Times](#) from the Connect Screen in the LoggerNet software. The datalogger program sets the memory so that an equal number of days will be stored in the various data tables.

A CR310 datalogger can store several months of data before memory overwrite occurs. To prevent risk of data loss due to overwriting of the ring memory, or any other cause, download the data manually on a regular basis or set up LoggerNet to download it automatically on a regular time schedule.

Power Circuits

Users need not be concerned with the datalogger power circuits for the usual operation of the system. This information is provided to assist with diagnostic tests in case it is needed.

Datalogger 12 Vdc Power Input

The datalogger is powered by 12 Vdc, from the UPS, which is applied via the battery and charger connector which is the main power to the system. Unplugging this connector will power down the datalogger and its sensors. The battery/charger connector provides pins for + and - 12 Vdc . In this system all +12 Vdc power circuits into and out of the datalogger are RED wires.

Datalogger 12 Vdc Switched Power Output

The datalogger switched power output [SW12V](#) terminal is used to power the piezo alert for the door alert functions. Do not connect anything else to this port.

Power Ground

The terminals on the datalogger panel marked **G** are the power ground terminals. Each device that is connected to the +12 Vdc power terminal must have its ground (-ve or common) wire connected to one of the **G** terminals. In this system all power ground circuits are BLACK wires.

Analog Ground

The terminals on the datalogger panel marked \perp are analog ground for single ended analog inputs, excitation returns, and a ground for sensor shield wires. Do not connect power ground wires to the analog ground. The 107 temperature sensor is connected to analog ground.

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Station Setpoints

```
.....
** ZooRef Food Storage Refrigeration Monitoring, Data Logging, and Alarms Control *
** Station Setpoints File For: *
** Copyright 2015-2023 Adena Scientific Limited *
** Datalogger: Campbell Scientific CR300 Series *
** File name: STATION_SETPOINTS_ZOOREF_R01.CR300 *
** Revision Date: 2024-02-11 *
.....

'Temperature Setpoints.
'WARNING: Must be at Least 4 degrees C difference between HI and LO setpoints.
'
ConstTable(Setpoints)                                'Beginning of editable constants table
'
Const SET_FREZ_HI = 22.0                              'Freezer Hi Temperature Alarm deg C
Const SET_FREZ_LO = 12.0                              'Freezer Lo Temperature Alarm deg C
'
Const SET_FRIG_HI = 22.0                              'Fridge Hi Temperature Alarm deg C
Const SET_FRIG_LO = 16.5                              'Fridge Lo Temperature Alarm deg C
'
Const SET_PNTY_HI = 25.0                              'Pantry Hi Temperature Alarm deg C
Const SET_PNTY_LO = 8.0                              'Pantry Hi Temperature Alarm deg C
'
EndConstTable                                         'End of editable constants table

.....
**                                     END OF INCLUDE FILE *
.....
```

The station setpoints are constants that determine the upper and lower temperatures at which alarms will be triggered. Each food storage room has its own high and low temperature alarm setpoints.

The station setpoints constants are programmed into a structure called a constants table which can be edited using the CRBasic Editor, or by using the datalogger's built-in web site while logged in with administrator level privileges, the later being the easier and recommended method. The setpoints table is stored in a separate program file named `STATION_SETPOINTS_ZOOREF_R01`, hereinafter simply referred to as the `STATION_SETPOINTS` file, so they are not overwritten whenever an updated program is uploaded to the datalogger.

To change the station setpoints constants by editing the `STATION_SETPOINTS` file it is necessary to use the CRBasic editor, then load the updated file into the datalogger. To do so, users need to have access to the program code on a Windows computer that has the Campbell Scientific LoggerNet program suite installed on it.

For full information on using the LoggerNet software please refer to the LoggerNet Manual which is downloadable from the Campbell Scientific web site.

WARNING: When editing setpoints ensure that only the numeric value is changed. Do not change anything else, especially the constant name or the = sign otherwise compile errors will be the likely result.

To change the setpoint constants using the datalogger's built-in web site, first login to the web site as an administrator, then select the `Setpoints` data table from the list of available tables. Edit the desired value(s) by double clicking on the current value, typing in the new value, and pressing the `[Enter]` key.

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Once the change(s) are complete move down to the [ApplyAndRestart](#) value, the last value in the table, and change it from [false](#) to [true](#) then press the [\[Enter\]](#) key. This will cause the datalogger to restart and put the newly entered values into effect.

If the [STATION_SETPOINTS](#) file is edited using the CRBasic editor, it is essential to manually stop the program running and then restart it so the datalogger will recompile the program and make the new setpoints operational.

Do not change the name of the [STATION_SETPOINTS](#) file. The datalogger expects this file to be present and cannot run the program without it.

Freezer Temperature Alarm Setpoints

The high temperature and low temperature alarm setpoints for the freezer, in degrees Celsius.

[Const SET_FREZ_HI = -15.0](#)

[Const SET_FREZ_LO = -20.0](#)

These are the highest and lowest temperatures within which the freezer is required to be operating. If either of these temperature setpoints is crossed by more than [ALARM_DEGREES](#), typically 0.5 degrees, an email alarm message is generated. They should be set to a few degrees each side of the temperature that the freezer's refrigeration plant is set to operate at.

Fridge Temperature Alarm Setpoints

The high temperature and low temperature alarm setpoints for the fridge, in degrees Celsius.

[Const SET_FRIG_HI = 8.0](#)

[Const SET_FRIG_LO = 2.0](#)

These are the highest and lowest temperatures within which the fridge is required to be operating. If either of these temperature setpoints is crossed by more than [ALARM_DEGREES](#), typically 0.5 degrees, an email alarm message is generated. They should be set to a few degrees each side of the temperature that the fridge's refrigeration plant is set to operate at.

Pantry Temperature Alarm Setpoints

The high temperature and low temperature alarm setpoints for the pantry, in degrees Celsius.

[Const SET_PNTY_HI = 25.0](#)

[Const SET_PNTY_LO = 8.0](#)

These are the highest and lowest temperatures within which the pantry is required to be operating. If either of these temperature setpoints is crossed by more than [ALARM_DEGREES](#), typically 0.5 degrees, an email alarm message is generated. Typically a pantry will be "room temperature" so these setpoints should be set to the temperatures at which foods that can be safely stored at "room temperature" could become spoiled.

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Station Constants

```
*****
* ZooRef Food Storage Refrigeration Monitoring, Data Logging, and Alarms Control *
* Station Constants File For: *
* Copyright 2015-2023 Adena Scientific Limited *
* Datalogger: Campbell Scientific CR300 Series *
* File name: STATION_CONSTANTS_ZOOREF_R01.CR300 *
* Revision Date: 2024-03-02 *
*****

'Declare General Station Constants.
Const ENCLOSURE As String = "NEW STATION" 'Enclosure name
Const EXT_DATA_ENABLE = True 'If external temp & RH data use enabled
Const DOOR_OPEN_ALERT = 120 'Seconds door is open before piezo warning sounds
Const DOOR_OPEN_ALARM = 300 'Seconds door is open before alarm is triggered

'Declare Alarms Module Constants.
Const ALARM_ENABLE = True 'Alarm enable = true, disable = false
Const ALARM_DEGREES = 0.5 'Alarm temperature trigger +/- From temperature setpoints
Const ALARM_RESET = 1.5 'Alarm temperature reset +/- From alarm setpoints

'Declare Email Module Constants.
Const EMAIL_ENABLE = False 'Enable sending of alarm email messages (True/False)
Const EMAIL_TEST = False 'Divert alarm email messages to test file (True/False)
Const EMAIL_RESEND = 300 'Resend time for alarm emails time in seconds (min 10 seconds)
Const EMAIL_TRIES = 3 'Number of times to resend new alarm states (Typically 3)
Const EMAIL_NAG = True 'Resend email outstanding alarms daily at NAG_HOUR True, False
Const EMAIL_NAG_HOUR = 8 'Hour of the day to resend outstanding alarms
Const EMAIL_ATTACH = "" 'Email attachment file name (if desired)

'Declare Email Module Email Recipient Email Addresses.
'(Separate multiple addresses with commas).
Const TO_ADDR = "my.name@mycompany.co.nz, manager@mycompany.co.nz"

'Declare Comms Module Station Address Constants.
Const EXT_TRH1_ENABLE = False 'Ext T/RH primary remote station enable true/false
Const EXT_TRH1_PK = 91 'Ext T/RH primary remote station pakbus address (WLI=91)
Const EXT_TRH1_IP As String = "192.168.10.91" 'Ext T/RH primary remote station IP address
Const EXT_TRH2_ENABLE = False 'Ext T/RH secondary remote station enable true/false
Const EXT_TRH2_PK = 82 'Ext T/RH secondary remote station pakbus address (KNZ=82)
Const EXT_TRH2_IP As String = "192.168.10.82" 'Ext T/RH secondary remote station IP address
Const MAX_COMMS_FAILS = 6 'Maximum Number of comms failures before alarm

'Declare External Temp/RH Local Sensor Constants.
Const EXT_TRH_LOCAL = False 'Ext T/RH Local sensor installed True, False (Keep set to FALSE)
Const EXT_TRH_PRIMARY = False 'Ext T/RH Local sensor True = primary, False = secondary
Const EXT_SDI_ADDR As String = "0" 'Ext T/RH Local sensor Port C5 SDI-12 address (Normally "0")

'Declare Barometric Pressure Sensor Constants.
Const BARO_ENAB = False 'Barometric pressure display and logging enable (True/False)
Const BARO_STN_ELEV = 47 'Barometer sensor station elevation in metres above MSL
Const BARO_LOCAL = False 'Barometric pressure local sensor installed True, False
Const BARO_SDI_ADDR = "3" 'Barometric sensor, Port C5 SDI-12 address (Normally "3")

*****
* END OF INCLUDE FILE *
*****
```

The station constants determine various operating parameters for the station. They are intended to be configured during system commissioning and usually don't need changing later.

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The station constants are stored in a separate program file named `STATION_CONSTANTS_ZOOREF_R01`, hereinafter simply referred to as the `STATION_CONSTANTS` file, so they are not overwritten whenever an updated program is uploaded to the datalogger.

To change the station constants it is necessary to edit the `STATION_CONSTANTS` file, then load the updated file into the datalogger. To do so, users need to have access to the program code on a Windows computer that has the Campbell Scientific LoggerNet program suite installed on it.

For full information on using the LoggerNet software please refer to the LoggerNet Manual which is downloadable from the Campbell Scientific web site.

If the `STATION_CONSTANTS` file is edited using the CRBasic editor, it is essential to manually stop the program running and then restart it so the datalogger will recompile the program and make the new setpoints operational.

Do not change the name of the `STATION_CONSTANTS` file. The datalogger expects this file to be present and cannot run the program without it.

WARNING: When editing the constants ensure that only the value is changed. Do not change anything else, especially the constant name or the = sign otherwise compile errors will be the likely result.

Enclosure Name

The name that is used to identify the building the food storage areas are located in for alarm email messages.

```
Const ENCLOSURE As String = "ANEC"
```

Set the text between the "" marks to a suitable name. The maximum length is 25 characters including spaces.

External Data Enable

Enables or disables the display and logging of external (outside) sensor data.

```
Const EXT_DATA_ENABLE = True"
```

Logical True or False. Normally set to True unless there is no external sensor data available from this station and any remote stations. Set to False to remove external temperature, relative humidity, and barometric pressure measurement from the `Public` table display and data logging. Setting to false is normally only necessary for standalone stations.

Door Open Alert Time

The number of seconds a door can be open before the piezo alert begins chirping to alert staff.

```
Const DOOR_OPEN_ALERT = 120
```

An integer value, normally set in the range of 60 seconds to 120 seconds (1 to 2 minutes). This value **MUST** be a multiple of the program scan rate (normally 2 seconds) or the timer will malfunction. The door timer is held reset at zero while all the doors are closed and begins counting when a door is opened. If another door is opened while a door is still open the timer resets to zero and begins counting again.

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Door Open Alarm Time

The number of seconds a door can be open before the piezo sounds continuously and an alarm is triggered.

`Const DOOR_OPEN_ALARM = 300`

An integer value, normally set in the range of 120 seconds to 360 seconds (2 to 6 minutes). This value MUST be a multiple of the program scan rate (normally 2 seconds) or the timer will malfunction. The door timer is held reset at zero while all the doors are closed and begins counting when a door is opened. If another door is opened while a door is still open the timer resets to zero and begins counting again.

NOTE: The door open alert and door open alarm timers operate concurrently. The resultant sequence is:

1. Door opened, Timers start - Piezo alert is silent.
2. Door still open, `DOOR_OPEN_ALERT` time exceeded - Piezo alert begins chirping.
3. Door still open, `DOOR_OPEN_ALARM` time exceeded - Piezo alert begins sounding continuously.
4. Door closed, timers reset - Piezo alert is silent

Alarm Enable

Flag determines whether or not the alarm system should be operational.

`Const ALARM_ENABLE = True`

Logical True or False. Normally set to True unless an ongoing maintenance problem is causing excessive nuisance alarms, in which case it can be set to False until the problem can be resolved. The alarms must be enabled in order for alarm events to be written to the Event Log data table.

Alarm Trigger Level

The number of degrees beyond the temperature setpoint at which an alarm is triggered.

`Const ALARM_DEGREES = 0.5`

A decimal value, typically 0 to 0.5 degrees. The high and low setpoints determine the highest and lowest acceptable temperatures in each food storage room. If the temperature rises above the high setpoint or falls below the low setpoint it will trigger an alarm once it has moved by `ALARM_DEGREES` past the setpoint.

For example, if the room high setpoint is 6 degrees and `ALARM_DEGREES` is set to 0.5 degree, the high temperature alarm will be triggered at 6.5 degrees. If the room low setpoint is 2 degrees and `ALARM_DEGREES` is set to 0.5 degrees, the low temperature alarm will be triggered at 1.5 degrees.

Alarm Reset Level

The number of degrees beyond the temperature setpoint at which to reset the alarm.

`Const ALARM_RESET = 1.0`

A decimal value, typically 0.5 to 1.5 degrees. After the cause of a temperature alarm has been resolved and the enclosure temperature returns to within the normal temperature range, the temperature alarm is reset.

For example, if the room high setpoint is 6 degrees and `ALARM_RESET` is set to 1.0 degree, the high temperature alarm will be reset at 5 degrees. If the low setpoint is 2 degrees and `ALARM_RESET` is set to 1.0, the low temperature alarm will be reset at 3 degrees.

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Email Enable

Flag determines whether or not the email system should be operational.

`Const EMAIL_ENABLE = True`

Logical True or False. Normally set to True unless there is no internet connectivity available, or an ongoing maintenance problem is causing excessive nuisance emails, in which case it can be set to False until the problem can be resolved.

NOTE: The Campbell Scientific Email Relay server has a limit of 100 emails per day (USA time) from any given datalogger which, if exceeded, results in the Email Relay server rejecting further emails from that datalogger until the next day.

Email Test

Flag determines whether or not the email system is to operate in test mode and divert email messages to a file.

`Const EMAIL_TEST = False`

Logical True or False. Normally set to False unless email messages are to be diverted to a file for test purposes. The file name is `EmailTest.txt` and is stored in the datalogger. This function allows extensive testing of the alarms and email messaging systems without actually sending the email messages via the Email Relay server.

Email Resend

The number of seconds between retry attempts when an email message fails to send.

`Const EMAIL_RESEND = 60`

An integer value, normally set in the range of 60 seconds to 300 seconds (1 to 5 minutes). This value MUST be a multiple of the program scan rate (normally 2 seconds) or the timer will malfunction.

Email Tries

The number of times the email system attempts to send an email message.

`Const EMAIL_TRIES = 3`

An integer value, normally set in the range of 1 to 4. A value of 1 means the system will only attempt to send an email message once, if it fails to send there are no retries. A value greater than 1 enables the email system to retry sending an email message that wasn't sent successfully. A value of 3 means the system will attempt the first message send and if it fails it will retry a further two times at the interval determined by the constant `EMAIL_RESEND`, see above.

Email Daily Resend Enable

Flag indicates if an alarm email reminder message should be sent once each day for outstanding alarms.

`Const EMAIL_NAG = True`

Logical True or False. Normally set to True unless users prefer to not have an alarms email message sent to them daily as a reminder of any alarms that have not yet been cleared.

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Email Daily Resend Time

The hour of the day at which the daily alarm resend is to occur.

```
Const EMAIL_NAG_HOUR = 8
```

Set to a number between 0 and 23, zero being midnight and 1 to 23 being the hour of the current day. Normally set to 8 for 08:00am so emails arrive among the first inbox deliveries for the day so staff have the opportunity to schedule whatever response they consider appropriate into their day. These email messages will be sent an hour earlier during Daylight Savings time as the datalogger is always operating on Standard Time.

Email Attachment File Name

The filename of a file to be sent as an attachment with each alarm email message.

```
Const ATTACH = ""
```

Not currently used. The filename is entered between the quotes and must be present in the datalogger's file storage space. If no attachment is desired, empty quotes must be defined.

Email Message Recipients

The email addresses of the staff who are to receive alarm email messages.

```
Const TO_ADDR = staff1.name@domain, staff2.name@domain, staff3.name@domain
```

A comma separated list of the email addresses for all the staff who are to receive the alarm messages from this station. Each station can have a different email recipient list so alarms can be sent to the staff member(s) usually responsible for each specific animal enclosure.

In addition to sending the alarm messages to the staff usually responsible for each enclosure, its a good idea to send the messages to a back-up staff member or a supervisor, and to have a protocol in place whereby the staff member responding to the alarm notifies the other staff on the list that they are responding. Such a protocol reduces the risk of an alarm inadvertently not being responded to in a timely manner.

Primary Remote Station Communications

Flag enables or disables network communications to the primary remote station.

```
Const EXT_TRH1_ENABLE = False
```

Logical True or False. Normally set to True unless this station has the only external temperature and RH sensor on the network. If this station has an external temperature and RH sensor installed, a remote station can provide a second pair of external sensor values. If this station has no external sensor installed, the primary remote station provides the external temperature and RH sensor values for use by this station.

Primary Remote Station PakBus Address

The PakBus address of the primary remote station.

```
Const EXT_TRH1_PK = 91
```

An integer value. Each station on the network has a unique PakBus address in the range from 1 to 3999. PakBus addresses from 4000 to 4094 are reserved for software such as LoggerNet. By convention we use the same number for the PakBus address as the last octet of the dataloggers IPv4 network address when IPv4 network addressing is in use.

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Primary Remote Station IP Address

The static IP address of the primary remote station.

```
Const EXT_TRH1_IP = 192.168.10.91
```

Each station on the network has a unique IPv4 or IPv6 address. By convention we use the same number for the last octet of the station IPv4 network address for the PakBus address when IPv4 addressing is in use.

Secondary Remote Station Communications

Flag enables or disables network communications to the secondary remote station.

```
Const EXT_TRH2_ENABLE = False
```

Logical True or False. Set to True if a secondary remote station is available on the network that can provide the external sensor values. This is a fall back in case the communications to the primary remote station fails or if the primary remote station constant `EXT_TRH1_ENABLE` is set to False.

Secondary Remote Station PakBus Address

The PakBus address of the secondary remote station.

```
Const EXT_TRH2_PK = 82
```

An integer value. Each station on the network has a unique PakBus address in the range from 1 to 3999. PakBus addresses from 4000 to 4094 are reserved for software such as LoggerNet. By convention we use the same number for the PakBus address as the last octet of the dataloggers IPv4 network address when IPv4 network addressing is in use.

Secondary Remote Station IP Address

The static IP address of the secondary remote station.

```
Const EXT_TRH2_IP = 192.168.10.82
```

Each station on the network has a unique IPv4 or IPv6 address. By convention we use the same number for the last octet of the station IPv4 network address for the PakBus address when IPv4 addressing is in use.

Maximum Communications Failures Before Alarm

The number of times communications to the remote station(s) can fail before an alarm is triggered.

```
Const MAX_COMMS_FAILS = 6
```

An integer value normally set between 3 and 9. The communications module will attempt to obtain the comms array from the designated remote station(s) every five minutes. If a remote station cannot be reached within the set number of tries an alarm is triggered.

NOTE: The alarm is always logged but depending upon the cause of the comms failure it may not be possible to send the alarms email message. For example, if the network cable is unplugged from the local station it won't be able to send email messages or communicate with a remote station; if the network cable is unplugged from the remote station, the local station will be able to send email messages but won't be able to communicate with the remote station.

ZooRef Refrigeration Monitoring System Reference Manual

External Temperature and Relative Humidity Sensor Installed

Flag indicates if an external air SDI-12 Temperature and RH sensor is installed on this datalogger.

`Const EXT_TRH_LOCAL = False`

Logical True or False. Always set to False unless an external Temperature and RH sensor installed.

NOTE: The ZooRef program can either use two kWh meters or one kWh meter and an external air temperature and RH sensor. Setting this flag True selects the external sensor option and changes the port configuration of port C2 from a pulse counter for a kWh meter to an SDI-12 data interface for connection to an SDI-12 sensor.

External Temperature and Relative Humidity Installed Is Primary Sensor

Flag indicates if the external air Temperature and RH sensor is installed on this datalogger is the primary sensor.

`Const EXT_TRH_PRIMARY = False`

Logical True or False. Always set to False unless this station is has an external Temperature and RH sensor installed and it is to be the primary external temperature and RH station on the network. When set True the external temperature and RH sensor installed at this station is the primary external sensor for the network. When set False it is the secondary external sensor for the network.

The primary sensor provides the values `CommsEx1TC` and `CommsEx1RH` while the secondary sensor provides the values `CommsEx2TC` and `CommsEx2RH` into the communication array for sharing across the network.

NOTE: The ZooRef program can either use two kWh meters or one kWh meter and an external air temperature and RH sensor. This flag is only operational when the setting `EXT_TRH_LOCAL` is set to true to configure port C2 for use with an SDI-12 temperature and RH sensor instead of a kWh meter.

External Temperature and Relative Humidity Sensor SDI-12 Address

The SDI-12 address for the local external temperature & relative humidity sensor, if Installed.

`Const EXT_SDI_ADDR = "0"`

An integer value. Normally set to "0" with sensor wired to port C1. May be any other valid SDI-12 address value provided that it is unique for all sensors wired to the same port. If a local external temperature and RH sensor is installed on the local datalogger an address must be set. If no local external sensor is installed the constant is ignored. The SDI-12 address must be unique for each sensor installed on the same port.

Barometric Pressure Enable

Flag determines whether or not the Barometric Pressure is displayed and logged.

`Const BARO_ENAB = True`

Logical True or False. Normally set to False unless a Barometric Pressure sensor is installed. The sensor may be installed on the local station or on a remote station. The station barometric pressure is retrieved from the communications array and corrected to Mean Sea Level for display.

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Barometric Pressure Station Elevation

The elevation of the barometric pressure sensor station above Mean Sea Level.

```
Const BARO_STN_ELEV = 47
```

An integer value. The elevation above Mean Sea Level, in metres, of the station with the Barometric Pressure sensor installed. This value is used to calculate the correction of the station pressure to Mean Sea Level barometric pressure for display and logging. This value is ignored if `BARO_ENAB` is set to False.

Barometric Pressure Sensor Installed

Flag indicates if an external SDI-12 Barometric Pressure sensor is installed on this datalogger.

```
Const BARO_LOCAL = True
```

Logical True or False. Normally set to False unless a Barometric Pressure sensor is installed on this datalogger. This optional sensor measures the atmospheric pressure at the station, referred to as the station pressure. The measurement value is placed into the communications array so it is available to all stations on the network.

Barometric Pressure Sensor SDI-12 Address

The SDI-12 address for the local Barometric Pressure sensor, if Installed.

```
Const BARO_SDI_ADDR = "3"
```

An integer value. Normally set to "3" with the sensor wired to port `C5`. May be any other valid SDI-12 address value provided the sensor is wired to port `C5` and the address is unique for all sensors wired to that port. If a barometric pressure sensor is installed on the local datalogger an address must be set.

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Data Tables

TOA5_OKH_AN1_DL01_CR300_15614_CR310.Std.10.07_CPU:OKH_AN1_DL01_R01.CR300_19908_E00_REFRIG_T_10M						
TIMESTAMP	RECORD	FreezerTC	FridgeTC	PantryTC	ExtAirTC	
TS	RN	deg C	deg C	deg C	deg C	
		Avg	Avg	Avg	Avg	
2021-07-18 16:00:00	0	-17.73	5.75	18.76	19.34	
2021-07-18 16:10:00	1	-17.89	5.97	18.92	19.27	
2021-07-18 16:20:00	2	-17.7	5.84	18.81	19.22	
2021-07-18 16:30:00	3	-17.32	5.78	18.51	19.17	
2021-07-18 16:40:00	4	-17.58	5.53	18.55	19.04	
2021-07-18 16:50:00	5	-17.74	5.65	18.68	18.94	
2021-07-18 17:00:00	6	-17.79	5.72	18.75	18.94	
2021-07-18 17:10:00	7	-17.85	5.78	18.81	18.87	
2021-07-18 17:20:00	8	-17.92	5.86	18.88	18.72	
2021-07-18 17:30:00	9	-17.99	5.94	18.96	18.52	
2021-07-18 17:40:00	10	-16.05	5.99	19.01	18.38	
2021-07-18 17:50:00	11	-16.07	6.04	19.06	18.25	
2021-07-18 18:00:00	12	-16.12	6.08	19.1	18.16	
2021-07-18 18:10:00	13	-16.14	6.12	19.13	18.07	
2021-07-18 18:20:00	14	-16.15	6.15	19.16	18.01	
2021-07-18 18:30:00	15	-16.17	6.19	19.18	17.93	
2021-07-18 18:40:00	16	-16.33	6.28	19.3	17.83	
2021-07-18 18:50:00	17	-16.36	6.33	19.34	17.76	

The datalogger stores all data in files called data tables. Data tables are made up of records and fields. Each row in a table represents a record and each column represents a field. The datalogger program determines the number of tables and the number of fields in each record. The image above shows a typical data table's contents and this is explained below; all other tables follow the same general format but will contain different information. Data files are typically stored as CSV text files with a .dat extension which can be imported and formatted into a spreadsheet, as has been done in the above example, or directly accessed by tools in Campbell Scientific LoggerNet software.

Data Table Header Rows

The data table contains four header rows providing information about the datalogger, the table, and its fields, with each field surrounded by double quotes which we have not shown in the diagram above for clarity.

First Row

The first header row of the data table is the environment line consisting of eight fields. The example image shown above contains the following:

TOA5 - Table output format. Can be changed using LoggerNet.

OKH_AN1_DL01 - The datalogger station name in LoggerNet. Can be changed using LoggerNet.

CR300 - The datalogger model range.

15614 - The datalogger serial number.

CR310.Std.10.07 - The datalogger operating system version.

CPU:OKH_AN1_DL01_R01.CR300 - Datalogger program name. Can change by sending new program.

19908 - Datalogger program signature. Changed by revising program or sending a new program.

E00_REFRIG_T_10M - The data table name as defined in the datalogger program.

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Second Row

The second header row of the data table contains the field names. The default field names are either a combination of the variable names (or aliases) from which the data is derived with an underscore and a three letter suffix, or a specified field name. The suffix is an abbreviation of the data process that outputs the data to final storage. The example image shown above contains the following field names:

TIMESTAMP - The date and time field showing when the record was created.

RECORD - A numerical record number field. Resets to zero when data tables are reset.

FreezerTC - Freezer room temperature field.

FridgeTC - Fridge room temperature field.

PantryTC - Pantry room temperature field.

ExAirTC - External (Outside) air temperature field.

Third Row

The third header row of the data table contains the engineering units for the fields. These units are defined at the beginning of the datalogger program. The example image shown above contains the following units information:

TS - Time stamp for the time stamp field.

RN - Record Number for the record number field.

deg C - Degrees C for the freezer room temperature field.

deg C - Degrees C for the fridge room temperature field.

deg C - Degrees C for the pantry room temperature field.

deg C - Degrees C for the external (outside) temperature field.

Fourth Row

The fourth header row of the data table contains the abbreviations for the data process used to produce the field data. The example image shown above contains the following units information:

Blank - No special data processing is used for the time stamp field.

Blank - No special data processing is used for the record number field.

Avg - Average used for the freezer room temperature field.

Avg - Average used for the fridge room temperature field.

Avg - Average used for the pantry room temperature field.

Avg - Average used for the external (outside) temperature field.

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Data Processing Abbreviations

Data processing instructions, such as average, maximum, minimum, or instantaneous sample, are used in the datalogger program to determine the type of data that is stored in the data tables. The following list contains all the abbreviations that can be used in the fourth row of the data tables and conditionally as field name suffixes on the first row. Not all of these are used in the ZooDAC system programs but are shown here for completeness.

Data Processing Abbreviations	
Data Processing Name	Abbreviation
Totalize	Tot
Average	Avg
Maximum	Max
Minimum	Min
Sample at Max or Min	SMM
Standard Deviation	Std
Moment	MMT
Sample	No abbreviation
Histogram1	Hst
Histogram4D	H4D
FFT	FFT
Covariance	Cov
Level Crossing	LCr
WindVector	WVc
Median	Med
ET	ETsz
Solar Radiation (from ET)	RSo
Time of Max	TMx
Time of Min	TMn

It is important to understand how the output data processing operates. All fields, except for instantaneous samples, are processed to produce the logged value. The example table shown in the image at the beginning of this section shows records that are logged at a ten minute interval, and at 18:50:00 the freezer temperature average ([FreezerTC](#)) for record 17 was logged as -16.36 degrees Celsius. Therefore -16.36 degrees Celsius is the average of all the measurements made by the datalogger over the ten minute interval from 18:40:01 to 18:50:00. The refrigeration room temperature sensors are measured every minute so this logged average is therefore the average of ten sensor measurements.

Data Table Data Record Rows

All rows after the fourth header row are called data records.

Data records are normally created at programmed regular intervals such as every ten minutes, hourly, or daily as shown by their time stamps. Event records are created whenever specified events occur, such as alarms or system errors, so the time stamp will show irregular record times.

The time stamp always indicates the time at the beginning of the datalogger program scan in which the record was written to the table. In the example table, shown in the image above, record number 17 was written at 18:50:00 (6:50 pm) on July 18, 2021.

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Default Data Table Definitions

The datalogger includes three default data tables which are always present. Each of these data tables only contains the most recent measurements and information.

The default data tables are not downloaded when the logged data is downloaded from the datalogger as doing so is unnecessary, however they are available for viewing on a computer while it is connected to the datalogger with the LoggerNet software, or via a web browser.

DataTableInfo

The [DataTableInfo](#) data table is automatically created when a datalogger program produces other data tables. It reports statistics related to the data tables and is only updated when viewed.

Viewing this data table enables staff to determine the amount of data record storage used and available.

Table Name - [DataTableInfo](#)

[TIMESTAMP](#) - Record Date and Time (DateTime).

[RECORD](#) - Record Number (Integer).

[DataTableName\(1\)](#) - Name of the first data table created by the program (Text).

[DataTableName\(2\)](#) - Name of the second data table created by the program (Text).

[SkippedRecord\(1\)](#) - Number of skipped records in the first data table (Integer).

[SkippedRecord\(2\)](#) - Number of skipped records in the second data table (Integer).

[DataRecordSize\(1\)](#) - Number of records allocated to the first data table (Integer).

[DataRecordSize\(1\)](#) - Number of records allocated to the first data table (Integer).

[DataRecordSize\(2\)](#) - Number of records allocated to the second data table (Integer).

[DataRecordSize\(2\)](#) - Number of records allocated to the second data table (Integer).

[SecsPerRecord\(1\)](#) - Data output interval for the first data table (Integer).

[SecsPerRecord\(2\)](#) - Data output interval for the second data table (Integer).

[DataFillDays\(1\)](#) - Number of days required to fill the first data table (Decimal).

[DataFillDays\(1\)](#) - Number of days required to fill the first data table (Decimal).

[DataFillDays\(2\)](#) - Number of days required to fill the second data table (Decimal).

[DataFillDays\(2\)](#) - Number of days required to fill the second data table (Decimal).

[DataFilled\(1\)](#) - Percent of first data table filled (Decimal + Text).

[DataFilled\(1\)](#) - Percent of first data table filled (Decimal + Text).

[DataFilled\(2\)](#) - Percent of second data table filled (Decimal + Text).

[DataFilled\(2\)](#) - Percent of second data table filled (Decimal + Text).

NOTE: The example above is for a datalogger program that produces two data tables. The first or only number in brackets is the table number and increments for each new data table that is produced. A second number in the brackets, if present, indicates 1 for storage in on board memory or 2 for storage in an SD card and is only present for datalogger models such as the CR1000X that support multiple storage options.

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Status

The [Status](#) data table includes information about the health of the datalogger and is updated only when viewed. The information in this data table is primarily intended to assist technical staff to verify that the datalogger and its program are functioning correctly and can be helpful if diagnosing problems. Users do not normally need to view this table. For full details of the fields in this data table, please refer to section "23.2 Status Table System Information" in the CR310 Product Manual.

Public

The [Public](#) data table is configured by the datalogger program and updated at the scan interval set within the datalogger program. It shows measurement and calculation results as they are made. This data table is for the ZooRef program and is an extremely useful tool for monitoring the station.

We recommend that users view this table as a daily check that everything is operating as expected.

Table Name - [Public](#)

[TIMESTAMP](#) - Record date and time (DateTime).

[RECORD](#) - Record number (Integer).

[Platform](#) - The software platform, in this case ZooRef.

[Station](#) - The name of the station (Text).

[BattV](#) - Battery voltage in Volts (Decimal).

[FreezerTC](#) - Freezer room current temperature in degrees C (Decimal).

[FridgeTC](#) - Fridge room current temperature in degrees C (Decimal).

[PantryTC](#) - Pantry room current temperature in degrees C (Decimal).

External section if external sensors are in use on site.

[ExtAirTC](#) - External (Outside) temperature in degrees Celsius (Decimal).

[ExtAirRH](#) - External (Outside) Relative Humidity in percent (Decimal).

End of external section.

Optional Barometric Pressure Sensor Display

[ExtBaroMsl](#) - External (Outside) barometric pressure in hectopascals.)

End of Optional Barometric Pressure Sensor Display

[PowerCurHr](#) - Electricity used in kitchen in current hour in kWh (Decimal).

[PowerCurDay](#) - Electricity used in kitchen in current day in kWh (Decimal).

Auxiliary services electricity meter section if auxiliary services configured on site.

[PowerAuxCurHr](#) - Electricity used for auxiliary services in current hour in kWh (Decimal).

[PowerAuxCurDay](#) - Electricity used for auxiliary services in current day in kWh (Decimal).

End of auxiliary services electricity meter section.

[FreezerTcState](#) - The current state of the freezer temperature (Text).

[ALARM - HIGH TEMP](#) - The freezer temperature is above the high temperature alarm setpoint.

[WARN - NEAR HIGH](#) - The freezer temperature is close to the high temperature alarm setpoint.

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OK - The freezer temperature is within the setpoints (normal operation).

WARN - NEAR LOW - The freezer temperature is close to the low temperature alarm setpoint.

ALARM - LOW TEMP - The freezer temperature is below the low temperature alarm setpoint.

ERROR SETPOINTS - The freezer alarm setpoints are too close together.

ALARM - SENSOR FAIL - The freezer temperature sensor has failed, no measurement is possible.

FridgeTcState - The current state of the fridge temperature (Text).

ALARM - HIGH TEMP - The fridge temperature is above the high temperature alarm setpoint.

WARN - NEAR HIGH - The fridge temperature is close to the high temperature alarm setpoint.

OK - The fridge temperature is within the setpoints (normal operation).

WARN - NEAR LOW - The fridge temperature is close to the low temperature alarm setpoint.

ALARM - LOW TEMP - The fridge temperature is below the low temperature alarm setpoint.

ERROR SETPOINTS - The fridge alarm setpoints are too close together.

ALARM - SENSOR FAIL - The fridge temperature sensor has failed, no measurement is possible.

PantryTcState - The current state of the pantry temperature (Text).

ALARM - HIGH TEMP - The pantry temperature is above the high temperature alarm setpoint.

WARN - NEAR HIGH - The pantry temperature is close to the high temperature alarm setpoint.

OK - The pantry temperature is within the setpoints (normal operation).

WARN - NEAR LOW - The pantry temperature is close to the low temperature alarm setpoint.

ALARM - LOW TEMP - The pantry temperature is below the low temperature alarm setpoint.

ERROR SETPOINTS - The pantry alarm setpoints are too close together.

ALARM - SENSOR FAIL - The pantry temperature sensor has failed, no measurement is possible.

FreezerFaultState - The current state of the freezer electrical circuit breaker (Text).

OK - The freezer circuit breaker is not tripped, normal operation.

FAULT - The freezer circuit breaker is tripped, possible freezer electrical fault.

FridgeFaultState - State of the fridge electrical circuit breaker (Text).

OK - The fridge circuit breaker is not tripped, normal operation.

FAULT - The fridge circuit breaker is tripped, possible fridge electrical fault.

DoorState - The current state of the food storage rooms doors (Text).

DOORS CLOSED - All the doors are closed.

X DOOR(S) OPEN - The number 'X' of doors currently open.

DOOR OPEN ALERT - One or more doors has been open longer than normal, the alert is sounding.

DOOR OPEN SILENT - One or more doors is open and the alert has been silenced.

ALARM - DOOR OPEN - One or more doors has been open too long, the alarm is activated.

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EmergencyState - The current state of the emergency panic buttons (Text).

OK - The panic buttons are all in the normal position.

ALARM - EMERGENCY - The emergency panic button in one of the food storage rooms is pressed.

External section if external sensors are installed on the local station.

ExtSensState - (Option) The current state of the external air temperature & RH sensor (Text).

TC OK, RH OK - External sensor is installed, Temperature sensor is OK, RH sensor is OK.

TC FAIL, RH OK - External sensor is installed, Temperature sensor has failed, RH sensor is OK.

TC OK, RH FAIL - External sensor is installed, Temperature sensor is OK, RH sensor has failed.

TC FAIL, RH FAIL - External sensor is installed, Temperature sensor has failed, RH sensor has failed.

End of external sensor section.

Optional Local Barometric Pressure Sensor

BaroSensState - The current state of the local external barometric pressure sensor (Text).

OK (QM n.nn) - The barometric pressure sensor is working normally.

RECALIBRATE SOON - The sensor will need recalibrating in two to three months.

FAIL (QM n.nn) - The barometric pressure sensor needs recalibrating or has failed.

End of Optional Local Barometric Pressure Sensor

PowerState - The current state of mains electricity supply (Text).

OK - Mains power supply is OK.

POWER FAIL - Mains power supply has failed.

AlarmState - The current state of the alarm system (Text).

DISABLED - The alarm system has been disabled, no alarms will be detected.

INITIALISING - The alarm system is starting up and determining if any alarms are active.

NO ALARMS - All alarms are cleared.

>> ALARMS << - One or more alarms have been triggered.

EmailState - The current state of the email system (Text).

DISABLED - The email messaging system is set to disabled, email messages will not be sent.

TEST MODE - The email messages are diverted to a file for test purposes.

SYSTEM READY - The email system is ready to begin sending email messages.

SEND ATTEMPT - The email system is attempting to send a message.

SENT OK - The Email Relay server has received the message and relayed it to the recipients.

COMMS FAIL - Connection to the Email Relay server failed, the message was not sent.

DATA ERROR - The `EmailRelay()` function was called but not executed, the message was not sent.

COMMS ERROR - Error in communication to the Email Relay server, the message was not sent.

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CommsState - The current state of the remote station (datalogger) communications (Text).

DISABLED - Remote station communications is not in use and has been disabled.

INITIALISING - The communications system is starting up.

COMMS ATTEMPT - The communications system is attempting to contact a remote station.

COMMS RETRY - The last attempt to contact a remote station failed and is now being tried again.

COMMS OK - Communications with the primary remote station succeeded.

COMMS SEC OK - Communications with the secondary remote station succeeded.

COMMS FAIL - All attempts to contact a remote station have failed.

CommsEx1TC - The communications array primary external temperature in degrees C (Decimal).

CommsEx1RH - The communications array primary external relative humidity in % (Decimal).

CommsEx2TC - The communications array secondary external temperature in degrees C (Decimal).

CommsEx2RH - The communications array secondary external relative humidity in % (Decimal).

CommsExBaro - Reserved for barometric pressure sensor measurement.

CommsExSolar - Reserved for solar radiation sensor measurement.

CommsExRain - Reserved for rainfall sensor measurement.

CommsExWspd - Reserved for wind speed sensor measurement.

CommsExWdir - Reserved for wind direction sensor measurement.

ZooRef Data Table Definitions

The format of the data tables for each type of dataset are identical across all ZooDAC systems.

All records in data tables, except for the Event Log, are generated at predetermined time intervals, 10 Minutes, Hourly, or Daily and provide what is called time-series data. Time series data can be easily plotted on a graph. The Event Log is event driven so its records are generated at whatever time the event occurs.

Enclosure number E00 is for functions common to all areas of the building whilst EXT is for external (outside) measurements common to all buildings.

Event Log

The **EVENT_LOG** data table contains a descriptive indication of each event that occurs. Events are logged at the time they occur. This table is limited to 1000 events before its ring memory overwrites.

Table Name - **E00_EVENT_LOG**

TIMESTAMP - Record date and time (DateTime).

RECORD - Record number (Integer).

EventDetected - Event description (Text).

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Kitchen Hourly Electricity Use

The [E00_KWH_60M](#) data table provides an hourly accumulated total of the electricity used in the kitchen. It enables a profile of the electricity consumption across any given day to be analysed for energy management purposes. This can help identify daily peaks and troughs in electricity use.

Table Name - [E00_KWH_60M](#)

[TIMESTAMP](#) - Record date and time (DateTime).

[RECORD](#) - Record number (Integer).

[PowerCurHr](#) - Electricity consumption for the past hour in kWh (Decimal).

Kitchen Daily Electricity Use

The [E00_KWH_DAY](#) data table provides a daily accumulated total of the electricity used in the kitchen. It enables a profile of the electricity consumption across any number of days or months to be analysed for energy management purposes. This can help identify seasonal peaks and troughs in electricity use.

Table Name - [E00_KWH_DAY](#)

[TIMESTAMP](#) - Record date and time (DateTime).

[RECORD](#) - Record number (Integer).

[PowerCurDay](#) - Electricity consumption for the past day in kWh (Decimal).

Auxiliary Services Hourly Electricity Use (Optional)

The [E01_KWH_60M](#) data table provides an hourly accumulated total of the electricity used on the first floor. It enables a profile of the electricity consumption across any given day to be analysed for energy management purposes. This can help identify daily peaks and troughs in electricity use.

Table Name - [E01_KWH_60M](#)

[TIMESTAMP](#) - Record date and time (DateTime).

[RECORD](#) - Record number (Integer).

[PowerCurHr](#) - Electricity consumption for the past hour in kWh (Decimal).

Auxiliary Services Daily Electricity Use (Optional)

The [E01_KWH_DAY](#) data table provides a daily accumulated total of the electricity used on the first floor. It enables a profile of the electricity consumption across any number of days or months to be analysed for energy management purposes. This can help identify seasonal peaks and troughs in electricity use.

Table Name - [E01_KWH_DAY](#)

[TIMESTAMP](#) - Record date and time (DateTime).

[RECORD](#) - Record number (Integer).

[PowerCurDay](#) - Electricity consumption for the past day in kWh (Decimal).

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Food Storage Rooms Ten Minute Temperatures

The [E00_REFRIG_T_10M](#) data table provides high resolution 10 minute monitoring of the temperatures in each of the food storage rooms and is ideal for graphing to ensure that food is being stored within the desired temperature ranges. This data table also records the external (outside) air temperature which, when plotted on a graph against the food storage rooms temperatures, can help with analysis of the refrigeration performance. The averages are calculated across all measurements made during the 10 minute interval.

Table Name - [E00_REFRIG_T_10M](#)

[TIMESTAMP](#) - Record date and time (DateTime).

[RECORD](#) - Record number (Integer).

[FreezerTC_Avg](#) - Freezer room temperature 10 minute average in degrees C (Decimal).

[FridgeTC_Avg](#) - Fridge room temperature 10 minute average in degrees C (Decimal).

[PantryTC_Avg](#) - Pantry room temperature 10 minute average in degrees C (Decimal).

[ExAirTC_Avg](#) - External (Outside) air temperature 10 minute average in degrees Celsius (Decimal).

[ExAirRH_Avg](#) - Average external (outside) relative humidity in percent (Decimal).

Food Storage Rooms Daily Temperatures Summary

The [E00_REFRIG_T_DAY](#) data table provides a daily summary, logged at midnight (00:00), of the temperatures in the food storage rooms over the previous day. The table records the average temperature along with the minimum and maximum temperatures, and the times they occurred.

Table Name - [E00_REFRIG_T_DAY](#)

[TIMESTAMP](#) - Record date and time (DateTime).

[RECORD](#) - Record number (Integer).

[FreezerTC_Avg](#) - Freezer room average temperature for the day in degrees Celsius (Decimal).

[FreezerTC_Max](#) - Freezer room maximum temperature for the day in degrees Celsius (Decimal).

[FreezerTC_TMx](#) - Freezer room time of maximum temperature (DateTime).

[FreezerTC_Min](#) - Freezer room minimum temperature for the day in degrees Celsius (Decimal).

[FreezerTC_TMn](#) - Freezer room time of minimum temperature (DateTime).

[FridgeTC_Avg](#) - Fridge room average temperature for the day in degrees Celsius (Decimal).

[FridgeTC_Max](#) - Fridge room maximum temperature for the day in degrees Celsius (Decimal).

[FridgeTC_TMx](#) - Fridge room time of maximum temperature (DateTime).

[FridgeTC_Min](#) - Fridge room minimum temperature for the day in degrees Celsius (Decimal).

[FridgeTC_TMn](#) - Fridge room time of minimum temperature (DateTime).

[PantryTC_Avg](#) - Pantry room average temperature for the day in degrees Celsius (Decimal).

[PantryTC_Max](#) - Pantry room maximum temperature for the day in degrees Celsius (Decimal).

[PantryTC_TMx](#) - Pantry room time of maximum temperature (DateTime).

[PantryTC_Min](#) - Pantry room minimum temperature for the day in degrees Celsius (Decimal).

[PantryTC_TMn](#) - Pantry room time of minimum temperature (DateTime).

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External Daily Temperature and RH Summary

The [EXT_T_RH_DAY](#) data table provides a daily summary, logged at midnight (00:00), of the external (outside) temperature and relative humidity over the previous day. The table records the average temperature along with the minimum and maximum temperatures and relative humidities, the times they occurred.

Table Name - [EXT_T_RH_DAY](#)

[TIMESTAMP](#) - Record date and time (DateTime).

[RECORD](#) - Record number (Integer).

[ExAir TC_Avg](#) - Average external (outside) air temperature for the day in degrees Celsius (Decimal).

[ExAir TC_Max](#) - Maximum external (outside) air temperature for the day in degrees Celsius (Decimal).

[ExAir TC_TMx](#) - Time of maximum air temperature (DateTime).

[ExAirTC_Min](#) - Minimum external (outside) air temperature for the day in degrees Celsius (Decimal).

[ExAirTC_TMn](#) - Time of minimum air temperature (DateTime).

[ExAirRH_Max](#) - Maximum external (outside) air relative humidity for the day in percent (Decimal).

[ExAirRH_TMx](#) - Time of maximum air relative humidity (DateTime).

[ExAirRH_Min](#) - Minimum external (outside) air relative humidity for the day in degrees Celsius (Decimal).

[ExAirRH_TMn](#) - Time of minimum air relative humidity (DateTime).

External Hourly Barometric Pressure, Temperature and Humidity (Optional)

This data table provides an hourly record of the barometric pressure measurements, external (outside) temperature and relative humidity. It enables analysis of atmospheric conditions on an hourly basis and can be easily correlated with enclosure conditions for research purposes.

Table Name - [EXT_BARO_60M](#)

[TIMESTAMP](#) - Record date and time (DateTime).

[RECORD](#) - Record number (Integer).

[ExBaroStn_Avg](#) - Average barometric pressure at the station in hectopascals (Decimal).

[ExBaroMsl_Avg](#) - Average barometric pressure, corrected to Mean Sea Level, in hectopascals (Decimal).

[ExAirTC_Avg](#) - Average external (outside) temperature in degrees Celsius (Decimal).

[ExAirRH_Avg](#) - Average external (outside) relative humidity in percent (Decimal).

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Using The Web Interface

The datalogger has a built-in web interface which enables easy viewing of the station status and data using a web browser from any network connected computer. No additional software is needed.

The web interface allows users to view the data without being logged on and offers several administrative functions that can be accessed by logging on to the datalogger with an administrator level logon.

We recommend using the web interface for viewing data, and LoggerNet software for administrative tasks.

The web interface makes day to day station checks quick and easy for users, whereas LoggerNet enables all the functionality of the entire datalogger network to be efficiently configured, utilised and maintained.

Connecting To A Station

1. Open the web browser on the computer
2. Enter the IP address of the station, in the format 192.168.5.92, into the browser's address and press [Enter].
3. The Status page will be displayed.

Status Page

The screenshot displays the 'Status' page of the ZooRef web interface. At the top, there is a navigation bar with the Campbell Scientific logo and icons for various functions, and a menu with 'Status', 'Data', 'Files', and 'Utilities'. The main content area is titled 'Status' and is divided into two columns. The left column, 'Datalogger Information', lists: Name (15614), Timestamp (22/09/2023, 10:14:43 am), OS (CR310.Std.10.07, 09/07/2022, Signature:49485), Panel Temperature (27.93°C), Battery (12.02 V), Memory (627220 bytes), and Errors (Watchdog:0, Serial Flash:0). The right column, 'Program Information', lists: Current (CPU:OKH_AN1_DL01_R01_TEST.CR300), Start Time (22/09/2023, 12:15:10 am), Run Signature (40022), Program Signature (2330), Results for Last Program Compiled (CPU:OKH_AN1_DL01_R01_TEST.CR300 -- Compiled OK), Memory Free (19264 bytes), and Errors (Skipped Scans:0, Variables Out of Bounds:0). At the bottom of the page, there is a copyright notice: ©2023 Campbell Scientific, Inc.

The Status page gives key information about the datalogger and the program that is running in the datalogger. It can be selected by clicking on [Status](#) on the header/menu bar at the top of the page.

Click the [\[Refresh\]](#) button anytime it is desired to refresh the information on the page.

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The web interface Status page displays a subset of the information in the dataloggers [Status](#) data table, which is an automatically generated default table. The complete [Status](#) data table can be viewed using the LoggerNet software. Most fields in the [Status](#) table are read only, and of a numeric data type unless otherwise noted.

Full details of all the fields in the [Status](#) table can be found in section "23.2 Status Table System Information" in the CR310 Product Manual.

The fields displayed on the web interface Status page are described below in the order they are displayed.

Datalogger Information

Name - Datalogger station name stored in flash memory. Defaults to serial number. This is not the same name as that is entered into the LoggerNet software for the stations network name. This station name can be sampled into a data table, but it is not the name that appears in data file headers. Updated at startup or when the name is changed using the Device Configuration Utility in LoggerNet.

Timestamp - Datalogger date and time.

OS - Datalogger operating system version, release date and signature. Updates at startup.

Panel Temperature - Datalogger wiring panel temperature in degrees Celsius. Updates once per minute, when viewing the [Status](#) table, or programmatically.

Battery - Voltage of the 12V battery powering the system. Updates once per minute, when viewing the [Status](#) table, or programmatically.

Memory - Total final-data memory size (bytes) in the datalogger. Updated at startup.

Errors - Datalogger watchdog errors that have occurred while running this program, the count increments each time datalogger restarts due to error and resets automatically when a new program is compiled. Can be reset by entering 0. Updated at startup and on each error occurrence.

Program Information

Current - Program file that is currently running in the datalogger. Updates at startup.

Start Time - Date and time the CRBasic program was started. Updates at beginning of program compile.

Run Signature - Signature of the running binary (compiled) program. Value is independent of comments or non-functional changes. Often changes with operating system changes. Updates after compiling and before running the program.

Program Signature - Signature of the CRBasic program file including comments. Does not change with operating system changes. Updates after compiling the program.

Results for Last Program Compiled - Contains messages generated at compilation or during runtime. Updated after compile and for runtime errors such as variable out of bounds.

Memory Free - Unallocated final-data memory in the datalogger (bytes). Free memory is not necessarily available for data tables. As memory is allocated and freed, small sections of unallocated memory, which are unusable for data tables, may be created. Updated after compile completes.

Errors - Skipped Scans is the number of program scans that have been skipped while the CRBasic program is running. Does not include scans intentionally skipped as a result of program instructions [Do/Loop](#) and [ExitScan](#) instructions. Updated as skipped scans occur. Can be reset by entering 0.

Variables Out of Bounds is the number of attempts to write to an array outside of the declared size. The write does not occur. Indicates a CRBasic program error. Updated at runtime when the error occurs. Can be reset by entering 0.

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Data Page

The screenshot shows the 'Data' page interface. On the left is a 'Table List' with options: DataTableInfo, E00_EVENT_LOG, EXT_T_RH_DAY, F1_KWH_60M, F1_KWH_DAY, GF_KWH_60M, GF_KWH_DAY, GF_REFRIG_T_10M, GF_REFRIG_T_DAY, Public (selected), Setpoints, and Status. The main content area shows the 'Public' table with a 'Live' checkbox checked and 'Save' and 'Table View' buttons. The table data is as follows:

Field	Value
Timestamp	22/09/2023, 10:29:46 am
Record	18438
BattV	12.03
FreezerTC	21.99
FridgeTC	21.92
PantryTC	21.49
ExtAirTC	NAN
ExtAirRH	NAN
PowerGfCurHr	0
PowerGfCurDay	0
PowerF1CurHr	0
PowerF1CurDay	0

The Data page enables data tables stored in the datalogger to be viewed and downloaded. On some datalogger models* this page also allows selected fields to be graphed in realtime. It can be selected by clicking on [Data](#) on the header/menu bar at the top of the page.

When selecting this page, if you are not logged on, the logon dialog box is displayed. Click the [\[Cancel\]](#) button to continue as an anonymous user without a logon, if this option is allowed by datalogger security settings, or enter your logon credentials to continue. You must logon to be able to make administrative changes.

The [Table List](#) on the left hand side of the page shows the available data tables. The [Public](#) data table is selected by default when the page is opened. Choose the desired table by clicking on the table name in the Table List.

The grey header displays the name of the selected data table. Check the [Live](#) checkbox to allow the display to update automatically as new data arrives. Click the [\[Save\]](#) button to save the data table to the computer.

The button on the right of the [\[Save\]](#) button toggles between [\[Table View\]](#) and [\[Record View\]](#) display modes.

[\[Table View\]](#) - Selects the table view mode when the page is currently in record view mode.

[\[Record View\]](#) - Selects the record view mode when the page is currently in table view mode.

*NOTE: There is no Graph function on CR300 series dataloggers.

File Control Page

The screenshot displays the File Control interface. At the top, the Campbell Scientific logo is on the left, and navigation links for Status, Data, Files, and Utilities are on the right. The main heading is 'File Control'. On the left, a 'Device List' shows 'CPU' with 83.76 MB. To the right, a grey header contains 'Send', 'Delete', and 'Stop Program' buttons. Below this is a table with columns: File Name, Run Options, Size, Modified, and Attributes. One file is listed: 'OKH_AN1_DL01_R01_TEST.CR300' with run options 'running.power up', size 49637, modified on 22/09/2023 at 12:15:02 am, and attributes 'RW'. A checkbox is present to the left of the file name. At the bottom, the copyright notice '©2023 Campbell Scientific, Inc.' is displayed.

The File Control page enables management of the datalogger files. Files can be sent, deleted, activated, and deactivated. The files page can be selected by clicking on [Files](#) on the header/menu bar at the top of the page.

When selecting this page, if you are not logged on, the logon dialog box is displayed. Click the [\[Cancel\]](#) button to continue as an anonymous user without a logon, if this option is allowed by datalogger security settings, or enter your logon credentials to continue. You must logon to be able to make administrative changes.

We do not recommend making any changes using this page unless requested by technical support.

The available devices are listed in the [Device List](#) on the left hand side of the page. Normally there will only be the one device, the datalogger CPU, and it will be automatically selected.

The files loaded onto the selected device are displayed below the grey header/toolbar which provides the buttons for each task. A checkbox beside each file allows the files to be selected.

Send - Click to send a file to the datalogger. A dialog box opens to allow selection of the desired file. Double click the desired file to send it to the datalogger.

Delete - Click to delete the selected file. A confirmation dialog box appears. Click [\[Yes\]](#) to delete the file [\[No\]](#) to keep the file and cancel the delete operation.

Stop Program - Click to stop the program running in the datalogger. A confirmation dialog box appears. Click [\[Yes\]](#) to stop the program [\[No\]](#) to cancel the operation. The information shown under Run Options will change to indicate the program has stopped.

There should always be at least one program file in the list, this being the program currently running in the datalogger. Under the [Run Options](#) heading it will show [running](#), [power up](#) next to the file name.

When a program is upgraded to a new version, the datalogger will automatically set the new program to run on datalogger startup and retain the previous version. This is useful if an unexpected problem occurs with the new program version as it's easy to set the new program version to stop and then set the previous version to run.

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File Name Click

Clicking on the file name opens a Windows dialog box that allows the file to be saved to the computer or opened with a program on the computer. The save option is selected by default. Save the file as desired.

IMPORTANT: LoggerNet is required on the computer if the program file is to be edited.

Run Options Click

The Run Options shown next to the file name indicate if the datalogger program is running and whether or not it is set to start on power up. Clicking the Run Options opens the Run Options Dialog Box.

Run Program Options

CPU:OKH_AN1_DL01_R01_TEST.CR300

Run Now

Preserve data if no tables have changed.

Delete data tables created by the current program.

Run On Power-up

OK Close

If the datalogger program is running the dialog box will look like the example above with the Run Now options greyed out as they are not available.

If the program is stopped the Run Now options will be available.

Run Now Checkbox - Select to start the datalogger program, then choose the desired data table option.

Preserve data if no tables have changed - Datalogger will attempt to preserve the data tables.

Delete data tables created by the current program - The data tables will be deleted.

Run On Power-up - Select to enable the program to start automatically when the datalogger is powered up.

WARNING: Failure to select Run On Power-up will cause the control system to remain stopped after a power failure. It will then have to be manually started using the Run Options Dialog box every time there is a power failure to the datalogger until this setting is corrected.

Once the correct Run Options have been selected, click the **[OK]** button to start the datalogger program. The Run Options shown next to the file name will update to indicate the current status.

Utilities Page

The screenshot shows the 'Utilities' page in the ZooRef Refrigeration Monitoring System. The page has a dark header with the Campbell Scientific logo and navigation links for Status, Data, Files, and Utilities. The main content area is titled 'Utilities' and contains a sidebar with links for Clock, Terminal, and Web Site Update. The 'Clock' utility is active, displaying the current date/time (09/22/2023, 12:15:04), station time (09/22/2023, 12:15:05), and clock difference (-0.96 seconds). A dropdown menu for 'Date/Time Source' is set to 'Sync with Computer', and a 'Set Station Clock' button is visible. The footer shows the copyright notice: ©2023 Campbell Scientific, Inc.

The Utilities page enables setting the datalogger realtime clock and it provides a terminal function. It can be selected by clicking on [Utilities](#) on the header/menu bar at the top of the page.

The available utilities are listed on the left hand side of the page. Click to select the desired utility.

Clock Setting

When the page opens the Clock Setting utility is immediately available. It shows the current date and time from the computer, the station (datalogger) date and time, and the difference between the two.

The [Date/Time Source](#) drop down pick list offers two options for setting the time...

[Sync With Computer](#) - Click to set the station to the computer's time. Beware of daylight savings!

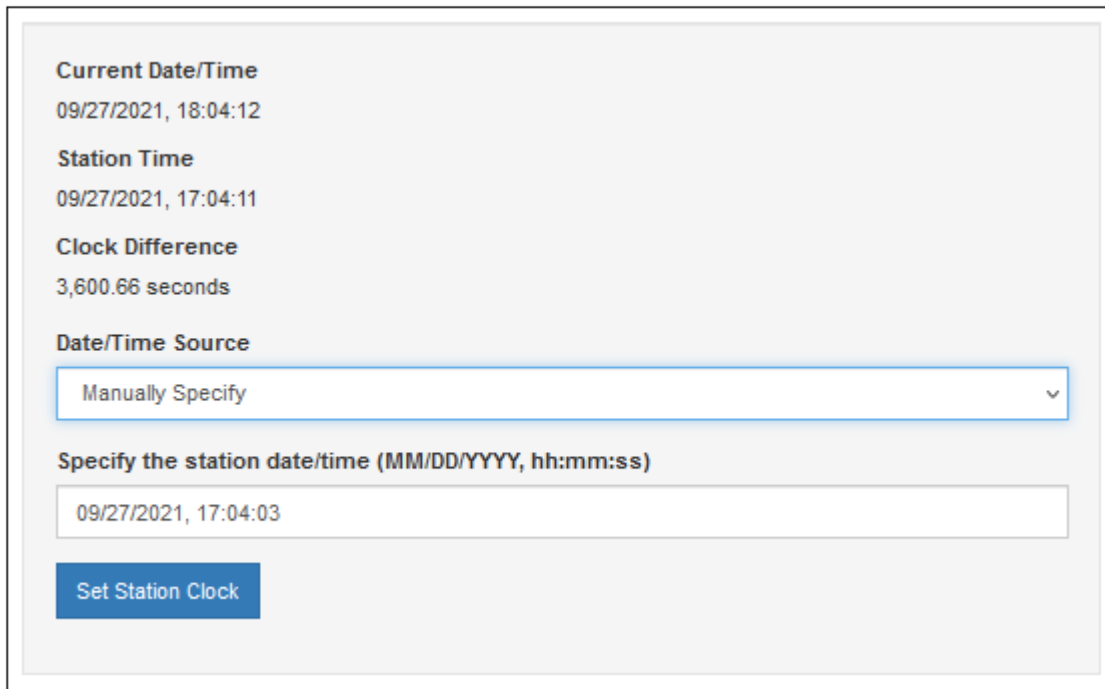
[Manually Specify](#) - Manually enter the correct time and date. This is the safest option.

WARNING: Always use the Manually Specify option when setting the station (datalogger) clock to avoid inadvertently setting the station to the computer's Daylight Savings Time, which may cause data loss.

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To reset the datalogger date and time to the correct date and time...

1. Choose the Manually Specify option from the Date/Time Source drop down pick list. The page will update and a text box [Specify the station date/time \(MM/DD/YYYY, hh:mm:ss\)](#) will be displayed as shown below.



The screenshot displays a configuration panel for the datalogger's date and time. It includes the following elements:

- Current Date/Time:** 09/27/2021, 18:04:12
- Station Time:** 09/27/2021, 17:04:11
- Clock Difference:** 3,600.66 seconds
- Date/Time Source:** A dropdown menu currently set to "Manually Specify".
- Specify the station date/time (MM/DD/YYYY, hh:mm:ss):** A text input field containing "09/27/2021, 17:04:03".
- Set Station Clock:** A blue button located below the text input field.

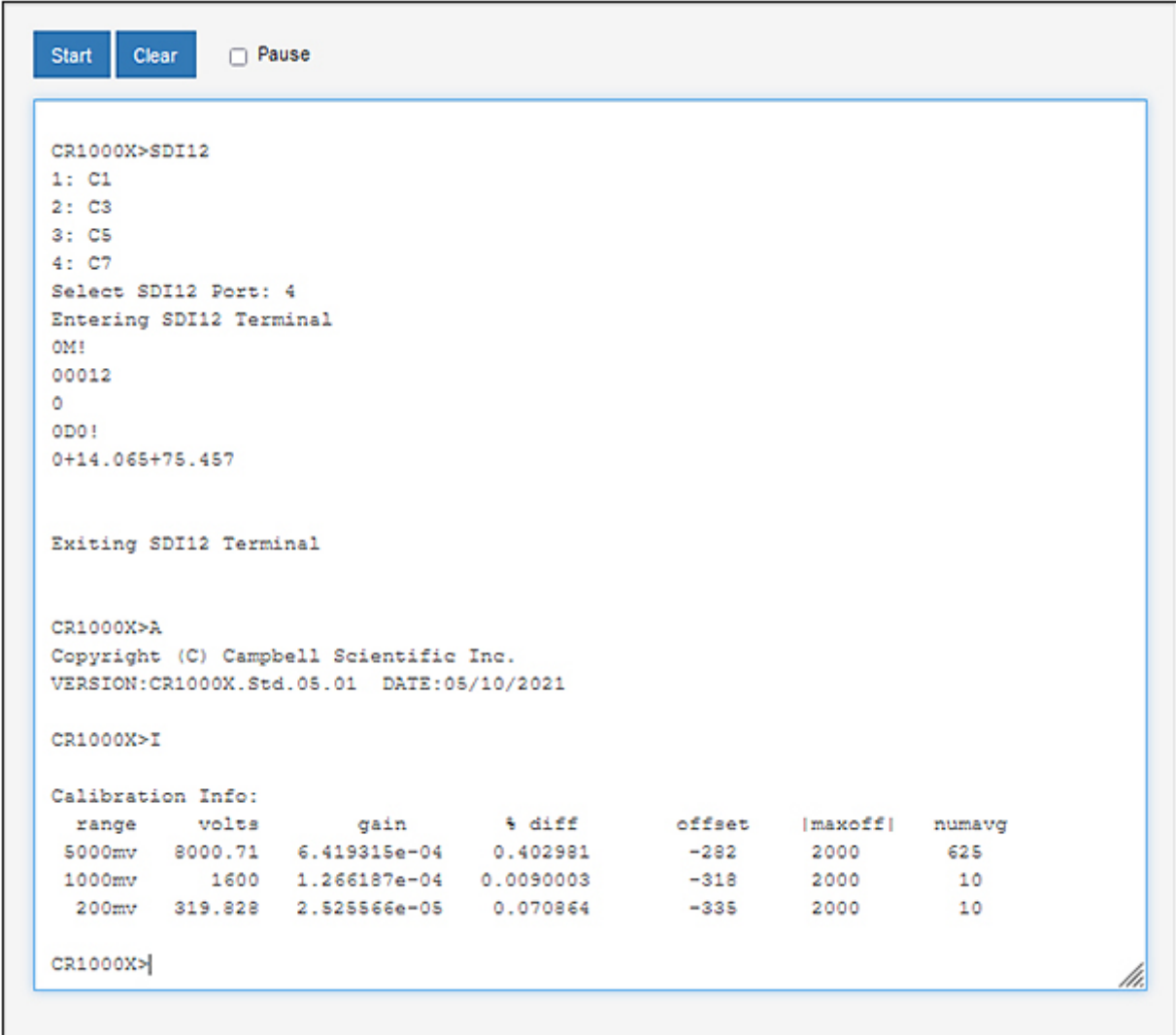
2. Edit the displayed date and/or time as necessary so the correct date and time is displayed.
3. Click the [\[Set Station Clock\]](#) button. A confirmation dialog box appears.
4. Click the [\[Yes\]](#) button to immediately update the station clock, or [\[No\]](#) to cancel the operation.

Tip: When editing the station time, enter a new time that is about thirty seconds ahead of the current time of day, then click the [\[Set Station Clock\]](#) button. Hover the mouse pointer over the [\[Yes\]](#) button on the confirmation dialog box and watch the [Current Date/Time](#) display approach the new time you entered for the station, then click the [\[Yes\]](#) button when the current time is one second before the time you have set.

WARNING: DO NOT adjust the station (datalogger) clock for daylight savings time as doing so creates data anomalies that cannot be easily corrected and may result in loss of data.

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Terminal



```
CR1000X>SDI12
1: C1
2: C3
3: C5
4: C7
Select SDI12 Port: 4
Entering SDI12 Terminal
OM!
00012
0
OD0!
0+14.065+75.457

Exiting SDI12 Terminal

CR1000X>A
Copyright (C) Campbell Scientific Inc.
VERSION:CR1000X.Std.05.01 DATE:05/10/2021

CR1000X>I

Calibration Info:
  range   volts   gain      % diff   offset  |maxoff|  numavg
5000mv   8000.71  6.419315e-04  0.402981  -282    2000    625
1000mv   1600     1.266187e-04  0.0090003  -318    2000    10
200mv    319.828  2.525566e-05  0.070864  -335    2000    10

CR1000X>|
```

The terminal function is primarily an engineering tool. It is not necessary to use it for routine datalogger operations other than configuring SDI-12 sensors. A sample Terminal session is shown above.

In this example the datalogger was placed into SDI-12 Transparent mode using the [SDI12](#) command, then selecting SDI-12 port C7 by entering the selection [4](#) from the choices given.

NOTE: Only one sensor can be connected to the datalogger SDI-12 port when Transparent mode is used.

The SDI-12 command [OM!](#) was issued to request the sensor initiate measurement. The [0](#) is the sensor SDI-12 address, [M](#) is the measurement instruction, and [!](#) is the command terminator.

The SDI-12 command [ODO!](#) was then issued to retrieve the measurement values from the sensor. The [0](#) is the sensor SDI-12 address, [DO](#) is the measurement instruction, and [!](#) is the command terminator.

The sensor responded with the values +14.065 and +75.457 which for the sensor used is the air temperature in degrees Celsius and the relative humidity in percent.

The SDI-12 Transparent mode was then exited and two commands issued to the datalogger.

Command [A](#) requested the datalogger operating system information, and command [I](#) requested the datalogger calibration information.

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Sensor Measurements

This section provides information about how the datalogger program obtains the various measurements that are used to monitor the operation of the food storage rooms and raise alarms in the event a problem is detected. All sensors are read and processed automatically by the datalogger program.

Meteorological grade temperature and relative humidity sensors are used to make all temperature and relative humidity measurements. The measurement values from the sensors are calibrated in degrees Celsius for the temperature and in percent for the relative humidity.

Food Storage Room Temperature Measurements

The food storage room temperatures are measured using Campbell Scientific 107 temperature sensors that utilise Measurement Specialties 100K6A1iA thermistors as the temperature sensing element. One temperature sensor is installed in each of the food storage rooms.

The datalogger program measures the food storage rooms temperature sensors once every minute then carries out a test to ensure that the measurement values obtained from each of the sensors are within the manufacturers specified operating range. This check cannot verify that functioning sensors are also accurately calibrated. Periodic calibration tests are recommended for this purpose.

The test criteria for the Campbell 107 sensor measurement values are:

$T^{\circ}C$ greater than -35 and $T^{\circ}C$ less than 50 and $T^{\circ}C$ is not NAN

If a sensor measurement fails this test, the state for that food storage room is set to [ALARM - SENSOR FAIL](#) and its value is set to NAN (Not A Number). The state for each food storage room sensor is displayed in its respective [FreezerTcState](#), [FridgeTcState](#), and [PantryTcState](#) field in the [Public](#) data table.

The temperature for each of the food storage rooms [FreezerTC](#), [FridgeTC](#), and [PantyrTC](#) is displayed in the [Public](#) data table and logged every ten minutes. NAN (Not A Number) is logged in place of the measurement value for any sensor that is flagged as faulty by the datalogger program, or if a sensor measurement value is not available at the time of logging which typically occurs when data is logged shortly after a program restart.

External Temperature and Relative Humidity Measurements

A Campbell Scientific HygroVUE5 SDI-12 combined temperature and relative humidity sensor is used for the optional external (outside) air sensor. An external sensor is not required for a standalone ZooRef installation although it is recommended as it can provide helpful information. An external sensor can be installed and configured to enable this station to operate as a primary or secondary external sensor data provider to other networked stations. If installed, the external sensor is measured once every minute.

When a site has multiple network connected stations, one or more remote stations can provide external sensor measurement values which the local station then obtains via network communications every five minutes.

Each time the external sensors are measured, the program carries out a test to ensure the measurement values obtained from the sensors are within the manufacturers specified operating range. If a sensor fails, it typically returns a measurement value that is out of range such as -9999 or NAN (Not A Number) so detecting such values enables the program to automatically disregard a sensor that is obviously defective.

The test criteria for HygroVUE5 temperature and RH sensor measurement values are:

$T^{\circ}C$ greater than -40 and $T^{\circ}C$ less than 70 and $T^{\circ}C$ is not NAN

$RH\%$ greater than 5 and $RH\%$ less than or equal to 100 and $RH\%$ is not NAN

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NOTE: This check cannot verify that functioning sensors are also accurately calibrated, periodic calibration tests are recommended for this purpose.

If an external sensor is installed on the datalogger, the external sensor state `ExtSensState` is displayed in the `Public` data table. Normally the sensor state displays "TC OK, RH OK" to indicate that the sensors are working normally. If a sensor measurement fails the above test, the state for the sensor changes to indicate the nature of the fault. The state "TC OK, RH FAIL" indicates the RH sensor has failed, "TC FAIL, RH OK" indicates the temperature sensor has failed, and "Tx FAIL, RHx FAIL" indicates that both sensors have failed.

NOTE: When external sensor values are acquired from remote stations via the comms array, a sensor failure does not raise an external sensor failure alarm on the local station. External sensor failure alarms are only generated by stations that have an external sensor installed on them.

The external air temperature and RH measurement values from the sensors, regardless of whether the sensors are local or remote, are placed into the `Public` data table fields `CommsEx1TC`, `CommsEx1RH`, `CommsEx2TC`, and `CommsEx2RH` (the communications array), so they are available to all dataloggers across the network.

For fail-safe redundancy two temperature and RH sensor measurements can be used, either with one sensor on the local station and one at a remote station, or with both at remote stations. If two measurements are available they are averaged and if one sensor fails the station continues operating using the remaining good sensor.

The following logic is applied to error check and average the external Temperature and RH sensors:

Test Sensor 1 and if Sensor 1 is Ok then

 Test Sensor 2 and if Sensor 2 is Ok Then

 Set Result to the Calculated average of Sensor 1 Value and Sensor 2 Value

 Otherwise Sensor 2 is Defective so

 Set Result to the Sensor 1 Value.

Otherwise Sensor 1 is Defective so Test Sensor 2 and if Sensor 2 is Ok then

 Set Result to the Sensor 2 Value.

Otherwise Sensor 1 and Sensor 2 are Both Defective so

 Set Result to NAN

If two external sensors are in use, the average measurements are determined using the following equation:

$$Average = (Value1 + Value2) \div 2$$

The resultant external temperature and relative humidity measurements, `ExtAirTC` and `ExtAirRH` are displayed in the `Public` data table and logged every ten minutes. NAN (Not A Number) is displayed and logged in place of the measurement value in the event that no valid measurement value can be obtained from the sensors, which may be the result of sensor failure or if the sensors have yet to be measured after a program restart.

Electricity kWh Meter Measurement

One, or optionally two, kWh meters are installed in the switchboard to monitor the building's electricity use.

These meters have a pulse output that produces 1 pulse for every 0.01 kWh of electricity used. The pulse output from each kWh meter is applied to a pulse counter input on the datalogger which counts the number of pulses that occur between each program scan. The datalogger program reads each pulse counter and accumulates the count as hourly and daily kWh totals.

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Recommended Maintenance Procedure

During maintenance when the datalogger program is not running, such as program updates, any pulses applied to the datalogger pulse counter input will not be counted and pulse counts not yet logged are lost. To avoid logging inaccurate kWh data when the datalogger is restarted, it is necessary to enter the correct kWh totals into the **Public** data table **PowerCurDay** and **PowerCurHr** fields after restarting the datalogger.

When commencing maintenance, write down the kWh reading from the meter(s), and the **PowerCurDay** and **PowerCurHr** values from the fields in the datalogger **Public** data table. At the conclusion of maintenance, write down the kWh reading from the meter(s) and subtract the start reading from the end reading to obtain the kWh used during maintenance. Add the kWh used during maintenance to the **PowerCurDay** and **PowerCurHr** values you wrote down at the start then enter those new values into the **PowerCurDay** and **PowerCurHr** fields in the datalogger **Public** data table using the LoggerNet software or the Web Interface.

Barometric Pressure Measurements (Optional)

A Campbell Scientific BaroVUE10 barometric pressure sensor may be installed on one station. If installed, the sensor is measured every six minutes. The resulting station pressure measurement (the pressure at that station's elevation) is placed into the communications array where it can be accessed by all stations on the network.

On the station where the barometric pressure sensor is installed, the station constant **BARO_SDI_ADDR** is set to the sensor's SDI-12 address and the station constant **BARO_LOCAL** is set to True to enable the datalogger program to obtain the measurement values from the sensor.

In order to display and log the barometric pressure values, the station constant **BARO_ENAB** must be set to True and the station's elevation above Mean Sea Level, in metres, must be entered into the **BARO_STN_ELEV** station constant in each station where the display and logging of the barometric pressures is required.

The station pressure is always displayed in the communications array **Public** table **CommsExBaro** variable whilst the pressure corrected to Mean Sea Level is calculated and displayed in the **Public** table **ExtBaroMsl** variable. The station pressure is useful in situations where a measure of the actual pressure is required, whilst the barometric pressure is consistent with the pressure shown on meteorological charts intended to indicate the prevailing atmospheric conditions.

The barometric pressure measurement, at Mean Sea Level, is derived from the station pressure measurement by calculating the difference pressure dP using the station elevation E above Mean Sea Level, in metres, then adding that difference pressure to the station pressure.

The difference pressure is determined using the following equation:

$$dP = 1013.25 \left\{ 1 - \left(1 - \frac{E}{44307.69231} \right)^{5.25328} \right\}$$

This equation assumes U. S. Standard Atmosphere and dry air (Atmospheric Science, Wallace and Hobbs 1977). and is as given in the Campbell Scientific BaroVUE10 Product Manual.

The datalogger logs the station pressure, barometric pressure, external (outside) temperature, and relative humidity every hour. These pressure measurements are recorded to assist zoo personnel with research activities and are not used by the datalogger program HVAC and lighting control functions.

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SDI-12 Sensor Address Settings

The SDI addresses should be set on the external and enclosure sensors as follows...

External (Ext) Temperature & Relative Humidity - Port C1 - Address 0

External (Ext) Barometric Pressure Port C1 - Address 3

Communications to Remote Stations

All stations (dataloggers) in the ZooDAC system are designed to operate either as a single standalone station, or as one station in a network of stations where one or more of the external sensors may be located at remote stations with communications between stations achieved across a conventional IP computer network. The values required to be retrieved via network communications must be present in the [Public](#) data table and are placed into an array. The datalogger program uses a designated communications array for this purpose. The measurement values stored in the communications array of any given station are available, via network communications, to all other stations across the network.

The station that a user can currently "touch" is referred to as the local station, all other stations are remote stations.

Up to two remote stations with can be configured as sources for remote sensor measurement values, one is designated as the primary remote station and the other is the secondary remote station. The primary remote station is normally the first that the communications attempts to retrieve the desired values from. If communications to the primary remote station fails, the communications will automatically try to retrieve the values from the secondary remote station.

Normally in a wired IP network the communications are very reliable and the secondary remote station is unlikely to be called, but in a wireless network where the link quality may vary the secondary remote station can provide an alternative path by which the desired values can be obtained when necessary.

External Temperature and Humidity Sensor Configuration Options

Correct configuration of external temperature and humidity sensors is critical to the proper functioning of the ZooDAC system. Only one external temperature and humidity sensor can be installed on any one datalogger and is referred to as the local external sensor. When two external sensors are available on the network one of them must be assigned as the primary external sensor, the other becomes the secondary external sensor.

All ZooDAC stations that provide climate control functions require at least one external air temperature and RH sensor, installed as either a local sensor or a remote sensor, to provide the external air reference used by the control system. ZooDAC monitoring only stations do not need an external air reference but can be configured to log data from a remote external sensor, or to provide a local external sensor to the network.

Single Primary Local Sensor Only

In this configuration the primary external sensor is connected to the local station and there are no remote sensors available. The local external sensor should be configured as the primary sensor when it is the only external sensor on the network. This is also the configuration for a single standalone datalogger installation.

The station constants settings are:

`EXT_TRH_LOCAL = True`

`EXT_TRH_PRIMARY = True`

Primary Local Sensor with a Remote Sensor

In this configuration the primary external sensor is connected to the local station and a secondary remote sensor is available. The local sensor is configured as the primary external sensor and the local station obtains the secondary external sensor measurement values from another station on the network.

The station constants settings are:

`EXT_TRH_LOCAL = True`

`EXT_TRH_PRIMARY = True`

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Secondary Local Sensor with a Remote Sensor

In this configuration the secondary external sensor is connected to the local station and a primary remote sensor is available. The local sensor is configured as the secondary sensor and the local station obtains the primary external sensor measurement values from another station on the network.

The station constants settings are:

`EXT_TRH_LOCAL = True`

`EXT_TRH_PRIMARY = False`

Single Remote Sensor Only

In this configuration there is no external sensor connected to the local station. The local external sensor is disabled. The local station obtains the external sensor values from another station on the network.

The station constants settings are:

`EXT_TRH_LOCAL = False`

`EXT_TRH_PRIMARY = False`

Two Remote Sensors

In this configuration there is no external sensor connected to the local station. The local external sensor is disabled. The local station obtains the external sensor values for both external sensors from another station on the network.

The station constants settings are:

`EXT_TRH_LOCAL = False`

`EXT_TRH_PRIMARY = False`

The Communications Array

A communications array is maintained by the datalogger program in the `Public` data table of the datalogger. This array contains the temperature and relative humidity values from the primary and, if installed, secondary external sensors, and may contain additional sensor values as well. Any station on the network can retrieve the array with all its values from any other station on the network. All values in the communications array are in the format "CommsValue" where the "Comms" prefix indicates it is a communications array value.

Communications array values are:

`CommsEx1TC` - The primary external air temperature sensor measurement.

`CommsEx1RH` - The primary external air relative humidity sensor measurement.

`CommsEx2TC` - The secondary external air temperature sensor measurement.

`CommsEx2RH` - The secondary external air relative humidity sensor measurement.

`CommsExBaro` - Reserved for barometric pressure sensor measurement.

`CommsExSolar` - Reserved for solar radiation sensor measurement.

`CommsExRain` - Reserved for rainfall sensor measurement.

`CommsExWspd` - Reserved for wind speed sensor measurement.

`CommsExWdir` - Reserved for wind direction sensor measurement.

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If a sensor is not present, or the sensor measurement returns an error, the corresponding communications array fields are loaded with "NAN" which means Not A Number. The program in each datalogger interprets that NAN as a sensor error and responds accordingly.

For the primary and secondary external air temperature and relative humidity measurements, the datalogger program reads the measurement values from the communications array, checks for obvious errors, averages the values if the values from two sensors are available, then uses the resultant external temperature and relative humidity values for HVAC control purposes as well as logging those values.

Remote Station Communication Configuration Options

Each station must be allocated its own static IP address and its own PakBus address, both of which must be unique on the network. These addresses are used to communicate with the station over the network and are set using the Device Configuration Utility in the LoggerNet software.

The datalogger program for each station must also be configured with the IP address and PakBus address of each remote station it is to communicate with, and the communications to each designated address must be enabled. These settings are made in the [STATION_CONSTANTS](#) file.

The examples below assume a private IP network (192.168.x.x) with the subnet 192.168.1.x). These IP address numbers may be different depending upon your specific network. Please consult your network administrator for IP address allocation information. The PakBus addresses are specific to the dataloggers on the network and will have been defined during datalogger installation.

A page is provided at the back of this manual that can be used to record the station names, IP addresses and PakBus addresses during installation for future reference.

Primary Remote Station

This is the remote station from which the local station will normally retrieve the desired values.

The station constants settings are:

`EXT_TRH1_ENABLE = True`

`EXT_TRH1_PK = 82`

`EXT_TRH1_IP = 192.168.1.82`

To disable the primary remote station, set:

`EXT_TRH1_ENABLE = False`

Secondary Remote Station

This is the remote station from which the local station will attempt to retrieve the desired values if the communications to the primary remote station fails or is disabled.

The station constants settings are:

`EXT_TRH2_ENABLE = True`

`EXT_TRH2_PK = 92`

`EXT_TRH2_IP = 192.168.1.92`

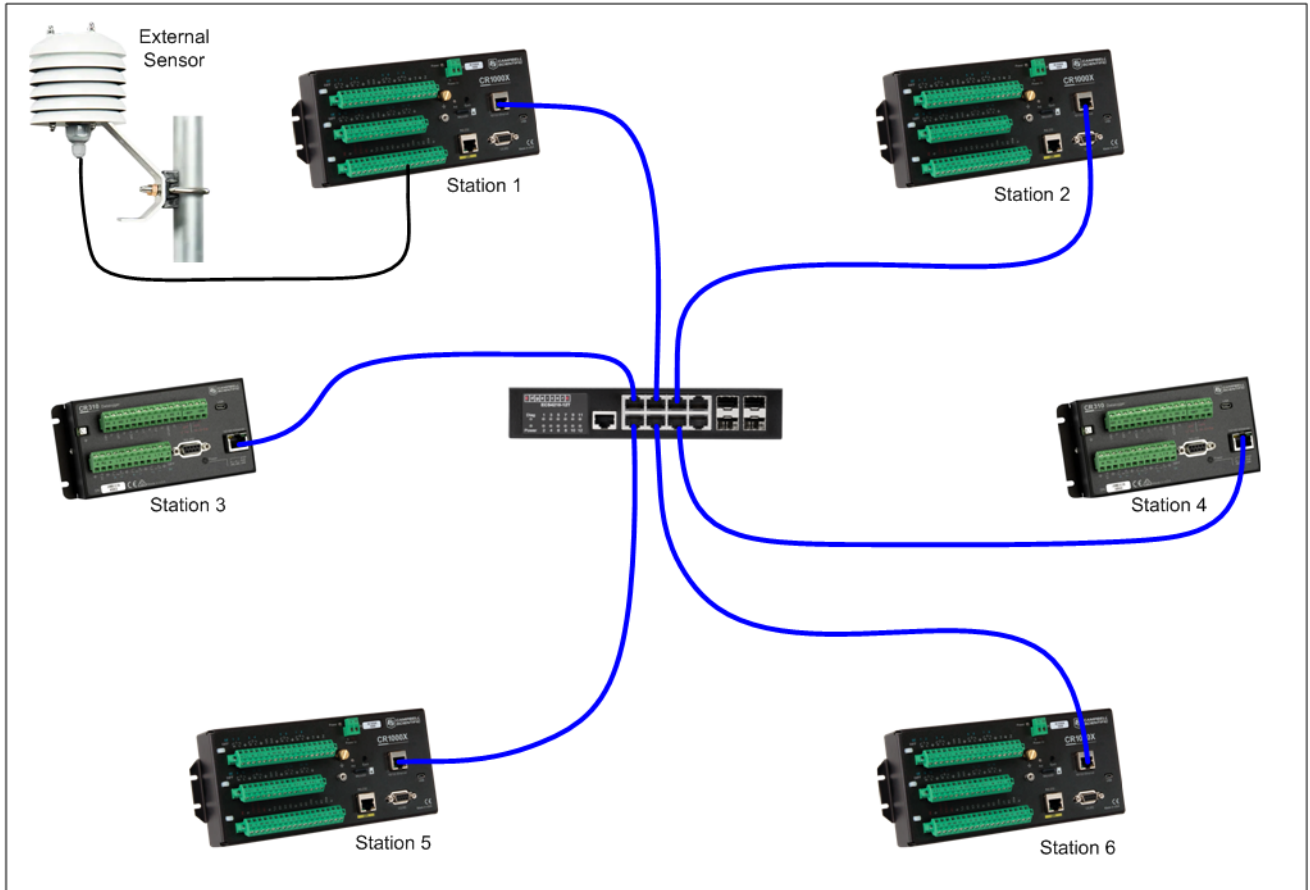
To disable the secondary remote station, set:

`EXT_TRH2_ENABLE = False`

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Small Network Example

The diagram below is an example of a small network. Station 1 has the primary external sensor and there is no secondary external sensor. All other stations retrieve the primary external sensor measurement values from Station 1. This solution doesn't offer failsafe redundancy for the external sensor but is perfectly adequate for a small network.



In this example, assuming the PakBus address and the IP address for each station is the station number in the diagram above, the configuration settings would be:

Station 1

EXT_TRH_LOCAL = True
EXT_TRH_PRIMARY = True
EXT_TRH1_ENABLE = False
EXT_TRH1_PK = 1 (ignored)
EXT_TRH1_IP = 192.168.1.1 (ignored)
EXT_TRH2_ENABLE = False
EXT_TRH2_PK = 2 (ignored)
EXT_TRH2_IP = 192.168.1.2 (ignored)

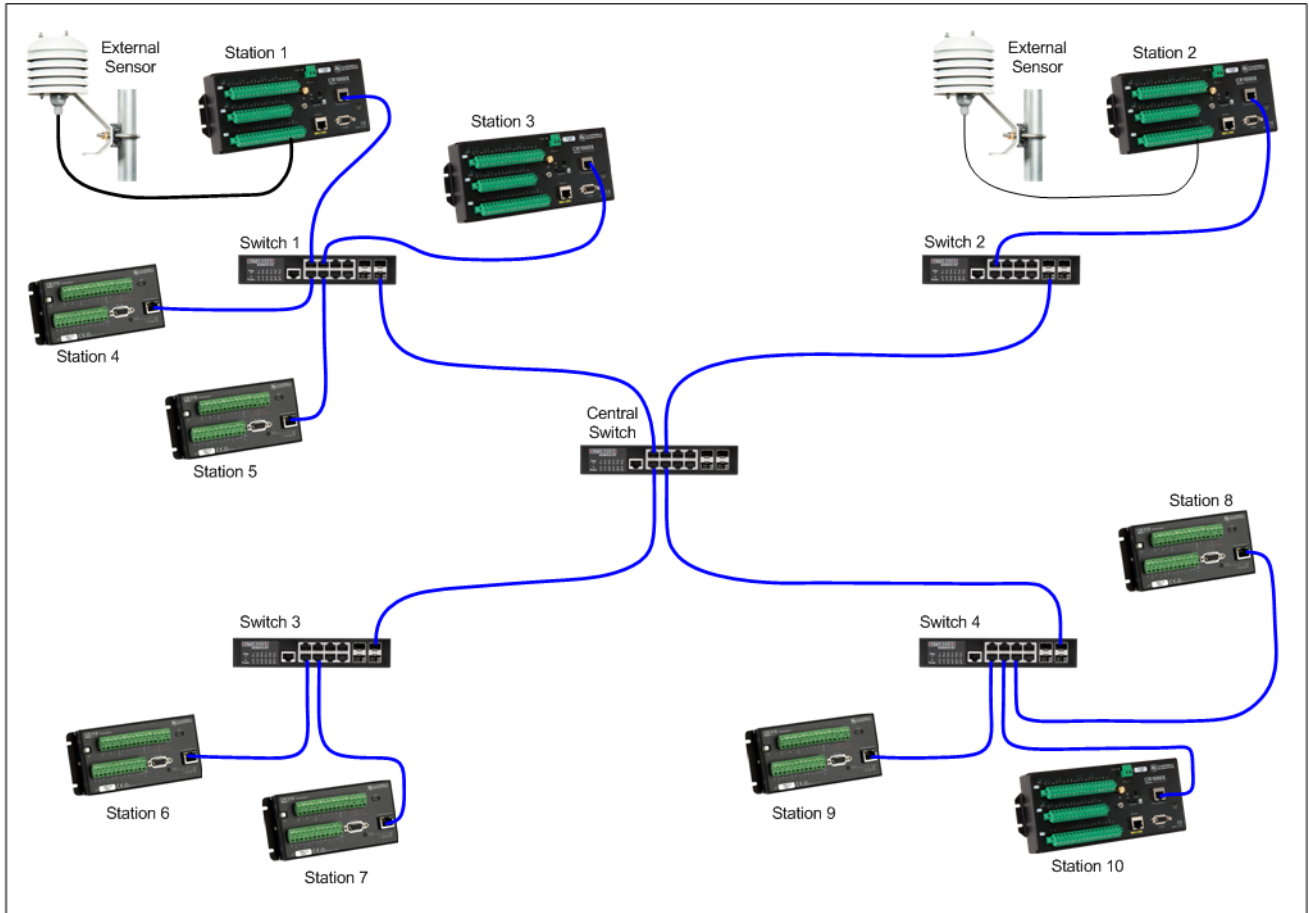
All Other Stations

EXT_TRH_LOCAL = False
EXT_TRH_PRIMARY = False
EXT_TRH1_ENABLE = True
EXT_TRH1_PK = 1
EXT_TRH1_IP = 192.168.1.1
EXT_TRH2_ENABLE = False
EXT_TRH2_PK = 2 (ignored)
EXT_TRH2_IP = 192.168.1.2 (ignored)

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Large Network Example

The diagram below is an example of a large network that includes failsafe redundancy for the external sensors. In this example, the stations are also configured so the communications that retrieves the external sensor measurement values is distributed across the network to improve network traffic management.



A good design technique is to keep communications between stations localised, as much as possible, to the network switches they are directly connected to.

Station 1 has the primary external sensor and retrieves the secondary external sensor measurement values from Station 2, while Station 2 has the secondary external sensor and retrieves the primary external sensor measurement values from Station 1. These two stations traverse the Central Switch to exchange the two values.

The other stations on Switch 1 all retrieve both external sensor measurement values from Station 1. Stations 6 and 8 traverse the central switch to retrieve both external sensor measurement values from Station 2. All other stations on Switch 2 (in this case none) would retrieve both external sensor measurement values from Station 2. All other stations on Switch 3 (in this case just Station 7) would retrieve both external sensor measurement values from Station 6. All other stations on Switch 4 (in this case Stations 9 and 10) would retrieve both external sensor measurement values from Station 8. This distributes the network traffic to avoid potential bottlenecks.

If a communications failure to the designated primary remote occurs for any station, except Stations 1 and 2 with local sensors installed, the station is able to retrieve the array of external sensor measurement values from a secondary remote station. All stations normally have the measurement values from both external sensors in its communications array so if the communications fails to a station with an external sensor installed on it, all stations can continue to operate using just the values from the remaining good external sensor station. This provides a high level of reliability of the shared external sensor values.

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In this example, assuming the PakBus address and the IP address for each station is the station number in the diagram above, the configuration settings would be:

Station 1

EXT_TRH_LOCAL = True
EXT_TRH_PRIMARY = True
EXT_TRH1_ENABLE = True
EXT_TRH1_PK = 2
EXT_TRH1_IP = 192.168.1.2
EXT_TRH2_ENABLE = False
EXT_TRH2_PK = 10 (ignored)
EXT_TRH2_IP = 192.168.1.10 (ignored)

Station 2

EXT_TRH_LOCAL = True
EXT_TRH_PRIMARY = False
EXT_TRH1_ENABLE = True
EXT_TRH1_PK = 1
EXT_TRH1_IP = 192.168.1.1
EXT_TRH2_ENABLE = False
EXT_TRH2_PK = 8 (ignored)
EXT_TRH2_IP = 192.168.1.8 (ignored)

Stations 3, 4 and 5

EXT_TRH_LOCAL = False
EXT_TRH_PRIMARY = False
EXT_TRH1_ENABLE = True
EXT_TRH1_PK = 1
EXT_TRH1_IP = 192.168.1.1
EXT_TRH2_ENABLE = True
EXT_TRH2_PK = 2
EXT_TRH2_IP = 192.168.1.2

Stations 6 and 8

EXT_TRH_LOCAL = False
EXT_TRH_PRIMARY = False
EXT_TRH1_ENABLE = True
EXT_TRH1_PK = 2
EXT_TRH1_IP = 192.168.1.2
EXT_TRH2_ENABLE = True
EXT_TRH2_PK = 1
EXT_TRH2_IP = 192.168.1.1

Station 7

EXT_TRH_LOCAL = False
EXT_TRH_PRIMARY = False
EXT_TRH1_ENABLE = True
EXT_TRH1_PK = 6
EXT_TRH1_IP = 192.168.1.6
EXT_TRH2_ENABLE = True
EXT_TRH2_PK = 2
EXT_TRH2_IP = 192.168.1.2

Stations 9 and 10

EXT_TRH_LOCAL = False
EXT_TRH_PRIMARY = False
EXT_TRH1_ENABLE = True
EXT_TRH1_PK = 8
EXT_TRH1_IP = 192.168.1.8
EXT_TRH2_ENABLE = True
EXT_TRH2_PK = 2
EXT_TRH2_IP = 192.168.1.2

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Communications States

The datalogger program displays the current communications state [CommsState](#) in the [Public](#) data table so users can easily check on the communications operation.

The possible communication states are:

[COMMS ATTEMPT X](#) - Attempting to contact a remote station.

This state is displayed while the local station is attempting to communicate with a remote station. The number "X" is the attempt number which increments for each successive attempt if communications is not established on the first attempt.

[COMMS OK](#) - Primary remote station contacted successfully.

This state is displayed after the local station has successfully completed communications with the primary remote station and collected the data in its communications array. This is the normal state.

[COMMS SEC OK](#) - Secondary remote station contacted successfully.

This state is displayed after the local station has successfully completed communications with the secondary remote station and collected the data from its communications array. This is the normal state that is expected when the primary remote station is either disabled or communications to it fails.

[COMMS RETRY X](#) - Communications retry needed after initial attempt failed.

This state is displayed after the local station failed an attempt to communicate with a remote station. The number "X" is the number of the pending retry and increments for each successive retry until either the maximum number of retries is reached or the communications succeeds.

[COMMS FAIL](#) - Communications failure, remote stations cannot be contacted.

This state is displayed when communications has been been successful and the maximum number of retries has been reached. This state triggers a [Comms Failure](#) alarm and is written to the Event Log.

[DISABLED](#) - Communications to remote stations is switched off and isn't used.

This state is displayed when communications is set to disabled because there are no remote stations to communicate with, or there is an unresolved communications problem and it was desirable to prevent a recurring communications alarm until repair work can be carried out.

[INITIALISING](#) - Communications state is undetermined while control system program is starting up.

This state is displayed when the datalogger program is starting up and the communications system has not yet made an attempt to communicate with a remote station. It represents a temporary indeterminate state that will resolve itself to one of the above states.

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Functional States

The datalogger program uses state switches to keep track of all the operation of all functions. The current setting of each state switch is displayed in the [Public](#) data table fields so system users can see what state each program function is in. State switches are provided for each of the food storage rooms temperature, an external temperature and relative humidity sensor if one is installed, mains power, refrigeration circuit breakers, and alarms.

Each of the state switches is detailed below.

Freezer Temperature State

The freezer room temperature state is displayed in the [Public](#) data table field [FreezerTcState](#). The datalogger program compares the freezer temperature [FreezerTC](#) against its setpoints [SET_FREZ_HI](#) and [SET_FREZ_LO](#) to determine the current state. Additional states such as sensor failure are also displayed when appropriate.

The possible freezer states are:

[ALARM - HIGH TEMP](#) - The freezer temperature is too high. Alarm triggered.

[WARN - NEAR HIGH](#) - The freezer temperature is close to alarm setpoint [SET_FREZ_HI](#).

[OK](#) - The freezer temperature is within the normal operating range.

[WARN - NEAR LOW](#) - The freezer temperature is close to alarm setpoint [SET_FREZ_LO](#).

[ALARM - LOW TEMP](#) - The freezer temperature is too low. Alarm triggered.

[ERROR - SETPOINTS](#) - The freezer temperature setpoints are set to values that are too close together.

[ALARM - SENSOR FAIL](#) - The freezer temperature sensor has failed. Alarm triggered.

[INITIALISING](#) - The freezer temperature sensor is waiting to be measured after program startup.

Fridge Temperature State

The fridge room temperature state is displayed in the [Public](#) data table field [FridgeTcState](#). The datalogger program compares the fridge temperature [FridgeTC](#) against its setpoints [SET_FRIG_HI](#) and [SET_FRIG_LO](#) to determine the current state. Additional states such as sensor failure are also displayed when appropriate.

The possible fridge states are:

[ALARM - HIGH TEMP](#) - The fridge temperature is too high. Alarm triggered.

[WARN - NEAR HIGH](#) - The fridge temperature is close to alarm setpoint [SET_FRIG_HI](#).

[OK](#) - The fridge temperature is within the normal operating range.

[WARN - NEAR LOW](#) - The fridge temperature is close to alarm setpoint [SET_FRIG_LO](#).

[ALARM - LOW TEMP](#) - The fridge temperature is too low. Alarm triggered.

[ERROR - SETPOINTS](#) - The fridge temperature setpoints are set to values that are too close together.

[ALARM - SENSOR FAIL](#) - The fridge temperature sensor has failed. Alarm triggered.

[INITIALISING](#) - The fridge temperature sensor is waiting to be measured after program startup.

Pantry Temperature State

The pantry room temperature state is displayed in the [Public](#) data table field [PantryTcState](#). The datalogger program compares the pantry temperature [PantryTC](#) against its setpoints [SET_PNTY_HI](#) and [SET_PNTY_LO](#) to determine the current state. Additional states such as sensor failure are also displayed when appropriate.

The possible pantry states are:

[ALARM - HIGH TEMP](#) - The pantry temperature is too high. Alarm triggered.

[WARN - NEAR HIGH](#) - The pantry temperature is close to alarm setpoint [SET_PNTY_HI](#).

[OK](#) - The pantry temperature is within the normal operating range.

[WARN - NEAR LOW](#) - The pantry temperature is close to alarm setpoint [SET_PNTY_LO](#).

[ALARM - LOW TEMP](#) - The pantry temperature is too low. Alarm triggered.

[ERROR - SETPOINTS](#) - The pantry temperature setpoints are set to values that are too close together.

[ALARM - SENSOR FAIL](#) - The pantry temperature sensor has failed.

[INITIALISING](#) - The pantry temperature sensor is waiting to be measured after program startup.

Freezer Fault State

The freezer fault state is displayed in the [Public](#) data table field [FreezerFaultState](#). The freezer room depends on refrigeration plant to maintain the required temperature range. In the event of an electrical fault the refrigeration plant may trip a circuit breaker in the switchboard which shuts off the electricity to the freezer refrigeration plant to prevent possible further damage. An alarm is triggered when such a fault is detected.

The possible freezer fault states are:

[OK](#) - The freezer circuit breakers are set in their normal operating position.

[FAULT](#) - A freezer circuit breaker has tripped, the refrigeration plant is NOT operating. Alarm triggered.

Fridge Fault State

The fridge fault state is displayed in the [Public](#) data table field [FridgeFaultState](#). The fridge room depends on refrigeration plant to maintain the required temperature range. In the event of an electrical fault the refrigeration plant may trip a circuit breaker in the switchboard which shuts off the electricity to the fridge refrigeration plant to prevent possible further damage. An alarm is triggered when such a fault is detected.

The possible fridge fault states are:

[OK](#) - The fridge circuit breakers are set in their normal operating position.

[FAULT](#) - A fridge circuit breaker has tripped, the refrigeration plant is NOT operating. Alarm triggered.

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Door State

The door state is displayed in the [Public](#) data table field [DoorState](#). The door state monitors the food storage room doors to alert staff when a door is open for too long. The door monitor operates collectively across all the food storage rooms to avoid the complexity of a separate monitoring system for each room.

The door alert can be silenced by pressing and releasing the panic button while the door is open. If the panic button function remains operational in all food storage rooms while the door alert is silenced so the emergency alarm will be triggered as normal.

The possible door states are:

[DOORS CLOSED](#) - All doors are closed.

[X DOOR\(S\) OPEN](#) - One or more doors are open, 'X' is the number of open doors, no alert is sounding.

[DOOR OPEN ALERT](#) - One or more doors have been open longer than normal, the alert is chirping.

[DOOR OPEN SILENT](#) - One or more doors have been open longer than normal, the alert has been silenced.

[ALARM - DOOR OPEN](#) - One or more doors have been open too long. Alarm triggered.

Emergency State

The emergency state is displayed in the [Public](#) data table field [EmergencyState](#). An emergency state is triggered when the panic button inside one of the food storage rooms is pressed. This is intended to summon immediate assistance if a person becomes trapped by a jammed door or such like.

The possible emergency states are:

[OK](#) - Normal operation, no panic buttons activated.

[ALARM - EMERGENCY](#) - A panic button is activated, immediate assistance required. Alarm triggered.

External Sensor State (Optional)

The external sensor state is displayed in the [Public](#) data table field [ExtSensState](#) when an external air temperature and relative humidity sensor is installed onto the datalogger. An external sensor can be installed to measure the external air temperature and relative humidity and make these measurements available to the datalogger network. A sensor failure alarm is triggered if the sensor state indicates that the temperature sensor, the relative humidity sensor, or both have failed.

The possible external sensor states are:

[TC OK, RH OK](#) - External sensor is installed, Temperature sensor is OK, RH sensor is OK.

[TC FAIL, RH OK](#) - External sensor is installed, Temperature sensor has failed, RH sensor is OK.

[TC OK, RH FAIL](#) - External sensor is installed, Temperature sensor is OK, RH sensor has failed.

[TC FAIL, RH FAIL](#) - External sensor is installed, Temperature sensor has failed, RH sensor has failed.

Power State

The mains power state is displayed in the [Public](#) data table field [PowerState](#). A prolonged power outage may result in the enclosure temperature reaching unacceptably high or low levels so any power outage triggers an alarm to alert staff. The datalogger is battery backed and is able to send alarm email messages while the UPS systems on the LAN are operating (typically 5-10 minutes after a power outage).

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The possible power states are:

OK - Mains power is available, either from the electricity supply company or an on site generator set.

POWER FAIL - The mains power supply has failed, no mains power is available. Alarm triggered.

Alarm State

The alarm state is displayed in the **Public** data table field **AlarmState**. The alarm system is designed record all alarm events into an Event Log data table so users can check on the recent system events, including any alarms. In addition to recording alarms in the Event Log, the alarms state is used to trigger the sending of alarms email messages via the email messaging system.

The possible alarms states are:

DISABLED - The alarm system has been disabled, no alarms will be detected.

INITIALISING - The alarm system is starting up and determining if any alarms are active.

NO ALARMS - All alarms are cleared.

>> ALARMS << - One or more alarms have been triggered.

NOTE: The alarms state displays **>> ALARMS <<** with the chevrons when alarms are active to make this item more conspicuous in the displayed list of **Public** data table fields. The alarms state is not intended to provide details on the various alarms, this information is available via the other state switch indications, the Event Log, and the email messages.

Barometric Pressure Sensor State

The barometric pressure sensor state is displayed in the **Public** data table field **BaroSensState**. This state switch is only displayed if the optional barometric pressure sensor is installed, either on the local station or a remote station, and the station constant **BARO_ENAB** is set to True. A barometric pressure sensor failure alarm is triggered if the sensor state indicates that the sensor has failed.

The current QM (Quality Metric) value is reported in the **BaroSensState** variable to provide a visible indication of the current calibration accuracy of the barometric pressure sensor card. A QM value of 6 or higher indicates a freshly calibrated sensor, 5 or higher indicates the calibration is OK, 4 to 4.99 indicates that recalibration is needed most likely in the next two to three months, and less than 4 indicates the sensor needs recalibration.

If the sensor state indicates FAIL with a QM value of 4 or higher, the fault may be in the instrument electronics or elsewhere, not necessarily in the sensor card.

The possible barometric pressure sensor states are:

OK (QM n.nn) - The barometric pressure sensor is working normally.

RECALIBRATE SOON - The sensor will need recalibrating in two to three months.

FAIL (QM n.nn) - The barometric pressure sensor needs recalibrating or has failed.

Other State Switches

For information on the communications state **CommsState** and the email message send state **EmailState** please see the "Communications to Remote Stations" and "Email Messaging System" sections respectively.

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Event Log

TOA5_OKH_AN1_DL01_CR300_15614_CR310.Std.10.07_CPU-OKH_AN1_DL01_R01_TEST2.CR300_19908_E00_EVENT_LOG		
TIMESTAMP	RECORD	EventDetected
TS	RN	
		Smp
2023-09-22 17:38:46.818	141	Datalogger Program Started
2023-09-22 17:39:10	142	Freezer Temp Too High
2023-09-22 17:39:10	143	Fridge Temp Too High
2023-09-22 17:39:10.166	144	Email Alarms
2023-09-22 17:39:10.278	145	EMAIL SENT OK
2023-09-22 17:40:46	146	Door Open Alert
2023-09-22 17:41:48	147	Door Alert Silenced
2023-09-22 17:42:10	148	Door Closed After 3.4 Minutes

The [EVENT_LOG](#) data table contains a descriptive indication of each event that occurs. This data table holds the most recent 1000 events, normally sufficient for several weeks of routine events, before its ring memory overwrites the oldest records with the newest records. The event log records all alarms and various other system events.

NOTE: Many of the event messages are also used to build the content of alarm email messages or appear in the various state fields displayed in the datalogger [Public](#) data table. Logging these events in the [EVENT_LOG](#) data table provides significant insights into the system operation and assists with problem resolution.

Viewing The Event Log

The Event log can be viewed two ways:

1. By collecting the data from the datalogger using LoggerNet, then opening the [EVENT_LOG](#) file with the View Pro utility which is part of LoggerNet. The data table is displayed in an easily readable format.
2. By viewing the data table in the dataloggers built-in web site.

Please see the Using The Web Interface chapter in this document for details on using the dataloggers built-in web site or the LoggerNet Product Manual, which can be downloaded from the Campbell Scientific web site, for details on using the various LoggerNet tools.

Event Messages

This section lists all the events that may be logged in the [EVENT_LOG](#) data table, for the ZooRef program, and provides an explanation of their meaning.

Freezer Room

[Alarm Freezer Temp Too High](#) - The freezer high temperature alarm was triggered.

[Freezer Temp Too High Cleared](#) - The freezer high temperature alarm was cleared.

These events occur when the temperature in the freezer room reaches or exceeds the [SET_FREZ_HI](#) setpoint and when the freezer temperature subsequently returns to a temperature that's at least 1 degree (set by the [TC_HYST](#) station constant) below the [SET_FREZ_HI](#) setpoint. Freezer room high temperature alarms typically result from the freezer door being left open or a refrigeration plant failure.

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Alarm Freezer Temp Too Low - The freezer low temperature alarm was triggered.

Freezer Temp Too Low Cleared - The freezer low temperature alarm was cleared.

These events occur when the temperature in the freezer room reaches or exceeds the **SET_FREZ_LO** setpoint and when the freezer temperature subsequently returns to a temperature that's at least 1 degree (set by the **TC_HYST** station constant above the **SET_FREZ_LO** setpoint). Freezer room low temperature alarms typically result from a refrigeration plant failure.

Alarm Freezer Sensor Failure - The freezer sensor failure alarm was triggered.

Freezer Sensor Failure Cleared - The freezer sensor failure alarm was cleared.

These events occur when the temperature sensor in freezer room fails and when the sensor is subsequently restored to normal operation. Sensor failures will most likely require replacement of the sensor but do not affect the operation of the refrigeration plant.

Alarm Freezer Electrical Fault - The freezer electrical fault alarm was triggered.

Freezer Electrical Fault Cleared - The freezer electrical fault alarm was cleared.

These events occur when an electrical circuit breaker, in the switchboard, that supplies the freezer refrigeration plant has tripped and is subsequently reset. The freezer refrigeration plant is inoperative so the freezer will gradually increase in temperature, resulting in a **Freezer Temp Too High** alarm. Try resetting the circuit breaker, if it trips again the refrigeration plant has a fault.

Fridge Room

Alarm Fridge Temp Too High - The fridge high temperature alarm was triggered.

Fridge Temp Too High Cleared - The fridge high temperature alarm was cleared.

These events occur when the temperature in the fridge room reaches or exceeds the **SET_FRIG_HI** setpoint and when the fridge temperature subsequently returns to a temperature that is at least 1 degree (set by the **TC_HYST** station constant) below the **SET_FRIG_HI** setpoint. Fridge room high temperature alarms typically result from the fridge door being left open or a refrigeration plant failure.

Alarm Fridge Temp Too Low - The fridge low temperature alarm was triggered.

Fridge Temp Too Low Cleared - The fridge low temperature alarm was cleared.

These events occur when the temperature in the fridge room reaches or exceeds the **SET_FRIG_LO** setpoint and when the fridge temperature subsequently returns to a temperature that is at least 1 degree (set by the **TC_HYST** station constant) above the **SET_FRIG_LO** setpoint. Fridge room low temperature alarms typically result from a refrigeration plant failure.

Alarm Fridge Sensor Failure - The fridge sensor failure alarm was triggered.

Fridge Sensor Failure Cleared - The fridge sensor failure alarm was cleared.

These events occur when the temperature sensor in fridge room fails and when the sensor is subsequently restored to normal operation. Sensor failures will most likely require replacement of the sensor but do not affect the operation of the refrigeration plant.

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Alarm Fridge Electrical Fault - The fridge electrical fault alarm was triggered.

Fridge Electrical Fault Cleared - The fridge electrical fault alarm was cleared.

These events occur when an electrical circuit breaker, in the switchboard, that supplies the fridge refrigeration plant has tripped and is subsequently reset. The fridge refrigeration plant is inoperative so the fridge will gradually increase in temperature, resulting in a **Fridge Temp Too High** alarm. Try resetting the circuit breaker, if it trips again the refrigeration plant has a fault.

Pantry Room

Alarm Pantry Temp Too High - The pantry high temperature alarm was triggered.

Pantry Temp Too High Cleared - The pantry high temperature alarm was cleared.

These events occur when the temperature in the pantry room reaches or exceeds the **SET_PNTY_HI** setpoint and when the pantry temperature subsequently returns to a temperature that is at least 1 degree (set by the **TC_HYST** station constant) below the **SET_PNTY_HI** setpoint. Pantry room high temperature alarms typically result from a very hot ambient temperature in the the building.

Alarm Pantry Temp Too Low - The pantry low temperature alarm was triggered.

Pantry Temp Too Low Cleared - The pantry low temperature alarm was cleared.

These events occur when the temperature in the pantry room reaches or exceeds the **SET_PNTY_LO** setpoint and when the pantry temperature subsequently returns to a temperature that is at least 1 degree (set by the **TC_HYST** station constant) above the **SET_PNTY_LO** setpoint. Pantry room low temperature alarms typically result from a very cold ambient temperature in the the building.

Alarm Pantry Sensor Failure - The pantry sensor failure alarm was triggered.

Pantry Sensor Failure Cleared - The pantry sensor failure alarm was cleared.

These events occur when the temperature sensor in pantry room fails and when the sensor is subsequently restored to normal operation. Sensor failures will most likely require replacement of the sensor.

Emergency Alarm

Alarm EMERGENCY Panic Alarm - The emergency alarm in one of the food storage rooms was activated.

EMERGENCY Panic Alarm Cleared - The emergency panic alarm buttons are all reset.

These events occur when an emergency panic button is pressed while the food storage room doors are closed and when the emergency panic buttons are subsequently reset. The piezo alert buzzer in the kitchen area will sound continuously while this alarm is active. This alarm is intended to provide a means by which a person who becomes trapped in a refrigerated space can summon help. This alarm is also applied to unrefrigerated pantry as there is no means of egress other than the door.

Food Storage Rooms Door Alarms

Door Open Alert - One or more doors has been open longer than normal.

This event is logged to provide an insight into how frequently food storage room doors are kept open for long enough to start the piezo buzzer chirping to alert staff to the open door(s). Having doors open for unnecessarily long periods of time results in the refrigeration plant having to run longer to maintain the correct temperatures in refrigerated rooms.

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Door Alert Silenced - The door alert piezo buzzer was set to silent.

This event occurs when a door to a food storage room needs to be kept open for an extended period of time, such as for maintenance work to be carried out, so the staff select the piezo alert to silent.

While the door alert is silenced, the timer for the door alert system is kept reset at zero to prevent the door alarm being triggered and the **Public** data table field **DoorState** displays **DOOR OPEN SILENT**. This is automatically returned to normal as soon as all the food storage room doors are closed.

Door Closed After xx Minutes - The duration in minutes 'xx' that one or more doors was open.

This event occurs as soon as all doors are closed after one or more of the food storage room doors has been open for long enough to start the piezo buzzer chirping. It provides an insight into how long doors need to be kept open while staff complete maintenance tasks that require doors to be kept open.

Alarm Refrigeration Door Open - The door open alarm was triggered.

Refrigeration Door Open Cleared - The door open alarm was cleared.

These events occur when one or more food storage room doors has been left open and when all the doors are subsequently closed. The piezo alert buzzer in the kitchen area will chirp for three minutes before the door alarm is triggered allowing staff ample time to either close the door or set it to silent, either of which will prevent the door alarm being tripped or reset an already tripped door alarm.

External Sensor (Optional)

Alarm EXT: Sensor Failure - The external temperature and RH sensor failure alarm was triggered.

EXT: Sensor Failure Cleared - The external temperature and RH sensor failure alarm was cleared.

These events occur when an optional external temperature and RH sensor connected to the local station fails and when it is subsequently restored to normal operation. Sensor failures will most likely require repair or replacement of the sensor by a service technician.

Barometric Pressure Sensor

Barometric Sensor OK (QM n.nn) - The barometric pressure sensor is working normally.

Barometric Sensor RECALIBRATE SOON - The sensor will require recalibration in two to three months.

Barometric Sensor FAIL (QM n.nn) - The barometric pressure sensor needs recalibrating or has failed.

These events indicate a change of the barometric pressure sensor's state switch **BaroSensState** and are based on the sensor's QM (Quality Metric) output. A QM of 5 or higher indicates the OK state, 4 to 4.99 indicates recalibration is needed soon, less than 4 indicates the sensor needs recalibration or has failed.

Alarm Barometric Sensor Failure - The barometric pressure sensor failure alarm was triggered.

Barometric Sensor Failure Cleared - The barometric pressure sensor failure alarm was cleared.

These events occur when the barometric pressure sensor fails and when it is subsequently restored to normal operation. Sensor failures usually require replacement of the sensor card to clear the alarm.

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Datalogger Program Restarts

Datalogger Program Started - Logged each time the datalogger program is started.

This event is logged to provide an indication of when the datalogger program was restarted. Restarts usually occur when a program update is loaded or the **Setpoints** table is edited but it can also happen if the datalogger detects an internal error (watchdog error) and automatically restarts itself. An occasional watchdog error is acceptable but frequent watchdog errors should be investigated.

Power Failure

Alarm Power Failure - The mains power failure alarm was triggered.

Power Failure Cleared - The mains power failure alarm was cleared.

These events occur when mains power fails and when the power is subsequently restored. Staff may need to respond to power outages of extended duration to prevent spoilage of refrigerated food, such as by installing a temporary generator to supply the building.

Remote Station Communications

COMMS FAIL - The communications to the remote stations has failed.

This event occurs when the local station cannot communicate with the remote station(s) to retrieve the external sensor data. It may correct itself before becoming an alarm event. Successful communications attempts are not logged. Excessive or continuous communications failures are usually the result of network problems, datalogger configuration errors, or hardware failures.

Alarm Comms Failure - The data network communications failure alarm was triggered.

Comms Failure Cleared - The data network communications alarm has been cleared.

These events occur when a network failure occurs and when the network is subsequently restored to normal operation. Communications failures generally point to network problems, a configuration or hardware problem with a remote station, or a configuration or hardware problem with the local station. On sites where radio communications form part of the network the radio links may cause random intermittent communications failures that come right on their own.

Email System

Email Alarms - An email message advising of the alarms for this station has been sent.

This event occurs when the datalogger sends an email message advising staff of the station's alarms and is a normal function of the system. The event is generated every time the alarms system for the station changes state (either a new alarm occurs or an existing alarm is cleared).

Email Alarms Re-Send - The daily outstanding alarms email message for this station has been sent.

This event occurs when the datalogger sends the outstanding alarms reminder email message. This is a normal function of the system that is intended to remind staff each day of all outstanding alarms that have not yet been resolved. This message is not sent unless it is enabled in the system settings and unresolved alarms are present.

Email Alarms Cleared - An email message advising all the alarms for this station have been cleared.

This event occurs when the datalogger sends an email message advising staff that all the station's alarms have been cleared. It is a normal function of the system.

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EMAIL SENT OK - The Email Relay server has received the message and relayed it to the recipients.

This event occurs when the datalogger successfully sends an email message. It is a normal function and the event is logged simply to enable confirmation that the email system is working.

EMAIL COMMS FAIL - The connection to the Email Relay server failed.

This event occurs when an email message cannot be sent because the datalogger is unable to connect to the Email Relay server. The error could be due to the Email Relay server being down in which case the system will return to normal operation when the Email Relay server administrator restores their server to operation. Other causes could be a network communications problem, a hardware fault, or a datalogger configuration error.

EMAIL DATA ERROR - The EmailRelay() function was called but not executed, the message was not sent.

This event occurs when an email message cannot be sent because execution of the EmailRelay() function did not occur due to lack of data records or not enough time. Possible causes include a network problem, a hardware fault, or a datalogger program error.

EMAIL COMMS ERROR - Error in communication to the Email Relay server, the message was not sent.

This event occurs when a connection to the Email Relay server was made but there was an error in communication, or the Email Relay server dropped the connection. Possible causes include a network problem, a datalogger program error, or a hardware fault.

This error also occurs if the datalogger has exceeded the maximum of 100 email messages sent via the Campbell Scientific Email Relay server in one day. If this limit is reached the Email Relay server terminates all further email send attempts by that datalogger until the next day (USA Time). A potential cause is an intermittent sensor fault that causes its measurement value to flip-flop between normal and an alarm state hundreds of times a day. This error will be obvious to staff as their email inbox will have been flooded with alarm email messages from the affected station.

EMAIL DISABLED - The email messaging system is set to disabled, email messages will not be sent.

This event occurs when an email message would have been sent but the email system was set to disabled as it is not required. This is an informative diagnostic message, not a fault in the system.

EMAIL TEST MODE - The email messages are diverted to a file for test purposes.

This event occurs when an email message would have been sent but the email system was set to Test Mode which diverts the messages to a file for test purposes. This is an informative diagnostic message, not a fault in the system.

Alarms Module

The datalogger program monitors the temperatures of the food storage rooms, the functioning of the temperature sensors, and various other parameters to determine the alarms. An alarm is triggered whenever an abnormal event is detected. An alarm reset occurs when the trigger event has returned to normal. No user intervention is required to reset the alarms, this process is fully automated, although staff may well need to take action to either remedy the cause of the alarm, or arrange for a service technician to repair the fault that caused the alarm.

The alarms control module must be enabled in the station constants setting for the alarms detection to operate.

Enabling The Alarms

The alarms module is enabled, or disabled, by setting the `ALARM_ENABLE` station constant as follows:

`ALARM_ENABLE = True` (The alarms are enabled), or

`ALARM_ENABLE = False` (The alarms are disabled).

NOTE: Enabling the alarms module enables alarms and alarm resets to be detected and then recorded in the `EVENT_LOG` data table. The email module must also be enabled in order for the datalogger program to send alarms email messages to staff. Please see the Email Messaging System chapter for further information.

Alarms Delay

The alarm delay time `AL_DELAY` (typically 10 seconds) is set in the program constants and is applied to all alarms to prevent nuisance alarms that would otherwise occur if an alarm condition is triggered and then immediately returns to normal. This delay time can be changed if necessary but is not intended to be user adjustable.

Alarms Event Logging

When the alarms module is enabled, each change of state of the alarms (alarms triggered and/or reset) will result in the alarm event being written to the event log. Please refer to the event log chapter for detailed information on all event messages and their meaning. Once an alarm is reset it is logged as being cleared as it no longer appears in the list of active alarms.

Alarms Module States

The datalogger program displays the current alarms state `AlarmState` in the `Public` data table so users can easily check on the overall state of the alarm system.

The possible alarm states displayed in the `Public` data table fields are:

`DISABLED` - The alarm system is not in use and has been disabled.

`INITIALISING` - The alarm system is starting up and determining if any alarms are active.

`NO ALARMS` - All alarms are cleared.

`>> ALARMS <<` - One or more alarms have been triggered.

The alarm state only indicates the state of the alarm system, not the state of each individual alarm. The state of the individual alarms is indicated via the state variables displayed in the `Public` data table, the event log, and the alarm email messages.

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EMERGENCY Alarms Operation

Each food storage room is equipped with a large red emergency panic button. This is a safety system that is intended to be used in the event of a person becoming trapped in a refrigerated room, if say the door became jammed. This alarm is also applied to unrefrigerated pantry as, like the refrigerated rooms, there is no there is no alternative escape route possible due to the nature of these rooms.

If a person is trapped in a refrigerated space for too long, hypothermia and death may result.

To activate the emergency panic alarm the trapped person only needs to push the button. The button latches in the pressed position and remains latched until it is released. The emergency panic alarm remains active while the button is latched.

The state of the emergency panic alarm is displayed in the [Public](#) data table field [EmergencyState](#) which has two possible states as follows:

OK - The panic buttons are all in the normal position.

ALARM - EMERGENCY - The emergency panic button in one of the food storage rooms is pressed.

To reset the emergency panic alarm, the button must be rotated approximately ¼ turn and released.

If the emergency panic button is accidentally pressed, it should immediately be released and if it is released within the [EM_DELAY](#) time (normally set to 10 seconds) the event is not logged and the alarm is not triggered.

When the emergency panic button is pressed the following sequence occurs:

1. The datalogger responds in two seconds, switching on the piezo alert so it sounds continuously. This alerts any staff working in the area adjacent to the food storage rooms so they can respond to the emergency.
2. The program waits for the [EM_DELAY](#) (typically 10 seconds) to time out.
3. The emergency event is logged to the [EVENT_LOG](#) data table and the alarm is triggered.
4. The program waits for the [AL_DELAY](#) (typically 10 seconds) to time out
5. The alarm is activated and the email alarm message is sent to designated staff to advise of the emergency. This ensures that a response is possible even if there are no other staff currently working in the area where the piezo alert can be heard.

When the trapped person has been rescued and the emergency panic button has been reset, the alarm system will send an email to designated staff which will show the emergency alarm is no longer active.

Door Alarms Operation

The door alarms system provides an initial interval where there is no alert sounding. This interval is long enough for most routine access to the food storage rooms. After the initial interval has elapsed, the piezo alert begins chirping much like many domestic fridges and freezers do. This can then proceed into a door alarm situation if it is not remedied by either closing the door again or by setting the door alert to silent.

As soon as the door to one of the food storage rooms is opened the following sequence occurs:

1. The program waits for the [DOOR_OPEN_ALERT](#) delay (typically 120 seconds) to time out.
2. The piezo alert begins chirping.
3. The program waits for the [DOOR_OPEN_ALARM](#) delay (typically 300 seconds) to time out.
4. The piezo alert begins sounding a continuous tone and the door open alarm is triggered.
5. The program waits for the [AL_DELAY](#) (typically 10 seconds) to time out

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- The alarm is activated and the email alarm message is sent to designated staff to advise of the alarm. The piezo continues sounding the continuous tone.

If the door to a food storage room is opened while another food storage room door is already open, the timer will reset and begin the above timed sequence again.

The state of the door alarm is displayed in the [Public](#) data table field [DoorState](#) which has five possible states as follows:

[DOORS CLOSED](#) - All the doors are closed.

[X DOOR\(S\) OPEN](#) - The number 'X' of food storage room doors currently open.

[DOOR OPEN ALERT](#) - One or more doors has been open longer than normal, the alert is sounding.

[DOOR OPEN SILENT](#) - One or more doors is open and the alert has been silenced.

[ALARM - DOOR OPEN](#) - One or more doors has been open too long, the alarm is activated.

The door alarm system is automatically reset when all the doors have been closed, at which time the alarm system will send an email to designated staff which will show the door alarm is no longer active.

Temporarily Silencing The Door Alarms

From time to time it is likely that one or more food storage room doors will need to be kept open while maintenance tasks are carried out. Having the piezo alert sounding and alarm emails being sent during such events is undesirable so the following procedure can be used to silence the piezo and prevent door alarms from being triggered.

After opening the door to a food storage room, press the emergency panic button, wait a few seconds for the piezo alert to begin sounding continuously, then immediately reset the emergency panic button.

When this is done the door state field [DoorState](#) will change from displaying [X DOOR\(S\) OPEN](#) to displaying [DOOR OPEN SILENT](#).

The door alert silencing procedure can be done any time after opening the door into a food storage room, including while the piezo alert is chirping, providing that it is done before the piezo alert begins sounding a continuous tone.

Once the piezo alert begins sounding a continuous tone, the alarm system has been triggered. Closing all the doors into the food storage rooms, or using the panic button press and reset procedure to silence the door alert, will reset the door alarm and silence the piezo alert.

The emergency panic alarm will continue to be operational even if one or more doors into the food storage rooms are open and the door alert/alarm has been set to silent. This ensures that even if one food storage room is open for maintenance a person becoming trapped in one of the other food storage rooms can still use the emergency panic alarm system to summon help.

Temperature Alarms Operation

The temperature alarms process is entirely automatic, once the cause of the temperature alarm has been remedied and the temperatures return to normal, the alarms will automatically reset.

The normal operating temperature range of the food storage rooms is bounded by high temperature and low temperature setpoints. Each food storage room has its own pair of setpoints. These setpoints are contained in the [Setpoints](#) data table in the datalogger and can be changed by users. The setpoints are normally chosen as being the upper and lower temperatures at which, if exceeded for an extended length of time, food spoilage would be likely to occur.

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The temperature sensors are measured once every minute and a temperature alarm is triggered if the measured temperature in a food storage room crosses that room's high or low setpoint.

Once an alarm has been triggered it remains in that state until that alarm's reset conditions are met. For temperature alarms, the reset condition is the temperature returning to within the normal range by at least the **ALARM_RESET** value which is typically set to 1 degree.

While the temperature is within the hysteresis range (The range between alarm trigger and alarm reset) the temperature state will display the respective warning message, either **WARN - NEAR HIGH** or **WARN - NEAR LOW**. The temperature alarm(s) automatically reset once the temperature state displays the **OK** message.

The following logic is applied to determine the state of the temperature alarm for each food storage room:

If Temperature is greater than or equal to $\text{SetpointHigh} + \text{ALARM_DEGREES}$ then

Set AlarmState to HighAlarm *(Trigger the high temperature alarm)*

Otherwise if Temperature is less than SetpointHigh and greater than $\text{SetpointHigh} - \text{ALARM_RESET}$ then

Set AlarmState to NearHighAlarm *(Within the hysteresis band so don't change alarm state yet)*

Otherwise if Temperature is less than $\text{SetpointHigh} - \text{ALARM_RESET}$ and greater than $\text{SetpointLow} + \text{ALARM_RESET}$ then

Set AlarmState to OK *(Reset the alarm as temperature is normal)*

Otherwise if Temperature is greater than SetpointLow and less than $\text{SetpointLow} + \text{ALARM_RESET}$ then

Set AlarmState to NearLowAlarm *(Within the hysteresis band so don't change alarm state yet)*

Otherwise if Temperature is less than or equal to $\text{SetpointLow} - \text{ALARM_DEGREES}$ then

Set AlarmState to LowAlarm *(Trigger the low temperature alarm)*

Each food storage room has its own state field displayed in the **Public** data table, these being **FreezerTcState**, **FridgeTcState**, and **PantryTcState** for the freezer, fridge and pantry rooms respectively, each of which has seven possible states as follows:

ALARM - HIGH TEMP - The pantry temperature is above the high temperature alarm setpoint.

WARN - NEAR HIGH - The pantry temperature is close to the high temperature alarm setpoint.

OK - The pantry temperature is within the setpoints (normal operation).

WARN - NEAR LOW - The pantry temperature is close to the low temperature alarm setpoint.

ALARM - LOW TEMP - The pantry temperature is below the low temperature alarm setpoint.

ERROR SETPOINTS - The pantry alarm setpoints are too close together.

ALARM - SENSOR FAIL - The pantry temperature sensor has failed, no measurement is possible.

The nature of the alarm is logged in the **EVENT_LOG** data table and sent to staff in the alarms email messages.

Sensor Failure Alarms Operation

Each of the food storage rooms has its own temperature sensor. These are normally extremely reliable and don't require any maintenance. In the event that a sensor does fail, it is likely to produce a value that is outside of its specified operating range, such as -9999, or perhaps NAN which means Not A Number.

When the datalogger program detects that a sensor is producing out of range measurement values it sets the applicable food storage room's state field, **FreezerTcState**, **FridgeTcState** or **PantryTcState** for the freezer, fridge and pantry rooms respectively, to **ALARM - SENSOR FAIL** which triggers the sensor failure alarm for the applicable food storage room.

The food storage room will remain in this state until the faulty sensor is repaired.

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NOTE: The food storage room temperature sensors used by the datalogger are independent of the refrigeration plant temperature controls, so even though the system is unable to monitor or log the temperature, or produce temperature alarms for a food storage room that has a faulty sensor, the refrigeration plant will continue to operate and maintain the room at its normal temperature setting.

The nature of the alarm is logged in the [EVENT_LOG](#) data table and sent to staff in the alarms email messages.

Refrigeration Electrical Fault Alarms Operation

The [FreezerFaultState](#) and [FridgeFaultState](#) fields in the [Public](#) data table indicate the state of the circuit breakers, in the electrical switchboard, that supply the refrigeration plant for the freezer room and the fridge room respectively.

Each of these fields has two possible states as follows:

OK - The circuit breakers are set in their normal operating position.

FAULT - A circuit breaker has tripped, the refrigeration plant is NOT operating. Alarm triggered.

NOTE: There are multiple circuit breakers for each refrigeration plant, typically one for the condenser and compressor unit outside the refrigerated room and one for the evaporator unit inside the refrigerated room. Any one of these circuit breakers being tripped will prevent the refrigeration plant from operating so there is only one electrical fault alarm for each refrigeration plant.

Before attempting to reset a tripped circuit breaker, first ascertain that nobody is carrying out maintenance on the refrigeration plant. If a circuit breaker continues to trip after being reset an electrical fault is the likely cause.

The refrigeration electrical failure alarm automatically resets when the circuit breakers have been reset.

The nature of the alarm is logged in the [EVENT_LOG](#) data table and sent to staff in the alarms email messages.

Barometric Pressure Sensor Failure Alarms Operation

The barometric pressure sensor failure alarms process is entirely automatic, once the faulty sensor has been repaired, the alarms will automatically reset. A sensor failure alarm can occur if the sensor card requires recalibration or if the sensor returns a pressure measurement value that is out of the manufacturers specified operating range. The sensor state is displayed in the [Public](#) table [BaroSensState](#) variable.

The possible states are:

OK (QM n.nn) - The barometric pressure sensor is working normally.

RECALIBRATE SOON - The sensor will need recalibrating in two to three months.

FAIL (QM n.nn) - The barometric pressure sensor needs recalibrating or has failed.

NOTE: The barometric pressure sensor card requires periodic recalibration, typically every one to two years.

The QM (Quality Metric) value is produced by the sensor each time it's measurement values are retrieved by the datalogger program. The QM value is displayed in the [Public](#) table [BaroSensState](#) variable. A newly calibrated sensor has a QM typically greater than 6 and its state is set to **OK**. As the sensor ages it's QM value diminishes. When the QM value drops below 4 the sensor needs recalibration and its state is set to **FAIL**. A warning that sensor recalibration will be needed in the next two to three months is produced while the QM value is in the range 4 to 4.99 during which time the state is set to **RECALIBRATE SOON**. If a sensor failure is displayed, check the QM value first. If the QM value is greater than 3.99 the failure may not be due to the sensor card, it could be a fault in the instrument electronics or elsewhere.

Please see the Campbell Scientific BaroVUE10 Product Manual for more information on recalibration procedures.

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Power Failure Alarm Operation

The [PowerState](#) field in the [Public](#) data table indicates the presence or absence of the mains electrical power supply to the building and has two possible states as follows:

[OK](#) - Mains power is available, either from the electricity supply company or an on site generator set.

[POWER FAIL](#) - The mains power supply has failed, no mains power is available. Alarm triggered.

Mains electric power failures are usually the result of a failure somewhere in the power distribution system off site, rather than a problem with the electrical system in the building that is monitored by the datalogger, and power will return as soon as the electricity supply company is able to remedy the fault. The alarm is provided so that staff are informed and have the opportunity to take action should it be required.

The power failure alarm automatically resets when the mains power is restored.

The nature of the alarm is logged in the [EVENT_LOG](#) data table and sent to staff in the alarms email messages.

Communications Failure Alarm Operation

Although the ZooRef system itself does not require external temperature and relative humidity measurement values, it can fully participate in the sharing of external sensor measurement data across the network. Any station can be installed and configured to provide external sensor measurements to the network. Typically there is one or two stations installed with external sensors on a site and all the stations then communicate with one another to share that, and other data.

Occasionally, particularly in wireless links, communications errors result in a loss of a communication link between stations. The datalogger handles communications failures with multiple retries and use of a secondary station if the communications to the primary station fails, so normally the required data values are retrieved. If communications cannot be achieved within the [MAX_COMMS_FAILS](#) station constant number of retries, a communications failure alarm is triggered. The alarm automatically resets when communications is restored.

If the cause of the failure is due to a fault in the local station or its network connection, emailed alarm messages cannot be sent, but all communications failure are logged in the [EVENT_LOG](#) and the current state of the communications is displayed in the [CommsState](#) field in the [Public](#) data table.

The possible communications states are:

[COMMS ATTEMPT X](#) - Attempting to contact a remote station.

[COMMS OK](#) - Primary remote station contacted successfully.

[COMMS SEC OK](#) - Secondary remote station contacted successfully.

[COMMS RETRY X](#) - Communications retry needed after initial attempt failed.

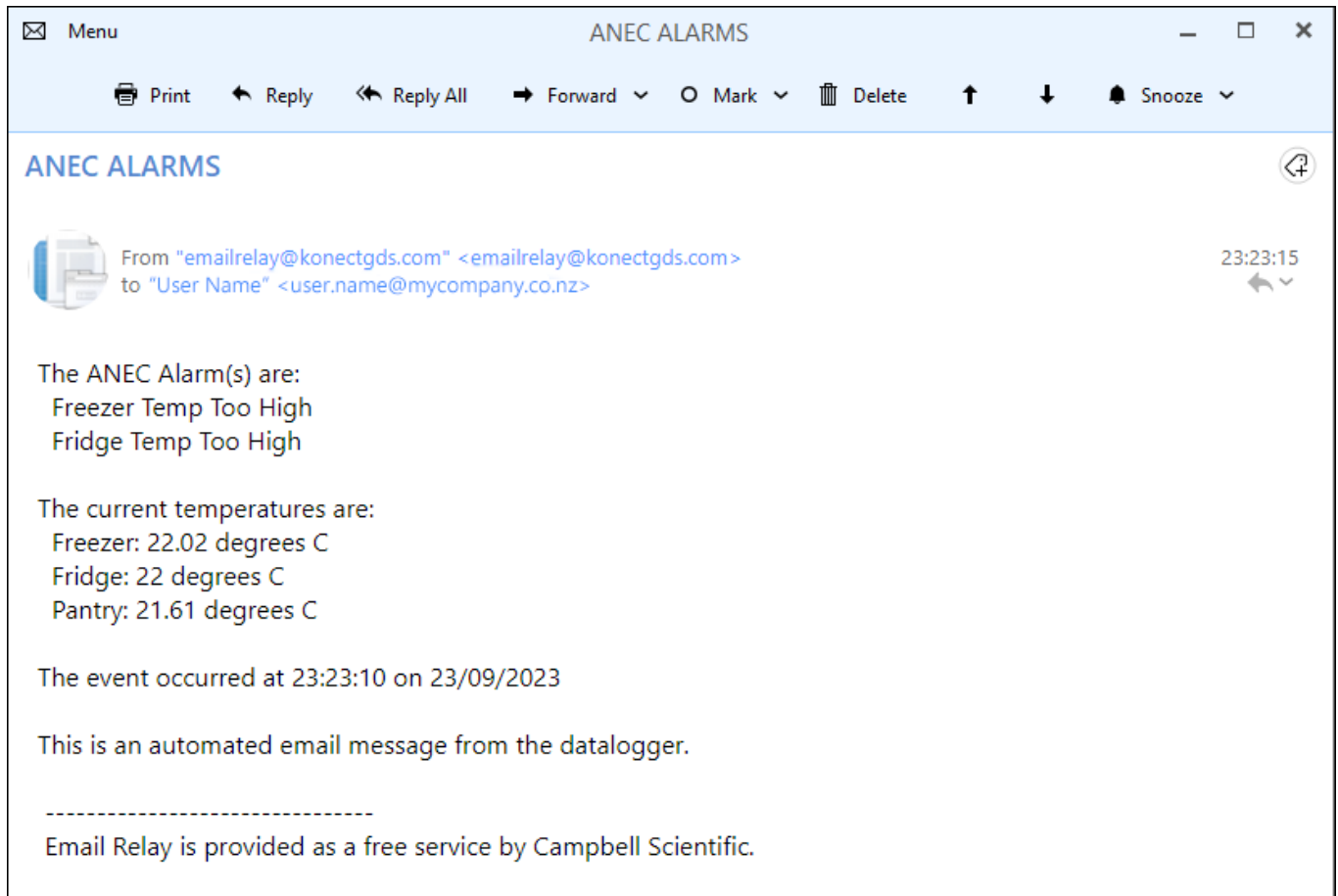
[COMMS FAIL](#) - Communications failure, remote stations cannot be contacted.

[DISABLED](#) - Communications to remote stations is switched off and isn't used.

[INITIALISING](#) - Communications state is undetermined while control system program is starting up.

The nature of the alarm is logged in the [EVENT_LOG](#) data table and sent to staff in the alarms email messages.

Email Messaging System



The datalogger can send alarm email messages advising users of events occurring at the station that need prompt attention. All messages are in the same format which is designed to alert users by the subject line alone, with more information contained in the message body. The format is designed to ensure messages are readily identified in a users email In-Box even on the smaller screens of mobile phones. A sample email message is shown above.

Alarms State Changed Email Messages

The operation of the email messaging system is completely automated.

The current state (active or inactive) of each alarm is stored in an array as a simple True or False, alarm active or alarm inactive respectively. Every two seconds the datalogger program checks the array to determine if the array contents have changed. If nothing has changed the alarms system does nothing further.

If the array contents have changed, the datalogger program creates a list of the alarms that are active and uses that list to build the body of a new email message. If no alarms are active (all previous alarms have been cleared) the list of alarms simply becomes a single "All Alarms Cleared" line instead of a list of current alarms. The current enclosure temperature measurements are added to the email message body along with the date and time the event occurred.

In this way, each alarm email message contains an up to date list of all the currently active alarms for the station. If there were two alarms listed on the previous email message and one of those has subsequently been cleared, the new email will simply list the remaining active alarm. This keeps the email message as concise as possible.

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The email message is then sent via Campbell Scientific's Email Relay server to all the email recipients in the recipients list which is stored in the `STATION_CONSTANTS` file.

If the email message is not successfully sent to the Email Relay server, the datalogger program will try to send it again. The number of tries and the time between each try is set in the `STATION_CONSTANTS` file, typically three tries five minutes apart. Usually email messages are sent successfully on the first try but this technique helps ensure email messages will be sent successfully if the first try fails.

Alarms Daily Reminder Email Messages

Once each day the datalogger program can check the alarms array to determine if there are any outstanding alarms for the station that might have been overlooked. If outstanding alarms are present, it can then send a reminder email message to advise staff of the current situation.

The daily reminder email message function is enabled by default. If necessary, it can be disabled by setting the station constant `ALARM_NAG = False` in the `STATION_CONSTANTS` file.

The reminder email message is normally sent at the beginning of the day so staff can schedule whatever remedial actions they consider appropriate into their day. The time at which the reminder email is sent is determined by the `EMAIL_NAG_HOUR` station constant. This setting, as with all ZooDAC system times, always operates in Standard Time. The default daily reminder email message send time setting is 8 for 08:00 hours.

If there are no outstanding alarms for the station, the reminder email message is not sent. This is to prevent cluttering up staff email inboxes with "All Alarms Cleared" messages on large sites with a number of stations.

Email Messaging System States

The datalogger program displays the current alarm email state `EmailState` in the `Public` data table so users can easily check on the messaging system operation.

The possible email message states are:

SENT OK - The Email Relay server has received the message and relayed it to the recipients.

This state is displayed after the local station successfully sends an email message. It indicates that the email message was sent normally.

COMMS FAIL - The connection to the Email Relay server failed.

This state is displayed when an email message cannot be sent because the local station is unable to connect to the Email Relay server. The error could be due to the Email Relay server being down in which case the system will return to normal operation when the Email Relay server comes back online. Other causes could be a network problem, a hardware fault, or a local station configuration error.

COMMS ERROR - Error in communication to the Email Relay server, the message was not sent.

This state is displayed when a connection to the Email Relay server was made but there was an error in communication, or the Email Relay server dropped the connection. Possible causes include a network problem, a program error, or a hardware fault.

This error also occurs if the local station has exceeded the maximum of 100 email messages sent via the Campbell Scientific Email Relay server in one day. If this limit is reached the Email Relay server terminates all further email send attempts by that datalogger until the next day (USA Time).

DISABLED - The email messaging system is set to disabled, email messages will not be sent.

This state is displayed when the email messaging system is set to disabled because it is not required. This is an informative indication, not a fault in the system.

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DATA ERROR - The `EmailRelay()` function was called but not executed, the message was not sent.

This state is displayed when an email message cannot be sent because execution of the `EmailRelay()` function did not occur due to lack of data records or not enough time. Possible causes include a network problem, a hardware fault, or a datalogger program error.

TEST MODE - The email messages are diverted to a file for test purposes.

This state is displayed when an email message would normally have been sent but the email system is set to Test Mode so the message was diverted to a file for test purposes. This is an informative diagnostic message, not a fault in the system.

Email Message Format

The email message subject is set as follows:

New Alarms - The **ENCLOSURE** plus the word "ALARMS".

Daily Re-sent Alarms - The **ENCLOSURE** plus the words "ALARMS (RE-SENT)".

Alarms Cleared - The **ENCLOSURE** plus the words "ALARMS CLEARED".

The first line in the message body "The **ENCLOSURE** Alarm(s) are:" identifies the station and provides a heading for the list of alarms.

Under the first line, the message body lists all of the current active alarms for the station. To avoid clutter any cleared alarms are not listed. If there were multiple alarms listed on the previous email and one of those alarms has subsequently been cleared, the newly cleared alarm is simply removed from the list.

When all alarms are cleared, an email message is sent stating "All Alarms Cleared" in place of the previous list of active alarms. This confirms to staff that there are no alarms outstanding.

A blank line follows the alarms list to separate it from the second list.

The second list has the heading "The current temperatures are:"

Following the second list heading the current temperatures for each of the food storage rooms are listed. These temperatures are listed on every alarms email message, and the alarms cleared message, to give staff an immediate indication of the current situation and assist them with making decisions on their alarm response. The temperatures are updated before each email message send retry if the message is not successfully sent on the first try.

A blank line follows the temperatures list to separate it from the remainder of the message body.

The subsequent lines in the message body indicate the time the event occurred and identify the message as being an automated message from the datalogger.

NOTE: The time the event occurred is retained for subsequent email message send retries if the initial email message fails to send. This helps provides staff with an indication of how much time has elapsed since the alarm actually occurred.

Each email message ends with a footer stating "Email Relay is provided as a free service by Campbell Scientific" which is automatically applied by Campbell Scientific's Email Relay server.

Alarms Email Messages

The following information details the various alarms that can be sent by the datalogger as email messages to the recipients listed in the `TO_ADDR` station constant. All email messages are designed to provide a consistent format and concise content.

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EMERGENCY Alarms Messages

EMERGENCY Panic Alarm - The emergency alarm in one of the food storage rooms was activated.

These events are logged when an emergency panic button is pressed while the food storage room doors are closed and when the emergency panic buttons are subsequently reset. The piezo alert buzzer in the kitchen area will sound continuously while this alarm is active. This alarm is intended to provide a means by which a person who becomes trapped in a refrigerated space can summon help. This alarm is also applied to the pantry as there is no means of egress other than the door.

If a person is trapped in a refrigerated space for too long, hypothermia and death may result.

Freezer Alarms Messages

Freezer Temp Too High - The freezer high temperature alarm was triggered.

This alarm is triggered when the temperature in the freezer room reaches or exceeds the **SET_FREZ_HI** setpoint. A freezer room high temperature alarm typically results from the freezer door being left open or a refrigeration plant failure.

Freezer Temp Too Low - The freezer low temperature alarm was triggered.

This alarm is triggered when the temperature in the freezer room reaches or exceeds the **SET_FREZ_LO** setpoint. A freezer room low temperature alarm typically results from a failure of the refrigeration system temperature controller.

Freezer Sensor Failure - The freezer sensor failure alarm was triggered.

This alarm is triggered when the temperature sensor in the freezer room fails. Sensor failures are rare and will most likely require replacement of the sensor. They do not affect the operation of the refrigeration plant.

Freezer Electrical Fault - The freezer electrical fault alarm was triggered.

This alarm is triggered when an electrical circuit breaker, in the switchboard, that supplies the freezer refrigeration plant has tripped. The freezer refrigeration plant is inoperative so the freezer will gradually increase in temperature, eventually resulting in a **Freezer Temp Too High** alarm. Try resetting the circuit breaker. If it trips again the refrigeration plant has a fault.

Fridge Alarms Messages

Fridge Temp Too High - The fridge high temperature alarm was triggered.

This alarm is triggered when the temperature in the fridge room reaches or exceeds the **SET_FRIG_HI** setpoint. A fridge room high temperature alarm typically results from the fridge door being left open or a refrigeration plant failure.

Fridge Temp Too Low - The fridge low temperature alarm was triggered.

This alarm is triggered when the temperature in the fridge room reaches or exceeds the **SET_FRIG_LO** setpoint. A fridge room low temperature alarm typically results from a failure of the refrigeration system temperature controller.

Fridge Sensor Failure - The fridge sensor failure alarm was triggered.

This alarm is triggered when the temperature sensor in the fridge room fails. Sensor failures are rare will most likely require replacement of the sensor. They do not affect the operation of the refrigeration plant.

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Fridge Electrical Fault - The fridge electrical fault alarm was triggered.

This alarm is triggered when an electrical circuit breaker, in the switchboard, that supplies the fridge refrigeration plant has tripped. The fridge refrigeration plant is inoperative so the fridge will gradually increase in temperature, eventually resulting in a **Fridge Temp Too High** alarm. Try resetting the circuit breaker. If it trips again the refrigeration plant will have a fault.

Pantry Alarms Messages

Pantry Temp Too High - The pantry high temperature alarm was triggered.

This alarm is triggered when the temperature in the pantry room reaches or exceeds the **SET_PNTY_HI** setpoint. A pantry room high temperature typically results from a high air temperature in the building.

Pantry Temp Too Low - The pantry low temperature alarm was triggered.

This alarm is triggered when the temperature in the pantry room reaches or exceeds the **SET_PNTY_LO** setpoint. A pantry room low temperature typically results from a low air temperature in the building.

Pantry Sensor Failure - The pantry sensor failure alarm was triggered.

This alarm is triggered when the temperature sensor in the pantry room fails. Sensor failures are rare and will most likely require replacement of the sensor.

External Sensor Alarm Message (Optional)

Ext: Sensor Failure - The external temperature and RH sensor failure alarm was triggered.

This alarm is triggered when the external temperature and RH sensor fails. Sensor failures will most likely require replacement of the sensor.

Failure of an external sensor is a critical failure if there is only one external sensor on site as the HVAC operation in every enclosure controlled by the ZooDAC system will be compromised.

Barometric Pressure Sensor Alarm Message

Barometric Sensor Failure - The barometric pressure sensor failure alarm was triggered.

This alarm is triggered when the sensor's Quality metric value falls below 4, or if the measurement value returned by the sensor is outside of the manufacturer's operating range. Check the QM value in the **Public** table **BaroSensState** variable first. If the QM values are greater than 3.99 the failure may not be due to the sensor card, it could be in the instrument electronics or elsewhere. If the QM values are less than 4 the sensor card requires recalibration.

General Fault Alarms Messages

Comms Failure - The data network communications failure alarm was triggered.

This alarm is triggered when a network failure occurs. Communications failures usually point to network problems or a configuration or hardware problem at either a remote station or the local station. On sites where radio communications form part of the network the radio links may cause random intermittent communications failures that come right on their own.

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Power Failure - The mains power failure alarm was triggered.

This alarm is triggered when a mains power failure occurs. Staff may need to respond to outages of extended duration to prevent spoilage of refrigerated food, such as by installing a temporary generator to supply the building.

Refrigeration Door Open - The door open alarm was triggered.

This alarm is triggered when one or more food storage room doors has been left open. The piezo alert buzzer in the kitchen area will chirp for three minutes before the door alarm is triggered allowing staff time to close the door or set it to silent, either of which will prevent the door alarm being triggered or reset an already triggered door alarm.

Email Messages Daily Limit

The maximum number of email messages that can be sent by a datalogger in any one day is 100. This is a function of the Email Relay server provided by Campbell Scientific and is designed to ensure the system is not open to abuse. It is highly unlikely this will be exceeded by a station operating with ZooDAC system software.

If a station does exceed the limit, the email server will respond with an error which is displayed in the **Public** data table **EmailState** field as "EMAIL COMMS ERROR". The Email Relay server will automatically reset at the end of the day, the time of which is determined by the server time (USA time).

Enabling The Email Messaging

The email messaging system is enabled, or disabled, by setting the **EMAIL_ENABLE** station constant as follows:

EMAIL_ENABLE = True - Sending email is enabled.

EMAIL_ENABLE = False - Sending of email is disabled, messages sent to test file instead.

Ensure there is at least one email address defined in the **TO_ADDR** station constant before enabling the email messaging system.

NOTE: The alarms must also be enabled for email messaging to operate. If the alarms are set to disabled the email messaging is also automatically disabled.

Recipient Email Addresses

The automated alarm email messages are sent to the list of recipients whose email addresses are set in the **TO_ADDR** station constant. There must be at least one email recipient address if the alarms are enabled.

The format is:

TO_ADDR = keeper1@myisp.co.nz, keeper2@myisp.co.nz, manager@myisp.co.nz

Each address in the list must be separated from the next address with a comma.

It is best to send the email messages to at least two staff members to ensure the alarms have the best chance of being received by someone who can respond in a timely manner.

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Email Test Function

The email module has a test function that enables the alarms and email system to be tested, without actually sending email messages, by diverting the messages to a file in the datalogger memory. This test function is enabled, or disabled, by setting the `EMAIL_TEST` station constant as follows:

`EMAIL_TEST = True` - Email messages are diverted to a file.

`EMAIL_TEST = False` - Email messages are sent to the email recipients.

The `EMAIL_ENABLE` constant must also be set to `True`.

When in the email test mode each email message is sent to a text file named `EmailTest.txt` in the datalogger. This file stores the exact text of every email message that is "sent" while the test mode is operating, including the email send retries because there is no confirmation from an Email Relay server. The file can be accessed by using the Campbell Scientific LoggerNet software and a text editor or by using the File Control Page from the datalogger's built-in web interface.

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Templates for Record Keeping

The following pages are intended to assist users with record keeping.

Good records are essential for audit, research and maintenance purposes. We recommend that users keep an ongoing file of all system settings in a manner that is appropriate to their business operations.

Each time settings are changed, a new record of the settings should be created and added to the file. Previous records should be retained when new records are added. This will provide an auditable trail of all setting changes that can assist research with site specific records of what works well for the animal species on display at that site.

These records also assist with maintenance. In the event that system settings have to be reinstated after maintenance work, the correct set of documented settings can be used to complete the reinstatement.

Please photocopy the following pages as needed and use them to create your own record keeping system.

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ZooRef Refrigeration Monitoring System Reference Manual

Station Configuration Record (Page 1 of 2)

Station Name: Site ID: Date:/...../.....

Datalogger Settings

Datalogger Model:	Serial Number:
PakBus Address:	IP Address:
Subnet mask:	Gateway:
Program name:	

Station Setpoints

SET_FREZ_HI =	SET_PNTY_HI =
SET_FREZ_LO =	SET_PNTY_LO =
SET_FRIG_HI =	
SET_FRIG_LO =	

Station Constants - General

ENCLOSURE =	EMAIL_NAG =
DOOR_OPEN_ALERT =	EMAIL_NAG_HOUR =
DOOR_OPEN_ALARM =	EMAIL_ATTACH =
ALARM_ENABLE =	EXT_TRH_LOCAL =
ALARM_DEGREES =	EXT_TRH_PRIMARY =
ALARM_RESET =	BARO_ENAB =
EMAIL_ENABLE =	BARO_STN_ELEV =
EMAIL_TEST =	BARO_LOCAL =
EMAIL_RESEND =	BARO_SDI_ADDR =
EMAIL_TRIES =	

Complete a new page each time the configuration is changed so an auditable record of changes is created.

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Station Configuration Record (Page 2 of 2)

Station Constants - Email Addresses

TO_ADDR =

Station Constants - Comms Module

EXT_TRH1_ENABLE =	EXT_TRH2_ENABLE =
EXT_TRH1_PK =	EXT_TRH2_PK =
EXT_TRH1_IP =	EXT_TRH2_IP =
MAX_COMMS_FAILS =	

Notes

Complete a new page each time the configuration is changed so an auditable record of changes is created.

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Station Change Log

Station Name: Site ID:

Date of Change:	Change(s) made:
Changed By:	

Date of Change:	Change(s) made:
Changed By:	

Date of Change:	Change(s) made:
Changed By:	

Date of Change:	Change(s) made:
Changed By:	

Date of Change:	Change(s) made:
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ZooRef Refrigeration Monitoring System Reference Manual

Station Change Log

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Changed By:	

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Changed By:	

Date of Change:	Change(s) made:
Changed By:	